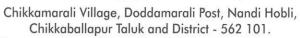
NAGARJUNA COLLEGE OF MANAGEMENT STUDIES



(Affiliated to Bengaluru North University, Approved by AICTE, New Delhi Recognized by Government of Karnataka)

A unit of Nagarjuna Education Society



Email: ncmsug@gmail.com, Ph: 70220 14433 / 76193 85524

NAGARJUNA GROUP OF INSTITUTIONS

Ref. No. NCMS 227 2023-24

Date: 27 02 2024

Note

The Energy Audit and Environmental Audit submitted herewith are audited and reported by Prakruti Institute of Environmental studies, Bengaluru – 560003.

The Green Audit is audited and Reported by Er. Ramesh kumar. B. N, Chief Environmental Officer (R), Karnataka State Pollution Control Board and Chairman, Prakruti Institute of Environmental studies, Bengaluru – 560003.

Nagarjuna College of Management Studies (NCMS) is run by Nagarjuna Education Society (NES) and the College is functioning in the Campus of Nagarjuna College of Engineering and Technology (NCET).

The name of Nagarjuna College of Management Studies (NCMS) and the undergraduate programs offered by the college have been mentioned in above said reports in the page numbers 10 & 11, under the sub heading 2.4 in the Energy Audit Report and the Green Audit Report. Page numbers 11 & 12, under the sub heading 2.4, in the Environmental Audit Report.

Since Nagarjuna College of Management Studies (NCMS) is situated in NCET campus which was previously civil block is run by the management of Nagarjuna Education Society (NES) and is functioning in the Campus of Nagarjuna College of Engineering and Technology (NCET), the Energy Audit, the Green Audit, and the Environmental audit of Nagarjuna College of Management Studies (NCMS) are a part of Audit Reports mentioned above.

Hence, Nagarjuna College of Management Studies (NCMS) building and its surrounding area are included in the above-mentioned Audit procedures and the contents of the Audit Reports.

MAGARJUNA COLLEGE OF MANAGEMENT STUDIES
CHICKBALLAPUR - 562101



## NAGARJUNA COLLEGE OF MANAGEMENT STUDIES

(Affiliated to Bengaluru North University, Approved by AICTE, Recognized by the Government of Karnataka) Chikkamarali Village, Doddamarali Post, Nandi Hobli, Chikkaballapura Taluk & District -562101

	Green Campus- Action Taken Report			
SL NO	POLICY	ACTION TAKEN		
1	Landscaping with trees and plants	The practice of celebrating 'The World Environmental day' and 'International Plantation Day' are conducted by planting trees and awareness programs by eminent people.		
2	Rain water harvesting	The runoff rain water from terrace of the building is channelized into recharge well.		
3	Sewage treatment plant	The waste water is treated in an STP installed in the campus and then it is released to the environment		
4	Waste management	* Solid Waste - NCMS has collaborated with scrap dealers for recycling waste paper from the college campus, incinerator have been installed in washroom for the disposal of used sanitary pads and dry leaves are collected in the pit for organic manure  * Liquid Waste - The college takes utmost care to maintain leak proof water fixtures and reuse of waste water		
		generated by the Reverse Osmosis system in washroom.  * E-waste- MOU has signed with third party for the proper		
5	Energy Saving	disposal E-waste collected in the campus.  College infrastructure has planned for the maximum usage of natural sunlight and initiated awareness to avoid wastage of electricity.		
6	Noise Pollution	Display boards have been placed in the strategic places to create awareness about noise pollution.		
7	Use of LED	As much as possible LED lights have been replaced to save electric power.		
8	Digital Library /e-learning center	Central library is equipped with digital library.		
9	Restricted entry of vehicles and parking	Entry of vehicles is restricted in the campus and diverting visitors vehicles to the parking lot.		
10	Electric powered vehicle for campus ride	Battery powered vehicles and bicycles are used for inhouse transport to reduce the pollution.		
11	Pedestrian friendly pathways	Tiles paved pedestrian friendly roads have been constructed for smooth commuting of students, faculty and staff.		
12	Ban on use of plastic	College is committed towards plastic free campus.		
13	Environment-centric activities	The college encourages all the departments and specific student societies like Green Warriors, NSS, and others to organize events, competitions, and training sessions that will bring about positive environmental changes at the grass root level.		

PRINCIPAL

NAGARJUNA COLLEGE OF MANAGEMENT STUDIES
\*\*CHICKBALLAPUR - 562101\*\*







# Nagarjuna Education Society

# 372/373, 13<sup>™</sup> 'A' Main, 80 Feet Road, Yelahanka New Town, Bengaluru - 560 064. Ph.: 080 - 65372605 / 28566811 Fax: 080 - 28566812

> Email: nesnagarjuna1995@gmail.com Website: www.nagarjunaeducation.com

Ref. No NES / 625 B 2023 - 24

Date: 22.06, 2023

Extract of the resolution passed by the Executive Committee of M/s. Nagarjuna Education Society in its meeting held at No. 38/1, Ramagondanahalli, Yelahanka Hobli, Bangalore-560064 on 03.06.2019 at 3.00 PM

Resolved to permit the Principal, Nagarjuna College of Management Studies (NCMS) to use the existing Sewage Treatment Plant. To effect this, the concerned technician of the NCMS is authorized to connect the Sewage generated at NCMS through proper plumbing to the existing Sewage Plant.

// Certified True Copy //.

For NAGARJUNA EDUCATION SOCIETY

**Authorized Signatory** 

NAGARJUNA COLLEGE OF MANAGEMENT STUDIES

Chikkaballapur-562101



# Nagarjuna Education Society

# 372/373, 13™ 'A' Main, 80 Feet Road, Yelahanka New Town, Bengaluru - 560 064. Ph.: 080 - 65372605 / 28566811 Fax: 080 - 28566812

> Email: nesnagarjuna1995@gmail.com Website: www.nagarjunaeducation.com

Ref. No NES / 625A 2023-24

Date: 22.06, 2017

Extract of the resolution passed by the Executive Committee of M/s. Nagarjuna Education Society in its meeting held at No. 38/1, Ramagondanahalli, Yelahanka Hobli, Bangalore-560064 on 03.06.2019 at 3.00 PM

Resolved to consider and approve the request made by the Principal, Nagarjuna College of Management Studies (NCMS) - Campus, Chikkaballapura to use the common facilties such as Hostel Accomodation, Staff Quarters, Libarary, Indoor & Outdoor Sports and Auditorium which are already available in the campus to be used by the students and staff members of NCMS.

It is further resolved to permit the staff and students of NCMS to use the common transportation facility, Canteen/Mess facility and Health Centre which are available in the same campus.

// Certified True Copy //

For NAGARJUNA EDUCATION SOCIETY

Authorized Signatory



## NAGARJUNA COLLEGE OF MANAGEMENT STUDIES

(Affiliated to Bengaluru North University, Approved by AICTE, Recognized by the Government of Karnataka) Chikkamarali Village, Doddamarali Post, Nandi Hobli, Chikkaballapura Taluk & District -562101

	Green Campus- Action Taken Report			
SL NO	POLICY	ACTION TAKEN		
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PAINCIPAL

NAGARJUNA COLLEGE OF MANAGEMENT STUDIES
CHICKBALLAPUR - 562101

## GREEN AUDIT REPORT

For the year 2023-24



Nagarjuna Education Society (NES), Beedaganahalli, Venkatagiri Kote, Post, Devanahalli, Bengaluru, Karnataka 562110



Audited by
Er. Ramesh Kumar B N
Chief Environmental officer (R)
Karnataka State Pollution Control Board
Chairman

Prakruthi Institute of Environmental Studies 2nd Floor, No.93, 7th Cross, Lower Palace Orchards, Bengaluru - 560003



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#### **EXECUTIVE SUMMARY**

Sustainability is not only spoken in various levels but also practiced by industries, organizations and educational institutes to optimize their resource utilization and make them environment friendly. Hence sustainability is the need of the hour for our country to provide our future generation a clean and safe environment. Educational institutions must play an active role in creating and modelling solution for such environmental problems. Green audit is one such concept or principle introduced to make the educational institutes environmentally sustainable. Through green audit one gets a direction as how to improve the condition of environment within the system. Green audit can be a useful tool for a college to determine how and where they are consuming more of energy or water or resources; the college can then consider how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan.



Green auditing and the implementation of mitigation measures is a win-win situation for the college, the learners and the planet. It can also create health consciousness promote environmental awareness, values and ethics. It provides staff and students better understanding of green impact on campus.

auditing promotes financial savings through reduction of resource use. It gives an opportunity for the development of ownership, personal and social responsibility to the students and teachers.

At Nagarjuna College of Engineering And Technology (NCET), the audit procedure commenced with initial discussions with management to elucidate policies, activities, records, and the level of collaboration from staff and students in executing mitigation measures. Subsequently, interviews were conducted with both staff and students, alongside data collection via questionnaires, record examination, observation of practices, and assessment of tangible outcomes. Furthermore, the approach emphasized the active involvement of both management and staff in the green auditing process within the college.



The baseline data prepared for the Nagarjuna College of Engineering And Technology will be a useful tool for campus greening, resource management, planning of future projects, and a document for implementation of sustainable development of the institution. The availability of existing data will enable the college to conduct comparisons between its programs and operations and those of similar institutions, identifying areas requiring improvement and prioritizing the implementation of upcoming projects. We anticipate a strong commitment from the management to enact the recommendations stemming from the green audit.



#### CHAPTER - 1

#### INTRODUCTION

A green audit, alternatively referred to as an environmental audit or sustainability audit, is a methodical assessment of an organization's operations, procedures, and methodologies. Its purpose is to evaluate their environmental effects, adherence to environmental standards, and to pinpoint avenues for enhancing sustainability practices.

A green audit serves as a valuable tool for colleges to analyze their energy, water, and resource usage patterns, enabling them to identify areas for potential changes and cost savings. Moreover, it aids in assessing the quantity and type of waste generated, facilitating the development of recycling initiatives or waste minimization plans. Additionally, it fosters health awareness and promotes environmental values and ethics among the college community, enhancing their understanding of the campus's environmental footprint.

Furthermore; just as self-inquiry is an inherent aspect of quality education, institutional self-evaluation is equally essential for a reputable educational establishment. Therefore, it is crucial for colleges to assess their contributions to a sustainable future. Given the increasing significance of environmental sustainability on a national scale, higher education institutions play a pivotal role in addressing these concerns.

#### 1.1 OBJECTIVES OF GREEN AUDIT

The Green Audit of an institution is becoming a paramount important these days for self-assessment of the institution, which reflects the role of the institution in mitigating the present environmental problems. The college has been putting efforts to keep the environment clean since its inception. But the auditing of this non-scholastic effort of the college has not been documented. Therefore, the purpose of the present green audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.

The main aim objectives of this green audit are to assess the environmental quality and the management strategies being implemented in Nagarjuna College of Engineering and Technology.

The specific objectives are:

> To assess the source and quantity and of the water in the Nagarjuna College of Engineering and Technology campus.



- > To know and monitor the energy consumption pattern in the campus.
- > To quantify the liquid and solid waste generation and management plans in the campus.
- > To assess the carbon foot print of the Campus.
- ➤ To impart environment management plans to the campus and college. Benefits of Green Audit to an Educational Institute:

There are many advantages of green audit to an Educational Institute:

It would help to protect the environment in and around the campus.

- Recognize the cost saving methods through waste minimization and energy conservation.
- Find out the prevailing and forthcoming complications.
- Empower the organization to frame a better environmental performance.
- It portrays good image of institution through its clean and green campus.

#### **Environmental Consciousness:**

Universities are playing a key role in development of human resources worldwide. Higher education institutes campus run various activities with aim to percolate the knowledge along with practical dimension among the society. Likewise different technological problems higher education institutes also try to give solution for issues related to environment. Different types of evolutionary methods are used to assess the problem concerning environment. It includes Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), Carbon Footprint Mapping, Green audit etc.

National Board of Accreditation (NBA) which is a self-governing organization that declares the institutions as Grade according to the scores assigned at the time of accreditation of the institution. Green Audit has become mandatory procedure for educational institutes under Criterion VII of NBA. The intention of green audit is to upgrade the environmental condition inside and around the institution. It is performed by considering environmental parameters like water and wastewater accounting, energy conservation, waste management, air, noise monitoring etc. for making the institution more eco-friendly.

Students are the major strength of any academic institution. Practicing green actions in any educational institution will inculcate the good habit of



caring natural resources in students. Many environmental activities like plantation and nurturing saplings and trees, Cleanliness drives, Bird watching camps, No vehicle day, Rain water harvesting, etc. will make the students good citizen of the country. Through Green Audit, higher educational institutions can ensure that they contribute towards the reduction of Global warming through Carbon Footprint reduction measures.



#### CHAPTER - 2

#### NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

## 2.1 ABOUT NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

Nagarjuna College of Engineering and Technology (NCET), a self-financing engineering college, was started in the year 2001 under the aegis of Nagarjuna Education Society, Bangalore. Nagarjuna Education Society (NES) was established in 1995 under the able guidance of Sri J.V.Rangaraju, leading industrialist and philanthropist. His commitment towards contribution to nation building is being achieved by imparting world-class education at all levels, viz. from primary, graduate, post-graduate to doctoral research degree.

Nagarjuna College of Engineering & Technology is affiliated to Visvesvaraya Technological University (VTU), Belagavi, and the only technological university in the state of Karnataka, recognized by Government of Karnataka and approved by AICTE, New Delhi. NCET has crafted the vision to be among the Top Engineering Colleges in Karnataka. All the strategies and policies that we plan have this over- arching goal as a guide. The college has very good infrastructural facilities and the people at NCET are among the best in their fields.

The world is changing at exponential rate such that future is no more an extrapolation of the past and the present. It is important to be innovative to keep pace with the world. Science & technology have a great role to play in building India into a developed nation.

The Nagarjuna College of Engineering and Technology is strategically located on the Bangalore-Hyderabad National Highway, a road that falls on the Golden quadrangle. Its proximity to the International airport at Bangalore gives it strategic location and commutability. We have lush green campus spread of 72 acres with on-campus residential facility for boys, girls and staff. These hostels have amenities like mess, recreation room and state of art Gymnasium etc. Students are encouraged to actively participate in outdoor games as well. The college has a spacious library with well stacked books and well subscribed e-journals and books. The college is also a member of the VTU Consortium for e- resources.

The college is recognized as Nodal Centre for virtual lab facility, sponsored by MHRD, GOI. The institution is associated with IIT B, Mumbai for the project titled eYantra on Robotic Technology for students and staff. ISRO



has recognized our college as one of the centre to carry out the student projects under STUDSAT. The institution also has MoUs with different leading industries like EMC2, Oracle, NCC, Data Talk etc.

The College was affiliated to Visvesvaraya Technological University, Belgaum till 2014-15. The college has received Autonomous status from Visvesvaraya Technological University and Government of Karnataka from the academic year 2015-16. The college is recognized by Government of Karnataka as a Centre of Innovative Science and Engineering Education. NCET departments have been recognized as research centres from Visvesvaraya Technological University, Belgaum to offer Ph.D. programme.

Nagarjuna College of Engineering & Technology also focuses on imparting training in soft-skills, logical reasoning, aptitude tests & interviews and provides placement to all eligible candidates in leading industries. The coordination & team work of all concerned at Nagarjuna Education Society and the commitment & determination of the management has made us to fulfill our vision "Leadership & excellence in education" and reach the goal.



Figure 1 Aerial view of Nagarjuna College of Engineering and Technology INFRASTRUCTURAL FACILITIES

Nagarjuna College of Engineering and Technology has adequate infrastructural facilities as per the AICTE requirements. Nagarjuna College of Engineering and Technology has adequate number of ventilated classrooms, Laboratories, Smart Classrooms (ICT enabled), Seminar halls,



Computer Labs, Research Centres, HOD cabins, Staff cabins, Common rooms, Rest rooms, Central & Department Library and Convention hall. The management consistently interacts with the stake holders to improve the infrastructure facilities.

**INFRASTRUCTURE AND LABORATORIES:** The College is located in a beautiful lush green landscape, free from polluted environment and excellent atmosphere and ambience ideally suited for growth of the soul & mind.

**LABORATORIES:** The institution has laboratories as per AICTE norms. Nagarjuna College of Engineering and Technology has laboratories with state of art laboratory equipment. The labs are well equipped with safety norms with list of experiments details. Labs are used by the students beyond the working hours for doing their projects.

**LIBRARY:** Apart from the books available in the library, students can also access online E-resources such as digital library to widen their knowledge and skills. The working time of library is from 9.00 am to 7.00 pm in working days and from 9.00 am to 4.00 pm in the holiday.

#### 2.2. UNDERGRADUATE PROGRAMS

- B.E CS Artificial Intelligence and Machine Learning
- B.E in Civil Engineering
- B.E. in Computer Science and Engineering
- B.E CS- Data Science
- B.E. in Electronics and Communication Engineering
- B.E. in Information Science and Engineering
- B.E. in Mechanical Engineering

#### 2.3. POST GRADUATE PROGRAMES

- MBA
- M.Tech. in Structural Engineering

#### 2.4. NAGARJUNA GROUP OF MANAGEMENT & STUDIES

- B.COM
- B.B.A
- B.C.A
- B.Sc



- M.C.A
- M.COM

#### 2.5. VISION

Leadership and Excellence in education

#### 2.6. MISSION

To fulfil the vision by imparting total quality education replete with the philosophy of blending human values and academic professionalism.

#### 2.7. GOALS

- Providing high quality graduates not only competent in their respective fields, but are also motivated to serve humanity at large.
- Producing research papers in all fields of Engineering, worthy of being published by National & International Journals.
- Providing all facilities for the pursuit of medical knowledge, relevant to the needs of contemporary society.
- Implementing public services beneficial to and relevant with the needs of the community at large, nationally and internationally.

#### 2.8. EDUCATIONAL OBJECTIVES

- To provide for instruction in training in such branches of learning as it may deem fit.
- To provide for research and for the advancement of and dissemination of knowledge.
- To undertake extra moral studies, extension programs and field outreach activities to contribute to the development of Society.
- To undertake the activities to strengthen the set objectives.



#### CHAPTER - 3

#### **METHODOLOGY ADOPTED**

The audit process unfolded across three distinct phases. Initially, secondary data essential for the study was gathered from diverse sources, including relevant departments such as engineering, hostel management, and gardening. A comprehensive review was conducted to gain a clear understanding of green auditing principles, supplemented by the examination of various case studies and methodologies. Subsequently, the chosen methodology for the present audit involved onsite visits, personal observations, and the utilization of questionnaire surveys as tools for data collection. Sets of questionnaires were tailored to meet the specific data requirements, which were then administered during visits to all university departments. The collected data was consolidated for further analysis. Based on the comprehensive findings of the study, a final report was compiled.

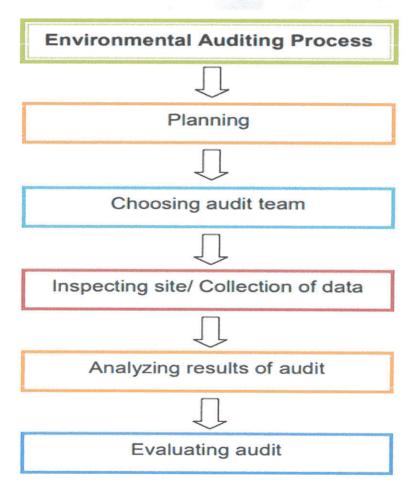


Figure 2 Audit Methodology



#### 3.1. SURVEY BY QUESTIONNAIRE:

The collection of baseline data for the preparation of the green audit report was conducted through a questionnaire survey method. The questionnaires utilized for the green audit on the university campus were developed based on guidelines, regulations, acts, and formats established by authorities such as the Ministry of Environment, Forest and Climate Change in New Delhi, the Central Pollution Control Board, and other relevant statutory bodies. While many of these guidelines and formats addressed broad aspects, some were not directly applicable to a university campus setting. Therefore, adaptations, modifications, and restructuring were undertaken, resulting in the creation of sets of questionnaires covering areas such as solid waste management, energy usage, water conservation, hazardous waste management, and e-waste disposal.

Each questionnaire comprised several modules. The first module focused on gathering general information about the respective department, including its name, the month and year of assessment, total student and employee counts, visitor numbers, average working days, and office hours. Subsequent modules addressed specific aspects such as current resource consumption (e.g., water, energy) and the management of solid and hazardous waste. Emphasis was placed on maintaining accurate records regarding the handling of solid and hazardous waste, given their significance in the context of the green audit process.

In the context of green audit, it's imperative to assess the potential loss of resources such as water and energy resulting from inadequate maintenance practices. To address this concern, a dedicated module within the questionnaire focuses on probing into these probabilities. Additionally, another module is dedicated to the meticulous maintenance of records, encompassing aspects such as solid waste disposal and recovery records. To facilitate the surveyor's task, certain statistics, such as fundamental energy consumption characteristics for electrical equipment, were conveniently included alongside the questionnaires.

#### **ONSITE VISIT AND OBSERVATIONS:**

Nagarjuna College of Engineering and Technology encompasses a substantial built-up area, housing diverse facilities including various departments, an administrative building, faculty and staff quarters, student hostels, a guest house, sports complex, and health center. Each of these amenities possesses unique infrastructure tailored to its specific needs. Surveyors conducted thorough visits to all these buildings, utilizing questionnaires to assess their current conditions. Personal observations



were also noted during the onsite inspections. To streamline the survey process and subsequent analysis, amenities were categorized based on their similarities and differences, facilitating a more efficient evaluation.

#### DATA ANALYSIS AND FINAL REPORT PREPARATION:

Green audit, the completed survey questionnaires from each group were systematically tabulated in Excel spreadsheets according to their respective modules. This tabulated data served as the basis for further analysis. To enhance comprehension and streamline the process, averages and percentages were calculated for the tables. The interpretation of the overall findings was then synthesized, encompassing both primary and secondary data, along with references and interrelations. Subsequently, the final report was prepared based on this comprehensive interpretation.

- In order to meet its objectives, this audit combined physical inspection with a review of relevant documentation and interviews with various stakeholders.
- Review of the Documentation.
- For the purpose of this audit the Green Policy of the institute was reviewed.
- Interviews.
- Interviews were conducted with the Principal's, Registrar and also faculties and students.
- Physical Inspection.
- The audit team was in the college to inspect the campus.

#### 3.2. LIST OF STUDENTS AND STAFF INVOLVED IN GREEN AUDITING

S1. No	Name	Designation		
1.	Dr. Srilakshmi G	Professor & Head, Department of Civil		
2.	Ms. Vidyashree MG	Assistant Professor, Department of Civil		
3.	Mr. Sharan Kumar SV	Lab Assistant		
4.	Mr Harish	Campus Admin		
5.	Ms Dhanashree	Student, Dept. of Civil Engg		
6.	Mr Tejas Sachin	Student, Dept. of Civil Engg		
7.	Mr Sunil	Student, Dept. of Civil Engg		



#### CHAPTER - 4

#### **GREEN AUDIT**

## ECO -FRIENDLY CAMPUS & GREEN PRACTICES IN NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

#### 4.1. AREAS OF GREEN AUDITING

#### 4.1.1. ENERGY AUDIT

This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment.

#### 4.1.2. WATER AUDIT

A water audit involves both qualitative and quantitative analyses of water consumption, aimed at identifying opportunities for reducing, reusing, and recycling water. It serves as an effective tool for minimizing losses and optimizing various water uses, thereby enabling significant water conservation across sectors including irrigation, domestic, power, and industrial. Essentially, a water audit is a technique used to identify means of conserving water by detecting inefficiencies in water distribution systems. Measuring water losses resulting from different uses within the system or utility is essential for implementing water conservation measures in such establishments.

This indicator addresses water consumption, water sources, irrigation, storm water, appliances and fixtures. Aquifer depletion and water contamination are taking place at unprecedented rates. It is therefore essential that any environmentally responsible institution should examine its water use practices.

Several factors, including climate, culture, dietary habits, work conditions, level of development, and physiological needs, influence water requirements. For communities with a population ranging from 20,000 to 100,000, the recommended water consumption ranges from 100 to 150 liters per person per day. Larger communities with populations exceeding 100,000 may require 150 to 200 liters per person per day. According to the standards outlined by the WHO Regional Office for South-East Asia, schools typically necessitate 10-15 liters per student for water-flushed toilets, while administrative areas (excluding staff accommodations) require 50 liters per person per day. Staff accommodations typically require 30 liters per person



per day, while water usage for sanitation purposes depends on the specific technology employed.

#### 4.1.3. BIODIVERSITY AUDIT

All living beings, including humans, are interconnected within a complex network of biodiversity, which is essential for our survival. Biodiversity plays a crucial role in maintaining healthy ecosystems and ensuring the well-being of our planet. It contributes to clean air and water, regulates the climate, and provides us with essential resources such as food, shelter, clothing, medicine, and other goods.

Every component of this intricate web suffers when one part weakens or disappears. Trees, for example, play a vital role in purifying the air we breathe. Through photosynthesis, their leaves absorb carbon dioxide and release oxygen, a process facilitated by sunlight, water, minerals, and chlorophyll. Additionally, trees' roots anchor the soil, preventing erosion by rain and wind. Given that the earth's fertile soil is typically only a thin layer, this stabilization is crucial for maintaining soil integrity and preventing loss through erosion.

#### 4.1.4. BIODEGRADABLE AND HAZARDOUS WASTE AUDIT

The waste streams generated within the college and hostel premises, from biodegradable waste originating from canteens to hazardous wastes produced in laboratories and discarded electric and electronic goods. Hazardous materials pose significant risks to both human health and ecological well-being. E-waste generated on campus contributes to the leaching of hazardous substances into the environment, resulting in long-term land and water contamination that can persist for generations.

These hazardous substances have the potential to accumulate in the tissues of organisms and become concentrated within food chains, leading to severe health consequences such as cancer, endocrine disruption, and birth defects. Minimizing, safely handling, and ultimately eliminating these hazardous materials are crucial steps toward ensuring the long-term health of our planet.

#### 4.2. LAND AREA STATEMENT

The land under the project is designated for Educational activities as per Karnataka Government. No additional burden on land has been created which may adversely affect land use pattern in the area. No natural drain is being obstructed. The University land does not interfere with any forest, wetland, river, lake, mountain, national park & sanctuary etc.



## The total area of campus - 1,55,498.29 sq.m

Sr. No.	Particulars	Area
1	Total area	1,55,498.29 Sq.mt
2	Built up area	141300.4 Sq. mt
3	Roads/parking	2,288 Sq.mt
4	Green belt area	64,080 Sq.mt
5	Vacant area for future development	25,000 Sq.mt
6	Building Configuration [Number of Blocks / Towers / Wings etc., with Numbers of Basements and Upper Floors, canteen, seminar halls, playground, auditorium, hostels, Labs]	21 Blocks as per build up area statement

## LAND USE BREAKUP WITHIN THE SITE

Sr. No.	Land Use	Area in Sqm.	%
1	Ground Coverage Area	17221.99	11.07
2	Drive Way Area	4118	2.65
3	Landscape Area	21865.00	14.06
4	Area under Services	355.65	0.23
5	Surface Parking	2288.00	1.47
6	Roads	19217	12.36
7	Playground	26352	16.95
8	Open Area	64080	41.21

#### **BUILD UP AREA STATEMENT**

Sr. No.	Name of the Building	BUA in Sqm	
1 Bo	oys Hostel	4405.88	



2	Civil Block	3880.52
3	Mechanical Block	2302.78
4	Main Block Ground, First & Second	8062.00
5	Canteen Block	2405.51
6	Gym Block and Computer Lab	3205.26
7	Boys Hostel- NRI	1839.06
8	Boys Hostel- 2	2270.00
9	Boys Hostel- 3	1639.97
10	Boys Hostel- 4	1639.97
11	Boys Hostel-5	2616.85
12	Boys Hostel- 6	2602.54
13	Girls Hostel- 1	2279.48
14	Girls Hostel- 2	4069.61
15	Staff Quarters	1455.49
16	Boys Hostel Block-8	2602.54
17	Bio-Tech Block	3584.00
18	Library Block	5480.93
19	Work Shop	1958.01
20	1 st Year block	23,000
21	New block	60,000
	Total BUA	141300.4 Sqm.

### 4.3. WATER REQUIREMENT:

The total water requirement for the University is 264 KLD. Water quality of ground water resources in the area has been studied for assessing the water environment. Municipal Supply, Groundwater and rain water are being used in the campus



Total requirement of water in VID	
Total requirement of water in KLD	
Fresh	159
Recycled	105
Total	264
Source of water	Municipal Supply, Groundwater and Rainwater
1.Whether canteen facility	Yes
provided for day students etc	
2. Waste water generation in KLD	211 KLD
STP capacity	300 KLD
Technology employed for	STP(SBR Technology)
Treatment and mode of disposal of	
treated sewage	
Scheme of disposal of	Gardening, Lawns, Toilet and Flush out, Floor
excess treated water if any	Washing
Any Treatment for lab water	
1 , , , , , ,	Ponds- 1
waterless urinals	Tans - 004
	Taps – 994
	Toilets – 519
No. and capacity of water tanks	20nos, total capacity- 570715 liters
for storage	

#### 4.4. WASTE WATER GENERATION

About  $211 \text{ m}^3/\text{day}$  of wastewater is being generated.

#### 4.5. WASTE WATER MANAGEMENT

The institution adheres to a systematic approach for the efficient management and disposal of liquid waste. Wet waste generated from the college, hostels, and canteen is directed to bio fertilizer plants for the production of environmentally friendly fertilizers. The treated water is subsequently utilized for gardening and other purposes. Moreover, the



institution actively engages in discussions with students to raise awareness about liquid waste management techniques.

- To manage domestic and other wastewater effectively, a sewage treatment plant (STP) has been installed and is operating successfully. The STP has a capacity of 300 kiloliters per day (KLD) to treat wastewater generated from various sources including college buildings, hostels, canteens, and recreational areas such as the gymnasium etc.
- The treatment scheme comprises of a biological treatment called SBR system wherein the aerobic bacteria stabilizes all the organic matter, neutralizes the microbial population.
- The STP has been performing smoothly and delivers effluents with BOD values below 10 mg/l. The aerobic treatment followed by disinfection results in microbe concentration below 100 units as stipulated in the consent. Likewise all other listed parameters are also complied with. Analysis reports are regularly forwarded to the KSPCB.
- The wet waste from the college, hostels and canteen is given away to bio fertilizer plants for making eco-friendly fertilizers.

#### 4.6. RECYCLE AND REUSE OF TREATED WASTEWATER:

The institution has installed sewage treatment plants (STPs) to manage wastewater originating from various areas within the Nagarjuna College of Engineering and Technology premises, including the college, hostels, staff quarters, and canteen areas. The sewage from these sources is treated in a 300 (KLD) STP. Typically, the STPs are operated below 80% capacity levels, and adjustments are made during semester breaks to accommodate fluctuations in influent levels. After biological treatment, the wastewater is disinfected using liquid chlorine before being pumped for various uses. Following the guidelines outlined by the Karnataka State Pollution Control Board (KSPCB), the treated wastewater is reused within the campus, as detailed in the subsequent sections.

In general the STPs are operated at not more than 80% of the designed capacity and at much lower capacity during vacations, lock down etc. The treated waste waters from STP are utilized for the following activities:







Figure 3 Sewage Treatment Plant

- Gardening and maintaining greenery within the campus. (50 %)
- Secondary flushing in toilets in the hostel buildings. (45%)
- Buses and other vehicles washing, Floor Washing within the campus.
   (5%)
- Treated water used for Flushing 105 KLD of STP treated water is used for flushing purpose.

### Bus/Car / Floor Washing:

The institute maintains a fleet of buses and other vehicles for transportation purposes. Furthermore, students residing on the premises utilize treated water for washing their cars and two-wheelers. A provision of 5 KLD has been allocated specifically for this purpose.

#### Green Belt Development:

Green belt development refers to the creation, enhancement, or preservation of vegetated areas within urban or industrial landscapes. These green belts serve various ecological, aesthetic, and recreational purposes, contributing to environmental sustainability and improving overall quality of life. They often involve planting trees, shrubs, and other vegetation along roadsides, water bodies, or in vacant spaces to mitigate environmental impacts, enhance biodiversity, regulate microclimates, and provide green spaces for recreation and relaxation. Green belt development projects may also include initiatives to protect natural habitats, restore degraded ecosystems, and promote sustainable land use practices.



This also requires regular watering for the survival. Through the hydrant systems network, the treated water is pumped from the STP and a total of 101 KLD is utilized for the purpose.





Figure 4 Green Belt Development

## 4.6.1. EXISTING WATER MANAGEMENT METHODS INSTALLED IN THE CAMPUS

- 1. Rain water harvesting
- 2. Construction of tanks and bunds
- 3. Waste water recycling

#### 1. Rain Water Harvesting:

- Rainwater harvesting is the process of collecting, storing, and utilizing rainwater for various purposes such as irrigation, household use, and groundwater recharge. It involves capturing rainfall from rooftops, paved surfaces, and other impermeable areas and directing it to storage tanks, cisterns, or underground reservoirs for later use. Rainwater harvesting systems typically include components such as gutters, downspouts, filters, and storage tanks to capture and store rainwater.
- The harvested rainwater can be used for a wide range of applications, including watering gardens, flushing toilets, washing clothes, and even drinking water with proper treatment. By harvesting rainwater, communities can reduce their reliance on traditional water sources, alleviate pressure on municipal water supplies, and improve water security, particularly in areas prone to water scarcity or drought.
- Rainwater harvesting also offers environmental benefits by reducing stormwater runoff, which can help prevent soil erosion, mitigate flooding, and replenish groundwater reserves. Additionally, it promotes sustainable water management practices and encourages



conservation efforts by maximizing the use of a natural resource that is often underutilized.

- As per the scheme the roof top water shall be collected in the underground tanks/ sumps, whereas the water collected from paved and unpaved areas shall pass through grease cum silt trap and clean water shall be either directly used or shall be used for recharging the existing bore wells within the campus as per drawings.
- There is one Groundwater Recharge Pit with tank capacity of 61174 litres.

#### 2. Waste Water Recycling

- Nagarjuna College of Engineering and Technology has installed and effectively operates a sewage treatment plant on its premises. With a capacity of 300 kiloliters per day (KLD), this plant manages wastewater generated from various sources including the college building, hostels, canteens, and recreational areas such as the gymnasium etc.
- The sewage treatment plant (STP) has been operating efficiently, consistently producing effluents with Biological Oxygen Demand (BOD) values below 10 mg/l. The aerobic treatment process, coupled with disinfection measures, ensures that microbial concentrations remain below 100 units, as required by the consent regulations. Moreover, all other specified parameters are duly met. Regular analysis reports are submitted to the Karnataka State Pollution Control Board (KSPCB) for compliance verification.

#### 3. Construction of Tanks and Bunds:

As the water crisis continues to become severe, there is a dire need of reform in water management system and revival of traditional systems. As a part of revival to traditional wisdom, the institution built rain water storage tank, to collect the rainwater and can be used whenever it is required.

## 4. Maintenance of water bodies and distribution system in the campus

Groundwater is pumped into storage tanks situated across various locations within the campus, including a limited number of overhead storage tanks. A well-organized pipe network facilitates the distribution of water throughout the premises. Drinking water, treated through a Reverse Osmosis (RO) plant, is supplied via a separate set of distribution pipes, while water for other purposes is distributed through another set of pipes. The entire distribution system is diligently overseen by Civil works personnel to prevent leakages and wastage of water through joints and valves. Additionally, water usage is optimized through the implementation of low-pressure flushes. All



stakeholders of the college receive thorough education on the importance of using water economically and efficiently.

#### 4.7. SOLID WASTE MANAGEMENT

The primary contributors to solid waste generation on campus comprise canteen waste, hostel kitchen waste, institutional waste, and staff quarters waste. Dry waste is predominantly stored at a transfer station located within the campus. Solid waste produced in the constituent colleges mainly consists of waste papers, answer sheets, and domestic waste such as kitchen waste.

The institute makes necessary arrangements for disposal of solid waste. Domestic biodegradable waste of 300.4 kg/day and 450.60 kg/day of non-biodegradable waste is generated.

The institution effectively implements solid waste management practices by enforcing waste segregation rules. Dustbins are strategically placed in classrooms, laboratories, restrooms, and mess areas across the campus. Dedicated sweepers are assigned to each floor to manage all waste generated within the premises. All waste, including that from the college and hostel, undergoes segregation at its source and is disposed of in an appropriate manner. They are proposing to install organic waste converter (OWC) with digester for gas generation. The gas will be used in the canteen for food preparation.

#### 4.7.1 WASTE GENERATION AND MANAGEMENT:

Sr. No.	Detail	Population	Total Solid Waste Generated	Organic Waste Kg/day	In-Organic Waste Kg/day
			(Kg/day)	(40%)	(60%)
	Educational	Hostel Students-	408.50 (0.5	163.40	245.10
	Institution 4242	817	Kg/capita/day)		
1.	Personnel	College Students	306.50 (0.1	122.60	183.90
1.	i croomici	3065	Kg/capita/day)		
		Staff- 360	36.0 (0.1	14.40	21.60
			Kg/capita/day)		
	Tota	al	751	300.40	450.60
	Sludge		1	5 Kg	L



#### 4.7.2 HAZARDOUS WASTE GENERATION AND MODE OF DISPOSAL:

Every year, the process of DG disposal results in the generation of 55 liters of DG oil. This oil is then repurposed and used in the construction industry as shuttering oil. Shuttering oil is an essential substance used in construction to prevent concrete from sticking to the surface of the mold or formwork during the curing process. By utilizing DG oil as shuttering oil, construction companies are able to reduce their reliance on traditional, petroleum-based products, which can have a negative impact on the environment.



Figure 5 Hazardous waste storage

#### 4.7.3. E-WASTE MANAGEMENT:

The institution has initiated several e-waste management initiatives aimed at fostering an eco-friendly environment on campus. To minimize e-waste generation, computers and their peripherals are regularly upgraded for continued usage, thus reducing wastage. Additionally, Memorandum of Understanding (MoUs) have been established with E-Parisaraa and Rashi E-Waste Solutions for effective e-waste management.







Figure 6 E-waste storage

#### **4.8 ENERGY MANAGEMENT**

Energy conservation plays a vital role in campus sustainability and is closely connected to the carbon footprint of the campus. Energy auditing focuses on conserving energy and implementing methods to reduce consumption, thereby addressing environmental degradation. Consequently, it is imperative for any environmentally conscious institution to scrutinize its energy usage practices.

	2021	2022	2023
	9032985 Rs	12972491 Rs	18184717 Rs
Electricity charges	8.10 Rs / unit	8.20 Rs/ unit	8.50 Rs / Unit
	1115183.33	1582011.1	2139378.47
	units / year	units / year	units / year
Number of Gas cylinders used per month	135 units		
Number of Diesel Generators	3 Nos Capacity—	-100 KVA, 125 l	KVA, 250 KVA
Quantity of Diesel consumed Cost of generator fuel	2000 liters per n	nonth @ 100 Rs	per liter
Total number of CFL bulbs	100		



Number of LED lights	LED lights-2000 Incandescent bulbs-00 Fans-
Incandescent bulbs	2000
fans AC's Tube lights	AC's -30
	Tube lights-5000 Electrical instruments-250
electrical instruments	Computers -850
computers	Photocopiers - 5
photocopiers	T.V's. – 15
T.V's. etc	

#### 4.9. SOLAR ENERGY

100 KW per day energy is generated by solar Panels installed inside the campus.

#### 4.10. AIR ENVIRONMENT

- In the University campus during construction in any stage water will be sprinkled on the soil to avoid dust generation.
- The debris and unused construction debris will be removed immediately for recycling, if any, or for designated land fill
- All vehicles for service activities at the University will be checked for vehicular emission. The agencies will be asked to keep them within prescribed limits. They will also be asked to maintain them properly.
- As discussed earlier there will be no other point source of Air pollution, which are noise free. Chimneys of suitable height have been provided to control the G.L.C. of PM 2.5, PM10, SO<sub>2</sub>, & NOx levels. Extensive tree plantations have been resorted to for further improving the air environment in general and minimize noise levels.

#### 4.10.1. AIR EMISSIONS AND NOISE LEVELS

The University has taken a commendable step towards ensuring environmental sustainability by installing noise-free generators for power backup. This move has significantly reduced the levels of noise pollution in and around the campus. Moreover, the University has also made it a point to avoid any other point source of emissions, such as boilers or furnaces that run on fossil fuels, which could have a negative impact on the air quality.



#### 4.10.2. TRAFFIC DENSITY

One of the rules that the students must follow while staying in the hostel is that they are not allowed to keep their own vehicles within the premises. This is to ensure the safety and security of all the residents in the hostel. However, this does not mean that the students are left stranded without any means of transportation. The University has taken into consideration the transportation needs of the local students and has provided its own buses that ply within the vicinity of the campus. The University has also taken care of the parking needs of the students who travel to the campus from outside. The layout of the campus has been meticulously planned to provide adequate space for parking within the premises. This ensures that students who commute to the campus from far-off places can comfortably park their vehicles without having to worry about their safety.

The provision of the University's own buses and ample parking space within the campus not only makes transportation easier but also contributes to reducing the carbon footprint. The University's efforts towards promoting sustainable transportation are commendable and set an example for other institutions to follow. In addition to this, the University has also taken initiatives to promote cycling as a means of transportation. The campus has dedicated bicycle parking areas, and students are encouraged to use bicycles as a sustainable and healthy mode of transportation.

#### 4.10.3. CARBON FOOTPRINT

The burning of fossil fuels has become a major concern in recent years due to its harmful effects on the environment. Fossil fuels such as petrol, coal, and natural gas are non-renewable resources that release greenhouse gases when burned. These gases, including carbon dioxide, water vapor, methane, nitrous oxide, and ozone, trap heat in the Earth's atmosphere and contribute to global warming and climate change. All the greenhouse gases, carbon dioxide are the most significant and prevalent. It currently makes up 402 ppm of the Earth's atmosphere, a level that has steadily increased since the Industrial Revolution. The primary source of carbon emissions is human activity, particularly the burning of fossil fuels for transportation, electricity, and heating.

In college campuses, vehicular emissions are a major contributor to carbon emissions. Cars, buses, and other modes of transportation that rely on fossil fuels emit significant amounts of carbon dioxide and other pollutants into the air. Therefore, it is essential to assess the transportation methods used by students, faculty, and staff to reduce carbon emissions and promote sustainable practices.



One way to reduce vehicular emissions on campus is to encourage the use of alternative modes of transportation. This can include walking, biking, carpooling, or using public transportation. By reducing the number of cars on the road, we can significantly decrease carbon emissions and improve air quality. Additionally, implementing eco-friendly policies such as energy-efficient buildings, recycling programs, and renewable energy sources can further reduce the campus's carbon footprint.

Carbon footprint		
Number of persons using cycles	50	
Number of persons using cars		
Number of persons uses two wheelers	150	
Number of persons using other transportations like bus etc	Bus- 665	
	Van -50	
	TT- 15	
Number of visitors per day	50	
Number of Students staying in the hostel	1100	
Number of Faculty and staff staying in the quarters	45	
Total Number of students	1819	
Total No. of faculty and staff	355	
Total number of E vehicles	2 number – name of vehicle – buggy	

## 4.11. GREEN AUDIT (Ecology & Bio-Diversity)

#### 4.11.1. FLORA

The campus has a rich collection of trees. About 510 tree species were identified. Most of the plants have important role in the maintenance of biodiversity and are the good carbon assimilators. Herbal garden and other ornamental gardens were maintained in the campus.

Apart from records of Forest department, field surveys were undertaken to study the vegetation and floral components in the campus.



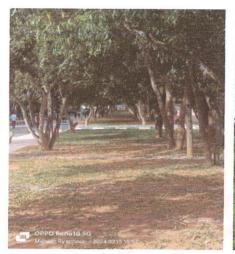








Figure 7 Flora at college campus
LIST OF TREES SPECIES OF NCET, BANGALURU

Sr. No.	Botanical Name	Family	Common Name	Total
1	Arecaceae	Arecaceae	Palm	58
2	Roystonea regia	Arecaceae	Cuban royal palm tree	53
3	Mangifera indica	Anacardiaceae	Mango	151
4	Phoenix sylvestris	Arecaceae	Badela Palm	35
5	Chukrasia velutina	Meliaceae	Chukrasiatabularis	168
6	Dalbergia sissoo	Fabaceae	Sissu / Tali	16
7	Moringa oleifera	Moringaceae	Saujana	24



8	Bambusoideae	Poaceae	Bamboo	50
9	Anacardium accidentale L.	Anacardiaceae	Kaju Badam	65
10	Cocos nucifera	Arecaceae	Coconut	37
11	Ficus benghalensis	Moraceae	Banyan Tree	1
12	Azadirachta indica	Meliaceae	Neem	53
13	Phyllanthus emblica	Phyllanthaceae	Amlakhi(Indian gooseberry	30
14	Artocarpus heterophyllus	Moraceae	Jackfruit	30
15	Musa sp.	Musaceae	Banana tree	8
16	Prunus amygdalus	Rosaceae	Almond Tree	40
17	Spathodea campanulata	Bignonias	African tulip tree	76
18	Areca catacheau	Arecaceae	Beetle nut	48
19	Grevillea robusta	Proteaceae	Silver Oak tree	489
20	Platycladus orientalis	Cupressaceae	Oriental thuja	55
21	Delonix regia	<u>Fabaceae</u>	Royal Poinciana tree (Kathi mara)	68
22	Punica granatum	Lythraceae	Pomegranate tree	26
23	Ficus virens	Moraceae	White fig tree	2
24	Syzygium cumini	<u>Myrtaceae</u>	Jamun	27
25	Terminalia neotaliala	Combretaceae	Mantaly tree	450
26	Eucalypts	Myrtaceae	Safeda tree	25
27	Rosa	Rosaceae	Rose tree	40



28	Citrus limon	Rutaceae	Lemon tree	18
29	Cassia fistula	Fabaceae	Golden rain tree	26
30	Tamarindus indica	Fabaceae	Tamarind tree	7
31	Eucalyptus globulus	Myrtaceae	Nilgiri tree	21
32	Tabernaemontana	Apocynaceae	Crepe jasmine	10
	divaricata			
33	Santalum album	Santalaceae	Sandalwood tree	5
34	Tectona grandis	Lamiaceae	Sagwan	50
35	Manilkara zapota	Sapotaceae	Sapota tree	50
36	Delonix regia	Fabaceae	Krishnachura (Flame Tree)	7
37	Acacia falciformis	Fabaceae	Mountain hickory	350
38	Magnolia champaca	Magnoliaceae	Sampangi tree (Champak)	5
39	Tsuga canadensis	Pinaceae	Eastern hemlock tree	38
40	Caryota	Arecaceae	Fishtail palm	5

### 4.11.2 FAUNA

Prolific wild life is not observed in the University campus, as there is no thick forest/ vegetation is noticed in the University Campus.

FAUNAL GROUP	SCIENTIFIC NAMES
	Myrmachne orientalis (Family Salticidae);Nephilaplipes (Family-Nephilidae); Heteropoda sp (Family-Sparassidae); Phintella vitatta (FamilySalticidae)



- T				
&Antheria assmensis;Bombyx mori;Philosamia ricini;				
Junonia atlites atlites ; Commander (Moduza procris				
procris);Ethope himachala ; Melanitis leda leda ;				
Paltoporia paraka paraka; Ypthima baldus ; Acraea				
terpsicore				
Elymnias, hypermnestra, undularis; Mycalesis perseus blasi				
us;Tanaecialepidealepidae;Euploea core				
Scarlet dragonfly; Pantala flavescens (wandering glider),				
grasshoppers, microbes				
squirrels, mouse, snake, lizard				
Acridotheres tristis (Common myna); Streptopelia				
orientalis (Oriental Turtle Dove); Athene noctua (little owl				
); Pycnonotus cafer (Red- vented Bulbul), crows, sparrows,				
peacock				
Monkeys, Dogs, Cats				



#### CHAPTER 5

#### CONCLUSION AND RECOMMENDATIONS

Nagarjuna College of Engineering and Technology is committed to fostering a green campus environment. Despite its primary focus on technology, the institution demonstrates notable awareness in prioritizing eco-friendly practices. Upon visiting the campus, visitors can appreciate the aesthetic appeal of the elegant buildings, well-maintained lawns, expansive sports grounds, and verdant surroundings, which create a conducive atmosphere for the teaching-learning process.

The institutional initiatives for greening the campus are as follows:

- Implementation of restricted entry for automobiles within the campus premises aims to minimize traffic congestion and enhance pedestrian safety.
- Designing pedestrian-friendly pathways prioritizes the convenience and safety of individuals traversing the campus on foot, promoting a healthy and sustainable mode of transportation.
- Enforcing a ban on the use of plastic within the campus helps to reduce environmental pollution and promotes the adoption of ecofriendly alternatives.
- Landscaping with trees and plants enhances the aesthetic appeal of the campus while also contributing to environmental sustainability by providing shade, improving air quality, and supporting biodiversity.

#### 1.RESTRICTED ENTRY OF AUTOMOBILES

The college maintains a fleet of buses that offer transportation services to various parts of Bengaluru, ensuring convenience for both students and staff. The institution promotes the use of college transport over personal vehicles, emphasizing benefits such as enhanced safety, security, fuel conservation, and reduction of environmental pollution. Additionally, the college buses undergo pollution checks conducted by authorized agencies to ensure compliance with environmental standards.

#### 2. PEDESTRIAN FRIENDLY PATHWAYS

Parking space for vehicles is available at the main entrance of the college campus. While the campus is primarily free of vehicles, with certain exceptions, students and staff enjoy the convenience of walking along



pedestrian-friendly pathways. Internal roads are adorned with trees and are diligently maintained by the campus maintenance committee.

#### 3. BAN ON USE OF PLASTIC

To mitigate the use of single-use plastic items like bottles, bags, spoons, straws, and cups, a complete ban has been enforced, with awareness initiatives conducted among both staff and students through orientations and display boards on the premises. Additionally, efforts have been made to reduce plastic usage by replacing plastic tea cups and glasses with steel alternatives in the canteen.

#### 4.LANDSCAPING WITH TREES AND PLANTS

The college's landscaping is visually stunning and exemplifies a keen aesthetic sensibility. A canopy of trees and plants has been meticulously cultivated to promote a pollution-free environment and safeguard the health of all occupants. The lawns and trees not only offer shade but also contribute to the serene ambiance of the campus. Trained gardeners and supervisors ensure the meticulous development and maintenance of the green landscaping. The construction and maintenance personnel of the college are responsible for nurturing and preserving the greenery on campus. Furthermore, the institute authorities are actively pursuing initiatives to transition the campus to a paperless environment. Internal communication within the campus is predominantly conducted through email or electronic messages, aligning with the goal of achieving a paperless office.

### 5.1. CONCLUSION AND RECOMMENDATIONS

The Green Audit serves as an effective tool for assessing both the strengths and weaknesses of environmental sustainability practices and devising solutions to address identified issues. It represents a professional approach towards responsible utilization of economic, financial, social, and environmental resources. Green audits contribute value to the management strategies adopted by the college by identifying, evaluating, and managing environmental risks, whether known or unknown. While the college has made strides in considering the environmental impacts of its operations in recent years and endeavors to act in an environmentally responsible manner, there remains room for improvement, particularly in waste, energy, and water management. The recommendations outlined in this report underscore various opportunities for the college to enhance its practices and evolve into a more sustainable institution.



#### 5.2. SUGGESTIONS

Some of the very important suggestions are:-

- Enhance awareness of environmentally sustainable development by utilizing every opportunity to engage the public, government, industry, foundations, and universities. Address the pressing need to transition towards a future that prioritizes environmental sustainability openly and proactively.
- Establish programs aimed at cultivating expertise in environmental management, sustainable economic development, population dynamics, and related fields. These initiatives ensure that all university graduates attain environmental literacy and possess the awareness and understanding necessary to become ecologically responsible citizens.
- Promote the engagement of all stakeholders, including government entities, foundations, and industries, in supporting interdisciplinary research, education, policy formulation, and information exchange concerning environmentally sustainable development. Expand collaboration with community and non-governmental organizations to aid in identifying solutions to environmental challenges.
- Facilitate collaboration between university faculty and administrators and environmental practitioners to devise interdisciplinary approaches for curricula, research endeavors, operations, and outreach activities that promote an environmentally sustainable future. Adopt the proposed Environmentally Responsible Purchasing Policy, and work towards creating and implementing a strategy to reduce the environmental impact of its purchasing decisions.
- As a responsible member of society, it is our duty to protect our environment and conserve resources. One way to achieve this goal is by adopting the 3R's approach reduce, reuse, and recycle. However, the success of this approach primarily depends on the awareness and willingness of people to adopt it. Therefore, it is essential to increase education and awareness about the 3R's approach on campus.
- Name all the trees and plants with its common name and scientific name.
- Display boards of fauna diversity to generate enthusiasm for learners.
- Organize earn while learn eco-friendly programs
- Conduct exhibitions for parents and public on environment and sustainable practices.
- Organize training programs focused on environmental management systems and nature conservation. Facilitate the involvement of both students and teachers in addressing local environmental concerns.



- Promote the use of renewable energy vehicles for transporting students and faculty, thereby decreasing reliance on fossil fuels.
- Conduct an assessment to explore the feasibility of installing wind turbines as a means of generating electricity, with the aim of reducing carbon emissions and minimizing the institution's carbon footprint.



PRINCIPAL

NAGARJUNA COLLEGE OF MANAGEMENT STUDIES

CHICKBALLAPUR - 56210'

# ENVIRONMENTAL AUDIT REPORT

For the year 2023-24



Prepared by

Prakruthi

Institute of Environmental Studies

2<sup>nd</sup> Floor, No. 93, 7<sup>th</sup> Cross, Lower Palace Orchards, Bengaluru – 560003 Submitted by:

Nagarjuna Education Society (NES),

Beedaganahalli, Venkatagiri Kote, Post, Devanahalli, Bengaluru, Karnataka 562110





Audited by
Er. Ramesh Kumar B N
Chief Environmental officer (R)
Karnataka State Pollution Control Board
Chairman

Prakruthi Institute of Environmental Studies 2nd Floor, No.93, 7th Cross, Lower Palace Orchards, Bengaluru -560003



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#### **EXECUTIVE SUMMARY**

Sustainability is not only spoken in various levels but also practiced by industries, organizations and educational institutes to optimize their resource utilization and make them environment friendly. Hence sustainability is the need of the hour for our country to provide our future generation a clean and safe environment. Educational institutions must play an active role in creating and modelling solution for such environmental problems. Environmental audit is one such concept or principle introduced to make the educational institutes environmentally sustainable. Through environmental audit one gets a direction as how to improve the condition of environment within the system. Environmental audit can be a useful tool for a college to determine how and where they are consuming more of energy or water or resources; the college can then consider how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can beused for a recycling project or to improve waste minimization plan.



Environmental auditing and the implementation of mitigation measures is a win-win situation for the college, the learners and the planet. It can also create health consciousness promote environmental awareness, values and ethics. It provides staff and students better understanding environmental impact on

campus. Environmental auditing promotes financial savings through reduction of resource use. It gives an opportunity for the development of ownership, personal and social responsibility to the students and teachers.

At Nagarjuna College of Engineering And Technology (NCET), the audit procedure commenced with initial discussions with management to elucidate policies, activities, records, and the level of collaboration from staff and students in executing mitigation measures. Subsequently, interviews were conducted with both staff and students, alongside data collection via questionnaires, record examination, observation of practices, and assessment of tangible outcomes. Furthermore, the approach emphasized the active involvement of both management and staff in the environmental auditing process within the college.



The baseline data prepared for the Nagarjuna College of Engineering And Technology will be a useful tool for campus energying, resource management, planning of future projects, and a document for implementation of sustainable development of the institution. The availability of existing data will enable the college to conduct comparisons between its programs and operations and those of similar institutions, identifying areas requiring improvement and prioritizing the implementation of upcoming projects. We anticipate a strong commitment from the management to enact the recommendations stemming from the environmental audit.



#### CHAPTER - 1

#### INTRODUCTION

An environmental audit, alternatively referred to as an environmental audit or sustainability audit, is a methodical assessment of an organization's operations, procedures, and methodologies. Its purpose is to evaluate their environmental effects, adherence to environmental standards, and to pinpoint avenues for enhancing sustainability practices.

A environmental audit serves as a valuable tool for colleges to analyze their energy, water, and resource usage patterns, enabling them to identify areas for potential changes and cost savings. Moreover, it aids in assessing the quantity and type of waste generated, facilitating the development of recycling initiatives or waste minimization plans. Additionally, it fosters health awareness and promotes environmental values and ethics among the college community, enhancing their understanding of the campus's environmental footprint.

Furthermore, just as self-inquiry is an inherent aspect of quality education, institutional self-evaluation is equally essential for a reputable educational establishment. Therefore, it is crucial for colleges to assess their contributions to a sustainable future. Given the increasing significance of environmental sustainability on a national scale, higher education institutions play a pivotal role in addressing these concerns.

#### 1.1 OBJECTIVES OF ENVIRONMENTAL AUDIT

The Environmental Audit of an institution is becoming a paramount important these days for self-assessment of the institution, which reflects the role of the institution in mitigating the present environmental problems. The college has been putting efforts to keep the environment clean since its inception. But the auditing of this non-scholastic effort of the college has not been documented. Therefore, the purpose of the present environmental audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.

The main aim objectives of this environmental audit are to assess the environmental quality and the management strategies being implemented in Nagarjuna College of Engineering and Technology.

The specific objectives are:

> To assess the source and quantity and of the water in the Nagarjuna



College of Engineering and Technology campus.

- > To know and monitor the energy consumption pattern in the campus.
- To quantify the liquid and solid waste generation and management plans in the campus.
- > To assess the carbon foot print of the Campus.
- > To impart environment management plans to the campus and college. Benefits of Environmental Audit to an Educational Institute:

There are many advantages of environmental audit to an Educational Institute:

It would help to protect the environment in and around the campus.

- Recognize the cost saving methods through waste minimization and energy conservation.
- · Find out the prevailing and forthcoming complications.
- Empower the organization to frame a better environmental performance.
- It portrays good image of institution through its clean and green campus.

#### **Environmental Consciousness:**

Universities are playing a key role in development of human resources worldwide. Higher education institutes campus run various activities with aim to percolate the knowledge along with practical dimension among the society. Likewise different technological problems higher education institutes also try to give solution for issues related to environment. Different types of evolutionary methods are used to assess the problem concerning environment. It includes Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), Carbon Footprint Mapping, Environmental audit etc.

National Board of Accreditation (NBA) which is a self-governing organization that declares the institutions as Grade according to the scores assigned at the time of accreditation of the institution. Environmental Audit has become mandatory procedure for educational institutes under Criterion VII of NBA. The intention of environmental audit is to upgrade the environmental condition inside and around the institution. It is performed by considering environmental parameters like water and wastewater accounting, energy conservation, waste management, air, noise monitoring etc. for making the institution more eco-friendly.



Students are the major strength of any academic institution. Practicing green actions in any educational institution will inculcate the good habit of caring natural resources in students. Many environmental activities like plantation and nurturing saplings and trees, Cleanliness drives, Bird watching camps, No vehicle day, Rain water harvesting, etc. will make the students good citizen of the country. Through Environmental Audit, higher educational institutions can ensure that they contribute towards the reduction of Global warming through Carbon Footprint reduction measures.



#### CHAPTER - 2

## NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

# 2.1 ABOUT NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

Nagarjuna College of Engineering and Technology (NCET), a self-financing engineering college, was started in the year 2001 under the aegis of Nagarjuna Education Society, Bangalore. Nagarjuna Education Society (NES) was established in 1995 under the able guidance of Sri J.V.Rangaraju, leading industrialist and philanthropist. His commitment towards contribution to nation building is being achieved by imparting world-class education at all levels, viz. from primary, graduate, post-graduate to doctoral research degree.

Nagarjuna College of Engineering & Technology is affiliated to Visvesvaraya Technological University (VTU), Belagavi, and the only technological university in the state of Karnataka, recognized by Government of Karnataka and approved by AICTE, New Delhi. NCET has crafted the vision to be among the Top Engineering Colleges in Karnataka. All the strategies and policies that we plan have this over- arching goal as a guide. The college has very good infrastructural facilities and the people at NCET are among the best in their fields.

The world is changing at exponential rate such that future is no more an extrapolation of the past and the present. It is important to be innovative to keep pace with the world. Science & technology have a great role to play in building India into a developed nation.

The Nagarjuna College of Engineering and Technology is strategically located on the Bangalore-Hyderabad National Highway, a road that falls on the Golden quadrangle. Its proximity to the International airport at Bangalore gives it strategic location and commutability. We have lush green campus spread of 72 acres with on-campus residential facility for boys, girls and staff. These hostels have amenities like mess, recreation room and state of art Gymnasium etc. Students are encouraged to actively participate in outdoor games as well. The college has a spacious library with well stacked books and well subscribed e-journals and books. The college is also a member of the VTU Consortium for e- resources.

The college is recognized as Nodal Centre for virtual lab facility, sponsored by MHRD, GOI. The institution is associated with IIT B, Mumbai for the project titled eYantra on Robotic Technology for students and staff. ISRO



has recognized our college as one of the centre to carry out the student projects under STUDSAT. The institution also has MoUs with different leading industries like EMC2, Oracle, NCC, Data Talk etc.

The College was affiliated to Visvesvaraya Technological University, Belgaum till 2014-15. The college has received Autonomous status from Visvesvaraya Technological University and Government of Karnataka from the academic year 2015-16. The college is recognized by Government of Karnataka as a Centre of Innovative Science and Engineering Education. NCET departments have been recognized as research centres from Visvesvaraya Technological University, Belgaum to offer Ph.D. programme.

Nagarjuna College of Engineering & Technology also focuses on imparting training in soft-skills, logical reasoning, aptitude tests & interviews and provides placement to all eligible candidates in leading industries. The coordination & team work of all concerned at Nagarjuna Education Society and the commitment & determination of the management has made us to fulfill our vision "Leadership & excellence in education" and reach the goal.



Figure 1 Aerial view of Nagarjuna College of Engineering and Technology
INFRASTRUCTURAL FACILITIES

Nagarjuna College of Engineering and Technology has adequate infrastructural facilities as per the AICTE requirements. Nagarjuna College of Engineering and Technology has adequate number of ventilated classrooms, Laboratories, Smart Classrooms (ICT enabled), Seminar halls,



Computer Labs, Research Centres, HOD cabins, Staff cabins, Common rooms, Rest rooms, Central & Department Library and Convention hall. The management consistently interacts with the stake holders to improve the infrastructure facilities.

**INFRASTRUCTURE AND LABORATORIES:** The College is located in a beautiful lush green landscape, free from polluted environment and excellent atmosphere and ambience ideally suited for growth of the soul & mind.

**LABORATORIES:** The institution has laboratories as per AICTE norms. Nagarjuna College of Engineering and Technology has laboratories with state of art laboratory equipment. The labs are well equipped with safety norms with list of experiments details. Labs are used by the students beyond the working hours for doing their projects.

**LIBRARY:** Apart from the books available in the library, students can also access online E-resources such as digital library to widen their knowledge and skills. The working time of library is from 9.00 am to 7.00 pm in working days and from 9.00 am to 4.00 pm in the holiday.

#### 2.2. UNDERGRADUATE PROGRAMS

- · B.E CS Artificial Intelligence and Machine Learning
- B.E in Civil Engineering
- B.E. in Computer Science and Engineering
- B.E CS- Data Science
- B.E. in Electronics and Communication Engineering
- B.E. in Information Science and Engineering
- B.E. in Mechanical Engineering

## 2.3. POST GRADUATE PROGRAMES

- MBA
- M.Tech. in Structural Engineering

# 2.4. NAGARJUNA GROUP OF MANAGEMENT & STUDIES

- B.COM
- B.B.A
- B.C.A
- B.Sc



- M.C.A
- M.COM

#### 2.5. VISION

Leadership and Excellence in education

#### 2.6. MISSION

To fulfil the vision by imparting total quality education replete with the philosophy of blending human values and academic professionalism.

#### 2.7. GOALS

- Providing high quality graduates not only competent in their respective fields, but are also motivated to serve humanity at large.
- Producing research papers in all fields of Engineering, worthy of being published by National & International Journals.
- Providing all facilities for the pursuit of medical knowledge, relevant to the needs of contemporary society.
- Implementing public services beneficial to and relevant with the needs
  of the community at large, nationally and internationally.

#### 2.8. EDUCATIONAL OBJECTIVES

- To provide for instruction in training in such branches of learning as it may deem fit.
- To provide for research and for the advancement of and dissemination of knowledge.
- To undertake extra moral studies, extension programs and field outreach activities to contribute to the development of Society.
- To undertake the activities to strengthen the set objectives.



#### CHAPTER - 3

#### METHODOLOGY ADOPTED

The audit process unfolded across three distinct phases. Initially, secondary data essential for the study was gathered from diverse sources, including relevant departments such as engineering, hostel management, and gardening. A comprehensive review was conducted to gain a clear understanding of environmental auditing principles, supplemented by the examination of various case studies and methodologies. Subsequently, the chosen methodology for the present audit involved onsite visits, personal observations, and the utilization of questionnaire surveys as tools for data collection. Sets of questionnaires were tailored to meet the specific data requirements, which were then administered during visits to all university departments. The collected data was consolidated for further analysis. Based on the comprehensive findings of the study, a final report was compiled.

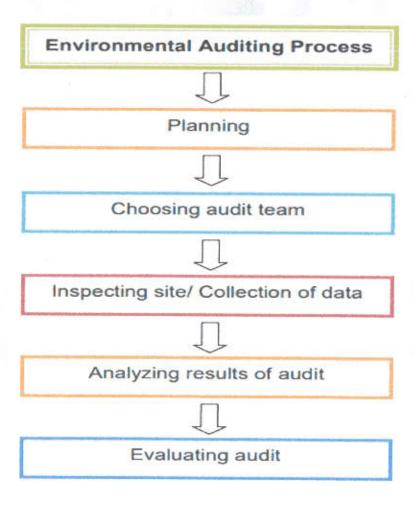


Figure 2 Audit Methodology



#### 3.1. SURVEY BY QUESTIONNAIRE:

The collection of baseline data for the preparation of the environmental audit report was conducted through a questionnaire survey method. The questionnaires utilized for the environmental audit on the university campus were developed based on guidelines, regulations, acts, and formats established by authorities such as the Ministry of Environment, Forest and Climate Change in New Delhi, the Central Pollution Control Board, and other relevant statutory bodies. While many of these guidelines and formats addressed broad aspects, some were not directly applicable to a university campus setting. Therefore, adaptations, modifications, and restructuring were undertaken, resulting in the creation of sets of questionnaires covering areas such as solid waste management, energy usage, water conservation, hazardous waste management, and e-waste disposal.

Each questionnaire comprised several modules. The first module focused on gathering general information about the respective department, including its name, the month and year of assessment, total student and employee counts, visitor numbers, average working days, and office hours. Subsequent modules addressed specific aspects such as current resource consumption (e.g., water, energy) and the management of solid and hazardous waste. Emphasis was placed on maintaining accurate records regarding the handling of solid and hazardous waste, given their significance in the context of the energy audit process.

In the context of environmental audit, it's imperative to assess the potential loss of resources such as water and energy resulting from inadequate maintenance practices. To address this concern, a dedicated module within the questionnaire focuses on probing into these probabilities. Additionally, another module is dedicated to the meticulous maintenance of records, encompassing aspects such as solid waste disposal and recovery records. To facilitate the surveyor's task, certain statistics, such as fundamental energy consumption characteristics for electrical equipment, were conveniently included alongside the questionnaires.

#### ONSITE VISIT AND OBSERVATIONS:

Nagarjuna College of Engineering and Technology encompasses a substantial built-up area, housing diverse facilities including various departments, an administrative building, faculty and staff quarters, student hostels, a guest house, sports complex, and health center. Each of these amenities possesses unique infrastructure tailored to its specific needs. Surveyors conducted thorough visits to all these buildings, utilizing questionnaires to assess their current conditions. Personal observations



were also noted during the onsite inspections. To streamline the survey process and subsequent analysis, amenities were categorized based on their similarities and differences, facilitating a more efficient evaluation.

#### DATA ANALYSIS AND FINAL REPORT PREPARATION:

Environmental audit, the completed survey questionnaires from each group were systematically tabulated in Excel spreadsheets according to their respective modules. This tabulated data served as the basis for further analysis. To enhance comprehension and streamline the process, averages and percentages were calculated for the tables. The interpretation of the overall findings was then synthesized, encompassing both primary and secondary data, along with references and interrelations. Subsequently, the final report was prepared based on this comprehensive interpretation.

- In order to meet its objectives, this audit combined physical inspection with a review of relevant documentation and interviews with various stakeholders.
- Review of the Documentation.
- For the purpose of this audit the Green Policy of the institute was reviewed.
- Interviews.
- Interviews were conducted with the Principal's, Registrar and also faculties and students.
- Physical Inspection.
- The audit team was in the college to inspect the campus.

# 3.2. LIST OF STUDENTS AND STAFF INVOLVED IN ENVIRONMENTAL AUDITING

Sl. No	Name	Designation
1.	Dr. Srilakshmi G	Professor & Head, Department of Civil
2.	Ms. Vidyashree MG	Assistant Professor, Department of Civil
3.	Mr. Sharan Kumar SV	Lab Assistant
4.	Mr Harish	Campus Admin
5.	Ms Dhanashree	Student, Dept. of Civil Engg
6.	Mr Tejas Sachin	Student, Dept. of Civil Engg
7.	Mr Sunil	Student, Dept. of Civil Engg



#### CHAPTER - 4

#### **ENVIRONMENTAL AUDIT**

# ECO -FRIENDLY CAMPUS & GREEN PRACTICES IN NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

#### 4.1. AREAS OF ENVIRONMENTAL AUDITING

#### 4.1.1. ENVIRONMENTAL AUDIT

This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment.

#### 4.1.2. WATER AUDIT

A water audit involves both qualitative and quantitative analyses of water consumption, aimed at identifying opportunities for reducing, reusing, and recycling water. It serves as an effective tool for minimizing losses and optimizing various water uses, thereby enabling significant water conservation across sectors including irrigation, domestic, power, and industrial. Essentially, a water audit is a technique used to identify means of conserving water by detecting inefficiencies in water distribution systems. Measuring water losses resulting from different uses within the system or utility is essential for implementing water conservation measures in such establishments.

This indicator addresses water consumption, water sources, irrigation, storm water, appliances and fixtures. Aquifer depletion and water contamination are taking place at unprecedented rates. It is therefore essential that any environmentally responsible institution should examine its water use practices.

Several factors, including climate, culture, dietary habits, work conditions, level of development, and physiological needs, influence water requirements. For communities with a population ranging from 20,000 to 100,000, the recommended water consumption ranges from 100 to 150 liters per person per day. Larger communities with populations exceeding 100,000 may require 150 to 200 liters per person per day. According to the standards outlined by the WHO Regional Office for South-East Asia, schools typically necessitate 10-15 liters per student for water-flushed toilets, while



administrative areas (excluding staff accommodations) require 50 liters per person per day. Staff accommodations typically require 30 liters per person per day, while water usage for sanitation purposes depends on the specific technology employed.

#### 4.1.3. BIODIVERSITY AUDIT

All living beings, including humans, are interconnected within a complex network of biodiversity, which is essential for our survival. Biodiversity plays a crucial role in maintaining healthy ecosystems and ensuring the well-being of our planet. It contributes to clean air and water, regulates the climate, and provides us with essential resources such as food, shelter, clothing, medicine, and other goods.

Every component of this intricate web suffers when one part weakens or disappears. Trees, for example, play a vital role in purifying the air we breathe. Through photosynthesis, their leaves absorb carbon dioxide and release oxygen, a process facilitated by sunlight, water, minerals, and chlorophyll. Additionally, trees' roots anchor the soil, preventing erosion by rain and wind. Given that the earth's fertile soil is typically only a thin layer, this stabilization is crucial for maintaining soil integrity and preventing loss through erosion.

#### 4.1.4. BIODEGRADABLE AND HAZARDOUS WASTE AUDIT

The waste streams generated within the college and hostel premises, from biodegradable waste originating from canteens to hazardous wastes produced in laboratories and discarded electric and electronic goods. Hazardous materials pose significant risks to both human health and ecological well-being. E-waste generated on campus contributes to the leaching of hazardous substances into the environment, resulting in long-term land and water contamination that can persist for generations.

These hazardous substances have the potential to accumulate in the tissues of organisms and become concentrated within food chains, leading to severe health consequences such as cancer, endocrine disruption, and birth defects. Minimizing, safely handling, and ultimately eliminating these hazardous materials are crucial steps toward ensuring the long-term health of our planet.

#### 4.2. LAND AREA STATEMENT

The land under the project is designated for Educational activities as per Karnataka Government. No additional burden on land has been created which may adversely affect land use pattern in the area. No natural drain is



being obstructed. The University land does not interfere with any forest, wetland, river, lake, mountain, national park & sanctuary etc.

# The total area of campus - 1,55,498.29 sq.m

Sr. No.	Particulars	Area
1	Total area	1,55,498.29 Sq.mt
2	Built up area	141300.4 Sq. mt
3	Roads/parking	2,288 Sq.mt
4	Green belt area	64,080 Sq.mt
5	Vacant area for future development	25,000 Sq.mt
6	Building Configuration [Number of Blocks / Towers / Wings etc., with Numbers of Basements and Upper Floors, canteen, seminar halls, playground, auditorium, hostels, Labs]	21 Blocks as per build up area statement

#### LAND USE BREAKUP WITHIN THE SITE

Sr. No.	Land Use	Area in Sqm.	%
1	Ground Coverage Area	17221.99	11.07
2	Drive Way Area	4118	2.65
3	Landscape Area	21865.00	14.06
4	Area under Services	355.65	0.23
5	Surface Parking	2288.00	1.47
6	Roads	19217	12.36
7	Playground	26352	16.95
8	Open Area	64080	41.21

#### BUILD UP AREA STATEMENT

Sr. No.	Name of the Building	BUA in Sqm



	Total BUA	141300.4 Sqm.		
21	New block	60,000		
20	1 st Year block	23,000		
19	Work Shop	1958.01		
18	Library Block	5480.93		
17	Bio-Tech Block	3584.00		
16	Boys Hostel Block-8	2602.54		
15	Staff Quarters	1455.49		
14	Girls Hostel- 2	4069.61		
13	Girls Hostel- 1	2279.48		
12	Boys Hostel- 6	2602.54		
11	Boys Hostel-5	2616.85		
10	Boys Hostel- 4	1639.97		
9	Boys Hostel- 3	1639.97		
8	Boys Hostel- 2	2270.00		
7	Boys Hostel- NRI	1839.06		
6	Gym Block and Computer Lab	3205.26		
5	Canteen Block	2405.51		
4	Main Block Ground, First & Second	8062.00		
3	Mechanical Block	2302.78		
2	Civil Block	3880.52		
1	Boys Hostel	4405.88		

# 4.3. WATER REQUIREMENT:

The total water requirement for the University is 264 KLD. Water quality of ground water resources in the area has been studied for assessing the water environment. Municipal Supply, Groundwater and rain water are being used in the campus



Total requirement of water in KLD			
Fresh	159		
Recycled	105		
Total	264		
Source of water	Municipal Supply, Groundwater and Rainwater		
1.Whether canteen facility	Yes		
provided for day students etc			
2. Waste water generation in KLD	211 KLD		
STP capacity	300 KLD		
Technology employed for	STP(SBR Technology)		
Treatment and mode of disposal of			
treated sewage			
Scheme of disposal of	Gardening, Lawns, Toilet and Flush out, Floor		
excess treated water if any	Washing		
Any Treatment for lab water			
No. of ponds, wells, taps, toilets,	Ponds- 1		
waterless urinals	T 004		
	Taps – 994		
	Toilets – 519		
No. and capacity of water tanks for storage	20nos, total capacity- 570715 liters		

#### 4.4. WASTE WATER GENERATION

About 211 m<sup>3</sup>/day of wastewater is being generated.

# 4.5. WASTE WATER MANAGEMENT

The institution adheres to a systematic approach for the efficient management and disposal of liquid waste. Wet waste generated from the college, hostels, and canteen is directed to bio fertilizer plants for the production of environmentally friendly fertilizers. The treated water is subsequently utilized for gardening and other purposes. Moreover, the



institution actively engages in discussions with students to raise awareness about liquid waste management techniques.

- To manage domestic and other wastewater effectively, a sewage treatment plant (STP) has been installed and is operating successfully. The STP has a capacity of 300 kiloliters per day (KLD) to treat wastewater generated from various sources including college buildings, hostels, canteens, and recreational areas such as the gymnasium etc.
- The treatment scheme comprises of a biological treatment called SBR system wherein the aerobic bacteria stabilizes all the organic matter, neutralizes the microbial population.
- The STP has been performing smoothly and delivers effluents with BOD values below 10 mg/l. The aerobic treatment followed by disinfection results in microbe concentration below 100 units as stipulated in the consent. Likewise all other listed parameters are also complied with. Analysis reports are regularly forwarded to the KSPCB.
- The wet waste from the college, hostels and canteen is given away to bio fertilizer plants for making eco-friendly fertilizers.

## 4.6. RECYCLE AND REUSE OF TREATED WASTEWATER:

The institution has installed sewage treatment plants (STPs) to manage wastewater originating from various areas within the Nagarjuna College of Engineering and Technology premises, including the college, hostels, staff quarters, and canteen areas. The sewage from these sources is treated in a 300 (KLD) STP. Typically, the STPs are operated below 80% capacity levels, and adjustments are made during semester breaks to accommodate fluctuations in influent levels. After biological treatment, the wastewater is disinfected using liquid chlorine before being pumped for various uses. Following the guidelines outlined by the Karnataka State Pollution Control Board (KSPCB), the treated wastewater is reused within the campus, as detailed in the subsequent sections.

In general the STPs are operated at not more than 80% of the designed capacity and at much lower capacity during vacations, lock down etc. The treated waste waters from STP are utilized for the following activities:



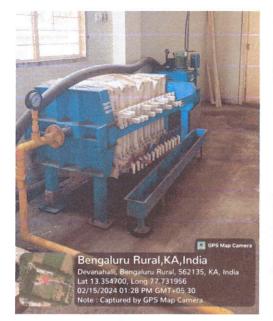




Figure 3 Sewage Treatment Plant

- Gardening and maintaining greenery within the campus. (50 %)
- Secondary flushing in toilets in the hostel buildings. (45%)
- Buses and other vehicles washing, Floor Washing within the campus.
   (5%)
- Treated water used for Flushing 105 KLD of STP treated water is used for flushing purpose.

# Bus/Car / Floor Washing:

The institute maintains a fleet of buses and other vehicles for transportation purposes. Furthermore, students residing on the premises utilize treated water for washing their cars and two-wheelers. A provision of 5 KLD has been allocated specifically for this purpose.

#### Green Belt Development:

Green belt development refers to the creation, enhancement, or preservation of vegetated areas within urban or industrial landscapes. These green belts serve various ecological, aesthetic, and recreational purposes, contributing to environmental sustainability and improving overall quality of life. They often involve planting trees, shrubs, and other vegetation along roadsides, water bodies, or in vacant spaces to mitigate environmental impacts, enhance biodiversity, regulate microclimates, and provide green spaces for recreation and relaxation. Green belt development projects may also include initiatives to protect natural habitats, restore degraded ecosystems, and promote sustainable land use practices.



This also requires regular watering for the survival. Through the hydrant systems network, the treated water is pumped from the STP and a total of 101 KLD is utilized for the purpose.





Figure 4 Green Belt Development

# 4.6.1. EXISTING WATER MANAGEMENT METHODS INSTALLED IN THE CAMPUS

- 1. Rain water harvesting
- 2. Construction of tanks and bunds
- 3. Waste water recycling

#### 1. Rain Water Harvesting:

- Rainwater harvesting is the process of collecting, storing, and utilizing rainwater for various purposes such as irrigation, household use, and groundwater recharge. It involves capturing rainfall from rooftops, paved surfaces, and other impermeable areas and directing it to storage tanks, cisterns, or underground reservoirs for later use. Rainwater harvesting systems typically include components such as gutters, downspouts, filters, and storage tanks to capture and store rainwater.
- The harvested rainwater can be used for a wide range of applications, including watering gardens, flushing toilets, washing clothes, and even drinking water with proper treatment. By harvesting rainwater, communities can reduce their reliance on traditional water sources, alleviate pressure on municipal water supplies, and improve water security, particularly in areas prone to water scarcity or drought.
- Rainwater harvesting also offers environmental benefits by reducing stormwater runoff, which can help prevent soil erosion, mitigate flooding, and replenish groundwater reserves. Additionally, it promotes sustainable water management practices and encourages



conservation efforts by maximizing the use of a natural resource that is often underutilized.

- As per the scheme the roof top water shall be collected in the underground tanks/ sumps, whereas the water collected from paved and unpaved areas shall pass through grease cum silt trap and clean water shall be either directly used or shall be used for recharging the existing bore wells within the campus as per drawings.
- There is one Groundwater Recharge Pit with tank capacity of 61174 litres.

# 2. Waste Water Recycling

- Nagarjuna College of Engineering and Technology has installed and effectively operates a sewage treatment plant on its premises. With a capacity of 300 kiloliters per day (KLD), this plant manages wastewater generated from various sources including the college building, hostels, canteens, and recreational areas such as the gymnasium etc.
- The sewage treatment plant (STP) has been operating efficiently, consistently producing effluents with Biological Oxygen Demand (BOD) values below 10 mg/l. The aerobic treatment process, coupled with disinfection measures, ensures that microbial concentrations remain below 100 units, as required by the consent regulations. Moreover, all other specified parameters are duly met. Regular analysis reports are submitted to the Karnataka State Pollution Control Board (KSPCB) for compliance verification.

#### 3. Construction of Tanks and Bunds:

As the water crisis continues to become severe, there is a dire need of reform in water management system and revival of traditional systems. As a part of revival to traditional wisdom, the institution built rain water storage tank, to collect the rainwater and can be used whenever it is required.

# 4. Maintenance of water bodies and distribution system in the campus

Groundwater is pumped into storage tanks situated across various locations within the campus, including a limited number of overhead storage tanks. A well-organized pipe network facilitates the distribution of water throughout the premises. Drinking water, treated through a Reverse Osmosis (RO) plant, is supplied via a separate set of distribution pipes, while water for other purposes is distributed through another set of pipes. The entire distribution system is diligently overseen by Civil works personnel to prevent leakages and wastage of water through joints and valves. Additionally, water usage is optimized through the implementation of low-pressure flushes. All



stakeholders of the college receive thorough education on the importance of using water economically and efficiently.

# 4.7. SOLID WASTE MANAGEMENT

The primary contributors to solid waste generation on campus comprise canteen waste, hostel kitchen waste, institutional waste, and staff quarters waste. Dry waste is predominantly stored at a transfer station located within the campus. Solid waste produced in the constituent colleges mainly consists of waste papers, answer sheets, and domestic waste such as kitchen waste.

The institute makes necessary arrangements for disposal of solid waste. Domestic biodegradable waste of 300.4 kg/day and 450.60 kg/day of non-biodegradable waste is generated.

The institution effectively implements solid waste management practices by enforcing waste segregation rules. Dustbins are strategically placed in classrooms, laboratories, restrooms, and mess areas across the campus. Dedicated sweepers are assigned to each floor to manage all waste generated within the premises. All waste, including that from the college and hostel, undergoes segregation at its source and is disposed of in an appropriate manner. They are proposing to install organic waste converter (OWC) with digester for gas generation. The gas will be used in the canteen for food preparation.

#### 4.7.1 WASTE GENERATION AND MANAGEMENT:

Sr. No.	Detail	Population	Total Solid Waste Generated (Kg/day)	Organic Waste Kg/day (40%)	In-Organic Waste Kg/day (60%)
1.	Educational Institution 4242	Hostel Students- 817	408.50 (0.5 Kg/capita/day)	163.40	245.10
	Personnel	College Students 3065	306.50 (0.1 Kg/capita/day)	122.60	183.90
		1	36.0 (0.1 Kg/capita/day)	14.40	21.60
Total		751	300.40	450.60	
Sludge			15 Kg		



# 4.7.2 HAZARDOUS WASTE GENERATION AND MODE OF DISPOSAL:

Every year, the process of DG disposal results in the generation of 55 liters of DG oil. This oil is then repurposed and used in the construction industry as shuttering oil. Shuttering oil is an essential substance used in construction to prevent concrete from sticking to the surface of the mold or formwork during the curing process. By utilizing DG oil as shuttering oil, construction companies are able to reduce their reliance on traditional, petroleum-based products, which can have a negative impact on the environment.



Figure 5 Hazardous waste storage

#### 4.7.3. E-WASTE MANAGEMENT:

The institution has initiated several e-waste management initiatives aimed at fostering an eco-friendly environment on campus. To minimize e-waste generation, computers and their peripherals are regularly upgraded for continued usage, thus reducing wastage. Additionally, Memorandum of Understanding (MoUs) have been established with E-Parisaraa and Rashi E-Waste Solutions for effective e-waste management.







Figure 6 E-waste storage

#### **4.8 ENERGY MANAGEMENT**

Energy conservation plays a vital role in campus sustainability and is closely connected to the carbon footprint of the campus. Environmental auditing focuses on conserving energy and implementing methods to reduce consumption, thereby addressing environmental degradation. Consequently, it is imperative for any environmentally conscious institution to scrutinize its energy usage practices.

Energy & power details					
	2021	2022	2023		
	9032985 Rs	12972491 Rs	18184717 Rs		
Electricity charges	8.10 Rs / unit	8.20 Rs/ unit	8.50 Rs / Unit		
	1115183.33	1582011.1	2139378.47		
	units / year	units / year	units / year		
Number of Gas cylinders used per month	135 units				
Number of Diesel Generators	3 Nos Capacity—100 KVA, 125 KVA, 250 KVA				
Quantity of Diesel consumed Cost of generator fuel	2000 liters per month @ 100 Rs per liter				
Total number of CFL bulbs	100				



Number of LED lights	LED lights-2000 Incandescent bulbs-00 Fans-
Incandescent bulbs	2000
fans AC's Tube lights	AC's -30
	Tube lights-5000 Electrical instruments-250
electrical instruments	Computers -850
computers	Photocopiers - 5
photocopiers	T.V's. – 15
T.V's. etc	

#### 4.9. SOLAR ENERGY

100 KW per day energy is generated by solar Panels installed inside the campus.

#### 4.10. AIR ENVIRONMENT

- In the University campus during construction in any stage water will be sprinkled on the soil to avoid dust generation.
- The debris and unused construction debris will be removed immediately for recycling, if any, or for designated land fill
- All vehicles for service activities at the University will be checked for vehicular emission. The agencies will be asked to keep them within prescribed limits. They will also be asked to maintain them properly.
- As discussed earlier there will be no other point source of Air pollution, which are noise free. Chimneys of suitable height have been provided to control the G.L.C. of PM 2.5, PM10, SO<sub>2</sub>, & NOx levels. Extensive tree plantations have been resorted to for further improving the air environment in general and minimize noise levels.

#### 4.10.1. AIR EMISSIONS AND NOISE LEVELS

The University has taken a commendable step towards ensuring environmental sustainability by installing noise-free generators for power backup. This move has significantly reduced the levels of noise pollution in and around the campus. Moreover, the University has also made it a point to avoid any other point source of emissions, such as boilers or furnaces that run on fossil fuels, which could have a negative impact on the air quality.



#### 4.10.2. TRAFFIC DENSITY

One of the rules that the students must follow while staying in the hostel is that they are not allowed to keep their own vehicles within the premises. This is to ensure the safety and security of all the residents in the hostel. However, this does not mean that the students are left stranded without any means of transportation. The University has taken into consideration the transportation needs of the local students and has provided its own buses that ply within the vicinity of the campus. The University has also taken care of the parking needs of the students who travel to the campus from outside. The layout of the campus has been meticulously planned to provide adequate space for parking within the premises. This ensures that students who commute to the campus from far-off places can comfortably park their vehicles without having to worry about their safety.

The provision of the University's own buses and ample parking space within the campus not only makes transportation easier but also contributes to reducing the carbon footprint. The University's efforts towards promoting sustainable transportation are commendable and set an example for other institutions to follow. In addition to this, the University has also taken initiatives to promote cycling as a means of transportation. The campus has dedicated bicycle parking areas, and students are encouraged to use bicycles as a sustainable and healthy mode of transportation.

#### 4.10.3. CARBON FOOTPRINT

The burning of fossil fuels has become a major concern in recent years due to its harmful effects on the environment. Fossil fuels such as petrol, coal, and natural gas are non-renewable resources that release greenhouse gases when burned. These gases, including carbon dioxide, water vapor, methane, nitrous oxide, and ozone, trap heat in the Earth's atmosphere and contribute to global warming and climate change. All the greenhouse gases, carbon dioxide are the most significant and prevalent. It currently makes up 402 ppm of the Earth's atmosphere, a level that has steadily increased since the Industrial Revolution. The primary source of carbon emissions is human activity, particularly the burning of fossil fuels for transportation, electricity, and heating.

In college campuses, vehicular emissions are a major contributor to carbon emissions. Cars, buses, and other modes of transportation that rely on fossil fuels emit significant amounts of carbon dioxide and other pollutants into the air. Therefore, it is essential to assess the transportation methods used by students, faculty, and staff to reduce carbon emissions and promote sustainable practices.



One way to reduce vehicular emissions on campus is to encourage the use of alternative modes of transportation. This can include walking, biking, carpooling, or using public transportation. By reducing the number of cars on the road, we can significantly decrease carbon emissions and improve air quality. Additionally, implementing eco-friendly policies such as energy-efficient buildings, recycling programs, and renewable energy sources can further reduce the campus's carbon footprint.

Carbon footprint				
Number of persons using cycles	10			
Number of persons using cars	50			
Number of persons uses two wheelers	150			
Number of persons using other transportations like bus etc	Bus- 665			
	Van -50			
	TT- 15			
Number of visitors per day	50			
Number of Students staying in the hostel	1100			
Number of Faculty and staff staying in the quarters	45			
Total Number of students	1819			
Total No. of faculty and staff	355			
Total number of E vehicles	2 number – name of vehicle – buggy			

# 4.11. ENVIRONMENTAL AUDIT (Ecology & Bio-Diversity)

#### 4.11.1. FLORA

The campus has a rich collection of trees. About 510 tree species were identified. Most of the plants have important role in the maintenance of biodiversity and are the good carbon assimilators. Herbal garden and other ornamental gardens were maintained in the campus.

Apart from records of Forest department, field surveys were undertaken to study the vegetation and floral components in the campus.



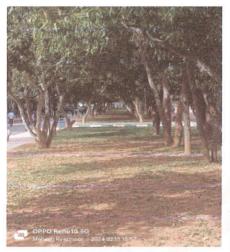








Figure 7 Flora at college campus

# LIST OF TREES SPECIES OF NCET, BANGALURU

Sr. No.	Botanical Name	Family	Common Name	Total
1	Arecaceae	Arecaceae	Palm	58
2	Roystonea regia	Arecaceae	Cuban royal palm tree	53
3	Mangifera indica	Anacardiaceae	Mango	151
4	Phoenix sylvestris	Arecaceae	Badela Palm	35
5	Chukrasia velutina	Meliaceae	Chukrasiatabularis	168
6	Dalbergia sissoo	Fabaceae	Sissu / Tali	16
7	Moringa oleifera	Moringaceae	Saujana	24



8	Bambusoideae	Poaceae	Bamboo	50
9	Anacardium accidentale L.	Anacardiaceae	Kaju Badam	65
10	Cocos nucifera	Arecaceae	Coconut	37
11	Ficus benghalensis	Moraceae	Banyan Tree	1
12	Azadirachta indica	Meliaceae	Neem	53
13	Phyllanthus emblica	Phyllanthaceae	Amlakhi(Indian gooseberry	30
14	Artocarpus heterophyllus	Moraceae	Jackfruit	30
15	Musa sp.	Musaceae	Banana tree	8
16	Prunus amygdalus	Rosaceae	Almond Tree	40
17	Spathodea campanulata	Bignonias	African tulip tree	76
18	Areca catacheau	Arecaceae	Beetle nut	48
19	Grevillea robusta	Proteaceae	Silver Oak tree	489
20	Platycladus orientalis	Cupressaceae	Oriental thuja	55
21	Delonix regia	<u>Fabaceae</u>	Royal Poinciana tree (Kathi mara)	68
22	Punica granatum	Lythraceae	Pomegranate tree	26
23	Ficus virens	Moraceae	White fig tree	2
24	Syzygium cumini	Myrtaceae	Jamun	27
25	Terminalia neotaliala	Combretaceae	Mantaly tree	450
26	Eucalypts	Myrtaceae	Safeda tree	25
27	Rosa	Rosaceae	Rose tree	40



28	Citrus limon	Rutaceae	Rutaceae Lemon tree		
29	Cassia fistula	Fabaceae Golden rain tree		26	
30	Tamarindus indica	Fabaceae	Tamarind tree	7	
31	Eucalyptus globulus	Myrtaceae	Nilgiri tree	21	
32	Tabernaemontana	Apocynaceae	Crepe jasmine	10	
	divaricata				
33	Santalum album	Santalaceae	Sandalwood tree	5	
34	Tectona grandis	Lamiaceae	Sagwan	50	
35	Manilkara zapota	Sapotaceae	Sapota tree	50	
36	Delonix regia	Fabaceae	Krishnachura (Flame Tree)	7	
37	Acacia falciformis	Fabaceae	Mountain hickory	350	
38	Magnolia champaca	Magnoliaceae	Sampangi tree (Champak)	5	
39	Tsuga canadensis	Pinaceae	Eastern hemlock tree	38	
40	Caryota	Arecaceae	Fishtail palm	5	

#### 4.11.2 FAUNA

Prolific wild life is not observed in the University campus, as there is no thick forest/ vegetation is noticed in the University Campus.

FAUNAL GROUP	SCIENTIFIC NAMES			
	Myrmachne orientalis (Family Salticidae);Nephilaplipes (Family-Nephilidae); Heteropoda sp (Family-Sparassidae); Phintella vitatta (FamilySalticidae)			



MOTHS	&Antheria assmensis;Bombyx mori;Philosamia ricini;				
BUTTERFLIES	Junonia atlites atlites ; Commander (Moduza procris procris);Ethope himachala ; Melanitis leda leda ; Paltoporia paraka paraka; Ypthima baldus ; Acraea terpsicore ; Elymnias,hypermnestra,undularis;Mycalesisperseusblasi us;Tanaecialepidealepidae;Euploea core				
OTHER INSECTS	Scarlet dragonfly; Pantala flavescens (wandering glider), grasshoppers, microbes				
REPTILES	squirrels, mouse, snake, lizard				
BIRDS	Acridotheres tristis (Common myna); Streptopelia orientalis (Oriental Turtle Dove); Athene noctua ( little owl ); Pycnonotus cafer (Red- vented Bulbul), crows, sparrows, peacock				
MAMMALS	Monkeys, Dogs, Cats				



#### **CHAPTER 5**

## ASSESSMENT OF BASELINE ENVIRONMENTAL CONDITIONS AT SITE

#### **5.1 WATER ENVIRONMENT**

#### 5.1.1 SAMPLING METHODOLOGY AND ANALYSIS

Borewell samples were collected and analysed.

Following procedures were used while sampling and & Methodologies adopted in assessing quality of water:

- Washing the bottles/cans with distilled water prior to the sampling;
- Before collection of water the bottles/cans are again washed 2-3 times with the same water
- For surface water, Bottles were lowered to a minimum depth of 30 cm below water surface.
- At each point, different sets of water samples were collected so as to cover all the parameters
- Sterilized bottles were used for the samples that are to be analyzed for bacteria
- Parameters like pH, TDS and temperature were analyzed in the field conditions. There are specific instruments for measuring TDS and pH in the field. These are portable. These instruments will be calibrated at laboratory before use. The results were reconfirmed after getting to the laboratory. DO is fixed and titrated in the field itself.
- Appropriate preservatives are added, depending upon the elements to be analyzed and marked accordingly (APHA / IS: 3025 (part I)).
- All the water samples collected in the ice box, were immediately transported to the laboratory and freezed at <5 °C for analysis.
- Field observations were noted in the field notebook.

# Sample Collection and Analysis of Water Sample

Parameter	Frequency	Sampling Methadology	Preservatio n Method	Analysis Method	Prescribed Standard
pH, TDS and Temperature	Once in a baseline		Not applicable	Onsite measurement	IS: 10500 specificatio



Other physico- chemical and biological parameters	period	(Part I)	IS: 3025 (Part I)	'Standard Methods for Examination of Water and Wastewater'	ns
				Published by American Public Health	
				Association (APHA) / IS: 3025	

#### 5.1.2 WATER SAMPLE ANALYSIS

Samples and were analyzed for various parameters as per the procedures specified in "Standard Methods for the Examination of Water and Wastewater" published by American Public Health Association (APHA). Different physicochemical parameters of ground water during study period were compared with standard at each monitoring stations and shown in the Table below.

Table: Primary Water Quality Criteria for Designated-Best-Use-Classes

Designated-Best-Use	Category	Criteria Description		
Drinking Water Source without conventional treatment but after disinfection	A	<ul> <li>Total Coliforms Organism MPN/100ml shabe 50 or less</li> <li>pH between 6.5 to 8.5</li> <li>Dissolved Oxygen 6mg/l or more</li> <li>Biochemical Oxygen Demand (5 days 20°0 2mg/l or less</li> <li>TDS max. 500 mg/lit</li> </ul>		
Outdoor bathing (Organized)	В	<ul> <li>Chlorides (as Cl-), 250 mg/L, Max</li> <li>Total Coliforms Organism MPN/100ml shad be 500 or less</li> <li>pH between 6.5 and 8.5</li> <li>Dissolved Oxygen 5mg/l or more</li> <li>Biochemical Oxygen Demand (5 days 20 3mg/l or less</li> </ul>		
Drinking water source after	С	• Total Coliforms Organism MPN/100ml shall be 5000 or less		



conventional		pH between 6 to 9		
treatment and		<ul> <li>Dissolved Oxygen 4mg/l or more</li> </ul>		
disinfection		• Biochemical Oxygen Demand (5 days 20°C)		
		3mg/l or less		
		• TDS max. 1500 mg/lit		
		• Chlorides (as Cl-), 600 mg/L, Max		
Propagation of Wild	D	pH between 6.5 to 8.5		
life and Fisheries		• Dissolved Oxygen 4mg/l or more		
		• Free Ammonia (as N) 1.2 mg/l or less		
Irrigation, Industrial	E	pH between 6.0 to 8.5		
Cooling, Controlled		• Electrical Conductivity at 25oC micro		
Waste disposal		mhos/cm Max.2250		
		Sodium absorption Ratio Max. 26		
		Boron Max. 2mg/1		
		• TDS max. 2100 mg/lit		
		• Chlorides (as Cl-), 600 mg/L, Max		
	Below-E	Not Meeting A, B, C, D & E Criteria		
	Topics Control			

Source: CPCB STANDARDS (CLASSIFICATION OF INLAND SURFACE WATER)

#### Table: Groundwater Test Results

S.	Parameters	Borewell	As Per IS 10500:201	
No			DL	PL
1	рН <u>@24.6°</u> С	6.89	6.5-8.5	No Relaxation
2	Total Dissolved Solids, mg/L	411	500	2000
3	Conductivity@25°C, μS/Cm	632		
4	Temperature, <sup>0</sup> C	25.5	-	-
5	Turbidity as NTU	<0.1	1	5
6	Chromium as Cr, mg/L	0.020	0.05	No Relaxation



7	Copper as Cu, mg/L	0.038	0.05	No Relaxation
8	Nickel as Ni, mg/L	0.018	0.02	No Relaxation
9	Iron as Fe, mg/L	<0.01	0.3	No Relaxation
10	Zinc as Zn, mg/L	0.067	5.0	15
11	Lead as Pb, mg/L	0.01	0.01	No Relaxation
12	Cadmium as Cd, mg/L	0.036	0.003	No Relaxation
13	Sodium as Na, mg/L	84	-	-
14	Potassium as K, mg/L	3.5	-	-
15	Sulphates, mg/L	BDL	200	400
16	Calcium as Ca, mg/L	51	75	200
17	Total Hardness as CaCO3, mg/L	178	200	600
18	Magnesium as Mg, mg/L	12	30	100
19	Chlorides as Cl, mg/L	127	250	1000
20	Total Alkalinity as CaCO3,mg/L	118	200	600
21	Nitrate Nitrogen as (NO3-N), mg/L	1.5	45	No Relaxation
22	Fecal Coliform, MPN/100ml	Absent		be detectable in ml Sample
23	E.Coli, CFU/100ml	Absent		be detectable in ml Sample
24	Fluorides as F,	0.8	1.	.0 1.5



	mg/L			
	Production of the Control of the Con		=	

ND: Not Detected

BDL - Below Detection Limit

#### 5.1.3 GROUND WATER RESULT AND ITS INTERPRETATION

The analysis results indicate that pH of the groundwater samples were found to be 6.89. The TDS was found to be between 411mg/l. All the parameters found in the range of prescribed limits. The water quality is potable in nature after giving necessary treatment (U.F + R.O) followed by disinfection process.

All of the parameters for Ground Water samples were found within the permissible limit as per drinking water norms IS 10500:2012. They are not directly using this bore well water for drinking purpose. They have to compulsory to treat this water before use for domestic and drinking purpose. Based on above data, it is interpreted that the ground water quality meets with the drinking water norms. However, this water shall be used for drinking after conventional treatment.

#### **5.2 STP Treated Water**

211 KLD of wastewater is generated from various activities inside the campus. This wastewater is treated in 300 KLD STP in the premises of Nagarjuna College of Engineering and Technology.

Samples from STP inlet and outlet was collected and tested for its quality which is discussed in table below:

**Table: STP Treated Water** 

S. No	Parameters	STP Outlet Water	Tolerance Limits	Test Method
1	pH@24.7°C	7.87	6.5-8.5	IS 3025:Part-11:1983 (Reaffirmed 2017)
2	Total Suspended Solids, mg/L	<1	20	IS 3025:Part-17:1984 (Reaffirmed-2017)
3	Bio-Chemical Oxygen	9	10	IS 3025:Part-44:1993



	Demand			(Reaffirmed-2019)
	(3Days at 27°C), mg/L			
4	Chemical Oxygen	48	50	IS 3025:Part-58:2006
	Demand, mg/L			(Reaffirmed-2017)
5	Ammonical nitrogen as	1.3	5	APHA 23 <sup>rd</sup> Edition
	NH <sub>3</sub> -N, mg/L			4500,NH <sub>3</sub> ,B,C:2017
6	Total nitrogen, mg/L	2.6	10	IS 3025:Part-34:1988
				(Reaffirmed-2019)
7	Fecal Coliform,	13	<100	APHA 23 <sup>rd</sup>
	MPN/100ml			Edition(9221B): 2017

### Interpretation:

All the tested parameters are within the tolerance limits. The results indicate that the STP is working efficiently.

#### **5.3 AIR ENVIRONMENT**

The ambient air quality monitoring was carried out in accordance with guidelines of Central Pollution Control Board (CPCB) and National Ambient Air Quality Standards (NAAQS) of CPCB of November 2009.

Table: Ambient air quality Results

S. No	PARAMETERS	UNIT	RESULTS	STANDARD LIMITS
			Near Admission block area	
1	Particulate Matter(PM <sub>10</sub> )	μg/m³	96.5	100 μg/m <sup>3</sup>
2	Particulate Matter(PM <sub>2.5</sub> )	μg/m³	42.8	60 μg/m <sup>3</sup>
3	Sulphur Dioixde as SO <sub>2</sub>	μg/m <sup>3</sup>	19.2	80 μg/m <sup>3</sup>
4	Nitrogen Dioxide as NO <sub>2</sub>	μg/m <sup>3</sup>	26.7	80 μg/m <sup>3</sup>



# **Interpretation of Results:**

All the parameters are within the permissible values.

#### **5.4 Noise Environment**

Noise levels were monitored at the main gate area and the values are presented in the table below:

**Table: Noise Monitoring Results** 

S.No	Monitored Location	Results dB (A) Day	Tolerance Limits
1	Near Main Gate Area	60.6	
2	Near Admission Block Area	58.2	IS 9989-1981
3	East Side Area	47.2	(Reaffirmed 2014)
4	West Side Area	48.1	
	CPCB Standard	75	

Noise levels are within the prescribed tolerance limits.



#### CHAPTER 6

#### CONCLUSION AND RECOMMENDATIONS

Nagarjuna College of Engineering and Technology is committed to fostering a green campus environment. Despite its primary focus on technology, the institution demonstrates notable awareness in prioritizing eco-friendly practices. Upon visiting the campus, visitors can appreciate the aesthetic appeal of the elegant buildings, well-maintained lawns, expansive sports grounds, and verdant surroundings, which create a conducive atmosphere for the teaching-learning process.

The institutional initiatives for greening the campus are as follows:

- Implementation of restricted entry for automobiles within the campus premises aims to minimize traffic congestion and enhance pedestrian safety.
- Designing pedestrian-friendly pathways prioritizes the convenience and safety of individuals traversing the campus on foot, promoting a healthy and sustainable mode of transportation.
- Enforcing a ban on the use of plastic within the campus helps to reduce environmental pollution and promotes the adoption of ecofriendly alternatives.
- Landscaping with trees and plants enhances the aesthetic appeal of the campus while also contributing to environmental sustainability by providing shade, improving air quality, and supporting biodiversity.

#### 1.RESTRICTED ENTRY OF AUTOMOBILES

The college maintains a fleet of buses that offer transportation services to various parts of Bengaluru, ensuring convenience for both students and staff. The institution promotes the use of college transport over personal vehicles, emphasizing benefits such as enhanced safety, security, fuel conservation, and reduction of environmental pollution. Additionally, the college buses undergo pollution checks conducted by authorized agencies to ensure compliance with environmental standards.

#### 2. PEDESTRIAN FRIENDLY PATHWAYS

Parking space for vehicles is available at the main entrance of the college campus. While the campus is primarily free of vehicles, with certain exceptions, students and staff enjoy the convenience of walking along



pedestrian-friendly pathways. Internal roads are adorned with trees and are diligently maintained by the campus maintenance committee.

#### 3. BAN ON USE OF PLASTIC

To mitigate the use of single-use plastic items like bottles, bags, spoons, straws, and cups, a complete ban has been enforced, with awareness initiatives conducted among both staff and students through orientations and display boards on the premises. Additionally, efforts have been made to reduce plastic usage by replacing plastic tea cups and glasses with steel alternatives in the canteen.

#### **4.LANDSCAPING WITH TREES AND PLANTS**

The college's landscaping is visually stunning and exemplifies a keen aesthetic sensibility. A canopy of trees and plants has been meticulously cultivated to promote a pollution-free environment and safeguard the health of all occupants. The lawns and trees not only offer shade but also contribute to the serene ambiance of the campus. Trained gardeners and supervisors ensure the meticulous development and maintenance of the green landscaping. The construction and maintenance personnel of the college are responsible for nurturing and preserving the greenery on campus. Furthermore, the institute authorities are actively pursuing initiatives to transition the campus to a paperless environment. Internal communication within the campus is predominantly conducted through email or electronic messages, aligning with the goal of achieving a paperless office.

#### 5.1. CONCLUSION AND RECOMMENDATIONS

The Environmental Audit serves as an effective tool for assessing both the strengths and weaknesses of environmental sustainability practices and devising solutions to address identified issues. It represents a professional approach towards responsible utilization of economic, financial, social, and environmental resources. Energy audits contribute value management strategies adopted by the college by identifying, evaluating, and managing environmental risks, whether known or unknown. While the college has made strides in considering the environmental impacts of its operations in recent years and endeavors to act in an environmentally responsible manner, there remains room for improvement, particularly in waste, energy, and water management. The recommendations outlined in this report underscore various opportunities for the college to enhance its practices and evolve into a more sustainable institution.



#### 5.2. SUGGESTIONS

Some of the very important suggestions are:-

- Enhance awareness of environmentally sustainable development by utilizing every opportunity to engage the public, government, industry, foundations, and universities. Address the pressing need to transition towards a future that prioritizes environmental sustainability openly and proactively.
- Establish programs aimed at cultivating expertise in environmental management, sustainable economic development, population dynamics, and related fields. These initiatives ensure that all university graduates attain environmental literacy and possess the awareness and understanding necessary to become ecologically responsible citizens.
- Promote the engagement of all stakeholders, including government entities, foundations, and industries, in supporting interdisciplinary research, education, policy formulation, and information exchange concerning environmentally sustainable development. Expand collaboration with community and non-governmental organizations to aid in identifying solutions to environmental challenges.
- Facilitate collaboration between university faculty and administrators and environmental practitioners to devise interdisciplinary approaches for curricula, research endeavors, operations, and outreach activities that promote an environmentally sustainable future. Adopt the proposed Environmentally Responsible Purchasing Policy, and work towards creating and implementing a strategy to reduce the environmental impact of its purchasing decisions.
- As a responsible member of society, it is our duty to protect our environment and conserve resources. One way to achieve this goal is by adopting the 3R's approach reduce, reuse, and recycle. However, the success of this approach primarily depends on the awareness and willingness of people to adopt it. Therefore, it is essential to increase education and awareness about the 3R's approach on campus.
- Name all the trees and plants with its common name and scientific name.
- Display boards of fauna diversity to generate enthusiasm for learners.
- Organize earn while learn eco-friendly programs
- Conduct exhibitions for parents and public on environment and sustainable practices.
- Organize training programs focused on environmental management systems and nature conservation. Facilitate the involvement of both students and teachers in addressing local environmental concerns.



- Promote the use of renewable energy vehicles for transporting students and faculty, thereby decreasing reliance on fossil fuels.
- Conduct an assessment to explore the feasibility of installing wind turbines as a means of generating electricity, with the aim of reducing carbon emissions and minimizing the institution's carbon footprint.



PRINCIPAL

NAGARJUNA COLLEGE OF MANAGEMENT STUDIES

CHICKBALLAPUR - 562101

# ENERGY AUDIT REPORT

For the year 2023-24



Prepared by

Prakruthi

Institute of Environmental Studies

2<sup>nd</sup> Floor, No. 93, 7<sup>th</sup> Cross, Lower Palace Orchards, Bengaluru – 560003



### Submitted by:

Nagarjuna Education Society (NES),

Beedaganahalli, Venkatagiri Kote, Post, Devanahalli, Bengaluru, Karnataka 562110





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#### **EXECUTIVE SUMMARY**

Sustainability is not only spoken in various levels but also practiced by industries, organizations and educational institutes to optimize their resource utilization and make them environment friendly. Hence sustainability is the need of the hour for our country to provide our future generation a clean and safe environment. Educational institutions must play an active role in creating and modelling solution for such environmental problems. Energy audit is one such concept or principle introduced to make the educational institutes environmentally sustainable. Through energy audit one gets a direction as how to improve the condition of environment within the system. Energy audit can be a useful tool for a college to determine how and where they are consuming more of energy or water or resources; the college can then consider how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan.



auditing Energy and implementation of mitigation measures is a win-win situation for the college, the learners and the planet. It can also create health consciousness and environmental promote awareness, values and ethics. It provides staff and students better understanding of energy impact on campus. Energy

auditing promotes financial savings through reduction of resource use. It gives an opportunity for the development of ownership, personal and social responsibility to the students and teachers.

At Nagarjuna College of Engineering And Technology (NCET), the audit procedure commenced with initial discussions with management to elucidate policies, activities, records, and the level of collaboration from staff and students in executing mitigation measures. Subsequently, interviews were conducted with both staff and students, alongside data collection via questionnaires, record examination, observation of practices, and assessment of tangible outcomes. Furthermore, the approach emphasized the active involvement of both management and staff in the energy auditing process within the college.



The baseline data prepared for the Nagarjuna College of Engineering And Technology will be a useful tool for campus energying, resource management, planning of future projects, and a document for implementation of sustainable development of the institution. The availability of existing data will enable the college to conduct comparisons between its programs and operations and those of similar institutions, identifying areas requiring improvement and prioritizing the implementation of upcoming projects. We anticipate a strong commitment from the management to enact the recommendations stemming from the energy audit.



#### CHAPTER - 1

#### INTRODUCTION

An energy audit, alternatively referred to as an environmental audit or sustainability audit, is a methodical assessment of an organization's operations, procedures, and methodologies. Its purpose is to evaluate their environmental effects, adherence to environmental standards, and to pinpoint avenues for enhancing sustainability practices.

A energy audit serves as a valuable tool for colleges to analyze their energy, water, and resource usage patterns, enabling them to identify areas for potential changes and cost savings. Moreover, it aids in assessing the quantity and type of waste generated, facilitating the development of recycling initiatives or waste minimization plans. Additionally, it fosters health awareness and promotes environmental values and ethics among the college community, enhancing their understanding of the campus's environmental footprint.

Furthermore, just as self-inquiry is an inherent aspect of quality education, institutional self-evaluation is equally essential for a reputable educational establishment. Therefore, it is crucial for colleges to assess their contributions to a sustainable future. Given the increasing significance of environmental sustainability on a national scale, higher education institutions play a pivotal role in addressing these concerns.

#### 1.1 OBJECTIVES OF ENERGY AUDIT

The Energy Audit of an institution is becoming a paramount important these days for self-assessment of the institution, which reflects the role of the institution in mitigating the present environmental problems. The college has been putting efforts to keep the environment clean since its inception. But the auditing of this non-scholastic effort of the college has not been documented. Therefore, the purpose of the present energy audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.

The main aim objectives of this energy audit are to assess the environmental quality and the management strategies being implemented in Nagarjuna College of Engineering and Technology.

The specific objectives are:

 $\triangleright$  To assess the source and quantity and of the water in the Nagarjuna



College of Engineering and Technology campus.

- > To know and monitor the energy consumption pattern in the campus.
- > To quantify the liquid and solid waste generation and management plans in the campus.
- > To assess the carbon foot print of the Campus.
- > To impart environment management plans to the campus and college. Benefits of Energy Audit to an Educational Institute:

There are many advantages of energy audit to an Educational Institute:

It would help to protect the environment in and around the campus.

- Recognize the cost saving methods through waste minimization and energy conservation.
- Find out the prevailing and forthcoming complications.
- Empower the organization to frame a better environmental performance.
- It portrays good image of institution through its clean and green campus.

#### **Environmental Consciousness:**

Universities are playing a key role in development of human resources worldwide. Higher education institutes campus run various activities with aim to percolate the knowledge along with practical dimension among the society. Likewise different technological problems higher education institutes also try to give solution for issues related to environment. Different types of evolutionary methods are used to assess the problem concerning environment. It includes Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), Carbon Footprint Mapping, Energy audit etc.

National Board of Accreditation (NBA) which is a self-governing organization that declares the institutions as Grade according to the scores assigned at the time of accreditation of the institution. Energy Audit has become mandatory procedure for educational institutes under Criterion VII of NBA. The intention of energy audit is to upgrade the environmental condition inside and around the institution. It is performed by considering environmental parameters like water and wastewater accounting, energy conservation, waste management, air, noise monitoring etc. for making the institution more eco-friendly.



Students are the major strength of any academic institution. Practicing green actions in any educational institution will inculcate the good habit of caring natural resources in students. Many environmental activities like plantation and nurturing saplings and trees, Cleanliness drives, Bird watching camps, No vehicle day, Rain water harvesting, etc. will make the students good citizen of the country. Through Energy Audit, higher educational institutions can ensure that they contribute towards the reduction of Global warming through Carbon Footprint reduction measures.



#### CHAPTER - 2

#### NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

# 2.1 ABOUT NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

Nagarjuna College of Engineering and Technology (NCET), a self-financing engineering college, was started in the year 2001 under the aegis of Nagarjuna Education Society, Bangalore. Nagarjuna Education Society (NES) was established in 1995 under the able guidance of Sri J.V.Rangaraju, leading industrialist and philanthropist. His commitment towards contribution to nation building is being achieved by imparting world-class education at all levels, viz. from primary, graduate, post-graduate to doctoral research degree.

Nagarjuna College of Engineering & Technology is affiliated to Visvesvaraya Technological University (VTU), Belagavi, and the only technological university in the state of Karnataka, recognized by Government of Karnataka and approved by AICTE, New Delhi. NCET has crafted the vision to be among the Top Engineering Colleges in Karnataka. All the strategies and policies that we plan have this over- arching goal as a guide. The college has very good infrastructural facilities and the people at NCET are among the best in their fields.

The world is changing at exponential rate such that future is no more an extrapolation of the past and the present. It is important to be innovative to keep pace with the world. Science & technology have a great role to play in building India into a developed nation.

The Nagarjuna College of Engineering and Technology is strategically located on the Bangalore-Hyderabad National Highway, a road that falls on the Golden quadrangle. Its proximity to the International airport at Bangalore gives it strategic location and commutability. We have lush green campus spread of 72 acres with on-campus residential facility for boys, girls and staff. These hostels have amenities like mess, recreation room and state of art Gymnasium etc. Students are encouraged to actively participate in outdoor games as well. The college has a spacious library with well stacked books and well subscribed e-journals and books. The college is also a member of the VTU Consortium for e- resources.

The college is recognized as Nodal Centre for virtual lab facility, sponsored by MHRD, GOI. The institution is associated with IIT B, Mumbai for the project titled eYantra on Robotic Technology for students and staff. ISRO



has recognized our college as one of the centre to carry out the student projects under STUDSAT. The institution also has MoUs with different leading industries like EMC2 , Oracle, NCC, Data Talk etc.

The College was affiliated to Visvesvaraya Technological University, Belgaum till 2014-15. The college has received Autonomous status from Visvesvaraya Technological University and Government of Karnataka from the academic year 2015-16. The college is recognized by Government of Karnataka as a Centre of Innovative Science and Engineering Education. NCET departments have been recognized as research centres from Visvesvaraya Technological University, Belgaum to offer Ph.D. programme.

Nagarjuna College of Engineering & Technology also focuses on imparting training in soft-skills, logical reasoning, aptitude tests & interviews and provides placement to all eligible candidates in leading industries. The coordination & team work of all concerned at Nagarjuna Education Society and the commitment & determination of the management has made us to fulfill our vision "Leadership & excellence in education" and reach the goal.



Figure 1 Aerial view of Nagarjuna College of Engineering and Technology
INFRASTRUCTURAL FACILITIES

Nagarjuna College of Engineering and Technology has adequate infrastructural facilities as per the AICTE requirements. Nagarjuna College of Engineering and Technology has adequate number of ventilated classrooms, Laboratories, Smart Classrooms (ICT enabled), Seminar halls,



Computer Labs, Research Centres, HOD cabins, Staff cabins, Common rooms, Rest rooms, Central & Department Library and Convention hall. The management consistently interacts with the stake holders to improve the infrastructure facilities.

**INFRASTRUCTURE AND LABORATORIES:** The College is located in a beautiful lush green landscape, free from polluted environment and excellent atmosphere and ambience ideally suited for growth of the soul & mind.

**LABORATORIES:** The institution has laboratories as per AICTE norms. Nagarjuna College of Engineering and Technology has laboratories with state of art laboratory equipment. The labs are well equipped with safety norms with list of experiments details. Labs are used by the students beyond the working hours for doing their projects.

**LIBRARY:** Apart from the books available in the library, students can also access online E-resources such as digital library to widen their knowledge and skills. The working time of library is from 9.00 am to 7.00 pm in working days and from 9.00 am to 4.00 pm in the holiday.

#### 2.2. UNDERGRADUATE PROGRAMS

- B.E CS Artificial Intelligence and Machine Learning
- B.E in Civil Engineering
- B.E. in Computer Science and Engineering
- B.E CS- Data Science
- B.E. in Electronics and Communication Engineering
- B.E. in Information Science and Engineering
- B.E. in Mechanical Engineering

#### 2.3. POST GRADUATE PROGRAMES

- MBA
- M.Tech. in Structural Engineering

#### 2.4. NAGARJUNA GROUP OF MANAGEMENT & STUDIES

- B.COM
- B.B.A
- B.C.A
- B.Sc



- M.C.A
- M.COM

#### 2.5. VISION

Leadership and Excellence in education

#### 2.6. MISSION

To fulfil the vision by imparting total quality education replete with the philosophy of blending human values and academic professionalism.

#### 2.7. GOALS

- Providing high quality graduates not only competent in their respective fields, but are also motivated to serve humanity at large.
- Producing research papers in all fields of Engineering, worthy of being published by National & International Journals.
- Providing all facilities for the pursuit of medical knowledge, relevant to the needs of contemporary society.
- Implementing public services beneficial to and relevant with the needs of the community at large, nationally and internationally.

#### 2.8. EDUCATIONAL OBJECTIVES

- To provide for instruction in training in such branches of learning as it may deem fit.
- To provide for research and for the advancement of and dissemination of knowledge.
- To undertake extra moral studies, extension programs and field outreach activities to contribute to the development of Society.
- To undertake the activities to strengthen the set objectives.



#### CHAPTER - 3

#### **METHODOLOGY ADOPTED**

The audit process unfolded across three distinct phases. Initially, secondary data essential for the study was gathered from diverse sources, including relevant departments such as engineering, hostel management, and gardening. A comprehensive review was conducted to gain a clear understanding of energy auditing principles, supplemented by the examination of various case studies and methodologies. Subsequently, the chosen methodology for the present audit involved onsite visits, personal observations, and the utilization of questionnaire surveys as tools for data collection. Sets of questionnaires were tailored to meet the specific data requirements, which were then administered during visits to all university departments. The collected data was consolidated for further analysis. Based on the comprehensive findings of the study, a final report was compiled.



Figure 2 Audit Methodology



#### 3.1. SURVEY BY QUESTIONNAIRE:

The collection of baseline data for the preparation of the energy audit report was conducted through a questionnaire survey method. The questionnaires utilized for the energy audit on the university campus were developed based on guidelines, regulations, acts, and formats established by authorities such as the Ministry of Environment, Forest and Climate Change in New Delhi, the Central Pollution Control Board, and other relevant statutory bodies. While many of these guidelines and formats addressed broad aspects, some were not directly applicable to a university campus setting. Therefore, adaptations, modifications, and restructuring were undertaken, resulting in the creation of sets of questionnaires covering areas such as solid waste management, energy usage, water conservation, hazardous waste management, and e-waste disposal.

Each questionnaire comprised several modules. The first module focused on gathering general information about the respective department, including its name, the month and year of assessment, total student and employee counts, visitor numbers, average working days, and office hours. Subsequent modules addressed specific aspects such as current resource consumption (e.g., water, energy) and the management of solid and hazardous waste. Emphasis was placed on maintaining accurate records regarding the handling of solid and hazardous waste, given their significance in the context of the energy audit process.

In the context of energy audit, it's imperative to assess the potential loss of resources such as water and energy resulting from inadequate maintenance practices. To address this concern, a dedicated module within the questionnaire focuses on probing into these probabilities. Additionally, another module is dedicated to the meticulous maintenance of records, encompassing aspects such as solid waste disposal and recovery records. To facilitate the surveyor's task, certain statistics, such as fundamental energy consumption characteristics for electrical equipment, were conveniently included alongside the questionnaires.

#### **ONSITE VISIT AND OBSERVATIONS:**

Nagarjuna College of Engineering and Technology encompasses a substantial built-up area, housing diverse facilities including various departments, an administrative building, faculty and staff quarters, student hostels, a guest house, sports complex, and health center. Each of these amenities possesses unique infrastructure tailored to its specific needs. Surveyors conducted thorough visits to all these buildings, utilizing questionnaires to assess their current conditions. Personal observations



were also noted during the onsite inspections. To streamline the survey process and subsequent analysis, amenities were categorized based on their similarities and differences, facilitating a more efficient evaluation.

#### DATA ANALYSIS AND FINAL REPORT PREPARATION:

Energy audit, the completed survey questionnaires from each group were systematically tabulated in Excel spreadsheets according to their respective modules. This tabulated data served as the basis for further analysis. To enhance comprehension and streamline the process, averages and percentages were calculated for the tables. The interpretation of the overall findings was then synthesized, encompassing both primary and secondary data, along with references and interrelations. Subsequently, the final report was prepared based on this comprehensive interpretation.

- In order to meet its objectives, this audit combined physical inspection with a review of relevant documentation and interviews with various stakeholders.
- Review of the Documentation.
- For the purpose of this audit the Green Policy of the institute was reviewed.
- Interviews.
- Interviews were conducted with the Principal's, Registrar and also faculties and students.
- Physical Inspection.
- The audit team was in the college to inspect the campus.

#### 3.2. LIST OF STUDENTS AND STAFF INVOLVED IN ENERGY AUDITING

Sl. No	Name	Designation
1.	Dr. Srilakshmi G	Professor & Head, Department of Civil
2.	Ms. Vidyashree MG	Assistant Professor, Department of Civil
3.	Mr. Sharan Kumar SV	Lab Assistant
4.	Mr Harish	Campus Admin
5.	Ms Dhanashree	Student, Dept. of Civil Engg
6.	Mr Tejas Sachin	Student, Dept. of Civil Engg
7.	Mr Sunil	Student, Dept. of Civil Engg



#### CHAPTER - 4

#### **ENERGY AUDIT**

# ECO -FRIENDLY CAMPUS & GREEN PRACTICES IN NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

#### 4.1. AREAS OF ENERGY AUDITING

#### 4.1.1. ENERGY AUDIT

This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment.

#### 4.1.2. WATER AUDIT

A water audit involves both qualitative and quantitative analyses of water consumption, aimed at identifying opportunities for reducing, reusing, and recycling water. It serves as an effective tool for minimizing losses and optimizing various water uses, thereby enabling significant water conservation across sectors including irrigation, domestic, power, and industrial. Essentially, a water audit is a technique used to identify means of conserving water by detecting inefficiencies in water distribution systems. Measuring water losses resulting from different uses within the system or utility is essential for implementing water conservation measures in such establishments.

This indicator addresses water consumption, water sources, irrigation, storm water, appliances and fixtures. Aquifer depletion and water contamination are taking place at unprecedented rates. It is therefore essential that any environmentally responsible institution should examine its water use practices.

Several factors, including climate, culture, dietary habits, work conditions, level of development, and physiological needs, influence water requirements. For communities with a population ranging from 20,000 to 100,000, the recommended water consumption ranges from 100 to 150 liters per person per day. Larger communities with populations exceeding 100,000 may require 150 to 200 liters per person per day. According to the standards outlined by the WHO Regional Office for South-East Asia, schools typically necessitate 10-15 liters per student for water-flushed toilets, while administrative areas (excluding staff accommodations) require 50 liters per person per day. Staff accommodations typically require 30 liters per person



per day, while water usage for sanitation purposes depends on the specific technology employed.

#### 4.1.3. BIODIVERSITY AUDIT

All living beings, including humans, are interconnected within a complex network of biodiversity, which is essential for our survival. Biodiversity plays a crucial role in maintaining healthy ecosystems and ensuring the well-being of our planet. It contributes to clean air and water, regulates the climate, and provides us with essential resources such as food, shelter, clothing, medicine, and other goods.

Every component of this intricate web suffers when one part weakens or disappears. Trees, for example, play a vital role in purifying the air we breathe. Through photosynthesis, their leaves absorb carbon dioxide and release oxygen, a process facilitated by sunlight, water, minerals, and chlorophyll. Additionally, trees' roots anchor the soil, preventing erosion by rain and wind. Given that the earth's fertile soil is typically only a thin layer, this stabilization is crucial for maintaining soil integrity and preventing loss through erosion.

#### 4.1.4. BIODEGRADABLE AND HAZARDOUS WASTE AUDIT

The waste streams generated within the college and hostel premises, from biodegradable waste originating from canteens to hazardous wastes produced in laboratories and discarded electric and electronic goods. Hazardous materials pose significant risks to both human health and ecological well-being. E-waste generated on campus contributes to the leaching of hazardous substances into the environment, resulting in long-term land and water contamination that can persist for generations.

These hazardous substances have the potential to accumulate in the tissues of organisms and become concentrated within food chains, leading to severe health consequences such as cancer, endocrine disruption, and birth defects. Minimizing, safely handling, and ultimately eliminating these hazardous materials are crucial steps toward ensuring the long-term health of our planet.

#### 4.2. LAND AREA STATEMENT

The land under the project is designated for Educational activities as per Karnataka Government. No additional burden on land has been created which may adversely affect land use pattern in the area. No natural drain is being obstructed. The University land does not interfere with any forest, wetland, river, lake, mountain, national park & sanctuary etc.



# The total area of campus - 1,55,498.29 sq.m

Sr. No.	Particulars	Area
1	Total area	1,55,498.29 Sq.mt
2	Built up area	141300.4 Sq. mt
3	Roads/parking	2,288 Sq.mt
4	Green belt area	64,080 Sq.mt
5	Vacant area for future development	25,000 Sq.mt
6	Building Configuration [Number of Blocks / Towers / Wings etc., with Numbers of Basements and Upper Floors, canteen, seminar halls, playground, auditorium, hostels, Labs]	21 Blocks as per build up area statement

#### LAND USE BREAKUP WITHIN THE SITE

Sr. No.	Land Use	Area in Sqm.	%
1	Ground Coverage Area	17221.99	11.07
2	Drive Way Area	4118	2.65
3	Landscape Area	21865.00	14.06
4	Area under Services	355.65	0.23
5	Surface Parking	2288.00	1.47
6	Roads	19217	12.36
7	Playground	26352	16.95
8	Open Area	64080	41.21

### **BUILD UP AREA STATEMENT**

Sr. No.	Name of the Building	BUA in Sqm
1	Boys Hostel	4405.88



	Total BUA	141300.4 Sqm.
21	New block	60,000
20	1 st Year block	23,000
19	Work Shop	1958.01
18	Library Block	5480.93
17	Bio-Tech Block	3584.00
16	Boys Hostel Block-8	2602.54
15	Staff Quarters	1455.49
14	Girls Hostel- 2	4069.61
13	Girls Hostel- 1	2279.48
12	Boys Hostel- 6	2602.54
11	Boys Hostel-5	2616.85
10	Boys Hos <mark>te</mark> l- 4	1639.97
9	Boys Hostel- 3	1639.97
8	Boys Hostel- 2	2270.00
7	Boys Hostel- NRI	1839.06
6	Gym Block and Computer Lab	3205.26
5	Canteen Block	2405.51
4	Main Block Ground, First & Second	8062.00
3	Mechanical Block	2302.78
2	Civil Block	3880.52

### 4.3. WATER REQUIREMENT:

The total water requirement for the University is 264 KLD. Water quality of ground water resources in the area has been studied for assessing the water environment. Municipal Supply, Groundwater and rain water are being used in the campus



Total requirement of water in KLD	
Fresh	159
Recycled	105
Total	264
Source of water	Municipal Supply, Groundwater and Rainwater
1.Whether canteen facility provided for day students etc	Yes
2. Waste water generation in KLD	211 KLD
STP capacity	300 KLD
Technology employed for Treatment and mode of disposal of treated sewage	STP(SBR Technology)
Scheme of disposal of excess treated water if any	Gardening, Lawns, Toilet and Flush out, Floor Washing
Any Treatment for lab water	
No. of ponds, wells, taps, toilets, waterless urinals	Ponds- 1 Taps – 994 Toilets – 519
No. and capacity of water tanks for storage	20nos, total capacity- 570715 liters

#### 4.4. WASTE WATER GENERATION

About 211 m³/day of wastewater is being generated.

#### 4.5. WASTE WATER MANAGEMENT

The institution adheres to a systematic approach for the efficient management and disposal of liquid waste. Wet waste generated from the college, hostels, and canteen is directed to bio fertilizer plants for the production of environmentally friendly fertilizers. The treated water is subsequently utilized for gardening and other purposes. Moreover, the



institution actively engages in discussions with students to raise awareness about liquid waste management techniques.

- To manage domestic and other wastewater effectively, a sewage treatment plant (STP) has been installed and is operating successfully. The STP has a capacity of 300 kiloliters per day (KLD) to treat wastewater generated from various sources including college buildings, hostels, canteens, and recreational areas such as the gymnasium etc.
- The treatment scheme comprises of a biological treatment called SBR system wherein the aerobic bacteria stabilizes all the organic matter, neutralizes the microbial population.
- The STP has been performing smoothly and delivers effluents with BOD values below 10 mg/l. The aerobic treatment followed by disinfection results in microbe concentration below 100 units as stipulated in the consent. Likewise all other listed parameters are also complied with. Analysis reports are regularly forwarded to the KSPCB.
- The wet waste from the college, hostels and canteen is given away to bio fertilizer plants for making eco-friendly fertilizers.

#### 4.6. RECYCLE AND REUSE OF TREATED WASTEWATER:

The institution has installed sewage treatment plants (STPs) to manage wastewater originating from various areas within the Nagarjuna College of Engineering and Technology premises, including the college, hostels, staff quarters, and canteen areas. The sewage from these sources is treated in a 300 (KLD) STP. Typically, the STPs are operated below 80% capacity levels, and adjustments are made during semester breaks to accommodate fluctuations in influent levels. After biological treatment, the wastewater is disinfected using liquid chlorine before being pumped for various uses. Following the guidelines outlined by the Karnataka State Pollution Control Board (KSPCB), the treated wastewater is reused within the campus, as detailed in the subsequent sections.

In general the STPs are operated at not more than 80% of the designed capacity and at much lower capacity during vacations, lock down etc. The treated waste waters from STP are utilized for the following activities:





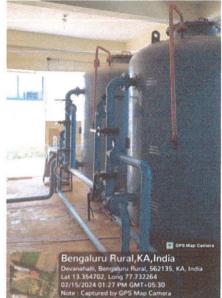


Figure 3 Sewage Treatment Plant

- Gardening and maintaining greenery within the campus. (50 %)
- Secondary flushing in toilets in the hostel buildings. (45%)
- Buses and other vehicles washing, Floor Washing within the campus.
   (5%)
- Treated water used for Flushing 105 KLD of STP treated water is used for flushing purpose.

### Bus/Car / Floor Washing:

The institute maintains a fleet of buses and other vehicles for transportation purposes. Furthermore, students residing on the premises utilize treated water for washing their cars and two-wheelers. A provision of 5 KLD has been allocated specifically for this purpose.

#### Green Belt Development:

Green belt development refers to the creation, enhancement, or preservation of vegetated areas within urban or industrial landscapes. These green belts serve various ecological, aesthetic, and recreational purposes, contributing to environmental sustainability and improving overall quality of life. They often involve planting trees, shrubs, and other vegetation along roadsides, water bodies, or in vacant spaces to mitigate environmental impacts, enhance biodiversity, regulate microclimates, and provide green spaces for recreation and relaxation. Green belt development projects may also include initiatives to protect natural habitats, restore degraded ecosystems, and promote sustainable land use practices.



This also requires regular watering for the survival. Through the hydrant systems network, the treated water is pumped from the STP and a total of 101 KLD is utilized for the purpose.





Figure 4 Green Belt Development

# 4.6.1. EXISTING WATER MANAGEMENT METHODS INSTALLED IN THE CAMPUS

- 1. Rain water harvesting
- 2. Construction of tanks and bunds
- 3. Waste water recycling

### 1. Rain Water Harvesting:

- Rainwater harvesting is the process of collecting, storing, and utilizing rainwater for various purposes such as irrigation, household use, and groundwater recharge. It involves capturing rainfall from rooftops, paved surfaces, and other impermeable areas and directing it to storage tanks, cisterns, or underground reservoirs for later use. Rainwater harvesting systems typically include components such as gutters, downspouts, filters, and storage tanks to capture and store rainwater.
- The harvested rainwater can be used for a wide range of applications, including watering gardens, flushing toilets, washing clothes, and even drinking water with proper treatment. By harvesting rainwater, communities can reduce their reliance on traditional water sources, alleviate pressure on municipal water supplies, and improve water security, particularly in areas prone to water scarcity or drought.
- Rainwater harvesting also offers environmental benefits by reducing stormwater runoff, which can help prevent soil erosion, mitigate flooding, and replenish groundwater reserves. Additionally, it promotes sustainable water management practices and encourages



conservation efforts by maximizing the use of a natural resource that is often underutilized.

- As per the scheme the roof top water shall be collected in the underground tanks/ sumps, whereas the water collected from paved and unpaved areas shall pass through grease cum silt trap and clean water shall be either directly used or shall be used for recharging the existing bore wells within the campus as per drawings.
- There is one Groundwater Recharge Pit with tank capacity of 61174 litres.

### 2. Waste Water Recycling

- Nagarjuna College of Engineering and Technology has installed and effectively operates a sewage treatment plant on its premises. With a capacity of 300 kiloliters per day (KLD), this plant manages wastewater generated from various sources including the college building, hostels, canteens, and recreational areas such as the gymnasium etc.
- The sewage treatment plant (STP) has been operating efficiently, consistently producing effluents with Biological Oxygen Demand (BOD) values below 10 mg/l. The aerobic treatment process, coupled with disinfection measures, ensures that microbial concentrations remain below 100 units, as required by the consent regulations. Moreover, all other specified parameters are duly met. Regular analysis reports are submitted to the Karnataka State Pollution Control Board (KSPCB) for compliance verification.

#### 3. Construction of Tanks and Bunds:

As the water crisis continues to become severe, there is a dire need of reform in water management system and revival of traditional systems. As a part of revival to traditional wisdom, the institution built rain water storage tank, to collect the rainwater and can be used whenever it is required.

### 4. Maintenance of water bodies and distribution system in the campus

Groundwater is pumped into storage tanks situated across various locations within the campus, including a limited number of overhead storage tanks. A well-organized pipe network facilitates the distribution of water throughout the premises. Drinking water, treated through a Reverse Osmosis (RO) plant, is supplied via a separate set of distribution pipes, while water for other purposes is distributed through another set of pipes. The entire distribution system is diligently overseen by Civil works personnel to prevent leakages and wastage of water through joints and valves. Additionally, water usage is optimized through the implementation of low-pressure flushes. All



stakeholders of the college receive thorough education on the importance of using water economically and efficiently.

#### 4.7. SOLID WASTE MANAGEMENT

The primary contributors to solid waste generation on campus comprise canteen waste, hostel kitchen waste, institutional waste, and staff quarters waste. Dry waste is predominantly stored at a transfer station located within the campus. Solid waste produced in the constituent colleges mainly consists of waste papers, answer sheets, and domestic waste such as kitchen waste.

The institute makes necessary arrangements for disposal of solid waste. Domestic biodegradable waste of 300.4 kg/day and 450.60 kg/day of non-biodegradable waste is generated.

The institution effectively implements solid waste management practices by enforcing waste segregation rules. Dustbins are strategically placed in classrooms, laboratories, restrooms, and mess areas across the campus. Dedicated sweepers are assigned to each floor to manage all waste generated within the premises. All waste, including that from the college and hostel, undergoes segregation at its source and is disposed of in an appropriate manner. They are proposing to install organic waste converter (OWC) with digester for gas generation. The gas will be used in the canteen for food preparation.

#### 4.7.1 WASTE GENERATION AND MANAGEMENT:

Sr. No.	Detail	Population	Total Solid Waste Generated (Kg/day)	Organic Waste Kg/day (40%)	In-Organic Waste Kg/day (60%)
	Educational Institution 4242	Hostel Students- 817	408.50 (0.5 Kg/capita/day)	163.40	245.10
1	Personnel	College Students 3065	306.50 (0.1 Kg/capita/day)	122.60	183.90
			36.0 (0.1 Kg/capita/day)	14.40	21.60
	Tot	al	751	300.40	450.60
Sludge		1	5 Kg		



#### 4.7.2 HAZARDOUS WASTE GENERATION AND MODE OF DISPOSAL:

Every year, the process of DG disposal results in the generation of 55 liters of DG oil. This oil is then repurposed and used in the construction industry as shuttering oil. Shuttering oil is an essential substance used in construction to prevent concrete from sticking to the surface of the mold or formwork during the curing process. By utilizing DG oil as shuttering oil, construction companies are able to reduce their reliance on traditional, petroleum-based products, which can have a negative impact on the environment.



Figure 5 Hazardous waste storage

#### 4.7.3. E-WASTE MANAGEMENT:

The institution has initiated several e-waste management initiatives aimed at fostering an eco-friendly environment on campus. To minimize e-waste generation, computers and their peripherals are regularly upgraded for continued usage, thus reducing wastage. Additionally, Memorandum of Understanding (MoUs) have been established with E-Parisaraa and Rashi E-Waste Solutions for effective e-waste management.







Figure 6 E-waste storage

### **4.8 ENERGY MANAGEMENT**

Energy conservation plays a vital role in campus sustainability and is closely connected to the carbon footprint of the campus. Energy auditing focuses on conserving energy and implementing methods to reduce consumption, thereby addressing environmental degradation. Consequently, it is imperative for any environmentally conscious institution to scrutinize its energy usage practices.

Energy & power details			
	2021	2022	2023
	9032985 Rs	12972491 Rs	18184717 Rs
Electricity charges	8.10 Rs / unit	8.20 Rs/ unit	8.50 Rs / Unit
	1115183.33	1582011.1	2139378.47
	units / year	units / year	units / year
Number of Gas cylinders used per month	135 units		
Number of Diesel Generators	3 Nos Capacity—	-100 KVA, 125	KVA, 250 KVA
Quantity of Diesel consumed Cost of generator fuel	2000 liters per n	nonth @ 100 Rs	per liter
Total number of CFL bulbs	100		



Number of LED lights	LED lights-2000 Incandescent bulbs-00 Fans-
Incandescent bulbs	2000
fans AC's Tube lights	AC's -30
	Tube lights-5000 Electrical instruments-250
electrical instruments	Computers -850
computers	Photocopiers - 5
photocopiers	T.V's 15
T.V's. etc	Topic.

### 4.9. SOLAR ENERGY

100 KW per day energy is generated by solar Panels installed inside the campus.

#### 4.10. AIR ENVIRONMENT

- In the University campus during construction in any stage water will be sprinkled on the soil to avoid dust generation.
- The debris and unused construction debris will be removed immediately for recycling, if any, or for designated land fill
- All vehicles for service activities at the University will be checked for vehicular emission. The agencies will be asked to keep them within prescribed limits. They will also be asked to maintain them properly.
- As discussed earlier there will be no other point source of Air pollution, which are noise free. Chimneys of suitable height have been provided to control the G.L.C. of PM 2.5, PM10, SO<sub>2</sub>, & NOx levels. Extensive tree plantations have been resorted to for further improving the air environment in general and minimize noise levels.

### 4.10.1. AIR EMISSIONS AND NOISE LEVELS

The University has taken a commendable step towards ensuring environmental sustainability by installing noise-free generators for power backup. This move has significantly reduced the levels of noise pollution in and around the campus. Moreover, the University has also made it a point to avoid any other point source of emissions, such as boilers or furnaces that run on fossil fuels, which could have a negative impact on the air quality.



#### 4.10.2. TRAFFIC DENSITY

One of the rules that the students must follow while staying in the hostel is that they are not allowed to keep their own vehicles within the premises. This is to ensure the safety and security of all the residents in the hostel. However, this does not mean that the students are left stranded without any means of transportation. The University has taken into consideration the transportation needs of the local students and has provided its own buses that ply within the vicinity of the campus. The University has also taken care of the parking needs of the students who travel to the campus from outside. The layout of the campus has been meticulously planned to provide adequate space for parking within the premises. This ensures that students who commute to the campus from far-off places can comfortably park their vehicles without having to worry about their safety.

The provision of the University's own buses and ample parking space within the campus not only makes transportation easier but also contributes to reducing the carbon footprint. The University's efforts towards promoting sustainable transportation are commendable and set an example for other institutions to follow. In addition to this, the University has also taken initiatives to promote cycling as a means of transportation. The campus has dedicated bicycle parking areas, and students are encouraged to use bicycles as a sustainable and healthy mode of transportation.

#### 4.10.3. CARBON FOOTPRINT

The burning of fossil fuels has become a major concern in recent years due to its harmful effects on the environment. Fossil fuels such as petrol, coal, and natural gas are non-renewable resources that release greenhouse gases when burned. These gases, including carbon dioxide, water vapor, methane, nitrous oxide, and ozone, trap heat in the Earth's atmosphere and contribute to global warming and climate change. All the greenhouse gases, carbon dioxide are the most significant and prevalent. It currently makes up 402 ppm of the Earth's atmosphere, a level that has steadily increased since the Industrial Revolution. The primary source of carbon emissions is human activity, particularly the burning of fossil fuels for transportation, electricity, and heating.

In college campuses, vehicular emissions are a major contributor to carbon emissions. Cars, buses, and other modes of transportation that rely on fossil fuels emit significant amounts of carbon dioxide and other pollutants into the air. Therefore, it is essential to assess the transportation methods used by students, faculty, and staff to reduce carbon emissions and promote sustainable practices.



One way to reduce vehicular emissions on campus is to encourage the use of alternative modes of transportation. This can include walking, biking, carpooling, or using public transportation. By reducing the number of cars on the road, we can significantly decrease carbon emissions and improve air quality. Additionally, implementing eco-friendly policies such as energy-efficient buildings, recycling programs, and renewable energy sources can further reduce the campus's carbon footprint.

Carbon footprint		
Number of persons using cycles	10	
Number of persons using cars	50	
Number of persons uses two wheelers	150	
Number of persons using other transportations like bus etc	Bus- 665	
	Van -50	
	TT- 15	
Number of visitors per day	50	
Number of Students staying in the hostel	1100	
Number of Faculty and staff staying in the quarters	45	
Total Number of students	1819	
Total No. of faculty and staff	355	
Total number of E vehicles	2 number – name of vehicle – buggy	

### 4.11. ENERGY AUDIT (Ecology & Bio-Diversity)

#### 4.11.1. FLORA

The campus has a rich collection of trees. About 510 tree species were identified. Most of the plants have important role in the maintenance of biodiversity and are the good carbon assimilators. Herbal garden and other ornamental gardens were maintained in the campus.

Apart from records of Forest department, field surveys were undertaken to study the vegetation and floral components in the campus.











Figure 7 Flora at college campus

## LIST OF TREES SPECIES OF NCET, BANGALURU

Sr. No.	Botanical Name	Family	Common Name	Total
1	Arecaceae	Arecaceae	Palm	58
2	Roystonea regia	Arecaceae	Cuban royal palm tree	53
3	Mangifera indica	Anacardiaceae	Mango	151
4	Phoenix sylvestris	Arecaceae	Badela Palm	35
5	Chukrasia velutina	Meliaceae	Chukrasiatabularis	168
6	Dalbergia sissoo	Fabaceae	Sissu / Tali	16
7	Moringa oleifera	Moringaceae	Saujana	24



8	Bambusoideae	<u>Poaceae</u>	Bamboo	50
9	Anacardium accidentale L.	Anacardiaceae	Kaju Badam	65
10	Cocos nucifera	Arecaceae	Coconut	37
11	Ficus benghalensis	Moraceae	Banyan Tree	1
12	Azadirachta indica	Meliaceae	Neem	53
13	Phyllanthus emblica	Phyllanthaceae	Amlakhi(Indian gooseberry	30
14	Artocarpus heterophyl <mark>lu</mark> s	Moraceae	Jackfruit	30
15	Musa sp.	Musaceae	Banana tree	8
16	Prunus amygdalus	Rosaceae	Almond Tree	40
17	Spathodea campanulata	Bignonias	African tulip tree	76
18	Areca catacheau	Arecaceae	Beetle nut	48
19	Grevillea robusta	Proteaceae	Silver Oak tree	489
20	Platycladus orientalis	Cupressaceae	Oriental thuja	55
21	Delonix regia	<u>Fabaceae</u>	Royal Poinciana tree (Kathi mara)	68
22	Punica granatum	Lythraceae	Pomegranate tree	26
23	Ficus virens	Moraceae	White fig tree	2
24	Syzygium cumini	Myrtaceae	Jamun	27
25	Terminalia neotaliala	Combretaceae	Mantaly tree	450
26	Eucalypts	Myrtaceae	Safeda tree	25
27	Rosa	Rosaceae	Rose tree	40



28	Citrus limon	Rutaceae	Lemon tree	18
29	Cassia fistula	Fabaceae	Golden rain tree	26
30	Tamarindus indica	Fabaceae	Tamarind tree	7
31	Eucalyptus globulus	Myrtaceae	Nilgiri tree	21
32	Tabernaemontana	Apocynaceae	Crepe jasmine	10
	divaricata			
33	Santalum album	Santalaceae	Sandalwood tree	5
34	Tectona grandis	Lamiaceae	Sagwan	50
35	Manilkara zapota	Sapotaceae	Sapota tree	50
36	Delonix regia	Fabaceae	Krishnachura (Flame Tree)	7
37	Acacia falciformis	Fabaceae	Mountain hickory	350
38	Magnolia <mark>c</mark> hampaca	Magnoliaceae	Sampangi tree (Champak)	5
39	Tsuga canadensis	<u>Pinaceae</u>	Eastern hemlock tree	38
40	Caryota	Arecaceae	Fishtail palm	5

#### 4.11.2 FAUNA

Prolific wild life is not observed in the University campus, as there is no thick forest/ vegetation is noticed in the University Campus.

FAUNAL GROUP	SCIENTIFIC NAMES		
SPIDERS	Myrmachne orientalis (Family Salticidae);Nephilaplipes (Family-Nephilidae); Heteropoda sp (Family-Sparassidae); Phintella vitatta (FamilySalticidae)		



MOTHS	&Antheria assmensis;Bombyx mori;Philosamia ricini;		
BUTTERFLIES	Junonia atlites atlites ; Commander (Moduza procris		
	procris);Ethope himachala ; Melanitis leda leda ;		
	Paltoporia paraka paraka; Ypthima baldus ; Acraea terpsicore		
	Elymnias, hypermnestra, undularis; Mycalesis perseus blasi		
	us;Tanaecialepidealepidae;Euploea core		
	us, ranacciaiepideaiepidae; Euploea core		
OTHER INSECTS	Scarlet dragonfly; Pantala flavescens (wandering glider), grasshoppers, microbes		
REPTILES	squirrels, mouse, snake, lizard		
BIRDS	Acridotheres tristis (Common myna); Streptopelia		
	orientalis (Oriental Turtle Dove); Athene noctua (little owl		
	); Pycnonotus cafer (Red- vented Bulbul), crows, sparrows,		
	peacock		
MAMMALS	Monkeys, Dogs, Cats		



#### CHAPTER 5

#### CONCLUSION AND RECOMMENDATIONS

Nagarjuna College of Engineering and Technology is committed to fostering a green campus environment. Despite its primary focus on technology, the institution demonstrates notable awareness in prioritizing eco-friendly practices. Upon visiting the campus, visitors can appreciate the aesthetic appeal of the elegant buildings, well-maintained lawns, expansive sports grounds, and verdant surroundings, which create a conducive atmosphere for the teaching-learning process.

The institutional initiatives for greening the campus are as follows:

- Implementation of restricted entry for automobiles within the campus premises aims to minimize traffic congestion and enhance pedestrian safety.
- Designing pedestrian-friendly pathways prioritizes the convenience and safety of individuals traversing the campus on foot, promoting a healthy and sustainable mode of transportation.
- Enforcing a ban on the use of plastic within the campus helps to reduce environmental pollution and promotes the adoption of ecofriendly alternatives.
- Landscaping with trees and plants enhances the aesthetic appeal of the campus while also contributing to environmental sustainability by providing shade, improving air quality, and supporting biodiversity.

#### 1.RESTRICTED ENTRY OF AUTOMOBILES

The college maintains a fleet of buses that offer transportation services to various parts of Bengaluru, ensuring convenience for both students and staff. The institution promotes the use of college transport over personal vehicles, emphasizing benefits such as enhanced safety, security, fuel conservation, and reduction of environmental pollution. Additionally, the college buses undergo pollution checks conducted by authorized agencies to ensure compliance with environmental standards.

#### 2. PEDESTRIAN FRIENDLY PATHWAYS

Parking space for vehicles is available at the main entrance of the college campus. While the campus is primarily free of vehicles, with certain exceptions, students and staff enjoy the convenience of walking along



pedestrian-friendly pathways. Internal roads are adorned with trees and are diligently maintained by the campus maintenance committee.

#### 3. BAN ON USE OF PLASTIC

To mitigate the use of single-use plastic items like bottles, bags, spoons, straws, and cups, a complete ban has been enforced, with awareness initiatives conducted among both staff and students through orientations and display boards on the premises. Additionally, efforts have been made to reduce plastic usage by replacing plastic tea cups and glasses with steel alternatives in the canteen.

### 4.LANDSCAPING WITH TREES AND PLANTS

The college's landscaping is visually stunning and exemplifies a keen aesthetic sensibility. A canopy of trees and plants has been meticulously cultivated to promote a pollution-free environment and safeguard the health of all occupants. The lawns and trees not only offer shade but also contribute to the serene ambiance of the campus. Trained gardeners and supervisors ensure the meticulous development and maintenance of the green landscaping. The construction and maintenance personnel of the college are responsible for nurturing and preserving the greenery on campus. Furthermore, the institute authorities are actively pursuing initiatives to transition the campus to a paperless environment. Internal communication within the campus is predominantly conducted through email or electronic messages, aligning with the goal of achieving a paperless office.

#### 5.1. CONCLUSION AND RECOMMENDATIONS

The Energy Audit serves as an effective tool for assessing both the strengths and weaknesses of environmental sustainability practices and devising solutions to address identified issues. It represents a professional approach towards responsible utilization of economic, financial, environmental resources. Energy audits contribute value management strategies adopted by the college by identifying, evaluating, and managing environmental risks, whether known or unknown. While the college has made strides in considering the environmental impacts of its operations in recent years and endeavors to act in an environmentally responsible manner, there remains room for improvement, particularly in waste, energy, and water management. The recommendations outlined in this report underscore various opportunities for the college to enhance its practices and evolve into a more sustainable institution.



#### 5.2. SUGGESTIONS

Some of the very important suggestions are:-

- Enhance awareness of environmentally sustainable development by utilizing every opportunity to engage the public, government, industry, foundations, and universities. Address the pressing need to transition towards a future that prioritizes environmental sustainability openly and proactively.
- Establish programs aimed at cultivating expertise in environmental management, sustainable economic development, population dynamics, and related fields. These initiatives ensure that all university graduates attain environmental literacy and possess the awareness and understanding necessary to become ecologically responsible citizens.
- Promote the engagement of all stakeholders, including government entities, foundations, and industries, in supporting interdisciplinary research, education, policy formulation, and information exchange concerning environmentally sustainable development. Expand collaboration with community and non-governmental organizations to aid in identifying solutions to environmental challenges.
- Facilitate collaboration between university faculty and administrators and environmental practitioners to devise interdisciplinary approaches for curricula, research endeavors, operations, and outreach activities that promote an environmentally sustainable future. Adopt the proposed Environmentally Responsible Purchasing Policy, and work towards creating and implementing a strategy to reduce the environmental impact of its purchasing decisions.
- As a responsible member of society, it is our duty to protect our environment and conserve resources. One way to achieve this goal is by adopting the 3R's approach reduce, reuse, and recycle. However, the success of this approach primarily depends on the awareness and willingness of people to adopt it. Therefore, it is essential to increase education and awareness about the 3R's approach on campus.
- Name all the trees and plants with its common name and scientific name.
- Display boards of fauna diversity to generate enthusiasm for learners.
- Organize earn while learn eco-friendly programs
- Conduct exhibitions for parents and public on environment and sustainable practices.
- Organize training programs focused on environmental management systems and nature conservation. Facilitate the involvement of both students and teachers in addressing local environmental concerns.



- Promote the use of renewable energy vehicles for transporting students and faculty, thereby decreasing reliance on fossil fuels.
- Conduct an assessment to explore the feasibility of installing wind turbines as a means of generating electricity, with the aim of reducing carbon emissions and minimizing the institution's carbon footprint.



PRINCIPAL

NAGARJUNA COLLEGE OF MANAGEMENT STUDIES CHICKBALLAPUR - 562101