7.1.6.
Quality audits on environment and energy are regularly undertaken by the institution

INDEX

Any other relevant information:

Quality Audit Report

Objectives of the Audit:

Quality Auditing is a management tool comprising systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing, with the aim of helping safeguard the environment by:

i. Facilitating management control of environmental practices.
ii. Assessing compliance with various policies which would include meeting regulatory requirements.
iii. Sensitizing students about the growing environmental issues.

There are various Audits carried out at the institute which stimulated the environmental sustainability and evaluation.

1. Green Audit
2. Energy Audit

1. Green Audit

The Green Audit of an institution is of a paramount importance these days for self-assessment of the institute, which reflects the role of the institute in mitigating the negative impacts of carbon emission. The institute has been putting efforts to reduce the emissions from electricity consumption by replacing conventional lights to LED. Star rated equipments and instruments and by installing solar panel for electricity generation. The purpose of the green audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards of intergovernmental panel on Climate Change (IPCC).

Objectives of the Green Audit:

The main objectives of carrying out Green Audit are:

a) To monitor and document the carbon emission from electricity consumption.
b) To record the diversity of plants, total green area and potential of carbon sequestration from tree plantations.

Calculation of Carbon Emissions from Electricity Consumption

S.No.	Particulars	Kwh
1.	Energy Consumption	650855
2	Energy Consumption from 400 Kwp Solar Plant	313597
3	Energy requirement through Grid	337258
4.	Energy Exported to grid via net metering facility	137233

Potential of Carbon Sequestration from Green Cover around the Institute:

Area earmarked for greenery			
Total area of the Institution (Sq. mts.)	Area earmarked for greenery (Sq. mts.)	Percentage of area with greenery	Attachments
1,70,824	**1,31,639**	**77%**	a, b, b2, b3, b4, c, d, e, m, o

Out of the total area earmarked for greenery, the area developed with greenery so far			
Total area earmarked for greenery (Sq. mts.)	Total area developed with greenery (Sq. mts.)	Percentage of area developed	Attachments
1,31,639	**1,31,639**	**100%**	f, g, h, i, j, k

Existing tree crown cover			
Total area of the Institute (Sq. mts.)	Total existing tree crown cover area in Sq. mts. (Tree crown area of an individual tree or a grove with a diameter of atleast 5m and above shall only be considered and computed for tree crown area calculation.)	Percentage of existing tree crown cover area	Attachments
1,70,824	**19,574**	**11.50%**	K1, k2, k3, k4, k5, k6, k7, l, n, p, q, r, s

Survival rate of plants planted during the last three years			
Year	No of plants planted	No. of plants survived	Attachments
2015	3682	3682	t, t2, t3, t4, u, v, w
2016	6770	6770	
2017	1930 (medical plants) + 7380	9310	
Total	19762	19762	
Survival percentage		100%	

Percentage of native tree species planted during the last three years			
Year	Number of tree species planted	Number of native tree species planted	Attachments
2015	55	21	x, x2, y
2016	50	27	
2017	64	33	
Total	169	81	
Percentage of native tree species planted		48%	

Recommendations:

- **The gross energy consumption from grid is** 337258 **kWh/ year. Total carbon emission from electricity is 269.80 tonnes/ year (Assuming 0.8 Kg / Kwh of energy). From planation data recorded from the campus, the net carbon emission from college campus is reduced. It is recommended that carbon emission reduction can further be done by usage of energy efficient lighting system. Appliances and sensor-based switches (smart switches). Further, plantation and installation of renewable energy system viz. solar power will reduce the emissions.**
- **Emissions from official or un official transportation of staff can also be included to get overall emissions.**
- **Tree plantation around institute is accounted in the calculation. The consideration of total plantation around the campus may have further reduced the emissions.**
- **CO_2 sequestration from soil can be included after getting total area of college campus in (hectares)**

2) Energy Audit

Energy Assessment and Audit

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

- The methodology adopted focuses on understanding the existing energy consumption by various electric appliances in the college.
- A walk through survey was carries out to understand the nature of the installed energy devices (fans, tube lights, AC, etc.)
- A total count of all the energy consuming devices/equipment was done.

Energy source utilized by all the departments and common facility centers and generation of Solar energy by installed solar panels of **400 kWp** is audited in the report. The total electricity utilization of the college for different purposes is **650855 kWh/yea**r. Energy saving is achieved through the replacement if tube lights with LED light and has been proved. To be a good energy management for the institute. The CFL tube lights were reused in the college campus by replacing with the damaged tube lights. All Computers are used with power saving mode. Staff, students and the house keeping team are encourages to switch off the lights, monitors and other equipment when not in use. All the computer labs have been facilitated with fans for reducing the use of Air Conditioners. Regular maintenance of Air Conditioners is carries out. Awareness boards are displayed to save energy.

Objectives of Energy Audit

The energy audit is an effective tool in defining and pursuing comprehensive energy management programmes. It helps in energy cost optimization, pollution control, safety aspects and suggests the methods to improve the operating and maintenance practices of the system. It is instrumental in coping with the situation of variation in energy cost, availability and reliability of energy supply, decision on appropriate energy mix, decision on using improved energy conservation measures and technology.

a) Energy Consumption

Table: Detailed of Energy Consumption in various facilities of institute

Total Campus Connected load

'Science & Humanities' block

S. No	Load type	Ground floor load (W)	1st floor load (W)	2nd floor load (W)	Total load (W)
1	Lighting load	847.00	860.00	1,188.00	2,895.00
2	Fan load	490.00	700.00	180.00	1,370.00
4	Air conditioning load	1,047.00	1,690.00	5,363.60	8,100.60
5	Electronic load	2,351.00	3,045.00	4,168.00	9,564.00
6	Motor load	0.00	0.00	0.00	0.00
7	Total floor load	4,735.00	6,295.00	10,899.60	21,929.60
8	Total wattage of department	**21,929.60**			

'EEE & IT' block					
S. No	Load type	Ground floor load (W)	1st floor load (W)	2nd floor load (W)	Total load (W)
1	Lighting load	3,762.00	3,920.00	3,099.00	10,781.00
2	Fan load	4,905.00	4,395.00	5,530.00	14,830.00
4	Air conditioning load	2,900.00	2,900.00	14,640.00	20,440.00
5	Electronic load	2,476.00	18,391.00	13,289.00	34,156.00
6	Motor load	1,725.00	0.00	0.00	1,725.00
7	Lab load	60,211.00	0.00	7,000.00	67,211.00
8	Total floor load	75,979.00	29,606.00	43,558.00	1,49,143.00
9	Total wattage of department	**1,49,143.00**			

'CSE' block					
S. No	Load type	Ground floor load	1st floor load	2nd floor load	Total load

		(W)	(W)	(W)	(W)
1	Lighting load	3,996.00	3,254.00	3,384.00	10,634.00
2	Fan load	2,554.00	4,684.00	5,810.00	13,048.00
4	Air conditioning load	8,126.00	7,840.00	7,840.00	23,806.00
5	Electronic load	28,668.00	13,792.00	12,928.00	55,388.00
6	Motor load	0.00	0.00	1,550.00	1,550.00
7	Total floor load	43,344.00	29,570.00	31,512.00	1,04,426.00
8	Total wattage of department	**1,04,426.00**			

'ECE' block					
S. No	Load type	Ground floor load (W)	1st floor load (W)	2nd floor load (W)	Total load (W)
1	Lighting load	3,965.00	4,236.00	3,200.00	11,401.00
2	Fan load	5,140.00	4,095.00	5,180.00	14,415.00
4	Air conditioning load	2,900.00	17,300.00	3,300.00	23,500.00
5	Electronic load	4,326.00	23,075.00	7,025.00	34,426.00
6	Motor load	0.00	0.00	1,550.00	1,550.00
7	Total floor load	16,331.00	48,706.00	20,255.00	85,292.00
8	Total wattage of department	**85,292.00**			

'Central Library' block					
S. No	Load type	Ground floor load (W)	1st floor load (W)	2nd floor load (W)	Total load (W)
1	Lighting load	1,753.00	1,281.00	1,080.00	4,114.00
2	Fan load	4,060.00	2,870.00	2,100.00	9,030
4	Air conditioning load	2,900.00	2,100.00	0.00	5,000
5	Electronic load	17,985.00	1,816.00	0.00	19,801
6	Motor load	0.00	0.00	0.00	0

7	Total floor load	26,698.00	8,067.00	3,180.00	37,945
8	Total wattage of department	**37,945.00**			

'MBA' block				
S. No	Load type	Ground floor load (W)	1st floor load (W)	Total load (W)
1	Lighting load	3,532.00	3,161.00	6,693.00
2	Fan load	3,455.00	4,740.00	8,195.00
4	Air conditioning load	2,900.00	9,700.00	12,600.00
5	Electronic load	16,786.00	6,398.00	23,184.00
6	Total floor load	26,673.00	23,999.00	50,672.00
7	Total wattage of department	**50,672.00**		

Civ. & Chem. Block					
S. No	Load type	Ground floor load (W)	1st floor load (W)	2nd floor load (W)	Total load (W)
1	Lighting load	3,595.00	3,978.00	3,278.00	10,851.00
2	Fan load	5,800.00	6,390.00	6,070.00	18,260.00
4	Air conditioning load	10,200.00	13,280.00	5,100.00	28,580.00
5	Electronic load	6,090.00	1,822.00	8,800.00	16,712.00
6	Motor load	1,119.00	0.00	1,119.00	2,238.00
7	Lab load	8,952.00	0.00	0.00	8,952.00
8	Total floor load	35,756.00	25,470.00	24,367.00	85,593.00
9	Total wattage of department	**85,593.00**			

'Mech.' block					
S. No	Load type	Ground floor load (W)	1st floor load (W)	2nd floor load (W)	Total load (W)

1	Lighting load	3,419.00	4,188.00	800.00	8,407.00
2	Fan load	3,890.00	8,400.00	1,890.00	14,180.00
4	Air conditioning load	6,300.00	6,600.00	0.00	12,900.00
5	Electronic load	16,866.00	1,987.00	165.00	19,018.00
6	Motor load	0.00	0.00	7,320.00	7,320.00
7	Lab load	3,738.00	0.00	0.00	3,738.00
8	Total floor load	34,213.00	21,175.00	10,175.00	65,563.00
9	Total wattage of department	**65,563.00**			

b) Energy Generated from Solar panels

MVGR has installed a grid connected 400Kwp solar energy system inside its campus. Altogether giving around 47% of campus's electricity demand. So far the solar energy systems have given around 1768985 kWh of electrical energy. Only 47% of solar energy generated in the campus is proportioned in the institute consumption. Since it is grid connected, wheeling is done automatically and we will be paid the unit charges by Discom as per the prevailing rate.

Recommendations: -

1. The electricity consumption can further be reduced by replacing tube lights with LED tubes, installing smart switches and procuring star rated electrical and electronic appliances in future.

Remarks: -

1. The auditing of electricity bills of last 3 financial years will further help in the identification of potential electricity loads and losses.

A REPORT ON WATER AUDIT OF MVGR COLLEGE OF ENGINEERING CAMPUS, VIZIANAGARM

Prepared by

Dr.S.Chandramouli, Professor

Dr.R.Maheswaran, Assoc.Professor

Mr T P Sreejani, Asst.Professor and

Mr A Sai Kumar, Asst.Professor

DEPATMENT OF CIVIL ENGINEERING

MVGR COLLEGE OF ENGINEERING (Autonomous):: VIZIANAGARAM

Declaration

Upon assigning the work to the department of Civil Engineering by our honorable principal, for preparation of water audit report of the campus, the work is taken up by Dr.S.Chandramouli and his team. The team is interacted with different stake holders in the campus including the people in the administration for advises and suggestions.

The work is mainly focused upon the following aspects:

a) Concept of Water Auditing
b) Description of Various Facilities in the MVGR Campus and Classification Of Different Areas in the Study Area
c) Conducting Survey Poll/Estimation of Actual Water Consumed Per Day By Various Stake Holders
d) Analysis of Infiltration Data
e) Study on Groundwater Levels In The Campus
f) Groundwater Quality Analysis

Based on the above tasks, the report is prepared. Still it requires lot of additions; however this report forms the basis for implementing strategies for effective utilization of groundwater during the critical periods by properly harvesting the rainwater by constructing various recharge structure.

(Dr.S.Chandramouli)

Professor in Civil Engg.,

MVGR College of Engineering(A)

Summary

Audit, an accounting procedure, is a systematic review of a site/industry/water utility that identifies the quantities and characteristics of all the water uses. Water audit ranges from simple to very complex, depending on the type of facility being reviewed and the time the customer is willing to spare in the review. The purpose of a water audit is to determine the amount of unaccounted water (UAW) or water lost in a water distribution system .UAW is calculated from verified supply and consumption records, factoring in various estimated usage figures. Due to potential short-term inaccuracies, a water audit generally considers data from the most recent 12-month period. Any period less than 12 months will not reflect seasonal climatic and population with the amount billed and account for the remaining water (loss).

In the present study, MVGR College of engineering is taken as a case study to carry out water auditing. The objectives set are 1) To estimate the water consumed by different stake holders 2) To estimate the water losses including RO reject water 3) To find out the strategies for minimizing the losses of water (or) alternative plans for effective utilization of water

To achieve the objectives stated above, the entire work is planned in finding Base line data, Analysis of Rainfall Data, Analysis of Infiltration Data, Estimation of total water pumped per day, Conducting Survey poll/estimation of actual water consumed per day by various stake holders, Estimation of water losses per day, Strategies for minimizing losses/Alternative plans for effective utilization.

INTRODUCTION

Water, food, clothing and shelter are the basic needs of every human being. The water intern is the key element for food, clothing and shelter. Any developmental activity mainly depends on the availability of water resources. The two main sources of water supply are surface water and water .the utility of water has increased enormously with the advancement of civilization.in all countries water requirements for domestic, irrigation and industrial purpose is constantly on the rise. Already there is acute shortage of both surface and ground water in many cities in the world. In 1990 the United Nations Environment Program (UNEP) reported that 200 scientists in 50 countries had identified water shortage and global warming as the two major environmental problems for the new millennium. Over the next few decades, the water consumption is estimated to increase by about 40% (BBC environment, 2002). Availability of natural resources, particularly land and water, for people in India is inequitable at global level. Presently with 2.4% of land and 4% water resources of the world, India has to support 16% of world population and 15% of livestock (Ministry of water Resources, GOI).

Precipitation is highly unevenly distributed with respective to time and space, all over the country. In four months of the monsoon period, 75% of total average annual precipitation is recorded. The erratic nature of precipitation is further likely to be aggravated on account of large-scale organization, deforestation and also due to impact of global warning and climate changes water cycle. The available utilizable water resources of the country is considered less to meet all feature needs under such a situation, in order to face the challenge of the water shortage, apart from accelerating pace of development of available utilizable water resources of India, all out efforts, on the part of people from every walk of life, may need to be made to save every drop of water and increased efficiency of every water resources project.

In view of the above, Water Audit is gaining momentum as it is accounting for the water consumption and water loss encountered in the water distribution system. In recent day's ministry of water resources (MOWR), government of India (GOI) has drafted guidelines for water audit and water conservation, which may come into force shortly. The regulatory bodies are also insisting on water auditing in the different organization to know the water

usage scenario and reduce the water losses therefore it is utmost important to account for the water supplied and used and practice good conservation measures by everyone. This will not only lead to conservation of the water in an organization but also meet the compliances as put forth by the regulating bodies.

In the present study, MVGR College of engineering is taken as a case study to carry out water auditing. The objectives set are:

1) To estimate the water consumed by different stake holders

2) To estimate the water losses including RO reject water

3) To find out the strategies for minimizing the losses of water (or) alternative plans for effective utilization of water.

CONCEPT OF WATER AUDITING

In 1997 the water task force, a five- country group formed by the international water association (IWA), launched its effort to develop a water audit structure for drinking water utilities. The same concept may be used for the water audit organization with appropriate modification to the methodology. Audit, an accounting procedure, is a systematic review of a site/industry/water utility that identifies the quantities and characteristics of all the water uses. Water audit ranges from simple to every complex depending on the type of facility being reviewed and the time the customer is willing to spare in the review.

The purpose of a water audit is to determine the amount of unaccounted –for water (UAW) or water lost from in a water distribution system .UAW is calculated from verified supply and consumption records, factoring in various estimated usage figures. Due to potential short-term inaccuracies, a water audit generally considers data from the most recent 12-month period. Any period less than 12 months will not reflect seasonal climatic and population with the amount billed and account for the remaining water (loss).

Comprehensive audits can give the utility a detailed profile of the distribution system and water users. Allowing easier management of resources and improved reliability. A comprehensive water audit plan associated with leak detection is an important step towards water conservation, which can save the utility a significant amount of money and time apart from the natural resources. The water audit may also prove as an effective tool for evaluation of the performance level of the present water supply, distribution and usage service for future expansion.

The major components of water audit include the determination or recording of the

a) Amount of water received from the raw water source.
b) Amount, of water delivered to metered users.
c) Amount of delivered to unmetered users.
d) Amount of water loss.
e) Measures to address water loss.

The water audit conducted in a water use facility creates awareness on water conservation and its importance among water users. It also helps the decision makers to gain

comprehensive understanding on the water leaks and loss detection and to act in the right direction in a water utilization. The major objective of water audits is to assess the

a) Water produced
b) Water used
c) Losses both physical and non-physical and
d) To identify and prioritize areas which need immediate attention for control

Water audit associated with leak detection programs are effective ways to minimize leakage and to fit small problems before they become major ones. These programs lead to the following benefits (Water audit guidance, Maryland)

a) Reduced water losses
b) Improved financial performance,
c) Improve reliability of supply system,
d) Enhanced knowledge of distribution system,
e) Efficient use of existing supplies,
f) Better safeguard to public health property,
g) Improved public relations,
h) Reduced legal liability, and
i) Reduced disruption, thereby improved level of service to customers.

In a legal water audit study is intended to reduce the annual water consumption through conservation, recycle and reuse of the effluent at various points within the system. The water audit is also inclined towards encouraging the usage of certain conservation gadgets and water saving practices. This will be achieved primarily by

1) Conducting comprehensive survey of water flow through the system distribution;
2) Characterization of the water from different sources;
3) Preparing the water balance chart or diagram.

Water Audit Methodology

Planning the Water Audit

Water audits can be designed by reviewing the system records and staff expertise and using these resources to develop and complete effective worksheets. Distribution system characteristics vary, so each utility will have different challenges in performing the water audit. Each system will be needed to decide how it can perform the audit accurately with the least cost. The important aspects in the planning process are

- Setting study period
- Develop a worksheet
- Defining the water losses
- Identifying the locations to make measurements

Worksheet can vary in detail and will determine how well the distribution system is described. A more detailed worksheet will provide better understanding of the water usage and could be a useful tool for the water utility.

Conducting the Audit

Once the study period has been set and a worksheet has been developed, the audit can be conducted. A set of model forms and instructions are included that can be used if the utility does not choose to develop one. Records should be complied and meters should be checked so accurate totals are recorded. Once totals are computed, the worksheet should then be filled in, and water delivered should be balanced with water used. Unmetered uses should be documented along with the methods to quantity them. An attempt to account for water loss should be made. Based on the findings of the audit, options should be developed to reduce water loss. This conducting water audit phase consists of the following three major stages

- Compile water production and sales data
- Make adjustments as necessary
- Comprehensive Audits (optional)

When making adjustments to metered amounts, document the adjustments and how they were calculated. All records should reflect any adjustments and should be variable. If adjustments are made for significant amounts of water then the system should be make changes to eliminate need of adjustments in the future. Adjustments could be known production meter in accuracy, or the difference between finished reservoir storage at the beginning and end of the study period. One difficulty might be in the existing records to fit the study period (www.mde.state.md.us). In addition to the above, a more through or comprehensive audit would include the development of an inventory of meters, analysis of water loss and methods to reduce the loss and checking the accuracy of meters. Compilation and processing the data obtained in this stage may be useful to design the follow up program.

Follow up Program

The follow up program is another important phase of the water audit. If the unaccounted or unmeasured water loss is greater than 10%, we are requesting that you prepare a plan within three months outlining steps that you intend to take for further identifying and reducing water losses. Cost benefit analyses should be conducted to choose the right option. If future annual audits continues to show unmeasured water greater than 10%, the plan for reducing water losses should be updated and re-submitted. The follow up program includes

1) Plan for reducing water loss
2) Cost and benefits of recovering water by reducing losses
3) Short term and long term goals

Costs include the personnel and equipment required to make improvements. Repair costs should not be included because these need to be done eventually short and long term follow up should include updating the audit, reducing loss checking meters. After the first audit, areas where data is lacking should be identified and addressed. Subsequent audits should provide greater accuracy and reduction of water losses. The major three components of water audit methodology can also be segregated into different stages, which are discussed below.

Stages of Water Audit

The water audit water can be conducted in a systematic way by proper planning of steps or stages and systematic analyses of the data obtained in all the stages the water audit may be divided into following six stages so as to make it simple and effective

1. Water supply and system input volume
2. Water quality assessment and distribution
3. Determined authorized consumption
4. Estimating of apparent and real losses
5. Documentation of the water audit

Water supply and systems input volume

The availability of water sources, annual volume input to the water supply systems at the inlet of the water treatment plant and past consumption patterns for various sectors must be studied to understand availability and supply of water and consumption patterns. Future programmers, may be designed, based on these studies. Any alternative source of water like rain water harvesting or effluent recycling may also be explored.

Water quality assessment and distribution

The supply of water needs to be tested to find out the level and nature of impurities present in the water. Depending on the types of application and degree of purity needed, the treatment system can be designed and developed. The distribution of water, the leakages assessment etc. form a part of this study.

Determining authorized consumption

The volume metered and/or unmetered water taken by registered customers, the water supplier and others who are implicitly or explicitly authorized to do so by the water supplier, for residential and commercial and industrial purposes. This does not include water exported (sold to neighboring utilities).

Estimating of apparent and real losses

The key performance indicators in water loss management are apparent losses, real losses. Water loss can be defined as the difference between system input volume and authorized consumption, consisting of apparent losses plus real losses (IWA).

Apparent losses consist of unauthorized consumption, volume of water lost through meter under registration, and data handling errors. The key impact of reducing apparent losses is an improved revenue stream to the water supplier and a more equitable distribution of cost to the customers.

Real losses consists of water leaks and breaks which can either be reported or non-reported, background leakages which is attributed to infrastructure condition, and reservoir or storage over flows or losses. The key impact of reducing real losses is a direct reduction in unnecessary demand.

Once volumes of apparent and real losses have been identified and validated, the values of these components can be clearly defined. The value of the loss, along with the cost of intervention, will be assessed and the cost effectiveness or business case can be built for reduction of volumes of loss to economic levels.

Documentation of water audit

Adequate planning and procedure may be necessary to be finalized and completed prior to undertaking the water audit of the system. A water audit can be accomplished on the basis of water allotted for a service and water actually utilized for that service. After loss of water and efficiency of systems are known steps needed for utilization of recoverable water loss may be listed. A cost benefit study for optimum recovery of water loss may be performed. A water audit report may be invariably contain (a) amount of water earmarked/made available to the service (b) amount of water utilized, both through metered and unmetered supplies and (c) water loss and efficiency of the system along with reason for such water losses. An effective water audit report may be purposeful in detection of leak in distribution system, taking timely action for plugging such leaks and thereby reducing conveyance losses of water and

improving efficiency of the system. Water audit of the system may not be considered as one off measure, but it should be undertaken at regular interval of time (MOWR, GOI).

System Audit

The current water usage and systems for water use under various sectors such as irrigation, industry and commerce, hydropower, domestic water supply, thermal power and others needed to be studied to check their operational efficiency and level of maintenance. The scope for any modification or up gradation may depend on the status of existing system.

Discharge analysis

The domestic wastewater, return flows from irrigation and effluent from the industry may necessarily be studied for conformity to environment standards, possibility of recovery of valuable by-products and the opportunity to recycle water.
The procedure described above may be modified without effecting the overall structure or framework to conduct the water audits. Among the

Types of Water Audit

The water audit may be classified based on the water use facility for which audits is Water Audit Procedure (WAP) intended to serve as a guide for facility management personnel who wish to conduct their own audit. By completing the water audit, facility managers will be able to anticipate the capital losses on account water wastage and predict the monetary savings that will result from water conservation measures.

The water audit is classified based on the type of facilities that is under consideration
1)Residential or household water audit 2)Institutional water audit 3) Commercial water audit 4)Municipal water audit 5) Industrial water audit and 6) Irrigation water audit .
Among the above the most important water audits are the residential or house hold, municipal, industrial, and irrigation water audit. The water audit may be conducted in different ways for each of the above audit with similar basic structure of water audit procedure.

ABOUT THE MVGR CAMPUS AND DESCRIPTION OF VARIOUS FACILITIES

The present study is on water auditing of an educational institution i.e. MVGR COLLEGE of Engineering, Vizianagaram. In this section, the details of study area such as the location, map, sources of water etc. are presented in detail.

Location of Study Area

The present study area chosen is the campus of M.V.G.R College of Engineering. The college is located at Chintalavalasa, outskirts of Vizianagram about 5km away from the town and adjacent to the Vizianagaram-Visakhapatnam highway. The latitude –longitude of the location are N 18^0 6' 49.7916'' and E 83^0 24' 33.6528'' respectively. It is located about 18Km inland for the Bay of Bengal, and 52 km northeast of Visakhapatnam.

About the Study Area

"Maharaj Vijayaram Gajapathi Raj College of Engineering" was out shooted from the tree of MANSAS in the year 1997." MVGR college of engineering is a huge campus covering a geographical area around **43 acres**. Throughout the year, the climate is characterized by moderate humidity. The seasonal rainfall is generally good. The south –west monsoon is the main source of rainfall for the present study area. The average annual rainfall recorded a nearby rain gauge station is around 1050 mm.

MVGR College of engineering has the following Departments.

B.Tech in

- Civil Engineering
- Computer Science and Engineering
- Chemical Engineering
- Electrical Engineering
- Information Technology
- Mechanical Engineering
- Electronics and Communication Engineering

P.G COURSES

- MBA
- M.TECH

The campus has facilities for training in games and sports like athletics, cricket, football, basketball, volleyball, tennis, badminton, squash and table tennis, National Cadet corps(NCC), National Service Scheme (NSS) as a compulsory extracurricular activity and fully equipped Gymnasium.

The college has the following buildings:

a) Civil and Chemical Engineering Block (G+2)
b) Administrative Block (G+2)
c) Library Block (G+1)
d) Boys Hostel (G+2)
e) Girls Hostel block (G+2)
f) CSE Block (G+2)
g) EEE & IT Block (G+2)
h) Mechanical Block (G+3)
i) ECE Block (G+2)
j) S&H and T&P Block (G+2)
k) MBA Block (G+1)
l) Amenities Block (GF)
m) Guest house (G+1)
n) Generator room (GF)
o) Workshops Sheds (08)(GF)
p) Bank (GF)
q) Sri Ganesh Temple (GF)
r) Main Gate (GF)
s) Food courts (04) (GF)
t) Servant Quarters (Twin-02)(GF)
u) Car/Scooter Parking Shed (03)(GF)
v) Canteen (G+1)
w) Fresh Choice (GF)
x) Bank ATM (GF)

Source for water

In the study area the main source of water for various needs is only ground water which is extracted through pumping. In the present study area, there are around 13 pumping units with 11 elevated water tanks.

Maps of the Study Area

the map downloaded from google is shown in fig 1

Figure 1: Study area (Source: Google)

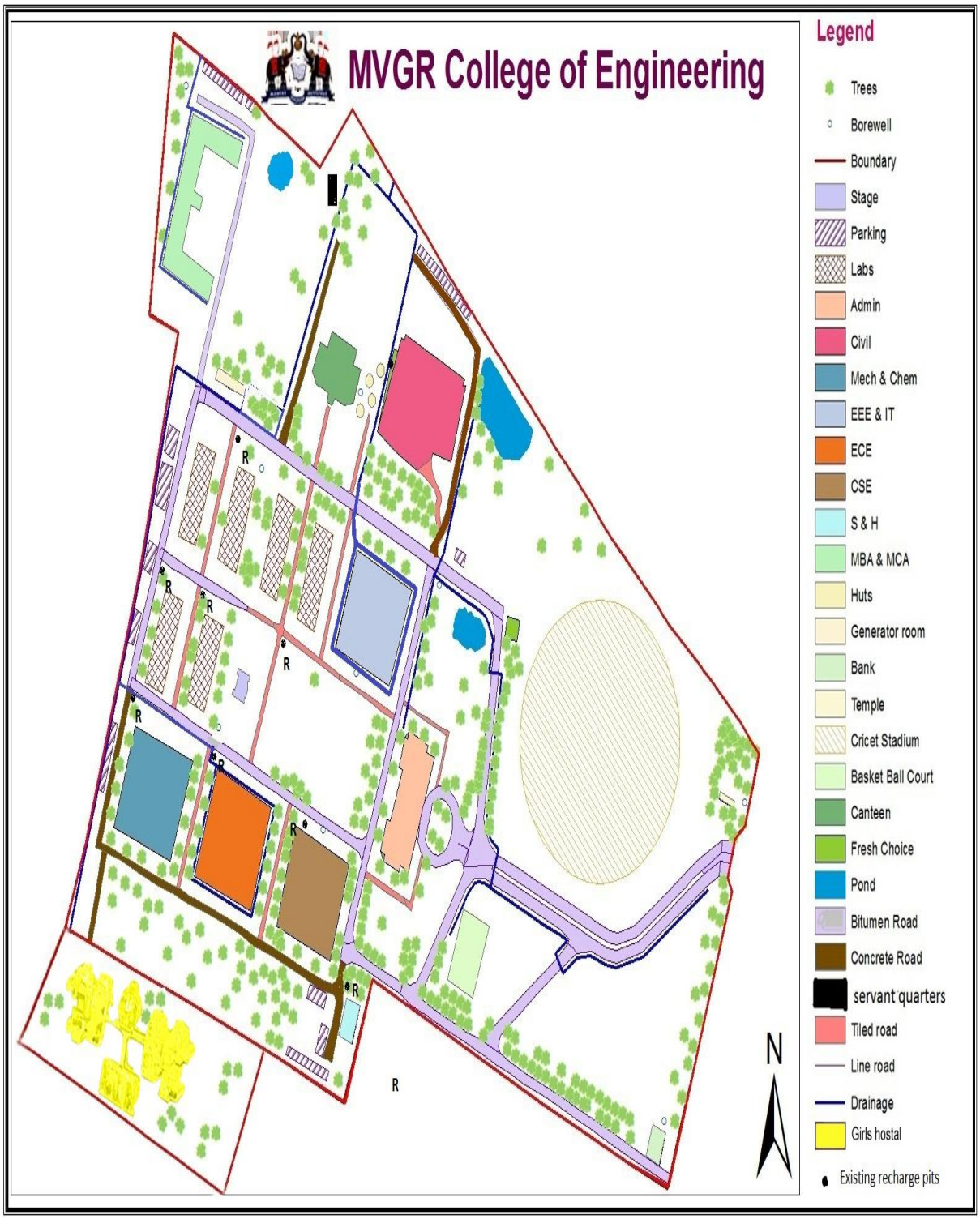


Figure: Map Showing Various details of the Study

METHODOLOGY

The entire work is planned in the following sub heads. (Flow-chart is in appendix-3)

1) **Base line data collection:** The following base line data is identified for carrying out water auditing project :
    - **a.** Finding the impervious and pervious areas
    - **b.** Estimation of Pump Discharges
    - **c.** Collection of Rainfall Data
    - **d.** Conducting field test for infiltration
    - **e.** Estimation of Pumps Run time
    - **f.** Survey for finding RLs at Bore Locations
    - **g.** Conducting Resistivity Survey
    - **h.** Identification of Various Water consuming units
    - **i.** Water Quality Analysis
    - **j.** Estimation of RO Reject water
    - **k.** Measurement of GWL at Bore-well

(Note: 1) Bore locations are identified in the campus and their elevations are determined w.r.t MSL and then periodically, the groundwater levels in these wells are measured.2) for finding the average pumps run times in a day, observations are made for one week on daily basis.

2) **Analysis of Rainfall Data**

    Collecting the latest rainfall records from our weather station and then performing the analysis of rainfall data.

3) **Analysis of Infiltration Data**

    In order to find the average Infiltration Characteristics of soils in the campus, certain locations are selected in the study area. At these locations, double ring infiltrometer test is conducted to find infiltration characteristics. The constant head method is used in this test. Horton's infiltration model is adopted for the present study.

4) **Estimation of total water pumped per day**

    At all pumps, the discharge is calculated by collecting certain volume of water in a bucket at the end of the delivery pipe and noted the time for collecting that volume of water.

A survey is conducted for one week to find out the daily run time of the pumps.

Then the volume of water pumper per day is calculated as discharge x pump run time.

5) Conducting Survey poll/estimation of actual water consumed per day by various stake holders

Various water consuming units are identified and then the daily consumption is estimated by conducting a rigorous survey.

The identified consuming units are listed below:

a) Drinking water for students and staff
b) Water in wash rooms for students and staff
c) Water for gardening
d) Water for floor cleaning, washrooms cleaning etc.,
e) Water for construction activity
f) Water for laboratories
g) Water during conduct of parents meet,FDPS,conferences, student fests etc.,
h) Water for canteen
i) Water for cleaning buses

6) Estimation of water losses per day

After estimating the water pumped per day and the actual consumption per day, the loss is calculated as the difference of water pumped per day and the actual consumption per day.

7) Strategies for minimizing losses/Alternative plans for effective utilization

ESTIMATION OF QUANTITY OF WATER PUMPED PER DAY BASED ON RUNTIME OF PUMPS AND DISCHARGE

In the campus, the pumps are located at the following locations.

1) Pump-1: Behind Civil Engineering Department (Nearer to Pond)
   (This pump is supplying water to Civil and Chemical blocks)
2) Pump-2: In between Civil Engineering Department and Canteen (Nearer to huts at Canteen)
   (This pump is supplying water to Canteen and Civil & Chemical blocks)
3) Pump-3: back side of Workshops near Mechanical Engineering Department (in open ground nearer to ECE Dept.)
   (This pump is supplying water to Mechanical block)
4) PUMP-4: at CSE Department (besides CSE Dept)
   (This pump is supplying water to CSE department, Admin Block and T&P block)
5) PUMP-5: at Canara Bank (nearer to front gate of campus)
   (This pump is supplying water to canara bank)
6) PUMP-6: at Vinayaka Temple (at front gate of campus)
   (This pump is supplying water to Sports block)
7) PUMP-7: at PT Lab
   (This pump is supplying water to amenities block)
8) PUMP-8: at EEE block (besides EEE block)
   (This pump is supplying water to EEE&IT and ECE blocks)
9) PUMP-9 : at MBA block (back side of MBA block)
   (This pump is supplying water to MBA dept)

Note: 1) Two RO Plants are located at Civil & Chemical Block and Mechanical blocks.

2) Details of the pumps are given in the **Appendix-1.**

The pump run-times and discharges are estimated and produced in the following table.

PUMP	SUPPLY TO	AVERAGE RUN TIME OF THE PUMP IN hrs	AMOUNT OF WATER COLLECTED in collecting Jar in liters	*Time of Collection in seconds*	*Discharge form the pump in liters per hour*	*Amount of Water Pumped per day in liters*	Remarks
1	Civil & Chemical Block	7.033	5	10.33	1742.50	12255	RO Plant
2	Civil & Chemical Block	3.5	20	10.82	6654.34	23290	RO Plant
	Canteen	3.5	20	10.81	6663.58	23323	
3	Mechanical Block	8.5	20	18.28	3938.73	33479	RO Plant
4	CSE Block	3.5	20	8.98	8028	28098	
	Admin Block	3.25	20	21.24	3391.2	11021	
	T&P Block	1.5	20	53.78	1338.79	2008	
5	Canara Bank	2	20	13.88	5187.32	10375	
6	Sports Block	0.75	20	15.21	4734.51	3551	
7	Amenities Block	2.7	20	27.11	2656.34	7172	
8	EEE&IT Block	2	20	13.2	5454.55	10909	
	ECE Block	2	20	11.23	6412.83	12825	
9	MBA Block	1.88	20	12.11	5964.73	11214	
Total Water pumped per day						189521	**Excluding boys and girls hostels**

Note: The data regarding average run time and times taken for collecting water in jar are given in **Appendix-2.**

ESTIMATION OF RO REJECT WATER AND ITS EFFECTIVE UTILIZATION

In the campus, Two RO plants are available. One plant is located on the top of Civil & Chemical Block and another one is located at on the top of Mechanical Block.

At each RO Plant, two Rotameters are available. One rotameter is connected in the inlet pipe to RO plant and another one at outlet of RO where potable water is coming out.

(Note: A **rotameter** is a device that measures the volumetric flow rate of fluid in a closed tube.)

Inorder to know the average inflow rate into the RO and also the average outflow from the RO, at several time intervals, the readings are noted down. The details are given below in tables.

(Note: RO Plants at hostels are not considered in the present study)

Readings taken at RO Plant at Civil & Chemical Block

Time	Inflow into RO Plant (Lph)	Outflow form RO (lph)	RO Reject (lph)	%of RO reject
11:40 am	1600	340	1260	78.75
11:50 am	1595	335	1260	79.00
12:00 pm	1620	360	1260	77.78
12:10 pm	1600	340	1260	78.75
12:20 pm	1560	360	1200	76.92
12:30 pm	1540	340	1200	77.92
12:40 pm	1600	340	1260	78.75
Average	**1588**	**345**	**1243**	**78**

The RO plant at Civil & Chem block is supplying drinking water to the following:

y) Civil and Chemical Blocks
z) Canteen
aa) EEE & IT Block

The tank capacity at this plant is **3000 liters.**

Readings taken at RO Plant at Mechanical Block

Time	Inflow into RO Plant (lph)	Outflow form RO (lph)	RO Reject (lph)	%of RO reject
12:50pm	2600	950	1650	63.46
1:00 pm	2600	950	1650	63.46
1:10 pm	2550	950	1600	62.75
1:20 pm	2600	950	1650	63.46
1:30 pm	2550	950	1600	62.75
1:40 pm	2560	950	1610	62.89
1:50 pm	2600	950	1650	63.46
Average	**2580**	**950**	**1630**	**63**

The RO plant at Mechanical block is supplying drinking water to the following:

1) Mechanical Block
2) MBA Block
3) ECE Blok
4) Admin Block
5) CSE Block
6) S&H Block (through 20 liters cans from CSE)

The tank capacity at this plant is **5000 liters.**

At present, the RO reject is not being used for any useful purpose. So it is recommended to divert the water into the overhand tanks by construction of baffle walls inside the tanks. This water can be used for wash rooms and cleaning the floors.

CONDUCTING SURVEY POLL/ESTIMATION OF ACTUAL WATER CONSUMED PER DAY BY VARIOUS STAKE HOLDERS

Various water consuming units are identified and then the daily consumption is estimated by conducting a rigorous survey.

The identified consuming units are listed below:

a) Drinking water for students and staff
b) Water in wash rooms for students and staff
c) Water for gardening
d) Water for floor cleaning, washrooms cleaning etc.,
e) Water for construction activity
f) Water for laboratories
g) Water during conduct of parents meet, FDPS, conferences, student fests etc.,
h) Water for canteen
i) Water for cleaning buses

The sample format for conducting survey regarding drinking water and for wash rooms is given below.

Format for Survey:

Department Of Civil Engineering
MVGR college of Engineering
Guide: Mr.T.P.Sreejani
Assistant Professor
Department of Civil Engineering
Members: Uday Kumar
Madhurima
Tarakavisweswararao
Eswar
Project Info: An audition of water usage in our college.
REQUEST: kindly fill the form.It will be very helpful for our college.
* Required

Department *
Civil Chemical EEE IT CSE ECE Mechanical MBA

Gender *
Male
Female

Hostler? *
yes
no

Drinking Water

How many times do you drink in a day? *
1/ 2/ 3/ 4/ 5/ 6/ 7/8/9/10

How do you drink water? (glass or bottle) and How many times? *
Answer pattern: example:: Glass, 3 times/day (or) bottle,1 time/day

Your answer

Do you wash your bottle/glass everytime when you drink water? *
yes
no
sometimes

Washroom

How many times you use washroom in a day? *
1/2/3/4/5

How many times you flush when you use latrine? *
1/2/not yet used

Hostler

How many times you bath in a day? *
1/2/3

How many buckets of water use for a bath?(for an avg 16 litre bucket,along with water used for dipping clothes) *
1/2/3/4/5

How many times you use letrine in a day? *
1/2/3

How many times you flush? *
1/2/3/4

How many times you wash your clothes in a week? *
1/2
I use washing machine(girls hostel)
I don't wash clothes in hostel

How many buckets of water you use per wash? *
0/1/2/3/4/5/6/7/8/9/10

How do you drink water? (glass or bottle) and How many times? *
Answer pattern: example:: Glass, 3 times/day (or) bottle,1 time/day

Your answer

BACK

SUBMIT

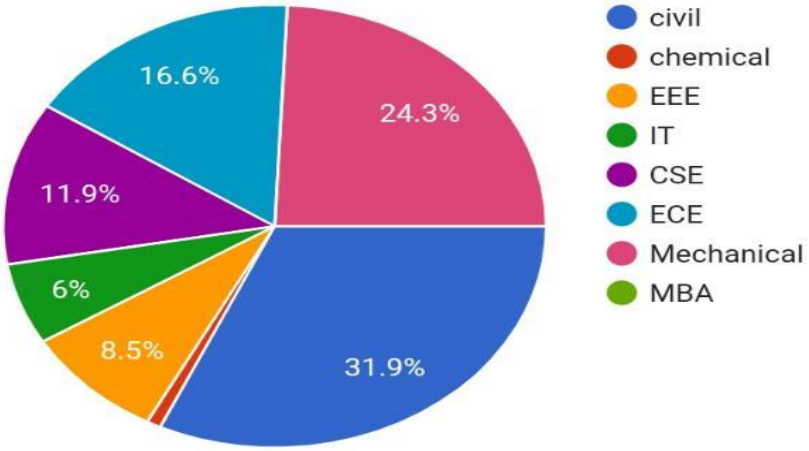
QUESTIONS RESPONSES 235

235 responses

SUMMARY INDIVIDUAL Accepting responses

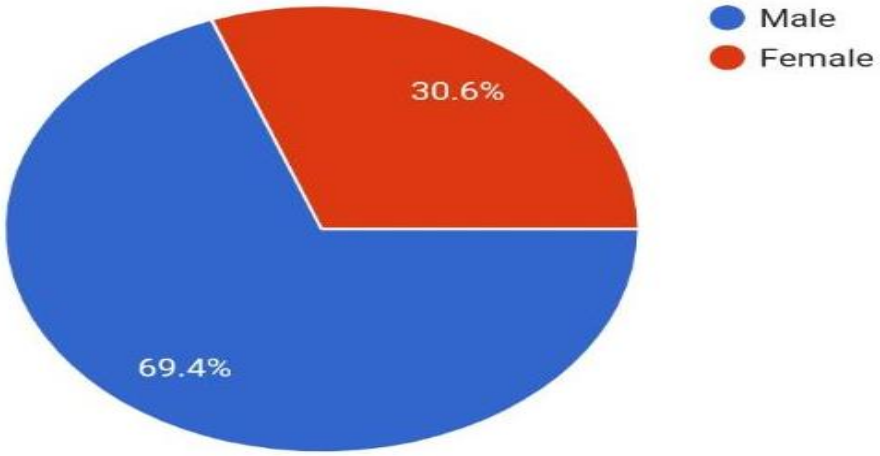
Department

235 responses



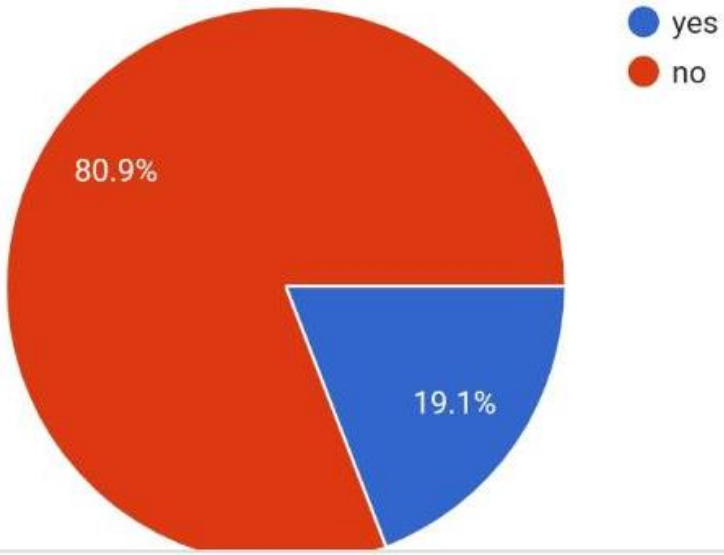
Gender

235 responses



Hostler?

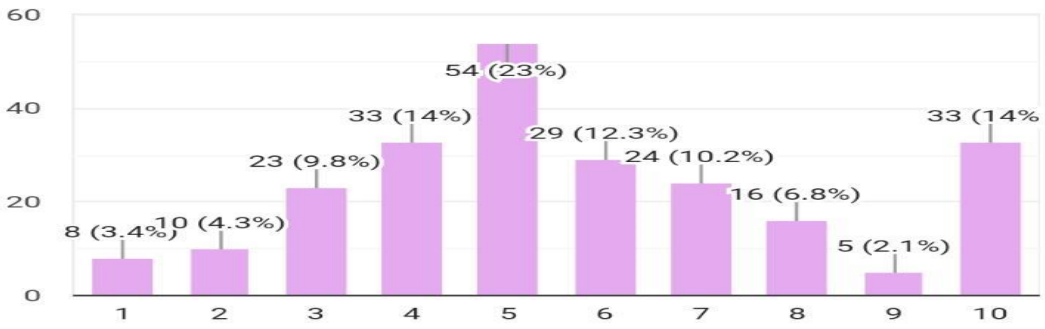
235 responses



Drinking Water

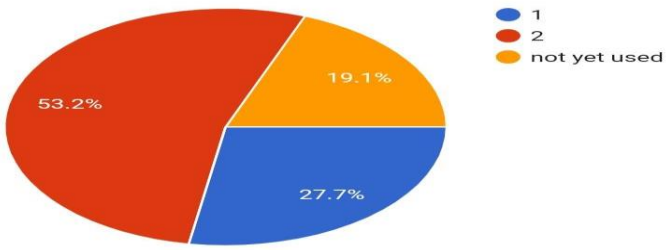
How many times do you drink in a day?

235 responses



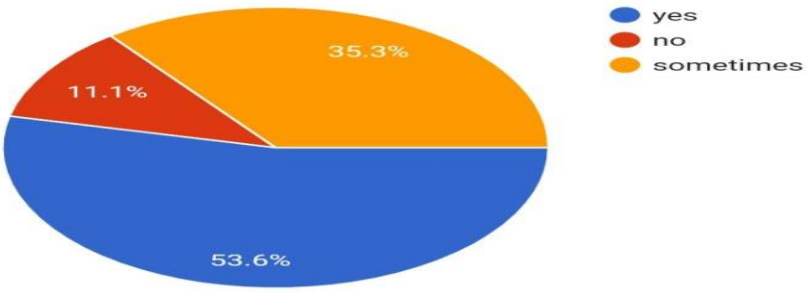
How many times you flush when you use letrine?

235 responses



Do you wash your bottle/glass everytime when you drink water?

235 responses



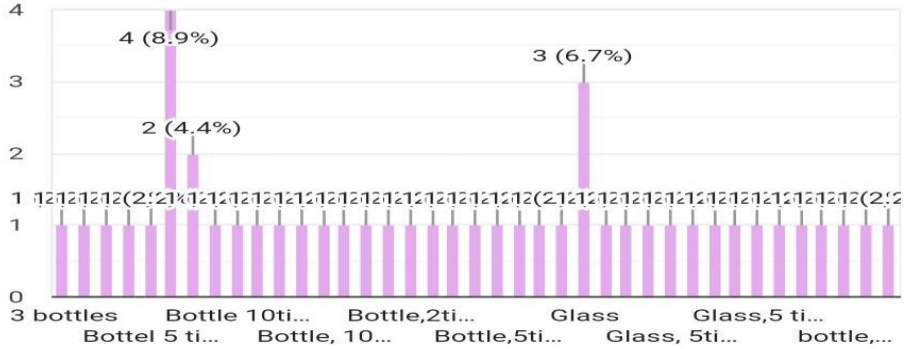
Washroom

How many times you use washroom in a day?

235 responses

How do you drink water? (glass or bottle) and How many times?

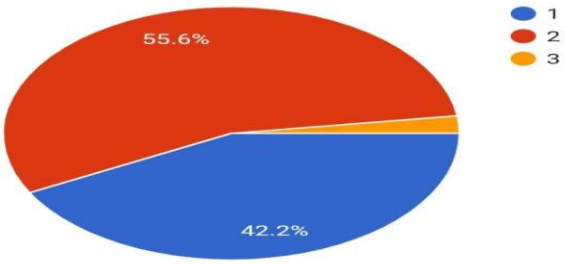
45 responses



Hostler

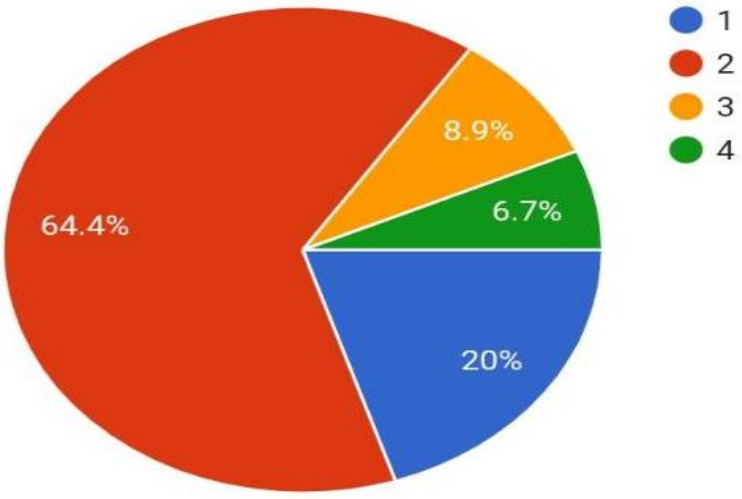
How many times you bath in a day?

45 responses



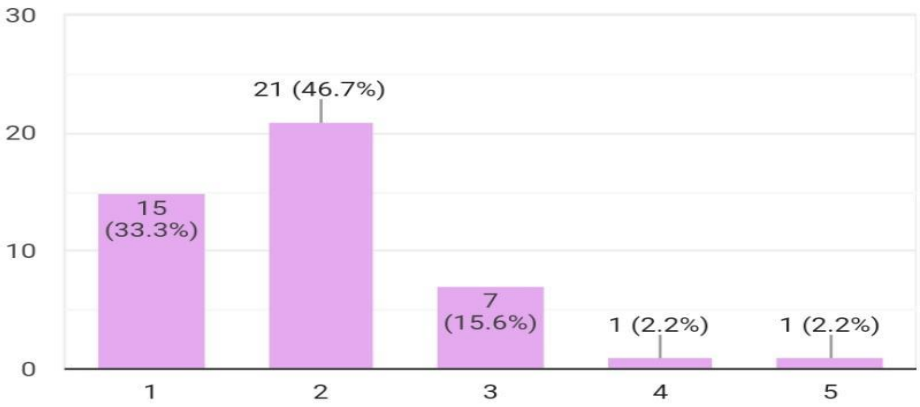
How many times you flush?

45 responses



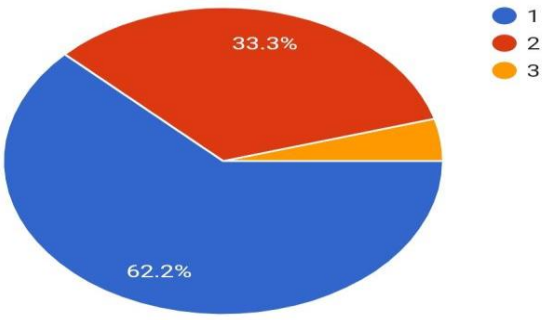
How many buckets of water use for a bath?(for an avg 16 litre bucket,along with water used for dipping clothes)

45 responses



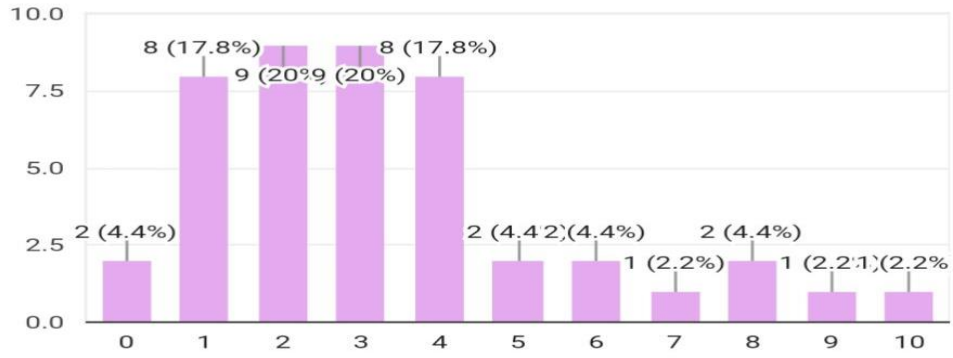
How many times you use letrine in a day?

45 responses



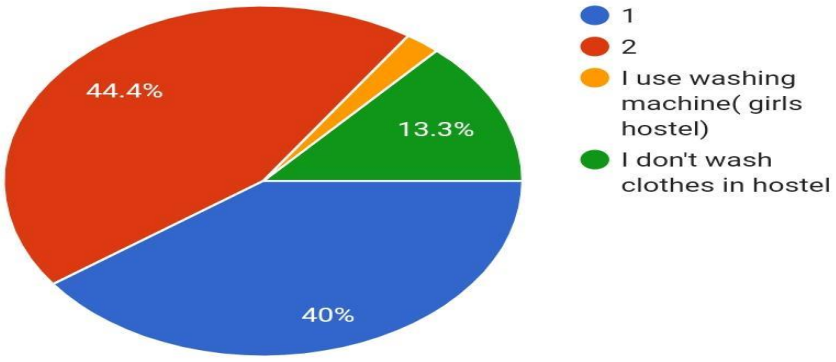
How many buckets of water you use per wash?

45 responses



How many times you wash your clothes in a week?

45 responses



1) Drinking water for students and staff

S.No	Department	Number of students	Number of Staff
1	Civil and Chemical	828	52
2	Mechanical	842	56
3	CSE	776	54
4	Admin	-	42
5	Canara Bank	-	12
6	S&H and T&P	-	25
7	Sports & Gym	-	4
8	Canteen	-	15
9	MBA	232	19
10	Bus Drivers	-	45
11	EEE & IT	752	52
12	ECE	829	50
Total		4259	426

(Note : outsourcing staff, bank staff, security staff and labours for construction activity and visitors are not considered)

Based on the survey, it is considered that the drinking water per day on an average is 1.5 liters.

Total of students and staff is 4685.So the total drinking water required is 4685*1.5 **=7028 liters per day**

From the RO reject statistics assuming that 30% of water is produced by ROs, then the raw water required per day is 7028/(0.3) =**23427 liters per day**

(Wastage of water from RO Plants in the form of reject water is 23427 -7028=16399 liters per day)

2) **Water in wash rooms for students and staff**

Based on the survey, by considering two times of use of wash room and two times of using flush button, the amount of water required is 2 liters

Total of students and staff is 4685.So the total water required for wash rooms is

4685*2 =**9370 liters per day**

3) **Water for gardening**

The equation to calculate water requirements of closely spaced trees and trees in mixed plantings is

Amount of water required in liters = ET_o x PF x LA x 0.623 x3.785

Where ET_o = Evapo Transpiration = 0.188 in/day

PF =Plant factor=0.7 for mixed vegetation

LA =Lawn Area = 288515.85 sq.ft

Therefore, amount of water required for gardening in liters is **89532 liters per day**

4) **Water for floor cleaning, washrooms cleaning etc.,**

Washrooms

Number of times of cleaning the wash rooms per day = 03

No.of staff toilets in the campus (6+6+6+6+6+4+10+10+6+2+2) =64

No.of Students toilets in the campus (18+21+21+21+21+12+12)=126

Water required for cleaning washrooms for one time = 240 liters per floor

For Civil and chemical block = 240*3*3=2160 liters

EEE & IT Block = 240*3*3=2160 liters

Mechanical Block = 240*3*3=2160 liters

ECE Block= 240*3*3=2160 liters

CSE Block= 240*3*3= 2160 liters

MBA = 240*2*3 = 1440 liters

Library Block = 240*2*3 = 1440 liters

S& H = 360*3 =1080 liters

Admin = 600*3 =1800 liters

Total = 16560 liters per day

Floor Cleaning

60 liters per floor per day

Total water required for floor cleaning = 25 *60 = 1500 liters per day

Grand total = 18060 liters per day

5) **Water for construction activity**

1000 liters of water per day is considered for construction purpose

6) **Water for laboratories**

500 liters of water per day is considered for all laboratories.

7) **Water during conduct of parents meet, FDPS, conferences, student fests etc.,**

Assumed 50 liters per day

8) **Water for canteen**

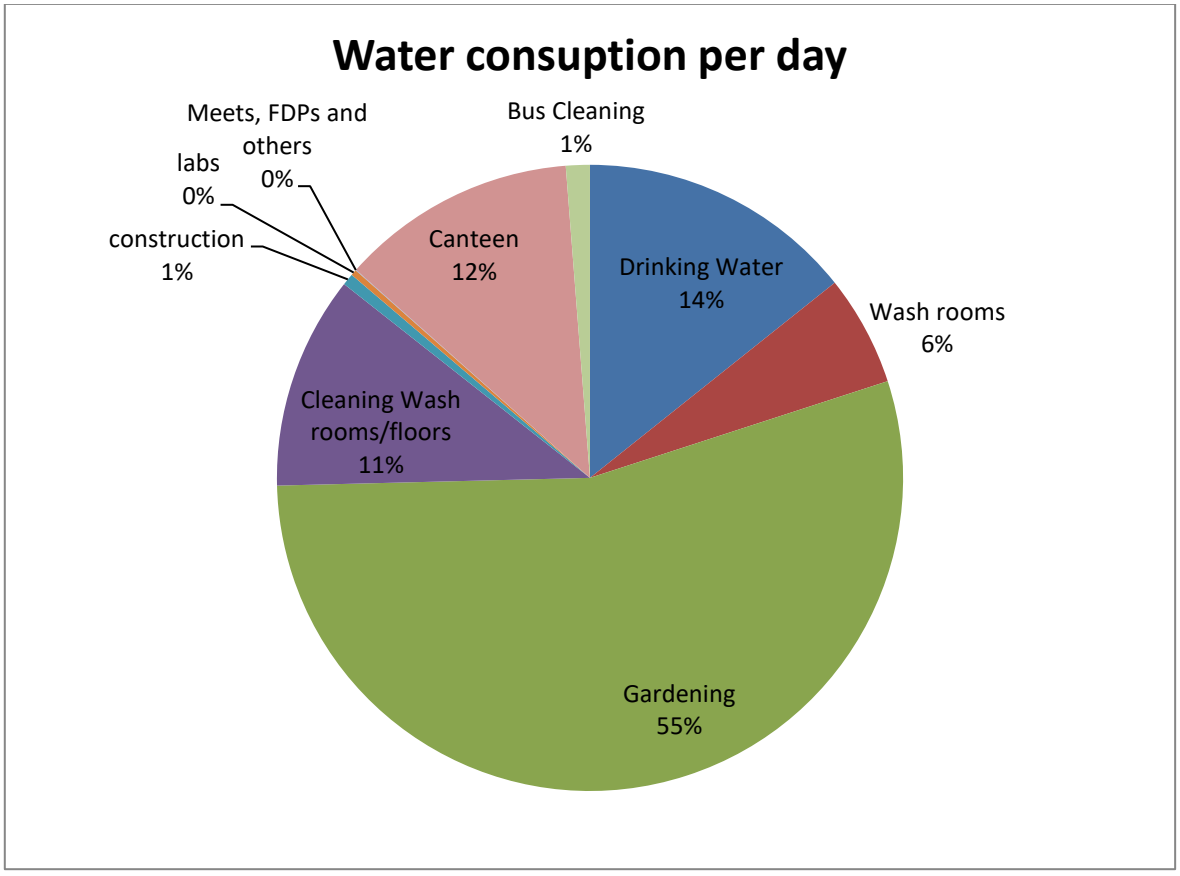
Assumed 20000 liters per day for preparation of food and others

9) **Water for cleaning buses**

Assuming 45 liters per vehicle per day for cleaning , the total water required is 45*45 =**2025** liters per day

GRAND TOTAL: 143964 liters per day

S.No	Water consuming unit	Consumption in Liters per day
1	Drinking Water	23427
2	Wash rooms	9370
3	Gardening	89532
4	Cleaning Wash rooms/floors	18060
5	construction	1000
6	labs	500
7	Meets, FDPs and others	50
8	Canteen	20000
9	Bus Cleaning	2025



Losses in liters per day = Water Pumped in liters per day – Water consumed in liters per day = 45557

ANALYSIS OF INFILTRATION DATA

Specifications of Double Ring Infiltrometer

Inner diameter= 30cm Outer diameter=60cm Height of ring=30cm

Volume of water required for 1 cm fall in inner diameter is 706.85ml

Volume of water required for 1 cm fall in outer diameter is 2120.57ml

Location -1: Location:- civil pond

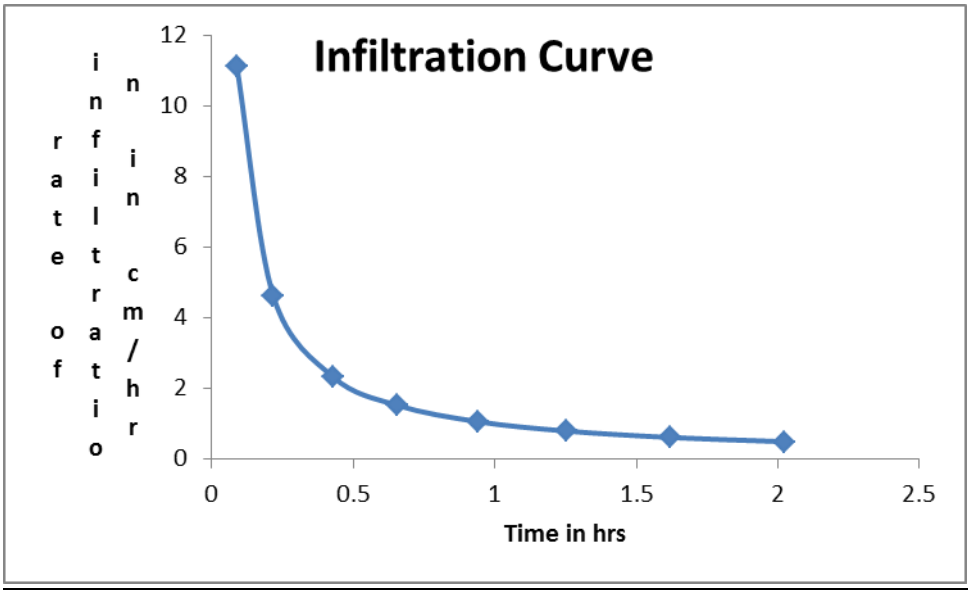
Latitude:- 18°3'41'' and Longitude:-83°24'20''

Basic data:-

S.NO	VOLUME OF WATER expressed in cm depth	TIME in minutes
1	1	5:23
2	1	13:08
3	1	25:47
4	1	39:22
5	1	56:27
6	1	1:15:21
7	1	1:37:11
8	1	2:01:32

Table of computation

S.NO	TIME IN min	CUMULATIVE DEPTH in cm	INFILTRATION RATE, fp in (cm/hr)	TIME In hr	ln(fp-fc)
1	5.38	1	11.235	0.089	2.365
2	13.13	2	4.568	0.218	1.404
3	25.78	3	2.327	0.429	0.606
4	39.36	4	1.524	0.656	0.030
5	56.45	5	1.062	0.940	-0.56
6	75.35	6	0.796	1.255	-1.19
7	97.18	7	0.617	1.619	-2.08
8	121.53	8	0.493	2.025	



Results: after performing calculations for the above data,

The values of Horton's infiltration model parameters obtained are

The constant rate of infiltration (fc) : 0.493 cm/hr

The maximum rate of infiltration (fo) : 6.593 cm/hr

The hydraulic conductivity of the soil is : 1.8 cm/hr

The above test is performed at the following conditions of soil: Soil moisture content @11.22 % and bulk density of soil @ 1.853 g/cc

Location 2:

@ ECE GROUND (near to EEE department)

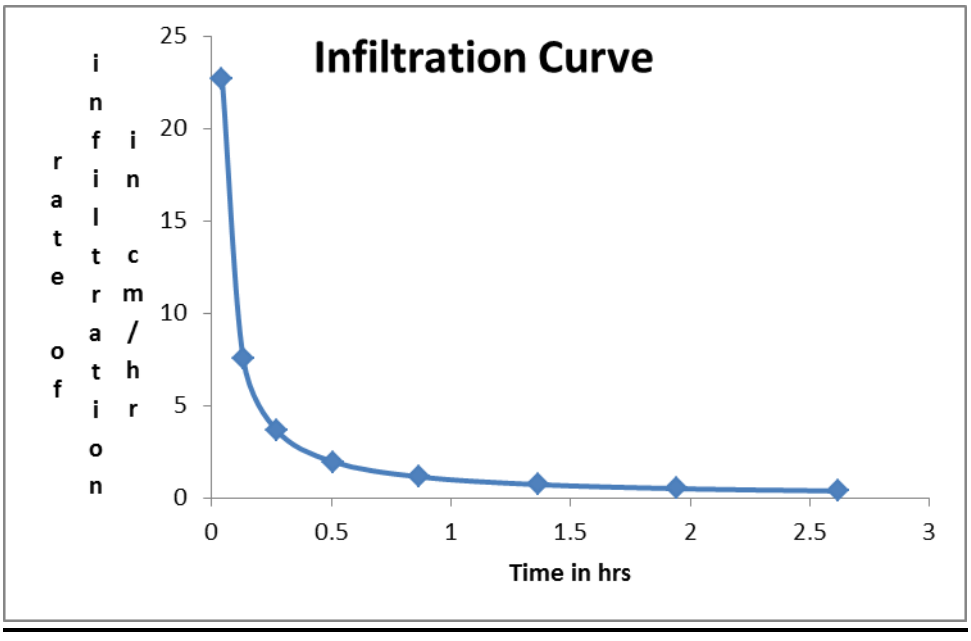
latitude:-83°24'18" and Longitude:- 18°3'38"

BASIC DATA

S.NO	VOLUME OF WATER in terms of depth (cm)	TIME in minutes
1	1	2:39
2	1	7:58
3	1	16:08
4	1	30:32
5	1	52:07
6	1	1:21:51
7	1	1:56:37
8	1	2:36:59
9	1	3:18:48

Table of Computations:

S.NO	TIME IN min	CUMULATIVE DEPTH fc(cm)	INFILTRATION RATE fp(cm/hr)	TIME IN hr	ln(fp-fc)
1	2.65	1	22.675	0.044	3.107
2	7.96	2	7.535	0.132	1.978
3	16.13	3	3.696	0.270	1.222
4	30.53	4	1.965	0.508	0.508
5	52.11	5	1.151	0.868	-0.16
6	81.85	6	0.733	1.364	-0.84
7	114.61	7	0.514	1.943	-1.54
8	156.98	8	0.382	2.616	-2.52
9	198.8	9	0.301	3.313	



Results: after performing calculations for the above data,

The values of Horton's infiltration model parameters obtained are

The constant rate of infiltration (fc) : 0.3018 cm/hr

The maximum rate of infiltration (fo) : 3.6518 cm/hr

The hydraulic conductivity of the soil is : 1.3681 cm/hr

The above test is performed at the following conditions of soil: Soil moisture content @22.65 % and bulk density of soil @ 1.843 g/cc

Location 3:

Infront of CSE department

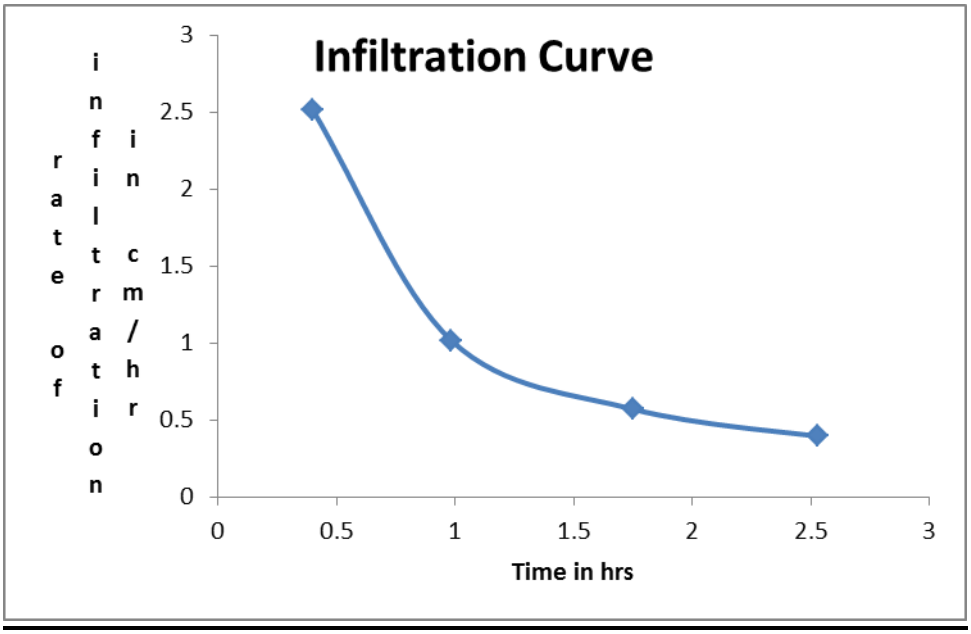
Latitude:- 18.059769 Longitude:- 83.405433

Basic Data

S.NO	VOLUME OF WATER expressed in depth (cm)	TIME (in minutes)
1	1	23:51
2	1	59:05
3	1	1:45:10
4	1	2:31:42

Table of Computations-

S.NO	TIME IN MIN	CUMULATIVE DEPTH fc(cm)	INFILTRATION RATE fp(cm/hr)	TIME IN hr	ln(fp-fc)
1	23.85	1	2.515	0.397	0.751
2	59.08	2	1.015	0.984	-0.47
3	105.16	3	0.5705	1.752	-1.74
4	151.17	4	0.395	2.528	



Results: after performing calculations for the above data,

The values of Horton's infiltration model parameters obtained are

The constant rate of infiltration (fc) : 0.3955 cm/hr

The maximum rate of infiltration (fo) : 4.6605 cm/hr

The hydraulic conductivity of the soil is : 2.0938 cm/hr

The above test is performed at the following conditions of soil: Soil moisture content @9.44 % and bulk density of soil @ 1.916 g/cc

The average values of infiltration characteristics are given below:

The constant rate of infiltration (fc) : 0.3968 cm/hr

The maximum rate of infiltration (fo) : 4.97 cm/hr

The hydraulic conductivity of the soil is : 1.75 cm/hr

STUDY ON GROUNDWATER LEVELS IN THE CAMPUS

Table: Groundwater levels at EEE block

S.No	Date	TIME	LOCATION	BGL(ft)	LATITUDE	LONGITUDE
1	17/08/2019	02:30 PM	EEE block	50.00	83.40558	18.060997
2	20/08/2019	03:10 PM	EEE block	47.00	83.40558	18.060997
3	27/08/2019	03:20 PM	EEE block	49.00	83.40558	18.060997
4	30/08/2019	15:58 PM	EEE block	49.00	83.40558	18.060997
5	07/09/2019	12:15 PM	EEE block	42.00	83.40558	18.060997
6	13/09/2019	03:50PM	EEE block	43.00	83.40558	18.060997
7	16/09/2019	03:40PM	EEE block	45.00	83.40558	18.060997
8	21/09/2019	10:45AM	EEE block	39.00	83.40558	18.060997
9	23/09/2019	03:05 PM	EEE block	38.03	83.40558	18.060997

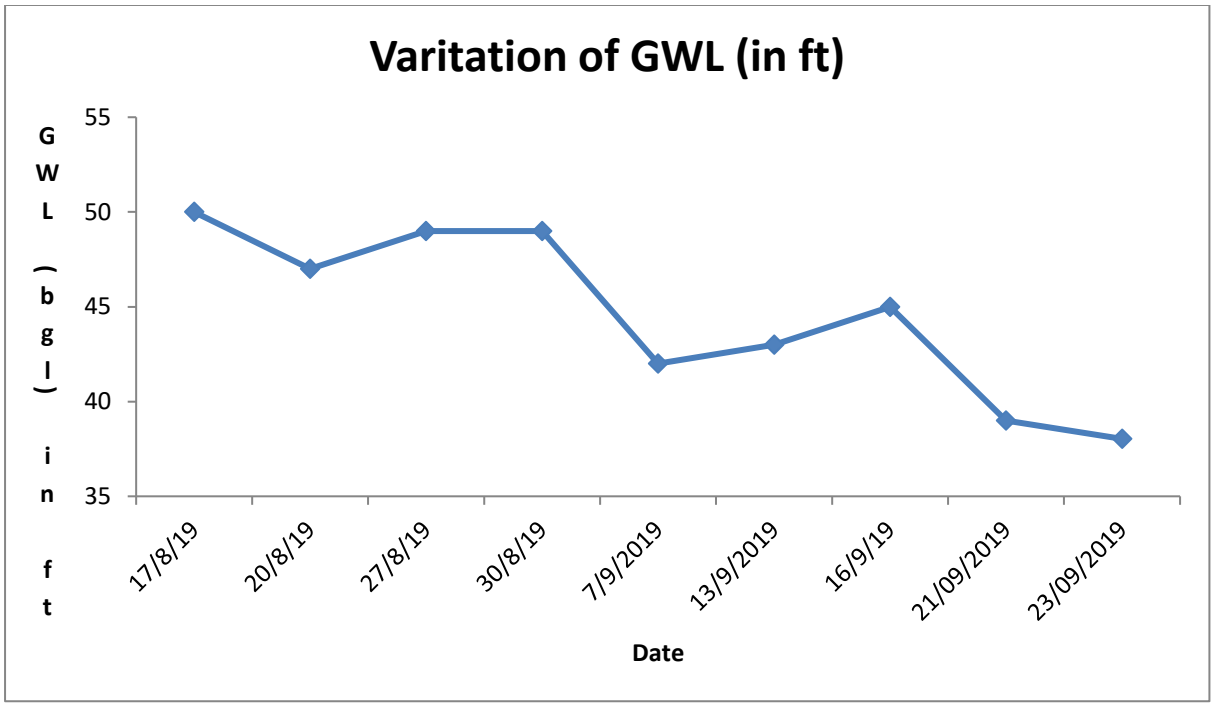
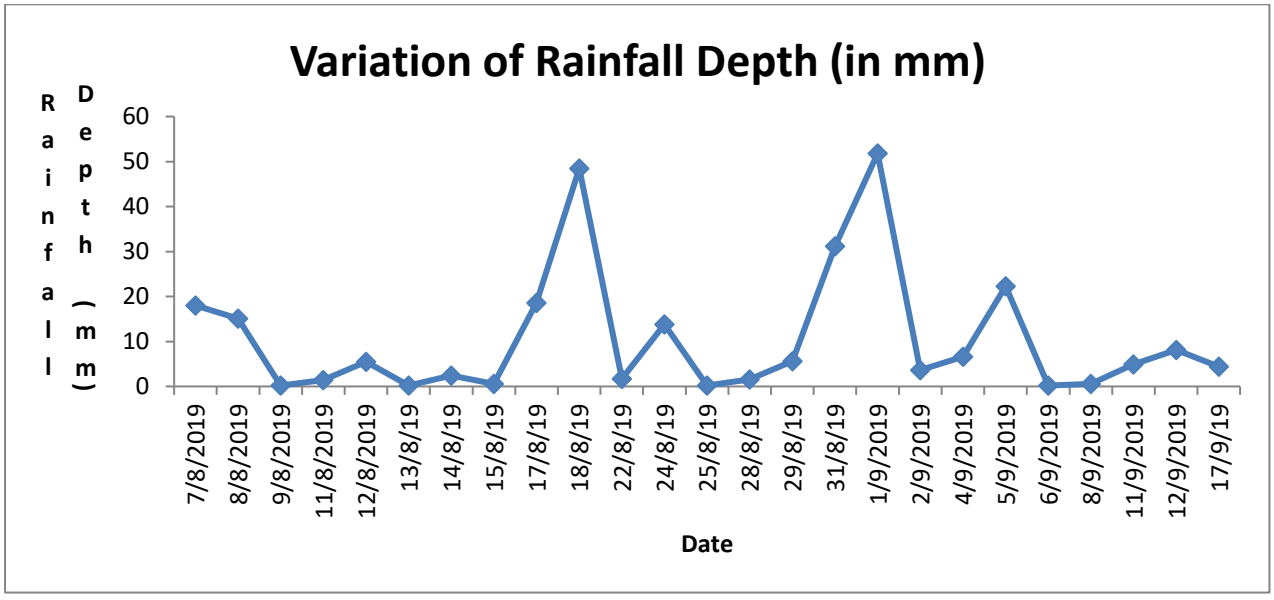


Fig. Variation of GWL at EEE Block

Rainfall Data in the Month of August and September, 2019

The rainfall data collected from our weather station is given below.

Date	Rainfall depth in mm	Date	Depth
07/08/2019	18	19/09/19	18.4
08/08/2019	15.1	20/09/19	23.4
09/08/2019	0.2	22/09/19	6.2
11/08/2019	1.4		
12/08/2019	5.5		
13/08/2019	0.2		
14/08/2019	2.4		
15/08/2019	0.6		
17/08/2019	18.6		
18/08/2019	48.5		
22/08/2019	1.7		
24/08/2019	13.8		
25/08/2019	0.2		
28/08/2019	1.6		
29/08/2019	5.6		
31/08/2019	31.2		
01/09/2019	51.8		
02/09/2019	3.6		
04/09/2019	6.6		
05/09/2019	22.3		
06/09/2019	0.2		
08/09/2019	0.6		
11/09/2019	4.9		
12/09/2019	8.1		
17/09/2019	4.4		
18/09/2019	36.5		



Ground Elevations of Bore Wells in the Campus

EAST(X)	NORTH (Y)	ZENITH(Z)	Remarks
1000	500	100	st-1 @ GH back gate 0 angle
1004.197	500	99.897	north corner
943.031	492.754	100.506	bore well-1@ GH westside
971.029	577.93	100.429	RF point@ GH security room
968.957	583.448	100.608	st-2
969.836	585.679	100.607	BW 2@ GH Security room
1014.262	597.279	100.478	ST-3
1011.815	601.967	100.477	RP2@ ECE South end
1022.414	626.484	100.295	ST-4 between ECE & CSE
1055.755	636.466	99.863	ST-5 @ B/w ECE &CSE
1051.557	668.554	99.784	BW-3@CSE
1125.507	681.175	98.577	BW-4@ South end
1083.308	594.41	99.333	st-6 @ front of ECE
1095.549	587.27	98.661	BW-5@Centre of ECE & MECH
1104.958	524.291	98.564	ST -7 @ Mech north west corner road
1230.051	566.089	96.974	st-8 electrical yard junction
1333.285	602.143	95.347	st-9@north east corner of MBA block
1347.842	565.134	94.897	st-10@MBA north west corner
1315.086	537.884	95.049	BW-6@MBA back 0.72m east bore well point
1207.453	625.567	97.433	ST-11 @opposite blacksmith
1201.998	617.199	97.461	BW-7@black smith area
1293.197	667.702	96.621	ST-12@NORTH WEST Corner in canteen path way
1168.641	749.628	98.368	ST-13@Civil junction Culvert

GROUNDWATER QUALITY ANALYSIS

Location	Alkalinity (mg/l as caco3) TA	due to OH	CO3	HCO3	Acidity (mg/l as caco3)	Total hardness	Dissolved Oxygen (mg/l)	Chlorides (mg/l)	Calcium hardness (mg/l as caco3)	(mg/l as ca)
CANTEEN	95	0	30	65	60	250	1.7	125.49	145	58
EEE	55	0	20	35	70	190	1.4	125.49	150	60
CANARA	55	0	10	45	80	180	2.1	75.29	100	40
MECH	70	0	10	60	85	170	2.2	150.59	120	48
CSE	65	0	10	55	115	170	2.1	145.57	145	58
SPORTS	75	0	20	55	45	150	1.7	155.61	100	40
MBA	55	0	20	35	75	265	1.8	185.72	150	60
BUS	65	0	30	35	65	251.5	1.3	245.96	185	74
CIVIL	70	0	20	50	105	205	2.9	95.37	110	44

Limiting Values :

Parameter	Desirable limit	Permissible limit
Alkalinity	200	600
Total hardness	300	600
Chlorides	250	1000
Calcium hardness	75	200
DO	4	
Acidity	50	

CLASSIFICATION OF DIFFERENT AREAS IN THE STUDY AREA

The entire campus of MVGR College of Engineering is divided into various categories such as built up area, bitumen roads, concrete roads, tiled roads and open areas..The various areas obtained are presented in table.

Table : Different Areas in The Study Area

SL NO	DESCRIPTION	AREA (Sq.mts)
BUILT UP AREA		
1	CIVIL BLOCK & CHEMICAL	1952
2	CANTEEN	578
3	BUS DRIVERS QUARTERS	150
4	PARKING SHEDS	971
5	FRESH CHOICE	37
6	ATM	32
7	SECURITY ROOM (Gate)	195
8	GENERATOR ROOMS	63
9	CANARA BANK	130
10	GANESH TEMPLE	65
11	ADMIN BLOCK	863
12	MECHANICAL BLOCK	1510
13	ECE BLOCK	1485
14	EEE & IT BLOCK	1479

15	CSE BLOCK	1510
16	MBA BLOCK	1564
17	LABS & WORKSHOPS	3083
18	CENTARAL LIBRARY	1448
19	HUTS	117
20	GYM & SPORTS block	150
21	BSH & TP BLOCK	168
	Total	**17550**
ROADS AREA		
23	BITUMEN ROAD	16848
24	CONCRETE ROAD	2527
25	TILED ROAD	1863
	Total	**21238**
OPEN AREA		
26	OPEN AREA	**133212**

Appendix-1

Details of the pumps and tanks

S.No	Name of Block	Tank Capacity (lts)	Bore depth (ft)	operatinng Head		Capacity of motor	Discharge range lit/sec	
				in ft	in m		Discharge range	Head Range(m)
1	Admin	10000	Nil	225	69	NIL	NIL	NIL
2	S&H	500	Nil	235	72	NIL	NIL	NIL
3	CSE	15000	190	235	72	2.0 HP Yield 1.5"	2.3-0.9	40-85
4	ECE	40000	Nil	240	73	NIL	NIL	NIL
5	EEE	15000	195	240	73	1.5 HP Yield 1.5"	1.2-0.4	40-100
6	ME(R.O 1000lit/hour)	30000	170	215	65	2.0 HP Yield 1.5"	2.3-0.9	40-85
7	CIVIL(R.O 500lit/hour)	20000	180	225	69	1.0 HP 2.0 Yield 1"	1.5-0.5	40-75
8	CANTEEN	16000	200	245	75	1.5 HP Yield 1.5"	1.2-0.4	40-100
9	MBA	5000	190	235	72	2.0 HP Yield 1.5"	2.3-0.9	40-85
10	AMENITIES (PT LAB)	5000	160	205	62	1.5 HP Yield 1.5"	1.2-0.4	40-100
11	BANK	6000	170	215	65	1.5 HP Yield 1.5"	1.2-0.4	40-100
12	TEMPLE SUMP	75000	180	225	69	2.0 HP Yield 1.5"	2.3-0.9	40-85
13	G.H(C-BLOCK)(R.O 250 Lit/Day)	20000	195	240	73	2.0 HP Yield 1.5"	2.3-0.9	40-85
14	GIRLS HOSTEL (A&B BLOCK)	20000	190	235	72	1.5 HP Yield 1.5"	1.2-0.4	40-100
15	N-E Corner of EEE Block	NIL	295	NIL	NIL	NIL	NIL	NIL
16	Sports block (from Temple)	5000	Nil	Nil	Nil	Nil	Nil	Nil

Appendix -2

The data regarding average run time and time taken for collecting water in jar are given

Pump run durations based on one week Survey on daily basis

Date	**24-08-2019**	**Duration in hrs**
Block	**Timings**	
CIVIL	8:15-3:30	7hrs 15 min
CSE	8:00-11:00	3
EEE	8:30-10:30	2
S&H	8:15-8:35,11:30-11:50,2:30-2:50	1
CANARA BANK	9:30-10:30	1
BUSES	9:30-10:30	1
SPORTS		
CANTEEN	6:30-6:45,11:00-11:30,3:30-4:30	2hrs 15 min
MBA	8:45-10:00,12:00-1:00	2hrs 15 min
ECE	8:30-10:30	2 hrs
MECH	8-4:30	8 hrs 30 min
ADMIN	9:00-10:30,1:00-4:30	5

Date	**26-08-2019**	**Duration in hrs**
CIVIL	8:15-9:30,12:15-4:00	5
CSE	8:45-10:00	1
EEE	8:30-10:30	1 Hr 15 min
S&H	9:30-9:50,12:30-12:50	40 min
CANARA BANK	8:30-9:30	1
BUSES	8:30-10:30	2
SPORTS	3:00-4:00	1
CANTEEN	6:00-6:45,11:00-11:30,3:30-4:30	2 hr 15 min
MBA	8:445-10:00,12:00-1:00	2 hr 15 min
ECE	8:30-10:30	2
MECH	8:00-4:30	8.5
ADMIN	9:00-10:30,1:00-4:30	6

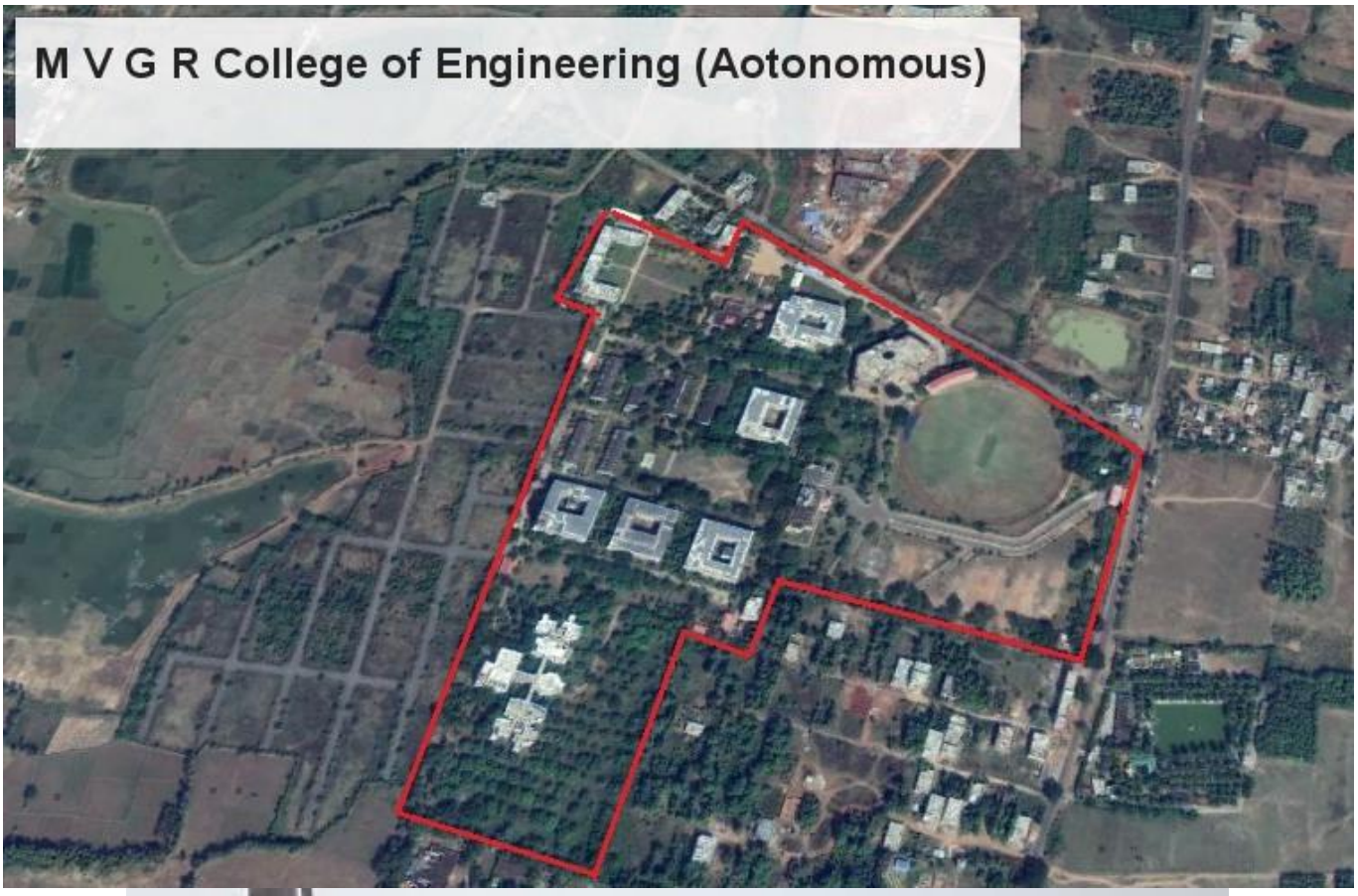
Date	27-08-2019	Duration in hrs
CIVIL	8:20-4:30	8 hr 10 min
CSE	8:00-9:00,10:30-11:30,2:30-3:30	3
EEE	8:45-10:45	2
S&H	9:30-9:50,2:30-2:50	40 min
CANARA BANK	8:30-10:00	1.5
BUSES	8:30-10:30	2
SPORTS	3:00-4:00	1
CANTEEN	6:00-6:45,11:00-11:30,3:30-4:00	1.75
MBA	8:45-1:00,12:00-1:00	5.25
ECE	8:30-11:30	2
MECH	8:00,-4:00	8
ADMIN	9:00-10:30,1:50-4:30	6

Date	30-08-2019	Duration in hrs
CIVIL	8:15-4:45	8.5
CSE	8:10-11:30,2:00-5:00	5 hr 20 min
EEE	8:45-10:11	1 hr 26 min
S&H	9:30-9:50,2:30-2:45	35 min
CANARA BANK	9:00-11:00	2
BUSES	8:00-8:30,2:00-3:00	1.5
SPORTS		1
CANTEEN	6:00-6;45,11:00-11:30,3:30-4:00	1.75
MBA	8:30-9:30	1
ECE	8:45-10:11	1 hr 26 min
MECH	8:00-4:30	8.5
ADMIN	9:00-10:30	1.5

Date	03-09-2019	Duration in hrs
CIVIL	8:15-4:30	8.25
CSE	8:00-11:30,3:30-4:30	4.5
EEE	8:40-9:40	1
S&H	8:30-8:45-2:30-2:45	0.5
CANARA BANK	8:00-11:00	3
BUSES	8:00-11:30	3.5
SPORTS	3:00-4:00	1
CANTEEN	6:00-6:45,11:00-11:30,3:30-4:00	1.75
MBA	8:30-9:30	1
ECE	8:40-9:45	1
MECH	8:00-4:30	8.5
ADMIN	10:30-12:00,1:30-3:30	3.5

Date	04-09-2019	Duration in hrs
CIVIL	8:15-4:30	8.25
CSE	8:00-11:30,3:30-4:30	4.5
EEE	8:30-10:30	2
S&H	8:30-8:45,2:30-2:45	0.5
CANARA BANK	8:00-10:30	2.5
BUSES	8:00-11:30	3.5
SPORTS	4:00-5:00	1
CANTEEN	6:00-6:45,11:00-11:30,3:30-4:00	1.75
MBA	08:30-9:30	1
ECE	8:30-10:30	2
MECH	8:00-4:30	8.5
ADMIN	10:30-12:00	1.5

Date	05-09-2019	Duration in hrs
CIVIL	8:15-10:30,3-4:30	3.75
CSE	8:00-12:00,3:00-4:00	
EEE	8:30-10:30	2
S&H	8:30-8:45,2:30-2:45	0.5
CANARA BANK	8:00-11:30	3.5
BUSES	8:00-11:30	3.5
SPORTS	10:30-11:30	1
CANTEEN	6:00-6:45,11:00-11:30,3:30-4:00	1.75
MBA	8:00-9:00	1
ECE	8:30-10:30	2
MECH	8:00-4:30	8.5
ADMIN	9:30-11:30	2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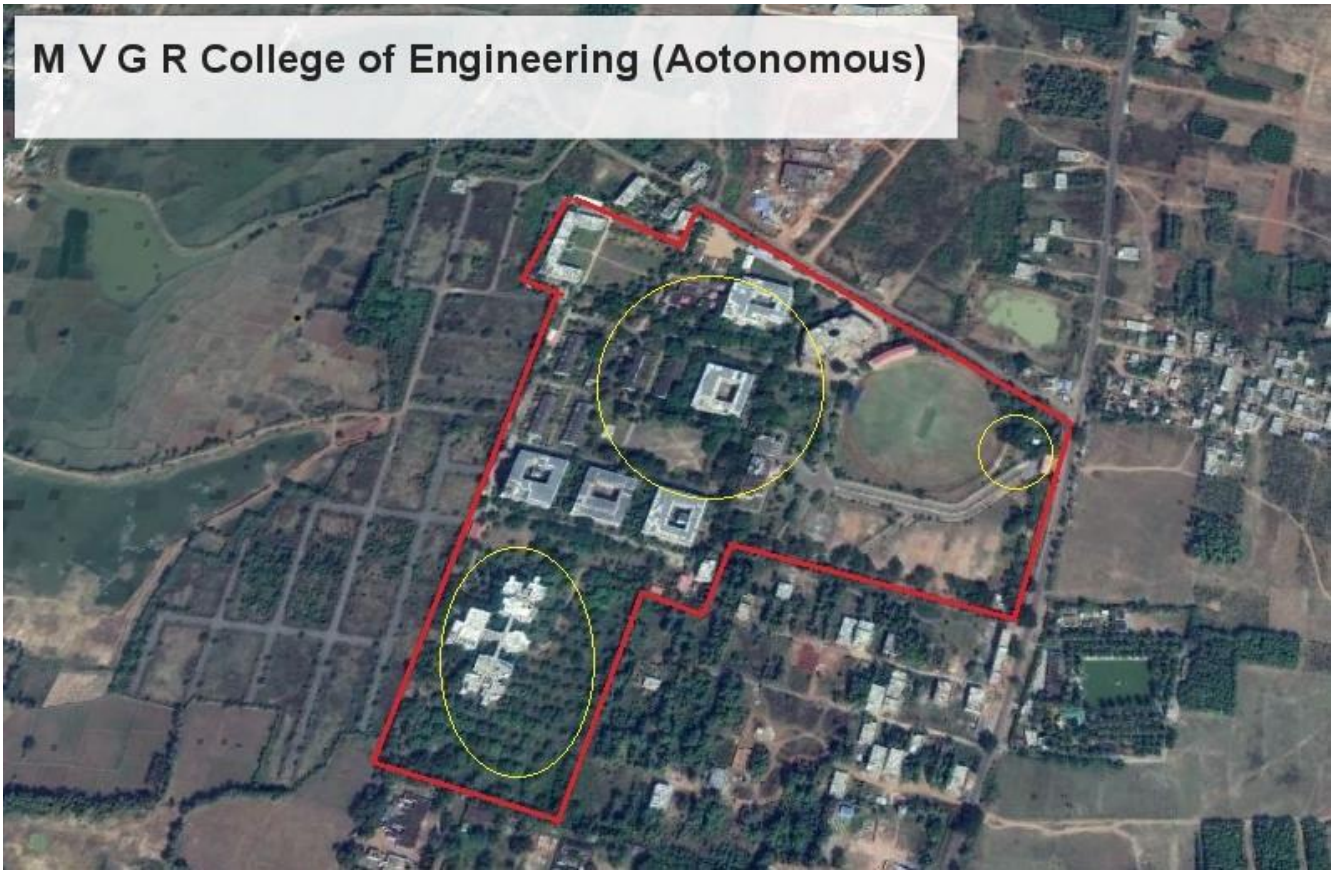
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