

# **DETAIL PROJECT REPORT**

## **3 DISTRICT HOSPITALS MON, WOKHA AND ZUNHEBOTO**

**Nagaland Health Project**

**2018**

## Final Assessment of Mon District Hospitals under Nagaland Health Project

### 1.0 Desk Study/Literature Review

All data collected at field level was revised using relevant literature on Water, Sanitation and Hygiene (WASH) in Hospitals and the available support data, reports and guidelines from the Hospital MS of the hospital and support staff and the minimum requirements of the CPHEEO Manual / BIS / National Building Codes. Not much information was available on the Hospital existing water and sanitation system in operation. The physical observation of the existing pipes and infrastructures related to water and sanitation is done. The dimensional drawings, Hospital boundaries, available land area, locations of septic tanks, other WASH related facility is assessed on basis of the available information and visible to the eyes. The physical dimensions of the buildings were carried using measuring tape and outer layout plans are prepared. The measurement and accuracy of data is not much reliable and the assumptive values are considered in lack of proper building plans, layout plans, plumbing drawings, sanitation, rainwater harvesting assets. The collected data and requirement of the works are based on available information the actual execution of works will vary at site.

Further there is requirement of acquiring the at least physical data of the site by carrying out the topographical survey, preparation of building layouts, plumbing details, rain water harvesting assets and available land with the hospitals. If this is not possible than on site visit the maximum available data is utilized for the preparation of the requirement of the Hospital for the WASH components.

**Table 1. Data Collection & Analysis Method**

Methods	Data Collected	Data Analysis
Literature review	<ol style="list-style-type: none"> <li>1) Existing Water, Sanitation and Hygiene (WASH) in Hospital</li> <li>2) Data available with the Hospital</li> </ol>	Analysis and framing of the intervention within the existing policy requirements.
Infrastructural Survey / direct observation	<ul style="list-style-type: none"> <li>• Hospital building status</li> <li>• Hospital Beds and Operating staff</li> <li>• Water access</li> <li>• Sanitation access/ facilities</li> <li>• Solid Waste Management</li> <li>• Rain Water Harvesting</li> <li>• Storm Drain system</li> <li>• Approach pathways / Roads</li> </ul>	<ul style="list-style-type: none"> <li>• Reported as per discussion and observation at site</li> <li>• Preparation of demand and requirements as per building codes / BIS / CPHEEO Manual.</li> <li>• Minimum requirements as per site conditions, land availability</li> </ul>
Key informants / semi structured interview	Strengths, Weaknesses, Opportunities and threats for Hospital in terms of water and sanitation services	Strength, Weakness, Opportunity, Threat (SWOT) analysis (Table 6) of primary stakeholders involved in WASH in hospital.

## **2.0 Infrastructural Survey**

A infrastructural survey was carried out at the Project Hospitals to evaluate what type of water and sanitation facilities were available and what their condition was. The observations allowed us to inspect the state of Hospital latrines, solid waste dumps and drinking water supply used at the Hospital level. The physical assessment helped in assessment of the requirement of the hospital for water, sanitation and rain water harvesting. The survey helped in assessment of the GAP and the minimum requirement of hospital to achieve 100 percent coverage of water supply and sanitation.

## **3.0 Semi-Structured Interviews / Discussion**

Semi-structured interviews / Discussions were conducted with MS, Hospital staffs, patients. Hospital Medical Superintendent were asked to highlight major challenges related to the water and sanitation infrastructures of their Hospital. To highlight the possibility based on the finding of the interviews, for primary stakeholders (Hospital Staff, Patients, and MS) to identify the key internal (strengths and weaknesses) and external factors (opportunities and threats) that are important for the successful provisions of these services at Hospital level.

The identified stakeholder groups were divided into three categories: primary, secondary and key stakeholders. Primary stakeholders were the category of stakeholders who were directly affected by the project and who could also be referred to as the direct beneficiaries of the project. The involvement, participation and contribution of primary stakeholders in the planning and implementation of the project activities were critical, especially for the purposes of ownership and sustainability.

## **4.0 EXISTING WATER SUPPLY AND RAIN WATER HARVESTING SYSTEM**

In Mon the new building for 100 bedded hospital is complete and would be in operational in short time. The existing building is having planned rain water harvesting system interconnected to various tanks and water is lifted to the Overhead tank by pumps. The PHE water also supplied to the hospital but on irregular basis.

New Mon hospital building having provision for the bore well in front of the hospital while in monsoon season rain water stored in the surface tank is used for flushing as well as for drinking purpose by boiling. All buildings having provision for the tap water which is connected through the elevated tank.

The New building for Mon hospital is having provisions required for the proper operational system of hospital for water supply. The water demand and assessment of requirement of the water for the hospital are provided below

## **5.0 GAP ASSESSMENT**

As per the National Building code HANDBOOK ON WATER SUPPLY AND DRAINAGE SP: 35 (S&T) -1987, page no 34, Table No 12 requirements for water supply for buildings other than residence'. The water requirement for hospital with capacity less than 100 bedded the requirement of water is 340 liters per bed per day (lpcd) and 45 lpcd for the working staff of the hospital.

The calculation for Mon district hospital is shown below;

Sr. No.	Description		Unit
1	Nos of beds in hospital	100	Bed
2	Water demand as per NBC / CPHEEO -1999 for water supply / BIS – 1172:1993 – Table -1 – for less than 100 bedded hospital	340	Liter Per Bed
3	Water demand for the Hospital for the bed occupancy	34000	Liter per day
4	Nos of Staff required for the hospital	147	Persons
5	Water demand as per NBC / CPHEEO -1999 for water supply / BIS – 1172:1993 – Table -1 – For hospitals	45	Liter per person per day
6	Water demand for staffs per day	6615	Liter Per day
7	Total Water Demand for Hospital Sum of Sr. no. 3 + Sr. No 5	40615	Liter per day
8	80 Percent of water supply generating as sewer – As per CPHEEO manual for Sewers -2013	32492	Liter per day
9	Sewer as infiltration of groundwater in system per Km – Avg., of Max 5000 per /km i.e., 2500	2500	Liter
10	Total sewer generation in the Mon hospital	34992	Liter per day
11	Say rounded up	35000	Liter Per Day
12	ETP of approx. capacity in KLD	20	KLD

## 6.0 RAIN WATER HARVESTING

Existing Infrastructure of the Hospital are defined above sections, at present the rain water harvesting system is in operational and excess water is connected over flow pipe to nearest storm drain. The feature and advantages of the rain water harvesting are defined.

### 6.1 Advantages of Rain Water Harvesting

- To arrest ground water decline and augment ground water table
- To beneficiate water quality in aquifers
- To conserve surface water runoff during monsoon
- To reduce soil erosion
- To inculcate a culture of water conservation

### 6.2 How to harvest rainwater:

Broadly there are two ways of harvesting rainwater:

- (i) Surface runoff harvesting
- (ii) Roof top rainwater harvesting

### 6.3 Surface runoff harvesting:

In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

### 6.4 Roof top rainwater harvesting (RTRWH):

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

### 6.5 Components of the roof top rainwater harvesting system

The illustrative design of the basic components of roof top rainwater harvesting system is given in the following typical schematic diagram/

The system mainly constitutes of following sub components:

- **Catchment**

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore the catchment is the area, which actually contributes rainwater to the harvesting system.

Area of the surface runoff – In the hospital buildings the roof water is considered for the rain water catchment connected to roof top collected rain water pipes.

- **Transportation**

Rainwater from rooftop should be carried through down take water pipes or drains to storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity. Water from sloping roofs could be caught through gutters and down take pipe. At terraces, mouth of each drain should have wire mesh to restrict floating material.

In present scope, there is already covered areas with rainwater collection pipes and connected to surface water tanks

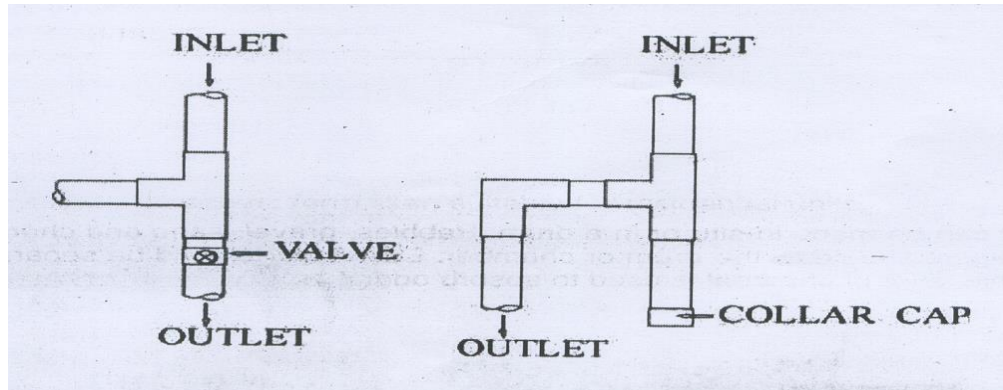
- **First flush**

First flush is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed-off to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere and the catchment roof. It will also help in cleaning of silt and other material deposited on roof during dry seasons Provisions of first rain separator should be made at outlet of each drainpipe.

- **Filter**

There is always some skepticism regarding Roof Top Rainwater Harvesting since doubts are raised that rainwater may contaminate groundwater. There is remote possibility of this fear coming true if proper filter mechanism is not adopted. Secondly all care must be

taken to see that underground sewer drains are not punctured and no leakage is taking place in close vicinity. Filters are used for treatment of water to effectively remove turbidity, colour and microorganisms. After first flushing of rainfall, water should pass through filters. There are different types of filters in practice, but basic function is to purify water.



TYPICAL ARRANGEMNT OF FIRST FLUSH BEFORE THE INLET TO GROUND RESERVIOR FOR STORAGE

Ground water aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are: -

- a) Recharging of bore wells
- b) Recharging of dug wells.
- c) Recharge pits
- d) Recharge Trenches
- e) Soak ways or Recharge Shafts
- f) Percolation Tanks

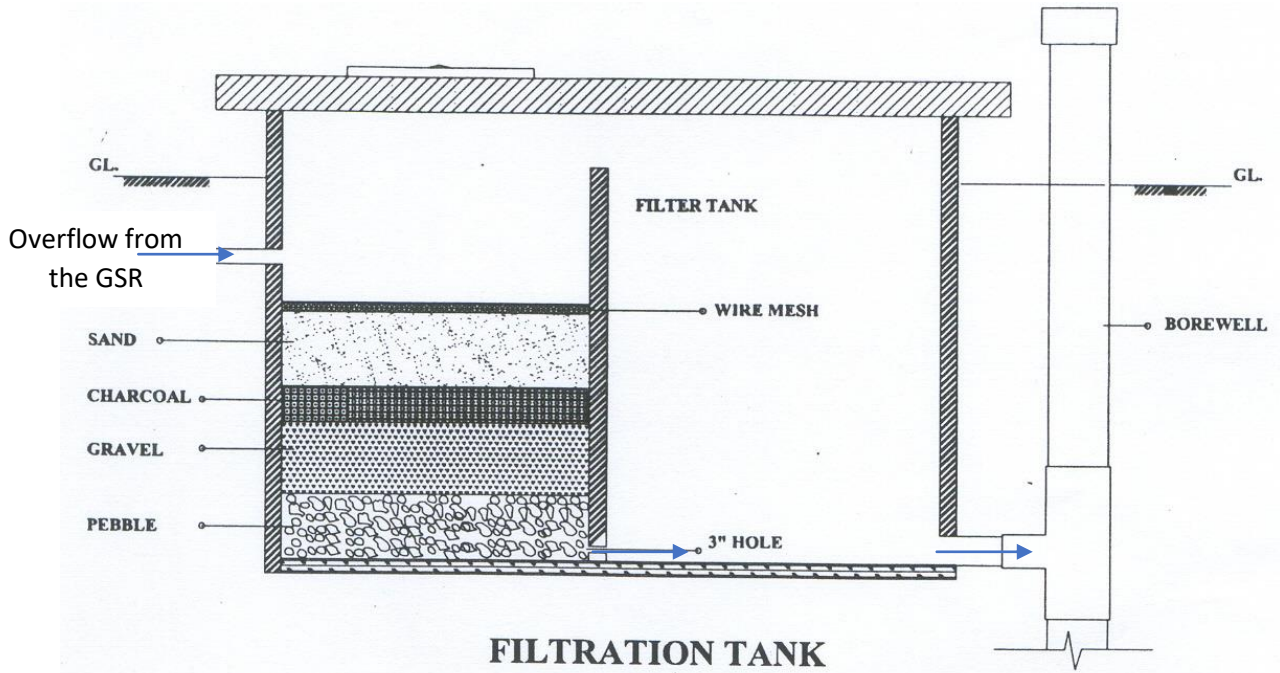
**Due to land constraints and better use of existing surface water tanks ground water recharge or tube well recharge system is adopted for the Mon Hospital**

## 6.6 Recharging of bore wells

Rainwater collected from rooftop of the building is diverted through drainpipes to settlement or filtration tank. After settlement filtered water is diverted to bore wells to recharge deep aquifers. Abandoned bore wells can also be used for recharge.

Optimum capacity of settlement tank/filtration tank can be designed on the basis of area of catchment, intensity of rainfall and recharge rate as discussed in design parameters. While recharging, entry of floating matter and silt should be restricted because it may clog the recharge structure. "first one or two shower should be flushed out through rain

separator to avoid contamination. This is very important, and all care should be taken to ensure that this has been done."



### 6.7 Calculations for potential of amount of rainwater harvesting as per CPWD guidelines for rainwater harvesting system.

Area of Roof available for rain water harvesting in Mon Hospital covering new and old building 5000 Sq. M and height of water is approx. 2 m as average annual rainfall in Nagaland is approx. 2000 mm

Rain water harvesting potential = Rain fall in M X surface area of the buildings  
 = 2.0 M X 5000 Sq. Mt  
 = 10000 Cum or 10Million Lakh Liter Water

Effectively harvested area for the corrugated areas of the roofs is between 0.7 to 0.9. Considering average efficiency of 0.8 and factor evaporation, spillage and first flush wastage etc., of 0.8

Therefore, the effective potential of rainwater can be harvested is = 10000 Cumc X 0.8 X 0.8  
 = 6400 cumec or 6.4 ML in years

At present total rain water surface storage capacity of approx. = 50000 liters or 50 KL.

The capacity of the recharge tank is designed to retain the runoff of at least 15 minutes of rainfall of the peak intensity, considering maximum of 30 mm of rainfall in 15 min. the calculated capacity of the recharge tank is as follows

- 1) Area of the catchment is (A) = 5000 Sq. M
- 2) Peak rainfall in 15 min duration (r) = 30 mm
- 3) Runoff coefficient for corrugated roofs = 0.80

Calculated capacity of the tank is =  $5000 \times 0.030 \times 0.80 = 120$  Cumec or 120000 Liters

The size of the tank is calculated as follows for the recharge tank is providing the depth of tank 3.5 Meter with 0.5 M freeboard the diameter of the tank is 6.8 M diameter. The provided water tank of the capacity of the 6.8 m dia., and the depth of 3.5 M with freeboard of 0.5 M.

**7.0 Conclusion and the recommended works required for better water supply is are as follows;**

Sr. No.	Description of work	Capacity / Remarks
1	Network connecting the system from various rain water storage tanks in the hospital compound	
2	Ground water recharge from the proposed GSR near the bore well / tube well by connecting over flow pipe	Provided to recharge the existing bore well water table for better utilization in lean seasons

**8.0 EXISTING SANITATION SYSTEM**

The existing system of sanitation at the hospital are based on individual septic tanks for flow from individual toilets or 2 toilets while waste from urinals are discharged into the open storm drains.

The septic tanks are constructed as and when the toilets are constructed for the hospital wards or new building is constructed.

The new building is sufficiently have provision of the toilets, while old building requires repair and modification of the toilets to be more patient friendly.

The existing 5 toilet in the old building are proposed for repair and diversion of sewer flow from new and old building to the new proposed STP.

**8.1 Following are recommended works in the GAP observed and suggestions made are**

- 1) Upgradation of existing Indian type of WC to dual purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan) for convenience of the patients
- 2) Diversion of all sewerage from septic tanks to ETP with construction of sewer network for flow of sewerage to the proposed ETP inlet chamber near regional diagnostic center.
- 3) Demolition of the existing septic tanks and filling of the same with soil and manure for the development of plantation or walk areas for the patients.
- 4) The diversion of the flow from septic tanks considering the locations of existing rain water storage tanks near to the septic tanks and contamination of the rain water due to seepage or contact with contaminated waste from septic tanks.

Sr. No.	Description of work	Capacity / Remarks
1	Modifications to existing toilets from Indian System to the dual-purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan)	5 Nos of Toilets
2	Laying, Jointing, testing and commissioning of sewer network from toilets and service chambers to proposed ETP near Regional diagnostic center	Construction of pipelines, manholes and inlet chamber to ETP and civil work for ETP as per manufacturer / Supplier of packaged ETP.
3	20 KLD Packaged ETP for treatment of sewer generated on hospital	20 KLD ETP near Regional diagnostic center. Presently the treated effluent water to be released into nearest storm drain, <b>in future the treated effluent shall be used for flushing of toilets and recharge of the ground water table by pumping treated effluent to the rain water recharge tank</b>
6	Demolishment of the existing septic tanks and refill with soil and manure to plant plants and flowers	

**8.2 What is Hospital Sewage and why to treat it?**

Generally, wastewater is defined as the composition of physical, chemical and biological waste present in wastewater. Hospital sewage is a wastewater generated relatively in larger quantities from all the units of the hospitals such as emergency and first aid,

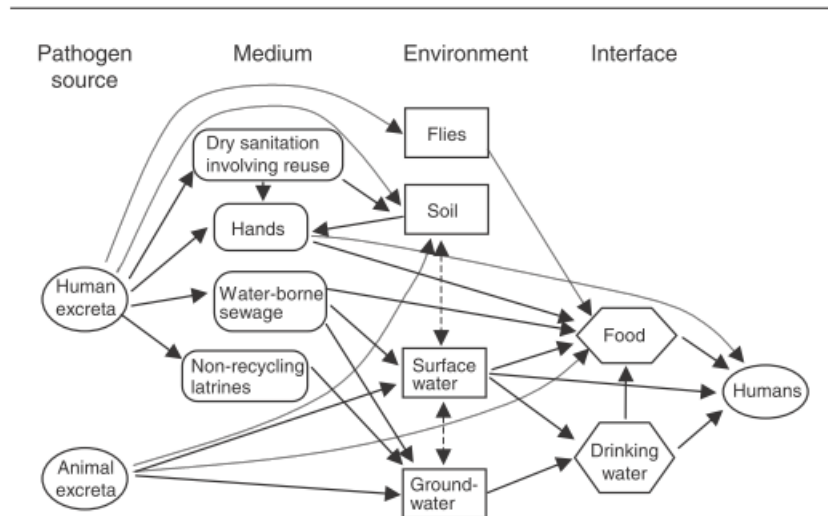
operating rooms, drug treatment, ICU, chemical and biological laboratories, radiology, canteen and laundry activities etc.

Since, hospital sewage/wastewater consists of various potentially hazardous components that will cause many risks on human and environment by polluting surface and ground water. Hence, hospital sewage treatment is very much required.

The major objective of hospital wastewater treatment plant is to treat the influent (untreated wastewater) generated by the hospitals and healthcare sectors before its direct release into natural environment. Hospital wastewater may have an adverse impact on environments and human health. Therefore, proper wastewater management in each and every hospital is prerequisite.

Therefore, proper wastewater management in each hospital is prerequisite. Importantly, however, removing a basic pathway (e.g. by providing safe drinking water or improved sanitation) is likely to be a precondition for the success of subsequent interventions to reduce disease burden.

#### Transmission pathways of fecal–oral disease



### 8.3 Hospital Sewage Characteristics:

Wastewater from hospitals around the world can generally contain traces of anything from viruses and multi-resistant bacteria to medical contrast agents and chemicals for cancer treatment. Small amounts of hormone-disrupting substances and other medicine

residues are also part of the mix that passes from patients through hospital toilets and into public sewer systems. Wastewater from various hospitals consists of:

1. Microbial pathogens and harmful bacteria and virus
2. Pharmaceuticals and its metabolites
3. Radioactive isotopes
4. Hazardous chemicals, heavy metals
5. Drug residues

#### **8.4 Hospital sewage or wastewater treatment plant process:**

Compact or packaged sewage treatment plant for hospitals is done in series of steps. Conventional treatment processes involved to remove impurities from the influent are listed below.

##### **8.4.1. Preliminary Stage or Pretreatment:**

As a first stage, preliminary treatment process is essential in most of the sewage treatment plant (STP). It removes items such as sticks, rags and other large debris and heavy inorganic solids contained in the hotel influent through bar screens. Removal of these materials protects plant's equipments from damage. The inorganic settled is called as grit which is removed using grit chamber.

##### **8.4.2. Primary Treatment Stage:**

This is the second step in sewage treatment system. Physical separation of solids and greases from wastewater is done in this stage. Now, water flows into primary filter or clarifiers for few hours to allow solid particles to settle down and lighter particles will float to the top will be skimmed off from the tank. The settled solid is called as primary sludge or primary effluent contains about 60-70% of solids. Partly treated wastewater is now subjected to next treatment level.

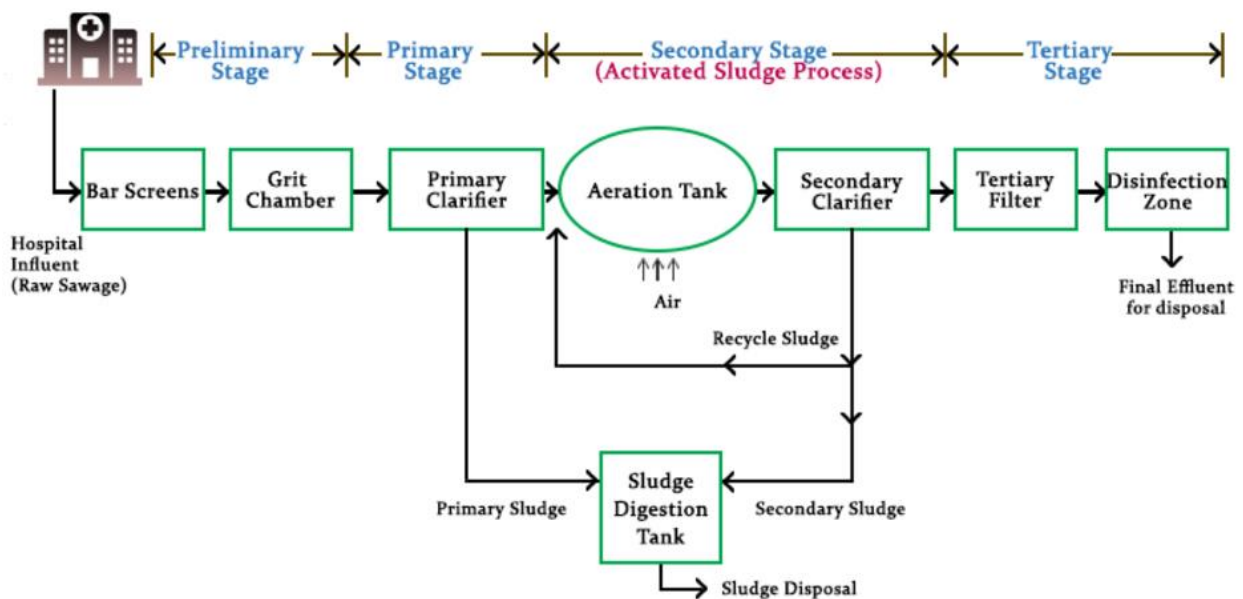
##### **8.4.3. Secondary Treatment Stage:**

It is a biological treatment process removes dissolved inorganic materials present in soluble and colloidal form from the wastewater. Here, bacteria are used convert the colloidal and dissolved organic matter. Now the partially treated wastewater from primary tank flows into the aeration tank and air is supplied through air blower to provide oxygen for microbes. When wastewater flows into secondary clarifier, where solids settle down which is called as secondary sludge and part of it is recycled for activated sludge process and remaining is mixed with primary sludge which will be send to sludge digestion tank and then disposes off. This stage removes about 90% of inorganic solids.

##### **8.4.4. Tertiary or Advanced Treatment Stage:**

This is the last stage in most of the STP's. This stage removes the suspended solids and organic matter which was not removed in secondary treatment. The pathogenic microorganisms which were not removed during biological treatment process will get removed by the process called disinfection. Several disinfection agents can be used depending on wastewater condition (pH, clarity etc). It is achieved by means of physical or chemical disinfectants like chlorine, UV light, ozone etc. Now, disinfected wastewater is suitable for disposal or reuse.

Conventional processes involved in Sewage Treatment Plant (STP) for Hospitals is shown below: -



**Hospital wastewater cannot be treated by ordinary means – by Conventional methods of Sewerage treatment of domestic wastewater**

Wastewater from hospitals around the world can generally contain traces of anything from viruses and multi-resistant bacteria to medical contrast agents and chemicals for cancer treatment. Small amounts of hormone-disrupting substances and other medicine residues are also part of the mix that passes from patients through hospital toilets and into public sewer systems.

**8.5 Wastewater is hazardous to health and the environment**

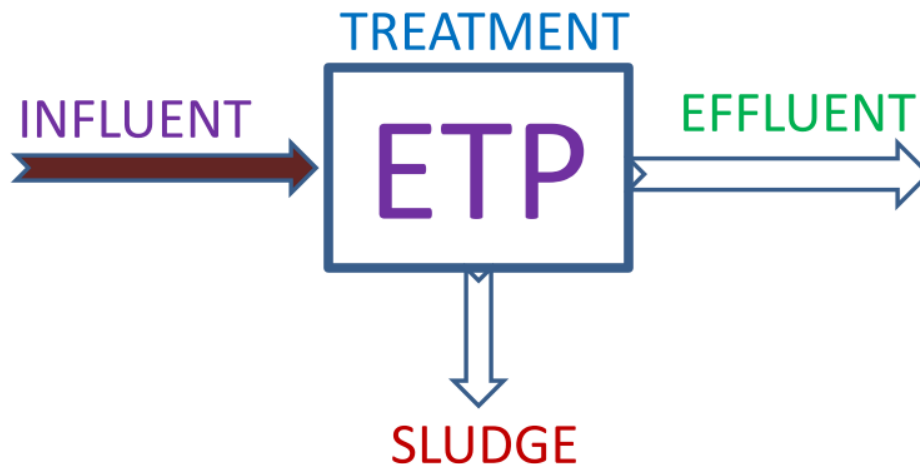
The hospital wastewater can pose a health hazard to humans, especially employees at wastewater treatment plants. During heavy rains and flooding, holding tanks in the sewer system can overflow.

There is also a danger to marine life. Once the sewage is treated and released into the environment along with its residual content of pathogens and pharmaceuticals, the local fauna are routinely at risk.

“Even in very low concentrations, the substances in hospital wastewater can affect animal life. “Estrogens, for example, can cause hermaphroditic fish, while some painkillers are poisonous to trout, and certain psychopharmaceuticals can affect fish and bird behavior.”

**9. ETP (Effluent Treatment Plant)** is a process design for treating the hospital waste water for its reuse or safe disposal to the environment.

- Influent: Untreated Hospital waste water.
- Effluent: Treated Hospital waste water.
- Sludge: Solid part separated from waste water by ETP



### 9.1 Need of ETP

- To clean Hospital effluent and recycle it for further use.
- To reduce the usage of fresh/potable water in Hospital.
- To cut expenditure on water procurement.
- To meet the Standards for emission or discharge of environmental pollutants from various Industries / Hospitals set by the Government and avoid hefty penalties.
- To safeguard environment against pollution and contribute in sustainable development.

### 9.2 Selected process for the Effluent treatment plant for the Hospital wastewater

The comparison of widely used treatment technologies for hospital wastewater has been summarized below:

**Table-2: Comparison of Widely Used Treatment Technologies for Hospital Wastewater**

Sr. No	Item Description	ASP	E.A.	SBR	FBR/FAB	SAFF	MBR
1.	Type of process	Suspended growth process	Suspended growth process	Suspended growth process	Suspended and attached growth process	Attached growth process	Suspended growth with solid-liquid separation process
2.	Typical influent characteristics for hospital waste water	pH : 6.5 - 8.5 ; BOD 5 : 150 – 350 mg/l ; COD : 250-800 mg/l ; TSS : 150-400 mg/l, E-Coli : 10 <sup>6</sup> -10 <sup>10</sup> MPN/100ml					
3.	Discharge standards for hospital wastewater ( Sources EPA 1998)	pH : 6.5 – 9.0 ; BOD 5 < 30 mg/l ; COD < 250 mg/l ; TSS < 100 mg/l; E-Coli < 10 <sup>3</sup> MPN/100ml					
4.	Discharge standards for hospital waste water ( MoEF in India)	pH : 6.5 – 8.5 ; BOD 5 < 10 mg/l ; COD < 100 mg/l ; TSS < 10 mg/l; E-Coli < 10 <sup>3</sup> MPN/100ml					
5.	Requirement of bio-media / diffusion membrane& their types	No	No	No	Yes & Floating Type	Yes & Fixed Type	Yes & membrane module
6.	Treatment for laundry and laboratory effluent	Yes	Yes	Yes	Yes	Yes	Yes
7.	Treatment for oil and grease from kitchen /cafeteria	Yes	Yes	Yes	Yes	Yes	Yes

8.	Pre-treatment and primary treatment for influent wastewater	Yes	Yes	Clarifier / tube settler can be eliminated	Clarifier / tube settler can be eliminated	Clarifier / tube settler can be eliminated	Clarifier / tube settler can be eliminated
9.	Secondary clarifier / tube settler tank	Yes	Yes	No	Yes	Yes	No
10	Requirement of Equalization tank	Yes	Yes	Can be avoided	Yes	Yes	Yes
11	Tertiary treatment system for further polishing treated wastewater	Yes	Yes	Yes	Yes	Yes	No
12	Expected quality of treated wastewater after tertiary treatment.	Fair	Good	Better	Much better	Much better	Excellent
13	5 day BOD removal efficiency	90%	95%	95-97%	95-98%	95-98%	99%
14	Remote monitoring of plant performance	No	No	Yes	No	No	Yes
15	Sludge digestion	Less	Less	High	High	High	High
16	Required power	Medium	Very high	Medium	Low	Very low	Very high
17	Required operator	A few staff with medium skill level	A few staff with high skill	A few staff with very high skill	A few staff with medium skill	A few staff with medium skill	A few staff with very high skill

18	Ease of operation and maintenance problems	Easy	Easy	Difficult to control	Medium	Easy	Difficult to control
19	Effects of climates	High	Medium	Small	Small	Small	Very Small
20	Required chemicals	Few or none	Few or none	Essential	Essential	Few or none	Essential
21	Need for lab control	every month	every day	every hour	every day	every day	every hour
22	Facing shock loads	No problem	Affected highly	Affected highly	Some problem	No problem	No problem
23	Electro-mechanical Cost (Lac. /m3/d)	0.10-0.11	0.12-0.13	0.16-0.18	0.13-0.15	0.13-0.14	0.25-0.30
24	Power cost (Kwh / ML treated)	150-200	180-225	200-250	170-200	175-225	225-275
25	O & M cost (Rs. million / year /mld)	0.2-0.4	0.3-0.5	1.0-1.75	0.6-0.75	0.75-1.14	1.5-2.0
26	Land requirement (m2 / KLD)	1.5 - 2.5	2 - 3.5	0.5-0.6	0.6-0.7	0.6-0.7	0.5
27	Application for re-use of treated sewage water.	Irrigation /horticulture	Irrigation / horticulture	Irrigation / horticulture, flushing water, cooling tower water make-up etc.	Irrigation /horticulture, flushing water, cooling tower water make-up etc.	Irrigation / horticulture, flushing water, cooling tower water make-up etc.	Irrigation /horticulture, flushing water, cooling tower water make-up etc.

Although each of these techniques/ technologies have their own advantages and disadvantages. The selection of suitable treatment technology among the widely used technologies in domestic wastewater including hospital. The comparison of widely used

treatment technologies will help designers, engineers, architects, economists in selection of treatment technologies in terms of their efficiency, energy, operation, performance, land requirement, cost etc. The selected process considering availability of packaged plants for small capacity of wastewater and to meet the discharge standards of the MoEF.

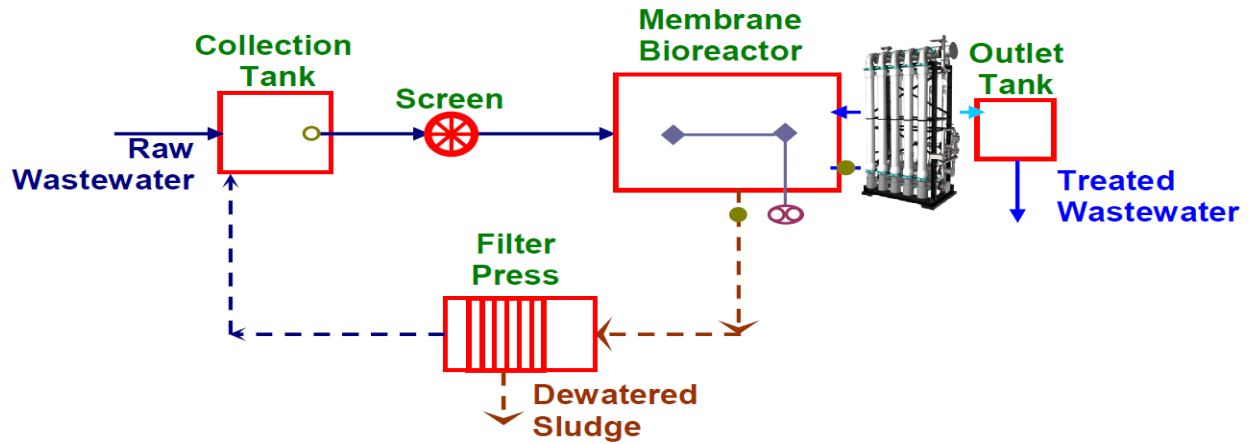
- 1) Availability of land at the hospital compounds
- 2) Quality of treated effluent and the point of disposal
- 3) Quantity of wastewater generation
- 4) Climatic condition prevailing in state of Nagaland
- 5) Less manual interference to the plant

The selected process for the proposed plants is FBR / FAB or SAFF or MBR, due to land availability, the power requirement for plant would be met by the solar power mostly for the system. The packaged plant of desired capacity is available. The required capacity of the 35 KLD ETP for the Wokha is selected considering the present occupancy and the water demand for the 100-bedded hospital as per CPHEEO manual / NBCC / IS requirement. It is recommended to procure the ETP from the manufacturer and the manufacturer shall operate the system for at least 6 months and transfer with training to designated plumber / electrician/ technician available with the hospital for day today O & M and minor repairs. The provision of minimum spares for the plant shall be made in the procurement documents. The provision in the contract is made for O & M for 4 years after 1 year of Defect liability period.

At present the proposed arrangement is to discharge the effluent to nearest storm drain. In future, the treated effluent can be used for ground water recharging or toilet flushing purpose with installation of dual plumbing system or for construction purpose for new building in around the hospital.

The proposed process for the effluent treatment of the sewerage generated from the hospital is as shown in process scheme and the process flow diagram.

The Process Scheme is as follows



## PROCESSFLOW

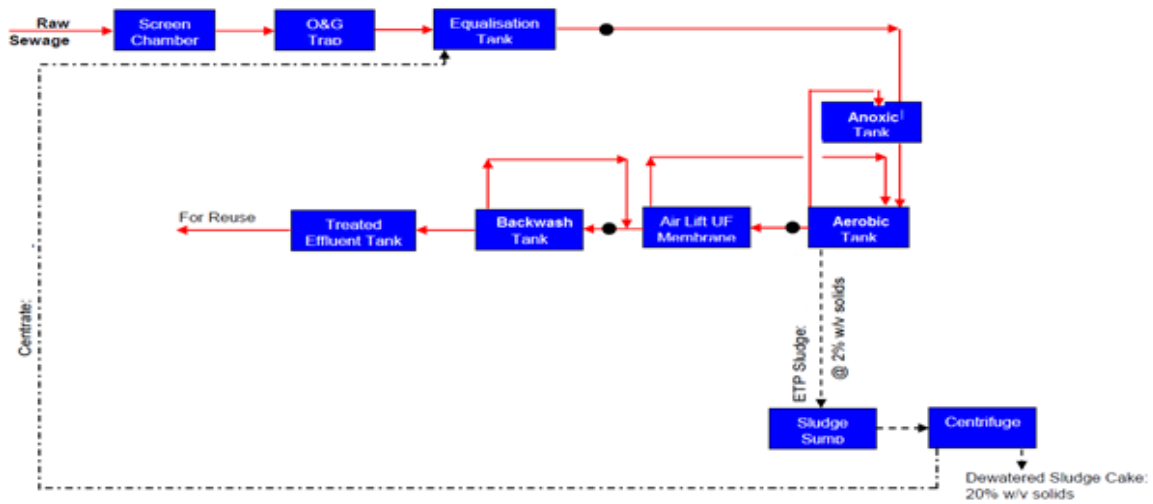


Figure1Treatmentscheme

Collection tank O&G Removal Equalization Anoxic Tank  
Aeration Tank Membrane System Chlorination Final treated water storage tank.

- The scope of work involves for development of the hospital building as model building in water and sanitation purpose

Sr. No.	Description of work	Capacity / Remarks
1	Network connecting the system from various rain water storage tanks in the hospital compound	HDPE Pipe network connecting the overflow

		water from the rain water harvesting tanks and the roof water from the new building
2	Construction of 20 KLD ETP for the Treatment.	For safe disposal of the generated sewerage of the Hospital Premises
3	Ground water recharge from the proposed GSR near the bore well / tube well by connecting over flow pipe	For ground water recharge and tube well at Mon Hospital

## 11. BASIS OF COST ESTIMATES

The cost estimates for the various works components for the water and sanitation have been based on following Schedule of Rates

- Public Works Department – Nagaland – Year 2016
- Municipal corporation of Greater Mumbai (MCGM) -2014 – (due to fairness of rates)
- Delhi schedule of rates for year 2016-17

For such items where these items are not found in these SORs, either rate analysis is carried out or the quotation from the reputed vendors / market rate or prevailing market rates are considered. Other State schedule of rates are not considered while framing of document considering the fairness of rates of MCGM and Delhi.

The quantities are calculated based on linear field measurement, collected details by physical observations and provided linear plan of the hospital and general dimensions on the field.

The estimated cost for the works at Mon District hospital is defined below;

Item No.	Description of Item
1	Repair, Modification of existing Indian WC to vitreous china dual purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan) with repair, painting of walls etc., complete - As per scope of work and specifications - Inside the Patient wards.
2	Water Supply works for the Hospital
	Water supply, plumbing, construction of GSR of 25000 Liter Capacity and carrying out all necessary works for making Hospital free from Manual lifting of water
3	Supply, installation, testing and commissioning of Sewer Network upto Inlet of ETP, including Inlet Chamber
4	Supply, installation, testing and commissioning of ETP of 35 KLD Capacity. With discharge pipe for treated effluent to nearest drain at back of Diagnostic Center. Work Includes also one month training the designated staff of staff for day today Operation and Maintenance
5	Demolition of the existing septic tanks, carting away the septage to nearest solid waste management site and filling of the land with Soil and making it to level.
6	Minor civil works in the hospital to make the hospital more functional.

# Wokha District Hospital Report

## Final Assessment of Wokha District Hospitals under Nagaland Health Project

### 1.0 Desk Study/Literature Review

All data collected at field level was revised using relevant literature on Water, Sanitation and Hygiene (WASH) in Hospitals and the available support data, reports and guidelines from the Hospital MS of the hospital and support staff and the minimum requirements of the CPHEEO Manual / BIS / National Building Codes. Not much information was available on the Hospital existing water and sanitation system in operation. The physical observation of the existing pipes and infrastructures related to water and sanitation is done. The dimensional drawings, Hospital boundaries, available land area, locations of septic tanks, other WASH related facility is assessed on basis of the available information and visible to the eyes. The physical dimensions of the buildings were carried using measuring tape and outer layout plans are prepared. The measurement and accuracy of data is not much reliable and the assumptive values are considered in lack of proper building plans, layout plans, plumbing drawings, sanitation, rain water harvesting assets. The collected data and requirement of the works are based on available information the actual execution of works will vary at site.

Further there is requirement of acquiring the at least physical data of the site by carrying out the topographical survey, preparation of building layouts, plumbing details, rain water harvesting assets and available land with the hospitals. If this is not possible than on site visit the maximum available data is utilized for the preparation of the requirement of the Hospital for the WASH components.

**Table 1. Data Collection & Analysis Method**

Methods	Data Collected	Data Analysis
Literature review	<ol style="list-style-type: none"> <li>1) Existing Water, Sanitation and Hygiene (WASH) in Hospital</li> <li>2) Data available with the Hospital</li> </ol>	Analysis and framing of the intervention within the existing policy requirements.
Infrastructural Survey / direct observation	<ul style="list-style-type: none"> <li>• Hospital building status</li> <li>• Hospital Beds and Operating staff</li> <li>• Water access</li> <li>• Sanitation access/ facilities</li> <li>• Solid Waste Management</li> <li>• Rain Water Harvesting</li> <li>• Storm Drain system</li> <li>• Approach pathways / Roads</li> </ul>	<ul style="list-style-type: none"> <li>• Reported as per discussion and observation at site</li> <li>• Preparation of demand and requirements as per building codes / BIS / CPHEEO Manual.</li> <li>• Minimum requirements as per site conditions, land availability</li> </ul>
Key informants / semi structured interview	Strengths, Weaknesses, Opportunities and threats for Hospital in terms of water and sanitation services	Strength, Weakness, Opportunity, Threat (SWOT) analysis (Table 6) of primary stakeholders involved in WASH in hospital.

### 2.0 Infrastructural Survey

A infrastructural survey was carried out at the Project Hospitals to evaluate what type of water and sanitation facilities were available and what their condition was. The observations allowed us to inspect the state of Hospital latrines, solid waste dumps and drinking water supply used at the Hospital level. The physical assessment helped in assessment of the requirement of the hospital for water, sanitation and rain water harvesting. The survey helped in assessment of the GAP and the minimum requirement of hospital to achieve 100 percent coverage of water supply and sanitation.

### 3.0 **Semi-Structured Interviews / Discussion**

Semi-structured interviews / Discussions were conducted with MS, Hospital staffs, patients. Hospital Medical Superintendent were asked to highlight major challenges related to the water and sanitation infrastructures of their Hospital. To highlight the possibility based on the finding of the interviews, for primary stakeholders (Hospital Staff, Patients, and MS) to identify the key internal (strengths and weaknesses) and external factors (opportunities and threats) that are important for the successful provisions of these services at Hospital level.

The identified stakeholder groups were divided into three categories: primary, secondary and key stakeholders. Primary stakeholders were the category of stakeholders who were directly affected by the project and who could also be referred to as the direct beneficiaries of the project. The involvement, participation and contribution of primary stakeholders in the planning and implementation of the project activities were critical, especially for the purposes of ownership and sustainability.

## 4.0 **EXISTING WATER SUPPLY AND RAIN WATER HARVESTING SYSTEM**

Present water supply of Wokha hospital is from bore well while in monsoon season rain water stored in the surface tank is used for flushing as well as for drinking purpose by boiling. Admin building and OPD building are having provision of tap water, while all other buildings are dependent in hospital premises are provided by buckets with manual means. The hospital does not have any public water supply from municipality or PHE / PWD department at present

The provision of proper drinking water and water in toilet discourage most of patients to visit the hospital. The present capacity of the Wokha hospital is of 50 Bedded and with staff requirement for 24 X 7 operating hospital is 124 Nos. The rain water stored in surface tank is susceptible to contamination due to not so frequent use or replenishment on daily basis as per hospital requirement.

## 5.0 **GAP ASSESSMENT**

As per the National Building code HANDBOOK ON WATER SUPPLY AND DRAINAGE SP: 35 (S&T) -1987, page no 34, Table No 12 requirements for water supply for buildings other than residence'. The water requirement for hospital with capacity less than 100 bedded the requirement of water is 340 liters per bed per day (lpcd) and 45 lpcd for the working staff of the hospital.

Table 3. The calculation for Wokha district hospital is shown below;

Sr. No.	Description		Unit
1	Nos of beds in hospital	50	Bed

2	Water demand as per NBC / CPHEEO -1999 for water supply / BIS – 1172:1993 – Table -1 – for less than 100 bedded hospital	340	Liter Per Bed
3	Water demand for the Hospital for the	17000	Liter per day
4	Nos of Staff required for the hospital	124	Persons
5	Water demand as per NBC / CPHEEO -1999 for water supply / BIS – 1172:1993 – Table -1 – For hospitals	45	Liter per person per day
6	Water demand for staff per day	5580	Liter Per day
7	Total Water Demand for Hospital Sum of Sr. no. 3 + Sr. No 5	22580	Liter per day
8	80 Percent of water supply generating as sewer – As per CPHEEO manual for Sewers -2013	18084	Liter per day
9	Sewer as infiltration of groundwater in system per Km – Avg., of Max 5000 per /km i.e., 2500	2500	Liter
10	Total sewer generation in the WOKHA hospital	20834	Liter per day
11	Say rounded up	20000	Liter Per Day
12	ETP of approx. capacity in KLD	20	KLD

As per standards the approx. capacity of ground service reservoir of 25 KL is needed to be constructed near existing Bore well / Tube well. In monsoon season the flow from all rain water ground reservoirs would be diverted into this service reservoir and the excess rain water shall be used to charge the ground water level at the site. The ground water recharge is not considered into present scope of work. If required same would be considered in future stage to recharge the ground water table.

The ground water service reservoir is provided with the surface water pump of 10 cum/Hr discharge and 14 M hydraulic head. The consideration of the half day storage as elevated service / roof top tanks is considered for total 2 fillings day considering unreliable electricity supply.

## 6.0 RAIN WATER HARVESTING

Existing Infrastructure of the Hospital are defined above sections

### 6.1. Advantages of Rain Water Harvesting

- To arrest ground water decline and augment ground water table
- To beneficiate water quality in aquifers
- To conserve surface water runoff during monsoon
- To reduce soil erosion
- To inculcate a culture of water conservation

### 6.2 How to harvest rainwater:

Broadly there are two ways of harvesting rainwater:

- (i) Surface runoff harvesting
- (ii) Roof top rainwater harvesting

### 6.3 **Surface runoff harvesting:**

In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

### 6.4 **Roof top rainwater harvesting (RTRWH):**

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

### 6.5 **Components of the roof top rainwater harvesting system**

The illustrative design of the basic components of roof top rainwater harvesting system is given in the following typical schematic diagram/

The system mainly constitutes of following sub components:

- **Catchment**

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore the catchment is the area, which actually contributes rainwater to the harvesting system.

Area of the surface runoff – In the hospital buildings the roof water is considered for the rain water catchment connected to roof top collected rain water pipes.

- **Transportation**

Rainwater from rooftop should be carried through down take water pipes or drains to storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity. Water from sloping roofs could be caught through gutters and down take pipe. At terraces, mouth of each drain should have wire mesh to restrict floating material.

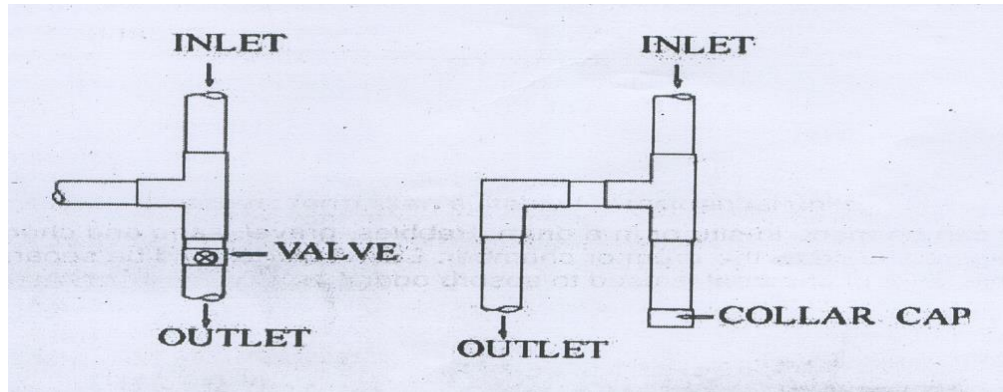
In present scope, there is already covered areas with rainwater collection pipes and connected to surface water tanks

- **First flush**

First flush is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed-off to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere and the catchment roof. It will also help in cleaning of silt and other material deposited on roof during dry seasons Provisions of first rain separator should be made at outlet of each drainpipe.

- **Filter**

There is always some skepticism regarding Roof Top Rainwater Harvesting since doubts are raised that rainwater may contaminate groundwater. There is remote possibility of this fear coming true if proper filter mechanism is not adopted. Secondly all care must be taken to see that underground sewer drains are not punctured and no leakage is taking place in close vicinity. Filters are used for treatment of water to effectively remove turbidity, colour and microorganisms. After first flushing of rainfall, water should pass through filters. There are different types of filters in practice, but basic function is to purify water.



TYPICAL ARRANGEMNT OF FIRST FLUSH BEFORE THE INLET TO GROUND RESERVIOR FOR STORAGE

Ground water aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are: -

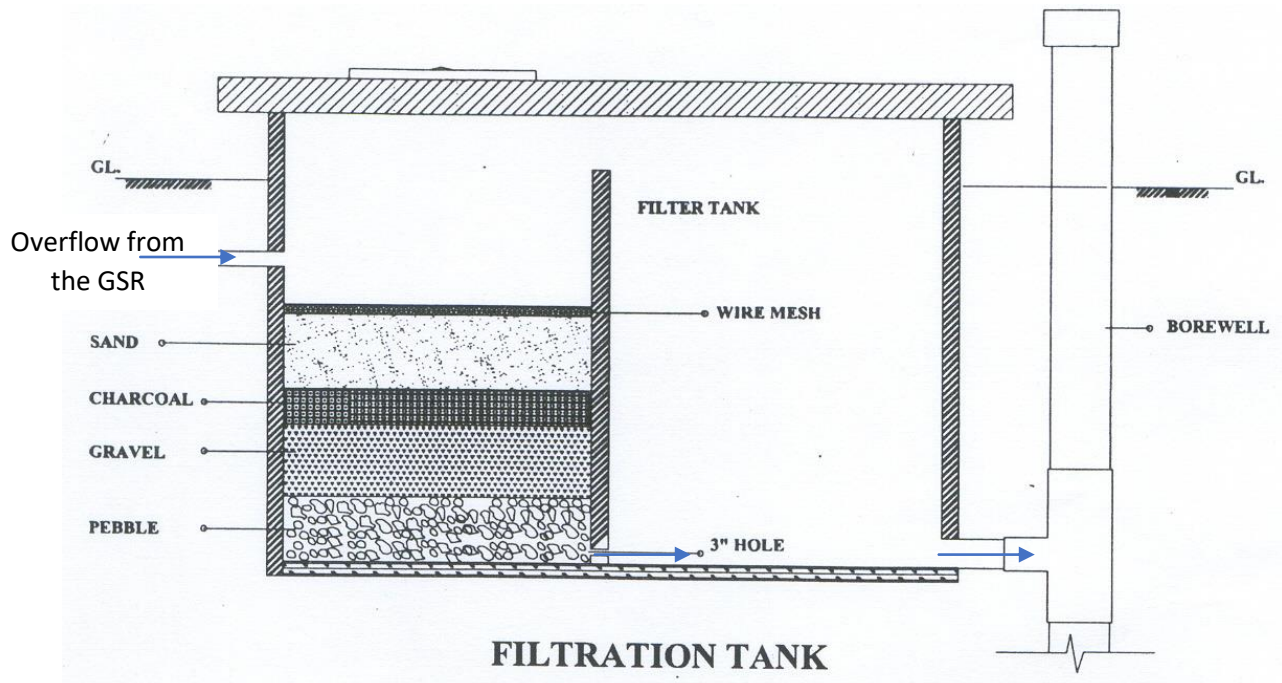
- a) Recharging of bore wells
- b) Recharging of dug wells.
- c) Recharge pits
- d) Recharge Trenches
- e) Soak ways or Recharge Shafts
- f) Percolation Tanks

**Due to land constraints and better use of existing surface water tanks ground water recharge or tube well recharge system is adopted for the Wokha Hospital**

### 6.6 Recharging of bore wells

Rainwater collected from rooftop of the building is diverted through drainpipes to settlement or filtration tank. After settlement filtered water is diverted to bore wells to recharge deep aquifers. Abandoned bore wells can also be used for recharge.

Optimum capacity of settlement tank/filtration tank can be designed on the basis of area of catchment, intensity of rainfall and recharge rate as discussed in design parameters. While recharging, entry of floating matter and silt should be restricted because it may clog the recharge structure. "first one or two shower should be flushed out through rain separator to avoid contamination. This is very important, and all care should be taken to ensure that this has been done."



Calculations for potential of amount of rainwater harvesting as per CPWD guidelines for rainwater harvesting system.

Area of Roof available for rain water harvesting is 3000 Sq. M and height of water is approx. 2 m as average annual rainfall in Nagaland is approx. 2000 mm

$$\begin{aligned}
 \text{Rain water harvesting potential} &= \text{Rain fall in M X surface area of the buildings} \\
 &= 2.0 \text{ M X } 3000 \text{ Sq. Mt} \\
 &= 6000 \text{ Cum or 6 Million Lakh Liter Water}
 \end{aligned}$$

Effectively harvested area for the corrugated areas of the roofs is between 0.7 to 0.9. Considering average efficiency of 0.8 and factor evaporation, spillage and first flush wastage etc., of 0.8

$$\begin{aligned}
 \text{Therefore, the effective potential of rainwater can be harvested is} &= 6000 \text{ Cumc X } 0.8 \text{ X } 0.8 \\
 &= 3840 \text{ cumec or 3.84 ML in years}
 \end{aligned}$$

At present total rain water surface storage capacity of approx. = 25000 liters or 25 KL.

The capacity of the recharge tank is designed to retain the runoff of at least 15 minutes of rainfall of the peak intensity, considering maximum of 25 mm of rainfall in 15 min. the calculated capacity of the recharge tank is as follows

- 1) Area of the catchment is (A) = 3000 Sq. M
- 2) Peak rainfall in 15 min duration (r) = 50 mm
- 3) Runoff coefficient for corrugated roofs = 0.80

$$\text{Calculated capacity of the tank is } = 3000 * 0.050 * 0.80 = 12 \text{ Cumec or 12000 Liters}$$

The size of the tank is calculated as follows for the recharge tank is providing the depth of tank 2.5 Meter with 0.5 M freeboard the diameter of the tank is 2.5 M diameter. The provided water tank of the capacity of the 3.5 m dia., and the depth of 2.5 M with freeboard of 0.5 M.

**7 Conclusion and the recommended works required for better water supply is are as follows;**

Sr. No.	Description of work	Capacity / Remarks
1	Ground water service reservoir of 25 KL for rain water storage – for rain water and tube-well storage	25000 Liter
2	Polyethylene water storage tank, IS: 1270 – of 3 Nos of 1.5 KL, 0.5 KL for hot water for solar hot water	Total – 5 KL - Total 3.5 KL on OPD Building and 1.5 KL on Admin Building
3	Network connecting the system from various rain water storage tanks in the hospital compound	
4	Realignment of the existing overhead tank filling system	Water from tube well to proposed ground water tank.
5	Water distribution or plumbing system from roof top tanks to toilets, for Kitchen and the proposed 4 Nos., of RO + water cooler for drinking water	3 For Hospital Building and one to the Kitchen building
6	Ground water recharge from the proposed GSR near the bore well / tube well by connecting over flow pipe	Provided to recharge the existing bore well water table for better utilization in lean seasons

**8 EXISTING SANITATION SYSTEMS**

The existing system of sanitation at the hospital are based on individual septic tanks for flow from individual toilets or 2 toilets while waste from urinals are discharged into the open storm drains.

The septic tanks are constructed as and when the toilets are constructed for the hospital wards or new building is constructed.

There are insufficient number of toilets in the general wards in the hospitals and some wards are not even without any provision of toilets at all.

The situation of toilets at Wokha district hospitals is as follows

Sr. No.	Building	Building	Present Condition
1	Admin Building	New Building	Provided
2	OPD	New Building	Provided - and Provision for Visitors also
3	Male Ward -1 and Female Ward -1	Old Building	One toilet each – Condition is not good and Indian Style which is difficult for the old / patients to use
4	Male Ward -2 and Female Ward -2	Old Building	One toilet each – Condition is not good and Indian Style which is

			difficult for the old / patients to use
5	Emergency room	New Building	Provided
6	New Labour Room	New Building	Provided
7	Special cabins and Chapel Building	Old Building	Provided
8	Maternity Wards and new born area	Old Building	Provided
9	X – Ray Building	Old Building	Provided – Not properly maintained due to availability of water supply
10	Regional Diagnostic center	Old Building	Provided – Not properly maintained due to availability of water supply
11	Immunization center and Store	-	Not
12	OSD	Old Building	Provided
13	Kitchen area	Old Building	None – Kitchen is not in use
14	Pediatric, Isolation ward, Old Labor Room	Old Building	Toilet in Labor room and isolation ward. As per discussion old labor room would be converted into laundry and store room for the linen

**Following are recommended works in the GAP observed and suggestions made are**

- 1) Construction of one new toilet in male ward -1 and female ward -1 also in the male ward -2 and female ward -2. Total of 4 nos., of toilets of dual purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan) and one number in existing Kitchen for use of staff and visitors.
- 2) Upgradation of existing Indian type of WC to dual purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan) for convenience of the patients
- 3) Refurbishment of kitchen and construction of wash room for staff and the visitors at the kitchen for food.
- 4) Diversion of all sewerage from septic tanks to ETP with construction of sewer network for flow of sewerage to the proposed ETP inlet chamber near regional diagnostic center.
- 5) Demolition of the existing septic tanks and filling of the same with soil and manure for the development of plantation or walk areas for the patients.
- 6) The diversion of the flow from septic tanks considering the locations of existing rain water storage tanks near to the septic tanks and contamination of the rain water due to seepage or contact with toxic waste from septic tanks.

Sr. No.	Description of work	Capacity / Remarks
1	Modifications to existing toilets from Indian System to the dual-purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan)	5 Nos of Toilets – 2 of Male ward and 2 nos., of Female ward and one of OPD building
2	Construction of new toilets in the 2 Nos to Male ward and 2 Nos to Female wards and 1 Nos to Kitchen	5 Nos of
3	Repair of the existing visitor's toilet	1 Nos near OPD building
4	Laying, Jointing, testing and commissioning of sewer network from toilets and service chambers to proposed ETP near Regional diagnostic center	Construction of pipelines, manholes and inlet chamber to ETP and civil work for ETP as per manufacturer /

		Supplier of packaged ETP.
5	20 KLD Packaged ETP for treatment of sewer generated on hospital	20 KLD ETP near Regional diagnostic center. Presently the treated effluent water to be released into nearest storm drain, <b>in future the treated effluent shall be used for flushing of toilets and recharge of the ground water table by pumping treated effluent to the rain water recharge tank</b>
6	Demolishment of the existing septic tanks and refill with soil and manure to plant plants and flowers	

### 8.1 What is Hospital Sewage and why to treat it?

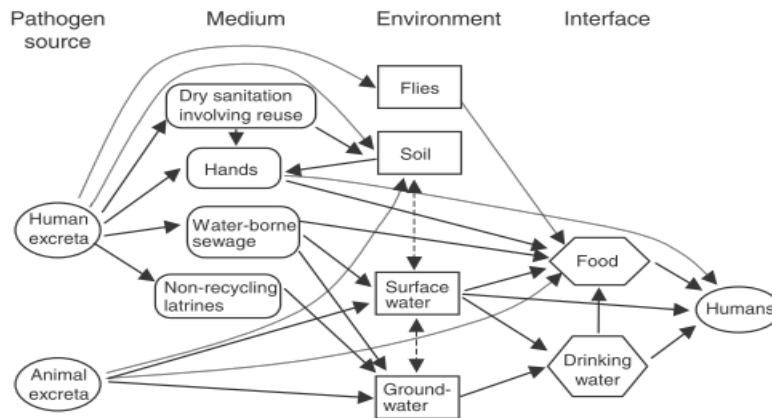
Generally, wastewater is defined as the composition of physical, chemical and biological waste present in wastewater. Hospital sewage is a wastewater generated relatively in larger quantities from all the units of the hospitals such as emergency and first aid, operating rooms, drug treatment, ICU, chemical and biological laboratories, radiology, canteen and laundry activities etc.

Since, hospital sewage/wastewater consists of various potentially hazardous components that will cause many risks on human and environment by polluting surface and ground water. Hence, hospital sewage treatment is very much required.

The major objective of hospital wastewater treatment plant is to treat the influent (untreated wastewater) generated by the hospitals and healthcare sectors before its direct release into natural environment. Hospital wastewater may have an adverse impact on environments and human health.

Therefore, proper wastewater management in each hospital is prerequisite. Importantly, however, removing a basic pathway (e.g. by providing safe drinking water or improved sanitation) is likely to be a precondition for the success of subsequent interventions to reduce disease burden.

## Transmission pathways of fecal–oral disease



### 8.2 Hospital Sewage Characteristics:

Wastewater from hospitals around the world can generally contain traces of anything from viruses and multi-resistant bacteria to medical contrast agents and chemicals for cancer treatment. Small amounts of hormone-disrupting substances and other medicine residues are also part of the mix that passes from patients through hospital toilets and into public sewer systems. Wastewater from various hospitals consists of:

1. Microbial pathogens and harmful bacteria and virus
2. Pharmaceuticals and its metabolites
3. Radioactive isotopes
4. Hazardous chemicals, heavy metals
5. Drug residues

### 8.3 Hospital sewage or wastewater treatment plant process:

Compact or packaged sewage treatment plant for hospitals is done in series of steps. Conventional treatment processes involved to remove impurities from the influent are listed below.

**8.3.1 Preliminary Stage or Pretreatment:** As a first stage, preliminary treatment process is essential in most of the sewage treatment plant (STP). It removes items such as sticks, rags and other large debris and heavy inorganic solids contained in the hotel influent through bar screens. Removal of these materials protects plant's equipments from damage. The inorganic settled is called as grit which is removed using grit chamber.

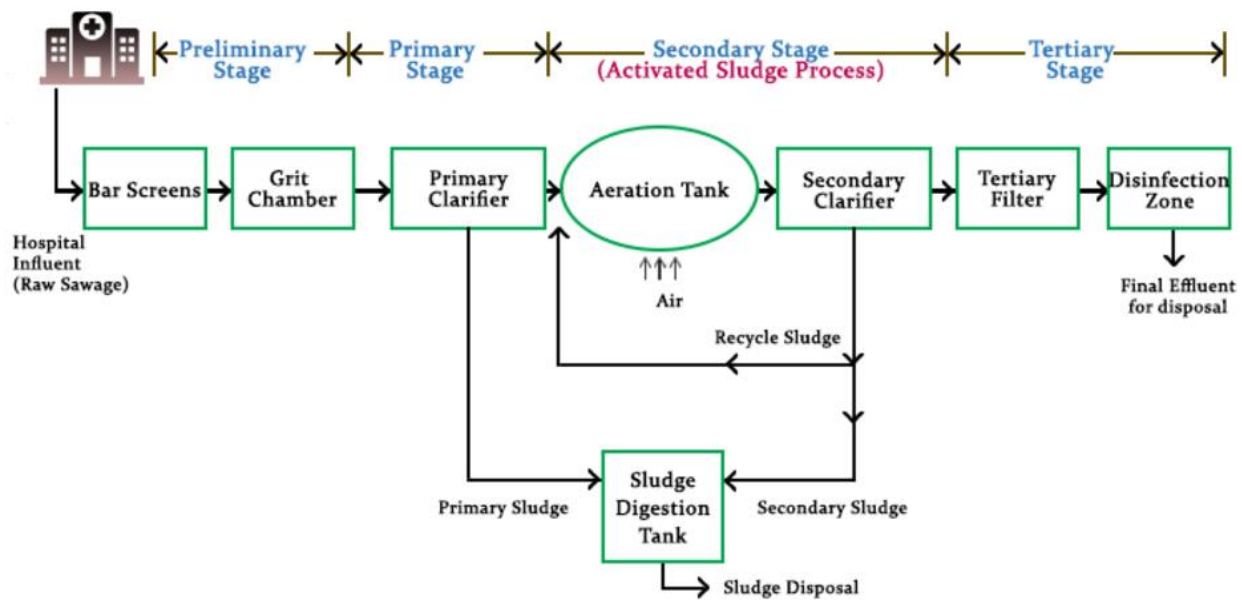
**8.3.2 Primary Treatment Stage:** This is the second step in sewage treatment system. Physical separation of solids and greases from wastewater is done in this stage. Now, water flows into primary filter or clarifiers for few hours to allow solid particles to settle down and lighter particles will float to the top will be skimmed off from the tank.

The settled solid is called as primary sludge or primary effluent contains about 60-70% of solids. Partly treated wastewater is now subjected to next treatment level.

**8.3.3 Secondary Treatment Stage:** It is a biological treatment process removes dissolved inorganic materials present in soluble and colloidal form from the wastewater. Here, bacteria are used convert the colloidal and dissolved organic matter. Now the partially treated wastewater from primary tank flows into the aeration tank and air is supplied through air blower to provide oxygen for microbes. When wastewater flows into secondary clarifier, where solids settle down which is called as secondary sludge and part of it is recycled for activated sludge process and remaining is mixed with primary sludge which will be send to sludge digestion tank and then disposes off. This stage removes about 90% of inorganic solids.

**8.3.4 Tertiary or Advanced Treatment Stage:** This is the last stage in most of the STP's. This stage removes the suspended solids and organic matter which was not removed in secondary treatment. The pathogenic microorganisms which were not removed during biological treatment process will get removed by the process called disinfection. Several disinfection agents can be used depending on wastewater condition (pH, clarity etc.). It is achieved by means of physical or chemical disinfectants like chlorine, UV light, ozone etc. Now, disinfected wastewater is suitable for disposal or reuse.

Conventional processes involved in Sewage Treatment Plant (STP) for Hospitals is shown below: -



**Hospital wastewater cannot be treated by ordinary means – by Conventional methods of Sewerage treatment of domestic wastewater**

Wastewater from hospitals around the world can generally contain traces of anything from viruses and multi-resistant bacteria to medical contrast agents and chemicals for cancer treatment. Small amounts of hormone-disrupting substances and other medicine residues are also part of the mix that passes from patients through hospital toilets and into public sewer systems.

### 8.3.5 Wastewater is hazardous to health and the environment

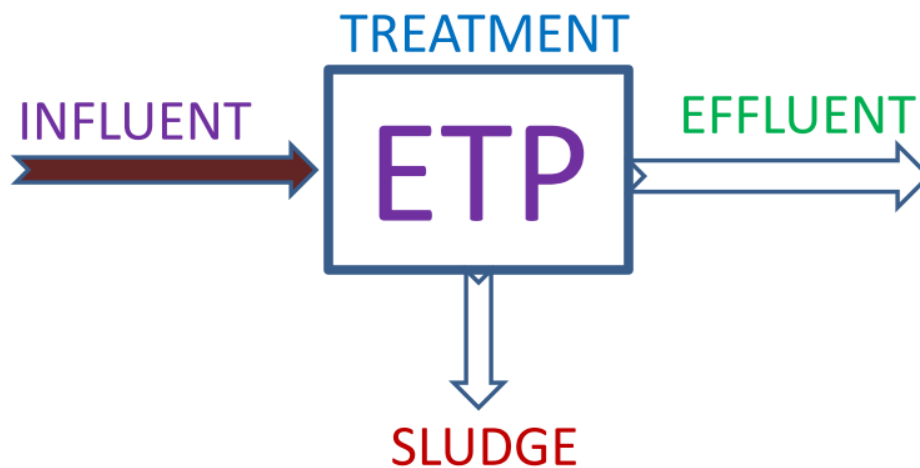
The hospital wastewater can pose a health hazard to humans, especially employees at wastewater treatment plants. During heavy rains and flooding, holding tanks in the sewer system can overflow.

There is also a danger to marine life. Once the sewage is treated and released into the environment along with its residual content of pathogens and pharmaceuticals, the local fauna are routinely at risk.

“Even in very low concentrations, the substances in hospital wastewater can affect animal life. “Estrogens, for example, can cause hermaphroditic fish, while some painkillers are poisonous to trout, and certain psychopharmaceuticals can affect fish and bird behavior.”

9. **ETP (Effluent Treatment Plant)** is a process design for treating the hospital waste water for its reuse or safe disposal to the environment.

- Influent: Untreated Hospital waste water.
- Effluent: Treated Hospital waste water.
- Sludge: Solid part separated from waste water by ETP



#### 9.1 Need of ETP

- To clean Hospital effluent and recycle it for further use.
- To reduce the usage of fresh/potable water in Hospital.
- To cut expenditure on water procurement.
- To meet the Standards for emission or discharge of environmental pollutants from various Industries / Hospitals set by the Government and avoid hefty penalties.
- To safeguard environment against pollution and contribute in sustainable development.

#### 9.2 Selected process for the Effluent treatment plant for the Hospital wastewater

The comparison of widely used treatment technologies for hospital wastewater has been summarized below:

**Table-4: Comparison of Widely Used Treatment Technologies for Hospital Wastewater**

Sr. No	Item Description	ASP	E.A.	SBR	FBR/FAB	SAFF	MBR
1.	Type of process	Suspended growth process	Suspended growth process	Suspended growth process	Suspended and attached growth process	Attached growth process	Suspended growth with solid-liquid separation process
2.	Typical influent characteristics for hospital wastewater	pH : 6.5 - 8.5 ; BOD 5 : 150 – 350 mg/l ; COD : 250-800 mg/l ; TSS : 150-400 mg/l, E-Coli : 10 <sup>6</sup> -10 <sup>10</sup> MPN/100ml					
3.	Discharge standards for hospital wastewater ( Sources EPA 1998)	pH : 6.5 – 9.0 ; BOD 5 < 30 mg/l ; COD < 250 mg/l ; TSS < 100 mg/l; E-Coli < 10 <sup>3</sup> MPN/100ml					
4.	Discharge standards for hospital wastewater ( MoEF in India)	pH : 6.5 – 8.5 ; BOD 5 < 10 mg/l ; COD < 100 mg/l ; TSS < 10 mg/l; E-Coli < 10 <sup>3</sup> MPN/100ml					
5.	Requirement of bio-media / diffusion membrane& their types	No	No	No	Yes & Floating Type	Yes & Fixed Type	Yes & membrane module
6.	Treatment for laundry and laboratory effluent	Yes	Yes	Yes	Yes	Yes	Yes
7.	Treatment for oil and grease from kitchen /cafeteria	Yes	Yes	Yes	Yes	Yes	Yes
8.	Pre-treatment and primary treatment for influent wastewater	Yes	Yes	Clarifier / tube settler can be eliminated	Clarifier / tube settler can be eliminated	Clarifier / tube settler can be eliminated	Clarifier / tube settler can be eliminated
9.	Secondary clarifier / tube settler tank	Yes	Yes	No	Yes	Yes	No

10	Requirement of Equalization tank	Yes	Yes	Can be avoided	Yes	Yes	Yes
11	Tertiary treatment system for further polishing treated wastewater	Yes	Yes	Yes	Yes	Yes	No
12	Expected quality of treated wastewater after tertiary treatment.	Fair	Good	Better	Much better	Much better	Excellent
13	5 day BOD removal efficiency	90%	95%	95-97%	95-98%	95-98%	99%
14	Remote monitoring of plant performance	No	No	Yes	No	No	Yes
15	Sludge digestion	Less	Less	High	High	High	High
16	Required power	Medium	Very high	Medium	Low	Very low	Very high
17	Required operator	A few staff with medium skill level	A few staff with high skill	A few staff with very high skill	A few staff with medium skill	A few staff with medium skill	A few staff with very high skill
18	Ease of operation and maintenance problems	Easy	Easy	Difficult to control	Medium	Easy	Difficult to control
19	Effects of climates	High	Medium	Small	Small	Small	Very Small
20	Required chemicals	Few or none	Few or none	Essential	Essential	Few or none	Essential
21	Need for lab control	every month	every day	every hour	every day	every day	every hour
22	Facing shock loads	No problem	Affected highly	Affected highly	Some problem	No problem	No problem
23	Electro-mechanical Cost (Lac. /m3/d)	0.10-0.11	0.12-0.13	0.16-0.18	0.13-0.15	0.13-0.14	0.25-0.30
24	Power cost (Kwh / ML treated)	150-200	180-225	200-250	170-200	175-225	225-275
25	O & M cost (Rs. million / year /mld)	0.2-0.4	0.3-0.5	1.0-1.75	0.6-0.75	0.75-1.14	1.5-2.0
26	Land requirement (m2 / KLD)	1.5 - 2.5	2 - 3.5	0.5-0.6	0.6-0.7	0.6-0.7	0.5

27	Application for re-use of treated sewage water.	Irrigation /horticulture	Irrigation / horticulture	Irrigation / horticulture, flushing water, cooling tower water make-up etc.	Irrigation /horticulture, flushing water, cooling tower water make-up etc.	Irrigation / horticulture, flushing water, cooling tower water make-up etc.	Irrigation /horticulture, flushing water, cooling tower water make-up etc.
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Although each of these techniques/ technologies have their own advantages and disadvantages. The selection of suitable treatment technology among the widely used technologies in domestic wastewater including hospital. The comparison of widely used treatment technologies will help designers, engineers, architects, economists in selection of treatment technologies in terms of their efficiency, energy, operation, performance, land requirement, cost etc. The selected process considering availability of packaged plants for small capacity of wastewater and to meet the discharge standards of the MoEF.

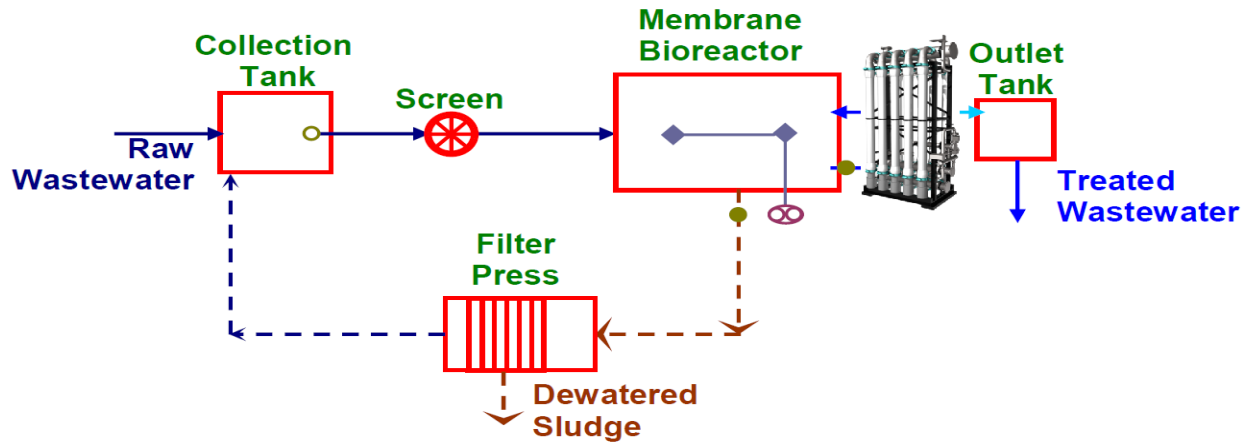
- 1) Availability of land at the hospital compounds
- 2) Quality of treated effluent and the point of disposal
- 3) Quantity of wastewater generation
- 4) Climatic condition prevailing in state of Nagaland
- 5) Less manual interference to the plant

The selected process for the proposed plants is FBR / FAB or SAFF or MBR, due to land availability, the power requirement for plant would be meet by the solar power mostly for the system. The packaged plant of desired capacity is available. The required capacity of the 15 KLD ETP for the Wokha is selected considering the present occupancy and the water demand for the 50-bedded hospital as per CPHEEO manual / NBCC / IS requirement. It is recommended to procure the ETP from the manufacturer and the manufacture shall operate the system for at least 6 months and transfer with training to designated plumber / electrician/ technician available with the hospital for day today O & M and minor repairs. The provision of minimum spares for the plant shall be made in the procurement documents.

At present the proposed arrangement is to discharge the effluent to nearest storm drain. In future, the treated effluent can be used for ground water recharging or toilet flushing purpose with installation of duel plumbing system or for construction purpose for new building in around the hospital.

The proposed process for the effluent treatment of the sewerage generated from the hospital is as shown in process scheme and the process flow diagram.

The Process Scheme is as follows



PROCESSFLOW

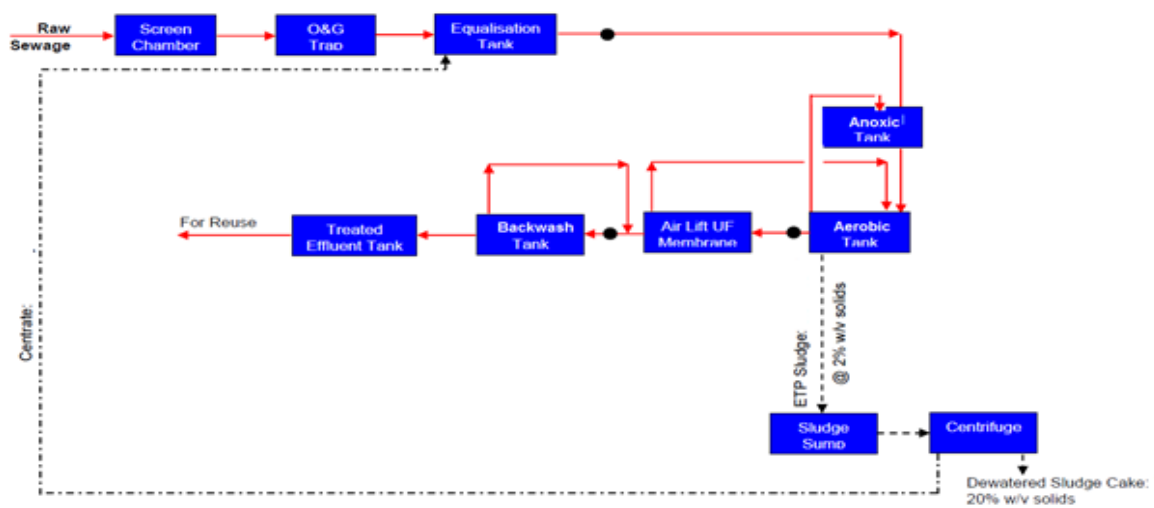


Figure1Treatmentscheme

Collection tank O&G Removal Equalisation Anoxic Tank  
 Aeration Tank Membrane System Chlorination Final treated water storage tank.

9. Conclusion of the Works under Water and Sanitation works

The scope of work involves for development of the hospital building as model building in water and sanitation purpose

Sr. No.	Description of work	Capacity / Remarks
1	Ground water service reservoir of 25 KL for rain water storage – for rain water and tube-well storage	25000 Liter
2	Polyethylene water storage tank, IS: 1270 – of 3 Nos of 1.5 KL, 0.5 KL for hot water for solar hot water	Total – 5 KL - Total 3.5 KL on OPD Building and 1.5 KL on Admin Building
3	Network connecting the system from various rain water storage tanks in the hospital compound	
4	Realignment of the existing overhead tank filling system	Water from tube well to proposed ground water tank.
5	Water distribution or plumbing system from roof top tanks to toilets, for Kitchen and the proposed 3 Nos., of RO + water cooler for drinking water	
6	Ground water recharge from the proposed GSR near the bore well / tube well by connecting over flow pipe	Not in present scope will be considered at later stage

10 Others Miscellaneous works required to carry out the proper functional the hospital at Wokha

Sr. No.	Description of work	Capacity / Remarks
1	Refurbishment of the existing kitchen with construction fume chimney, modification of the kitchen furniture	
2	Paving of the paver blocks for the approach roads on existing roads, pathways in the roads of the hospital for better facility for movement of the patients	
3	Repair the building walls of old buildings, removal of plaster, re-plastering, coating the surface	

## 11. BASIS OF COST ESTIMATES

The cost estimates for the various works components for the water and sanitation have been based on following Schedule of Rates

- Public Works Department – Nagaland – Year 2016
- Municipal corporation of Greater mumbai (MCGM) -2014 – (due to fairness of rates)
- Delhi schedule of rates for year 2016-17

For such items where these items are not found in these SORs, either rate analysis is carried out or the quotation from the reputed vendors / market rate or prevailing market rates are considered. Other State schedule of rates are not considered while framing of document considering the fairness of rates of MCGM and Delhi.

The quantities are calculated based on field measurement and general dimensions on the field. For exact working of the quantity and scope of work there is requirement of proper development of topographical maps and detailed dimensional drawings of the hospital compounds.

The abstract of estimated cost for the work for water and sanitation works for the Wokha Hospital is

Item No.	Description of Item
1	Construction of dual purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan) with all necessary works upto the Inspection Chamber- As per scope of work and Specifications
2	Repair, Modification of existing Indian WC to vitreous china dual purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan) with repair, painting of walls etc., complete - As per scope of work and specifications - Inside the Patient wards.
3	Repair, Modification of existing Indian Wc for Visitors near OPD building with repair, painting of walls etc., complete - As per scope of work and specifications
4	Supply, Installation of 2 Nos of Water Purifiers in the Hospital Compound as per Specification
5	Water Supply works for the Hospital
	Water supply, plumbing, construction of GSR of 25000 Liter Capacity and carrying out all necessary works for making Hospital free from Manual lifting of water
5	Supply, installation, testing and commissioning of Sewer Network upto Inlet of ETP, including Inlet Chamber
6	Supply, installation, testing and commissioning of ETP of 20 KLD Capacity. With discharge pipe for treated effluent to nearest drain at back of Diagnostic Center. Work Includes also one month training the designated staff of staff for day today Operation and Maintenance
7	Demolition of the existing septic tanks, Carting away the seepage to nearest solid waste management site and filling of the land with Soil and making it to level.
8	Constructing walk way in the hospital from entrance to the hospital
9	Minor civil works in the hospital to make the hospital more functional

## Report on Zunheboto Hospital

### 1.0 Desk Study/Literature Review

All data collected at field level was revised using relevant literature on Water, Sanitation and Hygiene (WASH) in Hospitals and the available support data, reports and guidelines from the Hospital MS of the hospital and support staff and the minimum requirements of the CPHEEO Manual / BIS / National Building Codes. Not much information was available on the Hospital existing water and sanitation system in operation. The physical observation of the existing pipes and infrastructures related to water and sanitation is done. The dimensional drawings, Hospital boundaries, available land area, locations of septic tanks, other WASH related facility is assessed on basis of the available information and visible to the eyes. The physical dimensions of the buildings were carried using measuring tape and outer layout plans are prepared. The measurement and accuracy of data is not much reliable and the assumptive values are considered in lack of proper building plans, layout plans, plumbing drawings, sanitation, rain water harvesting assets. The collected data and requirement of the works are based on available information the actual execution of works will vary at site.

Further there is requirement of acquiring the at least physical data of the site by carrying out the topographical survey, preparation of building layouts, plumbing details, rain water harvesting assets and available land with the hospitals. If this is not possible than on site visit the maximum available data is utilized for the preparation of the requirement of the Hospital for the WASH components.

**Table 1. Data Collection & Analysis Method**

Methods	Data Collected	Data Analysis
Literature review	<ol style="list-style-type: none"> <li>1) Existing Water, Sanitation and Hygiene (WASH) in Hospital</li> <li>2) Data available with the Hospital</li> </ol>	Analysis and framing of the intervention within the existing policy requirements.
Infrastructural Survey / direct observation	<ul style="list-style-type: none"> <li>• Hospital building status</li> <li>• Hospital Beds and Operating staff</li> <li>• Water access</li> <li>• Sanitation access/ facilities</li> <li>• Solid Waste Management</li> <li>• Rain Water Harvesting</li> <li>• Storm Drain system</li> <li>• Approach pathways / Roads</li> </ul>	<ul style="list-style-type: none"> <li>• Reported as per discussion and observation at site</li> <li>• Preparation of demand and requirements as per building codes / BIS / CPHEEO Manual.</li> <li>• Minimum requirements as per site conditions, land availability</li> </ul>
Key informants / semi structured interview	Strengths, Weaknesses, Opportunities and threats for Hospital in terms of water and sanitation services	Strength, Weakness, Opportunity, Threat (SWOT) analysis (Table 6) of primary stakeholders involved in WASH in hospital.

### 2.0 Infrastructural Survey

A infrastructural survey was carried out at the Project Hospitals to evaluate what type of water and sanitation facilities were available and what their condition was. The observations allowed Us to inspect the state of Hospital latrines, solid waste dumps and drinking water supply used at the Hospital level. The physical assessment helped in assessment of the requirement of the hospital for water, sanitation and rain

water harvesting. The survey helped in assessment of the GAP and the minimum requirement of hospital to achieve 100 percent coverage of water supply and sanitation.

### **3.0 Semi-Structured Interviews / Discussion**

Semi-structured interviews / Discussions were conducted with MS, Hospital staffs, patients. Hospital Medical Superintendent were asked to highlight major challenges related to the water and sanitation infrastructures of their Hospital. To highlight the possibility based on the finding of the interviews, for primary stakeholders (Hospital Staff, Patients, and MS) to identify the key internal (strengths and weaknesses) and external factors (opportunities and threats) that are important for the successful provisions of these services at Hospital level.

The identified stakeholder groups were divided into three categories: primary, secondary and key stakeholders. Primary stakeholders were the category of stakeholders who were directly affected by the project and who could also be referred to as the direct beneficiaries of the project. The involvement, participation and contribution of primary stakeholders in the planning and implementation of the project activities were critical, especially for the purposes of ownership and sustainability.

### **4.0 LOCATION OF HOSPITAL**



## 5.0 EXISTING WATER SUPPLY AND RAIN WATER HARVESTING SYSTEM

Present water supply of Zunheboto hospital is from natural stream located across the river. The water from natural stream is tapped by upvc pipe and water from there is discharged near the river bank. The head is sufficient in winter to full the elevated reservoir of 1500-2000 liter near the substation. There is provision of another elevated reservoir and structure is already constructed for same. All buildings of hospital are connected by water pipe line except the new OT building, toilets for general male and female wards and kitchens. The buildings have temporary arrangement of rain water harvesting with 2 Nos of 1000 liter Plastic tanks kept in wards buildings.

The provision of proper drinking water and water in toilet discourage most of patients to visit the hospital. The present capacity of the Zunheboto hospital is of 66 Bedded which can be upgraded to 100 bedded as per proposal sent to the Govt of Nagaland for redevelopment of some old buildings and with staff requirement for 24 X 7 operating hospital is

124 Nos. The rain water harvesting will be done to utilize the rain water in lean period when the water from nearest natural stream availability is less.

## 6.0 GAP ASSESSMENT

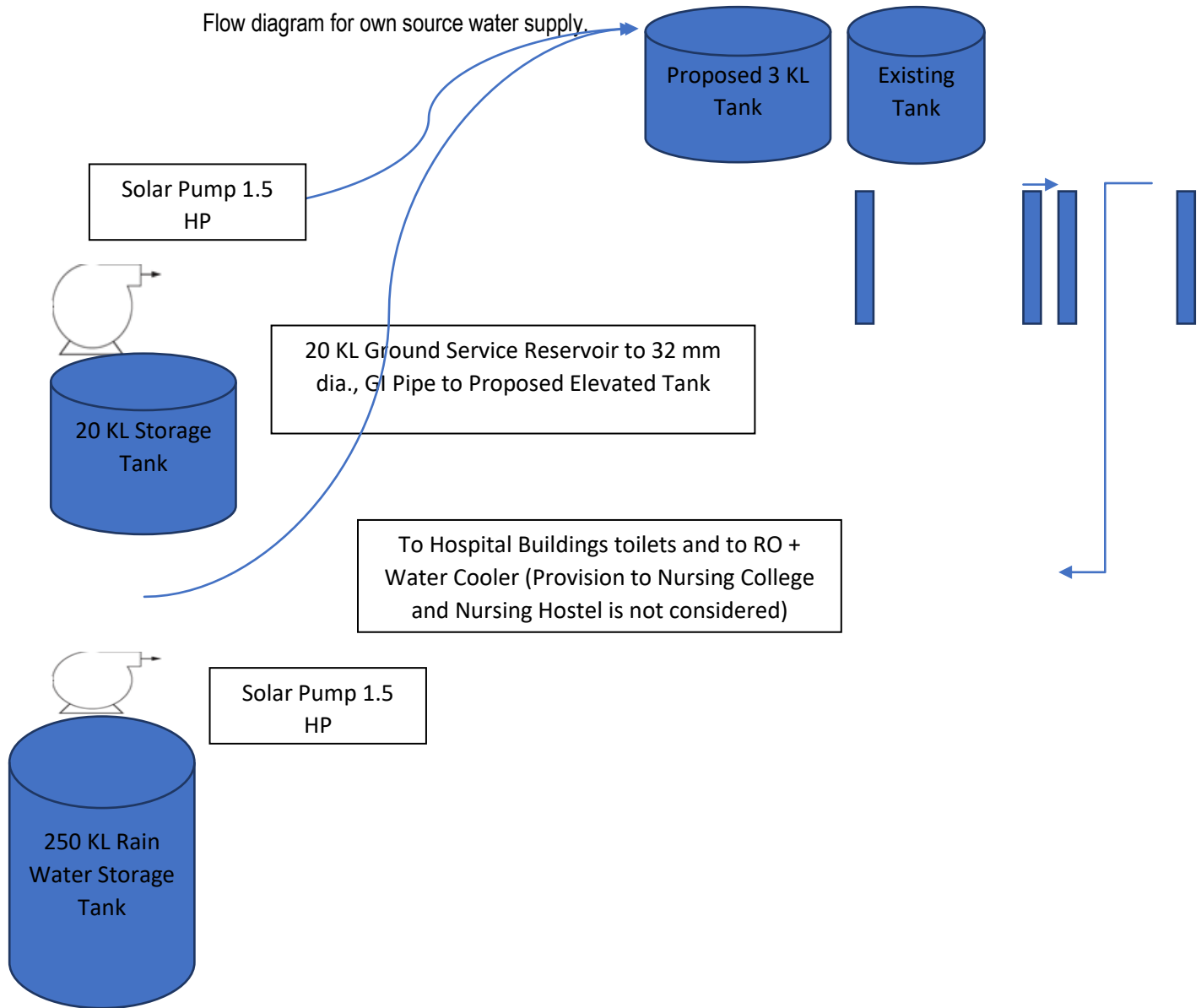
As per the National Building code HANDBOOK ON WATER SUPPLY AND DRAINAGE SP: 35 (S&T) -1987, page no 34, Table No 12 requirements for water supply for buildings other than residence'. The water requirement for hospital with capacity less than 100 bedded the requirement of water is 340 liters per bed per day (lpcd) and 45 lpcd for the working staff of the hospital.

Table 3. The calculation for Zunheboto district hospital is shown below;

Sr. No.	Description		Unit
1	Nos of beds in hospital – for upgraded capacity	100	Bed
2	Water demand as per NBC / CPHEEO -1999 for water supply / BIS – 1172:1993 – Table -1 – for less than 100 bedded hospital	450	Liter Per Bed
3	Water demand for the Hospital for the	45000	Liter per day
4	Nos of Staff required for the hospital	124	Persons
5	Water demand as per NBC / CPHEEO -1999 for water supply / BIS – 1172:1993 – Table -1 – For hospitals	45	Liter per person per day
6	Water demand for staff per day	5580	Liter Per day
7	Total Water Demand for Hospital Sum of Sr. no. 3 + Sr. No 5	50580	Liter per day
8	80 Percent of water supply generating as sewer – As per CPHEEO manual for Sewers -2013	40464	Liter per day
9	Sewer as infiltration of groundwater in system per Km – Avg., of Max 5000 per /km i.e., 2500	2500	Liter
10	Total sewer generation in the Zunheboto hospital	42964	Liter per day
11	Say rounded up	45000	Liter Per Day
12	ETP of approx. capacity in KLD	45	KLD
13	Water demand for lean period of 100 days – In non-rainy season for 100 patients and the 124-working staff of 124 at rate of 20 liter per day	448000	Liters for 100 days
14	Daily water demand of 50 KL for hospital the minimum elevated water reservoir capacity required is at least 10 Percent of daily demand	5000	Liter
15	Required capacity of elevated service reservoir after deducting existing capacity	3000	Liter

As per standards the approx. capacity of elevated service tank of 5KL capacity and Ground Water Storage Tank capacity of 20 KL to tap own water source. In monsoon season the flow from all rain water ground reservoirs would be diverted into this service reservoir and the excess rain water will be diverted to the nearest storm drain. The ground water recharge is not considered into present scope of work. If required same would be considered in future stage to recharge the ground water table.

The ground water service reservoir is provided with the solar powered surface water pump of 1.5 HP and 1.5 HP from the rain water storage tank to the elevated service tank, with all necessary piping etc., complete.



## 7.0 RAIN WATER HARVESTING

Existing Infrastructure of the Hospital are defined above sections

### 7.1. Advantages of Rain Water Harvesting

- To arrest ground water decline and augment ground water table
- To beneficiate water quality in aquifers
- To conserve surface water runoff during monsoon
- To reduce soil erosion
- To inculcate a culture of water conservation

### 7.2 How to harvest rainwater:

Broadly there are two ways of harvesting rainwater:

- (i) Surface runoff harvesting
- (ii) Roof top rainwater harvesting

### 7.3 Surface runoff harvesting:

In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

### 7.4 Roof top rainwater harvesting (RTRWH):

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

### 7.5 Components of the roof top rainwater harvesting system

The illustrative design of the basic components of roof top rainwater harvesting system is given in the following typical schematic diagram/

The system mainly constitutes of following sub components:

- **Catchment**

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore the catchment is the area, which actually contributes rainwater to the harvesting system.

Area of the surface runoff – In the hospital buildings the roof water is considered for the rain water catchment connected to roof top collected rain water pipes.

- **Transportation**

Rainwater from rooftop should be carried through down take water pipes or drains to storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity. Water from sloping roofs could be caught through gutters and down take pipe. At terraces, mouth of each drain should have wire mesh to restrict floating material.

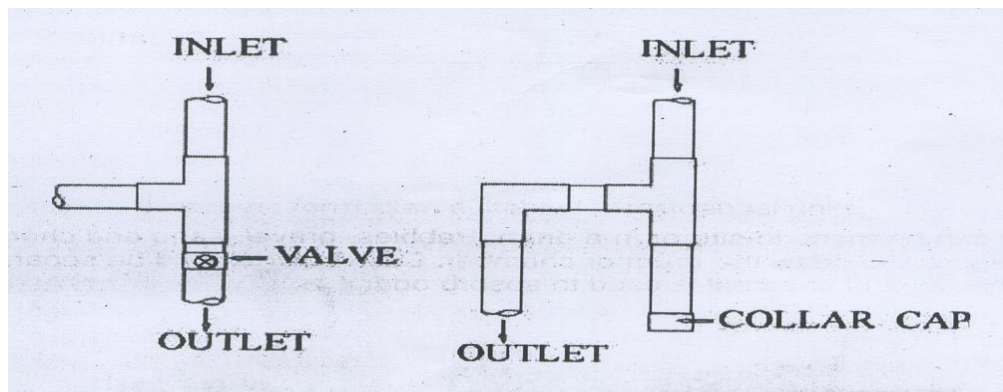
In present scope, there is already covered areas with rainwater collection pipes and connected to surface water tanks

- **First flush**

First flush is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed-off to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere and the catchment roof. It will also help in cleaning of silt and other material deposited on roof during dry seasons Provisions of first rain separator should be made at outlet of each drainpipe.

- **Filter**

There is always some skepticism regarding Roof Top Rainwater Harvesting since doubts are raised that rainwater may contaminate groundwater. There is remote possibility of this fear coming true if proper filter mechanism is not adopted. Secondly all care must be taken to see that underground sewer drains are not punctured and no leakage is taking place in close vicinity. Filters are used for treatment of water to effectively remove turbidity, colour and microorganisms. After first flushing of rainfall, water should pass through filters. There are different types of filters in practice, but basic function is to purify water.



TYPICAL ARRANGEMNT OF FIRST FLUSH BEFORE THE INLET TO GROUND RESERVIOR FOR STORAGE

Ground water aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are: -

- a) Recharging of bore wells
- b) Recharging of dug wells.
- c) Recharge pits
- d) Recharge Trenches
- e) Soak ways or Recharge Shafts
- f) Percolation Tanks

**Due to land constraints it is proposed to have rain water storage tank and solar powered surface water pump to fill the elevated service reservoir. The ground water recharge is not considered in present scope subject to the land ownership issue and the hospital's management interested in the redevelopment of the old buildings. In future the overflow from these tanks will be diverted to the ground water recharge pit.**

The calculations for the rain water harvesting potential and the ground water recharge is as calculated below;

The Zunheboto hospital buildings having approx. spread over in area of 15,000 sq.M. The provision of rain water is done on buildings of surgical wards, general wards. The spread area of these buildings is approx 1400 Sq.M the area between the buildings will be utilized for the storage tanks and from second the water will be pumped to the elevated service tank.

Calculations for potential of amount of rainwater harvesting as per CPWD guidelines for rainwater harvesting system.

Area of Roof available for rain water harvesting is 1400 Sq. M and height of water is approx. 2 m as average annual rainfall in Nagaland is approx. 2000 mm

Rain water harvesting potential = Rain fall in M X surface area of the buildings  
= 2.0 M X 1400 Sq. Mt  
= 2800 Cum or 2.8 Million Lakh Liter Water

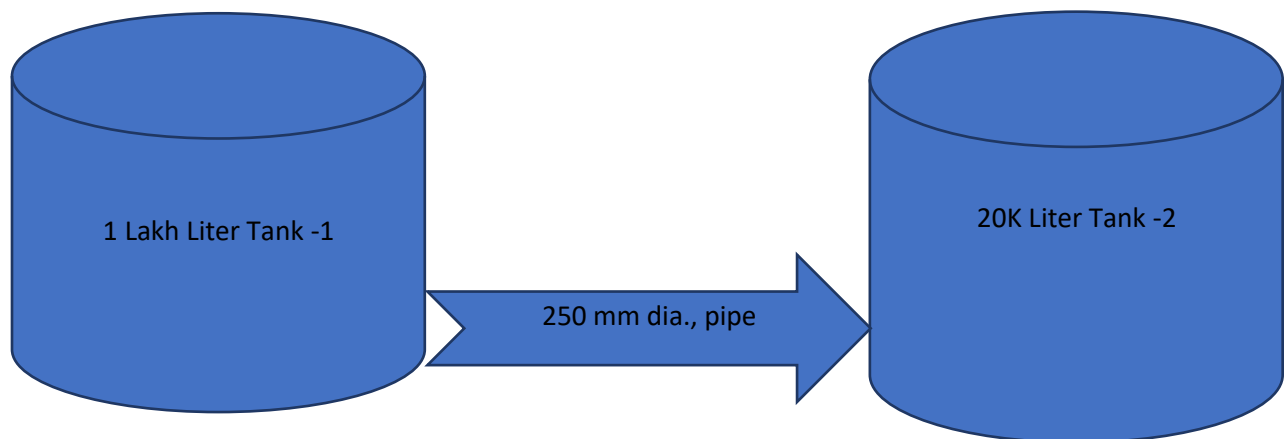
Effectively harvested area for the corrugated areas of the roofs is between 0.7 to 0.9. Considering average efficiency of 0.8 and factor evaporation, spillage and first flush wastage etc., of 0.8

Therefore, the effective potential of rainwater can be harvested is = 2800 Cumc X 0.8 X 0.8  
= 1792.0 cumec or 1.79 ML in years

At present total rain water surface storage capacity of approx. = 2000 liters or 2.0 KL.

The required storage of water for 100 days of lean period at rate of 20 liter for 224 persons is approx. 448.0KL or 0.4 KL. It is proposed to provide 1.2 Lakh Liter storage of water in hospital capacity of tanks in the premises and over flow to nearest storm drain.

The two tanks of 1Lakh capacity ground storage reservoir partly below ground and partly above ground interconnected with 250 mm dia., pipe at bottom level. And over flow from tanks to the nearest storm drains.



**8 Conclusion and the recommended works required for better water supply is are as follows;**

<b>Sr. No.</b>	<b>Description of work</b>	<b>Capacity / Remarks</b>
1	Ground water service reservoir of 100 KL for rain water storage – for rain water and tube-well storage	100000 Liter + Hand Pump provision on lower level tank and Surface water solar pump of 1.5 HP
2	Steel Tank / PVC tank of 2000-liter capacity	Total – 2KL on existing structure near existing elevated service reservoir
3	Network connecting the system from various rain water storage tanks in the hospital compound	
4	Ground water storage tank for lifting of existing source water to elevated reservoir	20 KL tank + solar powered surface water pump of 1.5 HP
5	Water distribution or plumbing system from elevated tanks to toilets and other facilities	

**9 EXISTING SANITATION SYSTEMS**

The existing system of sanitation at the hospital are based on individual septic tanks for flow from individual toilets or 2 toilets while waste from urinals are discharged into the open storm drains.

The septic tanks are constructed as and when the toilets are constructed for the hospital wards or new building is constructed.

There are 15 number of toilets in overall hospitals and almost all buildings have provision of the toilets. The toilets are mostly constructed in recent years as buildings are developed are nearly 50-year-old.

The situation of toilets at Zunheboto district hospitals is as follows

<b>Sr. No.</b>	<b>Building</b>	<b>Building</b>	<b>Present Condition</b>
1	Admin Building – MS / CS building	New Building	Provided - But building is not in use
2	OPD	Old Building but RCC	Provided –and provided with septic tank
3	Male Ward -1 and Female Ward -1	Old Building	Two toilet each – Condition is good and Indian Style access is not covered the shed is required.
4	Male Ward -2 and Female Ward -2	Old Building	Two toilet each – Condition is good and Indian Style access is not covered the shed is required.
5	Old Building with OT	Old Building	Provided - Taps are there but running water is not there
6	Labour Room and Emergency	Old Building	Provided - Taps are there but running water is not there

7	Special cabins and Chapel Building	Old Building	Provided
8	Maternity Wards and new born area	Old Building	Provided
9	X – Ray Building (New OT building)	New Building	Provided – Water supply is issue – regular water supply after installation of elevated reservoir
10	Regional Diagnostic center	New Building	Provided – Water supply is issue – regular water supply after installation of elevated reservoir
11	Pediatric, Isolation ward, Old Labor Room	Old Building	Toilet in Labor room and isolation ward. As per discussion old labor room would be converted into laundry and store room for the linen
12	Sewer disposal	All buildings	Regular disposal of septic waste is done by office Grade – IV staff.

**Following are recommended works in the GAP observed and suggestions made are**

- 1) Upgradation of existing Indian type of WC to dual purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan) for convenience of the patients

Sr. No.	Description of work	Capacity / Remarks
1	Modifications and repair to existing toilets from Indian System to the dual-purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan)	2Nos of Toilets – 1 of Male ward and 1 nos., of Female ward.

**10. Conclusion of the Works under Water and Sanitation works**

The scope of work involves for development of the hospital building as model building in water and sanitation purpose

Sr. No.	Description of work	Capacity / Remarks
1	Ground water service reservoir of 100 KL + 20K for storage of own source water	120000 Liter
2	Polyethylene water storage tank, IS: 1270 – of 1 Nos of 2 KL,	Total – 2 KL -
4	Connecting pipes and chamber for the rain water collection	
5	Water distribution or plumbing from tanks to filling of elevated service reservoirs and provision of plumbing to the toilets	
6	Repair and upgradation of male and female ward toilets and over roof shed connecting wards to toilets	
7	Solar Pumps of 1.5 HP – AC Type for Filling of Elevated tanks.	

11 Others Miscellaneous works required to carry out the proper functional the hospital at Zunheboto

Sr. No.	Description of work	Capacity / Remarks
1	Concrete pavement in the hospital from the entrance to the hospital.	Approx – 450 M x 2 M Wide pathway

## 12. BASIS OF COST ESTIMATES

The cost estimates for the various works components for the water and sanitation have been based on following Schedule of Rates

- Public Works Department – Nagaland – Year 2016
- Municipal corporation of Greater mumbai (MCGM) -2014 – (due to fairness of rates)
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The quantities are calculated based on field measurement and general dimensions on the field. For exact working of the quantity and scope of work there is requirement of proper development of topographical maps and detailed dimensional drawings of the hospital compounds.

The abstract of estimated cost for the work for water and sanitation works for the Zunheboto Hospital is

Item No.	Description of Item
1	Repair, Modification of existing Indian WC to vitreous china dual purpose closet suitable for use as squatting pan or European type water closet (Anglo Indian W.C pan) with repair, painting of walls etc., complete - As per scope of work and specifications - Inside the Patient wards.
2	Supply, Installation of 2 Nos of Water Purifiers in the Hospital Compound as per Specification
3	Water Supply works for the Hospital
	Water supply, plumbing, construction of Bore Well, Elevated Plastic Storage tank, Ground water Recharge Storage Tank Hospital free from Manual lifting of water
4	Approach Road / Pathways to the CS - MS Building
5	Demolition of the existing septic tanks, Carting away the septage to nearest solid waste management site and filling of the land with Soil and making it to level.
6	Biomedical Waste pit development
7	Minor Civil works in the hospital for renovation