CONCEPTUAL PLAN

INTRODUCTION

Jag Pravesh Chandra Hospital is a 210 bedded multi-speciality secondary level Hospital situated in North East District GNCT of Delhi. A total number of 523 beds are being proposed for the expansion of the project. The main objective of hospital is to provide free basic health care to the people living in North East District. Hospital is providing OPD, Round the clock Indoor and Casualty services including routine diagnostic services in general specialties. It is intended that all service seekers receive courteous & prompt attention. The hospital OPD services were started in October 2003 Indoor and casualty services were commenced later on in 2007 and 2009 respectively.

SITE DESCRIPTION

Expansion Project of Jag Pravesh Chandra Hospital Delhi -110053

The Geographical Co-ordinates of the project site are

Latitude - 28°40'34.32"N

Longitude - 77°15'46.44" E

Google earth image showing project site & surroundings within 500m & Toposheet showing project site & surrounding within 10 + 15 km are attached.

CONNECTIVITY

The nearest highway NH-9 is only 3.01 km to the NNE of the project. The nearest railway station is Hazrat Nizzamuddin Railway Station, approx. 9.27 km away towards East-South-East direction. Anand Vihar metro station is at app. 6 km in South East direction.

The nearest airport is Indira Gandhi International Airport (IGI), which is approx. 20.76 Km away from the project site in South West direction.

AREA STATEMENT

The total area of the project site is 19694 m2. The detailed Area Statement of the project is provided below in Table-1.

POPULATION DENSITY

The total (existing + expansion) population of Hospital will be approx. 2000 persons which include outdoor patients, indoor patients, and attendants with indoor patients and staff). Population breakup is given below in Table 2.

S. No.	Description	Existing (m^2)	New construction	Total (m^2)
1.	Plot area			19694
2.	Permissible Ground Coverage (40% +5%of plot area)	8862.3		
3.	Proposed Ground Coverage (29% of plot area)	6087	1378	7465
4.	Permissible FAR (@ 2.5)	49235		
5.	Proposed FAR (@ 1.5)	16790	7879	24669
6.	OPD Block	-	1324	1324
7.	Basement area	3236	-	3236
8	Multi Storied Parking	-	8076	8076
9.	**Total Built-up area**	20026		37305
10.	Green Area	5092.4		5092.4

Table-2: Population Break-up (Existing + Expansion)

S. No	Type of population	Existing	Expansion	Total
A.	Outdoor patients	375	500	875
B.	Indoor patients	210	523	733
C.	Staff (doctors, nurses, etc.) + Attendants with IPD patients	180	212	392
	TOTAL (A + B + C)	765	1235	**2000**

WATER REQUIREMENT

The total (existing + expansion) water requirement for the project will be approx. 360KLD. The water supply will be provided by Delhi Jal Board (DJB). The fresh water requirement will be approx. 172 KLD. Daily water requirement calculation is given below in Table 3:

Table 3: Calculations for Daily Water Demand (Existing+Expansion)

S. No.	Description	Occupancy	Rate of water demand (lpcd)	Total Water Requirement (KLD)
A.	**Domestic water**			
	• Inpatients/Beds	733	450	329.9
	• OPD patients	875	15	13.12
	• Staff (Doctors + Nurses) and Inpatient attendants	392	45	17.64
Sub-Total (A)				**360.66 KLD Say 360**
B.	**Horticulture**	5092.4 m^2	6 l/sqm	30.5
C.	**DG Sets**	4200 kVA	0.9 lit/KVA/hr	22.6
Grand total (A+B+C)				**413 KLD**

**Considering 6 hrs working of DG sets per day*

Table-6(a): Total Wastewater Calculations w.r.t. ETP

S. No.	Description	Quantity (KLD)
1.	Fresh and flushing water requirement for the hospital including: • IPD (@15% of total IPD water requirement) • OPD (@100% of total OPD water requirement) • OT, Blood Bank and Lab	**79.35** 49.35 30
2.	Wastewater going to ETP @ 80% of and 100% of 30 KLD	39.5 + 30 = **69.5 Say 70 KLD**
3.	ETP Capacity	**90 KLD**

Table-6(b): Total Wastewater Calculations w.r.t. STP

S. No.	Description	Quantity (KLD)
1.	Fresh water requirement for the hospital (excluding IPD, OPD, OT, Blood Bank & Lab) @ 70% of (252–79.35 = 172 KLD)	**172 KLD**
2.	Flushing water requirement for (excluding IPD, OPD, OT, Blood Bank & Lab) @ 30% of (108 – 88.48 = 219.52 KLD)	**28.65 say 29 KLD**
3.	Wastewater going to STP @ 80% of (137.6 KLD) and 100% of (29KLD)	**166.6 KLD**
4.	STP Capacity	**200 KLD**

The water balance diagram is shown below in Figure 1.

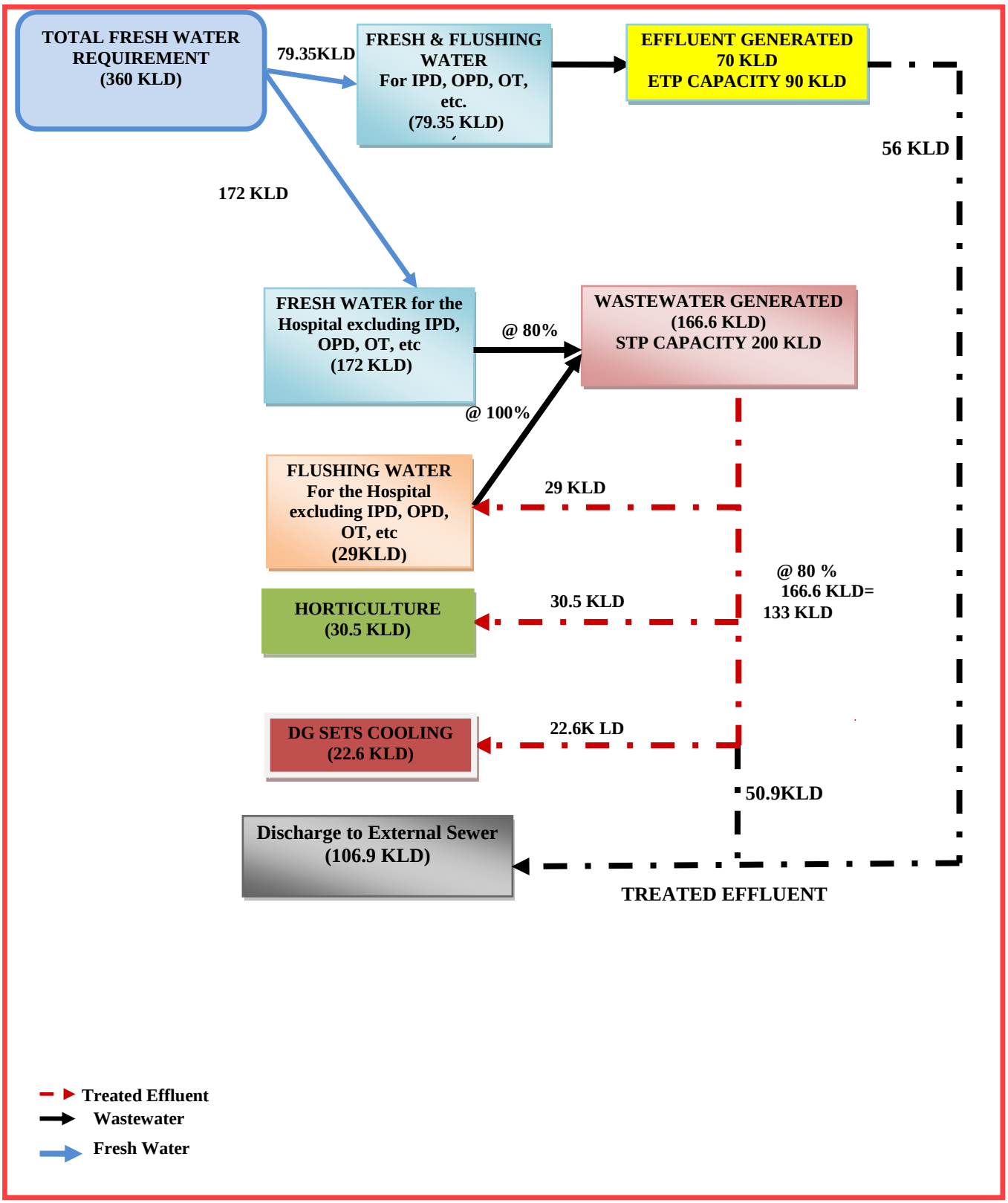

Figure-1: Water Balance Diagram

Waste Water/ Effluent Generation & Treatment

It is expected that waste water (domestic sewage) generated from the project will be approx. 166.6 KLD(@ 80% of fresh water, 100 % flushing water). The domestic sewage will be treated in onsite STP capacity of 200 KLD generating 133 KLD of recoverable water from STP which will be reused for Flushing, Horticulture, DG sets cooling and surplus treated water will be discharged to sewer.

The wastewater (trade effluent) generated from OPD, IPD, OT, Blood bank and Labs will be approx. 70 KLD, which will be treated in onsite ETP of 90 KLD capacity.

EFFLUENT TREATMENT PLANT TECHNOLOGY

DESIGN BASIS:

Capacity **90 KLD**
Operating Hours **24**

Table 7 (a): Inlet ETP Characteristics

S.No.	PARAMETERS	AVERAGE CHARACTERISTICS
1.	pH	5.5-8.5
2.	Total suspended solids	200-300 mg/lit
3.	Oil & Grease	20-40 mg/lit
4.	Biological Oxygen Demand (BOD) (5 day at 20°C)	250-350 mg/lit
5.	C.O.D.	450-600 mg/lit

PROCESS DETAILS:

Bar Screen

Effluent from the source is usually received into the bar screen chamber by gravity. Screen provided will remove all floating and big size matter such as plastic bottles, polythene bags, glasses, stones, etc., which may otherwise choke the pipeline and pumps.

Oil and Grease Trap

If the effluent generated includes higher concentrations of oil and grease, it needs to be removed before biological treatment as it otherwise may cause problems for biological treatment. Usually, a small civil construction tank with a baffle wall and slotted oil pipe skimmer is provided. The oil and grease removed by gravity floats to the surface, which is removed by the oil skimmer.

Equalization Tank

Usually, effluent generation is irregular so we need to have an EQT to maintain universal flow to keep system on regular process.

Transfer of Effluent

Our scope starts from transfer of effluent from Equalization Tank to FMR tank. The distance of transfer should not exceed beyond 20 meter. The transfer pump can be either submersible or non-submersible type for this application. However we have considered centrifugal non-submersible type.

Treatment process

Online dosing of alum, lime and poly shall be dosed to control the COD and after that effluent shall pass through the aerobic process to stabilize the biological process and after that finally it will be pass through Tube settler to settle the waste.

Moving Bed Bio Reactor Tank

After the tube settler the effluent shall overflow to the Moving Bed Bio Reactor Tank, is a favourable environment for the microorganism. . PVC satirized fluidized media is provided for the prevailing of microorganism on it for the treatment of the Sewage biologically. The biologically treated water with bio flocs shall be transferred to the secondary settling tank, where tube deck media is provided to enhance the settling of the bio flocs.

Chlorine tank

After settling tank chlorine shall be dosed to remove bacterial effects at Chlorination tank by chlorine dosing pump.

Break water tank

The clarified water shall be stored in break water tank to feed in Filtration plant and carbon filter for final treatment.

Multi Grade Filtration Plant

After Break water tank it will be pumped to filtration plant to treat further

Activated carbon Filter

After Filtration plant filtered water shall be pass through ACF to remove chlorine and smell and colour.

Final treated water tank

Final treated water shall be stored in final tank for further re- uses and other low end applications.

Sludge

The sludge from the Clarifier to be removed from the bottom of the Clarifier once in a week by gravity to sludge holding tank and it will be pumped to sludge drying beds for final dewatering.

Final solid shall be used as manure and water shall be re-circulated to EQT.

Table 7 (b): Outlet ETP Characteristics

S.No.	PARAMETERS	AVERAGE CHARACTERISTICS
1.	pH	6.5-8.5
2.	Total suspended solids	<30 mg/lit
3.	Oil & Grease	<10 mg/lit
4.	Biological Oxygen Demand (BOD) (5 day at 20°C)	<5 mg/lit
5.	C.O.D.	<100 mg/lit

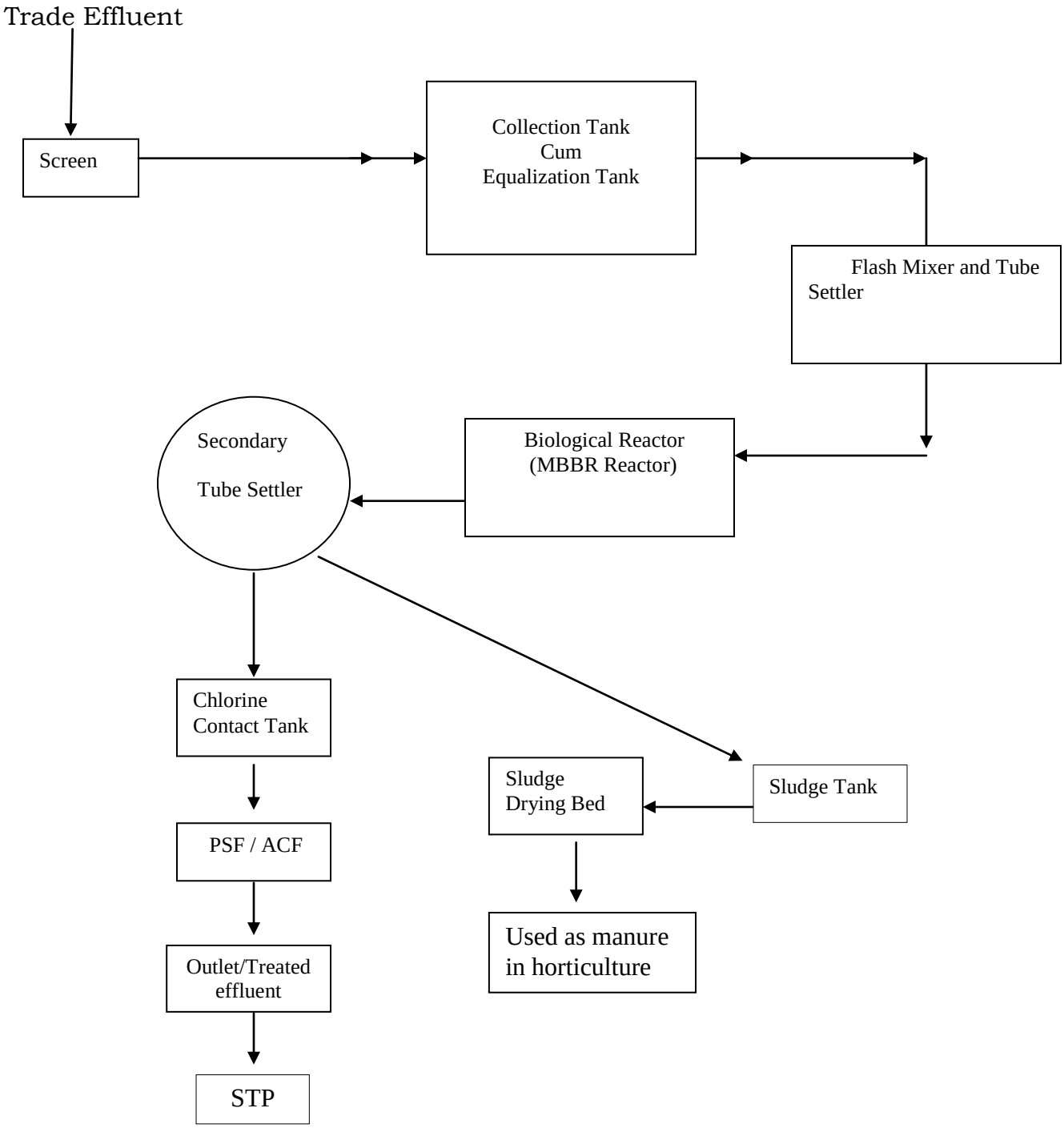

Figure 2: Schematic Diagram of ETP

SEWAGE TREATMENT TECHNOLOGY

FAB TECHNOLOGY:

Sewerage System

An external sewage network will collect the sewage from all units, and flow by gravity to the proposed sewage treatment plant.

Following are the benefits of providing the Sewage Treatment Plant in the present circumstances:

- Reduced net daily water requirements, source for Horticultural purposes by utilization of the treated wastewater.
- Reduced dependence on the public utilities for water supply and sewerage systems.
- Sludge generated from the Sewage Treatment Plant will be rich in organic content and an excellent fertilizer for horticultural purposes.

a. Wastewater Details

(a)	Daily load	:	166.6 KLD (STP)
(b)	Duration of flow to STP	:	24 hours
(c)	Temperature	:	Maximum 32°C
(d)	pH	:	6.0 to 8.5
(e)	Colour	:	Mild
(f)	T.S.S. (mg/l)	:	300-450 mg/l
(g)	BOD (mg/l)	:	200-300 mg/l
(h)	COD (mg/l)	:	300-450 mg/l
(i)	Oil & Grease ABS	:	< 50 mg/l

b. <u>Final discharge characteristics</u>

(a)	pH	:	6.0 to 8.5
(b)	Oil & Grease	:	<10 mg/l
(c)	B.O.D.	:	<5 mg/l
(d)	C.O.D.	:	<150 mg/l
(e)	Total Suspended Solids	:	<90 mg/l

c. <u>Treatment Technology</u>

The technology is based on attached growth aerobic treatment followed by clarification by a tube settler. Lime will be dosed in for suppression of foaming tendencies. The clarified water will be filtered in a pressure sand filter after dosing of coagulant (alum) for removal of unsettled suspended impurities. This water will be passed through an activated carbon filter for removal of organics. The filtered water from ACF is then chlorinated & stored in the flushing tank.
The attached growth fluidized aerobic bed reactor (FAB) process combines the biological processes of attached & suspended growth. It combines submerged fixed film with extended aeration for treatment of the wastewater.

The wastewater after screening is collected in an equalization tank. The equalization tank is required for preventing surges in flow & facilitating equalization of characteristics over the entire quantity of effluent in a given time. A provision for pre-aeration is made in the equalization tank in order to ensure mixing & to prevent the sewage from going septic.
The equalized sewage is then pumped into the FAB reactor for biological processing. The water enters the bottom of the reactor & flows up through the fixed film media which grossly enhances the hydraulic retention time & provides a large surface area for growth of biological micro – organisms. The FAB reactor is aerated by fine pore sub – surface diffusers which provide the oxygen for organic removal. The synthetic media floats on the water & the air agitation ensures good water to micro-organism contact.

The FAB treatment is an attached growth type biological treatment process where in, the majority of biological activity takes place on the surface of the PVC media. Continuous aeration ensures aerobic activity on the surface of the media. Micro – organisms attach themselves on the media & grow into dense films of a viscous jelly like nature. Wastewater passes over this film with dissolved organics passing into the bio-film due to concentration gradients within the film. Suspended particles & colloid may get retained on this sticky surface where they are decomposed into soluble products. Oxygen from the aeration process in the wastewater provides oxygen for the aerobic reactions at the bio-film surface. Waste products from the metabolic processes diffuse outward & get carried away by the wastewater or air currents through the voids of the media.

The aerated effluent passes into a tube deck settler for clarification. The theory of gravity tube settler system is that the carrier fluid maintains laminar flow in the settling media at specified maximum viscosity. These two

parameters of a carrier fluid, flowing through a hydraulic configuration, will determine the velocity gradients of the flow, the height of boundary layer at the inclined surface and the residence time within the media.

The carrier fluid must be viscous Newtonian, exhibiting a Reynolds number of less than 1000 and preferably, a number under 400. The laminar flow, through the inclined tubes, will produce velocity gradients sufficiently large to form an adequate boundary layer, where the velocity of fluid approaches zero. Boundary layers are necessary in functioning tube settlers, to allow suspended solids to separate from the viscous carrier fluid. Under gravitational forces, they will settle to the hydraulic surface of the tube and subsequently from the clarifier media.

Since the tubes are inclined at 60 degrees, solids settled on the tubes are continually discharged down. This downward rolling action increases particle contact and hence further agglomeration, which increases the sludge settle ability. Studies show that these agglomerated sludge particles can have a settling rate in excess of ten times the settling rate of the individual floc particles in the influent. These heavy agglomerated masses quickly slide down the 60 degree inclined tube and settle at the bottom of the tank.

At the bottom of the Tube deck, where the sludge leaves the Tube surface, the larger agglomerated captures smaller particles in the upcoming stream. This solid contact phenomenon greatly enhances the capture efficiency.

Stages of Treatment: The treatment process consists of the following stages:

- Equalization
- Bio- Degradation
- Clarification & Settling
- Filtration

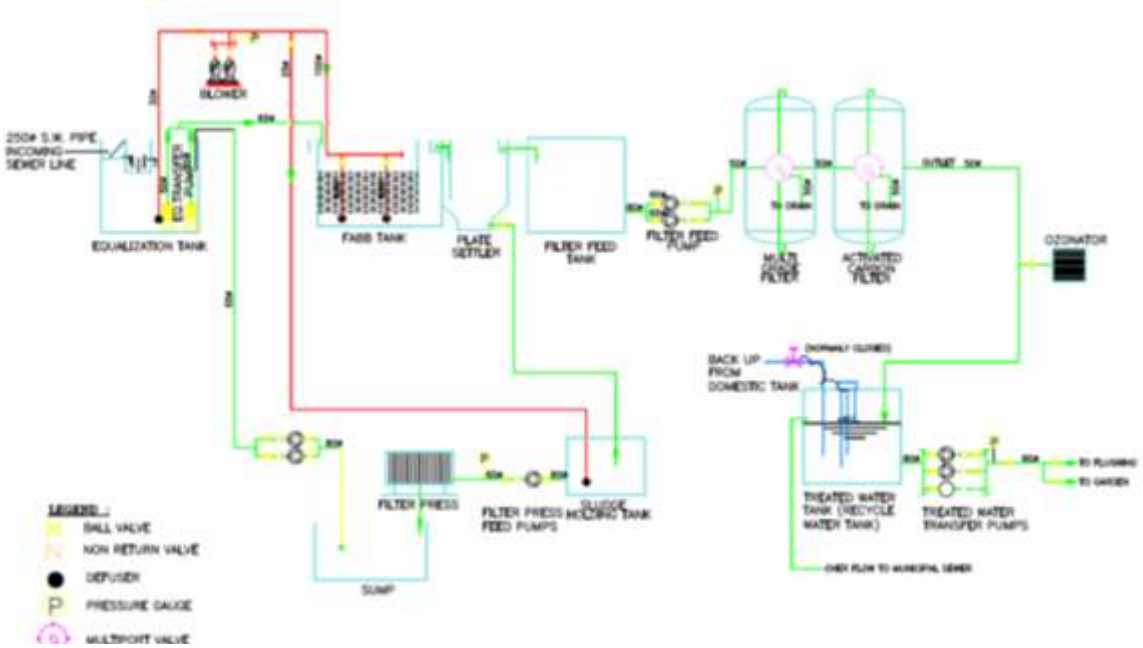

Figure 3: Schematic Diagram of STP

Sewer System

The alignment and slope of the sewer line will follow the road network, drains or natural ground surface and will be connected to the trunk sewers. The discharge point will be a treatment plant, a pumping station, a water course or an intercepting sewer. Pumping stations would be provided at places where the natural slope of the terrain is insufficient to permit gravity flow or the cost of excavation is uneconomical to do the same.

RAIN WATER HARVESTING

The storm water collection system for the premises shall be self-sufficient to avoid any collection/stagnation and flooding of water. The amount of storm water run-off depends upon many factors such as intensity and duration of precipitation, characteristics of the tributary area and the time required for such flow to reach the drains. The drains shall be located near the carriage way along either side of the roads. Taking the advantage of road camber, the rainfall run off from roads shall flow towards the drains. Storm water from various parts of the building shall be connected to adjacent drain by a pipe through catch basins. Therefore, it has been calculated to provide 3 rainwater

harvesting pit at selected locations, which will catch the maximum run-off from the area.

1) Since the existing topography is congenial to surface disposal, a network of storm water pipe drains is planned adjacent to roads. All building roof water will be brought down through rain water pipes.
2) Proposed storm water system consists of pipe drain, catch basins and seepage pits at regular intervals for rain water harvesting and ground water recharging.
3) For basement parking, the rainwater from ramps will be collected in the basement storm water storage tank. This water will be pumped out to the nearest external storm water drain.

Rain water harvesting has been catered to and designed as per the guideline of CGWA. Peak hourly rainfall has been considered as 45 mm/hr. Dimensions of the recharge pits are 6.23m × 2.7 m × 3 m will be constructed for recharging the water. Inside the recharge pit, a recharge bore will be constructed having adequate diameter depth. At the bottom of the recharge well, a filter media is provided to avoid choking of the recharge bore. Design specifications of the rain water harvesting plan are as follows:

- Catchments/roofs would be accessible for regular cleaning.
- The roof will have smooth, hard and dense surface which is less likely to be damaged allowing release of material into the water. Roof painting has been avoided since most paints contain toxic substances and may peel off.
- All gutter ends will be fitted with a wire mesh screen and a first flush device would be installed. Most of the debris carried by the water from the rooftop like leaves, plastic bags and paper pieces will get arrested by the mesh at the terrace outlet and to prevent contamination by ensuring that the runoff from the first 10-20 minutes of rainfall is flushed off.
- No sewage or wastewater would be admitted into the system.
- No wastewater from areas likely to have oil, grease, or other pollutants has been connected to the system.

Calculations for storm water load

Roof-top area = Ground Coverage = 7465 m^2
Green Area = 5092.4 m2
Paved Area = Total Plot Area – (Roof-top Area + Green Area)
=19694– (5092.4+ 7465)

= 7136.6 m^2

Runoff Load

Roof-top Area = 7465× 0.045× 0.9
= 302.33 m^3/hr

Green Area = 5092.4 × 0.045 × 0.15
= 34.37 m^3/hr

Paved Area = 7136.6 ×0.045 ×0.7
= 224.8 m^3/hr

Total Runoff Load* = (302.33+34.37+224.8) m^3/hr
= 561.5 m3/hr

Taking 15 minutes Retention Time, total volume of storm water = 561.5 /4
=140. 4 m^3

The effective length, breadth and depth of a Recharge pit are 6.23 m, 2.7 and 3.0 m respectively. Volume of a single Recharge pit (a) = L X B X H = 6.23m × 2.7 m × 3 m

= 50.463 m3

Hence No. of Rain Water Harvesting pit required = 140.4/50.463

= 2.7 say 3

3Rain Water Harvesting pit has been proposed for artificial rain water recharge within the project premises.

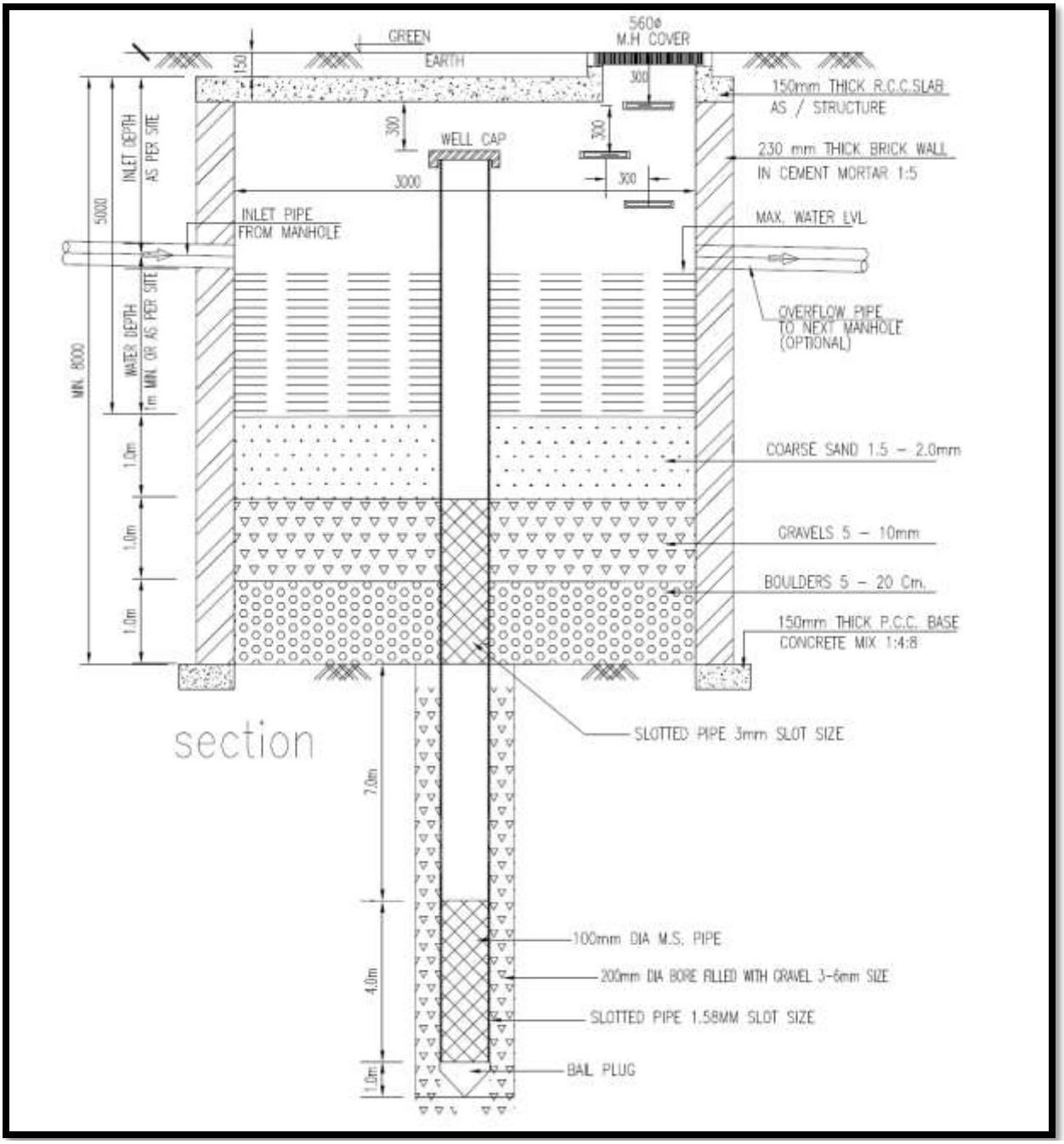

Figure 4: Rain Water Harvesting Pit Design

VEHICLE PARKING FACILITIES

Adequate provision will be made for car/vehicle parking at the project site. There shall also be adequate parking provisions for visitors so as not to disturb the traffic and allow smooth movement at the site.

As per MoEF&CC Norms:

For **Medical Facilities** = 1 ECS / 2 beds
= 733/2
= **366 ECS**

As per DDA Norms:

For **Public/Semi-Public facilities** = 1.0 ECS / 100 m^2 FAR
= 1.0 x 24669/100
= **246 ECS**

Parking Proposed:

S.NO	PARTICULAR	AREA PROOPSED FOR PARKING (m^2)	AREA REQUIRED (m^2)/ECS	CALCULATION	ECS PROPOSED
1	OPEN SURFACE PARKING + BASEMENT	12190	23	12190/23	**733**
					733

POWER REQUIREMENT

The power supply is supplied by Delhi State Electricity Board / Delhi Vidyut Board. The total connected load for this Project has been estimated at about 5000 kVA.

Details of D.G Sets

Power backup has been proposed for the hospital project. DG Sets (Total No. of DG Sets with Capacity) (Existing +Expansion)
– 2 sets of 600kVA (existing)- 1200 kVA
- 3 sets of 1000 kVA (proposed)- 3000 kVA

SOLID WASTE GENERATION

Solid waste would be generated both during the construction as well as during the operation phase. The solid waste expected to be generated during the construction phase will comprise of excavated materials, used bags,bricks, concrete, MS rods, tiles, wood etc. The following steps are proposed to be followed for the management solid waste:

- Construction yards are proposed for storage of construction materials.
- Remaining soil shall be utilized for refilling / road work / rising of site level at locations/ selling to outside agency for construction of roads etc.

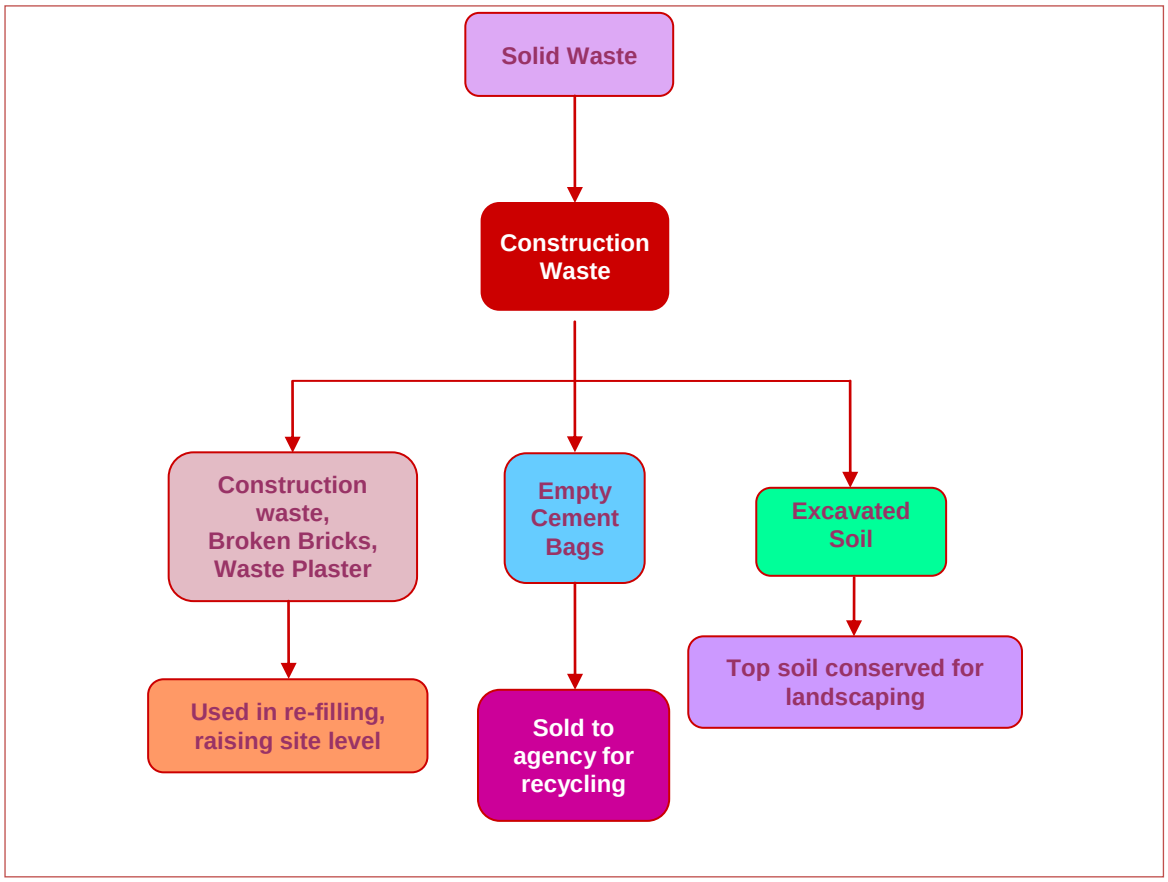

Figure-6: Solid Waste Management Scheme (Construction Phase)

The solid waste generated during operation phase of the project shall be approx. 1487 kg/day forHealthcare unit (@1.5 kg per capita per day for Inpatients, @ 0.5 kg per capita per day for the staff (doctors + nurses), @ 0.15 kg/day form the out-patients, ETP sludge and STP sludge). It is estimated that there will be a Bio medical waste generation of approx. 206.25kg/day. Following arrangements will be made at the site in accordance to Municipal Solid Wastes (Management and Handling) Rules, 2016 and Bio-Medical Waste (Management and Handling) Rules, 2016.

Table 9: Calculation of Solid Waste Generation for total area of the Project

S. No.	Category	Waste (Kg/capita/day)	Waste generated (kg/day)
1.	Inpatients	733@ 1.5 kg/day	1099.5
2.	Staff (Doctors + Visitors)	392@ 0.5 kg/day	196
3.	Out-Patients	875@ 0.15 kg/day	131.25
5.	Landscape waste (1.25 acre)	@ 0.2 kg/acre/day	0.3
	Total Municipal (domestic) Waste Generated		**1427.05 kg/day**
6.	STP Sludge		8.3
7.	ETP Sludge		3.2
	Total Solid Waste Generated		**1438.5 kg/day**
8.	Total estimated Bio-Medical waste	@ 25% of the waste generated from IPD beds	**274. 8 kg/day.**

**As per the Bio-medical waste (Management and Handling) Rules, 2016*

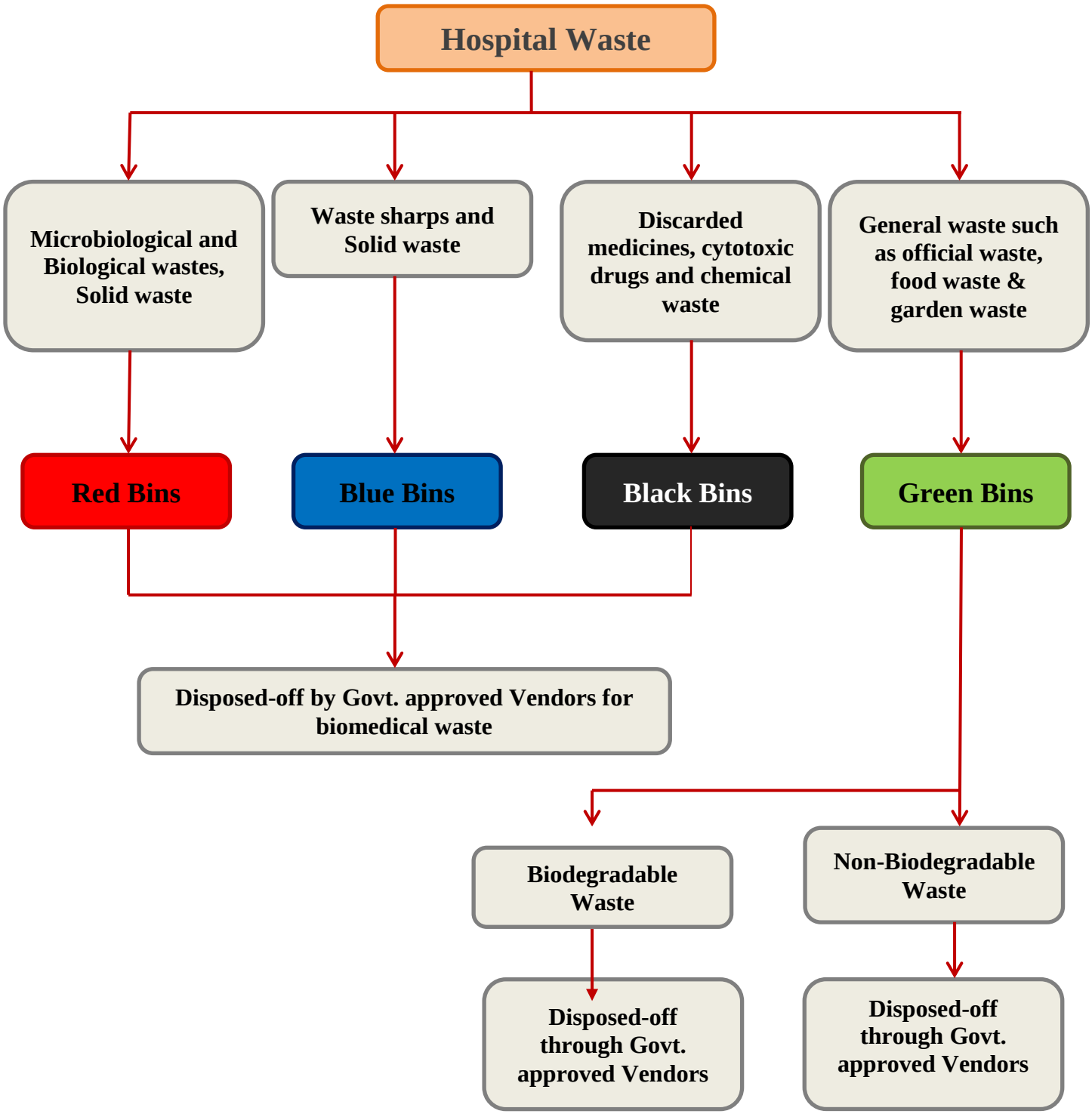

Figure-7: Solid Waste Management (Operation Phase)

- **Collection and Segregation of waste**

1. For Hospital waste collection, adequate numbers of colored bins (Red, Yellow, Black, Blue and dark blue bins) are proposed to be provided at the strategic locations of the Hospital area.
2. Red bins:For the disposal of IV tubings, plastic bottles, syringes without needles, drainage tubes, catheters, locally autoclaved microbiological waste.
3. Yellow bins: For the disposal of anatomical parts, amputated body parts, placenta. Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, bedding, other material contaminated with blood.
4. Black bins: For the discard of paper, wrappers, tissue and other general items.
5. Blue bins: For the disposal of glass bottles, ampoules, broken glass, vials, other glass items.
6. Dark Blue bins: For the disposal of sharps. Does not contain disinfectant. Includes needles, stillet, lancets and blades.

- **Treatment of waste**

- Bio-Degradable wastes

1. Bio-degradable waste will be disposed-off through a govt. approved vendor for decomposition.
2. STP sludge is proposed to be used for horticultural purposes as manure.
3. ETP sludge is proposed to be sold out through Govt. vendors.
4. Horticultural Waste is proposed to be composted and will be used for gardening purposes.

- Recyclable wastes

i. Grass Recycling – The cropped grass will be spread on the green area. It will act as manure after decomposition.
ii. Recyclable wastes like paper, plastic, metals etc. will be sold off to recyclables.

- **Disposal**

Recyclable and non-recyclable wastes will be disposed through Govt. approved agency. Hence, the Municipal Solid Waste Management will be conducted as per the guidelines of Municipal Solid Wastes

(Management and Handling) Rules, 2016. Bio-Medical waste will be disposed through the govt. approved vendors for Bio-Medical waste. Bio-Medical waste management will be conducted as per the Bio-Medical Waste (Management and Handling) Rules, 2016.

GREEN AREA

Total green area measures 5092.4 m^2 for the project which will include green belt/area under tree plantation and lawns within the project site. Following is the list of species proposed to be planted.

Table 10: Speciesproposed to be planted within the premises

S. No.	Scientific Name	Common Name
1	*Bougainvillea spectabilis*	Bougainvillea
2	*Ficusbenjamina*	Weeping fig
3	*Delonixregia*	Gulmohar
4	*Alstoniascholaris*	Black board tree
5	*Dypsislutescens*	Areca Palm
6	*Hyophorbelagenicaulis*	Bottle Palm
7	*Cycas Palm*	Cycas Palm
8	*Caryotaurens*	Fish tail Palm
9	*Arecaceae*	Palm
10	*Bauhinia blakeana*	Bauhinia Trees
11	*Durantaerecta*	Duranta Shrub
12	*ThevetianeriifoliaJuss*	Yellow Kaner
13	*BambusaTextilisGracilis*	Bamboo clumps
14	*Saracaasoca*	Ashoka tree

DETAILS OF CONSTRUCTION MATERIALS

List of building materials being used at site:

1. Coarse sand
2. Fine sand
3. Stone aggregate
4. Stone for masonry work
5. Cement
6. Reinforcement steel
7. Pipe scaffolding (cup lock system)
8. Bricks
9. CLC fly ash blocks
10. Crazy (white marble) in grey cement
11. P.V.C. conduit
12. MDS, MCBs
13. PVC overhead water tanks
14. 2 1/2'' thick red colour paver tiles
15. PPR (ISI marked)
16. PVC waste water lines
17. S.W. sewer line up to main sewer
18. PVC rain water down take
19. Joinery hardware- ISI marked

MATERIALS USED FOR CONSTRUCTION & THEIR U VALUES

Table 11: List of construction materials

Type of Construction	U Values (in W/m^{2}deg C)
WALLS:	
Bricks:	
Plastered both sides-114mm	3.24
Solid, Unplastered-228mm	2.67
Plastered both sides-228mm	2.44
Concrete, ordinary, Dense:	
-152mm	3.58
-203mm	3.18
Concrete block, cavity, 250mm (100mm + 50mm), outside rendered, inside plastered	
Aerated concrete blocks	1.19

Hollow concrete block, 228mm, single skin outside rendered, inside plastered	
Aerated concrete blocks	1.70
Roofs pitched:	
Tiles, slates on boarding and felt with plaster ceiling	1.70
Roofs flat:	
Reinforced concrete slab, 100mm, screed 63-12mm, 3 layers, bituminous felt	3.35
Floors:	
Concrete on ground or hardcore fill	1.13
+GranoTerazzo or tile finish	1.13
+Wood block finish	0.85
WINDOWS:	
Exposure South, Sheltered:	
Single glazing	3.97
Double glazing 6mm space	2.67

LIST OF MACHINERY USED DURING CONSTRUCTION

1. Dumper
2. Concrete mixer with hopper
3. Excavator
4. Concrete Batching Plant
5. Cranes
6. Road roller
7. Bulldozer
8. RMC Plant
9. Tower Cranes
10. Hoist
11. Labour Lifts
12. Pile Boring Machines
13. Concrete pressure pumps
14. Mobile transit mixer