PROJECT REPORT
CE412A
NAME : KAUSHAL KUMAR JHA
ROLL : 200498

PROBLEM STATEMENT : A developer has 100 acres of land available for development. The design period is 20 years, i.e., 2022 – 2041. It is stipulated that 30 percent of the available land area may be used for development of residential and commercial spaces, 10 percent be used for roads and other infrastructural facilities, and the remaining 60 percent be maintained as a park. Allowable Floor Area Ratio (FAR) is 2.5. Assume that 75 percent of the built up area will be used for residential purposes.

OBJECTIVE : To design unit operations and processes for producing potable water quality from turbidity and pathogen –free water supply which will be adequate at the end of the design period. Water is available from a river flowing near the site.

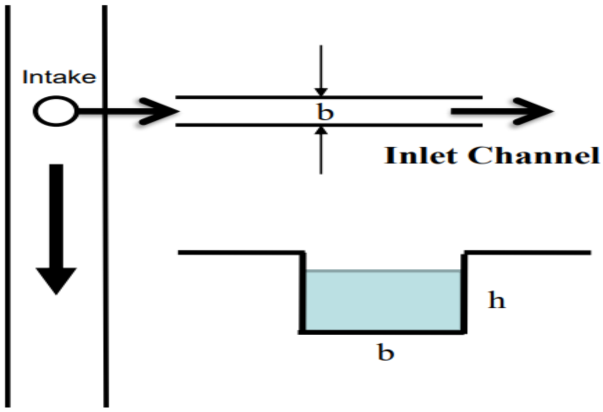
ESTIMATION OF POPULATION

Land available	100	acres		Given
Built-up area	30	acres	30 % of available land area	Calculated
FAR	2.5			Given
Allowable floor area	250	acres	2.5(available land area)	Calculated
Allowable floor area	1,011,500	m²	1 acre = 4046 m²	Calculated
Average building height	8	stories	$\frac{Allowable\ floor\ area}{Built\text{–}up\ area}$	Calculated
Residential Area	758,625	m²	75% of allowable floor area	Calculated
Population Density	25	m²/person		Given
Population in 2041	***30,345***	persons	$\frac{Residential\ area}{Population\ density}$	Calculated

ESTIMATION OF WATER DEMAND IN 2041

Domestic Water Demand	235	lpcd		Given
Average Domestic Demand	7.13	MLD	$235.(30345)/10^6$	Calculated
Temporary Population	10000			Given
Temporary Water Demand	60	lpcd	As per IS 1172	Given
Average Temporary Demand	0.6	MLD	$60.(10000)/10^6$	Calculated
Commercial Water Demand	3.57	MLD	50 percent of domestic demand	Calculated
Horticulture Demand	1.21	MLD	(0.5/100).60.(4046)/1000	Calculated
Average Daily Demand	12.51	MLD	Average Daily Demand = Domestic + Temporary + Commercial + Horticultural	Calculated
Maximum Daily Demand	**22.52**	**MLD**	(1.8)(Average Daily Demand)	Calculated
Peak Hourly Demand	37.53	MLD	3(Average Daily Demand)	Calculated
Fire Demand	0.55	ML	Fire Demand (in m^3) = 100(Population in thousands)$^{0.5}$	Calculated
Duration of Storage	6	hours		Choose
Total Storage	4.30	ML	(Maximum Hourly Demand – Maximum Daily Demand)*Storage time + Fire Demand	Calculated

INLET CHANNEL DESIGN



No particle <2.5 mm in diameter must settle in the inlet channel

Scouring Velocity Vsc	0.805	m/s	4[gd(ps-p)/p]^0.5	Calculated

Inlet Channel Design :

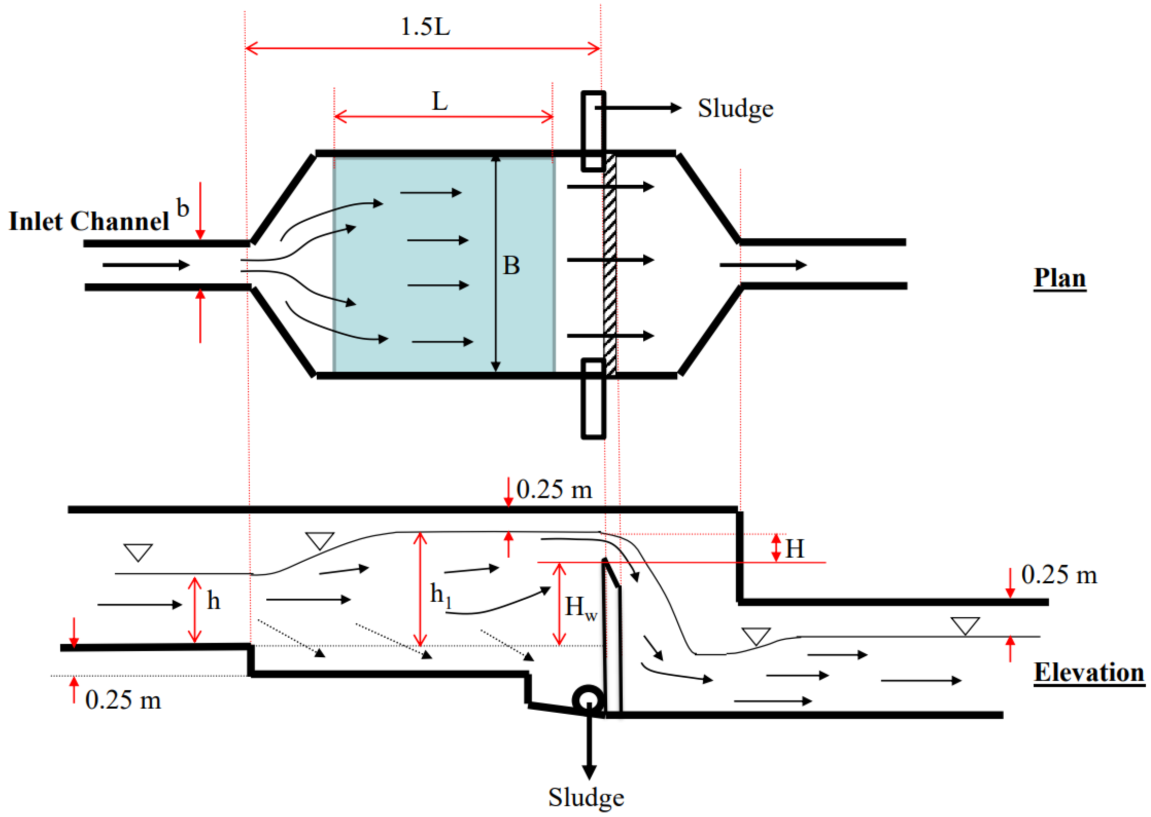
Design Flow	22.519	MLD		Given
	0.261	m^3/s		Given
Manning Coefficient	0.012			Given
Channel Slope	0.005			Given
Breadth	0.20	m		Given
Radius	0.916	m	(b.h)/(b + 2.h)	Calculated
Flow Cross Section	0.218	m^2	b.h	Calculated
Height	1.09	m		Calculated
Flow Velocity	1.197	m/s	Q/A	Calculated

Flow Velocity > Vsc, Hence our calculation is okay

SILT EXCLUDER

All particles greater than 0.25 mm diameter must settle in the silt extruder

Flow Rate(Q)	0.261	m^3/s		Given
Height of weir(H_W)	1.1	m		Given
Cw	0.95			Given
Width(B)	0.90	m		Choose
Height of flow over weir(H)	0.168	m	$Q=C_w(2g)^{1/2}B.H^{3/2}$	Calculated
Total Height of Flow(H1)	1.268	m	$H1=H_w+H$	Calculated
Horizontal velocity(v_H)	0.228	m/s	Q/(H1.B)	Calculated
Settling velocity(v_s)	0.032	m/s	$v_s=\frac{g(\rho_p-p)d^2}{18\rho v}$	Calculated
Detention time(T)	40.03	s	$T=h/v_s$	Calculated
Length(L)	9.14	m	$L=T.v_H$	Calculated
Length provided(L_{prov})	13.71	m	50% extra length	Calculated



PRIMARY SEDIMENTATION TANK (PST) DESIGN

a) Design of settling zone

To remove particles upto 20 μm size completely.

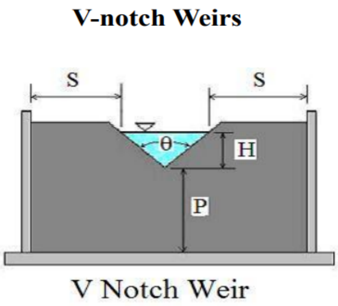
Flow rate (Q)	0.261	m^3/s		Calculated
Design SOR	30	$m^3/m^2/d$	A PST is generally designed with SOR of 30-50 $m^3/m^2/d$	Assume
Surface Area (A_s)	751.68	m^2	$\frac{Q}{SOR}$	Calculated
Surface Area (A_s)	760	m^2		Provided
No. of Tanks	2			Provided
Area of each Tank	380	m^2	$\frac{Total\ Surface\ Area}{No.\ of\ Tanks}$	Provided
Length(L)	25.33	m	$\frac{As}{B}$	Calculated
Width(B)	15	m	3 - 25 m	Given
L/B	1.69		1.0 - 7.5 (Okay)	Calculated
Depth(D)	4	m	3 - 5 m	Choose
L/D	6.33		4.2 - 25.0 m (Okay)	Calculated
Total Volume(V)	3040	m^3	V = (No. of Tanks)(LBD)	Calculated
Detention time(T)	3.24	hr	T = V/Q	Calculated
Scouring Velocity(V_{SC})	3.47×10^{-4}	m/s	Numerically equal to the SOR value	Calculated
Horizontal Velocity(V_H)	2.2×10^{-3}	m/s	$V_H = Q/2BD$	Calculated

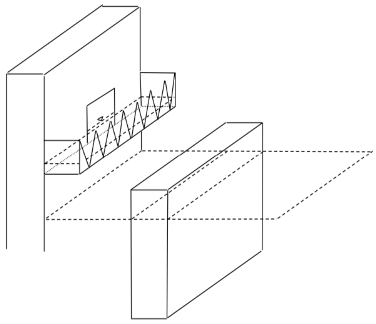
Here, $V_H > V_{SC}$

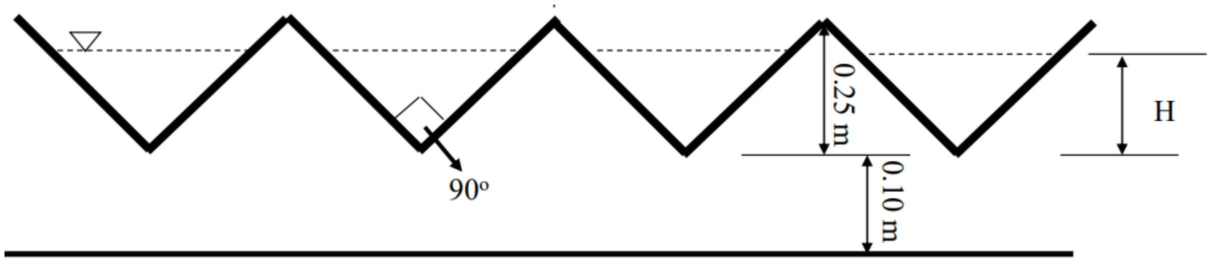
So we can provide L = 30 m , B = 15 m, D = 4 m

Hence Okay.

b) Design of Inlet Weir







$$Q = C_e.\tan(\theta/2).(H + k)^{5/2}$$, with H in m, θ in degrees and Q in m³/s,

$$k = 0.3048[0.0144902648 - (0.00033955535)\theta + (3.29819003 \times 10^{-6})\theta^2 - (1.06215442 \times 10^{-8})\theta^3] \text{ m}$$

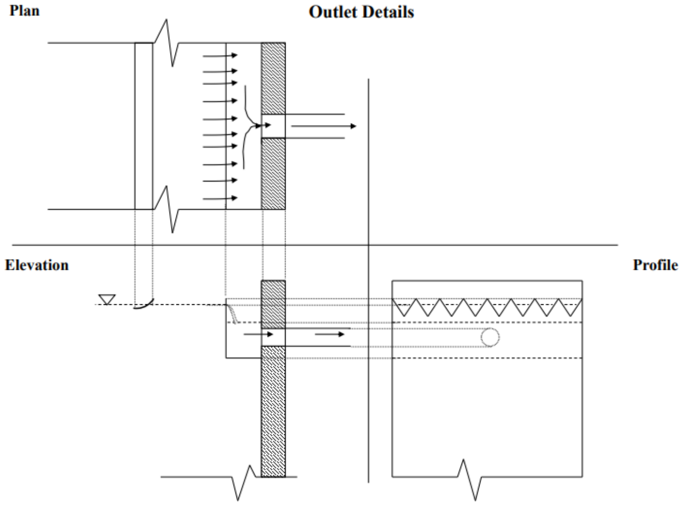
$$C_e = 2.36.[0.607165052 - (0.000874466963)\theta + (6.10393334 \times 10\text{-}6)\theta^2]$$

Design flow Q = 22.51 MLD = 0.261 m³/s

Weir Loading Rate	31.32	m³/m/h	Q/2B	Calculated
Length of weir(l)	*30*	m	No. of tanks × Width of tank = 2B	Calculated
Top width of weir	*0.5*	m	$\frac{Length\ of\ weir}{No.\ of\ weir} = \frac{30}{60}$	Calculated
Angle of V-notch	*90*	degrees		Given
No. of Weirs	*60*			Given
Flow per weir	4.35×10^{-3}	m³/s	$\frac{Design\ flow}{No.\ of\ weir}$	Calculated
Ce	1.429		Using formula	Calculated
k	4.26×10^{-3}	m	Using formula	Calculated

Depth of flow through weir, H	9.94	cm	$Q = C_e.\tan(\theta/2).(H+k)^{5/2}$	Calculated
Height of V-notch above inlet channel bed(h)	10.00	cm		Given
Width of weir channel(b)	1	m		Given
Detention time in weir channel(t)	22.91	sec	lb(H+h)/Q	Calculated

c) Design of outlet Weir



Weir Loading Rate	*12.50*	*m³/m/h*	*10-15 m³/m/h*	*Choosed*
Length of weir(l)	*75*	*m*	$\frac{Design\ flow}{Weir\ loading\ Rate}$	*Calculated*
Top width of weir	*2*	*m*	$\frac{No.\ of\ weirs}{Length\ of\ weir}$	*Calculated*
Angle of V-notch	*90*			*Given*
No. of Weirs	*150*			*Given*
Flow per weir	1.74×10^{-3}	*m³/s*	$\frac{Design\ flow}{No.\ of\ weirs}$	*Calculated*
Ce	1.429		*Using formula*	*Calculated*
k	4.26×10^{-3}		*Using formula*	*Calculated*
Depth of flow through weir, H	*6.86*		$Q = C_e.\tan(\theta/2).(H+k)^{5/2}$	*Calculated*
Height of V-notch above inlet channel	*10.00*	*cm*		*Given*

bed				
Width of weir channel(b)	*1*	*m*		*Given*
Detention time in weir channel(t)	*48.5*	*sec*	lb(H+h)/Q	*Calculated*

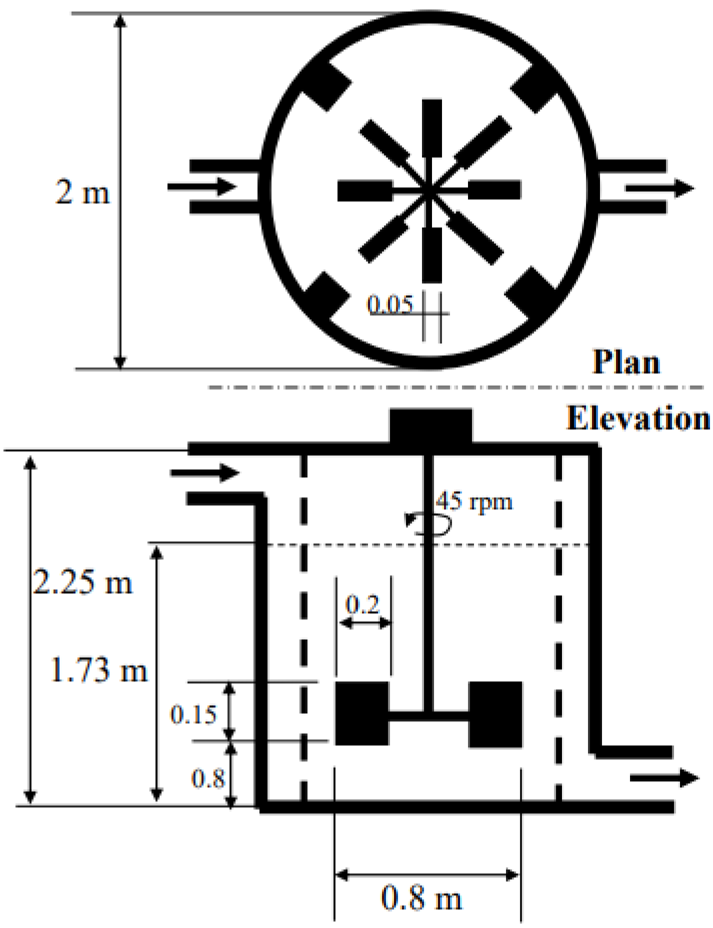
d) Primary sludge production

Q	0.261 22.51	m^3/s MLD		Given
Influent suspended solids concentration	750.00	mg/L		Given
Effluent suspended solids concentration	150.00	mg/L		Given
Mass of solids in sludge(daily basis)	13511	kg/d	(750 – 150).22.52	Calculated
Density of solids in sludge	2650	kg/m^3		Given
Volume of solids in sludge(daily basis)	5.10	m^3/d	= 13511/2650	Calculated
Percent solids in sludge	4.00	%		Given
Mass of sludge (daily basis)	337781	kg/d	= (13511/4).100	Calculated
Mass of water in sludge(daily basis)	324270	kg/d	= (337781 – 13511)	Calculated
Density of water	1000	kg/m^3		Given
Volume of water in sludge(daily basis)	324.27	m^3	= (324270/1000)	Calculated
Total volume of	***0.33***	***MLD***	= 324.27 + 5.10 = 329.37 m^3 = 0.33 MLD	Calculated

sludge(daily basis)				
Density of sludge	***1025.54***	***kg/m³***	= 337781/329.37	Calculated

DESIGN RAPID MIX

Design of a Rapid Mix Tank: Vertical Shaft Impeller



Vertical Shaft Impeller Design :

Detention time (t)	20-60	seconds
Ratio of tank height (H) to diameter (D)	1:1 to 1:3	
Ratio of impeller diameter (D_1) to tank diameter (D)	0.2:1 to 0.4:1	
Velocity gradient (G):	>300 /s	

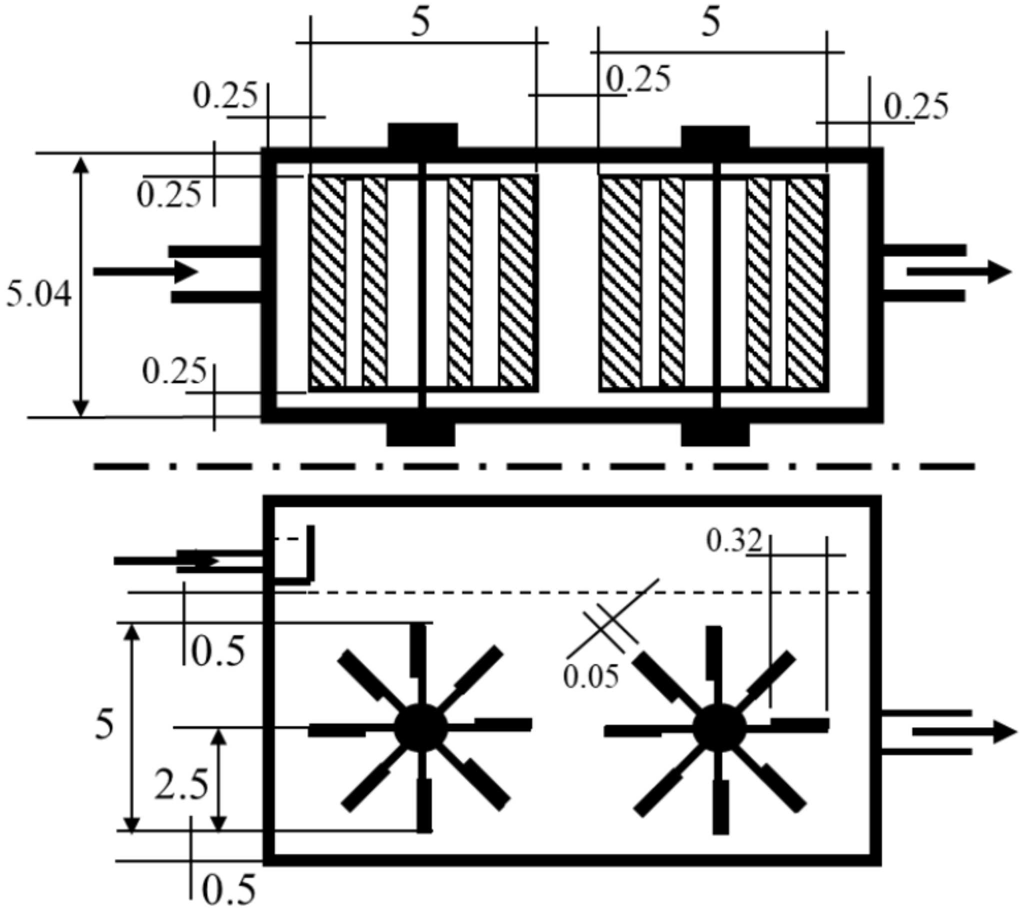
Gt	10000-20000	
Tank diameter (D)	< 3 m	
Blade tip speed (vp)	1.75 – 2.0	m/s
Velocity of blade relative to water (v)	0.75 x paddle tip speed	
Blade area (Ap)/Tank section area (A_T)	10:100 – 20:100	
Coefficient of drag on impeller blade (C_D)	1.8	
Maximum length of each impeller blade (L)	0.25 x impeller diameter	
Maximum width of impeller blade (B)	0.20 x impeller diameter	
Blade thickness	5	cm
Impeller height from bottom (H_B)	1.0 x impeller diameter	
Kinematic viscosity	1.003×10^{-6}	m^2 /s
Dynamic viscosity of water	1.002×10^{-3}	$N.s/m^2$

Solutions:

Water Supply (Q)	22.52	MLD		Given
	0.261	m^3/s		
t	20	s	between 20 – 60 s	choose
V	5.22	m^3	t.Q	Calculated
D	2	m		choose
A_{cs}	3.14	m^2		Calculated
H	1.6624	m	V/A_{cs}	Calculated
Freeboard	0.5	m		Choose
H_T	2.1624	m		
H/D	0.8312		(in the range 0.33 – 1.0)	Calculated
G	400	s^{-1}	>300 s_{-1}	Choose
G.t	16000		(in the range 10000 –	Calculated

			20000)	
blade tip speed (v_p)	1.8	m/s	((in the range, 1.75 – 2.00 m/s)	Choose
Velocity of the blade relative to water (v)	1.35	m/s	0.75.(1.8)	Calculated
A_p	0.378	m^2	$G = \left\{ \frac{C_d.A_p.v^3}{2.\nu.V} \right\}^{1/2}$;	Calculated
Tank sectional area (A_T)	3.3248	m^2	D.H	Calculated
A_p / A_T	0.1137		(between 0.10 – 0.20)	Calculated
Impeller diameter	0.8	m		Choose
D_I/D	0.4		(between 0.2 – 0.4)	Calculated
Length of each impeller blade (L)	0.20	m		Choose
L/D_I	0.25		(upto 0.25)	Calculated
Breadth of each impeller blade (B)	0.15	m		Choose
B/D_I	0.1875		(upto 0.20)	Calculated
Area of each blade	0.03	m^2		Calculated
Blade thickness	5	cm		
Number of blades to be provided	13			
Clearance of the paddles from the tank bottom	0.8	m		
Paddle rotation speed (w)	4.5	radians/s	2.v_p /D_I	Calculated
	45	revolutions/min		
Power requirement (P)	836.87	W	G = $[P/(V.\vartheta)]^{1/2}$	Calculated

DESIGN OF FLOCCULATION TANK: HORIZONTAL SHAFT PADDLE



Horizontal Shaft Paddle Design Problem:

Horizontal-shaft flocculation tank unit for flocculation of 22.52 MLD of settled raw water (after coagulant addition in a rapid mix tank) as per design parameters given below:

Detention time (t)	10-30	min
Velocity gradient (G)	20-75	/s
Gt	2×10^5-6×10^5	
Paddle tip speed (v_p)	0.25-0.75	m/s
Velocity of blade relative to water (v)	0.75 x paddle tip speed	
Paddle area per shaft/Tank section area	10:100 – 20:100	
Coefficient of drag on impeller blade (CD)	1.8	

The paddle shafts are provided across the width of the flocculation tank Paddle diameter	2-5	m
Length of each paddle (L)	2-5	m
Width of each paddle (B)	22-50	cm
Paddle thickness	5	cm
Bottom clearance	50	cm
Submergence	50	cm
Freeboard	50	cm
Side clearance of paddles	25 on each side	cm

End clearance of paddles	25 on each side	cm
Kinematic viscosity	1.003×10^{-6}	m^2/s
Dynamic viscosity of water	1.002×10^{-3}	$N.s/m^2$
Tank depth	Paddle diameter + submergence + bottom clearance	
Tank width	Paddle length + 2.(End clearance)	

Minimum number of paddles shafts provided	2	
Minimum number of paddle in each shaft	4	
Maximum horizontal distance between paddle shafts	2.(Paddle diameter) + 1m	m
Minimum horizontal distance between paddle shafts	2.(Paddle diameter) +0.25 m	m
Tank length to width ratio	2:1 to 6:1	

Solution:

Detention time (t)	20	minutes	(within 10-30 minutes)	choose
Velocity gradient (G)	30	/s	(within 20-75 /s)	choose
G.t	36000		(within 20000 – 60000)	Calculated
Volume of the tank (V)	313.2	m^3	t.Q	Calculated
Paddle diameter (D_p)	5	m	(within 2-5 m)	choose
Depth of the tank (D)	6	m	Paddle diameter + submergence + bottom clearance	Calculated
Surface Area of the tank (A)		m^2		Calculated
Length of the tank (L)	10.75	m	2.(end clearance) + 2.(paddle diameter) + 0.25	Calculated
Tank width (W)		m		Calculated
Length to width ratio	2:1			Calculated
Paddle length (Lp)	5	m	tank width -2.(End clearance)	Calculated
Paddle tip speed (v_p)	0.40	m/s	(within 0.25 – 0.75 m/s)	choose
Velocity of paddle relative to water (v)	0.30	m/s		Given
Total paddle area (A_p)		m^2		Calculated
Paddle area per shaft		m^2		Calculated
Tank sectional area		m^2		Calculated
paddles				choose
Area of each paddle				
Breadth of each paddle (B_p)			(Range: 22 - 50 cm)	

Paddle thickness	5	cm		Given
Paddle rotation speed (w)	0.16	radians/s	2Vp/Dp	Calculated
	1.53	revolutions/min		
Power requirement (G)		Watts	G= P/V	Calculated

RAPID SAND FILTER DESIGN

Design Parameters

Filter Depth:	60 cm
Filtration Rate:	8-12 m_3/m_2/hr (take 10 m_3/m_2/hr)
Filter Run Time:	7.5 hours
Terminal Head loss:	~3 m
Length:	< 7 m
Length: Width Ratio:	1.3-1.5: 1
Water Depth on top of filter:	up to 3 m
Freeboard:	0.5 m
Under drainage Depth:	1.5 m (Including gravel support and chamber)
Back wash Rate:	1 m_3/m_2/min
Backwash Time:	5 minutes
Diameter of sand:	0.5 mm
Influent/effluent Turbidity	10/<1 NTU

A filter unit will be off-line for 30 minutes during each backwash operation.

Total water to be filtered is more than 22.52 MLD, since filter backwash is cycled back to the head for the flocculation tank and filtered again

Total water produced	24128.45	m^3	TIme = 22.5 hrs, Using 107.23 m^2 filter

Cross-sectional area of each filter	13.40	m^2	Calculated
Filter backwash	1608.45	m^3/d	Calculated

L = 4.25 m; B = 3.15 m L/B = 1.35 (okay)

24128.45 m^3 filtered in 22.5 hours

1608.45 m^3 filtered in 1.50 hours = 90 minutes

Water (for consumption) actually produced by a filter for 22.5 – 1.5 = 21 hours

In 21 hours of useful operation per day, the filter produced 22520 m^3 of water

The filter produces further 1608.45 m^3 of water in 1.5 hours of operation to be used for backwashing Further, the filter is off-line (producing no water) for 1.5 hours a day for backwashing.

Filter Run Schedule:

	1st Cycle		2nd Cycle		3rd Cycle		
	Start	**Stop**	**Start**	**Stop**	**Start**	**Stop**	
Filter 1	00:00	07:30	08:00	15:30	16:00	23:30	
Filter 2	01:00	08:30	09:00	16:30	17:00	00:30	
Filter 3	02:00	09:30	10:00	17:30	18:00	01:30	
Filter 4	03:00	10:30	11:00	18:30	19:00	02:30	
Filter 5	04:00	11:30	12:00	19:30	20:00	03:30	
Filter 6	05:00	12:30	13:00	20:30	21:00	04:30	
Filter 7	06:00	13:30	14:00	21:30	22:00	05:30	
Filter 8	07:00	14:30	15:00	22:30	23:00	06:30	

Daily Operating Schedule of Filter 1:

	Backwash Water Production Period	**Volume of Backwash Water Produced (m^3)**	**Filtered Water Production Period**	**Volume of Filtered Water Produced (m^3)**	**Backwash Period**
Cycle 1	00:00 – 00:30	67	00:30 – 07:30	938	07:30 – 08:00
Cycle 2	08:00 – 08:30	67	08:30 – 15:30	938	15:30 – 16:00
Cycle 3	16:00 – 16:30	67	16:30 – 23:30	938	23:30 – 00:00
	Total:	**201**	**Total:**	**2814**	

Similar schedules can be made for the other filters also

Backwash Tank Input / Outputs

Time Period	Back wash water production		Backwashing	
	Filter	Time	Filter	Time
00:00 – 01:00	F1 – C1	00:00 – 00:30	F2 – C3	00:30 – 01:00
01:00 – 02:00	F2 – C1	01:00 – 01:30	F3 – C3	01:30 – 02:00
02:00 – 03:00	F3 – C1	02:00 – 02:30	F4 – C3	02:30 – 03:00
03:00 – 04:00	F4 – C1	03:00 – 03:30	F5 – C3	03:30 – 04:00
04:00 – 05:00	F5 – C1	04:00 – 04:30	F6 – C3	04:40 – 05:00
05:00 – 06:00	F6 – C1	05:00 – 05:30	F7 – C3	05:30 – 06:00
06:00 – 07:00	F7 – C1	06:00 – 06:30	F8 – C3	06:30 – 07:00
07:00 – 08:00	F8 – C1	07:00 – 07:30	F1 – C1	07:30 – 08:00
08:00 – 09:00	F1 – C2	08:00 – 08:30	F2 – C1	08:30 – 09:00
09:00 – 10:00	F2 – C2	09:00 – 09:30	F3 – C1	09:30 – 10:00
10:00 – 11:00	F3 – C2	10:00 – 10:30	F4 – C1	10:30 – 11:00
11:00 – 12:00	F4 – C2	11:00 – 11:30	F5 – C1	11:30 – 12:00
12:00 – 13:00	F5 – C2	12:00 – 12:30	F6 – C1	12:30 – 13:00
13:00 – 14:00	F6 – C2	13:00 – 13:30	F7 – C1	13:30 – 14:00
14:00 – 15:00	F7 – C2	14:00 – 14:30	F8 – C1	14:30 – 15:00
15:00 – 16:00	F8 – C2	15:00 – 15:30	F1 – C2	15:30 – 16:00
16:00 – 17:00	F1 – C3	16:00 – 16:30	F2 – C2	16:30 – 17:00
17:00 – 18:00	F2 – C3	17:00 – 17:30	F3 – C2	17:30 – 18:00
18:00 – 19:00	F3 – C3	18:00 – 18:30	F4 – C2	18:30 – 19:00
19:00 – 20:00	F4 – C3	19:00 – 19:30	F5 – C2	19:30 – 20:00
20:00 – 21:00	F5 – C3	20:00 – 20:30	F6 – C2	20:30 – 21:00
21:00 – 22:00	F6 – C3	21:00 – 21:30	F7 – C2	21:30 – 22:00
22:00 – 23:00	F7 – C3	22:00 – 22:30	F8 – C2	22:30 – 23:00
23:00 – 00:00	F8 – C3	23:00 – 23:30	F1 – C3	23:30 – 00:00
	Total backwash water production: 1608 m^3 / d (67.0 m^3 in each hour)		Total backwash water utilization: 1608 m^3 (67 m^3 in each hour)	

Summary of Operational Details

Eight filters in operation in parallel

Of these, one filter is employed for producing backwash water in the first half-hour of every hour

The backwash water produced as above is used to backwash a filter in the second half hour of every hour

Thus, water is effectively being produced by seven filters every hour

Total Filters	8	
Amount of backwash water produced	67	m^3
Backwash tank capacity	70	m^3
Water production per hour	134	m^3 / filter
Water production per day	22.52	MLD

DISINFECTION CHLORINATION

The water quality after rapid sand filtration was as follows :

Turbidity	<1	NTU	
BOD5	3	mg/L	imparts color, odor and taste to water
TKN	2	mg/L	ammonia nitrogen
pH	7.5		

This water is to be chlorinated using chlorine gas.
Enough chlorine must be added to water such that the chlorination objectives are satisfied.

The chlorination objectives are as follows:

1. BOD5 should be oxidized as far as possible, such that color, taste and odor of water is removed.
2. All TKN in water should be converted to N_2 (i.e., breakpoint chlorination), such that free chlorine (HOCl + OCl-) can exist in water.
3. Free chlorine residual in finished water should be 2 mg/L as Cl_2 . This is required as a check against re-contamination of water in the distribution system.
4. 5-Log removal of Giardia cysts is desired.

Given:
1. 1 mg/L chlorine is required to completely oxidize 1 mg/L BOD_5 .
2. 2.0-Log removal of Giardia cysts occur during conventional treatment.
3. “Ct” for 2-Log kill of Giardia cysts at pH 7 using free chlorine is 39 mg/L-min.
4. OCl^- is totally ineffective in killing microorganisms.

BOD_5	3	mg/L		Given
Instantaneous chlorine demand	3	mg/L Chlorine as Cl_2		Calculated
NH_4^+ Concentration in water to be oxidised	2	mg/L (as N)		Given
NH_4^+ Concentration in water	1.428×10^{-4}	moles/L		
Amount of free chlorine required for ammonia oxidation	2.143×10^{-4}	moles/L		
	15.21	mg/L Chlorine as Cl_2		Calculated
Chlorine Demand (up to breakpoint)	18.21	mg/L Chlorine as Cl_2		Calculated
Required free chlorine residual	2	mg/L Chlorine as Cl_2		Given
Total chlorine requirement	20.21	mg/L Chlorine as Cl_2		Calculated

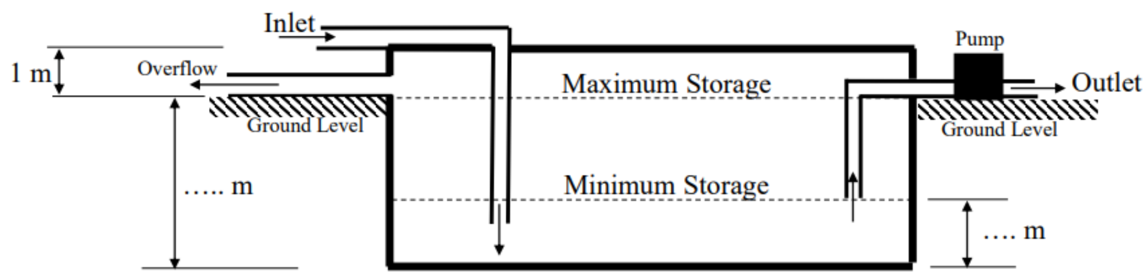
Disinfection objective:
5-Log kill of Giardia cysts required.
2-Log kill achieved through conventional treatment (‘CT’ credit)
3-Log kill is required through disinfection

fraction of HOCl at pH 7 ($F_{7.0}$)	0.759	$\frac{[H^+]}{[K]+[H^+]}$	$\frac{10^{-7}}{10^{-7}+10^{-7.5}}$	Calculated
Fraction of HOCl at pH 7.5 ($F_{7.5}$)	0.500		$\frac{10^{-7.5}}{10^{-7.5}+10^{-7.5}}$	Calculated
At pH 7.0		<u>Using simplified Chick-Watson Law</u>		

Ct	39			Given
λ	6.76×10^{-2}		$2\ (\lambda.F).(C.t)$	Calculated
At pH 7.5		<u>Using simplified Chick-Watson Law</u>		
Ct	89		$3\ (6.76\times10^{-2}).F_{7.5}\ .(Ct)$	Calculated

Required contact time = 89/2 = ***44.5 minutes*** for obtaining a total 5-Log removal. (2-Log removal by conventional treatment + 3-Log kill by disinfection) of Giardia Cys

UNDERGROUND STORAGE TANK



Water demand	22.52	MLD		Given
Peak water demand	37.53	MLD		
Total storage capacity (UG and OH tanks combined)	4.30	ML		
Minimum detention time in UG tank (t_{min})	44.4	min	V_{min}/Q_{max}	Calculated
V_{min}	1.16	ML	$T_{min}.Q_{max}$	Calculated
Maximum storage (V_{max})	2300	m^3		Choose
Maximum depth of storage (d_{max})	5	m		Choose
Freeboard	1	m		Given
Surface area	460	m^2		Calculated
Length	23	m		Given

Water demand	22.52	MLD		Given
Breadth	20	m		Given
Minimum depth of storage (d_{min})	2.52	m	(V_{min} / Surface Area)	Calculated

CONCLUSION

I have analysed the available water supply from a nearby river and proposed a treatment process that will effectively remove any suspended particles and pathogens to produce safe drinking water.

The proposed treatment process includes several unit operations such as coagulation, sedimentation, filtration, and disinfection

The designed process will ensure a reliable supply of safe drinking water to the local community. I have also considered future growth and demand in our design, making sure that the treatment process will be adequate at the end of the design period.

Overall, I am confident that the proposed treatment process is effective, efficient, and cost-effective. I recommend that the proposed design be implemented for the production of safe drinking water from the nearby river.