L&T Construction
Water, Smart World & Communication.

Water & Effluent Treatment - SBG, EDRC,
P.O.BOX – 979, MANAPAKKAM, CHENNAI-600 089, INDIA. PHONE : 044-3384 2085
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DRAWING / DOCUMENT TRANSMITTAL

To	Date:	28/1/2016.
Executive Engineer, TWSP Komarambheem-Asifabad Segment, Asifabad Govt. of Telangana.	Our Ref.:	LE 150883 /04.
	Your Ref.:	

Project	Providing drinking water to habitations in Komarambheem-Asifabad Segment in Adilabad District.
Subject	Drawings & Documents Submission.
Kind Attn.	The Executive Engineer, TWSP Komarambheem-Asifabad Segment, Asifabad.

Please find enclosed the following document / drawings for Approval as listed below.

Sl. No.	Description	Drawing/Document No.	Rev. No.	Qty.	Cat.	Type	Remarks
1	Basic Engineering Package for 30 MLD WTP	LE150883-P-WS-WT-BE-2001	B	1	A	SC	
2	Layout Plan for WTP	LE150883-P-WS-WT-PP-2002	B	1	A	SC	
3	Hydraulic Flow Diagram for 30MLD WTP	LE150883-P-WS-WT-HF-2003	B	1	A	SC	

NOTES:

Sl. No	Distribution	Qty.	Cat.	Type	Remarks
1	The Executive Engineer, TWSP Komarambheem-Asifabad Segment, Asifabad	-	I	SC	
2	EPS – BU Head, HQ.	-	I	SC	
3	SGD – Segment Head (South & East), HQ	-	I	SC	
4	PRH – Cluster Head, HYCO	-	I	SC	
5	RKS – Project Manager	-	I	SC	
6	MBS / BRJ – WS&D, EDRC	-	I	SC	
7	CVR / VVK / RR / VP / RR / RPV – WS&D, EDRC	-	I	SC	
8	RKP / LSV – Electrical & Instrumentation BU	-	I	SC	

CATEGORY (Cat.):
A – For Approval
B – As Built
G – Good for Construction
I – For Information
P – Preliminary
T – For Tender Purpose

Type:
CD – Compact Disc
FD – Floppy Disk
PR – Prints
RP – Reproducible
SC – Soft Copy
TR – Tracings
TC – Transmittal Copy
ZD – Zip Disk

Thanking you and assuring you of our best services at all times.

Yours faithfully,

(P. Balakumar).
Head - EDRC, WET SBG, Water & Effluent Treatment,
L&T CONSTRUCTION.

DATE	REV. NO.	DESCRIPTION	Prepared	Checked	Approved
		REVISIONS			
28.01.2016	B	As per consultant comments received by mail dtd. 25.01.2016	28.01.2016	28.01.2016	28.01.2016
30.12.2015	A		SRV	VVK	MBS/ BRJ

L&T CONSTRUCTION
WATER, SMART WORLD & COMMUNICATION

CLIENT :	CONSULTANT :
Govt. of Telangana Rural Water Supply & Sanitation Department	

PROJECT :

Providing drinking water to habitations in KomaramBheem-Asifabad segment in Adilabad district - 30 MLD WTP

SUPPLIER / CONTRACTOR:

L&T CONSTRUCTION - WATER & EFFLUENT TREATMENT SBG

Job No LE150883

	NAME	SIGN	DATE
PRED	SRV	SRV	24.12.2015
CHKD	VVK	VVK	28.12.2015
APPD	BRJ	BRJ	30.12.2015

TITLE :

BASIC ENGINEERING PACKAGE FOR 30 MLD WATER TREATMENT PLANT

DOC.No.	SIZE	REV.
LE1508 83-P-WS-WT-BE-2001	A4	B

RELEASED FOR: ☐ PRELIMINARY ☐ TENDER ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

WET SBG	L&T Construction WATER, SMART WORLD & COMMUNICATION				
	LIST OF CONTENTS				
PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad segment in Adilabad district - 30 MLD WTP		DRAWING/DOCUMENT NO	DATE	28.01.2016
CLIENT	Govt. of Telangana Rural Water Supply & Sanitation Department		LE150883-P-WS-WT-BE-2001	REV	B
CONSULTANT	-		Prepared By	Checked By	Approved By	Sheet 1
JOB NO	LE150883	TITLE CONTENTS	SRV	VVK	BRJ	

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	ii. Hydraulic Flow Diagram for WTP (Drg.No: LE150883-P-WS-WT-HF-2003)	
	iii. Process Flow Diagram (Drg.No: LE150883-P-WS-WT-PF-2004)	

CHAPTER -1

INTRODUCTION

CHAPTER-1

INTRODUCTION

The Telangana Drinking Water Supply Project envisages providing safe, adequate, permanent, sustainable and secured water supply system for covering Rural, Urban and Industrial areas by year 2018 on par with National Rural Drinking Water Supply Guidelines available for Rural Water Supply.

The project objective is to provide safe drinking water at house hold level up to kitchen at the defined and approved norms such that the people need not go to the streets for collection of water from public stand posts or for other modes of facilities.

KomaramBheem Dam is located in Asifabad Mandal of Adilabad district. As this is a dependable source in the vicinity, it is proposed to take water of the Dam as the source for this project.

The water treatment plant of **output capacity of 30 MLD** broadly consists of Cascade Aerator, Stilling Chamber, Pre & Post Chlorination, Parshall flume, Flash Mixer, Chemical dosing systems for alum, Clariflocculator and Rapid Gravity Sand Filters.

The above system has been awarded to Larsen & Toubro, ECC division, Chennai and the scope covers Design, Engineering, Procurement, Supply, Transportation, Construction, Manufacture/Fabrication, Erection, Testing, Painting, Civil work, Mechanical work, electrical work, Piping work, Instrumentation work, Inspection work, Storage at site, Transit & site insurance, Testing & Commissioning, Trial runs and performance guarantee test runs and handling over the entire works on Turnkey basis.

The scope this Basic Engineering and process package is presented in 7 chapters as given in the list of contents and broadly describes various aspects of process and other technical requirements of the water treatment plant.

CHAPTER - 2

PROCESS DESIGN BASIS

CHAPTER - 2

PROCESS DESIGN BASIS

The design, manufacture and performance of the drinking water treatment plant shall be in compliance with the NIT and requirements of Manual of Water Supply, Third Edition 1999 published by the expert committee of Central Public Health & Environmental Engineering Organization, Govt. of India.

The treatment plant scheme shall broadly comprise of coagulation, flocculation, clarification, filtration and disinfection processes for delivering treated water of specified physical, chemical, and bacteriological quality. The design basis considered for the raw water treatment plant is as given below.

The source of raw water is from KomaramBheem Dam in Asifabad Mandal of Adilabad district.

(i). Design output capacity of the plant: **30 MLD**

(ii).The raw water characteristics considered at the inlet of the treatment plant as given below.

1. The raw water characteristics considered at the inlet of the treatment plant are as per the Table-1 and the raw water analysis report attached in **Chapter 6**.

Table -1 (Raw water Quality considered for the design)

Sl. No.	Parameters	Value
1	Turbidity (NTU)	50
2	pH	7.5-8.5
3	Color (Cobalt Scale)	5
4	Total Aluminum	Nil

2. The treated water characteristics for the following parameters shall be as per NIT Specifications.

Colour – 3 or less on Cobalt scale

Turbidity – Not more than 1 NTU

Suspended Solids – Less than 2.5 mg/l

Total Aluminium – Less than 0.2 mg/l

Taste and Odour – Unobjectionable

Coliform organisms MPN /100ml – Nil.

CHAPTER - 3

TREATMENT PHILOSOPHY

CHAPTER - 3

TREATMENT PHILOSOPHY

The water treatment plant is designed for Treated Water Output of **30 MLD in 22 hours.** The Hydraulics of the treatment plant is designed in such a way that water flows by gravity from the cascade aerator to the clear water reservoir and the sludge generated from the Clariflocculator and the filter Backwash water will flow by gravity to the nearest drain through pipeline.

Broadly, the flow scheme shall comprise the following process units:

a) Cascade Aerator
b) Stilling chamber
c) Parshall Flume
d) Flash Mixer
e) Clariflocculator
f) Bypass Channel
g) Rapid Gravity Sand filters
h) Backwash overhead tank
i) Chemical house
j) Chlorination building

PROCESS DESCRIPTION

Broadly the process scheme for the WTP is described below:

The extent of work is to treat raw water from KomaramBheem Dam so as to ensure supply of 30 MLD treated water output @ 22 hours operation.

Cascade Aerator

The raw water is pumped to the inlet of the water treatment plant i.e. the raw water enters the cascade aerator at the inlet of the water treatment plant. The Cascade Aerator is of circular type of concrete construction with an inlet pipe, located at the center. The aerator shall have number of trays/steps. Water is introduced into the top tray through the central feed pipe and moves down successive trays. Air is naturally introduced to the water in such a way that some iron reduction will occur. A collecting launder shall provide to receive the aerated water falling from the lowest tray.

Design Criteria:

B

No of steps provided – 4 nos

Type -Circular

Surface loading rate – 0.015 $m^2/m^3/hr$

Rise between steps – 0.3 m

Stilling Chamber

Stilling chamber is provided to receive the water from cascade aerator and it is provided to avoid the turbulence before the water enters to the parshall flume, where the flow will be measured. The chlorine solution (Pre chlorination) shall be injected by bottom mounted diffuser pipe. This chamber is in R.C.C construction.

Design Criteria:

Retention time – 60 sec

Parshall Flume

Water from the stilling chamber flows through an R.C.C. channel installed with parshall flume of standard design where ultrasonic flow meter is installed to monitor the flow

through the channel. The alum is dosed at the upstream of the channel. The channel is also installed with Turbidity meter.

Flash Mixer

Flash mixer is provided for mixing of alum chemicals and shall be of RCC Construction. Alum is dosed at the upstream of the flash mixer and the tank is installed with agitator for uniform distribution of the chemicals through the water. Chemically mixed water from the flash mixer will flow to the Clariflocculator.

Design Criteria:

No of mixer provided -1 No.

Retention time – 60 sec

Clariflocculator

Clariflocculator is provided with combined coagulation and sedimentation processes effectively taking place in a single unit. The water, flash mixed with chemicals, is fed in the circular flocculation compartment, which is built at the centre and fitted with slowly revolving paddles of 2nos. which rotate on their vertical axis. The Clariflocculator arrangement is based on a central feed, flocculation and clarification. The flocculated water passes out from the bottom of the flocculation tank to the concentric outer clarifying zone, through a wide opening and the suspended particles will settle to the bottom of the clarifier and the clarified water overflows into the peripheral launders with Submerged Orifices through clarified water channel. The flocculation as well as clarification zones are served by inwardly raking rotating blades, hanging from the peripheral driven moving bridge so that the settled sludge is mechanically scraped and will flow by gravity to the nearest Drain.

Design Criteria:

No of Clariflocculators provided -1 No.

B Surface loading rate – 40 $m^3/m^2/day$

Retention time – < 2.5 hrs

Bypass Channel

One RCC channel is provided from Flash Mixer to the filter inlet channel to bypass the Clariflocculator if required. This Filter inlet channel will lead to the rapid sand gravity filters.

Rapid Gravity Sand Filters

The clarified water from clarified water channel or from the bypass channel enters into the filter inlet channel. It is then routed to the rapid gravity filters (declining rate type with manifold and Lateral for under drainage system). Filtration shall be by gravity downwards through a bed of filter sand. The filtered water is collected through the under drain system and flows into an outlet chamber and into the common filtered water channel. The dirty backwash water from filters shall be disposed to the nearest drain.

Design Criteria

No of Filters – 6 nos

Filtration rate – 5.5 m/hr

Type –Declining rate type

Back Wash Tank

When the filter head loss increases due to clogging of the bed, the filters shall be taken on back washing using air and water. There overhead backwash water storage tank sized for two filter washes will deliver the backwash water to filters. The backwash storage tank shall be filled by centrifugal pumps which will take the water from the filtered water channel.

Clear Water Reservoir

The filtered water from the filtered water channel is taken through the channel, which leads upto Clear water Reservoir.

Chemical House

The chemical house is provided for the necessary space for 90 days storage of chemicals.

Alum is used as a coagulant in the removal of raw water turbidity upto maximum 50ppm of dosage of alum is considered as 30 ppm for design.
A two storied chemical house of RCC structure with access to the first floor by means of stairs. Adequate area as per contract requirement shall be provided for the following:

Ground Floor:

- Chemical storage in ground floor for 90 days requirement for an average dosage of 20ppm.

First Floor:

- Chemical dosing tanks (2 nos) and dosing pumps (1W+1S) is provided.

Chlorination Building

Chlorine shall be dosed as disinfectant to eliminate algae and other microbial growths from the water. Pre chlorination in the stilling chamber is found to remove colour, odour & taste and chlorine will also oxidize iron & manganese which is present in raw water.
Post chlorination is to be done at filtered water outlet.

Chlorination building is designed for considering two month storage of chlorine drums.

Pre Chlorinators: 2 Nos (1W+1S)
Post Chlorinators: 2 Nos (1W+1S)
Type: Vacuum
Dosage: 5 ppm for Pre chlorination & 5 ppm for Post chlorination.
Storage: 5 ppm for Pre chlorination & 2 ppm for Post chlorination.

CHAPTER - 4

PROCESS DESIGN CALCULATION

WET SBG	L&T Construction WATER , SMART WORLD & COMMUNICATION				
	PROCESS DESIGN CALCULATIONS- 30 MLD WTP FOR KOMARAMBHEEM-ASIFABAD SEGMENT				
PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad segment in Adilabad district - 30 MLD WTP			DRAWING/DOCUMENT NO	DATE 28.01.2016
CLIENT	Govt. of Telangana, Rural Water Supply & Sanitation Department			LE150883-P-WS-WT-BE-2001	REV B Sheet 10
CONSULTANT				Prepared By	Checked By / Approved By
JOB NO	LE150883	TITLE	PROCESS DESIGN CALCULATIONS	SRV	VVK / BRJ

References:

1. Contract document of KomaramBheem-Asifabad segment in Adilabad district
2. CPHEEO Manual on water supply and Treatment, May 1999 Edition
3. IS 14371-1996. Measurment of Liquid flow in open channels - Parshall and Saniri flumes

The design, manufacture and performance of the Water Treatment plant (WTP) shall be in compliance with the requirements of Manual on Water Supply and Treatment, Third Edition 1999 published by the expert Committee, Central Public Health & Environmental Engineering Organisation, Govt. of India and relevant BIS codes of practice.

Basic Design criteria

Inlet Design Capacity	31.58	MLD
No of hours of operation	22	hours
Raw Water Quality	As per Table-1 in Chapter 2 & Chapter 6	
Treated Water Quality	As per Chapter 2	

Design flow

Outlet Capacity of WTP as per Contract specification	30	MLD
Outlet Flow in terms of cum/hr	1363.64	m3/hr
Inlet capacity of WTP with considering 5% losses	31.58	MLD
Flow in terms of cum/hr	1435.41	Cum/hr.
Flow in terms of cum/sec	0.40	Cum/sec.
Channels, conduits with 20% Overloading	1722.49	m^3/hr

Design Criteria

Cascade Aerator	: Cascade aerator is designed by considering a surface loading area of 0.015 $m^2/m^3/hr$
Stilling Chamber	: It is designed considering a detention time of 60 s .
Parshall Flume	: Designed as per IS code : 14371:1996 " Measurement of Liquid flow in open channels"
Flash Mixer	: Flash mixer is designed by considering a detention time of 60 s
Clariflocculator	: Clariflocculator is designed by considering SLR 40 $m^3/m^2/day$
Gravity Filters	: Filters are designed considering filtration rate of 5.5 $m^3/m^2/hr$ during normal flow rate with all filters in operation (declining rate)
Alum dosing	: Alum Mixing tanks are designed for Maximum dosage of 30ppm & Storage for average dosage of 20 ppm
Chlorination	: Pre & Post chlorination designed for dose of 5.0 ppm & storage of 5 ppm for Pre & 2 ppm for Post chlorination.

All channels including Bypass channel are designed for 20 % Overloading .

1.Cascade aerator

Design flow	1435.41	m^3/hr
No of cascade aerator provided	1.00	no
Flow per cascade aerator	1435.41	m^3/hr
Diameter of influent pipe	0.70	m
Diameter of the inlet bell mouth dia	1.00	m
Area of the bell mouth	0.79	m^2
Number of steps considered	4	nos

B

PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad segment in Adilabad district - 30 MLD WTP		DRAWING/DOCUMENT NO	DATE	28.01.2016
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	Size of tread considered	0.70	m
	Rise/spacing between steps	0.3	m
	Total Height of Fall	1.2	m
	Surface loading rate considered	0.015	$m^3/m^3/hr$
	Total Area Required	21.53	m^2
	Total area required including bell mouth	22.32	m^2
	Diameter of the Bottom Most Step	5.4	m
	Total Area Provided	22.91	m^2
B	**Size of Collection Launder**		
	Flow in Launder at Normal Condition	717.70	m^3/hr
	Velocity in Launder considered	0.70	m/s
	Cross Section Area	0.28	m2
	Width of the Launder Considered	0.55	m
	Side Water Depth/Height	0.5	m
	Free Board in Launder	0.30	m
	Flow in Launder at 20% Overloading Condition	861.24	m^3/hr
	Velocity in Launder considered	0.90	m/sec
	Cross Section Area	0.27	m^2
	Width of Launder considered	0.55	m
	Side Water Depth/Height	0.49	m
	Side water Depth considered	0.50	m
	Free Board in Launder	0.30	m

SIZE:	W(m)	LD (m)	FB (m)
Launder Size:	0.55	0.50	0.30

B	**At normal flow condition the velocity of the launder is 0.7m/s and at overloading condition the velocity is 0.9m/s.**		
	Diameter of each Cascade provided inclusive of Central Influent Pipe		
B	Diameter of the 1st cascade	1.2	m
	Diameter of the 2nd cascade	2.6	m
	Diameter of the 3rd Cascade	4.0	m
	Diameter of the 4th Cascade	5.4	m
	Diameter of Cascade aerator including launder	6.5	m

PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad segment in Adilabad district - 30 MLD WTP	DRAWING/DOCUMENT NO	DATE: 28.01.2016
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JOB NO: LE150883	TITLE: PROCESS DESIGN CALCULATIONS	SRV	VVK / BRJ

SIZE:	Dia (m)	H (m)	Steps nos.	Tread (m)	Rise (m)
Aerator Size:	5.40	1.2	4.0	0.7	0.3

2. Stilling Chamber

No. of Units	1	nos.
Total Design flow	1435.4	m^3/hr
	0.40	m^3/s
Detention time considered	60	s
Volume of the chamber required	23.94	m^3
Liquid depth considered	2.9	m
Area of stilling chamber required	8.26	m^2
Length of chamber required	2.87	m
Length of chamber considered	2.9	m
Width of chamber required	2.9	m
Volume of the chamber provided	24.39	m3
Free Board in chamber	0.3	m

SIZE:	L (m)	W (m)	LD (m)	FB (m)
Chamber Size	2.9	2.9	2.9	0.3

3. Raw Measuring channel with Parshall Flume

No. of Channel	1.00	No
Velocity through channel is considered as	0.50	m/s
Normal Flow to the channel	0.40	m^3/s
Flow with 20% overloading	0.48	m^3/s
Area of channel required	0.96	m^2
Channel depth considered	0.80	m
Width of channel required	1.2	m
Width of the channel provided	1.2	m
Free Board in channel	0.3	m

SIZE:	W(m)	LD (m)	FB (m)
Channel Size:	1.20	0.80	0.30

WET SBG	PROCESS DESIGN CALCULATIONS- 30 MLD WTP FOR KOMARAMBHEEM-ASIFABAD SEGMENT				
PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad segment in Adilabad district - 30 MLD WTP			DRAWING/DOCUMENT NO	DATE 28.01.2016
CLIENT	Govt. of Telangana, Rural Water Supply & Sanitation Department			LE150883-P-WS-WT-BE-2001	REV B Sheet 13
CONSULTANT				Prepared By	Checked By / Approved By
JOB NO	LE150883	TITLE	PROCESS DESIGN CALCULATIONS	SRV	VVK / BRJ

	Parshall Flume		
	Reference:		
	IS 14371:1996:" Measurement of Liquid Flow in Open channels - PARSHALL and SANIIRI FLUMES"		
	Flow to the Parshall flume	0.48	m^3/s
	As per Table 3 and Table 4 of IS 14371,1996 , for parshall flume no. 4		
	Hence as per the code,		
	Width of flume	1020	mm
	Throat width for parshall flume	450	mm
	4. Flash Mixer		
	No. of Units provided	1	no.
	Design flow per unit	1435.41	m^3/hr
	i.e	0.40	m^3/s
	Detention time considered	60	s
	Volume required	23.92	m^3
	Liquid depth considered	3.5	m
	Area of flash mixer required	6.84	m^2
	Length & Width of Flash mixer required & provided	2.7	m
	Volume of the flash mixer provided	25.52	m^3
	Free board in tank	0.3	m

SIZE:	L (m)	W (m)	LD (m)	FB (m)
Tank Size	2.7	2.7	3.5	0.3

	Detention time with 20% overloading	53.33	secs
	As per CPHEEO Manual, detention time for Flash Mixer shall range from 30-60 s	Hence O.K	
	5. Clariflocculator		
	Flocculator		
	Total design flow	1435.41	m^3/hr
	No.of Units	1	Nos.
	Design flow capacity per Unit	1435.41	m^3/hr
	Flocculation zone of Clariflocculator		
B	Retention time considered	30	min
	Volume of flocculator required	717.7	m^3
	Side water depth considered	3	m
	Plan area required for the flocculator	239.23	m^2

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	Velocity through central column is considered as	0.6	m/s
	Inside dia of central column arrived	1	m
	Consider wall thickness for central column and flocullator wall as	0.2	m
	Outer dia of Central column	1.4	m
	Area for the central column :	1.54	m^2
	Total area required for flocculator including central pipe =239.23+1.54=	240.77	m^2
B	Inside Diameter of the flocculator required	17.51	m
	Inside Diameter of the flocculator provided	17.60	m
	Plan area for the flocculator	243.28	m^2
	Volume of flocculator required	729.84	m3
	say	730	m^3
	Assume thickness of partition wall	0.3	m
	Flocculator outside Dia =17.6 + 2 x 0.3	18.2	m
	Area of flocculator including walls	260.02	m^2
	Volume provided in the flocculator including walls	780.06	m^3

Size of Flocculator:	Inside Dia. (m)	LD (m)	FB (m)
	17.6	3.0	0.3

	Clarifier:		
B	Surface Loading rate at rated capacity considered	40.0	$m^3/day/m^2$
	i.e	1.67	$m^3/hr/m^2$
	However provided SLR	1.67	$m^3/hr/m^2$
	Clarifier Area required : (1435.41/1.67)	861.2	m^2
	Total Area of clariflocculator required = 861.2+260.02	1121.22	m^2
	Dia of clariflocculator	37.8	m
	Provide dia of clariflocculator as	39.0	m
	Size of Clariflocculator : 39 m Dia x 3 m SWD + 0.3 m F.B		
	Area provided for clarification	933.96	m^2
	Detention time for Clariflocculator	2.8	hrs
B	**Note: The actual Surface Loading Rate for the provided dia. of Clariflocculator is 37 $m^3/day/m^2$**		
	Opening Port		
	Consider velocity in port	0.6	m/s
	Total area of port = 1435.41/3600/0.6	0.67	m^2
	Considering 4 nos of ports, area of each port	0.17	m^2
	Assume width of port	0.45	m

WET SBG	L&T Construction WATER , SMART WORLD & COMMUNICATION			
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	Depth of port	0.38	m
	Provided depth of port	0.4	m
	Provide 4 ports of size 0.45 m (W) X 0.40 m(H)		
	Clariflocculator launder sizing		
	Flow to Clariflocculator Launder with 20% overloading	1685.45	m^3/hr
	Flow to one half of the launder = 1685.46/2=	842.73	m^3/hr
		0.24	m^3/s
	Velocity considered	0.75	m/s
	Area of the flow	0.31	m^2
	Width of the launder considered	0.6	m
	Liquid depth arrived	0.55	m
	Size of the clariflocculator launder		
	0.6 m (W) x 0.55 m L.D		
	Clariflocculator overflow arrangement (Submerged orifice hole arrangement)		
	Flow with 20% overloading	1685.45	m^3/hr
	Velocity considered for sizing of orifices	0.21	m/s
	Hence, total area of orifice holes required	2.2294	m^2
	Diameter of each orifice hole considered	63	mm
	Hence cross-sectional area of each orifice hole	0.00312	m^2
	Hence total no. of orifices required	**716.00**	**Nos.**
	Wetted perimeter of one orifice hole	0.20	m
	Total wetted perimeter = Total weir length	141.71	m
	Actual weir loading rate obtained	11.89	$m^3/hr/m$
	Less than	12.5	$m^3/hr/m$
		Hence O.K	
	Peripheral Diameter of launder	117.81	m
	Hence C-C distance between orifice holes required	**164.5**	**mm**
	6. Bypass Channel / Clarified Water Channel		
B	**Flow in Channel at Normal Condition**	0.40	m^3/s
	Velocity through channel considered	0.7	m/s
	Area	0.56	m2
	Liquid Depth	0.75	m
	Width of the channel	0.75	m
	Free board in channel	0.30	m

	Flow in Channel at 20% Overloading Condition	0.48	m3/s
	Velocity through channel considered	0.90	m/s
	Area	0.53	m^2
	Liquid depth (LD)	0.75	m
	Width of channel required	0.71	m
	Width of channel provided	0.75	m
	Free board in channel	0.30	m

SIZE:	W (m)	LD (m)	FB (m)
Channel Size:	0.75	0.75	0.30

B At normal flow condition the velocity of the channel is 0.7m/s and at overloading condition the velocity is 0.9m/s.

7. Filter Inlet Channel

	No of channels	2	nos
	Normal Flow into the channel	0.20	m^3/s
	Flow into channel with 20% overloading	0.23	m3/s
	Velocity through channel considered	0.41	m/s
	Area	0.57	m^2
	Width of channel considered	0.40	m
	Liquid depth required	1.43	m
	Liquid depth provided	1.45	m
	Freeboard in channel	0.30	m

SIZE:	W(m)	LD (m)	FB (m)	No of Channel
Channel Size:	0.40	1.45	0.30	1.0

8. Rapid sand Gravity filters

	Type of filter	Declining rate	
	Input flow to the filter	1404.55	m^3/hr
	No. of Twin Bed Filters	6	nos.
	Design flow per bed	234.09	m^3/hr
	Rate of filtration considered	5.5	m/h
	Area of filtration required	42.56	m^2
	Length of twin bed filter considered	7.60	m
	Length of one bed	3.80	m
	Width of each bed required	5.6	m

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Width of the bed provided	5.6	m
Length to Width ratio provided	1.36	
As per CPHEEO clause 7.6.3.5 the L/B ratio of filter bed shall be 1.11 to 1.66		
averaging about 1.25 to 1.33		
Area of each twin bed filter provided	42.56	m^2
Rate of filteration adopted	5.50	m/hr
Central Gullet width of filter bed	1	m
Filtration rate when 1 filter is taken out for backwashing	**6.6**	**m/h**

SIZE of (Twin Bed)	L (m)	B (m)	Area of bed (m2)	Total No of beds
	7.60	5.6	42.56	6
SIZE of (Single Bed)	L (m)	B (m)	Area of bed (m2)	
	3.80	5.6	21.28	

9. Filter Gates & pipe size

(i) Filter Inlet gate size		
Flow to each filter with filtration rate of 8.5m/hr.	361.8	m^3/hr
	0.10	m^3/sec
Velocity considered	1.00	m/sec
Area	0.10	m^2
	0.32	m
Inlet gate size provided	**350*350**	**mm**
(ii) Filter Outlet valve size		
Flow from each filter with filtration rate of 8.5m/hr.	361.8	m^3/hr
	0.10	m^3/sec
Velocity considered	0.90	m/sec
Area	0.112	m^2
Dia	0.377	m
Filter Outlet Valve size provided	**400**	**mm**
(iii)Backwash Inlet valve size		
Backwash flow	638.4	m^3/hr
	0.177	m^3/sec
Velocity considered	3.50	m/sec
Area	0.05	m^2

	Dia	0.254	m
	Backwash inlet valve size provided	~~300~~ 300	**mm**
	(iv) Backwash Outlet Gate		
	Backwash flow	638.4	m^3/hr
		0.18	m^3/sec
	Velocity considered	1.80	m/sec
	Area	0.10	m^2
		0.314	m
	Backwash outlet gate size provided	**350 x 350**	**mm**
	Filter Media Specifications		
	Depth of sand bed provided	600	mm
	Depth of gravel	300	mm
	The depth of water over the top of sand media	~~1.80~~ 1.70	m
	Estimation of sand depth (Ref : Page 634 of CPHEEO Manual May 1999 Edition)		
	Assume the depth of sand as 600mm and effective size of sand as 0.6mm		
	The sand depth can be checked against break through of floc through sand bed by		
	calculating minimum depth required using Hudson formula		
	$Qd^3/l = 39323\ B$		
	Q : *Rate of filtration in m3/m2/hr*		
	: *11 m3/m2/hr considering 100% overloading of*		
	filter under exigencies		
	d : *Sand size in mm - 0.6mm (Mean diameter)*		
	h : *Terminal head loss in M - 2.5M*		
	(Under exigency condition)		
	B : *Break through index, $4x10^{-4}$* considered for poor		
	response to filtration and average degree of pre treatment		
	Therefore Sand depth (l) =	0.51	mm
	Hence Assumed depth of 600 mm is sufficient to avoid breakthrough of floc		
	Depth of sand provided	0.60	m
	Depth of gravel provided	~~0.30~~ 0.40	m
	Total depth of filer media provided	~~0.90~~ 1.0	m

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	10. Under drain system (Manifold & Laterals)		
	Plan area of the filter	21.28	m2
	Total area of perforations (0.3% of filters)	0.06	m^2
	Size of perforations	12	mm
	Total no. of perforations	564.78	Nos.
	say	566	Nos.
	Total c/s area of laterals	1787.60	cm2
	Area of central manifold	2681.4	cm2
		58.43	cm
		0.63	m
	Central manifold of 630 mm dia HDPE pipe		
	Assume spacing of laterals	20	cm
	No. of laterals required	56.00	Nos.
	No. of laterals provided	56.00	Nos.
	c/s area of laterals	31.9	cm2
	Dia of laterals	6.38	cm
	Provided dia of laterals	**75**	**mm**
	11. Back Wash Water Overhead Tank		
	Rate of Back wash Flow considered for overhead tank sizing	**30.00**	**$m^3/hr/m^2$**
	Tank designed for considereing one filter backwash volume		
	Area of one twin bed	42.56	m^2
	Backwash water flow rate required for one twin bed	1276.9	m^3/hr
	Duration of Back wash considered for water	10	min
	Backwash water flow rate required with water for one twin bed	212.81	m^3
	Total volume of backwash water required for two filter beds	425.6	m^3
	Water required for miscellaneous purposes like chemical dilution, flushing etc.	21.3	m^3
	Hence total Backwash tank volume considered as	446.9	m^3
	Consider Liquid depth of backwash water tank as	3.00	m
	Area of the Tank	148.97	m^2
	Hence diameter of the Tank required	13.77	m
	Diameter of the Tank provided	13.8	m
	Area of the tank provided	149.57	m^2
	Free board	0.30	m
	Volume of Tank Provided	449	m^3

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Backwash tank shall be provided as an independent structure

Size of tank	Diameter (m)	Liquid Depth (m)	F.B (m)
	13.8	3.0	0.30

12. Filter Backwashing		
Air Backwash		
No. of blowers considered	2	nos.
No. of working blowers	1	nos.
Area of each half of filter bed	21.28	m2
Rate of Air Backwash	40	$m^3/hr/m^2$
Air Flowrate reqired	851.2	m^3/hr @ 0.35 kg/cm^2
Air flowrate provided	900.0	m^3/hr @ 0.35 kg/cm^2
Velocity in air wash pipe	25	m/sec
Area of pipe Required	0.01	sqm
Diameter of air wash pipe required	0.113	m
Provided diameter of air pipe	150	mm
Backwash Water Pumps		
Backwash Pumps considered seperately to fill the Backwash Tank	2	nos.
No. of working pumps	1	no.
Capacity of each Backwash pump provided in two hrs to fill the tank	224.4	cum/hr
Pump capacity provided	225.0	m^3/hr
at tentative head	20.00	m
Backwash Trough		
Rate of flow of backwash	30.00	$m^3/m^2/hr$
Backwash water discharge from one half of bed	638.4	m^3/hr
	0.09	m^3/sec
Trough Space assumed	1.60	m
No of troughs	4.00	Nos
Discharge per trough	0.02	m^3/sec
Backwash water discharge Q = 1.376bh^1.5		
Assume width of trough, 'b' as	0.20	m
Depth	0.187	m
Total depth provided is	0.30	m

	Trough size provided	0.2 mW x 0.30 m Ht	
	13. Dirty Backwash Channel		
	Dirty Backwash Flow to the channel	638.4	m^3/hr
	Total flow for which the Dirty Backwash Channel has to be sized	638.4	m^3/hr
		0.18	m^3/sec
	Velocity considered	1.50	m/sec
	Area of Channel required	0.12	m^2
	Considering width of Channel	0.40	m
	Depth of Channel	0.30	m
	Depth of Channel provided	0.30	m
	Freeboard in channel	As per HFD	m

SIZE:	W(m)	LD (m)	FB (m)
Channel Size:	0.40	0.30	As per HFD

	DirtyBackwash Water from Channel will be disposed to near by drain.		
	14. Filtered Water Channel		
B	**Flow in channel at Normal Condition**	1363.64	m3/hr
	Flow through Channel	0.38	m3/s
	Velocity considered	0.7	m/s
	Area of the channel	0.53	m2
	Width of the channel	0.75	m
	Depth of the channel	0.7	m
	Free board in channel	0.30	m
	Flow in channel at 20% Overloading Condition	1636.36	m^3/hr
	Flow through Channel	0.45	m^3/s
	Velocity Considered	0.90	m/sec
	Area of Channel	0.51	m2
	Width of Channel	0.75	m
	Depth of Channel	0.67	m
	Depth of Channel provided	0.70	m
	Free board in channel	0.30	m

SIZE:	W(m)	LD (m)	FB (m)
Channel Size:	0.75	0.70	0.30

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B	**At normal flow condition the velocity of the channel is 0.7m/s and at overloading condition the velocity is 0.9m/s.**		
	15. Chemical House		
	Alum dosage		
	Alum dosage rate	30	mg/l
	Alum requirement per day	947.40	Kg/day
	Alum requirement per hour	43.1	Kg/hr
	Strength of Alum solution	10.00	%
	Volume of 10% Alum solution required	0.43	m^3/ hrs
	Detention Time	12.00	Hrs
	Volume required for 12 hours capacity	5.20	m^3
	Liquid Depth considered	1.75	m
	Free Board considered	0.30	m
	Plan area required	2.97	m^2
	Length and Width of the Tank (Square Tank)	1.72	m
	Length of the Tank	1.75	m
	Width of the Tank	1.75	m
	No. of Tanks	2	Nos

Size of tank:	L (m)	W (m)	LD (m)	FB (m)	No of tanks
	1.75	1.75	1.75	0.30	2

	Alum Storage Area Required :		
	Alum reqd. (100 %) for one day at 22 hours operations (Consider 20 ppm)	631.58	Kg/day
	Alum reqd. (100 %) for 90 days at 22 hours operations	56842	Kg /3 month
		56.80	Tonnes
	Considering bulk density of Alum : 1.1 T / m3	51.60	m^3
	Storage area required for stack ht. of 2 m	25.80	m^2
	Three months storage area provided	26.00	m^2
	Dosing System for Alum:		
	No of Pumps : 2 (1W+1S)	2	Nos (1W+1S)
	Capacity of Alum Dosing Pump required	430.0	LPH@ 20 m head

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	16. Chlorination		
	Pre Chlorination		
	Flow rate considered	1435.41	m^3/hr
	Max. Dose of chlorine considered	5	mg/L
	Quantity of chlorine reqd. per hr.	7.2	kg/hr
	Therefore capacity of chlorinator provided	8.0	kg/hr
	No. of Chlorinator	2.0	nos.
	No. of Chlorinator Provided (working)	1.0	nos.
	No. of Chlorinator Provided (stand by)	1.0	nos.
	Chorine required for 60 days of Pre Chlorination for average dose of 5.0 mg/L	9473.68	kg/ for 2 month
	Post Chlorination		
	Flow rate considered	1363.64	m^3/hr
	Max. Dose of Chlorine considered	5.0	mg/L
	Quantity of Chlorine reqd. per hr.	6.8	kg/hr
	Capacity of each Chlorinator	7.0	kg/hr
	No. of Chlorinator Required	2.0	nos.
	No. of Chlorinator Provided (working)	1.0	nos.
	No. of Chlorinator Provided (stand by)	1.0	nos.
	Chorine required for One month of post chlorination for average dose of 2.0 mg/L	3600	kg/for 2 month
	Total Chlorine required for 60 days considering average dose of 5.0 mg/l for Pre & 2.0 mg/l for Post Chlorination	13073.68	kg
	Assuming 930 kg per tonner, no of tonners required	14	nos
	Hence no.of tonners to be provided	14	nos
	No of tonners in one row	7.0	nos

"Designs Vetted"

M/s. S.K. Associates HYD-8

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CHAPTER - 5

HYDRAULIC CALCULATIONS

PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad Segment in Adilabad district 30 MLD WTP			DRAWING/DOCUMENT NO	DATE	28.01.2016.
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In this Chapter hydraulic flow calculations have been carried out to fix the hydraulic levels of various units to ensure smooth gravity flow of water from Cascade aerator to Clear Water Reservoir

REFERENCES :

1. Layout Plan for WTP (Drawing No. -LE150883-P-WS-WT-PP-2002)
2. CPHEEO - Manual on Water Supply and Treatment , May 1999 Edition
3. Top Water Level (TWL) of Clear Water Reservoir is taken as 279.36 m
4. Levels shall be transferred to Hydraulic Flow Diagram of WTP (Dwg No. LE150883.-P-WS-WT-HF-2003)
5. Two levels of FGL 279.5 & 280 considered for the Water Tratment Plant.

A) Following formula is used for arriving head loss due to fittings :

$$H_{L(f)} = KV^2 / 2g$$

Where,

K = Resistant co-efficient

V = Velocity of flow in m/sec

g = Acceleration due to gravity in m/sec^2 = 9.81 m/sec^2

The 'K' factor for valves and fittings are taken from CPHEEO manual

B) For gravity flows in open channels / circular conduits Manning's formula shall be used for arriving Head loss

$$V = 1/n \times R^{2/3} \times S^{1/2}$$

Where,

V = Velocity of flow in m/sec

n = Manning's co-efficient of roughness

R = Hydraulic radius in m

S = Slope of hydraulic gradient

Top water level (TWL) of CWR is taken as 279.36 m

As per clause 6.2.2 of CPHEEO Manual on Water Supply & Treatment, For general design purposes the Manning's co-efficient value of all sizes may be taken as of 0.013 for plastic pipes / 0.015 for other pipes / RCC channel - 0.014

C)Discharge through a rectangular weir is calculated by

$$Q = \frac{2}{3} Ce\sqrt{2gbe}\, H^{1.5}$$

where,

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be = effective width = Actual width of weir (b) + K (Value of k being 2.5 mm, 3 mm and 4 mm for b/B ranges of upto 0.4, 0.4 to 0.6 and 0.6 to 0.8 respectively

b/B = ratio of the width of the notch to the width of the channel

H = effective head = actual head measured (h) + 1 mm

g= acceleration due to gravity

C_e = varies from 0.58 to 0.7 for values of b/B from 0 to 0.8

D) Flow through pipes can be calculated by Modified hazen Williams Formula

$$h = [\,L(\frac{Q}{C_f})^{1.81}\,] / 994.62\, D^{4.81}$$

Where,

V= Velocity of flow in m/s;

C_f= pipe roughness coefficient; (1 for smooth pipes; <1 for rough pipes)

r = hydraulic radius in m;

s = friction slope;

D = internal diameter of pipe in m

h = friction head loss in m

L = length of pipe in m; and

Q = flow in pipe in m^3/s.

E) A following formula is used for arriving Head loss due to Launder

Critical depth at the end of Launder

$y_2 = (q/b)\ ^2/g)\ ^\ (1/3)$

Liquid depth at the upper end of the Launder

$y_1 = y2^2 + (2(q'\ LN)\ ^2\ /\ (GB^2y2)\ ^\ (1/2)$

Following K Values are used for arriving head loss	
Entrance Shape well rounded	0.50
Sudden Contractions	0.3 - 0.5
90 deg. Bend	0.75
45 deg. Bend	0.4 - 0.75
Tee 90 deg. Take off	1.50
Coupling	0.30
Gate valve	0.3 - 0.4
Butterfly valve	0.30
Orifice plate	1.00
Globe valve	10.00
Ball valve	0.50
Check valve	2.50
T-Type strainer	2/3.5

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	Diaphragm valve	2.30	
	Sluice gate	0.62	
	Entry to pipe	0.50	
	Exit to pipe	1.00	
1	**Head loss between Filtered Water pipe to Clear Water Reservoir (CWR)**		
	Top water level (TWL) of CWR is taken as	279.36	m
	$h = [\, L(\frac{Q}{Cr})^{1.81} \,] / 994.62\, D^{4.81}$		
	c).Head Loss in Filtered water channel (FWC):		
	Design flow in filtered water channel	1636.36	m^3/hr.
	Channel size selected		
	Width of channel	0.75	m
	Liquid depth of channel	0.70	m
	Velocity of water	0.9	m/s
	Length considered for head loss (as per layout)	68	m
	Using Manning's formula , n for concrete	0.014	
	Slope,S	0.00059	
	Loss of head	0.04	m
	Losses due to 90 deg. Bend $h=kv^2/2g$	0.03	m
	Total no of bend	1.00	no
	Total loss due to all bend	0.03	m
	Total losses	0.10	m
	Provided free fall of 0.3m	0.30	m
	Total losses between filtered water channel to CWR provided	0.4	m
	TWL of Filtered Water Channel	279.76	m
	Depth of the Filtered Water Channel	0.70	m
	Invert level of Filtered Water Channel	279.06	m
2	**Head Loss between filter control chamber & filter water channel**		
a.	**Head loss between filter control chamber and FWC provided with weir arrangement**		
	Flow over the weir	0.08	m^3/s
	Width of the weir	1.00	m
	Head over the Weir [Q = (2/3) C L (2g)^0.5 H^1.5, where C=0.624)]	0.12	m
	Head over the weir	0.12	m
	However, TWL at filter control chamber provided is	280.13	m
	Depth of Filter Control Chamber	1.0	m
	Invert level of Filter Control Chamber	279.13	m
	Provided free fall of 0.15mm from FWC to weir	0.15	m
	Weir Crest Level	280.01	m

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b.	**Head loss due to 90^0 bends**		
	Consider pipe dia as	400	mm
	Velocity of flow	0.8	m/s
	h=kv^2/2g		
	h = 0.75 x 0.8^2 / (2x9.81)	0.025	m
	No. of bends	2	nos
	Total loss of head	**0.05**	m
	Head loss due to pipe entry		
	Pipe size considered as	400	mm
	Velocity of flow	0.8	m/s
	Head loss due to pipe entry H=KV^2/2g	**0.017**	m
	Head loss due to pipe exit		
	Pipe size considered as	400	mm
	Velocity of flow	0.8	m/s
	Head loss due to pipe exit H=KV^2/2g	**0.033**	m
	Head loss due to orifice		
	V=Cdx(2gh)^1/2		
	Assume velocity as	0.6	m/s
	Cd	0.62	
	Head loss in orifice	**0.05**	m
c	**Head loss due to Filter Outlet Valve (Butterfly valve)**		
	Velocity	0.8	m/s
	h=KV^2/2g		
	h =0.3 x 0.8^2 / (2x9.81)	0.010	m
	Head loss due to outlet valve	**0.010**	m
d.	**Head Loss in the Filter Bed**		
	Initial Head Loss of Filter :(Ref: CPHEEO Manual)		
	For Design purpose sieve analysis of filter sand is considered as follows		

Sandsize , mm	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.45
% Sand smaller than stated size	0.0	2.0	10	27	50	70	90	100

Porosity of sand bed considered	0.4	
Sphericity of sand	1.0	

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Head loss for a clean filter is determined using Kozeny's equation for stratified beds

$$\frac{h}{l}=\frac{kV}{g}\nu\frac{(1-f)^2}{f^3}\left[\frac{6}{\varphi}\right]^2\sum_{i=1}^{n}\frac{p_i}{d_i^2}$$

Where,

h= head loss in m

l = depth of sand bed — 0.6 m

K = Carmen Kozeny constant — 5

V = Velocity of filtration — 0.0167 cm/s

v = Kinematic viscosity of water — 1.01E-02 cm^2/s

f = porosity of clean bed — 0.4

Ψ = grain sphericity — 1

P_i = Fraction of sand

d_i = geometric mean diameter of sand

Size of sand	% of sand larger than stated size	Sand fraction within adjacent sieve size p_i x100	d_i / 100 cm x	$\frac{p_i}{d_i^2}$
0.3	0	2	3.5	16
0.4	2	8	4.5	40
0.5	10	17	5.5	56
0.6	27	23	6.5	54
0.7	50	20	7.5	36
0.8	70	20	9	25
1	90	10	12	7
1.4	100	0	-	-
		100		234

h/l — 0.041 m

h — 0.03 m

Hence Total Head Loss — 0.235 m

Top level of the sand is considered as 150 mm less than the Weir Level — 279.86 m

However for dirty condition of bed a maximum head loss of 1.8 m is considered, before backwash. — 1.8 m ✓

Hence TWL of the Filter Bed is — 281.66 m

Bottom of the Trough Level considered 150% expansion & Slab thickness of trough — 280.31 m

Top of the Trough level considering 0.3m depth — 280.61 m

3 **Head loss in Filter Inlet Gate and Channel around Filters:**

a. **Head loss at Inlet Gate to Filters :**

Flow to each filter — 362.3 m^3/hr

PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad Segment in Adilabad district 30 MLD WTP			DRAWING/DOCUMENT NO	DATE 28.01.2016.
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CONSULTANT				Prepared By	Checked By / Approved By
JOB NO	LE150883	TITLE	HYDRAULIC CALCULATIONS	SRV	VVK / BRJ

			0.10	m^3/s
	Velocity of flow		1	m/s
	Area required		0.10	m^2
	Sluice Gate size	350mm x 350mm	350	mm
	Area of opening		0.12	m^2
	Velocity Provided		0.8	m/s
	Head loss through gate $H = KV^2/2g$			
		K	0.62	
		Head loss h	**0.022**	m
b.	**Head Loss in Filter Inlet Channel (FIC):**			
	No. of filters (twin beds) of FIC		6.00	nos
	Design flow of channel with 20% overloading		0.23	m^3/s
	Channel size selected			
		Width of Channel	0.40	m
		Liquid Depth of Channel	1.45	m
	Velocity of Water		0.50	m/s
	For estimation of length maximum length of channel around the filter beds considered.			
	Length considered for head loss		78.0	m
	Using Manning's formula , n for concrete		0.014	
		slope,S	0.00050	
	Total loss of head		**0.039**	m
c.	**Head loss due to 90° turn**			
		for k	0.75	
		headloss =0.75x0.5^2/(2*9.81)	0.010	m
		No of bends	1	
		Head loss	**0.010**	m
		Total losses	**0.071**	m
			281.73	m
	However the TWL of FIC is provided as		**281.76**	m
	Depth of Filter Inlet Channel		**1.45**	m
	Invert Level of FIC is provided as		**280.31**	m
4	**Head loss in Clariflocculator**			
	Head loss through Clarified Water Common Channel			
	Water flow		0.48	m^3/s

WET SBG	L&T Construction WATER, SMART WORLD & COMMUNICATION			
	HYDRAULIC CALCULATIONS-30 MLD WTP ASIFABAD SEGMENT IN ADILABAD DISTRICT			
PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad Segment in Adilabad district 30 MLD WTP	DRAWING/DOCUMENT NO	DATE	28.01.2016.
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CONSULTANT		Prepared By	Checked By	Approved By
JOB NO	LE150883 TITLE HYDRAULIC CALCULATIONS	SRV	VVK	BRJ

	Channel size provided		
	Width of Channel	0.75	m
	Liquid depth of channel	0.75	m
	Velocity	0.85	m/s
	Length of Channel from Layout	14	m
	Using manning's equation with n for concrete as	0.014	
	Slope,S	9.077E-04	
	Loss of head	0.013	m
	Total head loss provided	0.013	m
	TWL of Clarified Water Channel	281.78	m
	However, TWL of Clarified Water Channel provided is	281.81	m
	Depth of Clarified Water Channel	0.75	m
	Invert level of Clarified Water Channel	281.06	m
b.	**Head loss in Clarifier Orifice**		
	Outlet flow from the Clariflocculator	1685.45	m3/hr
	Weir length required	141.71	m
	Peripheral orifices of submerged condition		
	V=Cdx(2gh)^1/2		
	Assume velocity as	0.6	m/s
	Cd	0.62	
	Head loss in orifice	0.05	m
c.	**Head loss through Launder**		
	Overflow per half launder	842.73	m^3/hr
		0.23	m^3/s
	Discharge per unit width of launder, "q"	0.4	m^3/s
	Critical depth at the end of launder y2=[(q/b)^2/g]^(1/3)	0.36	m
	No.of sides the orifice recieves the flow (inside peripheral)	1	no
	Average length of overflow channel from upper to lower end, L	70.9	m
	Discharge per unit length of launder	0.006	m
	Liquid depth at the upper end of the launder, y1= [y2^2+{2(q'LN)^2/(gb^2y2)}^(1/2)]	0.45	m
	Average liquid depth	0.41	m
	Liquid Depth of launder	0.55	m
	Launder Width	0.6	m
	C/s area of flow	0.246	m^2
	Wetted Perimeter	1.42	m
	Hydraulic mean depth R= A/P	0.17	m
	Manning's coefficient,n	0.014	

PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad Segment in Adilabad district 30 MLD WTP		DRAWING/DOCUMENT NO	DATE	28.01.2016.
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	Velocity in launder V = 1/n R^(2/3) S^(1/2)	0.59	m/s
	Carrying capacity of the Launder	0.146	m^3/s
	The above selected launder size is adequate for carrying capacity indicated above		
	Head Loss in the launder	0.05	m
	Provided free fall of 0.5m	0.50	m
	However Provided WL in the launder at High Point	282.41	m
	IL of overflow launder at the High point	281.86	m
	IL of overflow launder at the Low point	281.81	m
	Provided TWL of Launder at low point	282.36	m
d	**Head loss due to Central Column**		
	Q= CA (2gh)^0.5		
	Flow through central column	1718	m^3/hr
		0.48	m^3/s
	C value to be considered	0.62	
	Area through openings	0.97	m^2
	Velocity through opening	0.495	m/s
	Head loss through central column	0.03	m
	Provided Head loss	0.1	m
	Consider 0.1 m losses for Flocculator	0.1	m
	TWL of Clarifier required	282.61	m
	Liquid Depth of Clarifier	3.0	m
	Invert level of Clarifier provided	279.61	m
	Invert level of Clarifier at bottom of sludge provided	277.51	m
5	**Head Loss between Flash Mixer to Clarifier**		
	The head loss is mainly due to:		
	a. Friction Loss in Inlet pipe to clarifier		
	b. Other losses due to Gate/ valve		
a.	**Head loss through Inlet Pipe**		
	Size of inlet pipe DN 900	0.9	m
	Head loss as per modified Hazen William's formula'		
	$h = \frac{L\left(\frac{Q}{C_R}\right)^{1.81}}{994.62D^{4.81}}$		
	Equivalent Length of pipe including bends(L)	30	m
	Flow (Q)	1722.5	m^3/hr
		0.48	m^3/s

PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad Segment in Adilabad district 30 MLD WTP			DRAWING/DOCUMENT NO	DATE 28.01.2016.
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CONSULTANT				Prepared By	Checked By Approved By
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	Roughness coeffecient for DI pipe, C_R		1	
		head loss, h	0.013	m
b.	**Head loss due to Entry and Exit of pipe**			
		HL(f) = KV^2 / 2g		
	K = 0.5+1 =1.5			
	Head loss due to fittings		0.02	m
c.	**Head loss due to fittings**			
		HL(f) = KV^2 / 2g		
	K = 0.75			
	Head loss due to entry and exit of pipe		0.01	m
			0.04	m
	TWL of Flash Mixer arrived		282.76	m
	Depth of Flash Mixer		3.5	m
	Invert level of Flash Mixer		279.26	m
6	**Head loss between Flash mixer and Parshall Flume**			
	PARSHALL FLUME:			
	Number of Parshall Flume to measure the flow		1.00	No.
	Flow,Q, design		1718.18	m^3/h
		=	0.48	m^3/s
	Flow,Q, Minimum	=	1718.18	m^3/hr
	Throat width,W	=	0.45	m
		=	0.45	m
	Min. flow through the selected throat width	=	0.0450	m^3/s
		=	162.00	m^3/h
	Max. flow through the selected throat width	=	0.63	m^3/s
		=	2268.00	m^3/h
	Discharge equation for the selected throat width : **Q (m^3/s) =1.038H1.537**			
	Liquid depth Upstream,H	=	0.6	m
	Liquid depth Downstream, h=0.6H	=	0.36	m
	Length of Parshall Flume for the above selected throat width			
	Axial length of converging section (l1)	=	1.43	m
	Rise in floor level at the inlet of converging section at slope 1:5	=	0.29	m
	Length of throat (F) (as per table 1,l)	=	0.60	m
	Length of diverging section (G) (As per Table 1,l2)	=	0.92	m
	Actual length of flume	=	2.95	m
	Width of upstream end of the flume (D) (as per table 1, b1)	=	1.02	m

PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad Segment in Adilabad district 30 MLD WTP		DRAWING/DOCUMENT NO	DATE	28.01.2016.
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	Width of the approach channel (P) (as per table 1, b2)	=	1.20	m
	Liquid depth in the approach channel (as per table 1, he)	=	0.95	m
	Velocity in approach channel	=	0.50	m/s
	Length of channel upstream of PF=6H	=	3.62	m
	Length of channel downstream of PF=2.5H	=	1.51	m
	Total required length of channel including PF	=	8.08	m
	Say	=	15.00	m
	Difference in elevation between lower end of flume & crest (K),hp_2	=	0.072	m
	Head loss across the Parshall Flume	=	0.3	m
	Head loss in Parshall Flume Provided	=	0.3	m
	WL in the Downstream of Parshall Flume	=	282.86	m
	WL at the Upstream of Parshall Flume	=	283.16	m
	IL of Parshall Flume at the Downstream	=	282.5	m
	IL of Parshall Flume at the Upstream	=	282.56	m
7	Top Water Level of Stilling Chamber Provided		283.26	m
	Liquid Depth of Stilling Chamber		2.9	m
	Invert Level of Stilling Chamber		280.36	m
8	Head loss between Stilling Chamber and Cascade Aerator			
	Top water level of Cascade Aerator Provided		283.36	m
	Invert level of Cascade Aerator Launder		282.86	m
9	Staging Height of Backwash Water Tank			
a.	Head Loss across filter bed during back washing:			
	Top level of the filter media (sand)		280.61	m
	Water level in filter bed above sand media		1.8	m
	Total depth of media		0.9	m
	Height of back wash trough		0.30	m
	Head Loss across filter bed during backwashing:			
	The maximum frictional resistance thet can be offered by the filter grains in the fluidized state is their			
	submerged weight. The head loss across the filter bed in fluidised conditions is given by,			
	$h_b = \frac{(\rho_m - \rho)}{\rho}(1-f)l$			
	Where,			
	h_b = Head loss across filter bed during backwash, m			
	ρ_m = mass density of filter grains in kg/m^3 (max)		2650.0	kg/m^3
	ρ = mass density of water		1000	kg/m^3

PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad Segment in Adilabad district 30 MLD WTP		DRAWING/DOCUMENT NO	DATE	28.01.2016.
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CONSULTANT			Prepared By	Checked By	Approved By
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	f = porosity of sand bed,	0.4	
	l = height of expanded bed (considering 150% bed expansion)	0.9	m
	head loss, h_b =	**0.891**	**m**
	say	**0.9**	**m**
b	**Head loss through Backwash Inlet at each section :**		
	Backwash water flow	636.1	m^3/hr
		0.18	m^3/s
	Back wash water main DN 300	0.30	m
	Using Hazen william's formula, head loss		
	$h = \frac{L\left(\frac{Q}{C_R}\right)^{1.81}}{994.62D^{4.81}}$		
	C_R	1.00	
	Equivalent length of pipe, L	70.00	m
	Flow in pipe	0.18	m^3/s
	Dia of pipe	0.30	m
	Head loss in pipe line from farthest filter to the bottom of wash water tank:		
	Length of pipe ~	70	m
	Head loss, h	**1.00**	**m**
	Head loss due to Lateral and Manifold		
	Total no of laterals in half bed	56.00	nos
	Backwash flowrate for single bed	636.10	m3/hr
	Flow rate for single lateral	11.36	m3/s
	Lateral size considered as	0.075	mm
	Velocity of flow	3.5	m/s
	Head loss due to entry $H=KV^2/2g$	**0.31**	**m**
	Head loss due to pipe entry		
	Pipe size considered as	300	mm
	Velocity of flow	2.5	m/s
	Head loss due to entry $H=KV^2/2g$	**0.16**	**m**
	Head loss due to filter media		
	h=(L(1-e) (sg-1)		
	L=depth of bed	0.90	m
	e=porosity	0.40	
	SG specific gravity	2.65	

WET SBG	L&T Construction WATER, SMART WORLD & COMMUNICATION			
	HYDRAULIC CALCULATIONS-30 MLD WTP ASIFABAD SEGMENT IN ADILABAD DISTRICT			
PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad Segment in Adilabad district 30 MLD WTP	DRAWING/DOCUMENT NO	DATE	28.01.2016.
CLIENT	Govt. of Telangana Rural Water Supply & Sanitation Department	LE150883-P-WS-WT-BE-2001	REV B	Sheet 35
CONSULTANT		Prepared By	Checked By	Approved By
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	head loss	0.59	m
	Head required	4.76	m
	For ensuring proper backwash the head has been considerd as	9	m
	Hence Bottom Level of Backwash Overhead Tank	288.86	m
	TWL of the Backwsh Overhead Tank	291.86	m

"Designs Vetted"

M/s. S.K. Associates HYD-8

Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

Executive Engineer
TDWSP Asifabad

"APPROVED"

SE, TDWSP
NIRMAL

CHAPTER - 6

RAW WATER ANALYSIS REPORT

Government of Telangana
State Level Water Quality Monitoring Laboratory
(Rural Water Supply & Sanitation Department)
Hyderabad
Report on Chemical Analysis of Water (Drinking)

Received from : Dy. Executive Engineer, RWS&S, Sub-Division,Mancherial, Adilabad
Date Received : 09.03.2015

Lab Ref. No. : 123 & 124

Particulars of the Sample :
Sample 1 : Ellampally Project, Mancherial (Mandal) Adilabad (District)
Sample 2 : Komaram Bheem Project,ADA, Asifabad (Mandal) Adilabad (District).

Sl.No.	Physcio-Chemical Parameters	Units	Sample Results 1	Sample Results 2	As per BIS (10500 - 2012)	
					Acceptable Limit	Permissible Limit
1	Colour	Co-Pt	Nil	Nil	5	15
2	Turbidity	NTU	Nil	Nil	1	5
3	pH		8.5	8.5	6.5	8.5
4	Electrical Conductivity	micromhos/cm	303	434	-	-
5	Total Dissloved Solids	mg/lit	197	282	500	2000
6	Total Alkalinity as $CaCO_3$	mg/lit	62	68	200	600
7	Total Hardness as $CaCO_3$	mg/lit	83	120	200	600
8	Calcium as Ca	mg/lit	13	19	75	200
9	Magnesium as Mg	mg/lit	12	18	30	100
10	Flouride as F^-	mg/lit	0.29	0.63	1.0	1.5
11	Chloride as Cl^-	mg/lit	37	53	250	1000
12	Nitrate as NO3	mg/lit	3.7	5.4	45	45
13	Sulphate as SO_4^-	mg/lit	12.8	18.3	200	400
14	Phosphate as PO_4^-	mg/lit	0.6	0.8	-	-
15	Sodium as Na	mg/lit	18	45	-	-
17	Potassium as K	mg/lit	2	3	-	-
	Metals					
15	Iron as Fe	mg/lit	0.0789	0.0989	0.1	0.3
18	Manganese (Mn)	mg/lit	0.005	0.0224	0.10	0.30
19	Copper (Cu)	mg/lit	0.0001	0.0001	0.05	1.5
20	Zinc (Zn)	mg/lit	0.0027	0.0032	5.0	15
21	Cadmium (Cd)	mg/lit	0.0003	0.004	0.003	0.003
22	Chromium (Cr)	mg/lit	0.0229	0.0183	0.05	0.05
23	Lead (Pb)	mg/lit	0.0073	0.0044	0.01	0.01
24	Arsenic (As)	mg/lit	0.0001	0.0001	0.01	0.05
24	**Pesticides**	No pesticide residues are found in water sample				

Remarks : Sample 1: The Chemical Parameters of the above water Sample is Chemically Satisfactory.
Sample 2: The Chemical Parameters of the above water Sample is Chemically Satisfactory.

Analyst

Asst. Chemist
State Level Laboratory

Chemist
State Level Laboratory

WET SBG

L&T Construction

WATER, SMART WORLD & COMMUNICATION

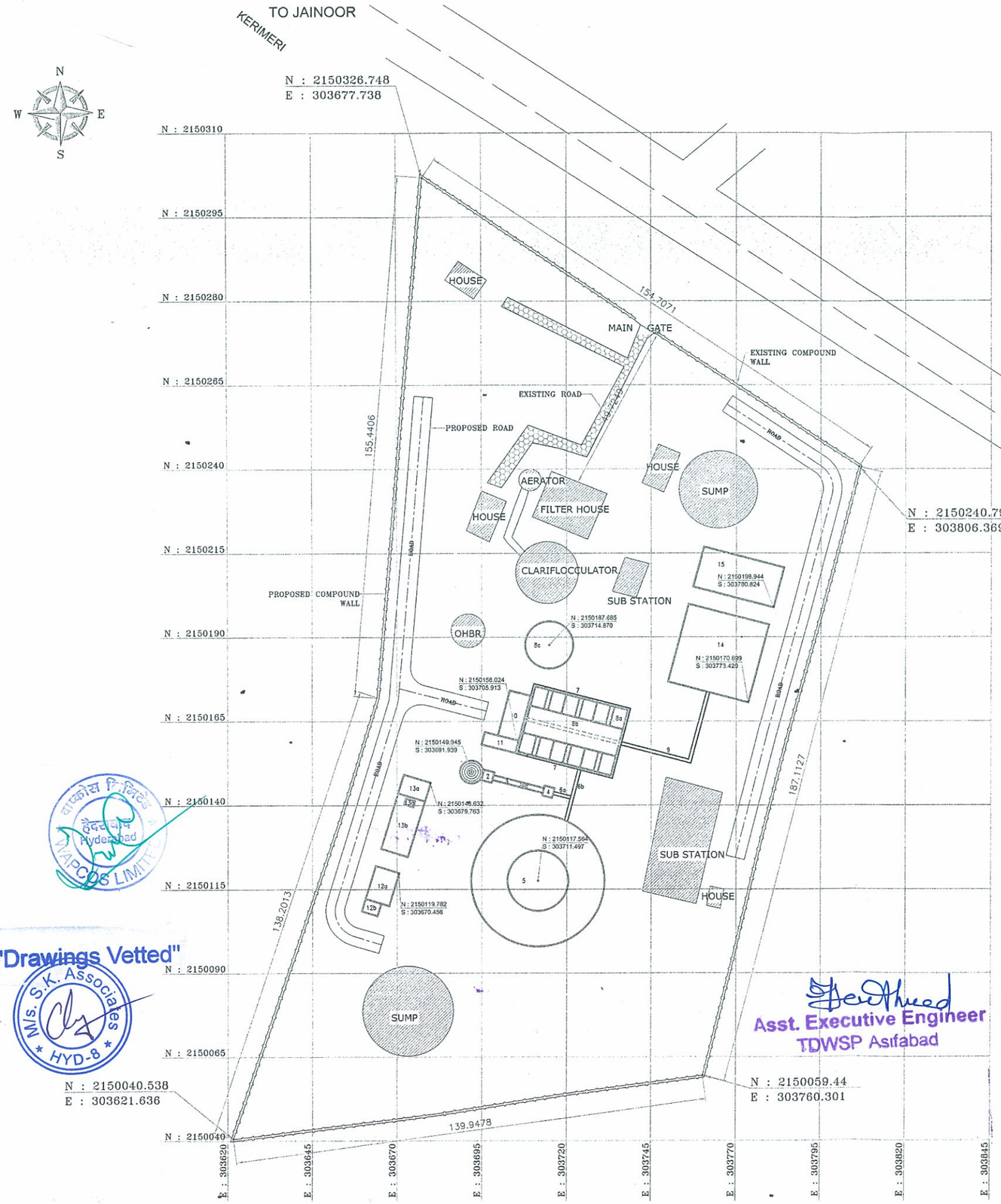
PROJECT	Providing drinking water to habitations in KomaramBheem-Asifabad segment in Adilabad district - 30 MLD WTP	DATE 28.1.2016
SUBJECT	Approval for BEP - LE150883-P-WS-WT-BE-2001 Layout Plan for 30 MLD WTP - LE150883 - P-WS-WT-PP-2002 Hydraulic flow diagram for WTP LE150883 - P-WS-WT-HF-2003 Process flow diagram -LE150883 - P-WS-WT-PF-2004	PAGE Sheet

Sl.No	Consultant Comments	Reply of L&T
	Basic Engineerong Package for Water treatment Plant (Doc no: LE150883-P-WS-WT-BE-2001) Rev A.	
	The above document revised with the following comments with reference to the Consultant Comments mail dated 25.1.2016 and subsequent telephonic discussion with the consultant dated 28.1.2016.	
1	At Aerator no. of steps to be provided 4nos instead of 3nos to increase the surface loading area.	Noted. Revised BEP (Rev.B) submitted.
2	Velocity to be considered 0.7m/s instead of 0.9m/s in Aerator launder & Channels.	At Normal Flow Condition the velocity considered for the channel & launder is 0.7m/s and at 20% Overloading Condition the velocity is 0.9m/s.
3	Retention time to be provide 30mins instead of 25mins in Clariflocculator.	As per Consultant comments mail dt:25.1.2016. and telephonic discussion with consultant the Retention time of flocculator is revised from 25minutes to 30 minutes and the Surface Loading Rate of Clarifier is revised from 35m3/day/m2 to 40m3/day/m2 and the revised BEP (REV.B) submitted.
4	Depth of filter sand to be cross checked again with ref standards/codes.	The Provided depth of the filter sand (0.6m) is within in the range of as per the CPHEEO manual on Water Supply and Treatment.

Checked by 28/1/2016.

Chapter- 7

DRAWINGS



LIST OF CIVIL UNITS

S.No.	DESCRIPTION	QTY	DIMENSION IN METERS
1	CASCADE AERATOR (Including Launder)	1	6.5ø x 4.56(HT)
2	STILLING CHAMBER	1	2.9(L) x 2.9(W) x 2.9(LD) +0.3(FB)
3	MEASURING CHANNEL / PARSHALL FLUME	1	1.2(W) x 0.8(LD) + 0.3(FB) THROAT WIDTH : 0.45m
4	FLASH MIXER	1	2.7(L) x 2.7(W) x 3.5(LD) + 0.3(FB)
5	CLARIFLOCCULATOR		
	FLOCCULATOR	1	17.6ø x 3.0(LD) + 0.3(FB)
	CLARIFIER	1	39.0ø x 3.0(LD) + 0.3(FB)
6a	BYPASS CHANNEL	1	0.75(W) x 0.75(LD) + 0.3(FB)
6b	CLARIFIED WATER CHANNEL	1	0.75(W) x 0.75(LD) + 0.3(FB)
7	FILTER INLET CHANNEL	1	0.4(W) x 1.45(LD) + 0.5(FB)
8a	RAPID GRAVITY SAND FILTERS WITH TWIN BEDS	6	7.6(L) x 5.6(W)
	SIZE OF EACH SINGLE BED		3.8(L) x 5.6(W)
8b	FILTER HOUSE GALLERY	1	27.9(L) x 8.0(W) x As per HFD
8c	BACK WASH OVERHEAD TANK (OHT)	1	13.8ø x 3.0(LD) + 0.3(FB)
9	FILTERED WATER CHANNEL	1	0.75(LD) x 0.70(W) + 0.3(FB)
10	FILTER ANNEXE BUILDING	1	13.5(L) x 8.0(W) + 5.0(HT)
	i) GROUND FLOOR (Blower, Backwash Pump & Unloading Bay)		
	ii) FIRST FLOOR (Laboratory,Office Room,Control Room and Toilet)		
11	MAIN SWITCHGEAR ROOM FOR WTP	1	10(L) x 3.5(W) x 4(HT)
12a	CHEMICAL HOUSE	1	
	1) GROUND FLOOR (Chemical Storage, Staircase, Passage)		10.0(L) x 7.0(W) + 4.5(HT)
	2) FIRST FLOOR (Dosing Tank & Pumps)		10.0(L) x 7.0(W) + 5.0(HT)
12b	MCC ROOM	1	4.5(L) x 3.5(W) x 4(HT)
13a	CHLORINATOR ROOM	1	8.0(L) x 5.5(W) + 4.5(HT)
13b	CHLORINE TONNER ROOM (inclusive Unloading Bay)	1	17.0(L) x 8.0(W) + 6.0(HT)
13c	NEUTRALISATION PIT	1	2.5(L) x 1.5(W) + 1.5(LD)
14	CLEAR WATER RESERVOIR	1	24.0(L) x 23.5(W) x 3.1(LD)
15	CLEAR WATER RESERVOIR PUMP HOUSE	1	24.0(L) x 12.0(W)

NOTES :

1) ALL DIMENSIONS ARE (INTERNAL DIMNS.) IN METERS UNLESS OTHERWISE SPECIFIED.
2) SPACE PROVISION FOR CLIENT EQUIPMENT HAVE NOT BEEN CONSIDERED & SAME ARE LISTED BELOW.
   i) Switchyard / Transformer.
   ii) CWPH Switchgear.
3) EXISTING WTP STRUCTURES.
4) EXISTING ROAD.

REFEERENCE DOCUMENT/DRAWINGS :

1. CONTRACT DOCUMENT OF KOMARAMBHEEM–ASIFABAD SEGMENT IN ADILABAD DISTRICT
2. BASIC ENGINEERING PACKAGE FOR WATER TREATMENT PLANT DOC.NO. LE150883–P–WS–WT–BE–2001
3. HYDRAULIC FLOW DIAGRAM FOR WATER TREATMENT PLANT DWG.NO. LE150883–P–WS–WT–HF–2003

REV.NO.	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
B	AS PER CONSULTANT COMMENTS MAIL DATED: 25/01/2016	SRV 28.01.16	ASA 28.01.16	VVK 28.01.16	MBS/BRJ 28.01.16
A	FOR APPROVAL	SRV 22.12.15	ASA 24.12.15	VVK 29.12.15	BRJ 30.12.15

REVISIONS

L&T Construction
Water, Smart World & Communication.

CLIENT : RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA.

CONSULTANT :

PROJECT : PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

SUPPLIER/CONTRACTOR : L&T Construction Water & Effluent Treatment SBG

JOB No :	LE150883	
NAME	SIGN	DATE
DSGN SRV	SRV	22.12.15
DRWN ASA	ASA	24.12.15
CHKD VVK	VVK	29.12.15
APPD BRJ	BRJ	30.12.15

TITLE : LAYOUT PLAN FOR WTP

SCALE 1:650

PROJECTION

CHECKED BY	SIGN	DATE
CIVIL & STRUCTURAL		28-01-2016
MECHANICAL		28/01/16
ELECTRICAL		29/01/16
INSTRUMENTATION		28/01/16

DRAWING No. LE150883-P-WS-WT-PP-2002 SIZE A1 REV. B

RELEASED FOR ☐PRELIMINARY ☐ TENDER ☐ INFORMATION ☑APPROVAL ☐CONSTRUCTION

"Drawings Vetted" M/s. S.K. Associates HYD-8

Executive Engineer TDWSP Asifabad

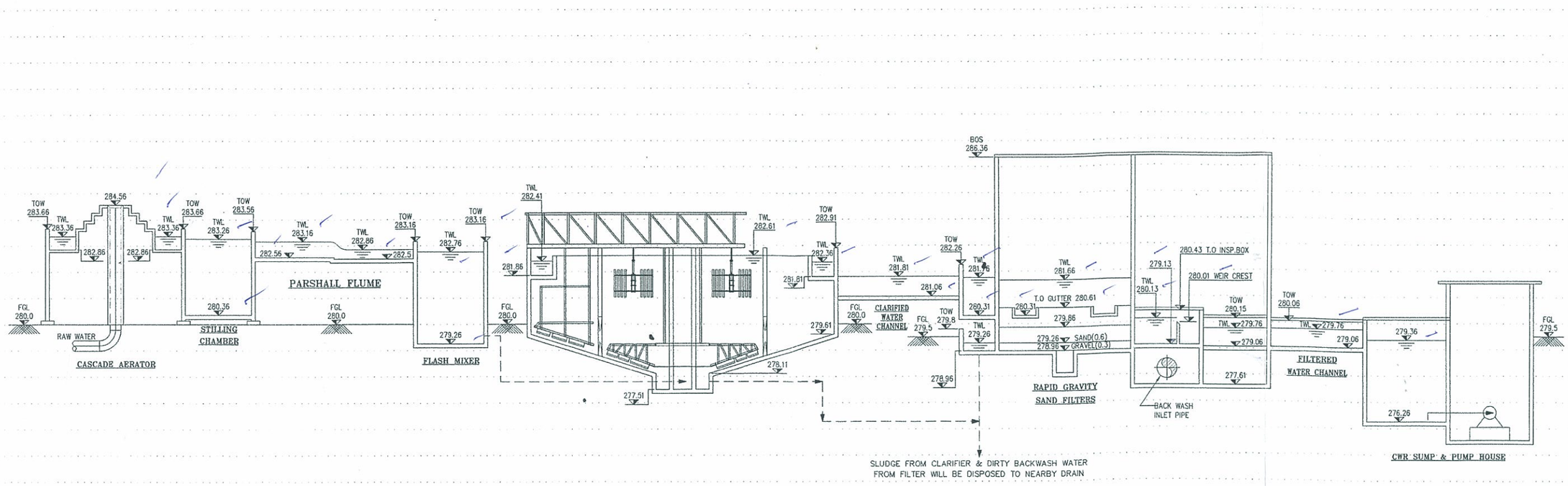
Asst. Executive Engineer TDWSP Asifabad

Dy. Executive Engineer TDWSP Asifabad

"APPROVED"

SE, TDWSP NIRMAL

MAPCOS LIMITED Hyderabad



"Drawings Vetted"

M/s. S.K. Associates HYD-8

Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

Executive Engineer
TDWSP Asifabad

"APPROVED"

SE, TDWSP
NIRMAL

वाप्कोस लिमिटेड हैदराबाद Hyderabad WAPCOS LIMITED

NOTES :

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED

REFERENCE DOCUMENT/DRAWINGS :

1. CONTRACT DOCUMENT OF KOMARAMBHEEM–ASIFABAD SEGMENT IN ADILABAD DISTRICT.
2. BASIC ENGINEERING PACKAGE FOR WATER TREATMENT PLANT DOC.NO. LE150883–P–WS–WT–BE–2001
3. LAYOUT PLAN FOR WATER TREATMENT PLANT DWG.NO. LE150883–P–WS–WT–PP–2002

LEGEND:

FGL : FINISHED GROUND LEVEL
FFL : FINISHED FLOOR LEVEL
BOS : BOTTOM OF SLAB
TWL : TOP WATER LEVEL
TOW : TOP OF WALL
HP : HIGH POINT
LP : LOW POINT

REV.NO.	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
B	AS PER CONSULTANT COMMENTS MAIL DATED : 25.01.2016	SRV 28.01.16	ASA 28.01.16	VVK 28.01.16	MBS/BRJ 28.01.16
A	FOR APPROVAL	SRV 29.12.15	ASA 29.12.15	VVK 29.12.15	BRJ 30.12.15

REVISIONS

L&T Construction
Water, Smart World & Communication.

CLIENT : RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA.

CONSULTANT :

PROJECT : PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

SUPPLIER/CONTRACTOR : L&T Construction Water & Effluent Treatment SBG

JOB No :	LE150883	
NAME	SIGN	DATE
DSGN SRV	SRV	29.12.15
DRWN ASA	ASA	29.12.15
CHKD VVK	VVK	29.12.15
APPD BRJ	BRJ	30.12.15

TITLE : HYDRAULIC FLOW DIAGRAM FOR WTP [30 MLD]

SCALE : NTS

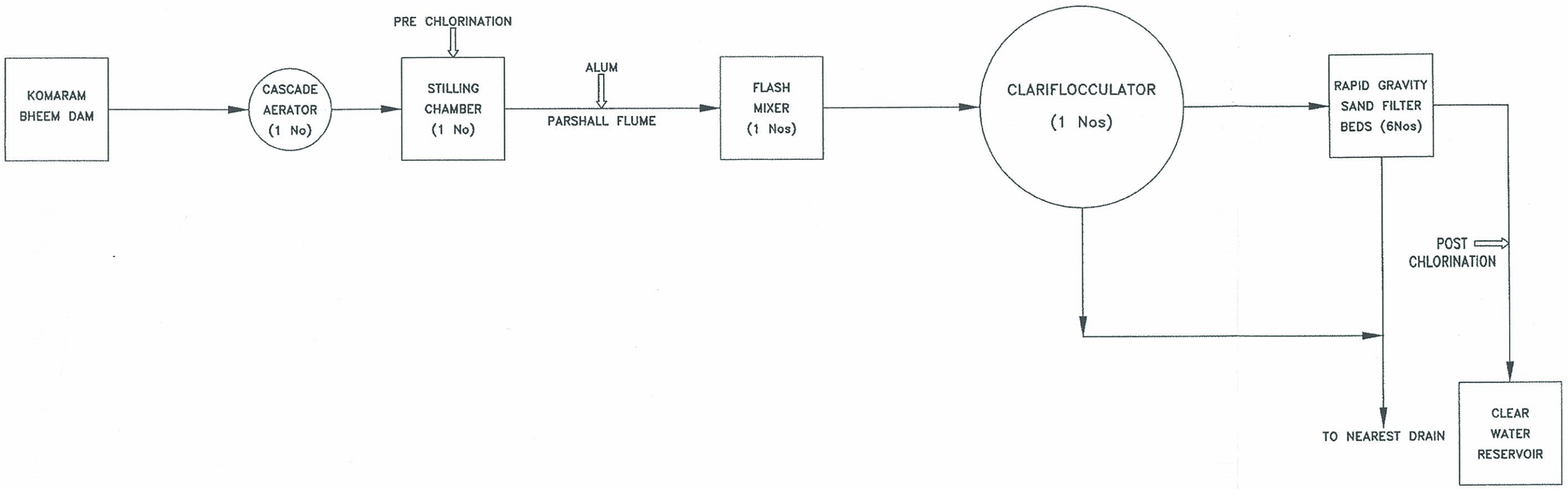
PROJECTION

CHECKED BY	SIGN	DATE
CIVIL & STRUCTURAL		28-01-2016
MECHANICAL		28/1/16
ELECTRICAL		
INSTRUMENTATION		

DRAWING No. LE150883-P-WS-WT-HF-2003

SIZE A2 | REV. B

RELEASED FOR ☐ PRELIMINARY ☐ TENDER ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION



"Drawings Vetted"

M/s. S.K. Associates HYD-8

Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

Executive Engineer
TDWSP Asifabad

"APPROVED"

SE, TDWSP
NIRMAL

REFERENCE DOCUMENT/DRAWINGS :

1. CONTRACT DOCUMENT OF KOMARAMBHEEM–ASIFABAD SEGMENT IN ADILABAD DISTRICT.
2. BASIC ENGINEERING PACKAGE FOR WATER TREATMENT PLANT DOC.NO. LE150883–P–WS–WT–BE–2001

WAPCOS LIMITED Hyderabad

REV.NO.	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	SRV 28.12.15	ASA 28.12.15	VVK 28.12.15	BRJ 30.12.15

REVISIONS

L&T Construction
Water, Smart World & Communication.

CLIENT : RURAL WATER SUPPLY AND SANITATION DEPARTMENT, TELANGANA.	CONSULTANT :

PROJECT : PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

SUPPLIER/CONTRACTOR : **L&T Construction** Water & Effluent Treatment SBG

JOB No :	LE150883

NAME		SIGN	DATE
DSGN	SRV		28.12.15
DRWN	ASA		28.12.15
CHKD	VVK		28.12.15
APPD	BRJ		30.12.15

TITLE : PROCESS FLOW DIAGRAM OF WTP [30 MLD]

SCALE: NTS

PROJECTION

CHECKED BY	SIGN	DATE
CIVIL & STRUCTURAL		
MECHANICAL		
ELECTRICAL		
INSTRUMENTATION		

DRAWING No. LE150883-P-WS-WT-PF-2004 | SIZE A3 | REV. A

RELEASED FOR ☐PRELIMINARY ☐TENDER ☐INFORMATION ☑APPROVAL ☐CONSTRUCTION