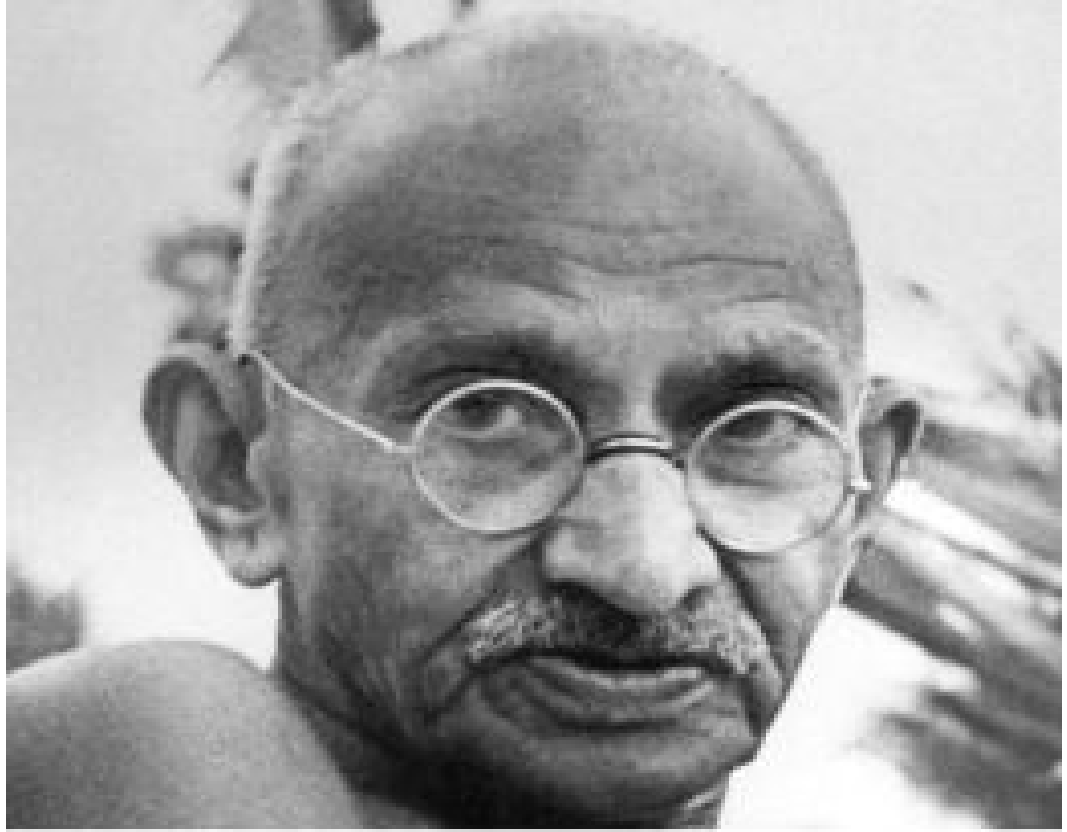
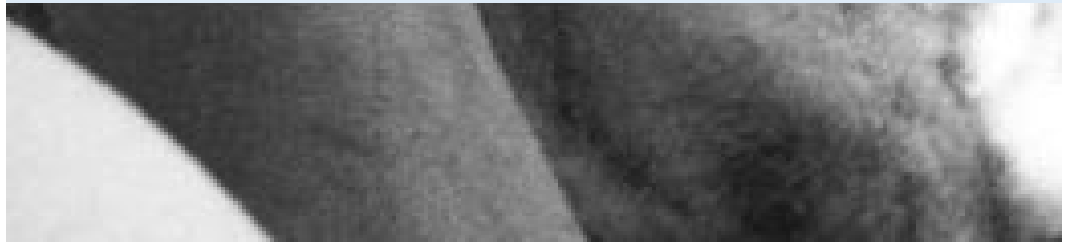

SEWAGE
REMOVING
IRRIGATION
CONDUCTIVITY
AGRICULTURE
PARTICULATES
SANITARY
DOMESTIC
OVERLAND
DISINFECTION
UNTREATED
MATTER
RAW
HIGH
DEVELOPED
INDUSTRIAL
URBAN
COUNTRIES
SEWAGE
CLASSED
PIPES
BACTERIOLOGICAL
FERTILISER
SEWERAGE
SEPTIC
AMMONIUM
POLLUTION
WASTE
URBANIZED
COMMUNITY
SLUDGE
COLLECTED
CEASING
IRRIGATED
COMPOSTING
SUSPENDS
LIQUID
PATHOGENIC
INTERCHANGED
FARMERS



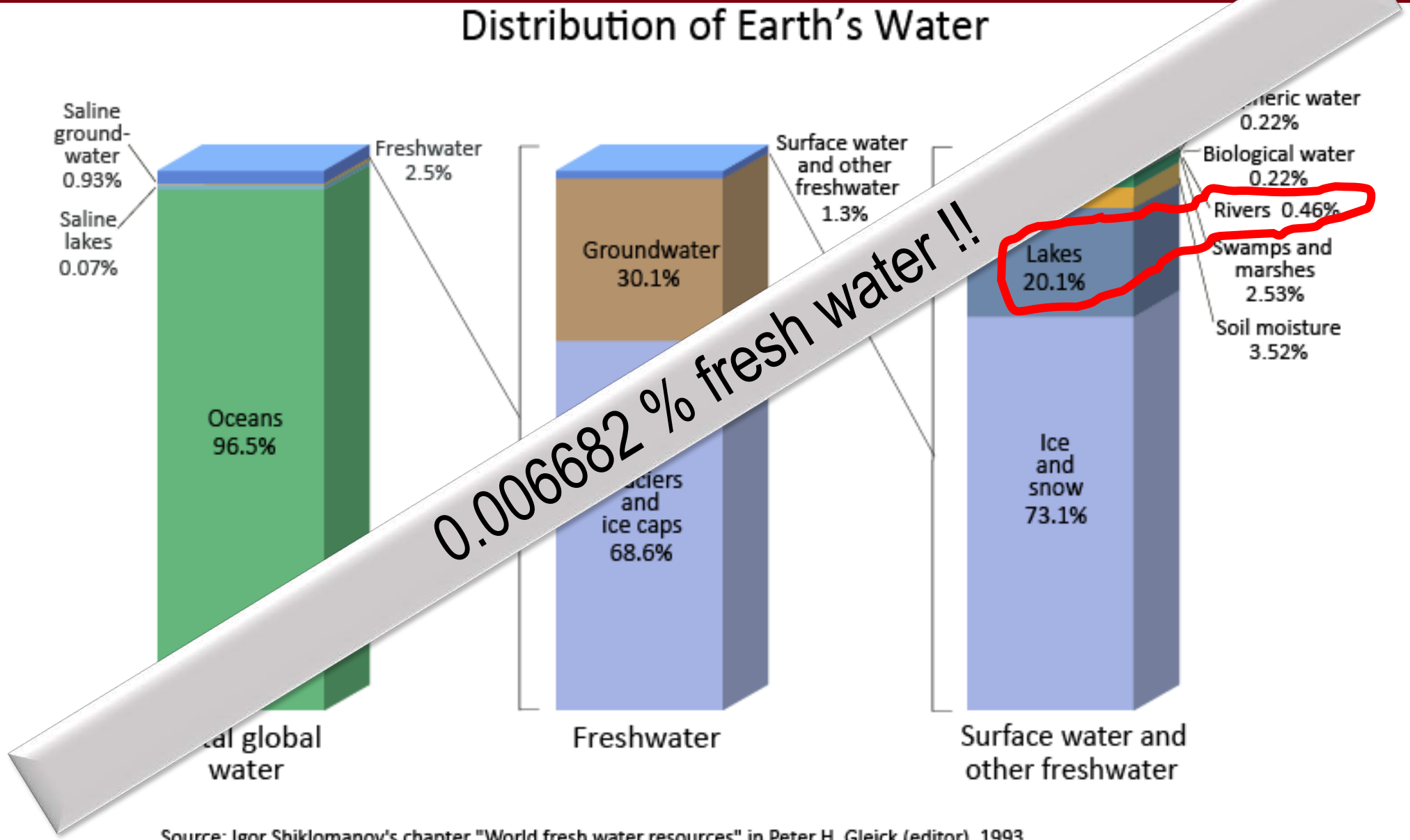
“BE THE CHANGE YOU WANT TO SEE IN THE WORLD”



COMMON MISTAKES BY CONSULTANTS IN PLANNING OF SEWER NETWORKS AND STP's

Col Naresh Sharma
Director (PHE), E-in-C's Br

PROLOUGE



Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources.

PROLOUGE

PER CAPITA WATER AVAILABILITY IN INDIA

Year	Population (Million)	Per capita water availability M^3/year
1951	361	5177
1955	395	4732
1991	846	2209
2001	1027	1820
2025	1394	1341
2050	1640	1140

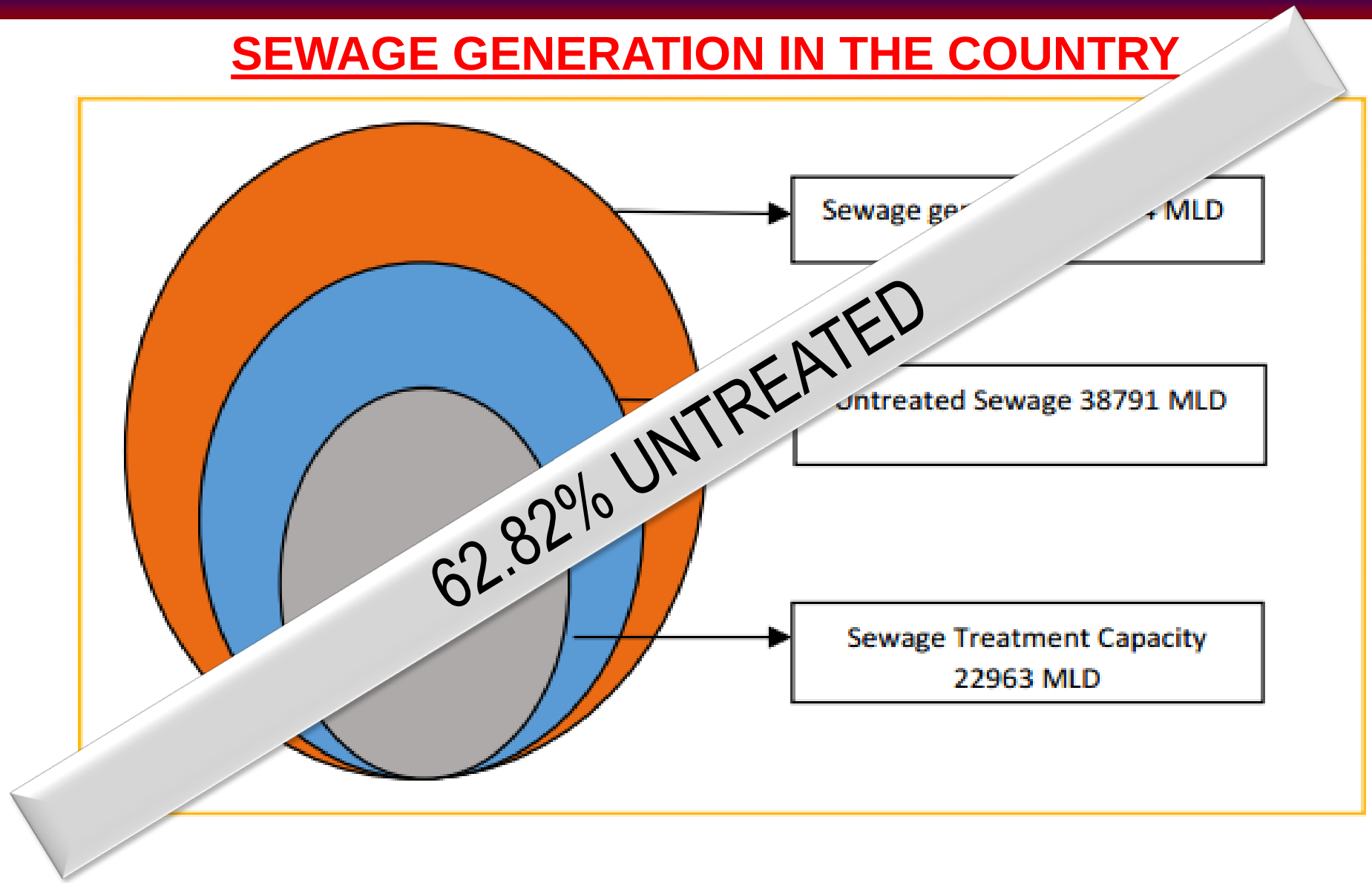
(Source: Govt. Of India, Ministry of Water Resources(2009)

"WATER STRESSED NATION"

WATER SCARCE NATION

PROLOUGE

SEWAGE GENERATION IN THE COUNTRY

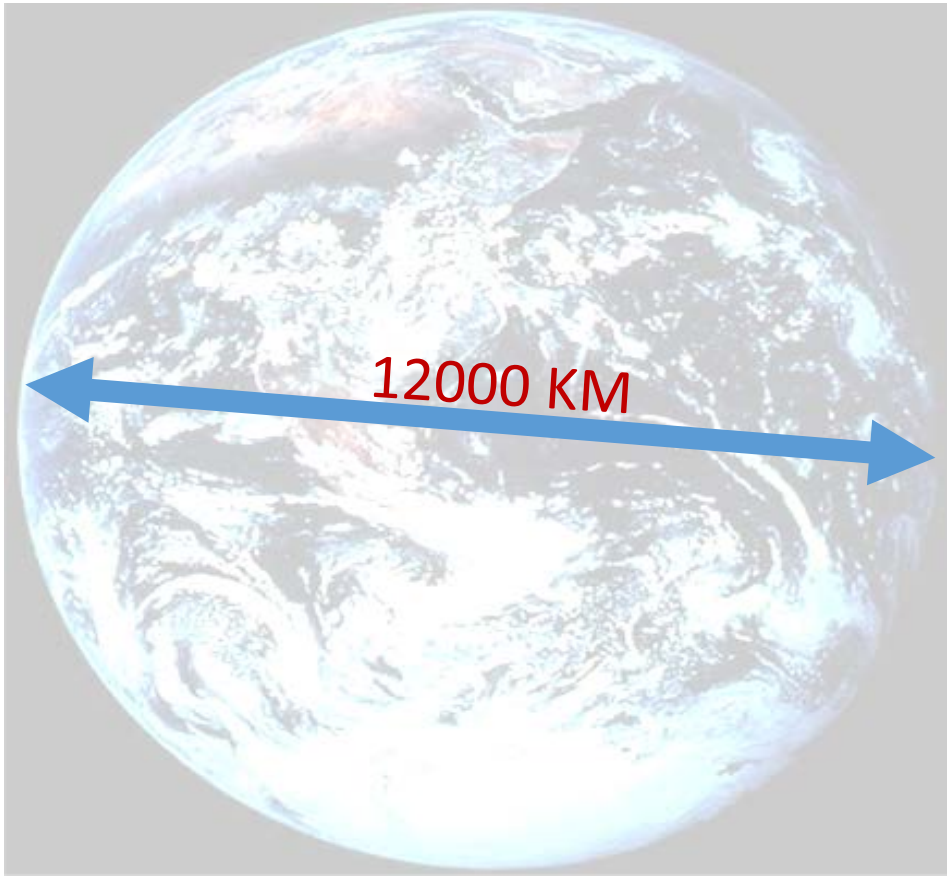


SHOCKING STATISTICS ABOUT SANITATION

- 80% of human diseases are water borne and water related due to water pollution and poor sanitation. (WHO Report)

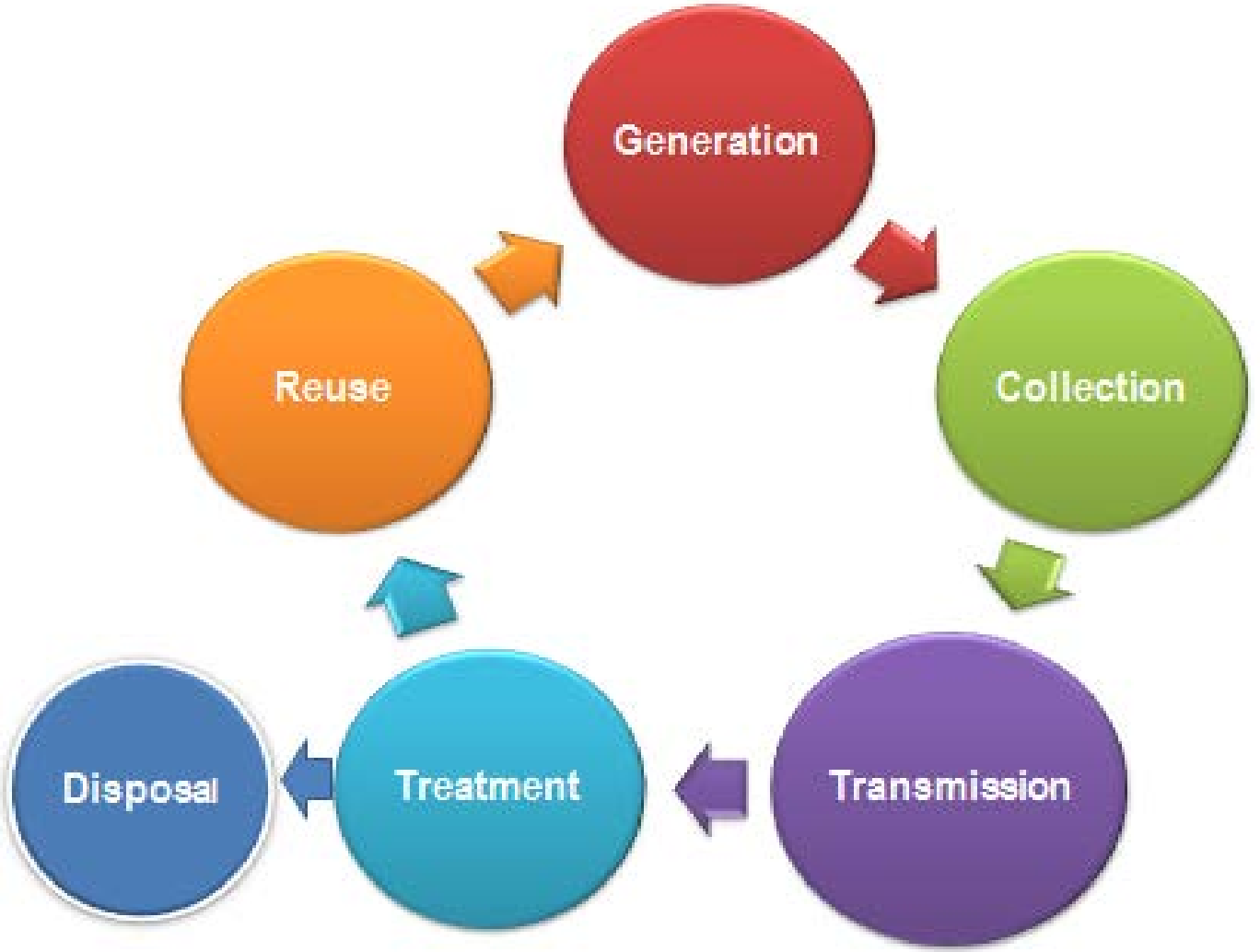
- India lost about 4.7% of GDP($ 105.797 billion) in 2016 due to poor sanitation.

DO YOU KNOW.....



- Total length of sewers in Mil Stns is about 16,000 Km
- Total cost of sewers in Mil Stns is approx 4,000 Crore
- About 50% - 80% cost of a Sewage related project is for sewers.

STAGES OF SEWAGE MGMT



PECULIAR ISSUES - Mil Stations

- LOW POPULATION DENSITIES
- REMOTE LOCATIONS
- EXTREME CLIMATE
  - COLD : -30 deg C
  - HOT : +50 deg C
  - WET : Highest to minimal Rainfall regions
- HIGH FLOW VARIATIONS

- VARYING BOD
- HIGH TURBIDITY
- HIGH INFILTRATION
- STRINGENT STANDARDS

- MBBR TECH
- STP SIZES- 100 KLD ONWARDS
- STRESS ON ZLD

ZONAL CEs hire consultants who normally work for civil set up and do not understand peculiarities of military establishments

CONTOUR & LAYOUT PLANS

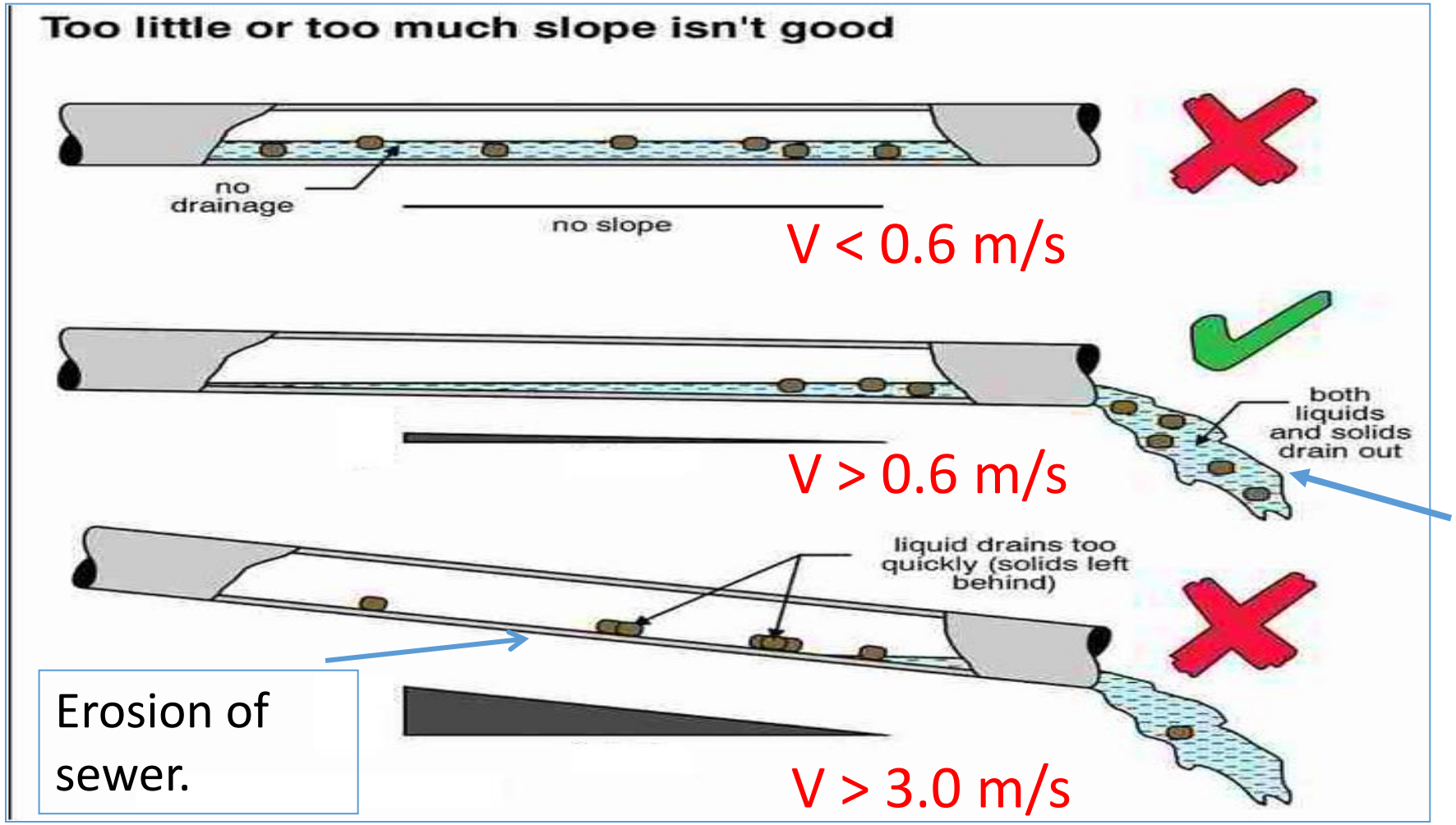
- Consultants tend to ignore importance of contours and layout plans for planning of network of sewers.

- Cases have been reported where sewers have been proposed from lower invert levels to higher invert level without any engineering application.

- Preferably layout plans should be prepared on scale 1:2000. Zoomed up detailed plans at scales 1: 250 to 1: 500 on A_3 sheets may be prepared along with key plans for ease of understanding and readability.

- Contours, existing networks, water supply lines, UG cables and other services should be marked. Details of existing sewers including size, load and invert level are essentially required for synchronization with new schemes.

GRAVITY SEWERS-SCV



Preferable 0.8 m/s

GRAVITY SEWERS-SCV

- Steeper slopes require deep excavation and hence costly.
- Slope should be made milder as soon as discharge permits.
- Sewers flow partially full at peak flow.
- Space for ventilation is required.

LOW INITIAL DISCHARGE

- **CENTRAL SEWAGE SYSTEMS ARE AUTHORIZED FOR ALL.**

- **AT MANY SITUATIONS LOW DISCHARGES ARE RECD**
  - **BUNGALOW TYPE ACCN**
  - **AMMUNITION DUMPS**
  - **REMOTE SECURITY /OUT POSTS etc**

- **AUTOMATIC FLUSHING TANK IS SUGGESTED TO CONSULTANTS**

- **SOMETIMES MORE THAN 100 AFTs ARE SUGGESTED WITHOUT REALIZING ADDL WATER REQMT AND MAINT ISSUES !!**

FLOW THROUGH GRAVITY SEWERS

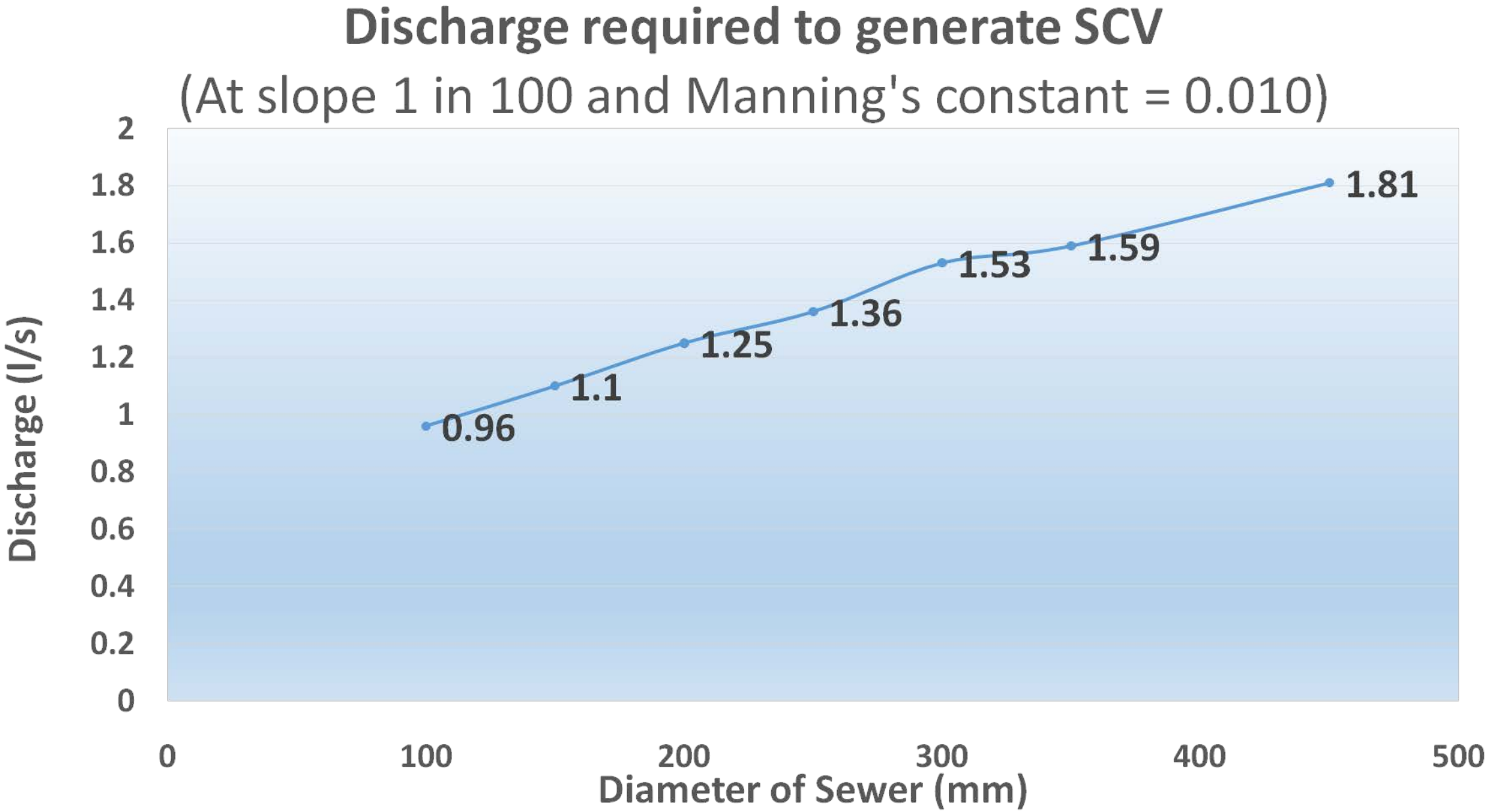
- CPHEEO Para 3.4.3.1, it is mentioned that for small discharges upto 30 l/s diameter of sewer does not have much effect on velocity.

- This 30 l/s of peak ~ population more than 2500.

- This value is considered as good discharge in Military Stations.

- Computer simulation was done for very low discharges. (<100 population).

DISCHARGE FOR SCV IN GRAVITY SEWERS



DAILY VARIATION OF SEWAGE FLOW

- The flow in sewers varies from hour to hour and seasonally. However, for the purpose of hydraulic design estimated peak flows are adopted. The peak factor or the ratio of maximum to average flows depends upon contributory population.

- Hitherto ,maximum peak flow in Mil Stn was 4 (against 3 in civil) but now it is being raised to 6 for small populations as per actual on ground and as per literature available in its support.

- Economical designs of gravity sewers.

PEAK FACTOR AS RECOMMENDED IN MIL STN

POPULATION	As per CPHEEO	As per Metcalf & Eddy	Hitherto in Mil est	Being proposed for CANTTS*
Below 500	3	4	4	6
501 - 5,000	3	4	4	4
5,001 - 20,000	3	3	3	3
20,001 - 50,000	2.5	2.5	2.5	2.5
50,001 - 7,50,000	2.25	2.25	2.25	2.25
Above 7,5001	2	2	2	2

*Based on actual ground experience and literature from IIT ,Kharagpur

SELECTION OF MATERIAL OF SEWER

- The importance of material of sewer is sometimes ignored by consultants.

- Tend to follow the traditional choice of SWG sewers for small diameters and NP-2 sewers for 200 mm and above.

- SWG sewers due to their inherent limitations:
  - Short length
  - High roughness coefficient
  - Cumbersome jointing procedure (now banned in Mil establishments).

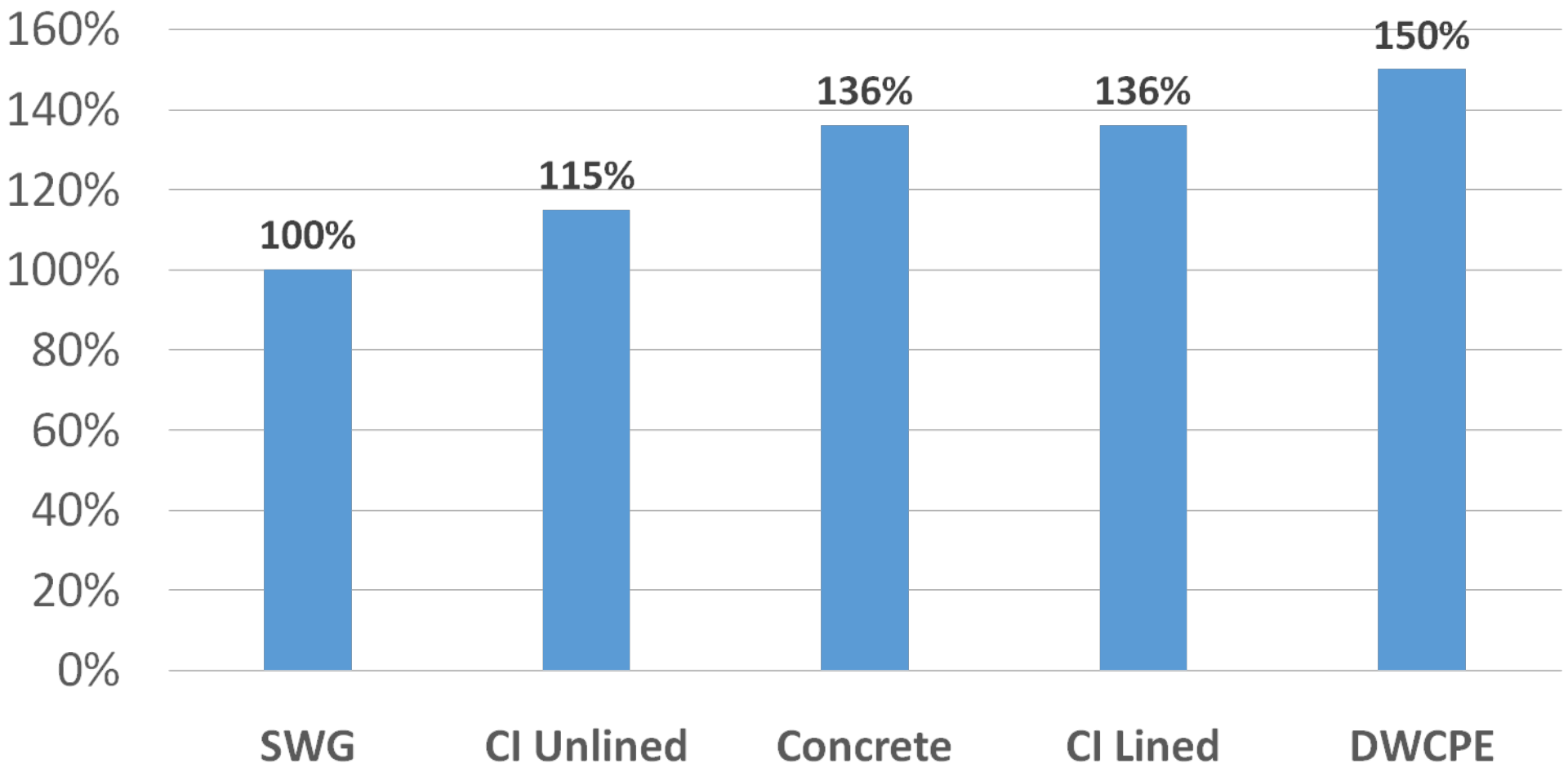
- NP-2 pipes also been replaced by NP-3 due requirement of stronger sewers to minimize in-situ concreting for bedding or cradle.

Transport Through Gravity Sewers

- Double Walled Corrugated PolyEtheylene (DWCPE) are available as per BIS **16098 (Part 2) : 2013. These are smooth, light weight and 6m long hence faster laying. These sewers** require safegaurds against uplifting.

- **A comparison of carrying capacity of various types of sewers has been made. It can be seen that DWCPE sewers are 50% more efficient than SWG sewers.**

RELATIVE EFFICIENCY OF GRAVITY SEWERS



AUTOMATIC FLUSHING TANKS FOR VERY SMALL POPULATIONS

- Consultants find it difficult to decide when AFT are to be provided.
- Suggestions - AFTs at all locations where SCV is not achieved.
- In certain cases more than 100 AFT have been suggested in a small station.
- Such high numbers of AFTs are undesirable due to demand of additional water apart from maintenance issues.
- Gravity sewers be designed optimally taking full advantage of flows.
- Once inescapable requirement of AFTs is obtained- one of the following approach can be used.
  - Provide AFT for very small populations.
  - Reuse of treated waste water for direct flushing.

AFTs - VARIOUS SLOPES AND POPULATIONS

Population	Slope of 160mm OD, DWCPE (SN8) Sewer				
	1 in 50	1 in 80	1 in 120	1 in 150	1 in 170
>50 and < 80	YES	YES	-	-	-
>80 and < 100	NO	YES	YES	YES	-
>100 and < 120	NO	NO	YES	YES	YES
>120 and < 150	NO	NO	NO	YES	YES
>150 and < 170	NO	No	NO	NO	YES
>170	NO	NO	NO	NO	NO

TREATED WASTEWATER USED FOR FLUSHING THE SEWERS

- New concept proposed for the first time in MES (may be first time in the country) to use treated sewage for flushing of sewers to replace AFTs.

- Being provided at three stations,, under CE(AF) Gandhinagar. In the original work treated sewage was to be reused for arboriculture.

- Lateral sewers close to point of reuse were not getting enough discharge to maintain SCV. To ensure that accidental cross connections with drinking water pipes do not take place violet or red coloured HDPE pipes are used and detachable spindles are provided.

- Ensured that only one point control of valves is provided close to pumping points. Only 10 – 15 min flow is required for flushing.

RESTRICTION ON MAXIMUM DEPTH OF GRAVITY SEWERS

- **Since in Military establishments, the diameters of sub-main gravity sewers are small, it is difficult to provide maintenance to such sewers at deeper depths.**

- **Hence depth of gravity sewers has been restricted to 6.0m.**

CLIMATE SPECIFIC RECOMMENDATIONS

Minimum Velocity for Preventing Hydrogen Sulphide.

(HOT CLIMATES)

- Avoid formation of foul gas H_2S, the velocity shall be not only be self-cleansing but also be sufficient to keep the submerged surfaces of the sewer free from slimes and prevent the generation gas which can attack the cement concrete sewers.

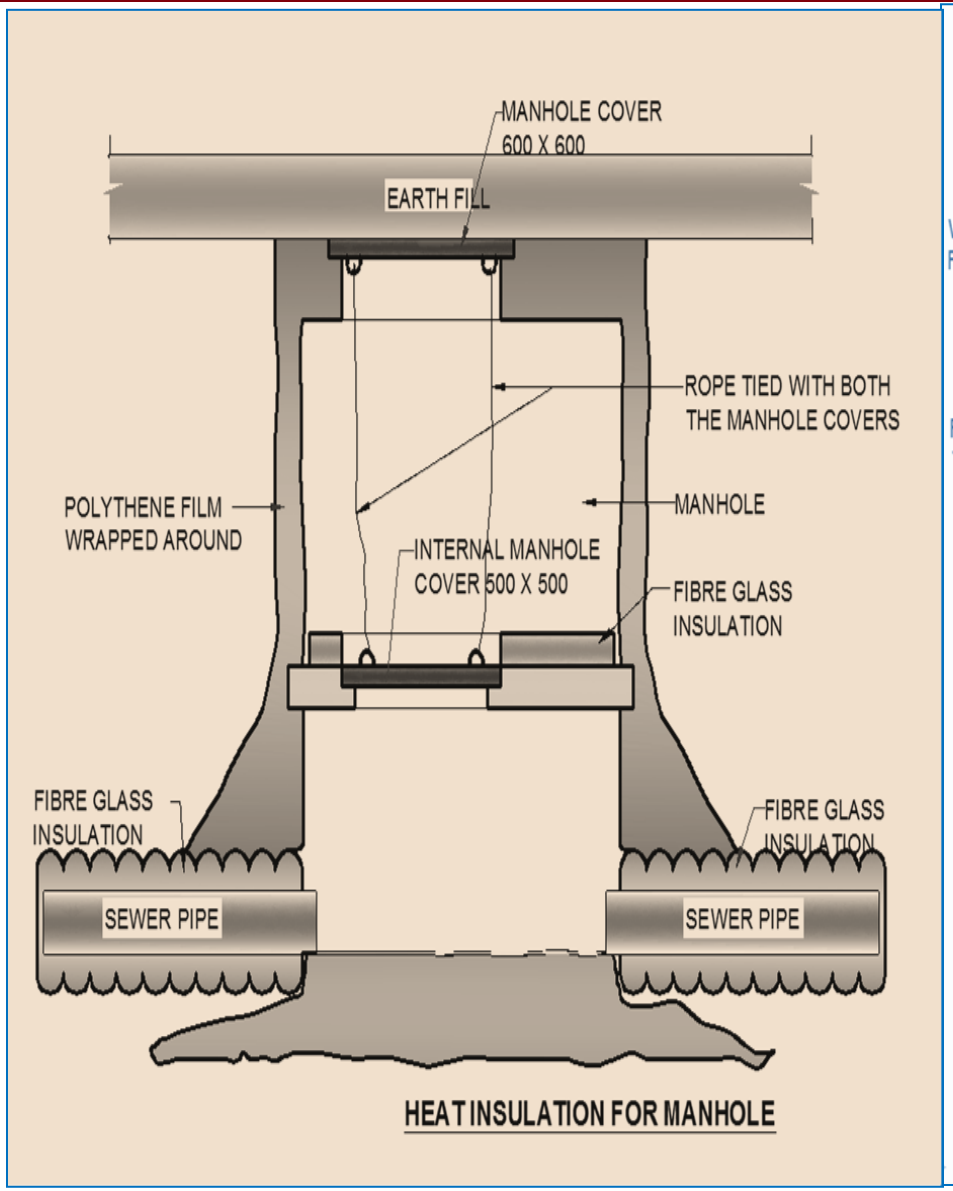
- Stations which are located in warm areas should preferably be designed to have velocity of 0.8 m/s at least once in a day. However this should not be the criteria for providing AFTs.

CLIMATE SPECIFIC RECOMMENDATIONS

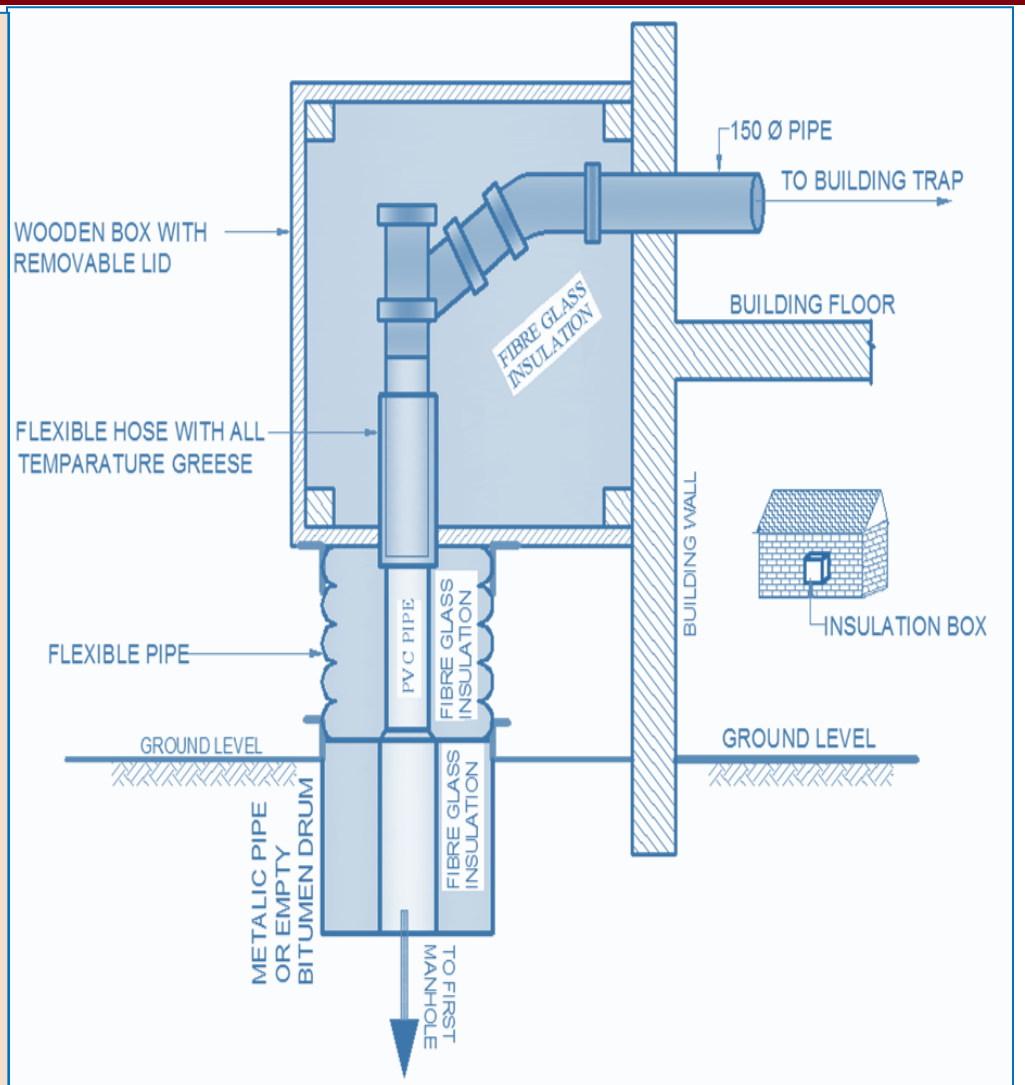
Extreme cold conditions.

- Consultants ignore extreme cold climatic conditions when proposals are given for extreme cold areas although IS code exists since 1986.
- Sewers and manholes insulated.
- Sewers should run below frost line
- Manholes should have double opening for insulation.
- Building sewers from toilets to UG sewer be specially insulated.
- Detailed drawings for these have been developed and are being included in next TI's.
- Draft for the same has been uploaded on MES web site.

THERMAL INSULATION OF SEWER SYSTEM



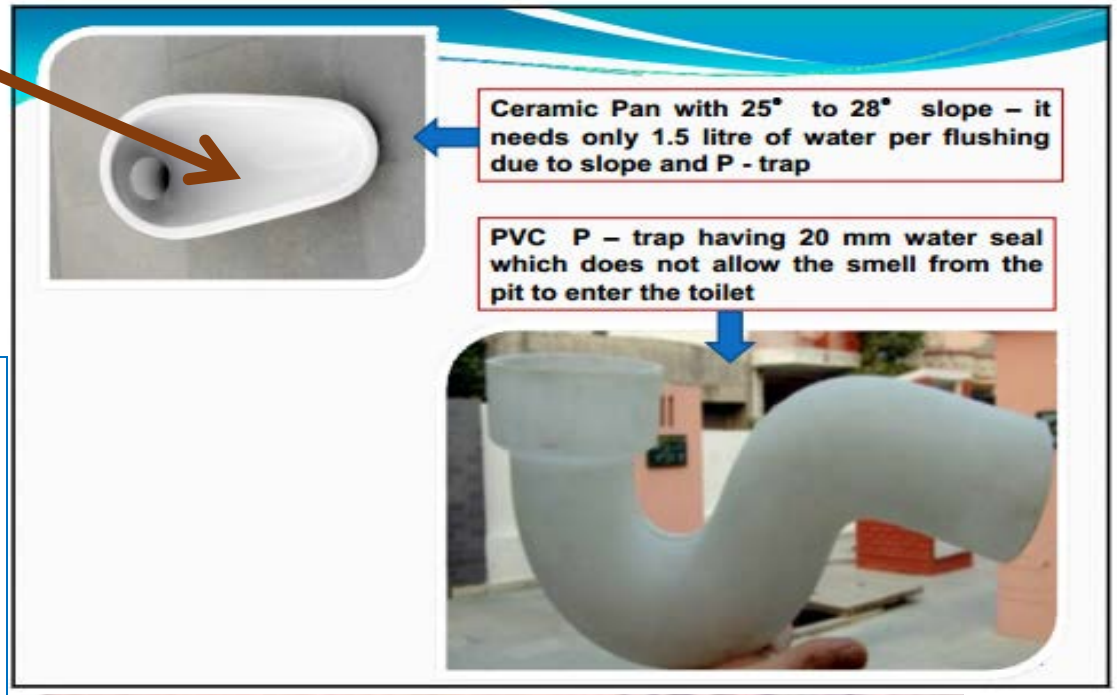
HEAT INSULATION FOR MANHOLE

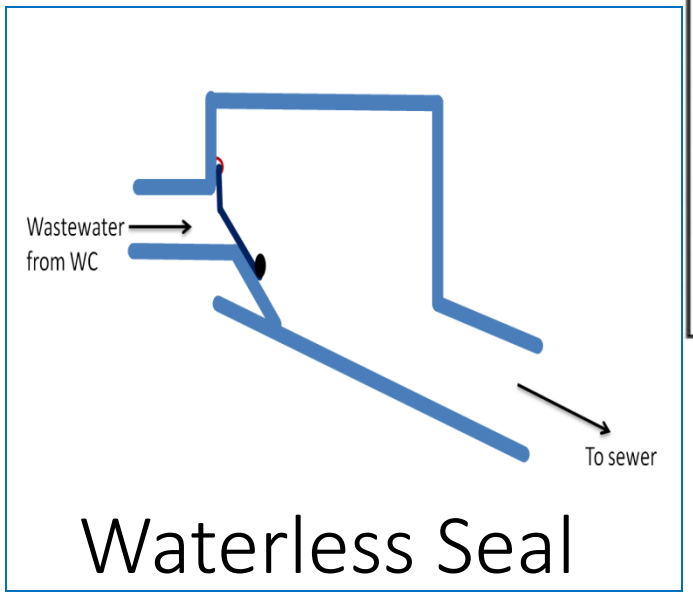


INSULATION OF SERVICE CONNECTION
THROUGH WALL

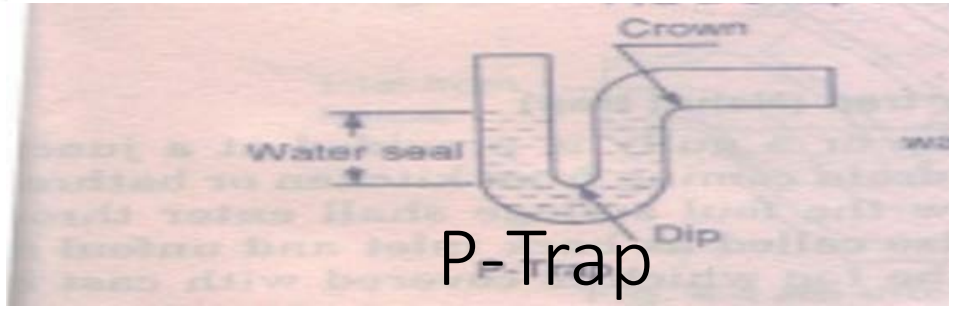
THERMAL INSULATION OF SEWER SYSTEM

Steep slope Pan





Waterless Seal

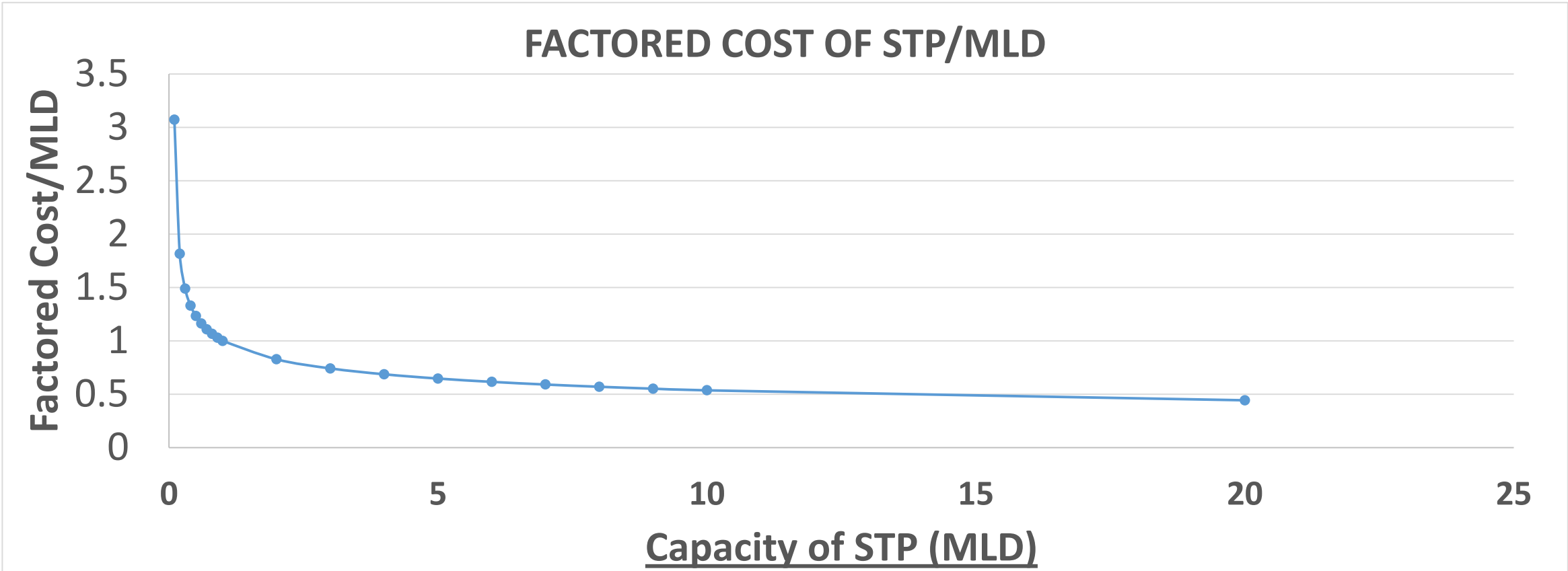


P-Trap

LIFT WELLS AND PUMPS FOR ALL FLOW CONDITIONS

- IL reaches 6.0 m - provide lift well.
- Sewage should not stagnate in lift well for more than 15 min to avoid development of septic conditions.
- Consultants do provide small lift wells but they ignore the fact that pumps should also be provided with the same logic.
- Capacity of pumps should be such that with in all three conditions i.e. peak, average and lean flow conditions there is no stagnation for more than 15 min and pumps are running at least for 2 min at a stretch. For this number of pumps may be 3-5 and level sensors and timer switches may be provided.

Decentralized STPs



- **CBA for all options must be done by consultant to facilitate selection of most efficient system.**
- **Cost per MLD increases inversely with reduction of size of STP**

CONCLUSION

Suggestions have been made to minimize these mistakes.

- Higher factor; 4 to 6 for peak flows
- Restrictive use of flushing tanks
- Reuse of treated wastewater for flushing
- Use of energy efficient DWCPE sewers
- Restrictions on depth of sewers for all stations
- For extreme cold conditions insulation of sewers and manholes is a must.
- For hot climates higher velocities; > 0.8 m/s
- Conditions for efficient lift wells have also been reiterated.
- STP selection must be judiciously worked out.

WE DON’T PRACTICE ENGG, WE ‘DO’ ENGG