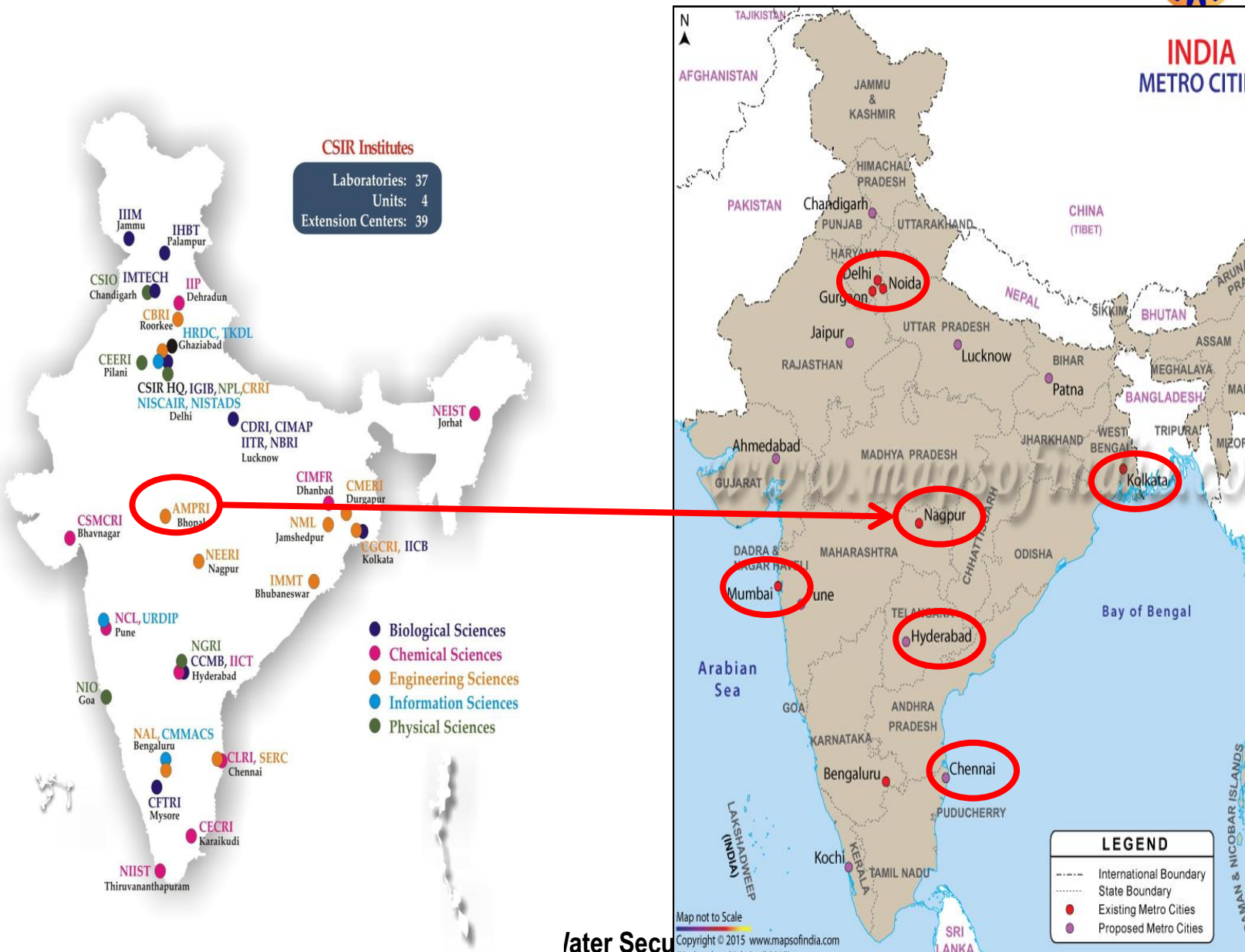
Supply of safe drinking water through Water Security & Safety Plan approach

April 19, 2017

CSIR – NEERI, NAGPUR

CSIR - National Environmental Engineering Research Institute (CSIR-NEERI)



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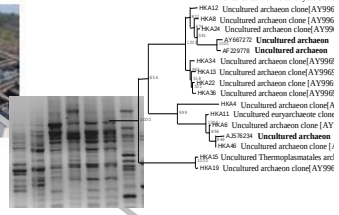
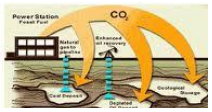
TSB Process for C & N removal in Agrochemical industry

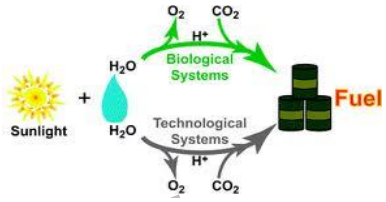


CETP aiming at ZLD for Textile Sector

Hazardous waste Management

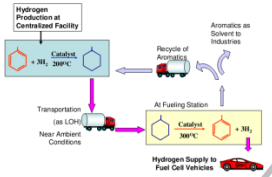


Carbon Capture & Sequestration



Solar to Chemical

- Rapid composting
- Smokeless Chulha
- Essential oils from citrus waste
- Cost effective fish food



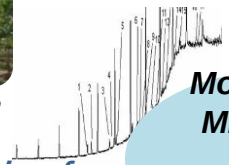
Hydrogen Storage & Delivery

CSIR 800

Phytorid for Sewage Treatment

Carbon Credit: Soil carbon estimation

Ecorestoration



Monitoring of Dioxins, Furans and PoPs

Monitoring, Mitigation & Restoration

Cleaner Energy

MSW Management

Safe Drinking Water

Materials for Arsenic, Fluoride & Iron removal

EIA Studies

Carrying Capacity

Solar Electro-Defluoridation

Tar Recovery

Industries

Energy Sector

Societal Mission

Health

- Impact of Vector Control
- Toxicogenomics
- Detection of waterborne Pathogens

CSIR-NEERI Towards Nation Building

Supply of safe water through Water Security & Safety Approach

Water Technology and Management Division

Supply of safe water through Water Security & Safety Approach

CSIR-NEERI Technologies

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Strategic plans for Rural Drinking water supply and sanitation

Parameter	2017	2022
households with piped water supply	**35%**	**90%**
Public (Stand) Post	20%	10%
Hand pumps	45%	10%

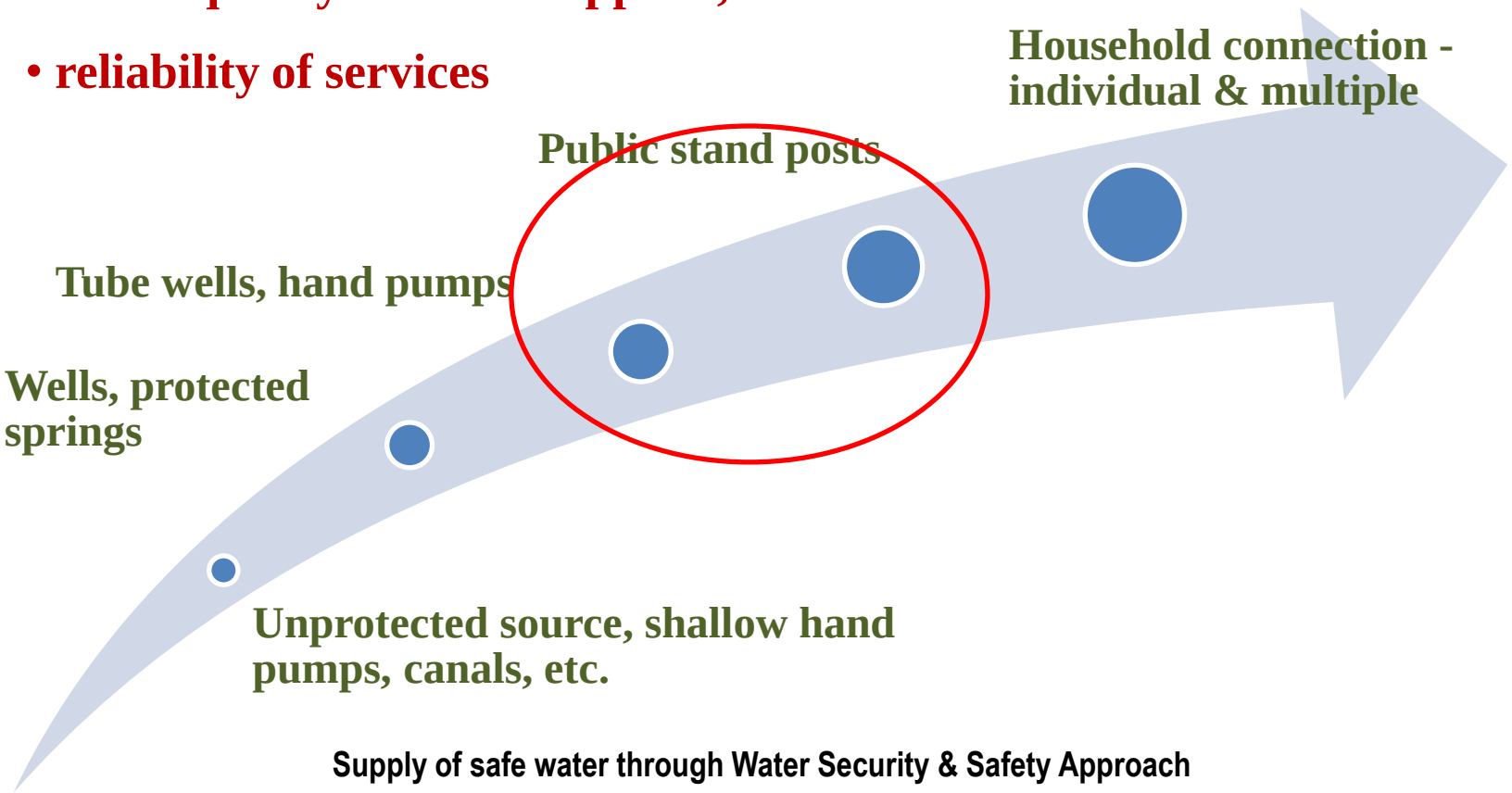
Source: Nation Rural Drinking Water Supply Guidelines, 2013

Supply of safe water through Water Security & Safety Approach

Technological position in water ladder

With increasing awareness, economic prosperity, people realizing the importance of time, rise in demand for :

- **adequate quantity of water**
- **better quality of water supplied, and**
- **reliability of services**



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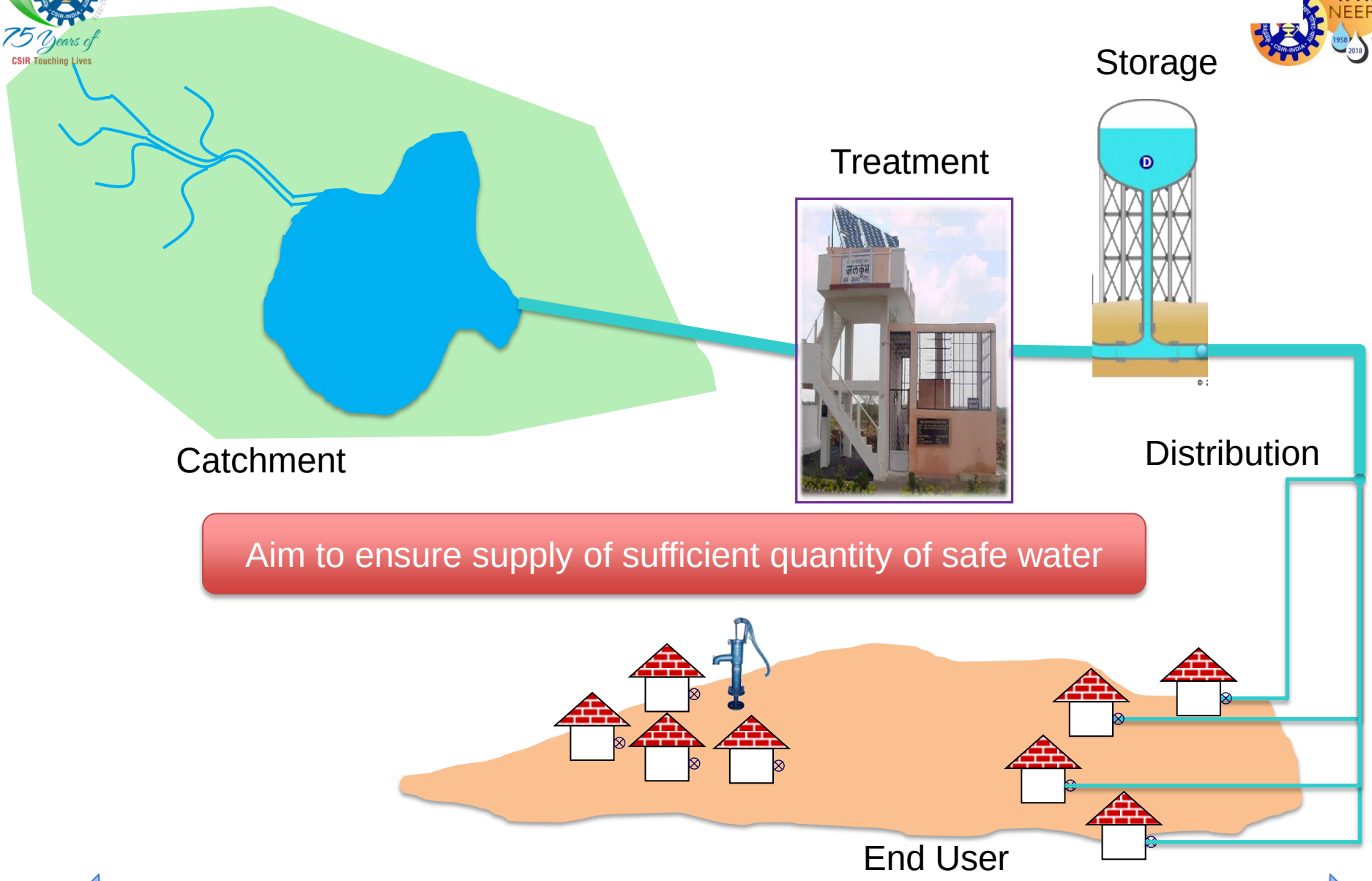
Water System Elements



Aim to ensure supply of sufficient quantity of safe water

Risk based approach (Catchment to Consumer)

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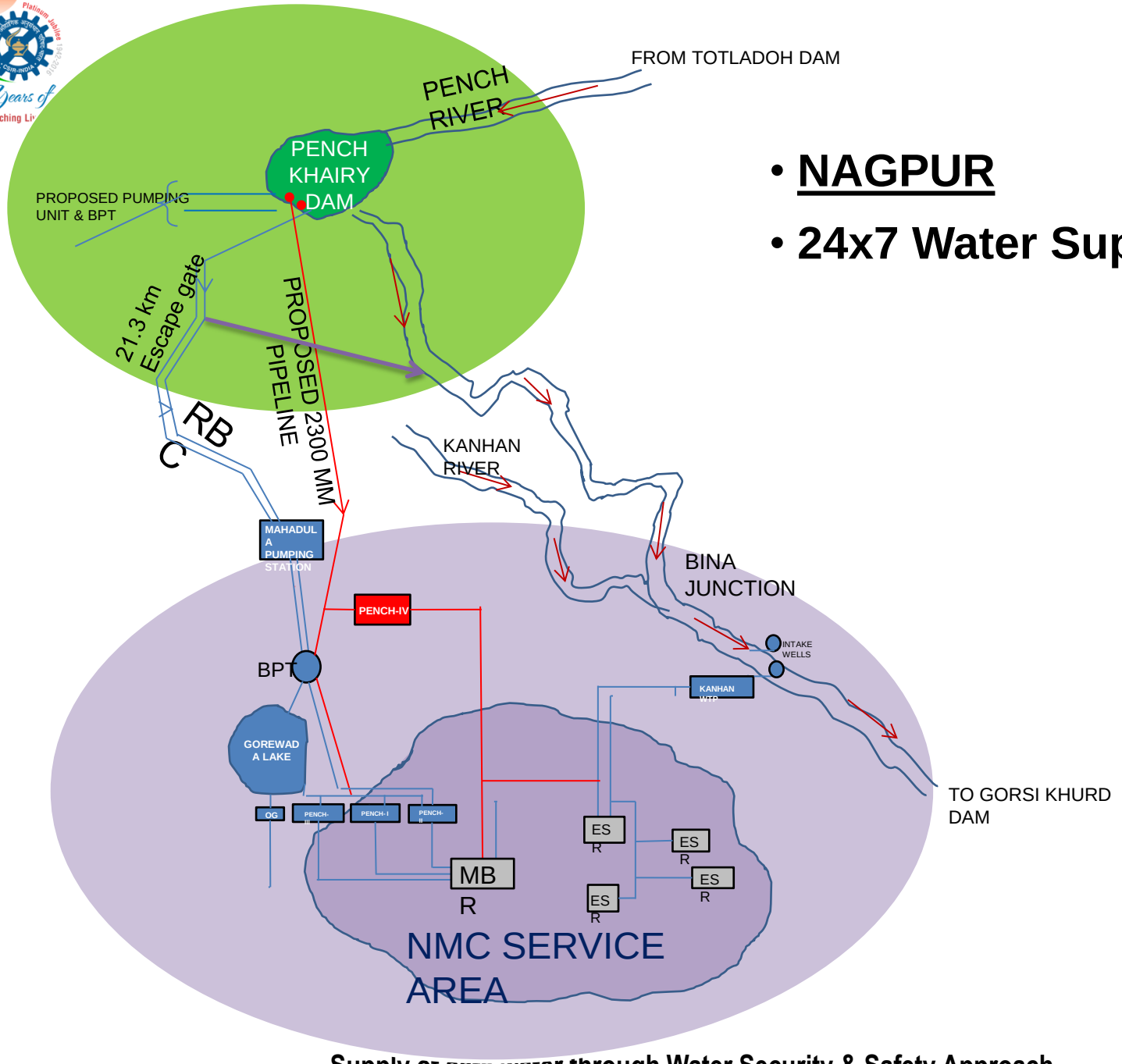

- **NAGPUR**
- **24x7 Water Supply started**

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Bhendala

Bhendala

Source : Google Maps

Village : Bhendala

Area : 7.56 km^2

Population: 1184 (census 2011)

No. of Households: 244

Nirmal Gram Puraskar in 2010

- ✓ Piped network
- ✓ Sanitary interventions
- ✓ VWSC
- ✓ Revenue collection system

Government Medical College and Hospital

- Main Hospital Building
- TB Ward Building
- Super Specialty Hospital Building
- Medical College Building
- Dental College Building

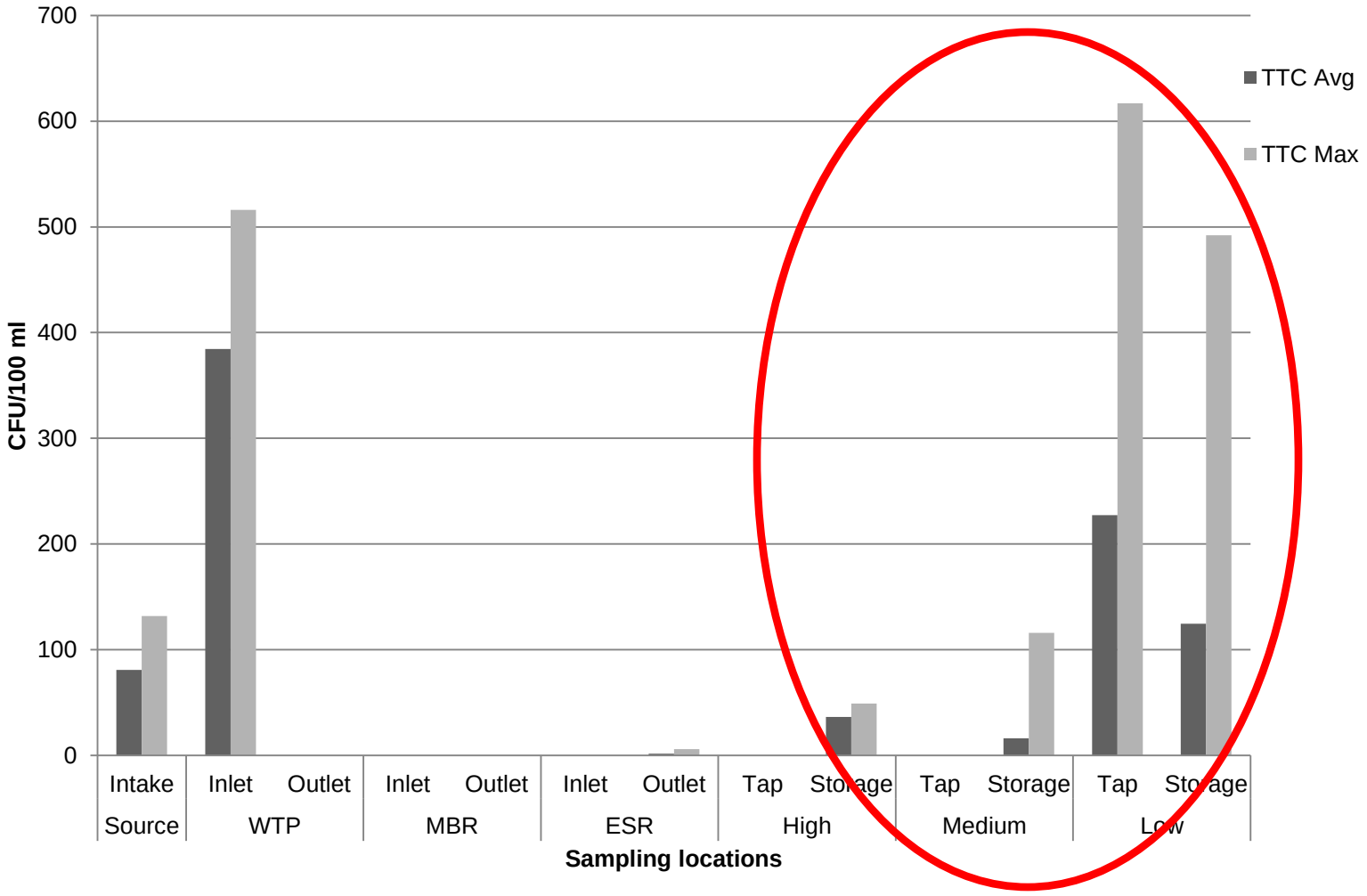
➢**Main Hospital building**

- 44 wards, OPDs, 6 OTs , Autoclave room and Kidney unit

➢ **TB ward building GMCH**

- Skin ward, Infectious ward and TB ward

Water Quality – Nagpur



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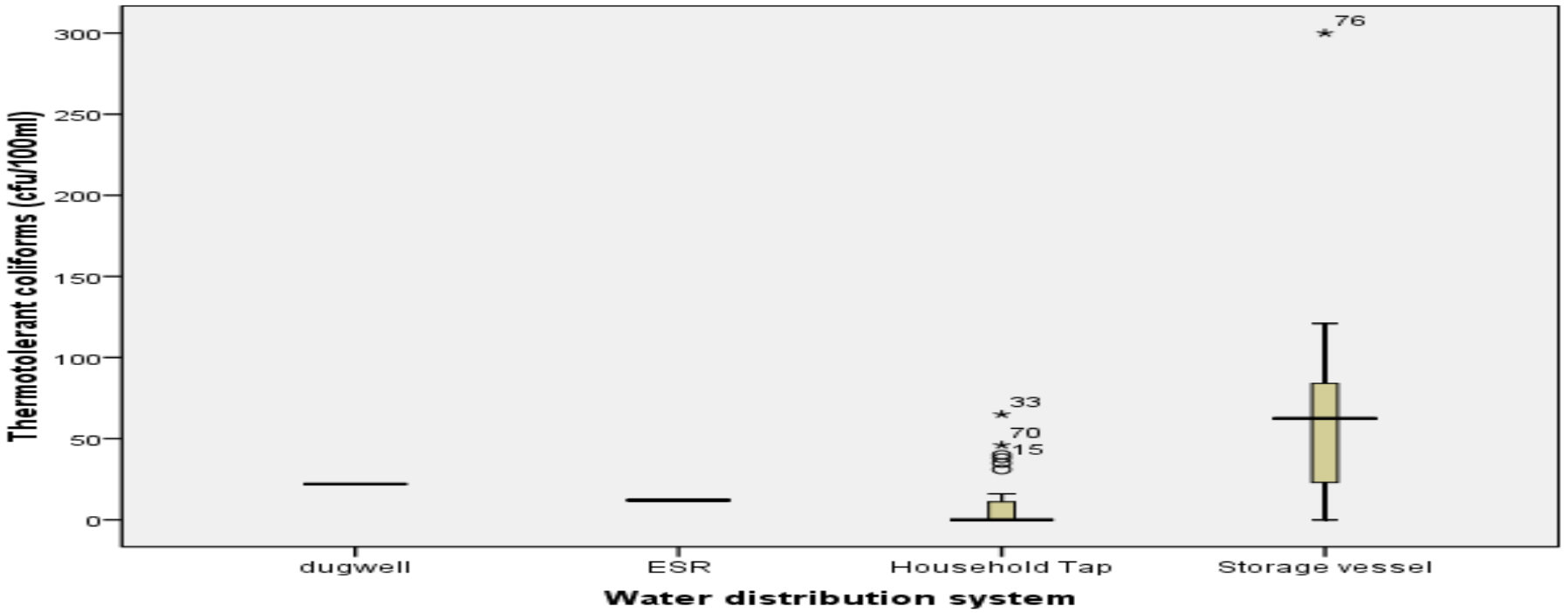
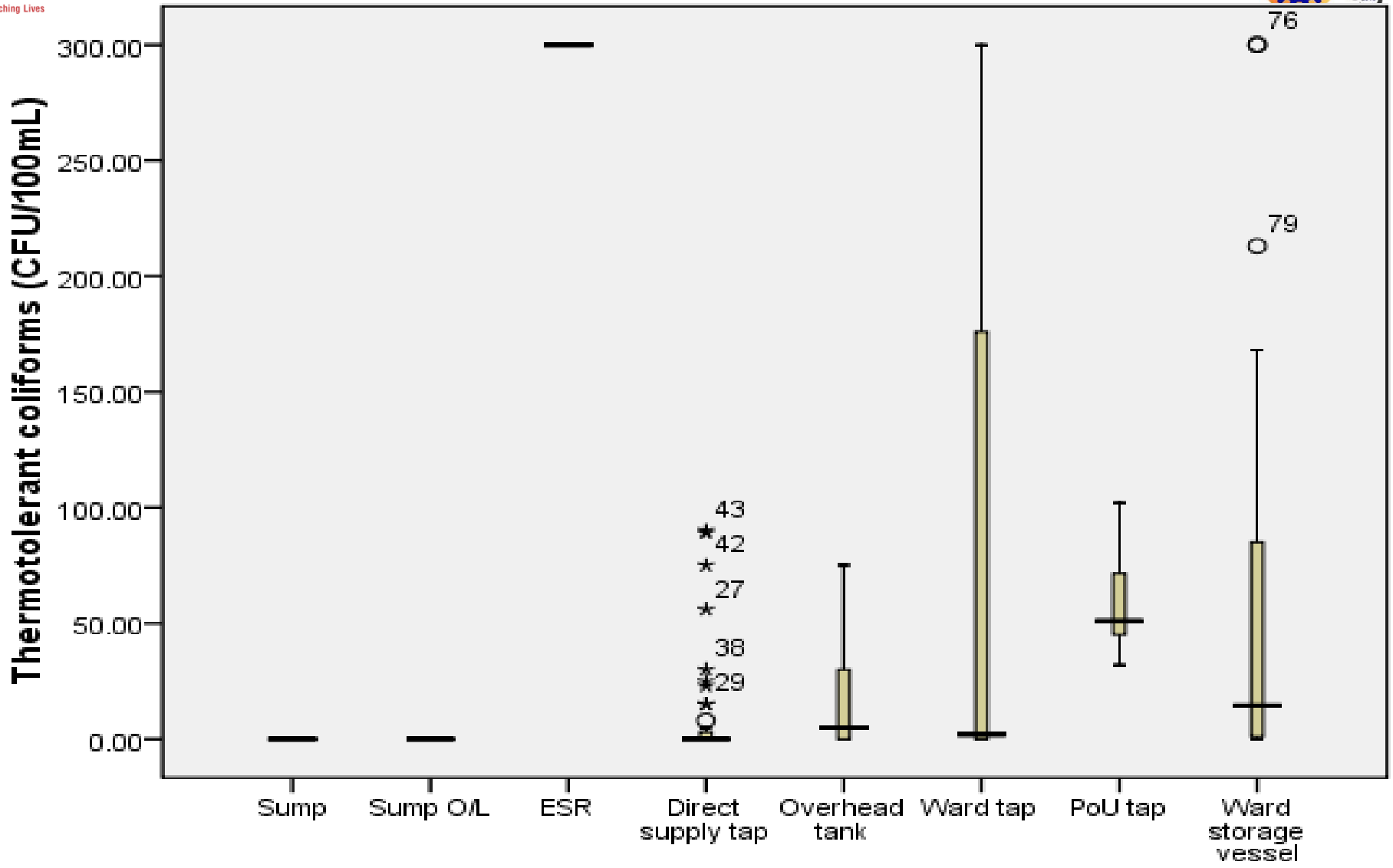
Water Quality - Bhendala

Source → ESR → Community Handpump & Household → Household Storage



Water Quality – GMC



Supply of safe water through Water Security & Safety Approach

Water Safety Plan Approach..

Risk Assessment

Likelihood			Potential Consequences				
			L6	L5	L4	L3	L2
			Minor injuries or discomfort. No medical treatment or measureable physical effects.	Injuries or illness requiring medical treatment. Temporary impairment.	Injuries or illness requiring hospital admission.	Injury or illness resulting in permanent impairment.	Fatality
			Not Significant	Minor	Moderate	Major	Severe
Expected to occur regularly under normal circumstances		Almost Certain	Medium	High	Very High	Very High	Very High
Expected to occur at some time		Likely	Medium	High	High	Very High	Very High
May occur at some time		Possible	Low	Medium	High	High	Very High
Not likely to occur in normal circumstances		Unlikely	Low	Low	Medium	Medium	High
Could happen, but probably never will		Rare	Low	Low	Low	Low	Medium

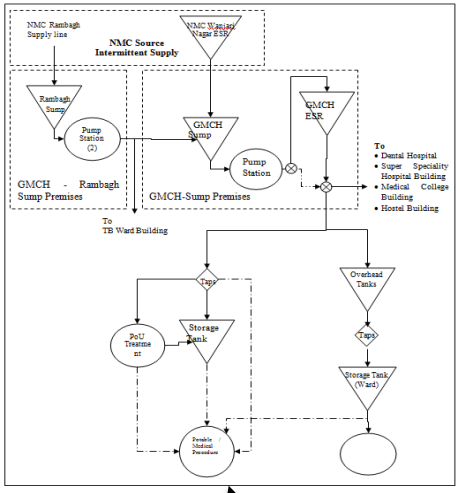
Control measures

Improvement Plan

Action	Arising from	Identified specific improvement plan
Implement measures to control Cryptosporidium-related risks.	Cryptosporidium has been identified as an uncontrolled risk. Cattle defecation in vicinity of	Install and validate ultraviolet light treatment. Validation includes comparing theoretical

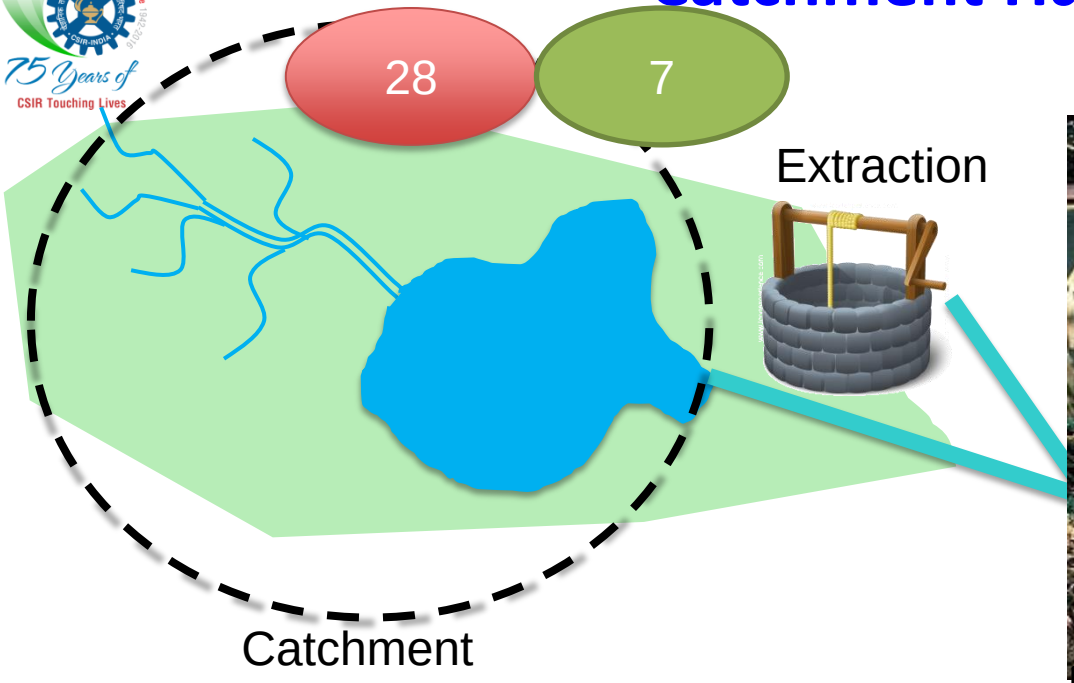
Monitoring + verification

System mapping



Supply of safe water through Water Security & Safety Approach

Catchment Hazard



Open drains contaminating source

Catchment

- Surface Water
  - Reservoirs, Lakes & Drams
  - Rivers
- Ground Water
  - Dug Well
  - Tube Well & Hand pumps
- Marine Water

Technological Intervention

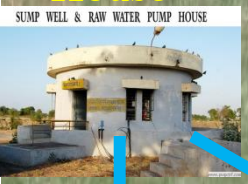
- Natural Constructed wetlands

EXISTING SOURCE TO WTP

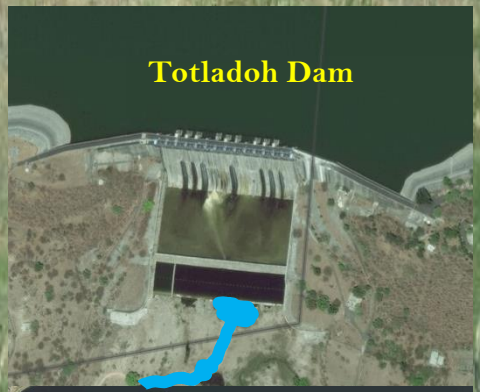
Impact of catchment on source water quality

PROPOSED SOURCE TO WTP

Pump House



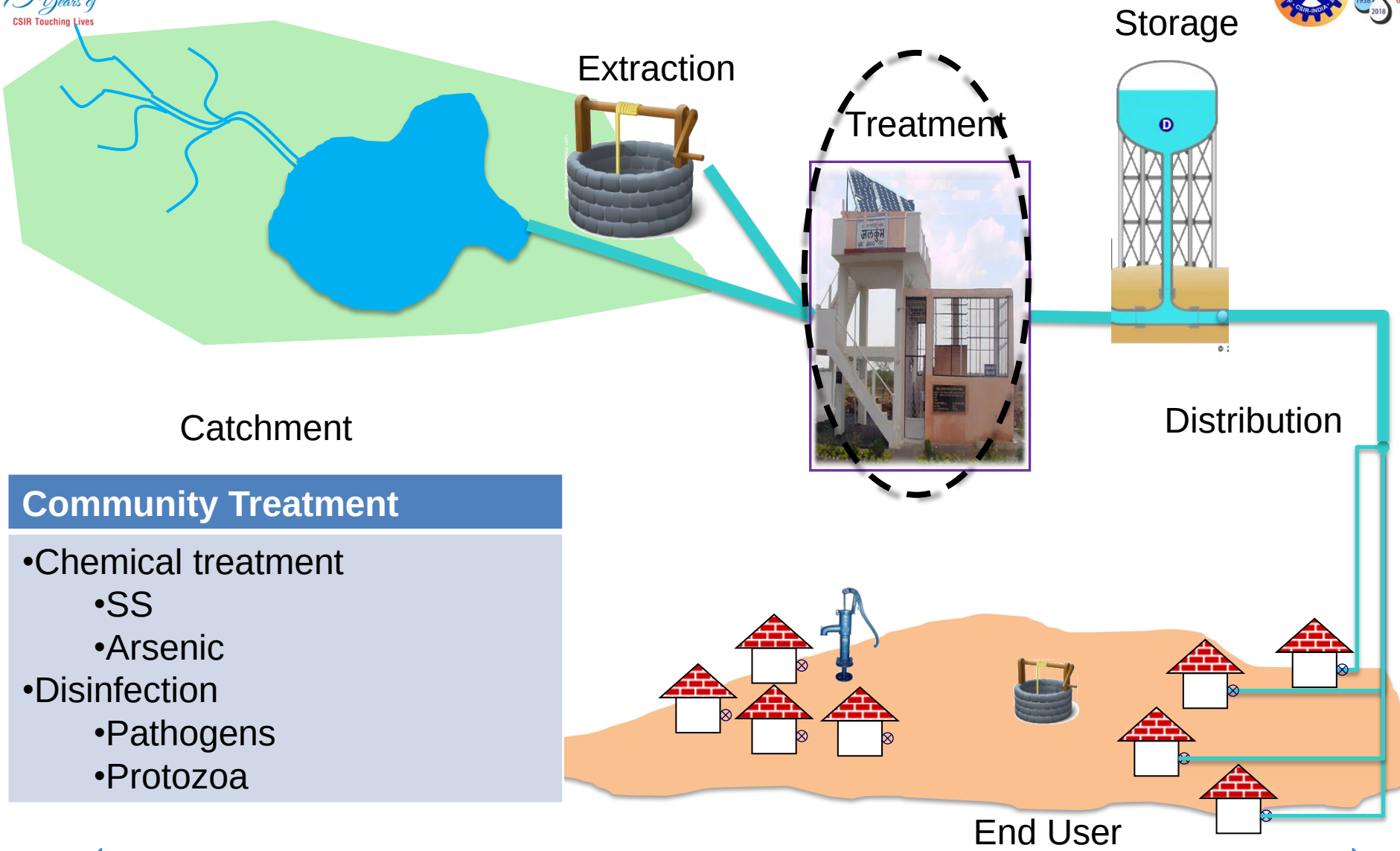
2300 mm Line



RBC

2000 mm Line

Treatment



Community Treatment

- Chemical treatment
  - SS
  - Arsenic
- Disinfection
  - Pathogens
  - Protozoa

Risk Based Appraoch(Catchment to Consumer)

Supply of safe water through Water Security & Safety Approach

Treatment - Hazards

Technological Intervention

- Community Arsenic Removal
- Disinfection Technologies

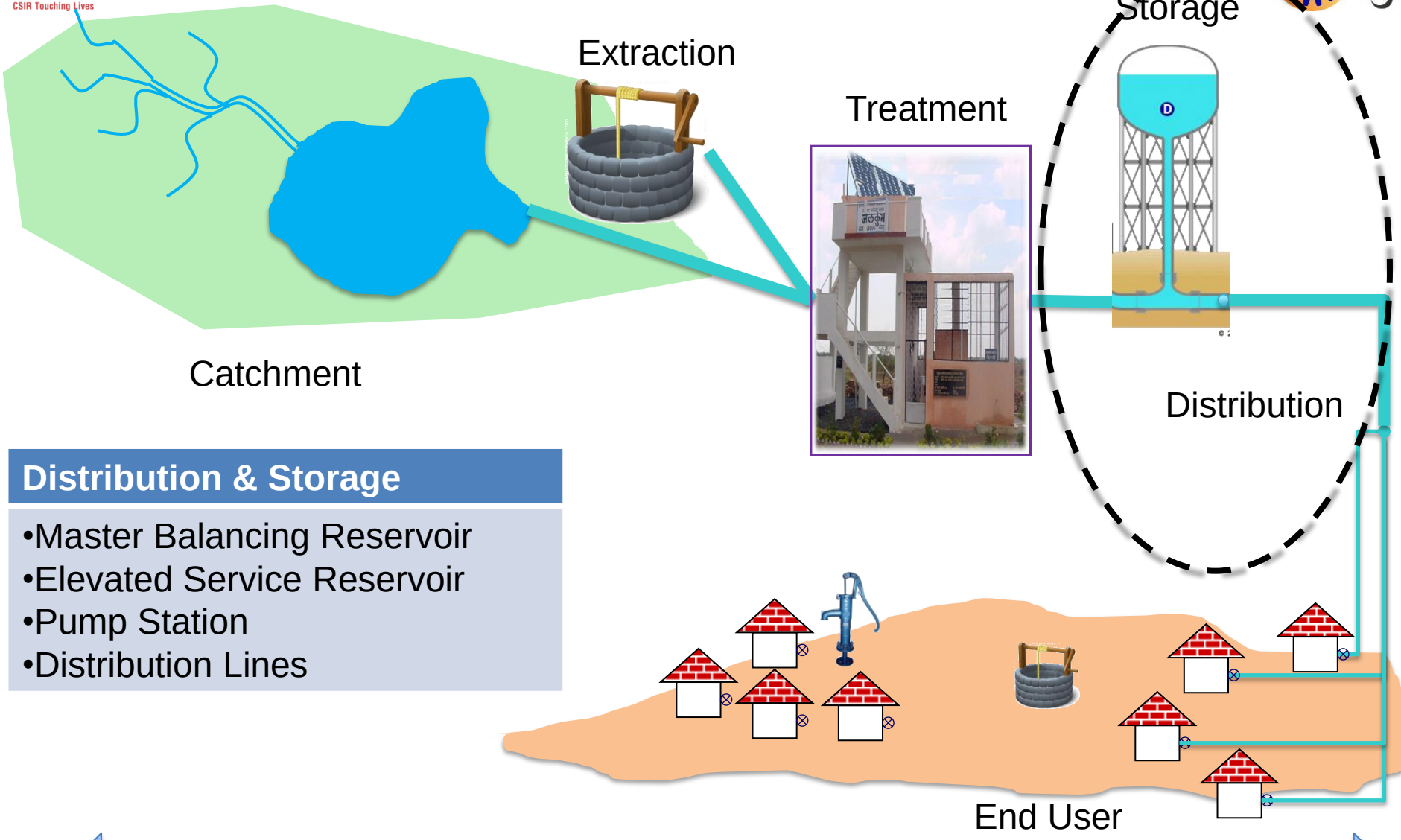
Community Treatment

- Chemical treatment
  - Arsenic
  - Suspended Solids
- Disinfection
  - Pathogens
  - Protozoa

Risk Based Approach (Catchment to Consumer)

Supply of safe water through Water Security & Safety Approach

Water System Elements - Catchment



Distribution & Storage

- Master Balancing Reservoir
- Elevated Service Reservoir
- Pump Station
- Distribution Lines

Risk Assessment (Catchment to Consumer)

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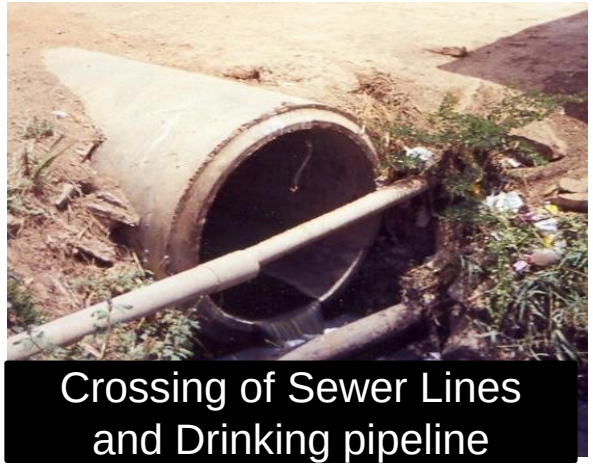
Water System Elements – Storage & Distribution

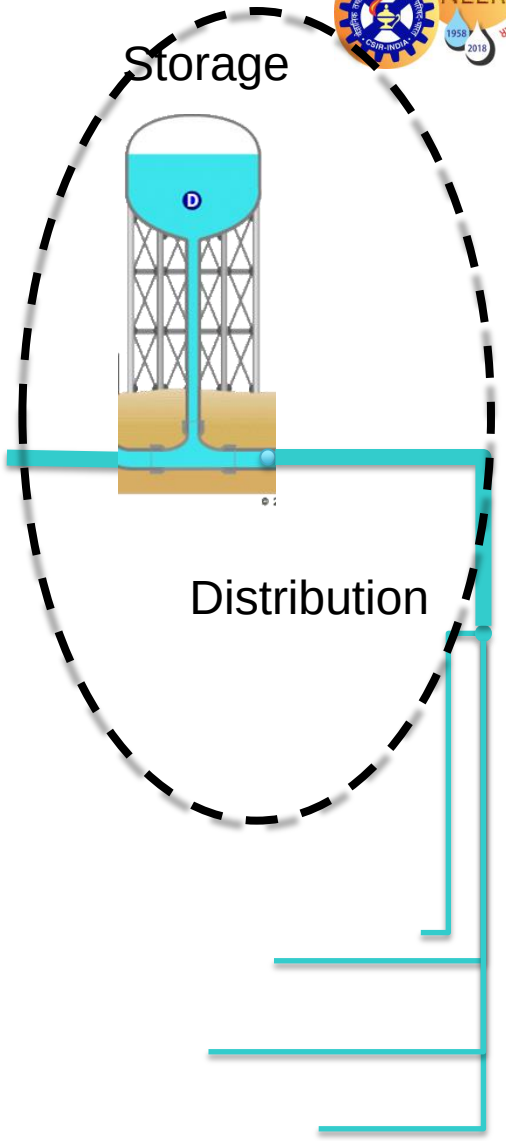
Corrosion of Pipes

Leakage – Contamination / Loss of water

Drinking pipeline laid in the open drain



Crossing of Sewer Lines and Drinking pipeline



Risk Assessment (Catchment to Consumer)

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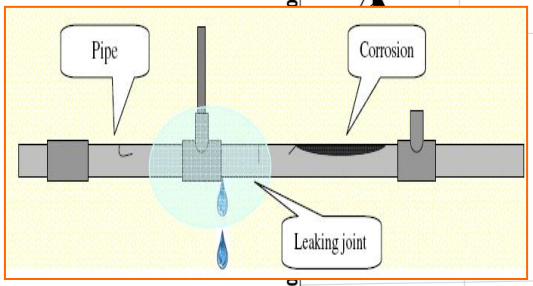
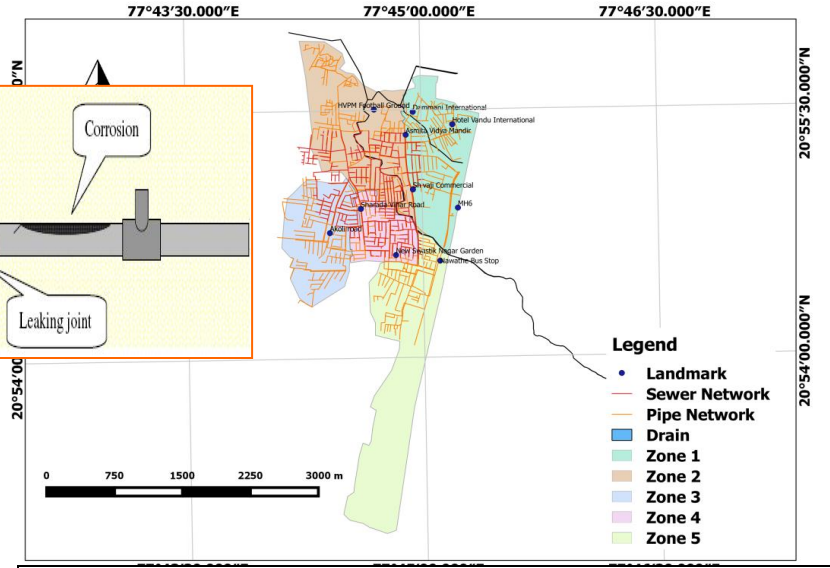
Risk Assessment Arrangement

Vulnerable Pipes

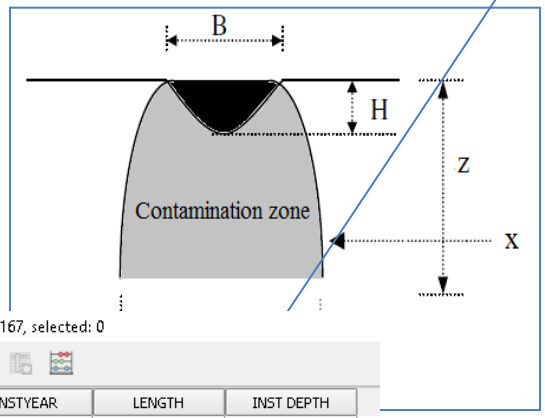
- Old Corroded Pipes
- Leakage in Network
- Intermittent Water Supply





Hazards to Water Pipe

- Pipes close to Sewer
- Supply Line in Contact with Drain
- Soil and Surface Water Pollution



Attribute table - exp-pipe-network :: Features total: 167, filtered: 167, selected: 0

	PIPEID	MATERIAL	DIAMETER	INSTYEAR	LENGTH	INST DEPTH
0	1	CI	100	1980	148.4075937000...	1.1000000000000...
1	2	CI	100	1980	109.2953617999...	1.1000000000000...
2	3	CI	100	1980	102.9464425999...	1.1000000000000...
3	4	CI	100	1980	548.8588267999...	1.1000000000000...
4	5	CI	100	1980	14.64673316999...	1.1000000000000...
5	6	CI	100	1980	5.032026837000...	1.1000000000000...

Vulnerability Computation

$$\lambda_l = -0.4197(D_l^{0.3762}) + 0.4168(L_l^{0.0872}) + 0.2813(P_l^{0.5668}) + 0.0903(H_l^{-1}) + 0.7408(Ag_l^{0.4281})$$

where,

λ_l is the failure rate of pipe i (based on the number of breaks/km/year);

D_l is the diameter of pipe i in mm;

L_l is the length of pipe i in km;

P_l is the hydraulic pressure of pipe i in meter;

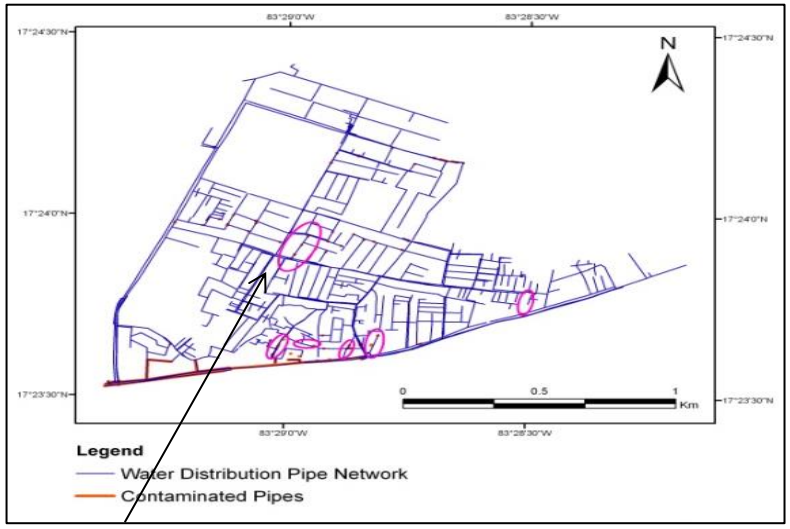
H_l is the installation depth of pipe i in meter; and

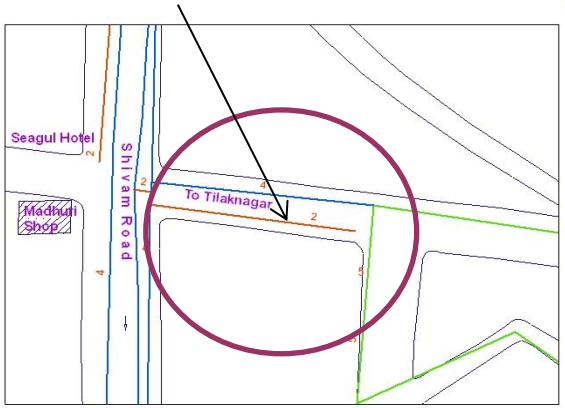
Ag_l is the age of pipe i in years.

Risk of Contaminant Ingress

ugh Water Security & Safety Approach

GIS Mapping and Risk Assessment Modeling





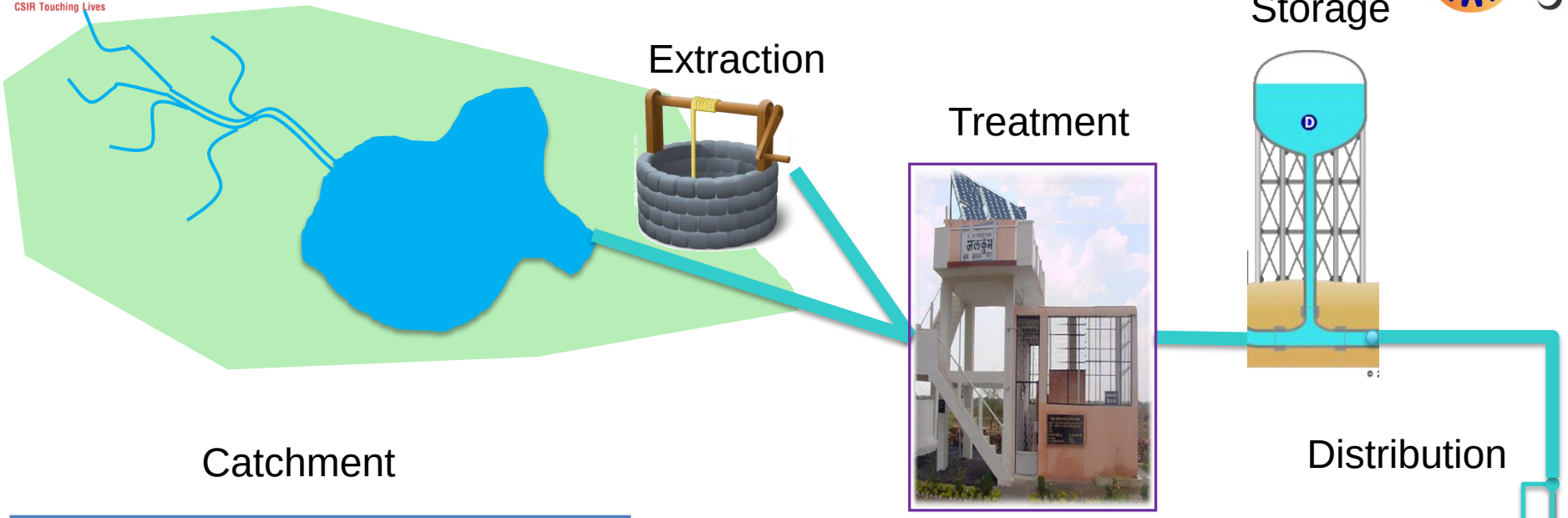
Pipes in contaminant zone

Results of Pipe Condition Assessment and Risk Assessment

PCA Classification	*No. of Pipes*
Very Bad	3
Bad	15
Medium	293
Good	327
Very Good	290

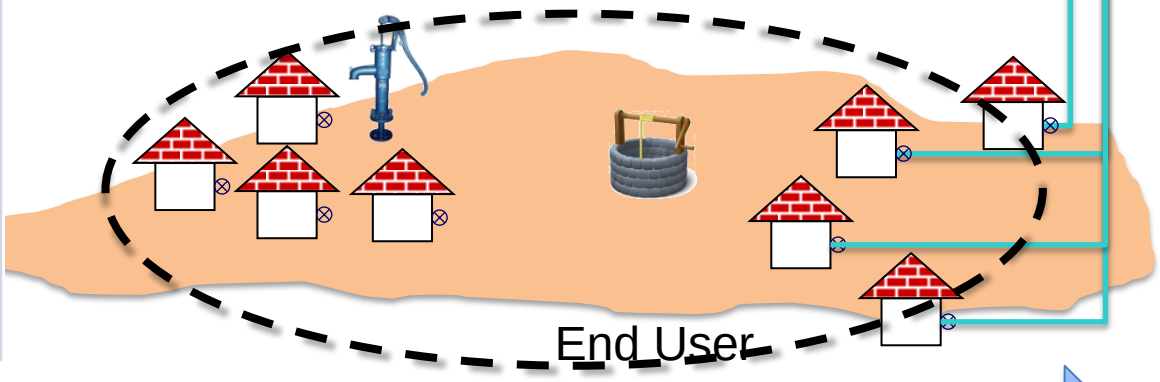
Risk Classification	*No. of Pipes*
Very High	3
High	17
Medium	490
Low	418

Household & PoU Treatment



PoU Treatment Technology

- Disinfection
- TDS / Hardness Removal
- Chemical Contamination
  - Arsenic
  - Fluoride
  - Nitrate….
- Handling Practices



Risk Assessment (Catchment to Consumer)

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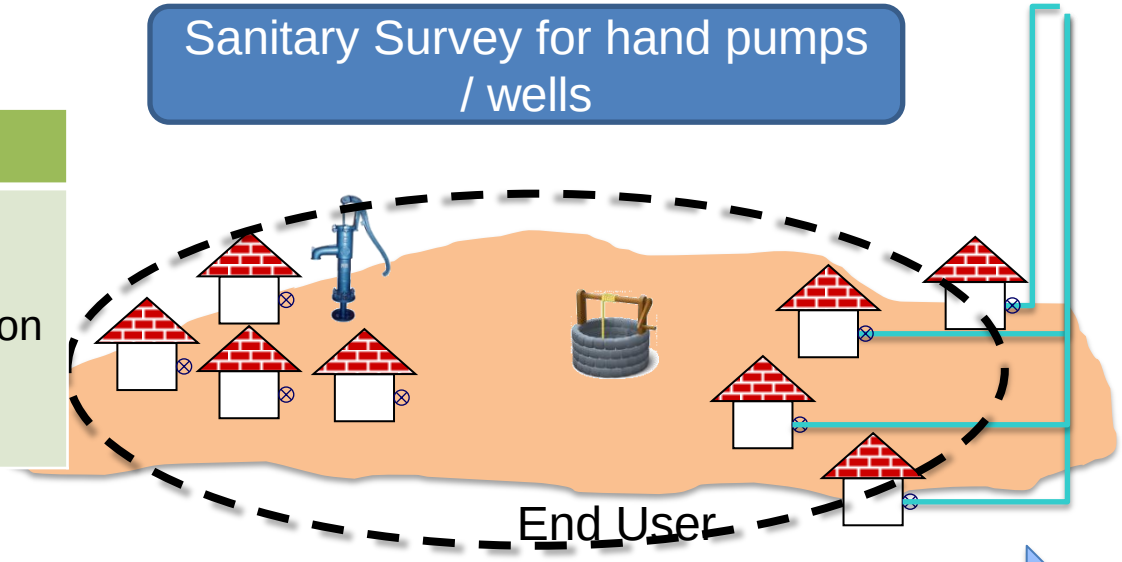
Household & PoU Treatment

PoU Treatment Technology

- Disinfection
- TDS / Hardness Removal
- Chemical Contamination
  - Arsenic
  - Fluoride
  - Nitrate….
- Handling Practices

Technological Intervention

- Nitrate Removal Technologies
- Electro Dearsenification / Defluoridation
- Chemo De aresenification / Defluoridation
- UV – Based Disinfection

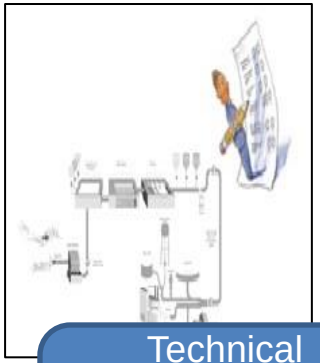


Risk Assessment (Catchment to Consumer)

Supply of safe water through Water Security & Safety Approach

Way Forward…

Interactions with Stakeholders



Technical Assistance (Preparation of WSP)

Training and awareness workshops

Monitoring, Feedback & Improvement

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Improvement Implementation

Supply of safe water throu h

Improvement Implementation

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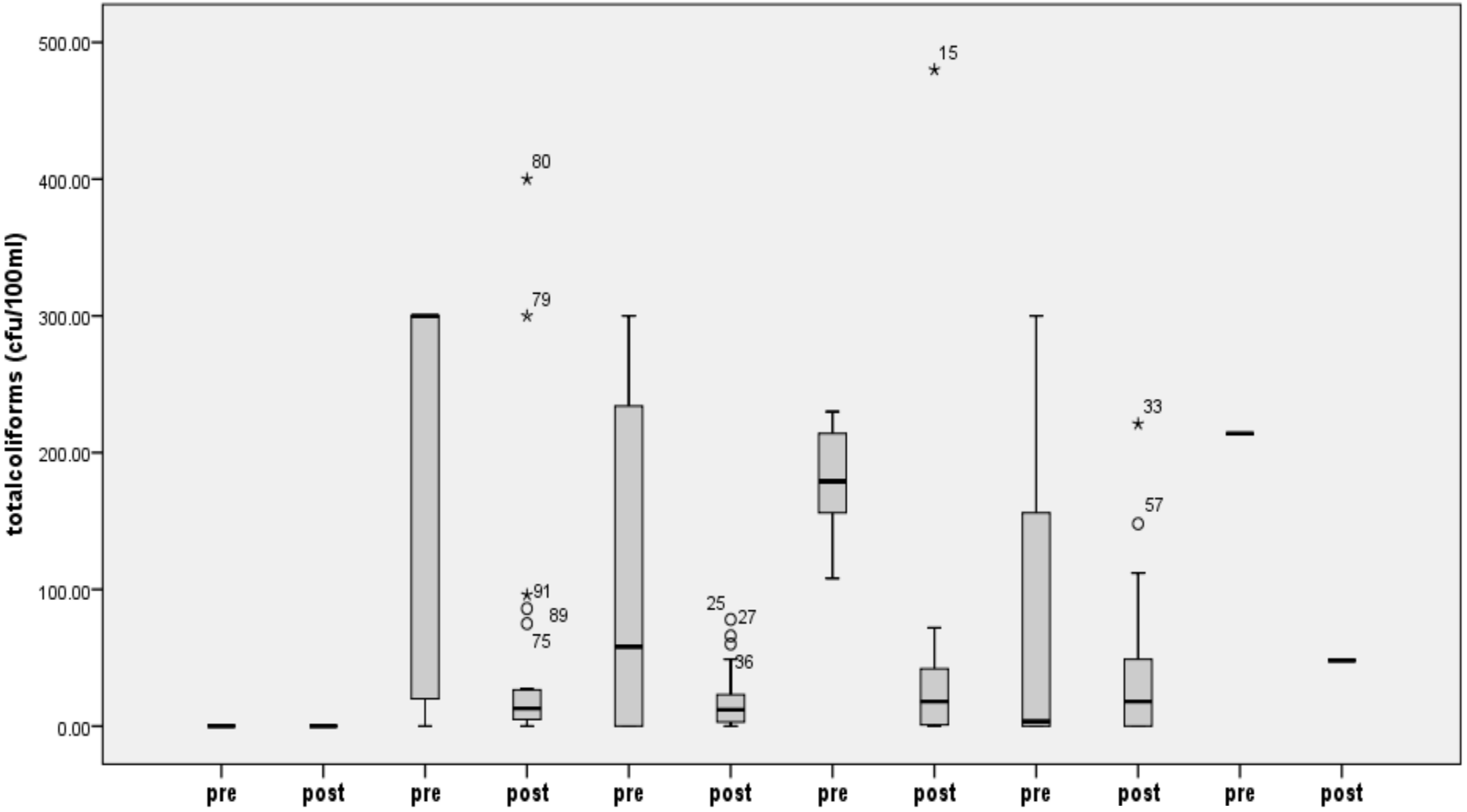
Change in water quality



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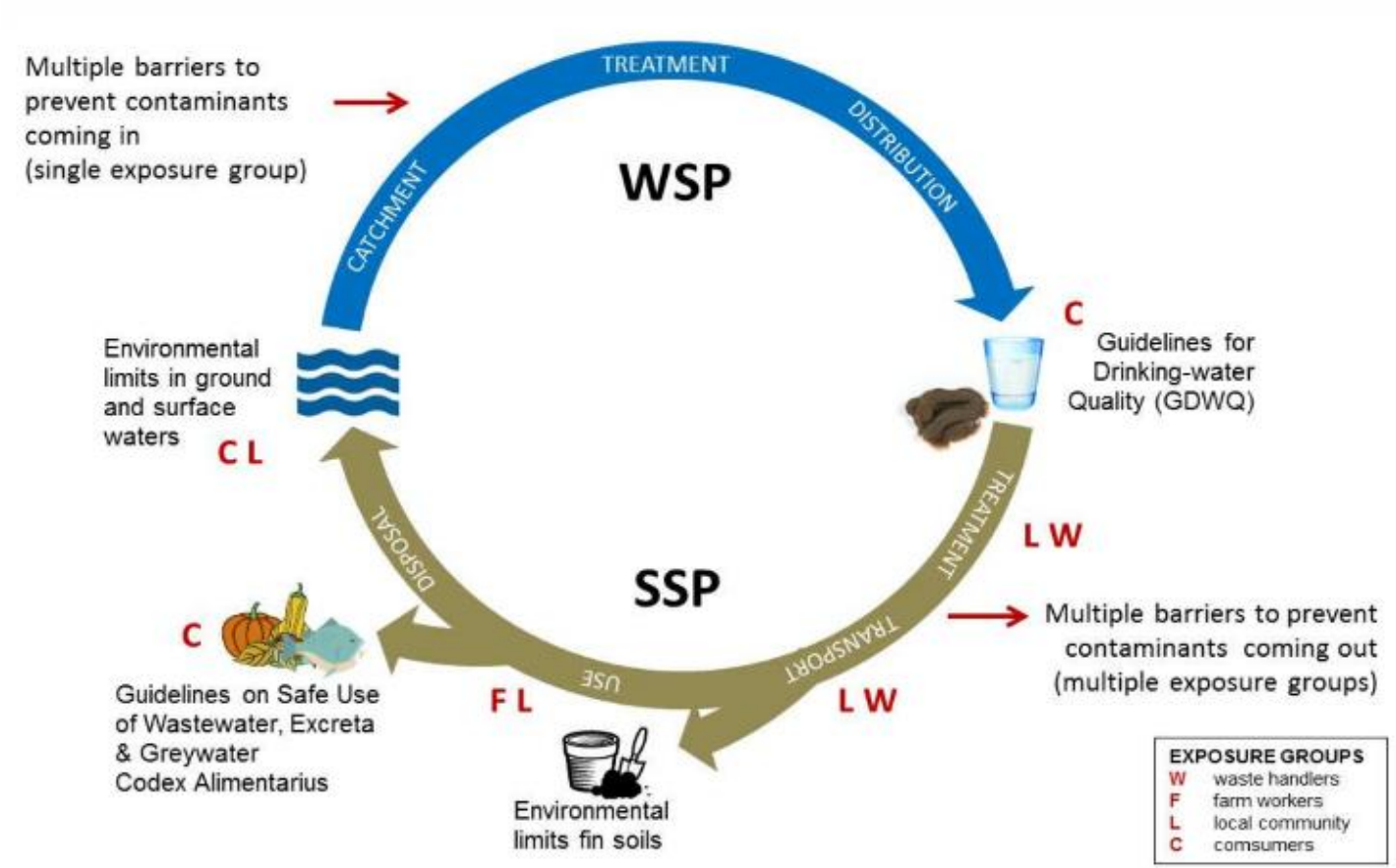
Integration of Water Safety Plan & Sanitation safety Plan

Safety planning approach



with courtesy of Kate Medlicott (WHO)

Thank You


SANITATION
SAFETY
PLANNING
MANUAL FOR SAFE USE AND
DISPOSAL OF WASTEWATER,
GREYWATER AND EXCRETA
World Health
Organization