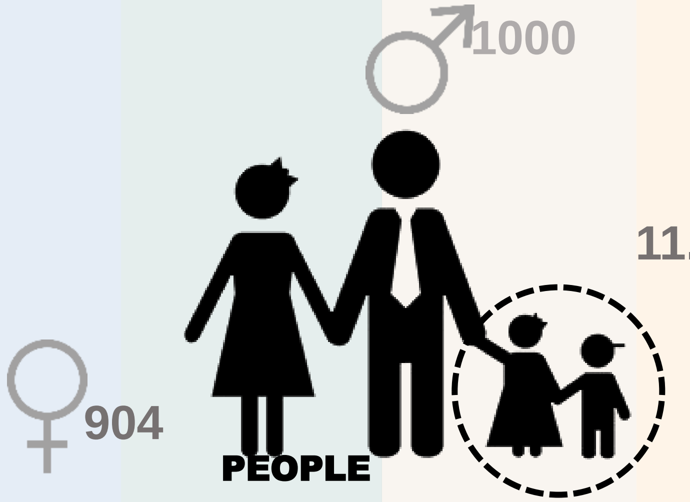
WATER SANITATION WARRIORS

OF

“AHMEDABAD”



AMC = 55,77,940

AUDA = 63,61,084

Population growth rate of Ahmadabad district was 24.03% during the decade.

As in 2011

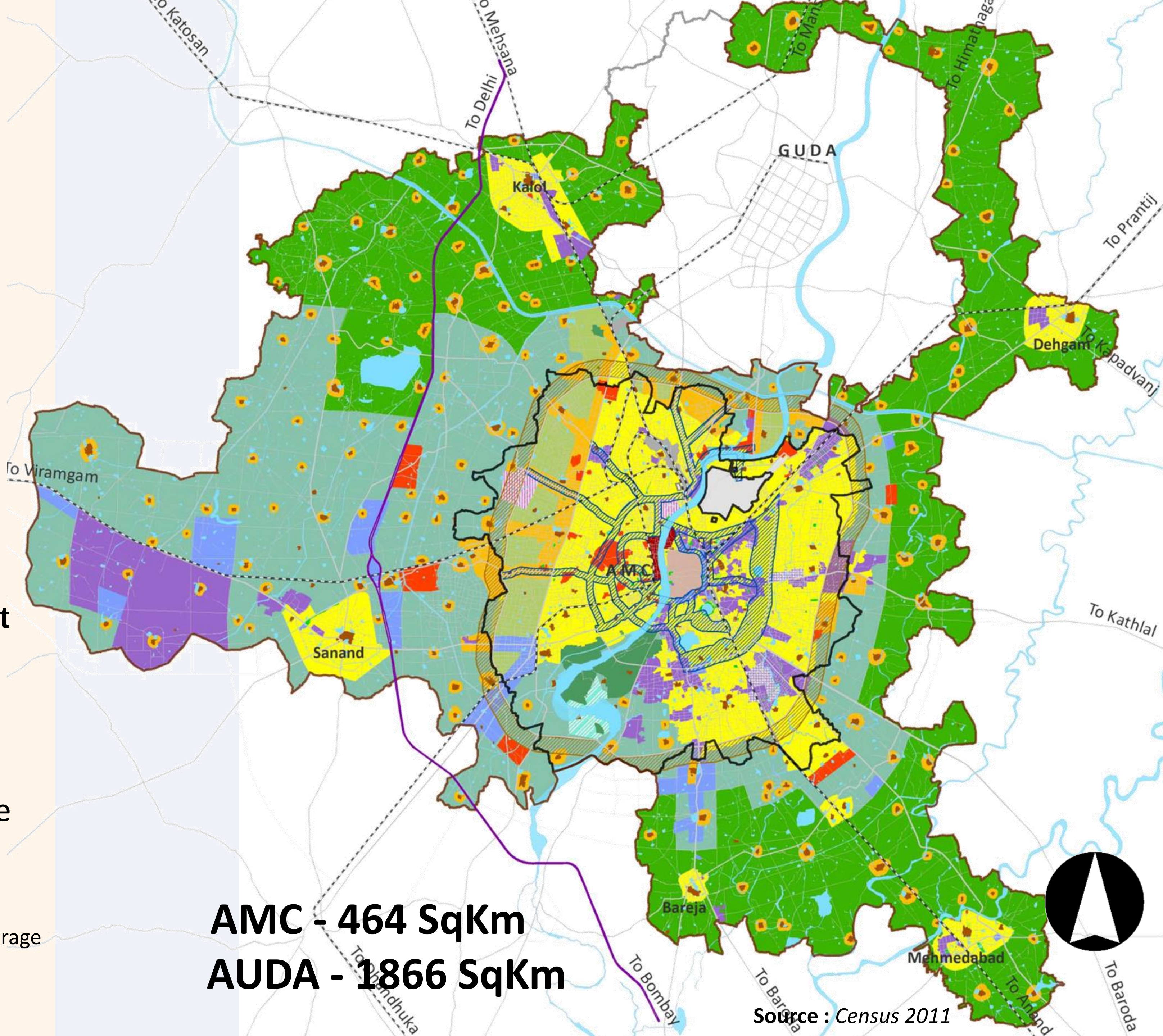
AMC gross density 120 Persons Per Hectare

As per CPHEEO Gross density

High density 500 pph
Medium density 100 to 500 pph
Low density <100 pph

As per URDPFI

For metropolitan city average density 125-175 PPH



AMC - 464 SqKm

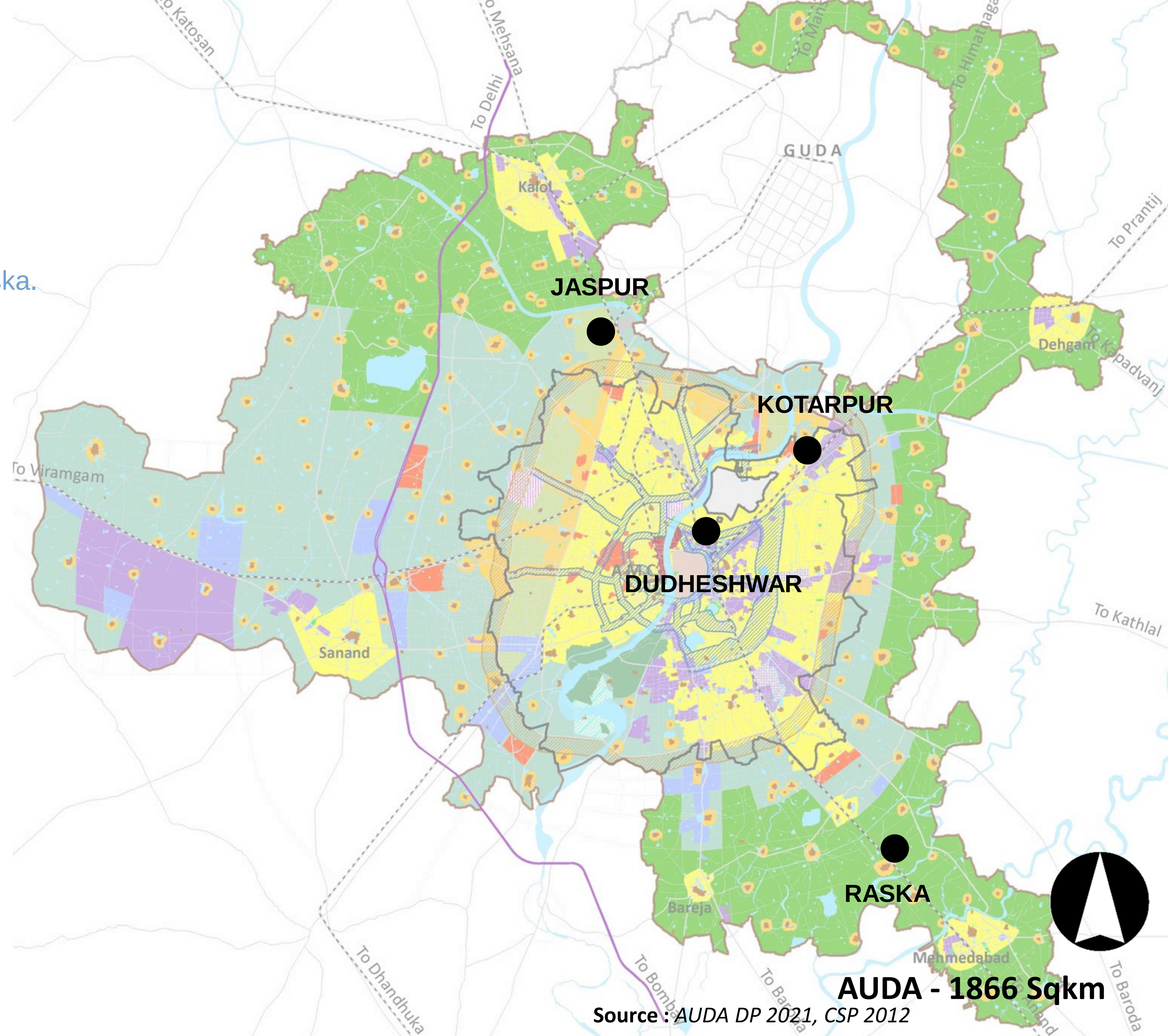
AUDA - 1866 SqKm

Source : *Census 2011*

WATER SANITATION INFRASTRUCTURE

WATER TREATMENT PLANT

4 Nos. in Dudheshwar, Kotarpur, Jaspur & Raska.



WATER SANITATION INFRASTRUCTURE

WATER TREATMENT PLANT

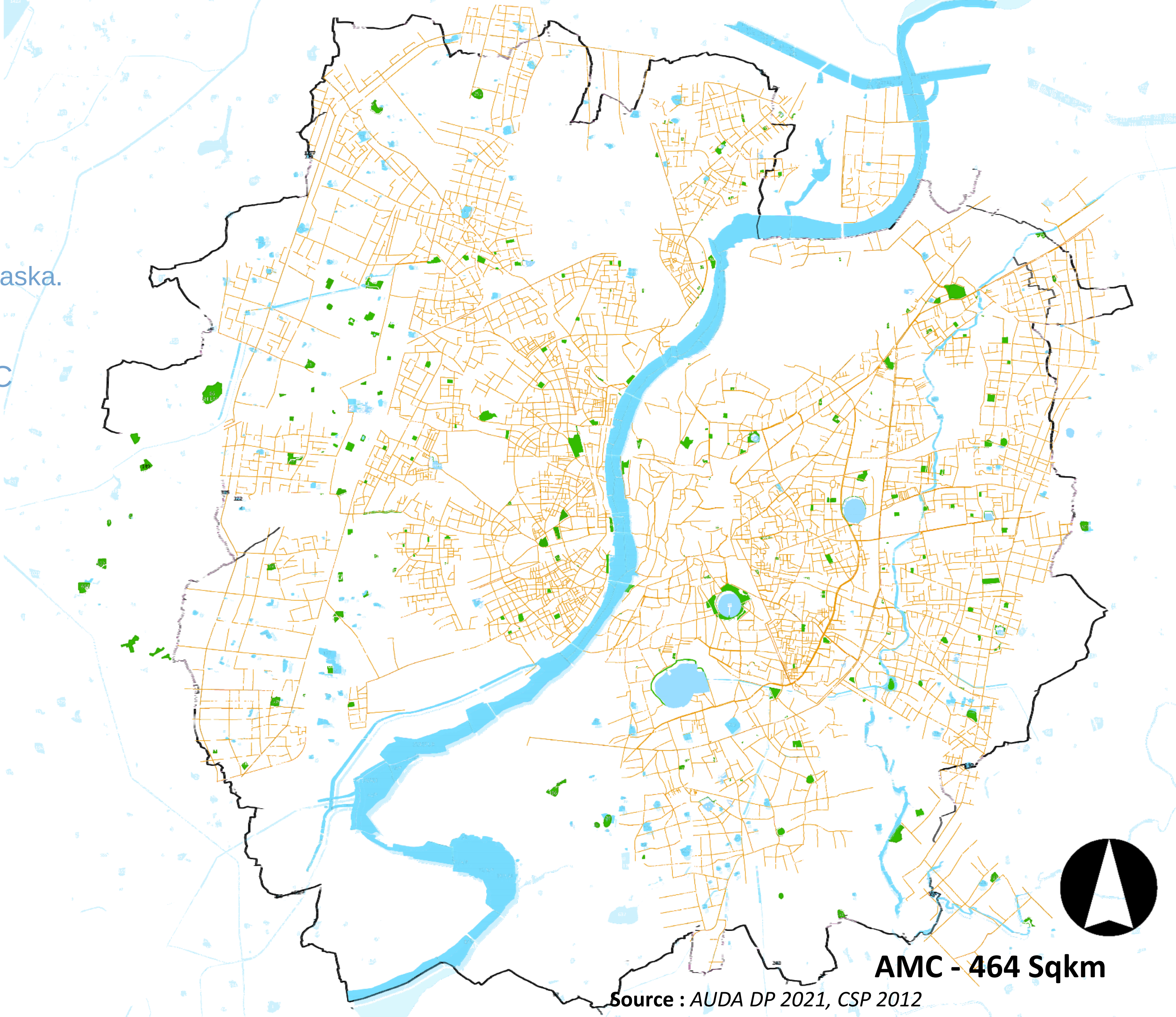
4 Nos. in Dudheshwar, Kotarpur, Jaspur & Raska.

LAKES / WATER BODIES

1411 Lakes totally in AUDA & 59 in AMC

PARKS/GARDENS

Nearly 201 Municipal parks and gardens



AMC - 464 Sqkm

Source : *AUDA DP 2021, CSP 2012*

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AGRICULTURAL LANDS

30.5% of the total AUDA area is agricultural area which is about 570 SqKm.

INDUSTRIES

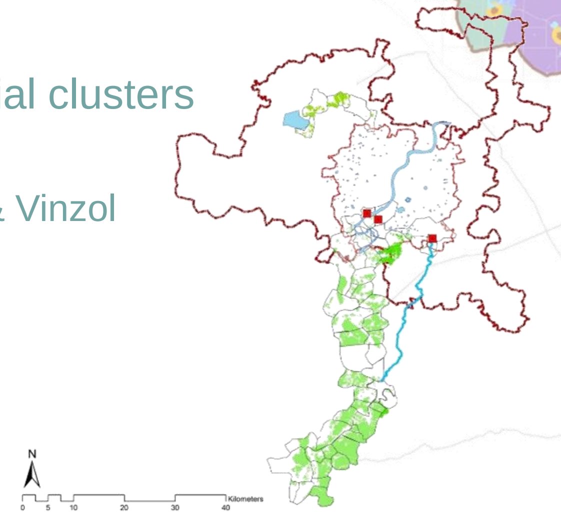
4 Nos. of major industrial clusters

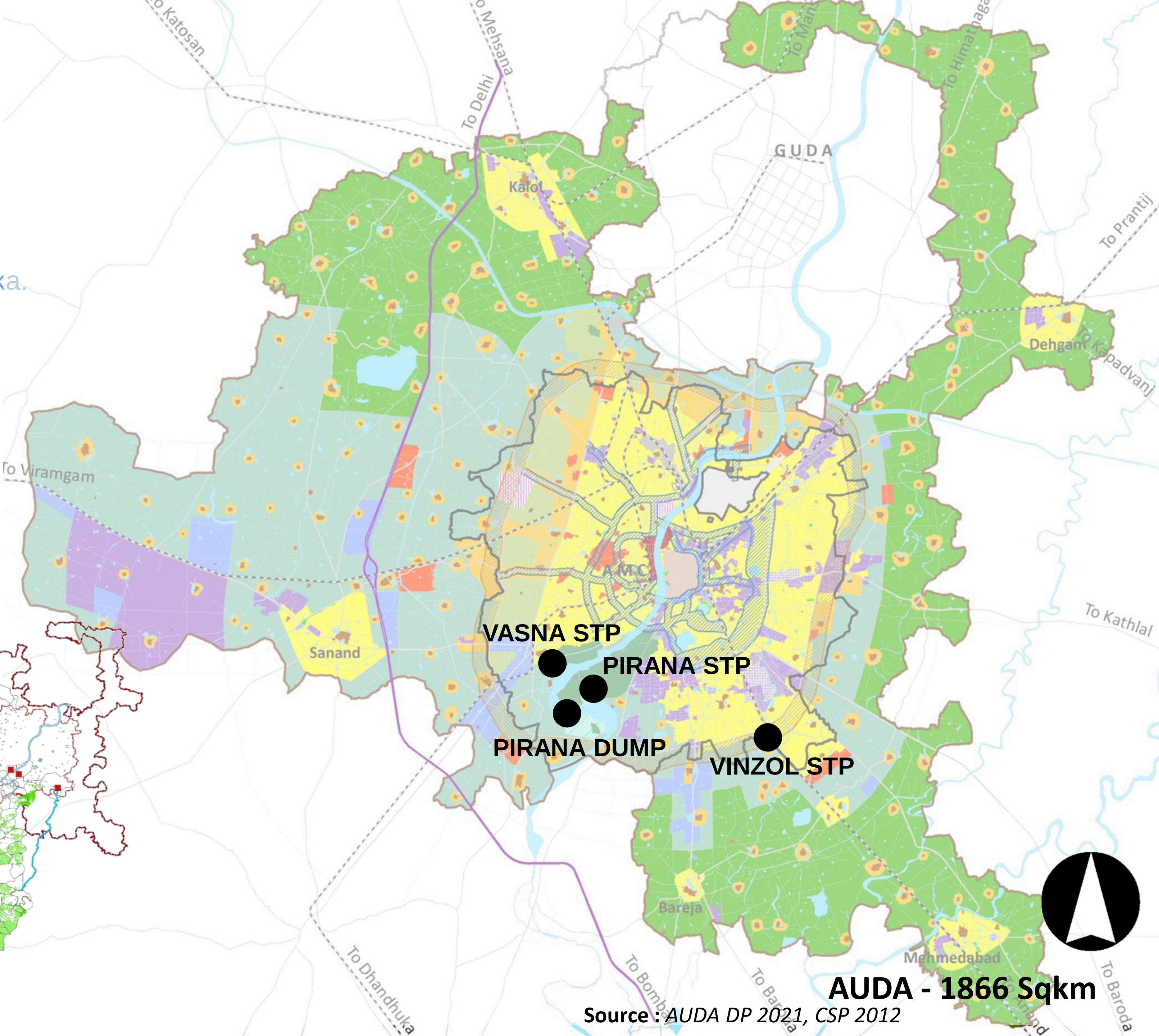
STP

9 STP in Pirana, Vasana & Vinzol

DUMP SITE

Pirana Dump site





Source : *AUDA DP 2021, CSP 2012*

WATER SANITATION INFRASTRUCTURE

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AGRICULTURAL LANDS

30.5% of the total AUDA area is agricultural area which is about 570 SqKm.

STP

9 STP in Pirana, Vasana & Vinzol

DUMP SITE

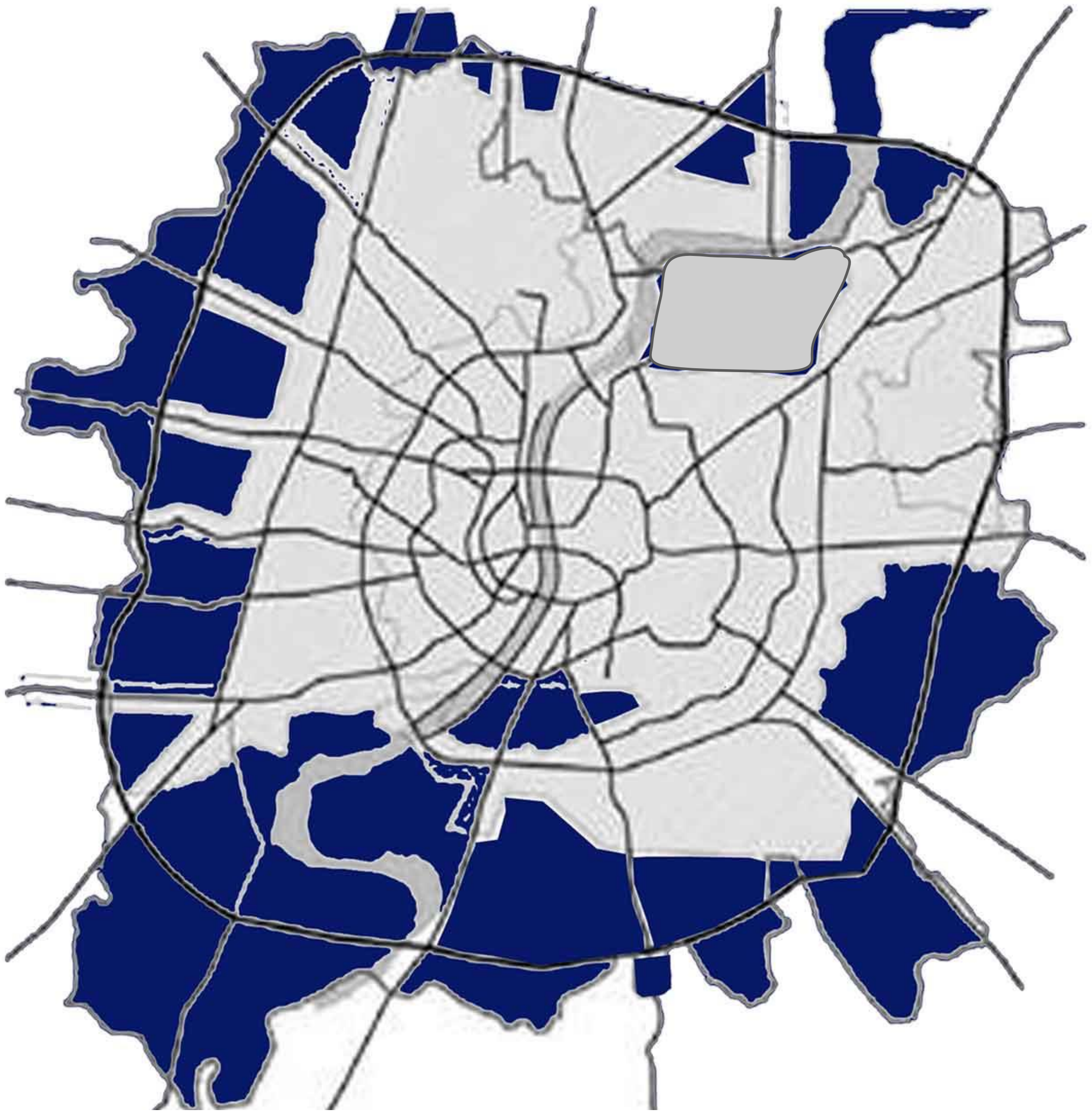
Pirana Dump site

Open Defecation

Total 28300 House Holds are defecating in open

Sewerage system

88.6% Households have access to sewerage system



Source : *AUDA DP 2021, CSP 2012*

WATER

	CDP	CSP	DP 2021
AUGMENTATION OF WATER SUPPLY NETWORK & COVERAGE	✓	-	✓
UPGRADATION of NEW ESR & WTP	✓	-	✓
RAIN WATER HARVESTING	✓	-	✓
NON REVENUE WATER	✓	-	✓
24*7 WATER SUPPLY	✓	-	✓
GIS BASED MODEL		-	✓

WASTE WATER

	CDP	CSP	DP 2021
AUGMENTATION OF THE NETWORK	✓	✓	✓
NEW SEWAGE PUMPING STATIONS	✓	✓	✓
UPGRADATION OF NEW STPS	✓	✓	✓
REFURBISHMENT OF THE EXISTING NETWORK	✓	✓	✓
SEWGAE RECYCLING AND REUSE PLANTS		✓	

SANITATION

	CDP	CSP	DP 2021
100% COLLECTION EFFICIENCY IN SEGREGATED MANNER	✓	✓	✓
SOLID WASTE MASTER PLAN 2031	✓	✓	✓
PREPERATION OF SWM BYELAWS	✓	✓	✓
CAPPING OF OPEN DUMP SITE AT PIRANAN	✓	✓	✓
PROPOSAL OF SIX TRANSFER STATIONS		✓	
WEALTH OUT OF WASTE		✓	
GREEN WASTE PROCESSING	✓	✓	✓
UPGRADATION OF LANDFILL SITE		✓	✓
SWM WORKSHOPS		✓	✓

Source : *AUDA DP 2021, CSP 2012, CDP 2006*

SWACCHA BHARAT ABHIYAAN

Generate **AWARENESS** about sanitation and its linkage with **PUBLIC HEALTH**

Enabling environment for **PRIVATE SECTOR PARTICIPATION**

BEHAVIOURAL change regarding healthy **SANITATION** practices

MODERN and **SCIENTIFIC** Municipal **SOLID WASTE MANAGEMENT**

Elimination of **OPEN DEFECATION**

SMART CITY GUIDELINES

SMART METER and management for **WATER**

PAN city initiative promote **WASTE WATER RECYCLING**

WASTE MANAGEMENT

AMRUT

Augmentation of existing **WATER SUPPLY**

Recharging of **GROUND WATER**

FAECAL SLUDGE MANAGEMENT

RECYCLING of water for beneficial purposes and **REUSE OF WASTEWATER**

Source : *Swacha Bharat guidelines, Smart city guidelines, Amrut guidelines*

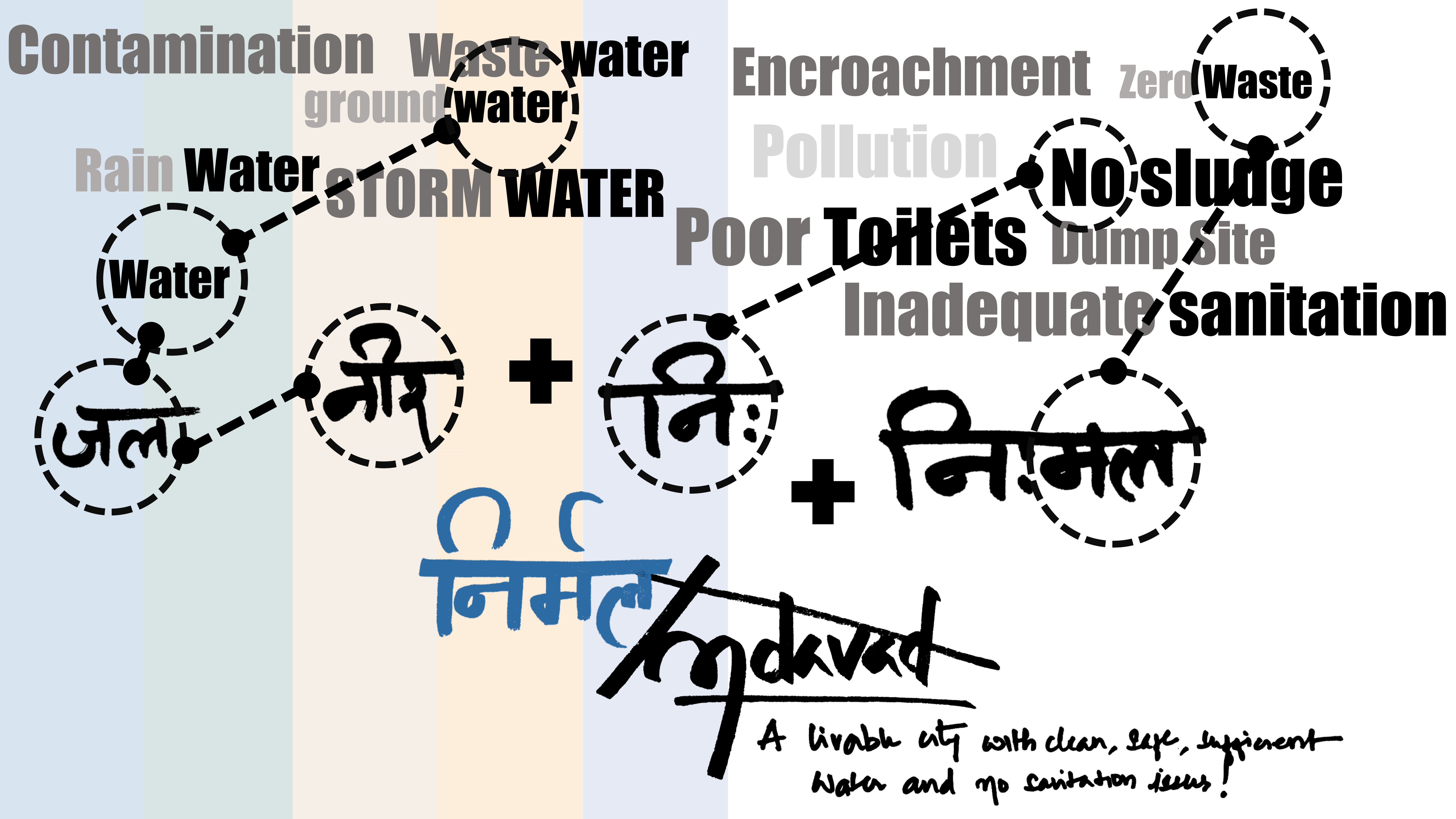
ROLE OF AUDA

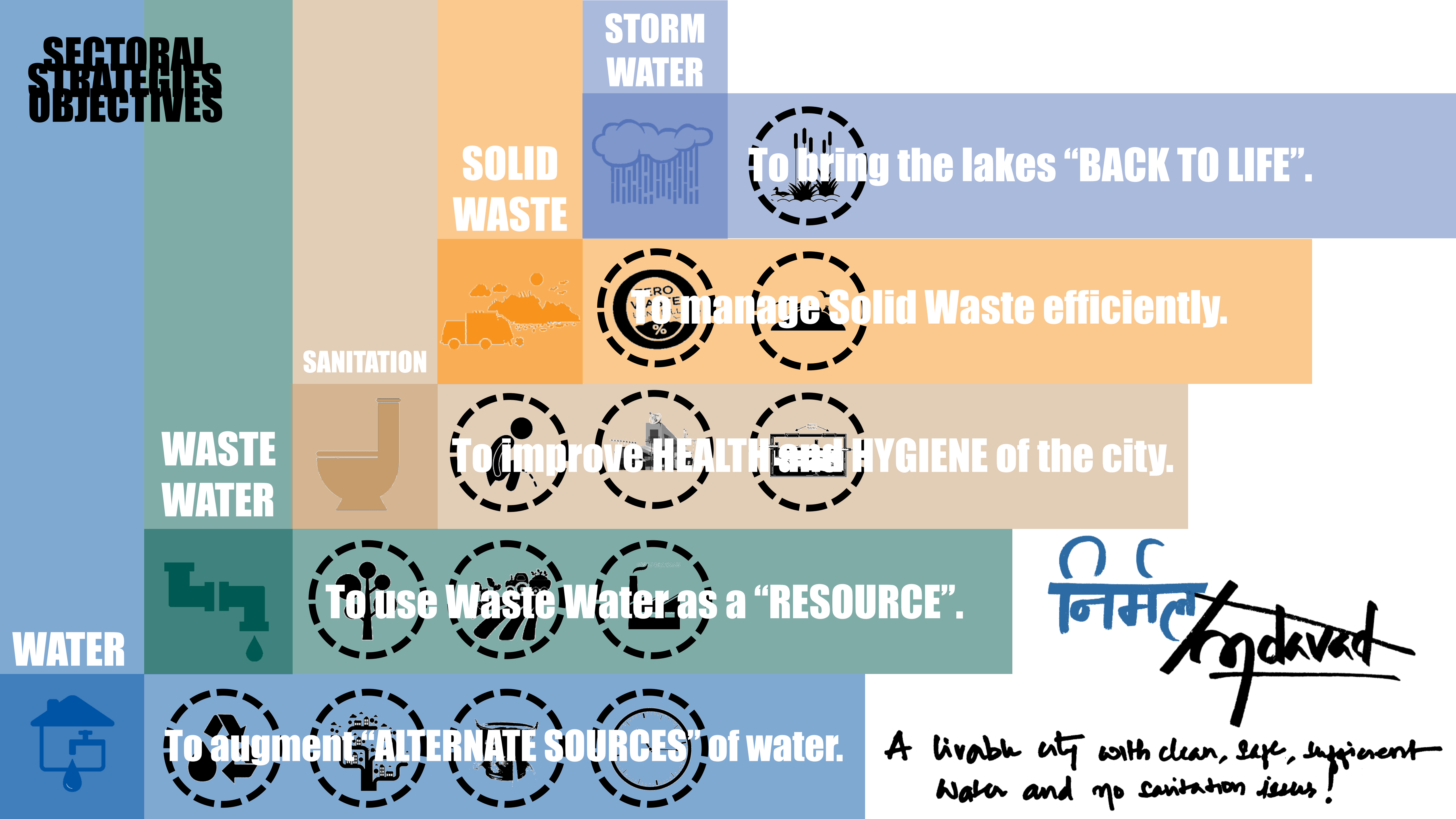
- **To Guide, Direct And Assist The Local Authority** Or Authorities And Other Statutory Authorities For The Functioning Of Water Supply And Sanitation.
- The State Government Shall Pay As Contribution, Either In One **Lump-sum Or In Such Installments For The Sanitation** Plan Towards The Expenses Incurred By The Urban Development Authority In The Discharge Of Its Functions.
- Any **Operational Construction** Related To Water And Sanitation
- Any Work For The Purpose Of **Inspecting, Repairing Or Renewing Any Drains**, Sewers, Mains, Pipes Cables, Telephone Or Other Apparatus Or The Breaking Open Of Any Street .
- The Urban Development Authority With The **Approval Of The State Government, Delegate Its Power To The Local** Authorities Related To Water Supply And Sanitation .
- An Appropriate Authority Shall Have To **Maintain Its Own Fund** For The Sanitation Plan Of The Area.

ROLE OF AMC

- To Execute Works Related To Water And Sanitation.
- To Levy And Collect Fees For The Execution Of Works
- Carry Out Surveys In The Urban Development Area.
- To Enter Into Contracts, Agreements Or Arrangements, With Any Local Authority, Person Or Organization For Water Supply And Sanitation For Performing Its Functions
- To Control The Development Activities Related To Water Supply And Sanitation In The Urban Development Area
- To Carry Any Development Works Of Water Supply And Sanitation In The Urban Development Area

Source : *Gujarat Town Planning & Urban Development Act, 1976, AUDA DP 2021*


Contamination
Waste water
ground water
Rain Water
STORM WATER
Water
जल
नीर
+
निः
+
निःमल
निर्मल
Encroachment
Zero Waste
Pollution
No sludge
Poor Toilets
Dump Site
Inadequate sanitation
Amdavad
A livable city with clean, safe, sufficient water and no sanitation issues!


SECTORAL STRATEGIES OBJECTIVES
STORM WATER
SOLID WASTE
SANITATION
WASTE WATER
WATER
To bring the lakes "BACK TO LIFE".
To manage Solid Waste efficiently.
To improve HEALTH and HYGIENE of the city.
To use Waste Water as a "RESOURCE".
To augment "ALTERNATE SOURCES" of water.
निर्मल Hyderabad
A livable city with clean, safe, sufficient water and no sanitation issues!

STUDIO WORK PLAN

Divided into SECTORAL GROUPS

- Overall Sectoral Analysis.
- Best Practices around the world.
- Policies/Programs that emerged.
- Looking at Ahmedabad context.
- Listing Problems - Solutions

Time to own a Project

- Preparing a Final list of strategies.
- Take a stand on one/two strategies.

Consolidation Phase

- Justifying the strategies.
- Site v/s sector Study.
- Field visits.
- Surveys.
- Working on innovative techniques.
- Analyse the problems in Ahmedabad

MID TERM

DETAILING OF THE PROJECTS

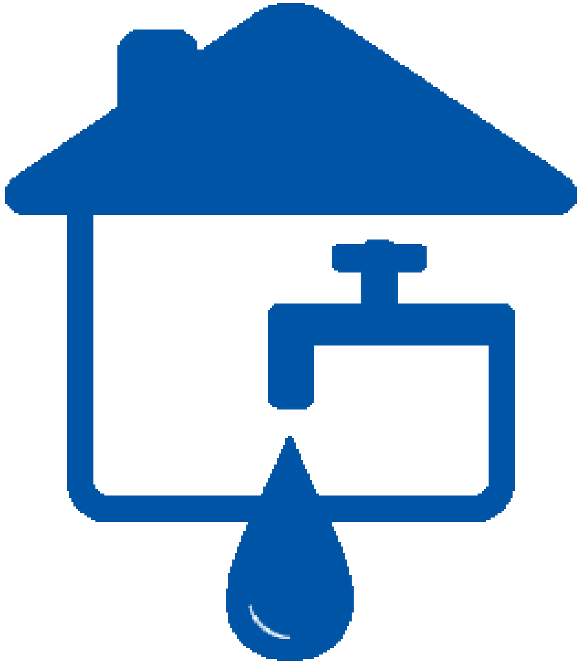
- Studied Case studies relevant to Ahmedabad context
- Came up with appropriate Solutions
- Understanding the Institutional Framework
- Develop Business models
- Looked closely at project executing agencies
- Looked at Cost-Benefit analysis
- From where will the money come?

WEEK 1 WEEK 3 WEEK 4 WEEK 8 WEEK 16

MID TERM

INTRODUCTION TO WATER SECTOR

(जल ही जीवन है)



Population of Ahmedabad

Adequate Water supply

Major Water Source

Water Treatment Plants

Water tariff structure

Number of water connections

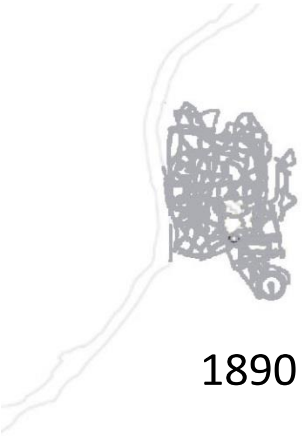
Water quality

Water distribution Network

Water related policies

TIMELINE- WATER SUPPLY COVERAGE

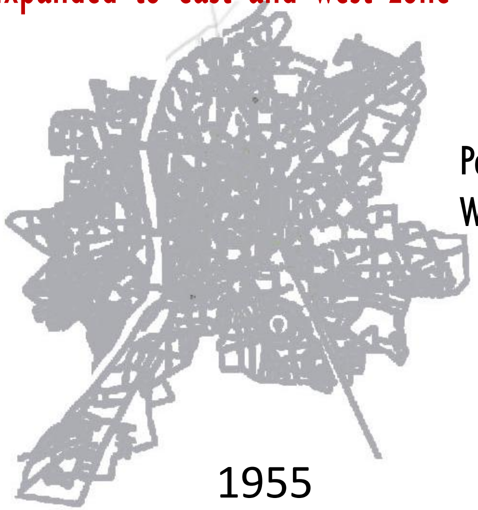
It started from Central zone: Dudeshwar



Population-1.5 lakhs
Water Demand=5.5MLD

1890

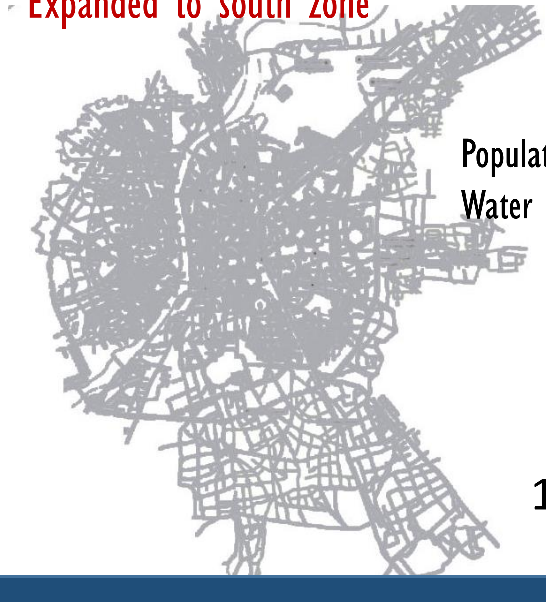
Expanded to east and west zone



Population-8.37 lakhs
Water Demand=99MLD

1955

Expanded to south zone



Population-39 lakhs
Water Demand=650MLD

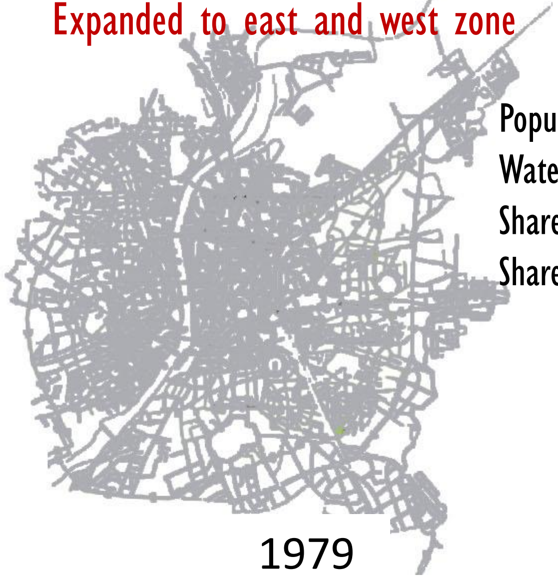
1997

Expanded to east zone

Population-3.1 lakhs
Water Demand=61 MLD

1931

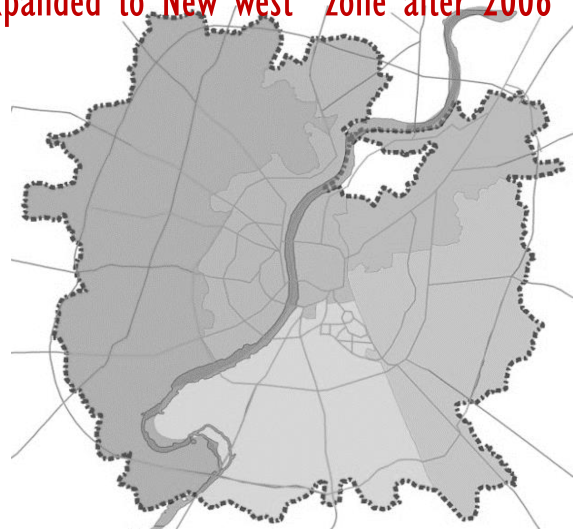
Expanded to east and west zone



Population-20.38 lakhs
Water Demand=397.5 MLD
Share of GW=61%
Share of SW=39%

1979

Expanded to New west zone after 2006

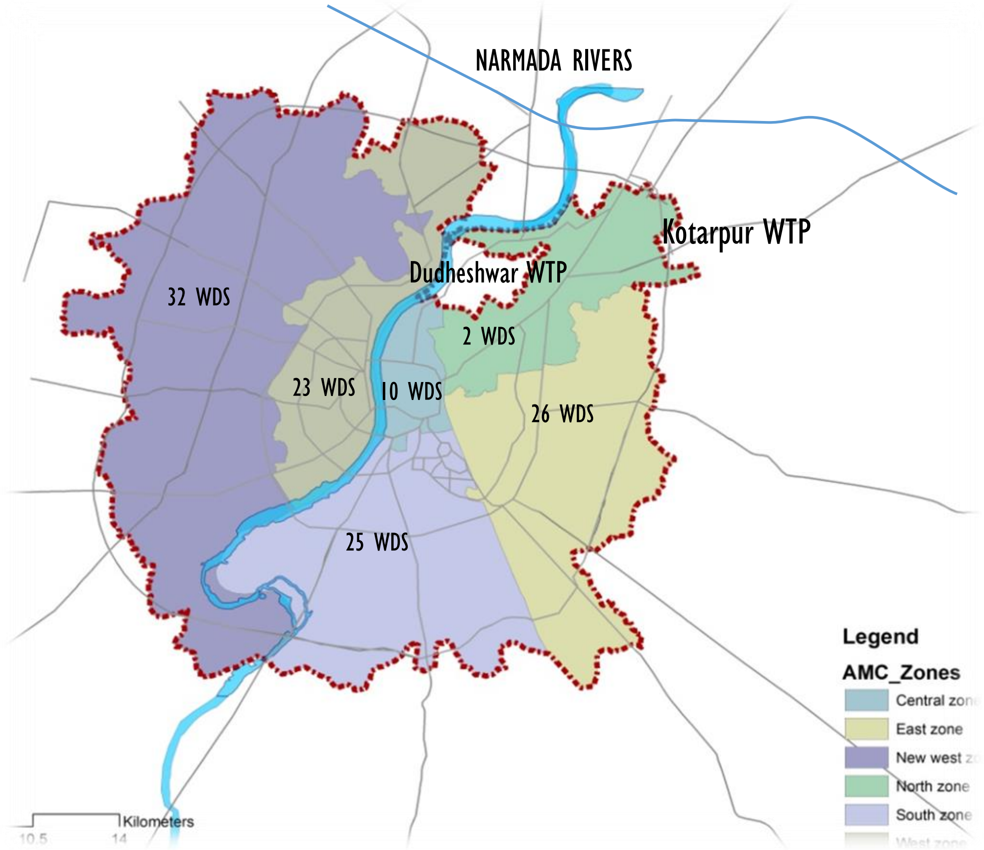


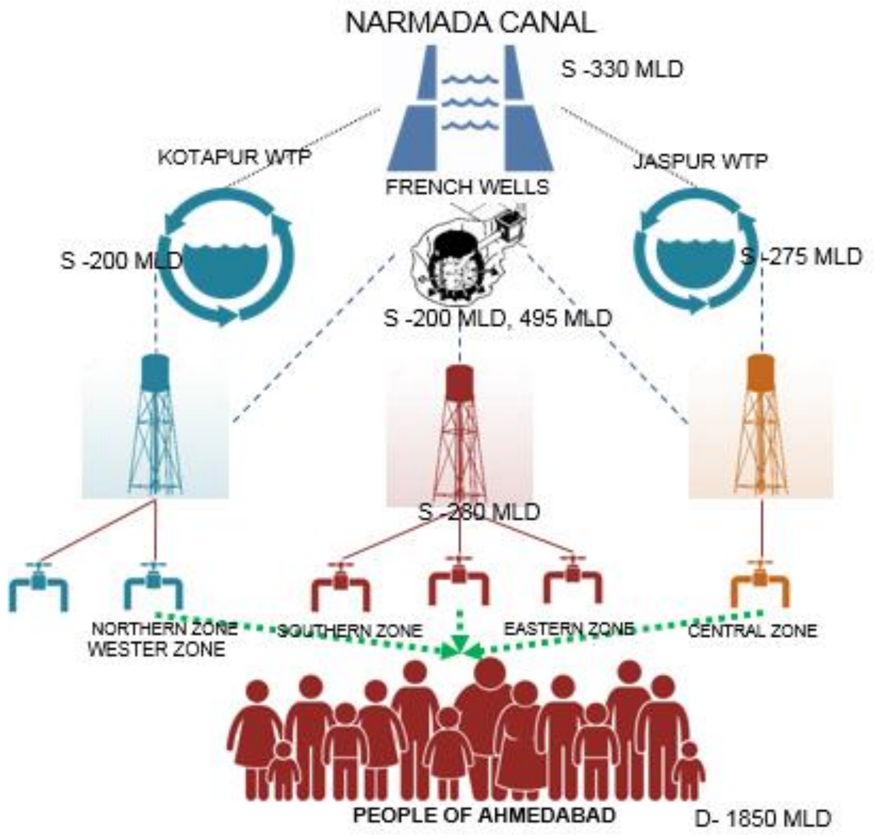
Population-55.68 lakhs
Water Demand=752 MLD
Share of GW=10%
Share of SW=90%
W. Supply coverage=92%

2012

source :CSP 2012

1851	1891	1970- 1980	2000	2008
WATER TAPPED FROM DHOLKA – BRANCH OF SABARMATI	PIPED DRINKING WATER – DUDESHWAR WATER WORKS	87% GROUND WATER EXTRACTED DHAROI RESERVOIR	GROUND WATER DEPLETION BY 3-4 MTS AMC STARTED SOURCING- SHEDHI BRANCH OF MAHI CANAL	WATER FROM NARMADAL – CHANNELIZED –TO SABARMATI





Water supply – Overview

source :CSP 2012

Number of WDS= **139**

Daily supply duration= **2.25 hours**

The distribution network of **3500 km** covers entire city.

The length of trunk main line is about **230 km**.

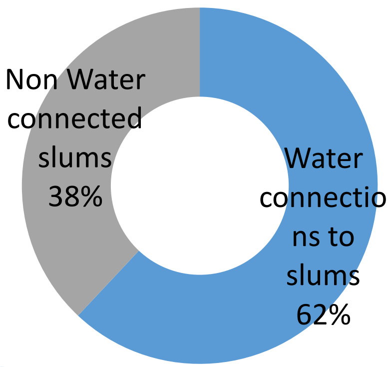
The average daily supply of water is around **1030 MLD**

Coverage of water supply connections- **92%**

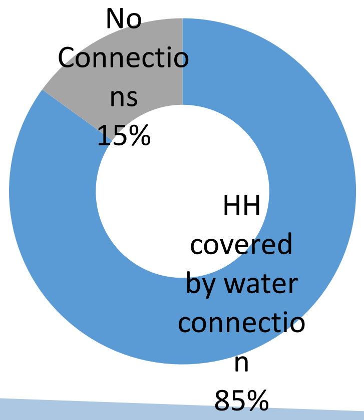
- Total water produced (MLD)= 1,215 MLD
- Ground water(MLD)= 135 MLD
- Surface water(MLD)=1,080 MLD

Out of overall 1620 MLD capacity 950 MLD is actually treated

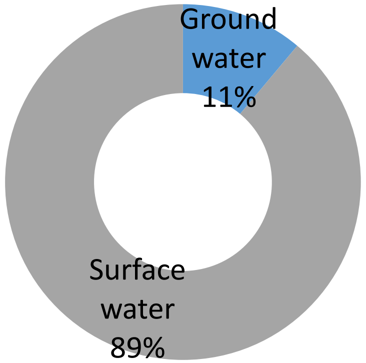
Water connections to slums



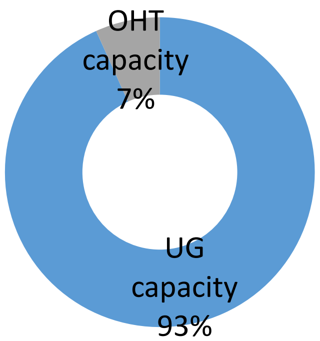
Water connections in Ahmedabad



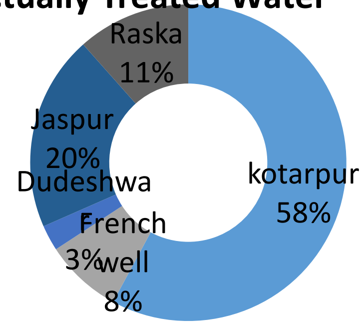
Water Source



Water capacity

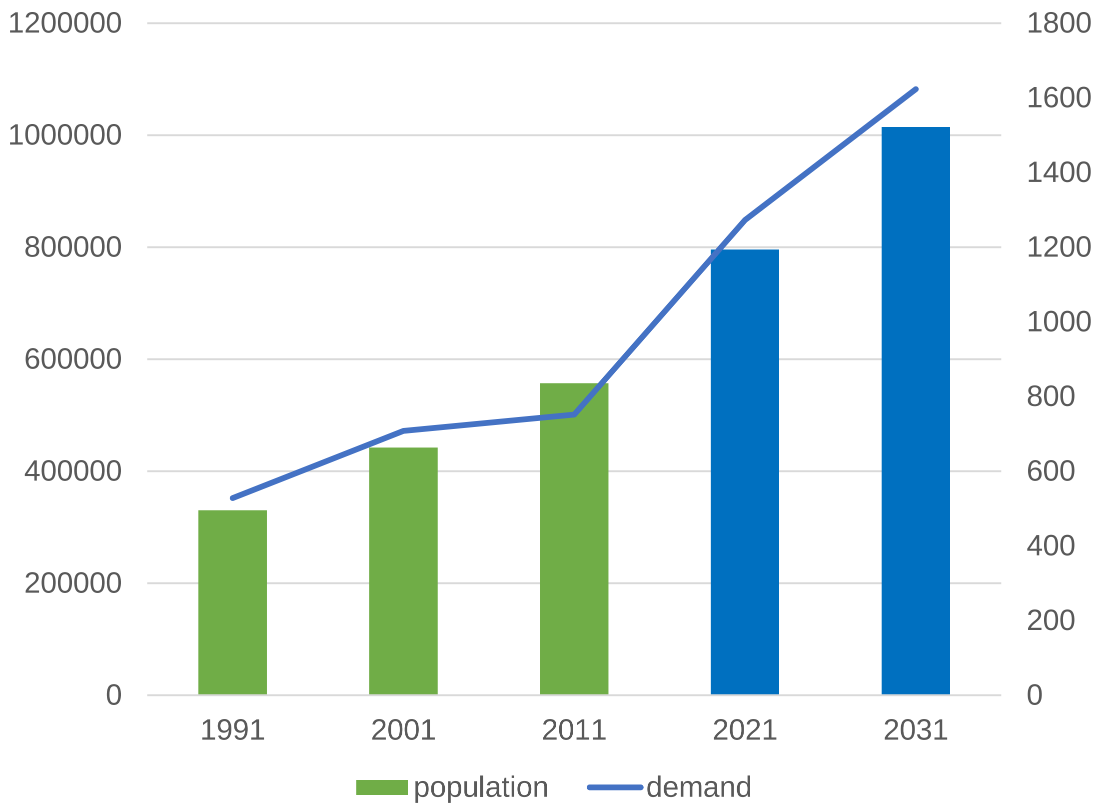


Actually Treated Water

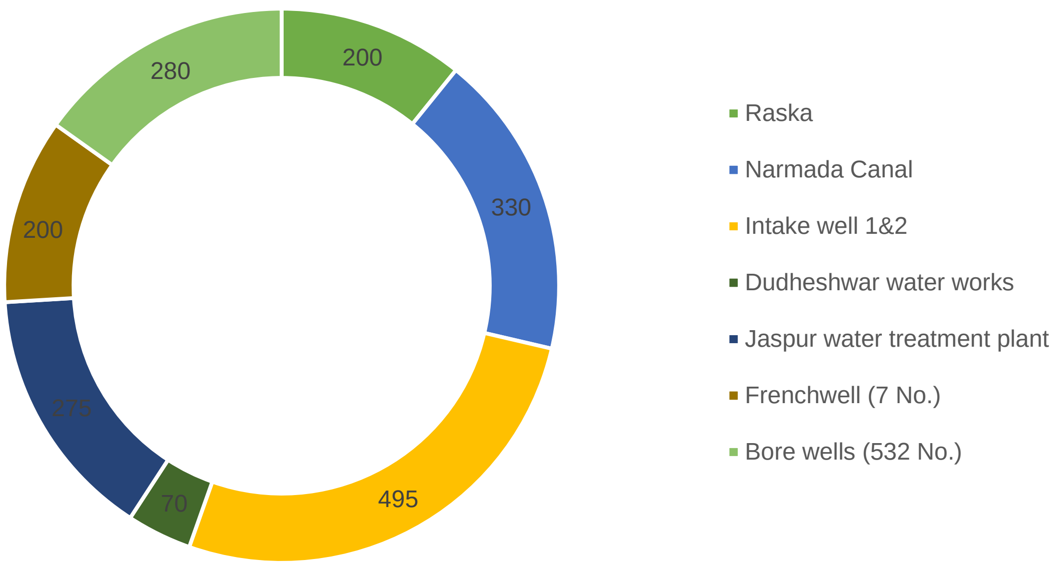


Present scenario

Source :CSP Ahmedabad 2012, *PAS data*



Year	Population	Demand
1991	330000	528
2001	442000	708
2011	557000	752
2021	796000	1273
2031	1014000	1623



Present water sources

Current average daily supply of water = **1030 MLD**

Forecasted water requirement- **1623 MLD**

Present and forecasted water requirement

Source – PAS DATA, **ICRIER** PREPARING FOR THE URBAN CHALLENGES OF 21ST CENTURY *CSP Ahmedabad (2011-2012), AMC AUDA Development plan 2022*
* national disaster report 2012, Ministry of home affairs,
http://www.rainwaterharvesting.org/rainfall_index.htm

National water policy 2012

- Adaptation to climate change
- Enhancing water available for use
- Demand management and water use efficiency
- Water pricing
- Conservation of river corridors, water bodies and infrastructure
- Water supply- Need to remove disparity in rural and urban water supply

AMRUT

- Augmentation of existing water supply, water treatment plants and universal metering.
- Rehabilitation of old water supply systems, including treatment plants.
- Rejuvenation of water bodies specifically for drinking water supply and recharging of ground water.

Smart city

•Adequate water supply

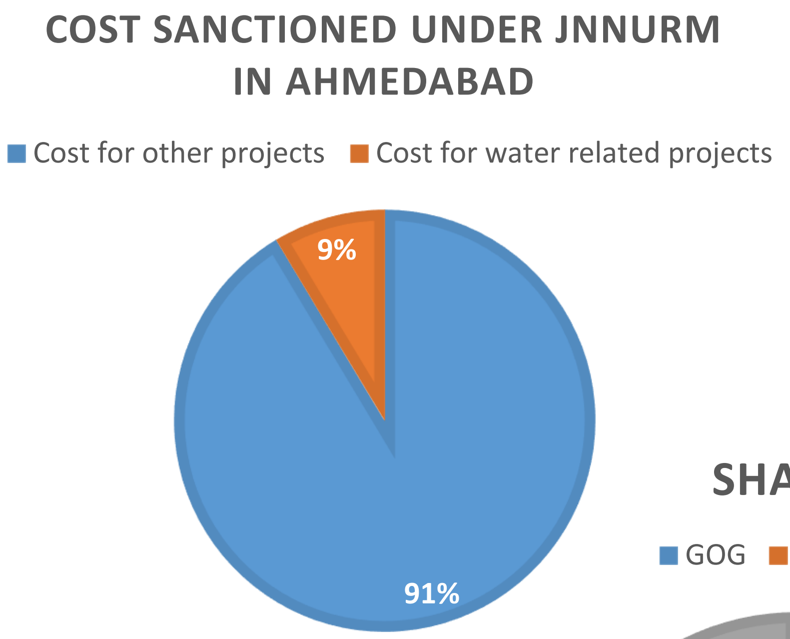
- Smart metering and management
- Leakage identification and prevention measures
- Water quality monitoring

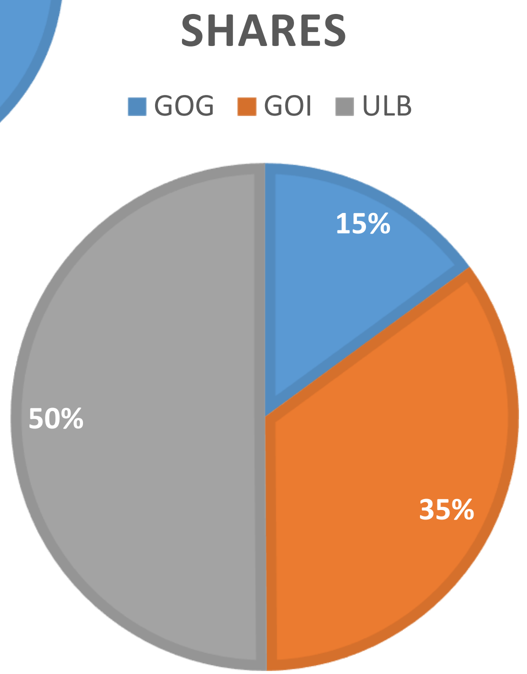
OVER VIEW- POLICIES

Source :National water policy 2012, *AMRUT and SMART city guidelines*

WATER PROJECTS UNDER JNNURM IN AHMEDABAD

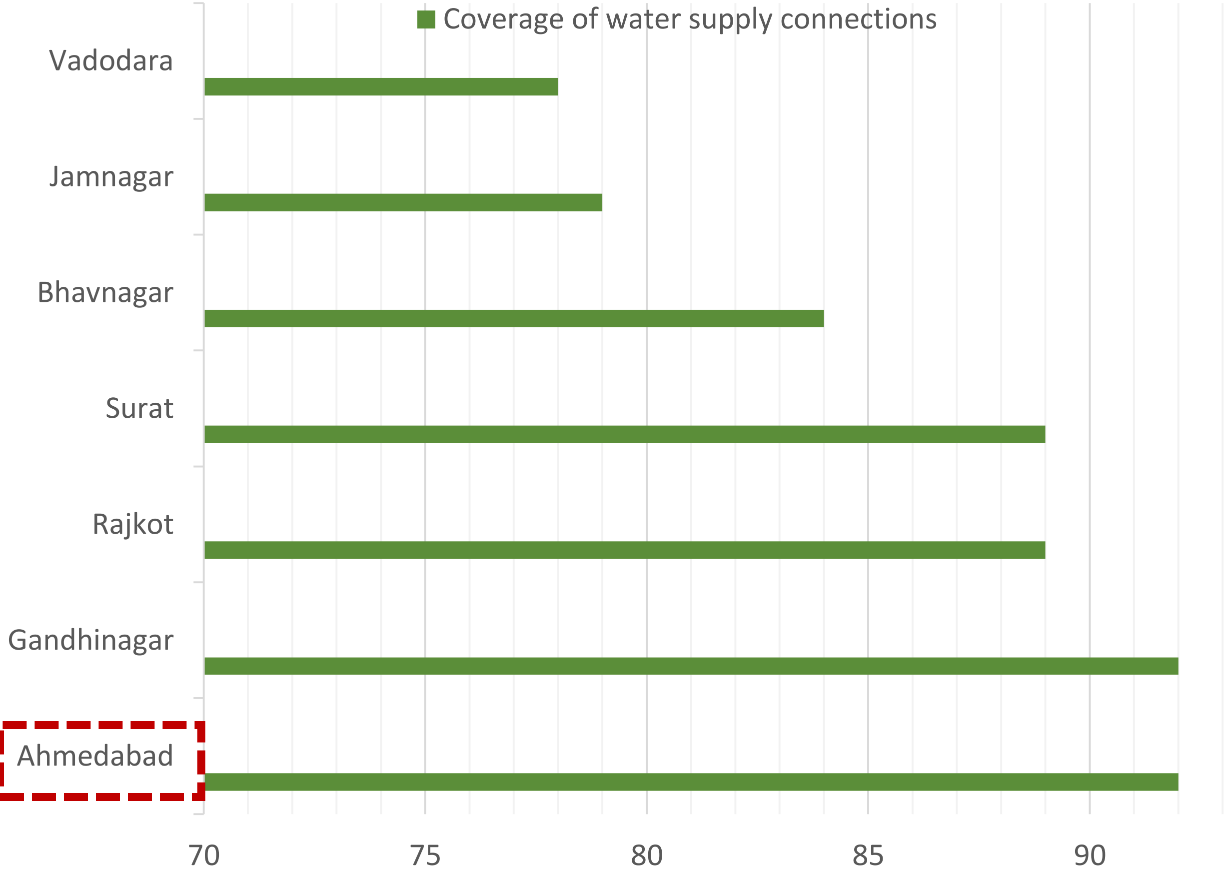
Projects sanctioned	Cost (in crores)
24 * 7 water supply in Jodhpur, new west zone , Ahmedabad	40
24 * 7 water supply at Navrangpura, Stadium, Juna Vadaj	13.58
Automation (SCADA based) of the Water Supply System	33.3

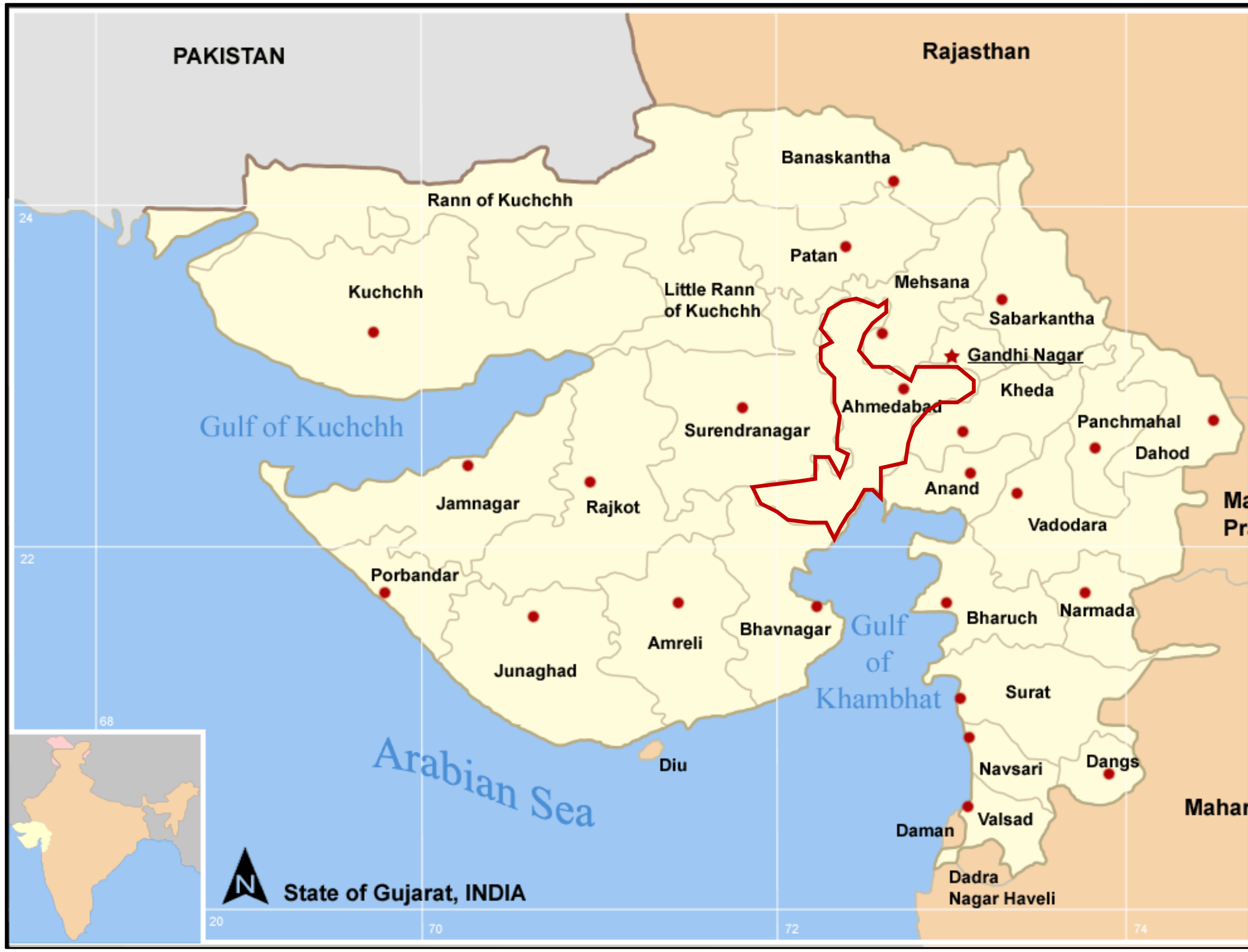




Overall Expenses on water sector of Ahmedabad=Nearly 86 Crores

Source: *CSEindia.org*

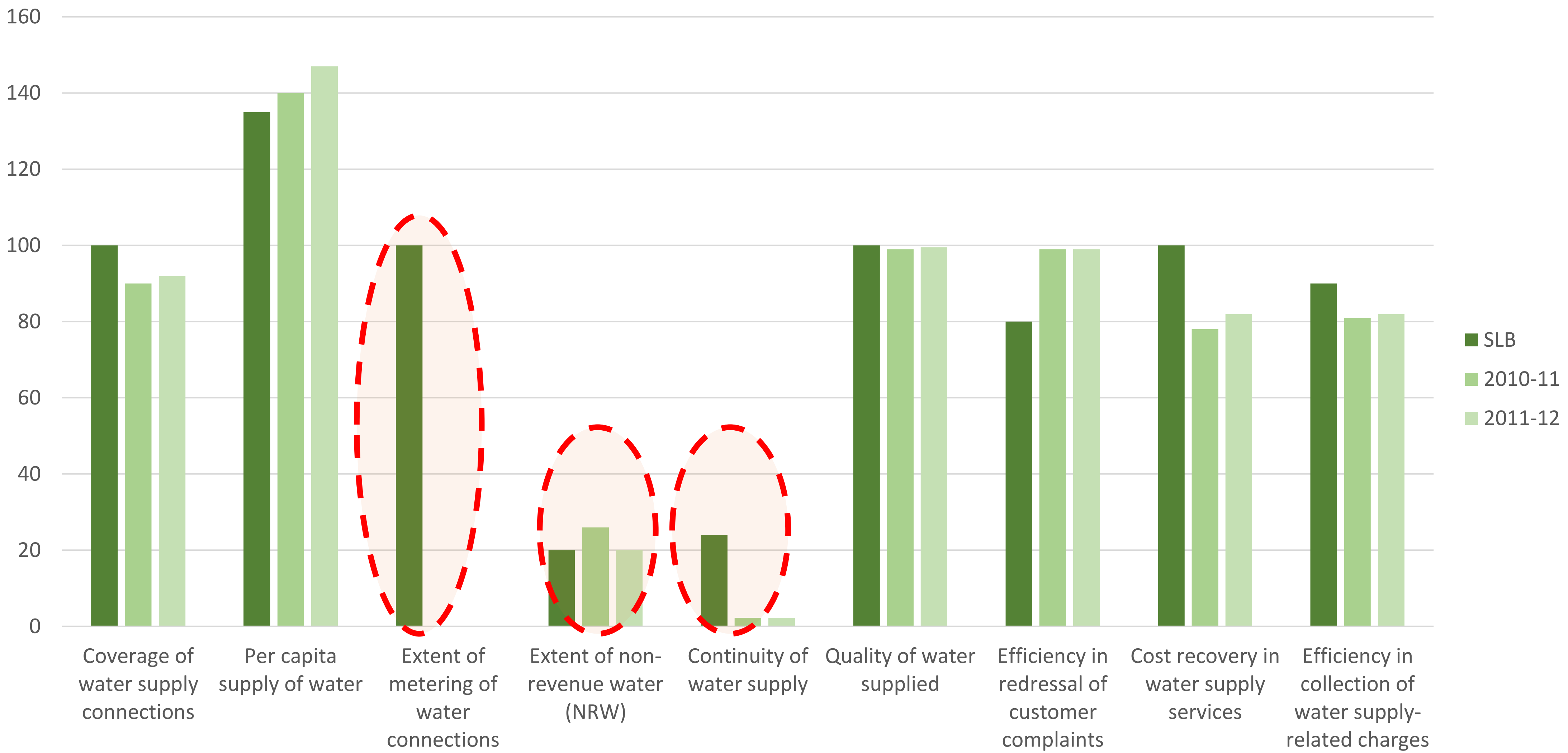




Comparison on water supply coverage

Source :CSP Ahmedabad 2012,*PAS data*

Comparison with Service level bench marks

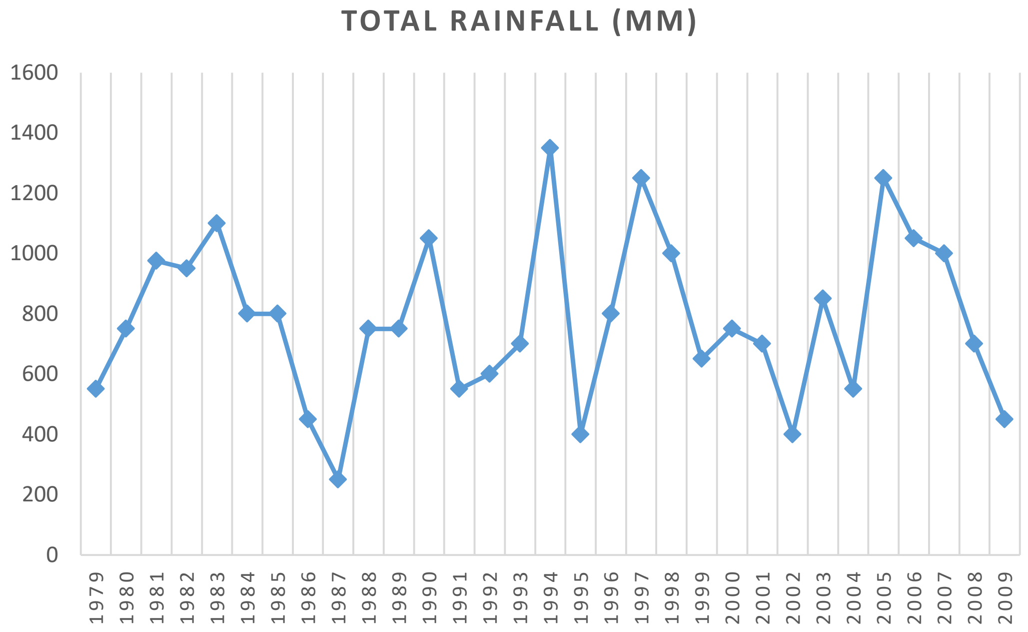


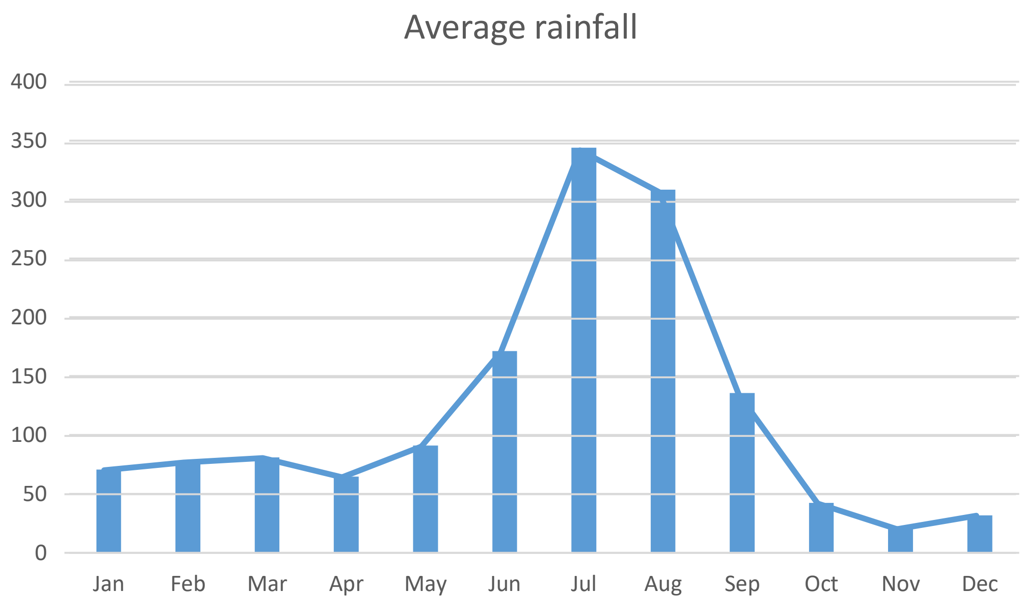
Comparison with SLB

source :CSP Ahmedabad 2012

- The average annual rainfall is of the order of 300 mm. Most of the rain is in the months of June, July, August and September. The average annual rainfall is of the order of **300 mm**. Most of the rain is in the months of June, July, August and September

- We need to emphasize more on the conservation of rain water by **introducing better technologies for rainwater harvesting** .



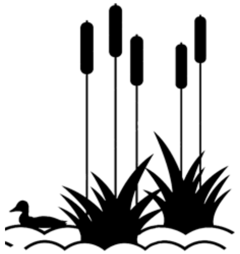


Useful for Augmenting New alternatives of Rainwater Harvesting

Present and forecasted water requirement

Source – PAS DATA, **ICRIER** PREPARING FOR THE URBAN CHALLENGES OF 21ST CENTURY *CSP Ahmedabad (2011-2012), AMC AUDA Development plan 2022*
* national disaster report 2012, Ministry of home affairs,
http://www.rainwaterharvesting.org/rainfall_index.htm

Major projects under water sector

 Lake Rejuvenation	 WSUD	 Rain water harvesting	 NRW	 24 * 7 water supply
Issues Degrading quality of available natural sources eg, Lakes, River basin etc	Issues Water Scarcity in future Inequity	Issues Water Scarcity in future	Issues Present NRW is 26% which is more than SLB	Issues: Water supply varies between 1-2.5 hours

Rain Water Harvesting

In Ahmedabad

WHY
Why are we doing this?

WHY NOT
Why has it not been done yet?

WHAT
What has been happening in India?

HOW
Where are we going to do it?

WHY

Why are we doing this?

GROWTH OF

AHMEDABAD

2006

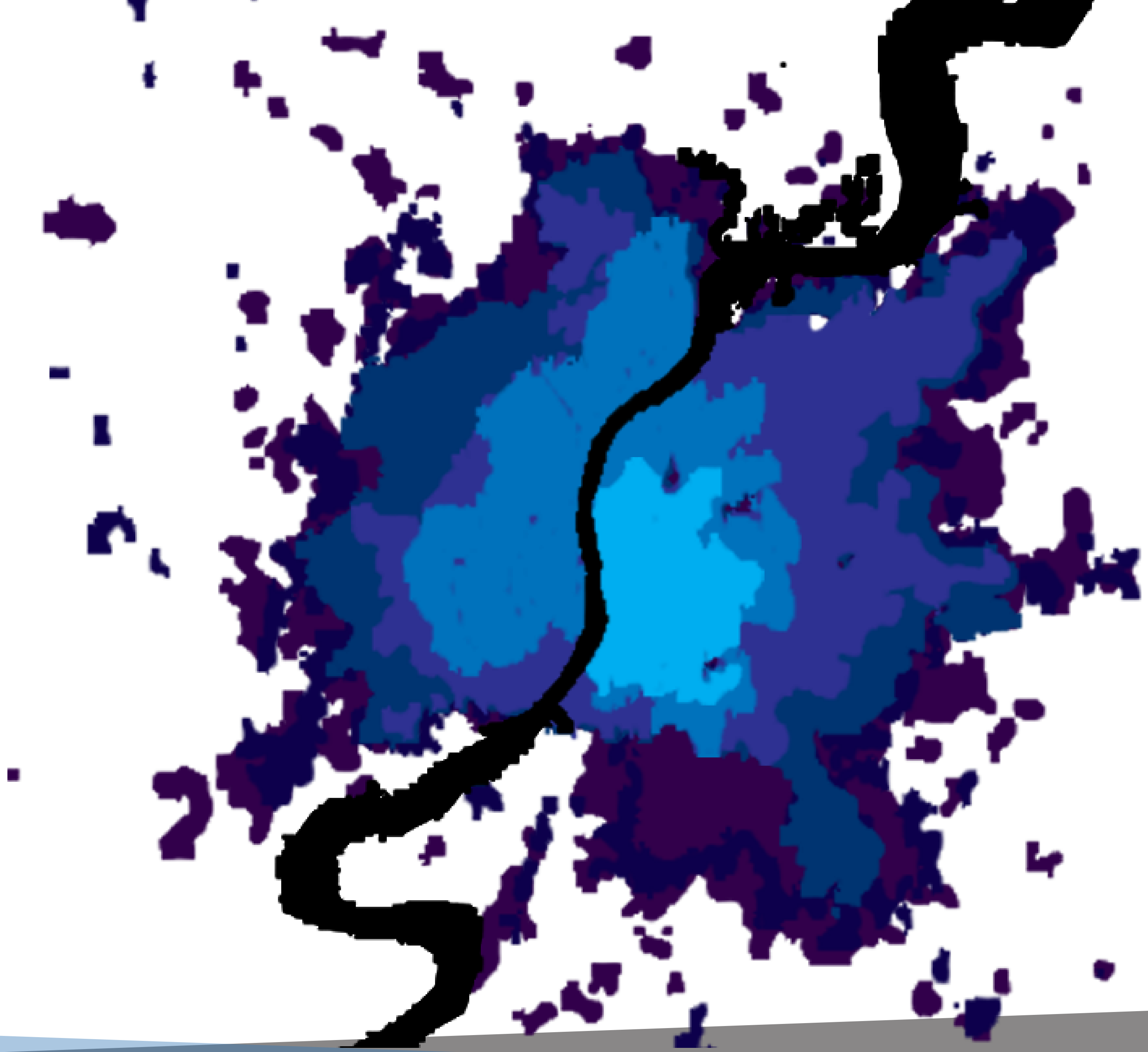
1990

1980

1960

1940

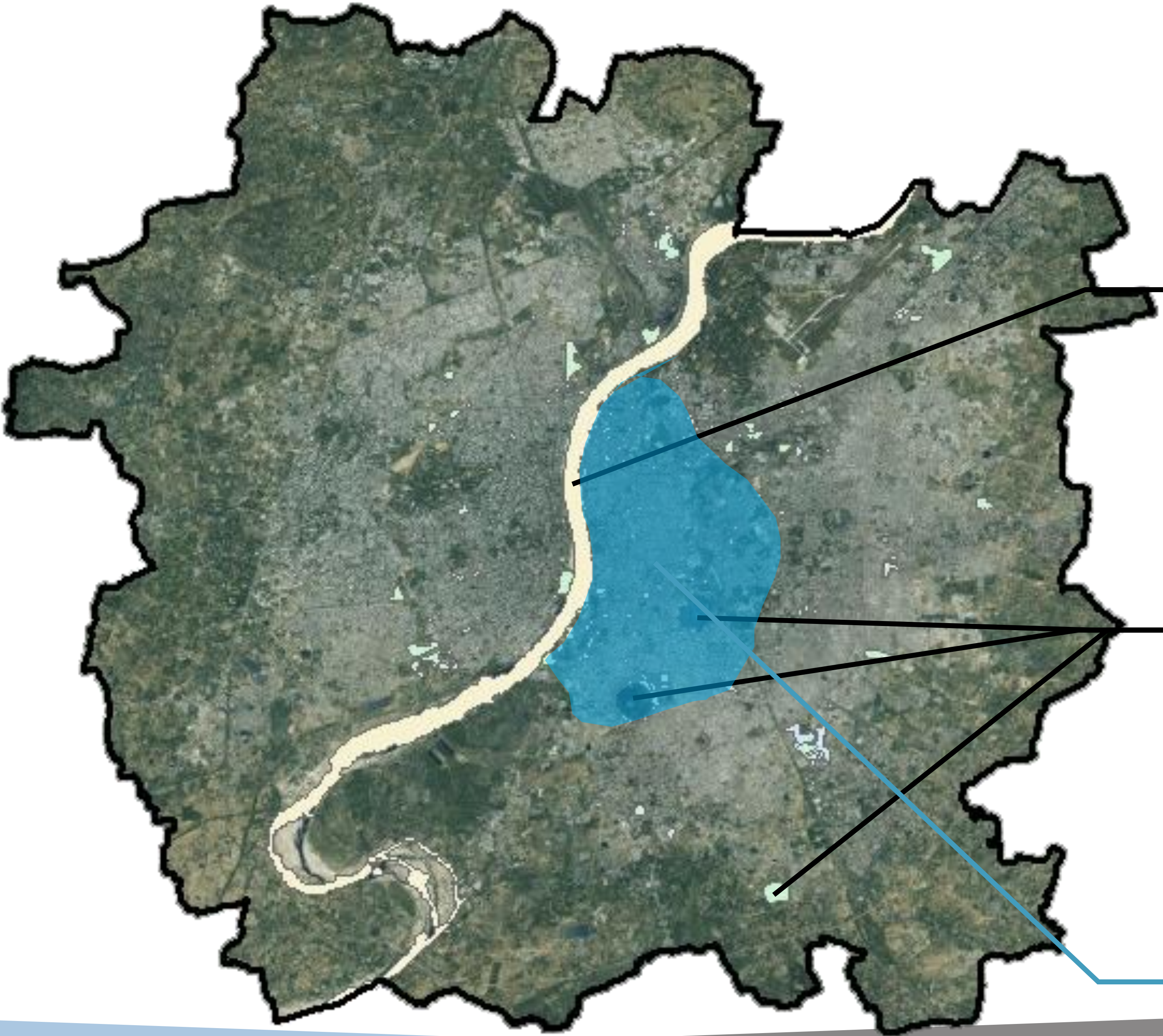
1850



Exploitation of Ground water

Water stress

Clogged Drains



Degrading Sabarmati

Depleting conditions of Lake

Unaccounted water use

IMPLICATIONS ?

Source : *Google , Sabarmati Riverfront Development, Integrated Environmental Improvement and Urban Revitalization, India Urban Conference, Mysore, November 2011*

WATER STRESS

54%

of India

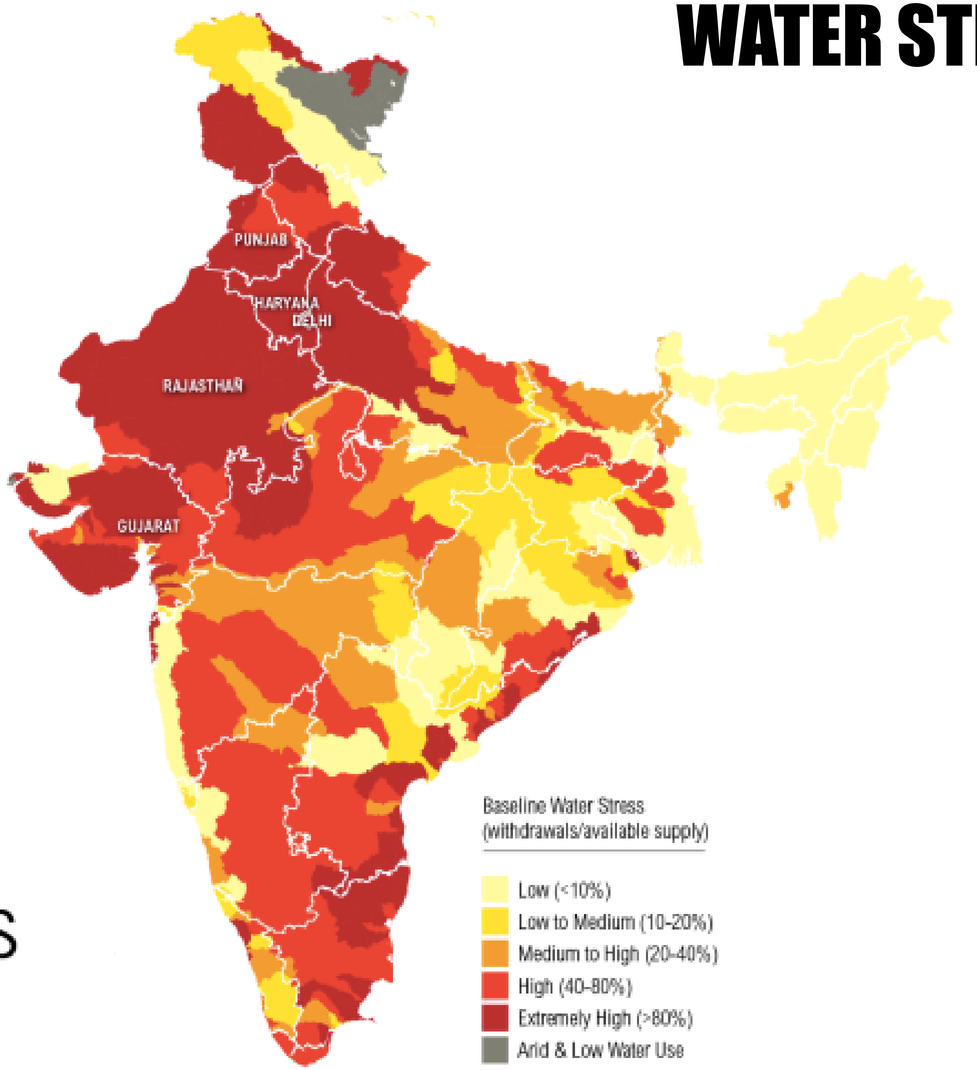
Faces

High to

Extremely

High

Water Stress

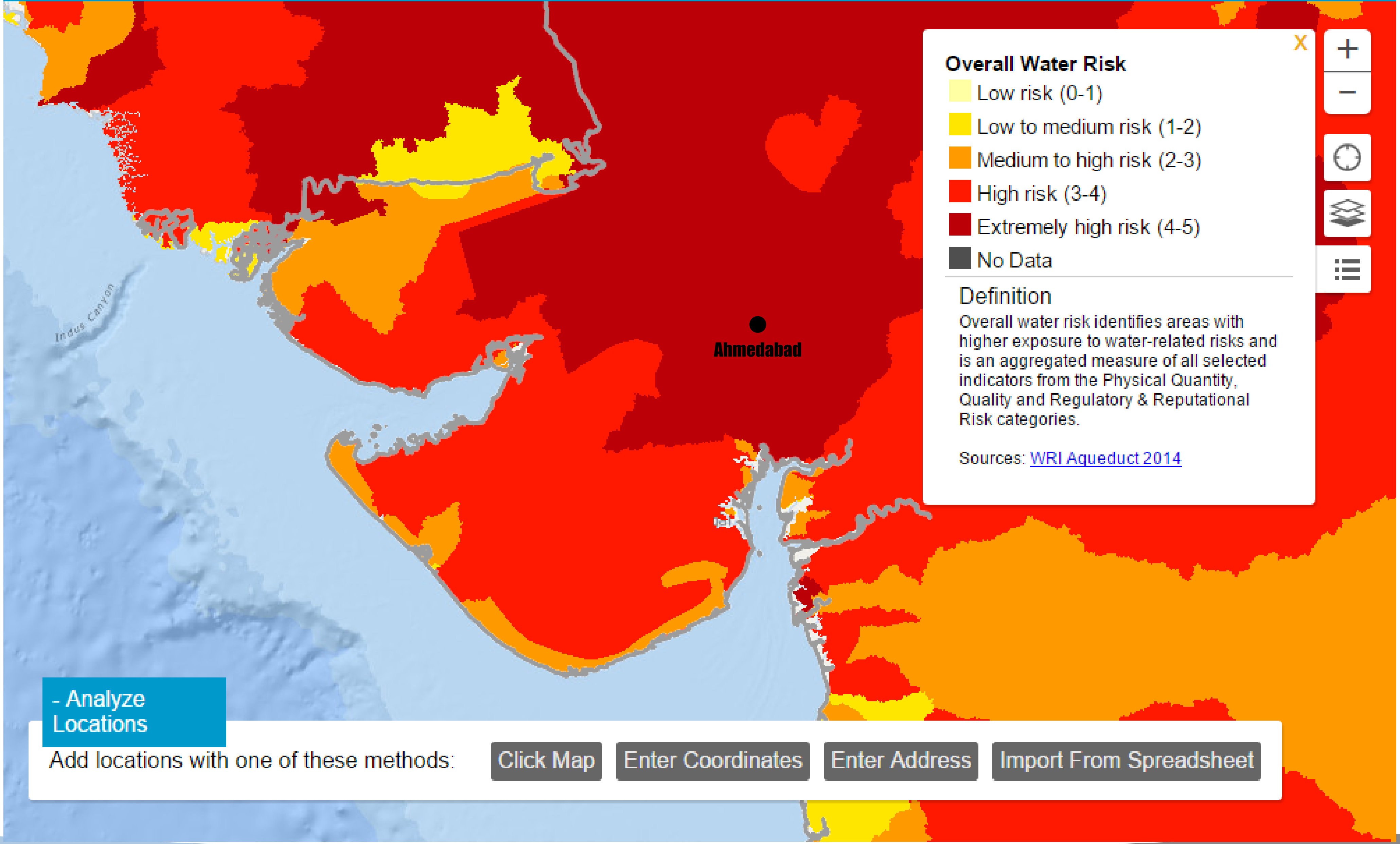


www.indiawatertool.in

WORLD RESOURCES INSTITUTE

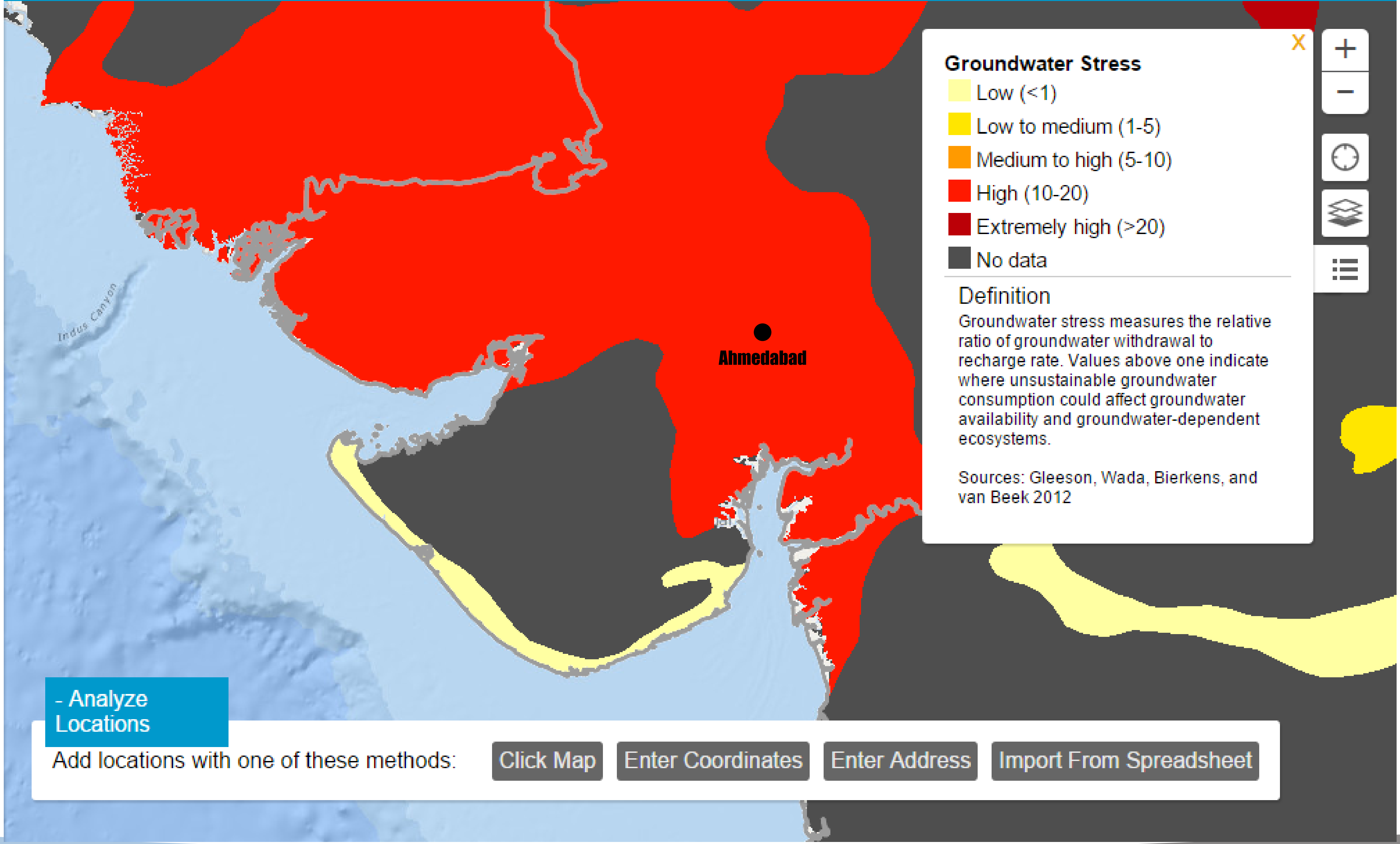
Source : Water resource institute , http://www.wri.org/our-work/topics/water, http://www.indiawatertool.in/

WHY



Source : *Water resource institute , http://www.wri.org/our-work/topics/water, http://www.indiawatertool.in/*

WHY



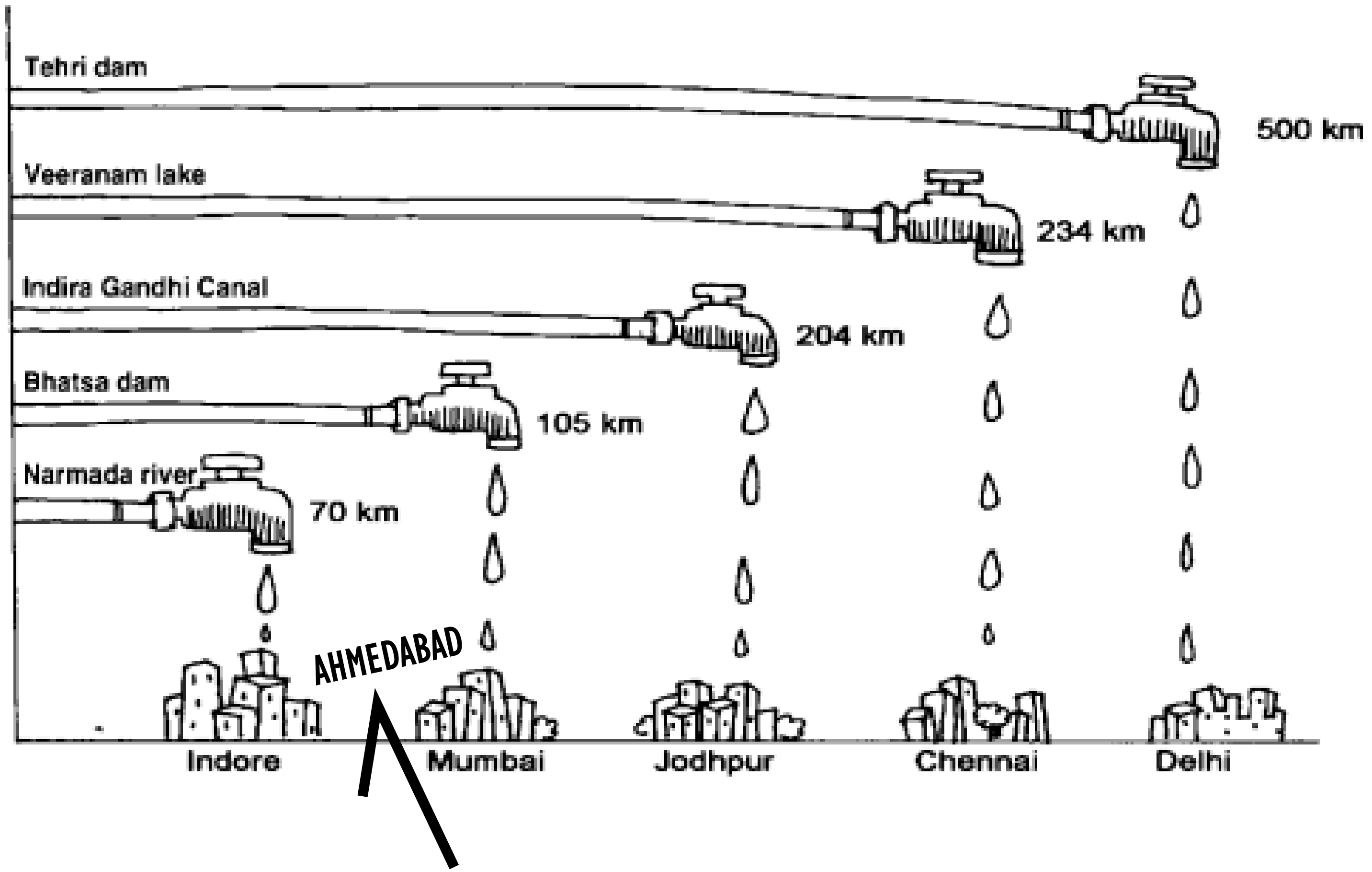
Source : *Water resource institute , http://www.wri.org/our-work/topics/water, http://www.indiawatertool.in/*

WHY

WHY NOT

Why has it not been done yet?

“Desperate times call for desperate measures”



“City administrations put great efforts to bring water at a huge cost through pipes and tankers.”

Source : *Report on water harvesting in Indian cities*

WHY NOT

ADMINISTRATIVE

AUDA had made rainwater harvesting mandatory for all buildings covering an area of over, 500 square meters.

GDCR – post 2002

Cover area- 1,500sqm.-one percolation well

4,000sqm.- + another well

IMPLEMENTATION

AMC sanctions building use permission only if they are provided with **RWH** structures as per rule.

MONITORING

NO other strict **REGULATIONS** for check on monitoring harvesting rain water. (monthly auditing for commercial buildings, nothing for residential buildings)

TECHNICAL

No technical innovations , new mechanisms found its way apart from the **TRADITIONAL** system of filtration beds, channelizing and percolation

PUBLIC AWARNESS

No promotions, awareness or initiatives have been taken forward to make people know it is for them , their benefit **NOT JUST FOR THE SAKE** of having it but using it to its fullest

__Source:__ : http://www.rainwaterharvesting.org/policy/legislation.html, http://www.cseindia.org/content/legislation-rainwater-harvesting, United Nation-HABITAT, Draft Comprehensive Development Plan 2021

WHY NOT

WHAT

What has been happening in India?

	ADMINISTRATIVE	IMPLEMENTATION	MONITORING	TECHNICAL	PUBLIC AWARNESS
KERALA	**Kerala Water Authority**			better than	
DELHI	MoUA, DDA **Mandatory for new buildings** based on roof	**Building permissions** not given , site inspection for		involvement	
INDORE	IMC, **Mandatory for all buildings old + new** based on area	**Separate dept. of RWH** Implementation in both	**Regular monitoring** by commission	**Separate** to guide RWH	**Information** RWH made
CHENNAI	Structures	ers, ponds,	TN Govt. created **separate dept.**	Department **RWH Friendly storm water drains** for	**Rain centers and working models** for propaganda
TAMIL NA	**CM+ ULB's** combat droughts	**ordinance,** Along NH, SH, MDR, open areas, ponds	**under** y.	**Hosted RWH website, technical guidance** 24x7	**Competitions, campaigns, workshops, seminars** for the public as well as the staff

SUBSIDIZATION

COST REDUCTION

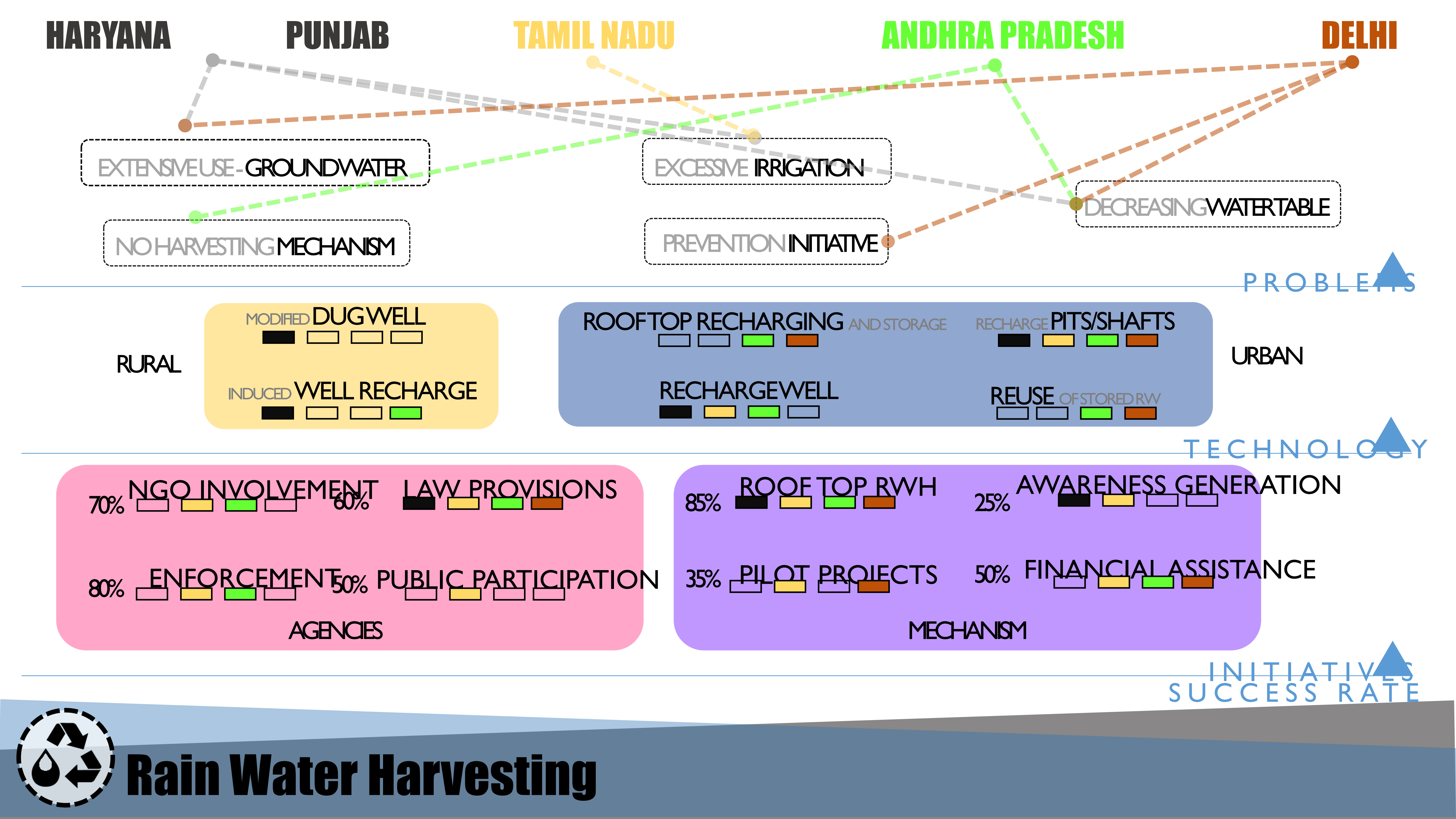
TAX REBATE

DISCONNECTION

MOTIVATION + REWARD

Source: : http://www.rainwaterharvesting.org/policy/legislation.html, http://www.cseindia.org/content/legislation-rainwater-harvesting, United Nation-HABITAT, Draft

WHAT



HARYANA
PUNJAB
TAMIL NADU
ANDHRA PRADESH
DELHI
EXTENSIVE USE - GROUNDWATER
EXCESSIVE IRRIGATION
NO HARVESTING MECHANISM
PREVENTION INITIATIVE
DECREASING WATER TABLE
PROBLEMS
RURAL
MODIFIED DUG WELL
INDUCED WELL RECHARGE
ROOFTOP RECHARGING AND STORAGE
RECHARGE PITS/SHAFTS
RECHARGE WELL
REUSE OF STORED RW
URBAN
TECHNOLOGY
70% NGO INVOLVEMENT
60% LAW PROVISIONS
80% ENFORCEMENT
50% PUBLIC PARTICIPATION
AGENCIES
85% ROOF TOP RWH
25% AWARENESS GENERATION
35% PILOT PROJECTS
50% FINANCIAL ASSISTANCE
MECHANISM
INITIATIVES
SUCCESS RATE
Rain Water Harvesting

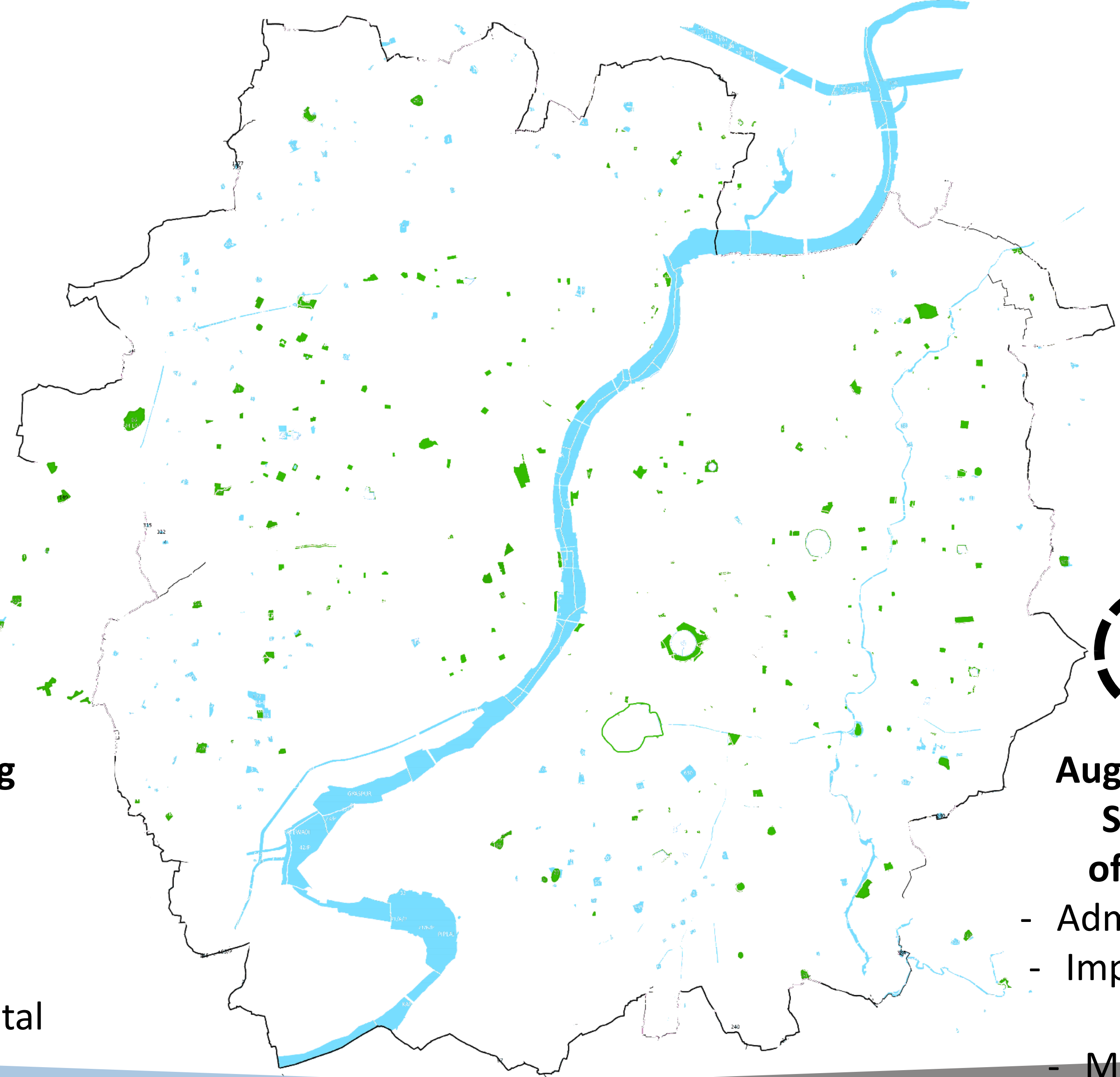
HOW

How are we going to do it?

LAKES

Augmenting Source of water
- Administrative
- Implementation
- Monitoring
- Technical
- Public Awareness

Rejuvenating the Lakes
- Technical
- Social
- Environmental

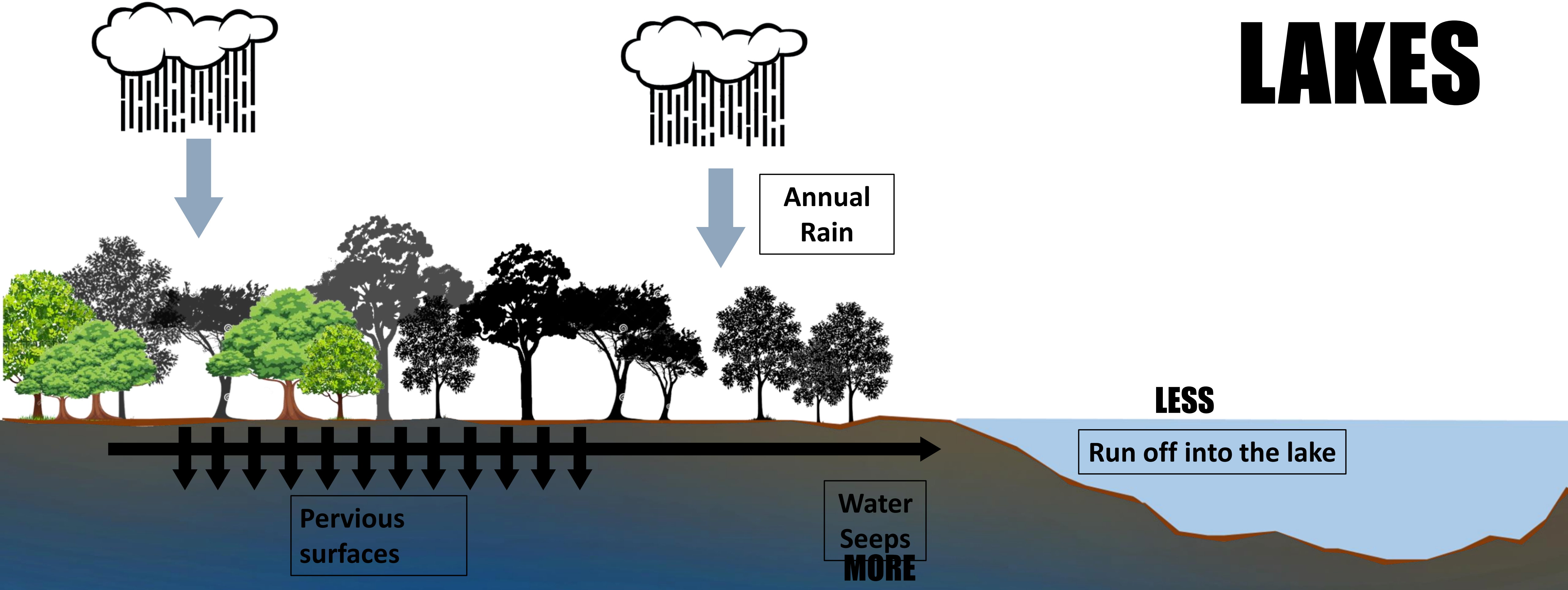


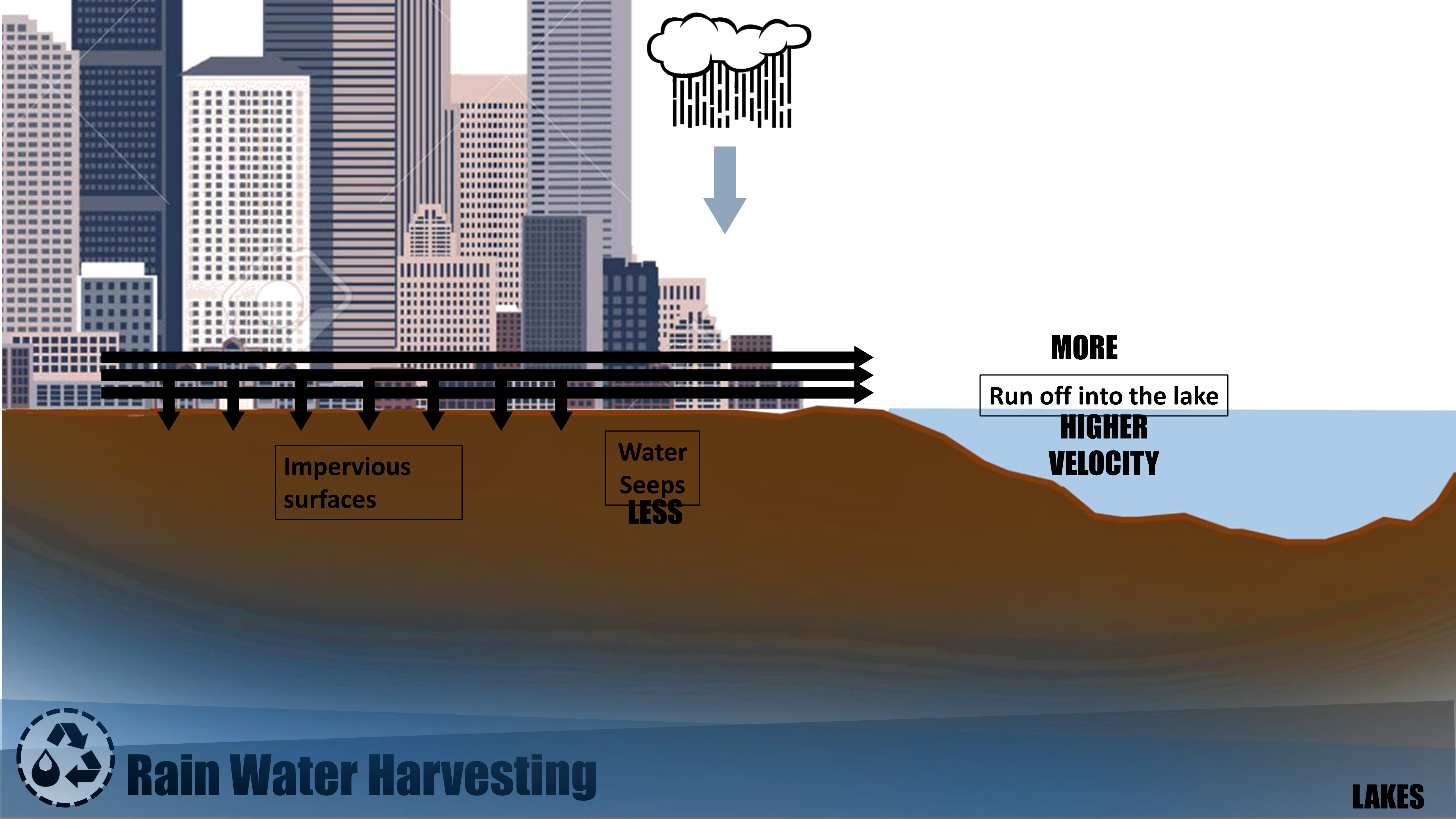
PARKS

Augmenting Source of water
- Administrative
- Implementation
- Monitoring
- Technical
- Public Awareness

Using Waste Water as a resource
- Technical

LAKES


Annual
Rain
LESS
Run off into the lake
Pervious
surfaces
Water
Seeps
MORE



MORE
Run off into the lake
HIGHER
VELOCITY
Impervious surfaces
Water Seeps
LESS
Rain Water Harvesting
LAKES

- Sabarmati river runs through the city, i.e., 22**km** of river bank.
- 1411 no of small and large lakes in **AUDA**
- 59lakes in **AMC**

Sr. No.		Total no of Lake with(area less than 50,000 Sq. mt.)	Total no of Lakes (area 50,000 to 75,000 Sq. mt.)	Total no of Lakes (area 75,000 to 1,00,000 Sq. mt.)	Total no of Lakes with (area more than 1,00,000 Sq. mt.)
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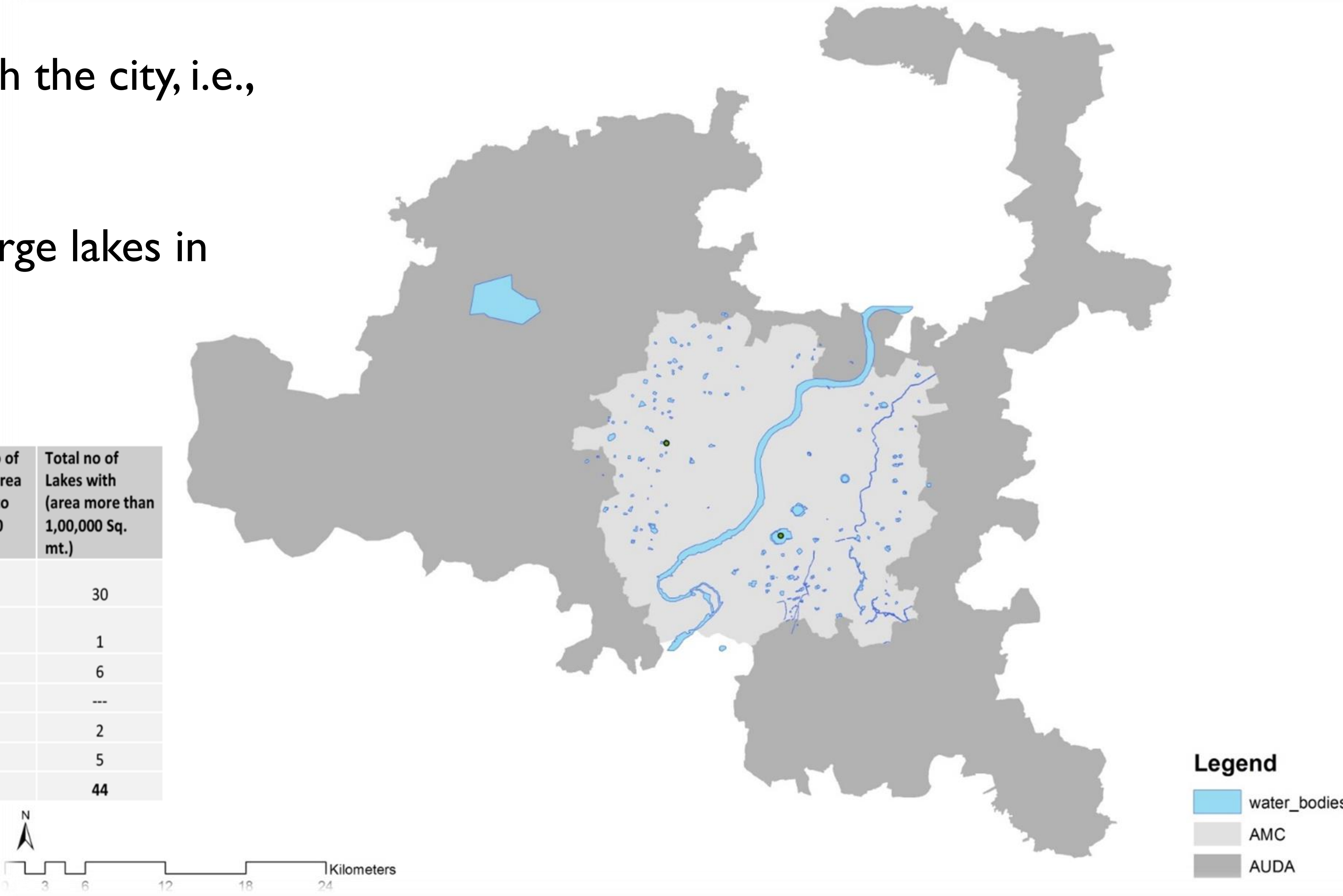
6	AMC	47	6	1	5
TOTAL		1411	42	22	44



Rain Water Harvesting

Source: **Draft Comprehensive Development Plan 2021(Second Revised)** ,AUD

No of Lakes: **100** in 1860's

I Lake is dying Each Year

Area:220 km²

77 in 1930's

59 in 2015 Area :464km²

Death of lakes is due to:

- **Urbanisation**

1. **Construction without consideration of natural waterways of lakes**
2. **Encroachment on the lakes periphery**
3. **Pollution of lakes due to solid waste and sewage.**
4. **Over exploitation**
5. **Eutrophication**

Rain Water Harvesting

Source: http://sindicatum.com/meteosystems/global-water-facts-and-figures/global-water-shortage/
Strategies for Lake Management in Urban Context: A Case of Ahmedabad, Diana **Pancholi**, **Faculty Of Planning, CEPT**

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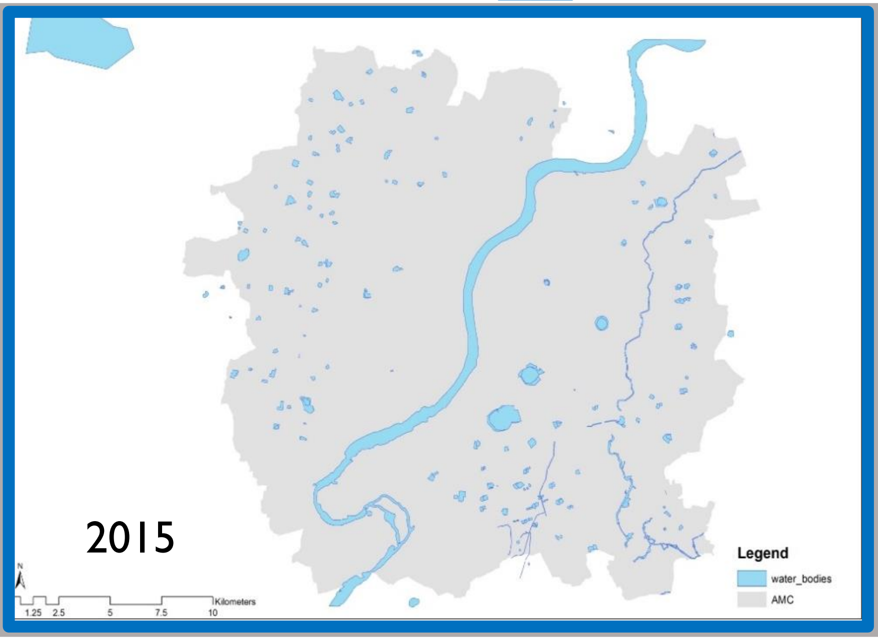

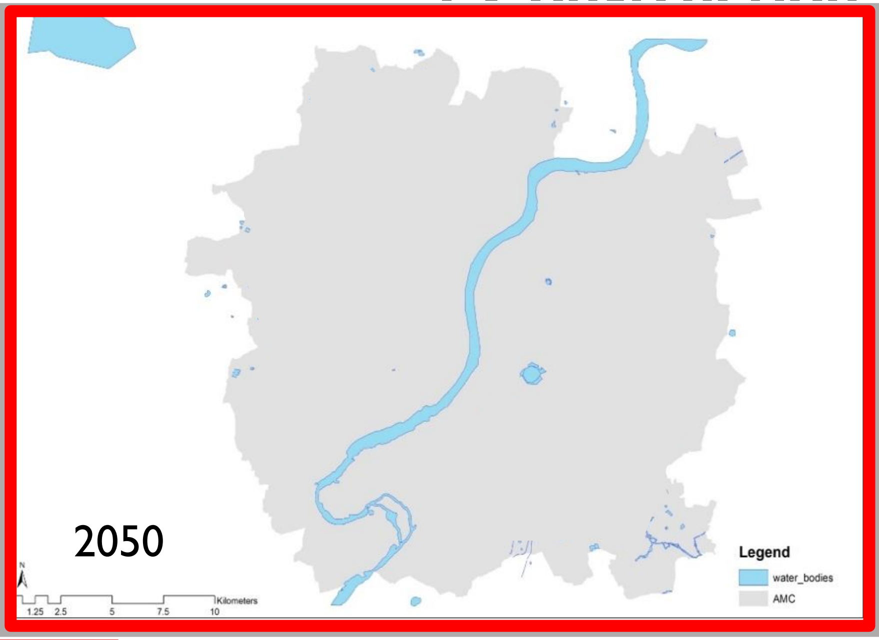

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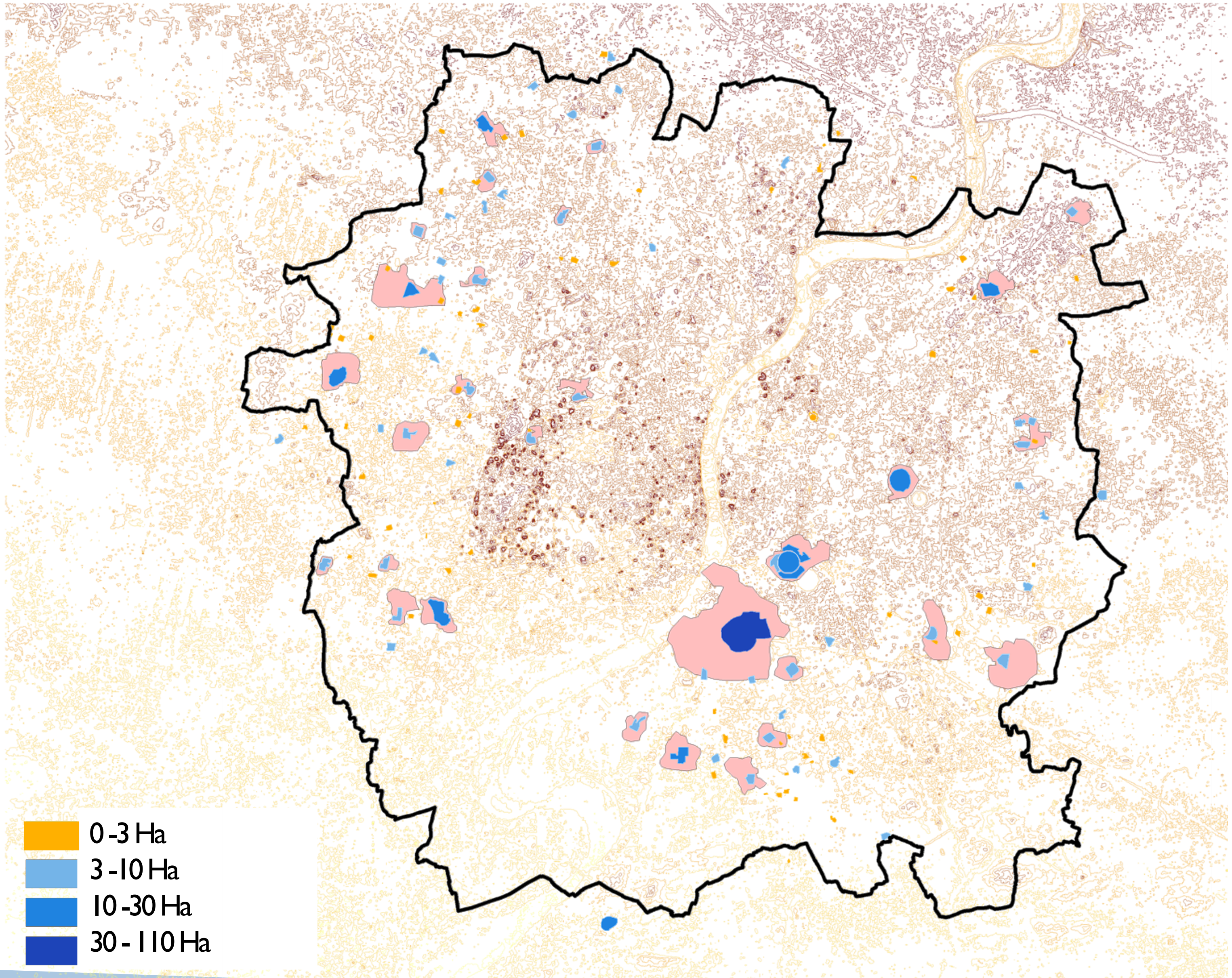


STEP 1

Lakes with area lesser than 3 Ha have been not included based on the theory from NATIONAL LAKE CONSERVATION PLAN , that much potential couldn't be tapped by these in terms of rain water harvesting

STEP 2

Lakes with area between 3 Ha to 30 Ha have been taken up as the medium and large scale.

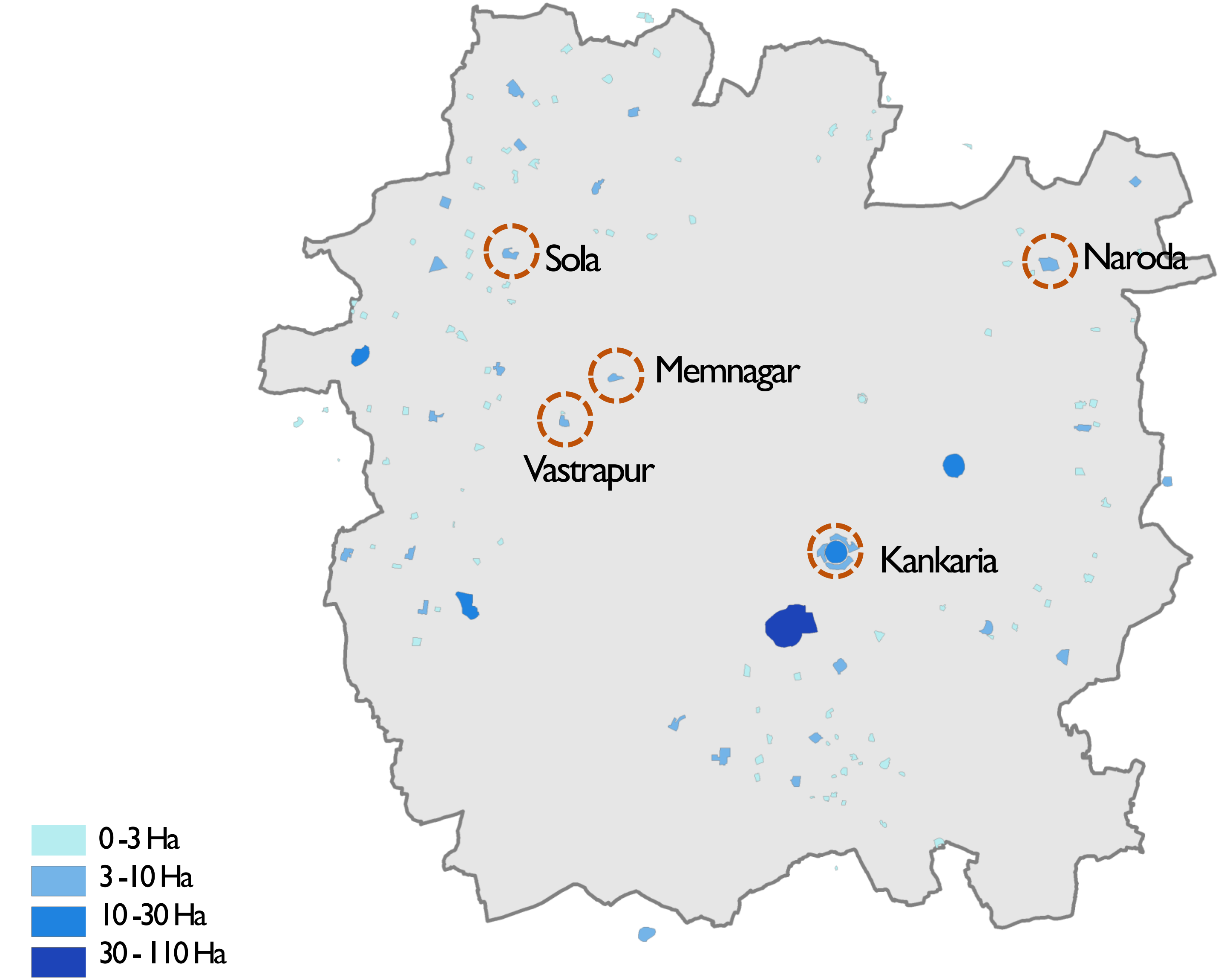
Based on the contours, calculations of the catchments are done .

STEP 3

Total potential of RWH has been estimated based on the CGWB, CPWD manuals

Rain Water Harvesting

SEGREGATION CRITERIA



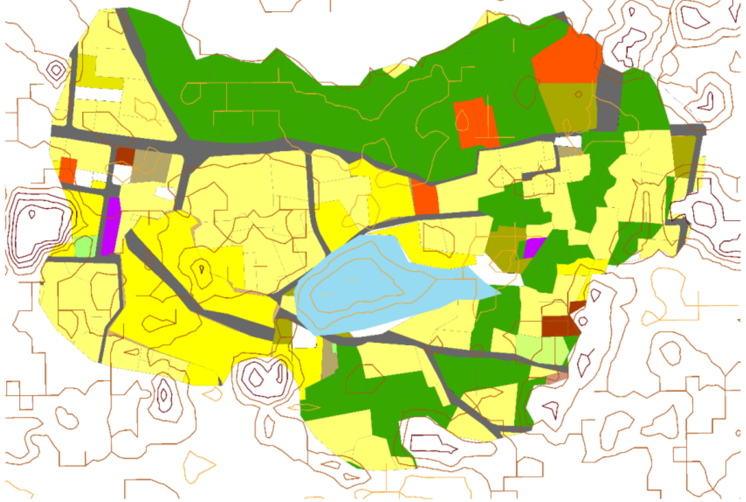
Developed lakes	Strom water drains	No storm water drains
1. Properly managed 2. City level recreational attraction 3. Water tapped from AMC	1. Storm water lines existing 2. Not working efficiently 3. Clogged or blocked due to built up structures 4. Rainfall + surface runoff	1. No drains 2. Only surface runoff 3. Tapped rainfall
Vastrapur 4.9 Ha Memnagar 5.7 Ha Kankaria 29 Ha	Naroda 12 Ha	Sola 2.8 Ha

Rain Water Harvesting

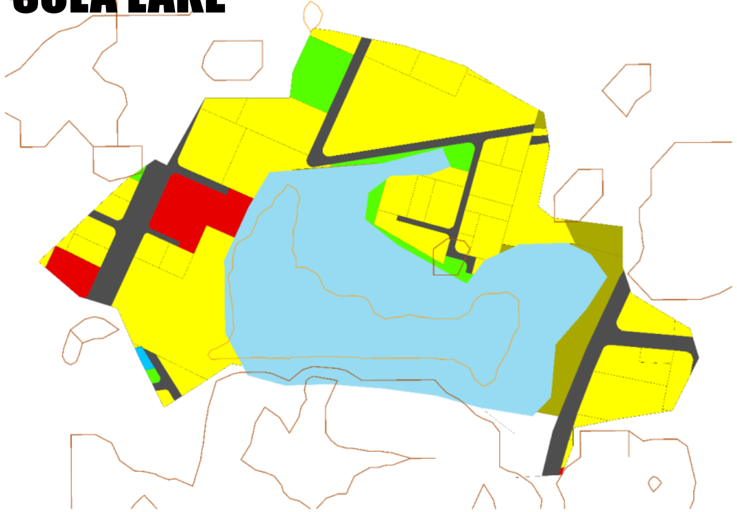
LAKE SELECTION

PERCOLATION MANUAL	CPWD	CSE	CGWB	OUR TAKE
Design= Avg annual rainfall, yield capacity Run off = mean annual rainfall – 7” / 100 x total rainfall	Rain water harvesting potential = rain fall (mm) x coefficient (based on surface typology) x area or catchment area	For harvesting = 80% {area x rain full }	Assumptions = 40% annual rainfall in 2-3 hrs (4/5 of cloud burst) Percolation peak intensity = 74hrs (1/10 of rainy days) Yield of runoff = 60%	Identify rainy months Calculate per day rainfall Consider, X Lts/hr/ unit , data for /day is acquired
	Storage potential/ design = area x annual rain fall x runoff coefficient x constant coefficient	Storage = area/size x intensity of rain fall x rate of recharge w.r.t material	Only 30% runoff captured by lakes	Total water which can be percolated = per day data x per day rainfall data x num. of rainy days
	Design = area x run off coefficient x peak rain fall in 15 min time in mm	Design = based on soil type, potential.	Peak intensity = 0.6cm/hr	

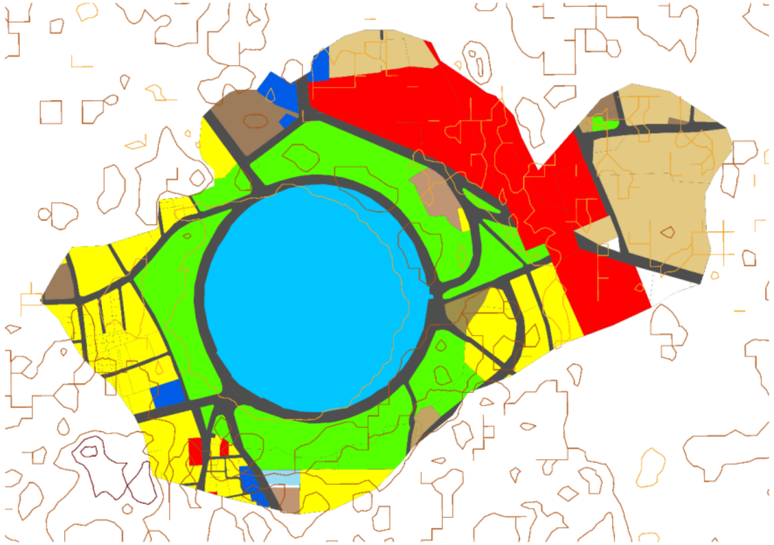
MEMNAGAR LAKE



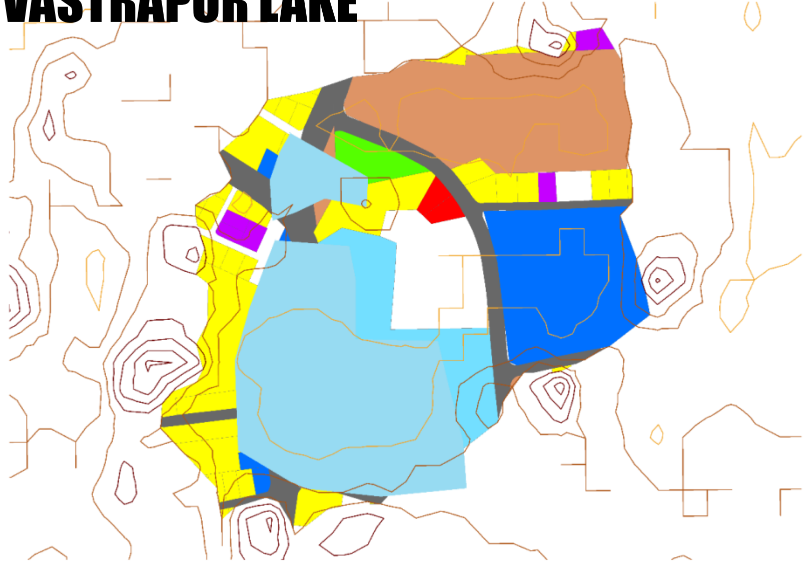
SOLA LAKE



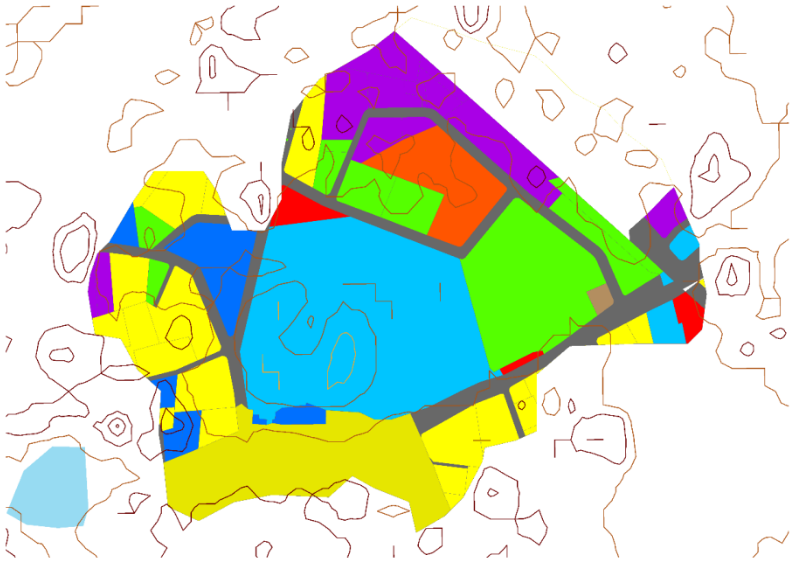
KANKARIA LAKE



VASTRAPUR LAKE



NARODA LAKE



Legend

merge_43ag

CONTOUR

- -45 - -25
- -24 - -15
- -14 - -5
- -4 - 5
- 6 - 25

Calculation

Rain Water Harvesting

Source:
Manual by CPWD – for coefficients
CGWD – for peak rainfall data

POTENTIAL ASSESSMENT

CATEGORY	No. LAKES	TOTAL CATCHMENT	ANNUAL RAINFALL	CONSTANT COEFFICIENT	ANNUAL POTENTIAL	PEAK RAINFAL (40% ARF)	PEAK POTENTIAL
SMALL	32	3008	0.74	0.5	1,11,29,600	0.29	44,51,840
MEDIUM + LARGE	29	2759	0.74	0.5	1,02,08,300	0.29	40,83,320

2,13,37,900 m3
ANNUAL

85,35,160 m3
PEAK

Ahmedabad Water Consumption

Per Day consumption by Ahmedabad = 1030 ML

Annual Consumption = 10300 x 365 = **37.5 x 10^6 KL**

Run off would be

56%

Of Ahmedabad's water Consumption

Rain Water Harvesting

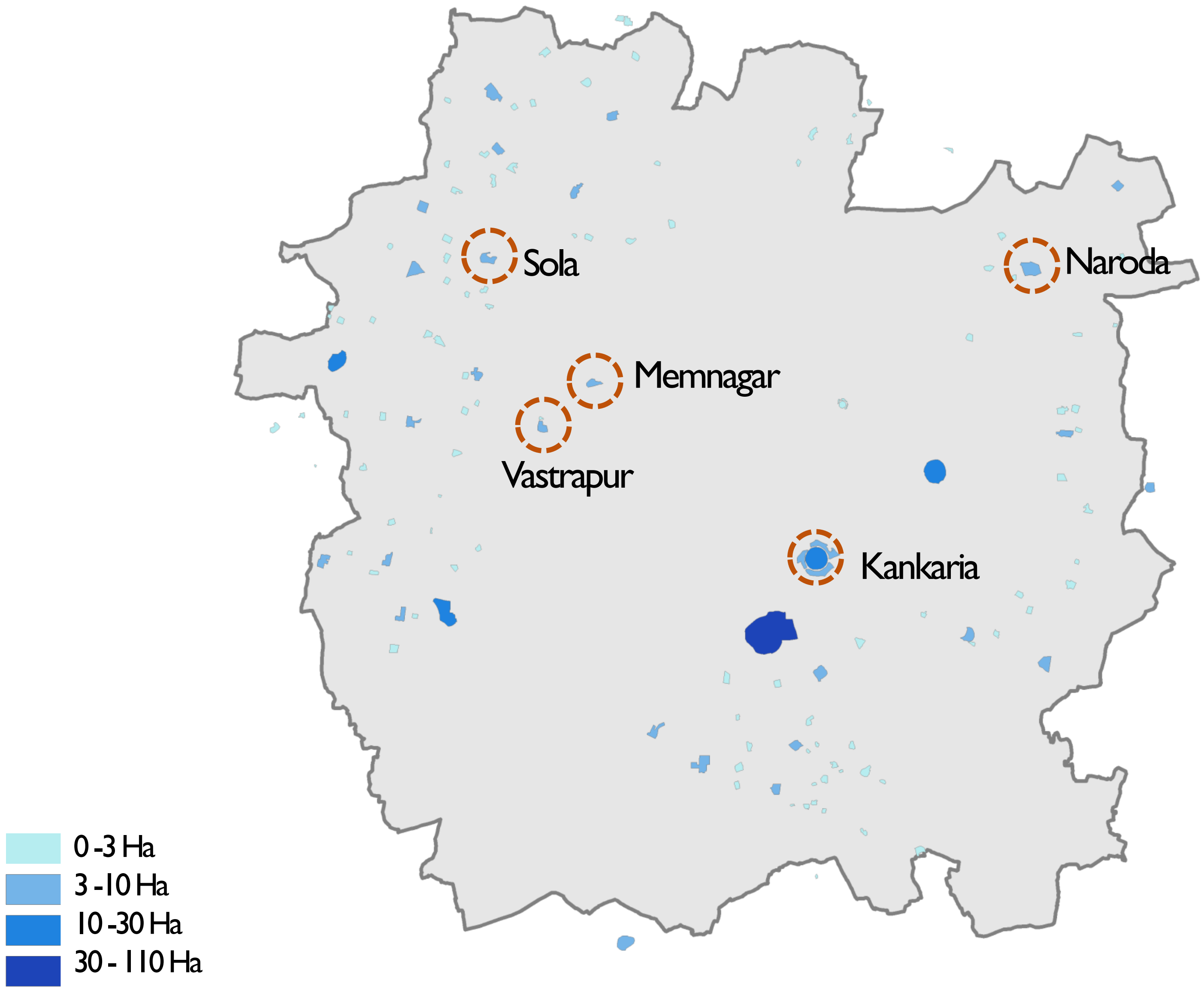
Source:
Manual by CPWD – for coefficients
CGWD – for peak rainfall data

Small Lake
Not much built up
More water as run off
Outskirts

	ANNUAL		PEAK	
	Tentative height increased	Height increased if inflow is 30%	Height increased during peak	Height increased during peak (30% inflow)
Memnagar	5.97	1.79	2.39	0.72
Vastrapur	1.59	0.48	0.81	0.24
Sola	123.38	37.01	49.40	14.82
Naroda	1.67	0.50	0.79	0.24
Kankaria	2.01	0.60	0.84	0.25

MAIN CHALLENGE 30% 40% 60% 80%

Source:
Manual by CPWD – for coefficients
CGWD – for peak rainfall data



ADMINISTRATIVE

GDCR – To include lakes into **RWH guidelines**
Lake conservation department to take the initiative
Private contractors managing the lakes prove to be managed better
Contracting out the operation and maintenance process

IMPLEMENTATION

Separate body from the AMC – LAKES DEPARTMENT to monitor the lakes
Financial assistance by mobilizing funds and external funding bodies

MONITORING

GDCR – scale of implementation and **maintenance by AMC** officials, periodic audits

TECHNICAL

Enhancement of the catchment, improving the percolation **capacity** of lakes, rain water storage facilities.
Laying of new storm water lines
Clearing the chocked drains

PUBLIC AWARNESS

Educating the public about use of lakes as water storage tanks apart from recreational or aesthetics
Already in few cases, public has taken initiative and pooled funds for the lake development i.e. people are already sensitized toward it
Proper channeling to be taken up

UNPLANNED URBAN DEVELOPMENT In the catchment areas of the lakes

Increasing built-up area

Increase in the population residing in the surroundings

Disturbance to natural drainage

Increase in surface runoff

Increasing pollution SW dumps

Water quantity in lakes reduced
Degraded lakes
Increased urban flooding

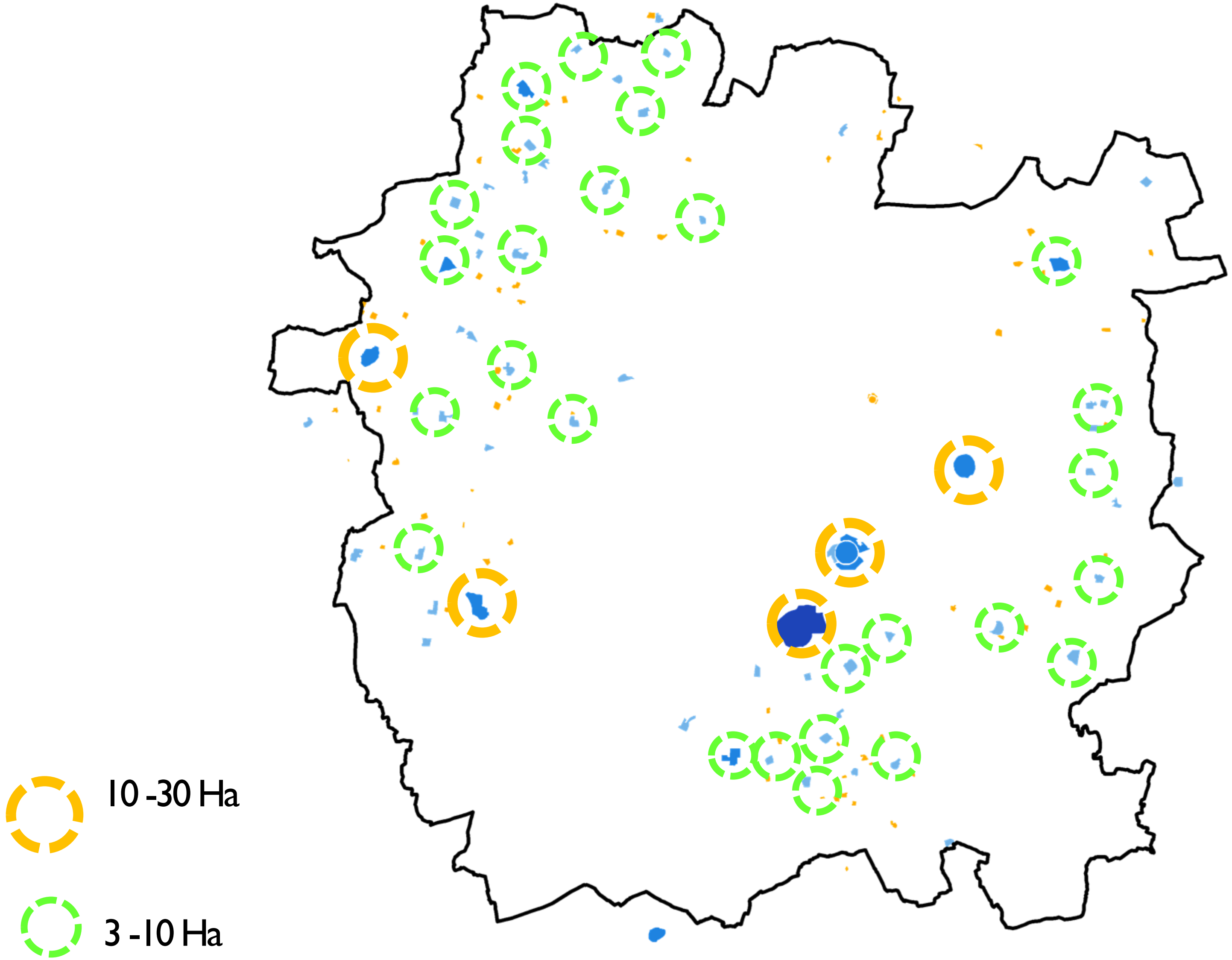
Negligence of lakes by local authorities

Encroachments by slums

Land allotment for lakes changed to other land uses

PROJECTS

1. Better urban planning mechanism 2. Regulation within GDCR – control on the percentage of pave surface around lakes and water bodies	AUDA AMC
3. Monitoring of the solid waste management at lakes 4. Water quality check and maintenance	PUBLIC AWR. CONTRACT
5. Clearances of the catchment area of the water bodies	CONTRACT
6. Construction of the storm water drains and clearing of blockages in the current system	CONTRACT AMC/ AUDA



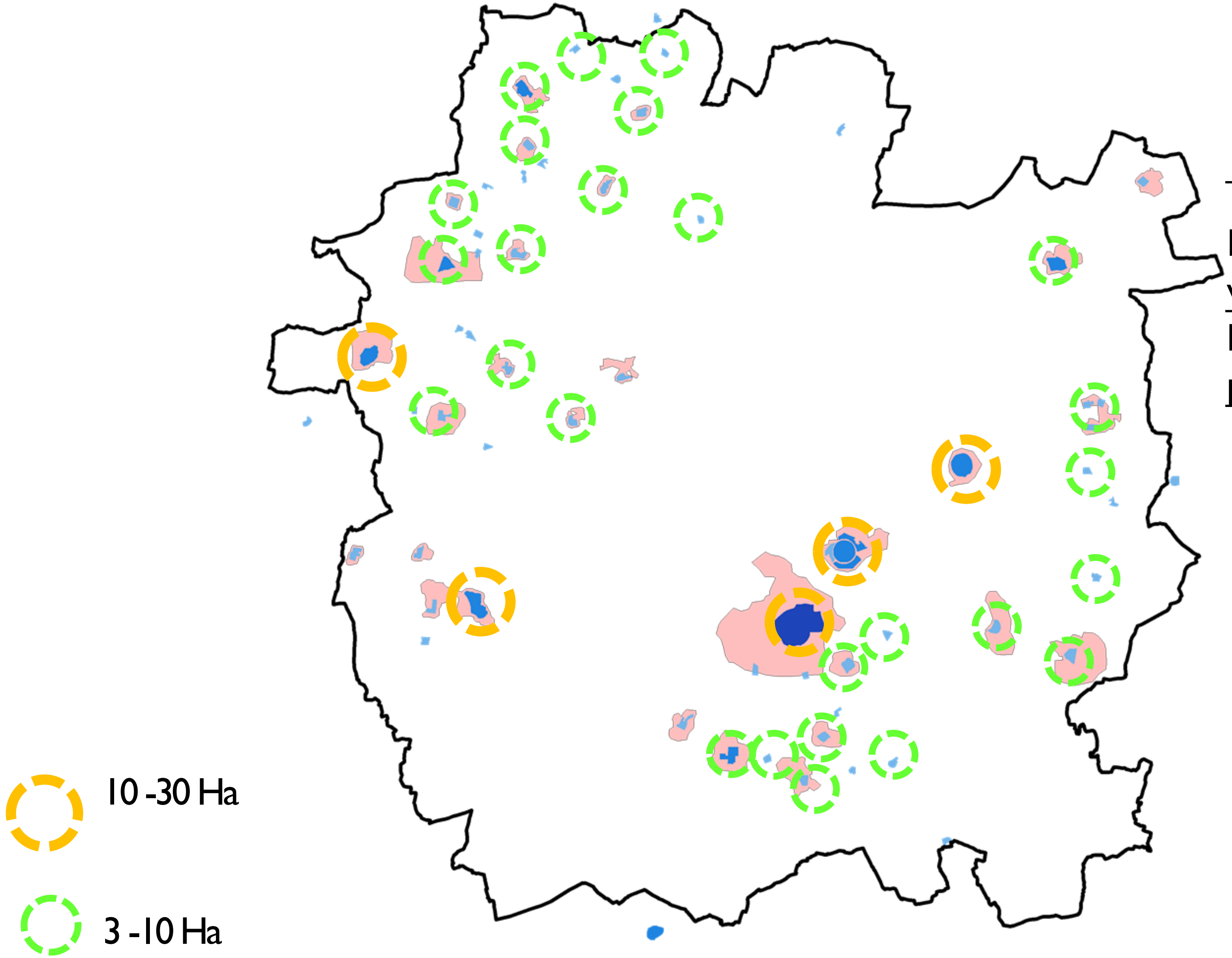
STAGE I

IN-SITU

	Cost in lakh per 50 acres	Cost for 1300 acres
Cleaning of the lakes & De weeding	120	3120
Solid waste removal	1.5	39
Water quality monitoring	2	52
	123.5	3211

Capital cost = Rs 32.11 Cr

Rain Water Harvesting



STAGE 2

	cost in lakh per 50 acres	cost for 1300 acres
Removal of clogs in the current storm water drains	11.5	299
Pavement of the surrounding with pervious materials	45	1170
	56.5	1469

Capital cost = Rs 14.69 Cr

STAGE 3

Regulation provisions in GDCR
Implementation
Monitoring

Total cost = Rs 46.80 Cr
Contingencies (2%)= Rs 0.93 Cr
Post operative expenses (5%) = Rs 2.43 Cr

~ Total capital cost = Rs 50.16 Cr

Rain Water Harvesting

3-TIER INSTITUTIONAL MECHANISM

NODAL DEPARTMENT

Interactions with MoEF, receipt & disbursement of funds, physical & financial monitoring of project Implementation

Lake development authority **(LDA)** or lake conservation authority **(LCA)**

PROJECT IMPLEMENTATION UNIT (PIU)

Construction and oversee the project implementation

PRIVATE CONTRACTS

Selection of contractor post screening and bidding process

MUNICIPAL COUNCIL/ CORPORATION/LOCAL BODY

O&M of the project

AMC
AUDA
PPP
COMM-PARTICIPATION
CSR

PARKS

Developed open green spaces are **7.99 %** of total land use.

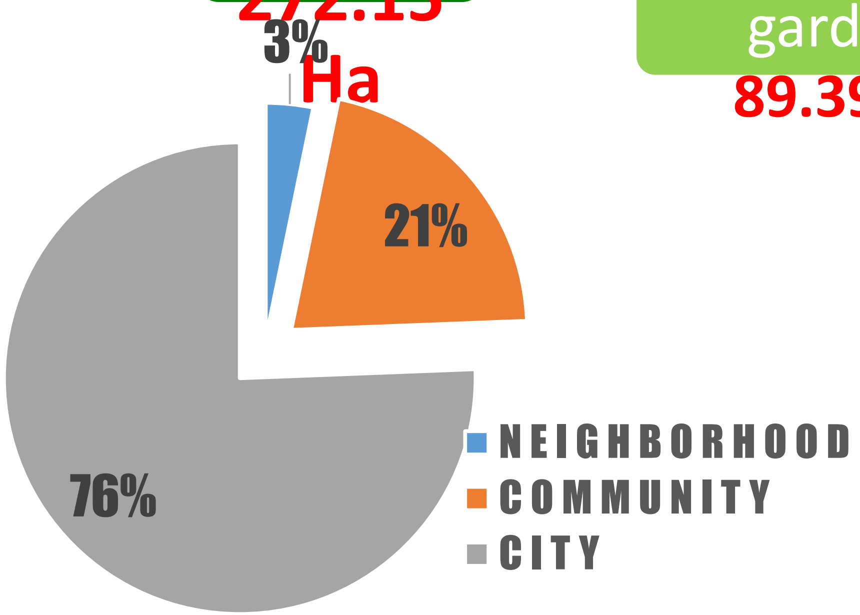
219

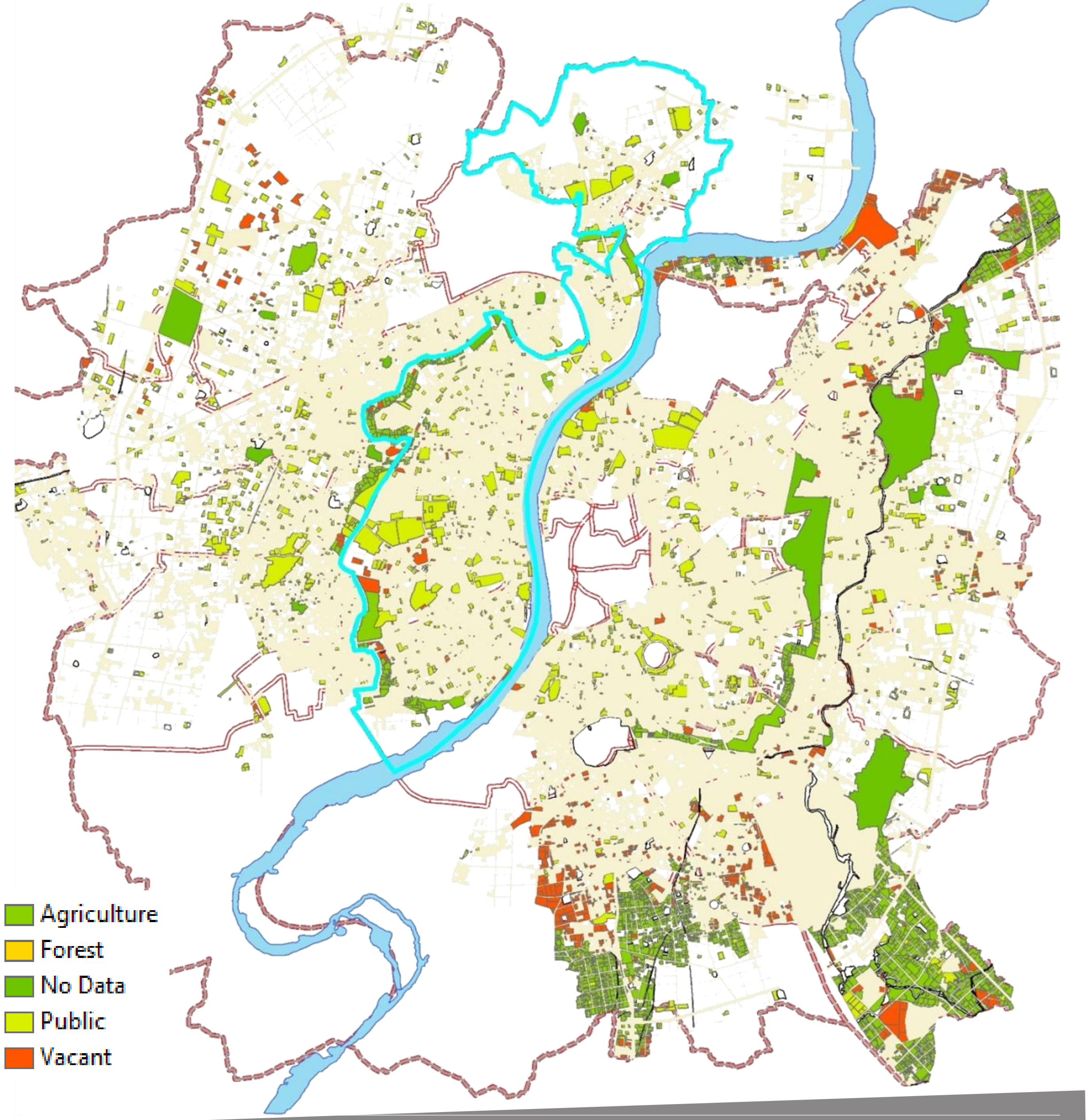
Ahmedabad Gardens
272.15 Ha

201

AMC gardens
18
182.76 Ha

AUDA gardens
89.39 Ha





Rain Water Harvesting

Source : AUDA DP, 2021 and CSP, 2012

PERCOLATING WELLS IN ALL MUNICIPAL GARDENS FOR RWH

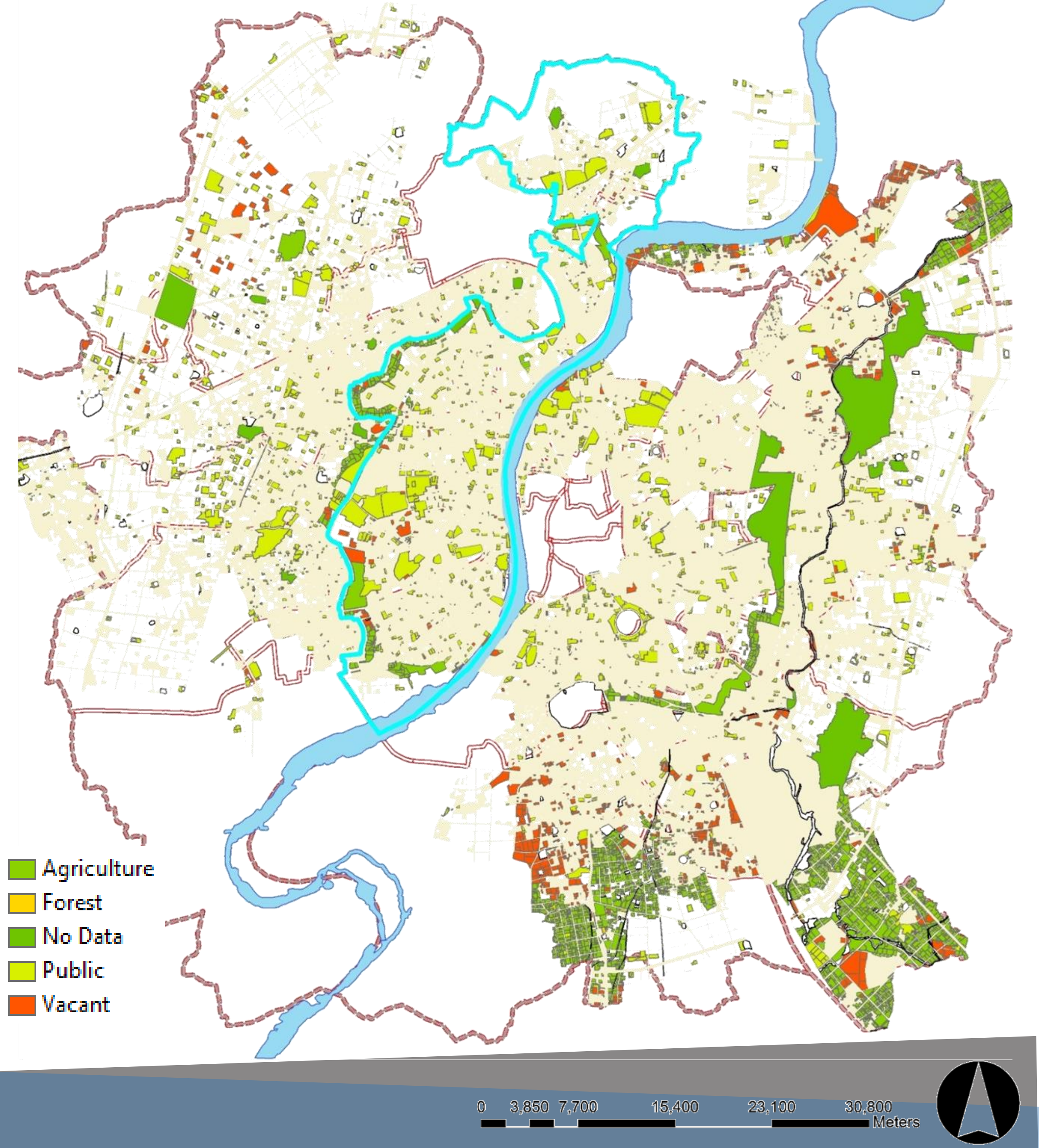
- AHMEDABAD MUNICIPAL CORPORATION
- TOI, 2010

SAMPLES OF SURVEY

1. WHO MAINTAINS THE PARKS
2. DO THE PARKS HAVE RWH SYSTEMS
3. IF YES WHAT IS THE SCALE OF OPERATION
4. WHO KEEPS A TRACK ON ITS MAINTENANCE
5. WHAT IS THE DIFFERENT BETWEEN PARKS FROM DIFFERENT ZONES OF AHMEDABAD

CONDITION

MAIN PLAYERS
AMC & MOTHER DAIRY
5% OF EACH ZONE FOR AMC = 15
5% OF EACH ZONE FOR MOTHER DAIRY PARKS=14
OTHERS =4



Rain Water Harvesting

Source :AUDA, Media archives

PARKS

LOCATION

Bhairavi Public Park, Visramnagar, Ghatlodia

AGENCY

AMUL

Area of Park = 10,178 Sq.Mts

Annual Rainfall = 740mm

Water Falling on ground ,

10178 x 0.74 = 7531M^3 (annual)

10178 x 0. 296= 2951M^3 (peak)

Runoff coefficient = 0.25

Water that can be percolated,

7531 x 0.25 = 1882 M^3 = 1882750 L (annual)

2951 x 0.25 = 737 M^3 = 737750 L (peak)

Rain Water Harvesting

Source :Google earth, Rain water harvesting and conservation by cpwd., Primary survey

PARKS

Total area Under Parks,
1727296 SQM

Water Falling on ground,
$1.7 \times 10^6 \times 0.74 = 1.2 \times 10^6$ M^3

Runoff coefficient = 0.25

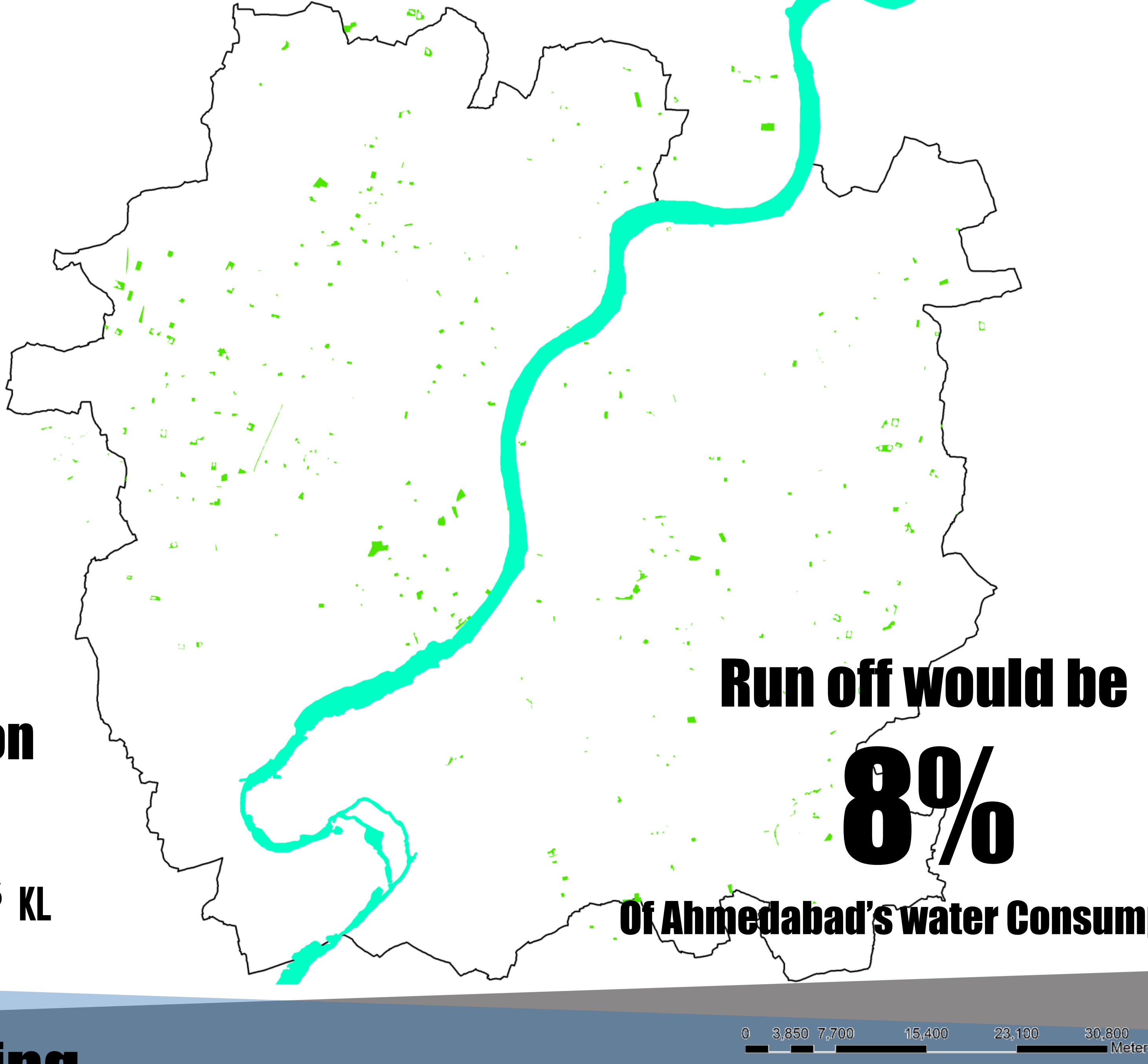
Annual water that can be percolated,
1.2×10^6 KL = 0.3×10^6 KL

Water percolated at Peak time,
40% of annual run off
0.12×10^6 KL

Ahmedabad Water Consumption

Per Day consumption by Ahmedabad = 1030 ML

Annual Consumption = 10300 x 365 = **37.5×10^6 KL**



Run off would be

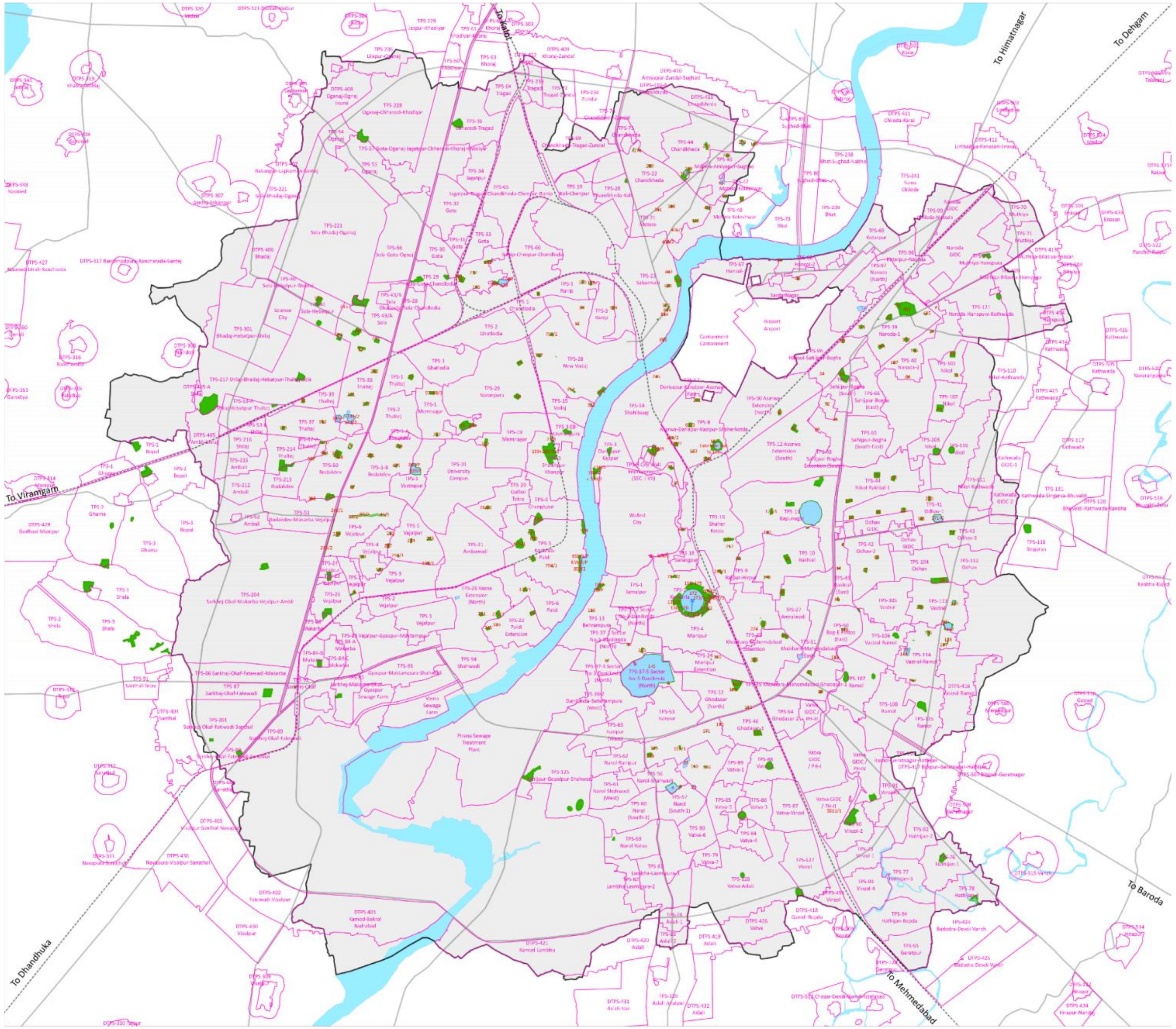
8%

Of Ahmedabad's water Consumption

Rain Water Harvesting

Source :GIS, Rain water harvesting and conservation by cpwd.

PARKS



ADMINISTRATIVE

Provisions to be revised from only percolation to storage, harvest and percolate

IMPLEMENTATION

Parks and gardens department **– AMC**

MONITORING

Making the security personnel **aware** of duties towards RWH at the parks , timely **auditing and checking**

TECHNICAL

Alignment and construction of recharge wells at **appropriate** locations , filtration, **ZERO RUN OFF**

PUBLIC AWARNESS

Not only prescribing but to stand as a best study for **motivating people** ,Rally's public gatherings, community participation

FINANCE – PARKS

Total area under parks – 16,18,157 sq.m = 161 Ha
For 1 Ha of park/ garden = 3 recharge pits
Therefore,

Total recharge pits/ trench required for Ahmedabad = 161 x 3 = 483 pits

Cost of construction of 1 pit/ trench = Rs 5000 – Rs 10,000/- (average Rs 8000/-)
Total cost of construction = 8000 x 483 = Rs 38,64,000 /-
Contingencies (@ 8%) = Rs 309120 /-
Operational and maintenance (@10%)= = Rs 3,86,400 /-

Total cost of the project ~ Rs 45,59,520/-

OPTION 1

Project contracted out on PPP

1. Private body constructs the pits/ trenches
2. Operates and maintains
3. Transfers it to AMC (BOT)

OPTION 2

Project contracted out

1. Private body constructs the pits/ trenches
2. Operates and maintains
3. Owns it

CONTRACTING – PARKS

INVITATION FOR BID

Section 1-
Preparation of Bids
Submission of Bids
Bid Opening and Evaluation Award of Contract

Section 2 -
Letter of Intent
Agreement Form
Work Order

Section 3-
Conditions of Contract General Conditions
Time Control
Quality Control
Cost Control
Finishing the Contract Special Conditions
Safety Manual

Section 4-
Forms of Securities
Bid Security

SELECTION OF THE CONTRACTOR

TECHNICAL SPECIFICATION

TENDER DRAWINGS

SCHEDULING OF THE QUANTITIES

REJUVENATION OF LAKES

Issues

PRESENT SCENARIO

Source: Primary survey

Policy Time Line For Lake Conservation

1983 NWCP under MoEF was formed

1987 1st National water policy

1992 The National Conservation Strategy and Policy Statement on Environment and Development

2001 NLCP was formed

2002 conservation of water body

2005 under National Capital Region plan town to protect identified water bodies

2009 National Water Mission under National Action Plan on Climate Change

2013 NLCP and NWCP combined to form NPCAE

Source: Briefing Paper-Legal institutional and technical framework for lake and wetland protection by CSE

Rejuvenation of lakes in India (case studies)

Name of the lake	**Jukkur Lake,Banglore** (160Acre)	**Powai Lake, Mumbai** (1800Acre)	**Kankaria, Ahmedabad**	**Lakes Interlinking Project, Ahmedabad**	**Pushkar lake, Rajasthan** (30Acre)
Rejuvenation Methodology & Technology	• ***Wetland Treatment Technology*** • Silt traps • Public Participation	• Shoreline development • Desilting(imported technology) • *Public Participation(Clean up drive)*	• Aerator(Fountain) • Desiltation • *Lake front development*	• *Urban watershed management/Storm water management* • Lakes interlinking • Lake development(44)	• *anaerobic cum facultative stabilization ponds* • Silt trap • Aeration • Heritage Tourism
Key Stakeholders	• BDA • ***JalPoshana(Satya Foundation)*** • Citizen groups • **Fishermen**	• MSAA • BMC • *IIT Bombay* • NLCP • MMRDA	• AMC • AUDA • State Govt.	• AUDA • AMC • Rejuvenation and Renovation of Urban Water Bodies of Ahmedabad	• GoR • PMB • MoEF
Finance	• BDA • 17Crores(Lake Development Project)	• BMC(6.24 crores) • IIT Bombay • NLCP	• AMC,Govt. of Gujarat • 36Crore(recreation and lake development)	• AMC(575 Crore) • Each year (20Crores for lakes development)	• MoEF(87Crores)
Operation And Maintenance	• BBMP • **JalPoshana**	• MSAA	• AMC(User fees)	• AMC	• PMB

Source: 1. http://www.egovamc.com/Citizens/CDP/chapter11.pdf 2. http://www.itc.nl/library/papers_2014/msc/upm/anand.pdf 3. http://www.iddkarnataka.gov.in/docs/23.Prefea_lake_cons.pdf

Lakes in Ahmedabad

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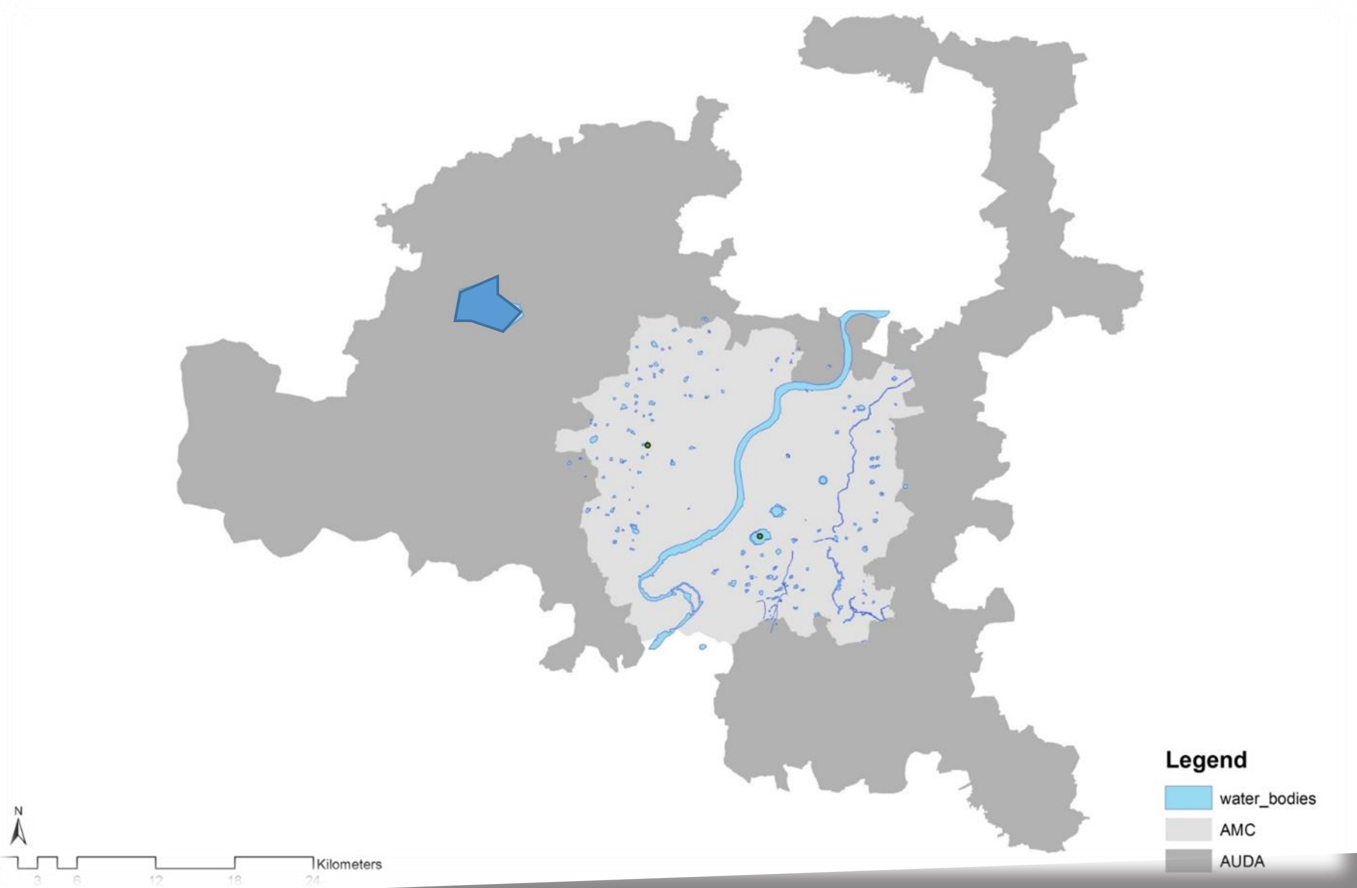
6	AMC	47	6	1	5
TOTAL		**1411**	**42**	**22**	**44**



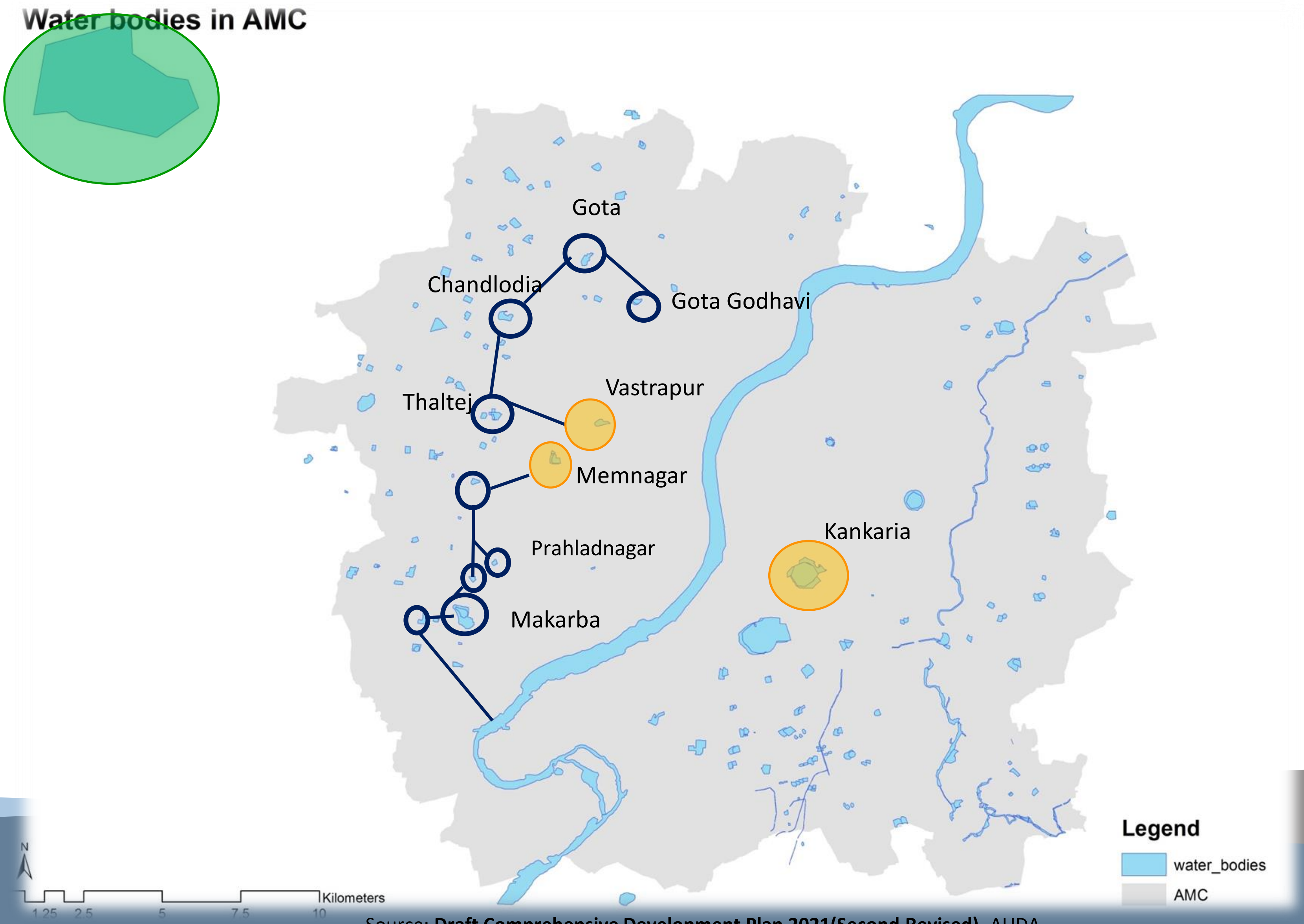
Source: **Draft Comprehensive Development Plan 2021(Second Revised)** ,AUDA

Rejuvenation interventions in Ahmedabad

- Lakes Interlinking

- **22** Lake Front Development And Slum Rehabilitation(Kankaria, Vastrapur, Memnagar)

- No Urban Development Buffer Around Thol



Source: **Draft Comprehensive Development Plan 2021(Second Revised)** ,AUDA

Current Institutional scenario- Ahmedabad

Identify → Plan → Execute → O & M

Mayor

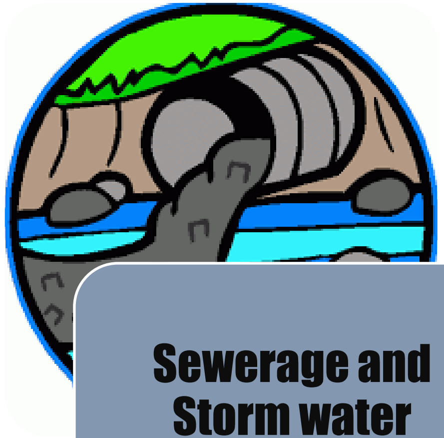
Standing Committee

AUDA

Ward/Political Interest

Sewerage And Storm Water Department

Consultants



Sewerage and Storm water Department

Housing Department

Garden Department

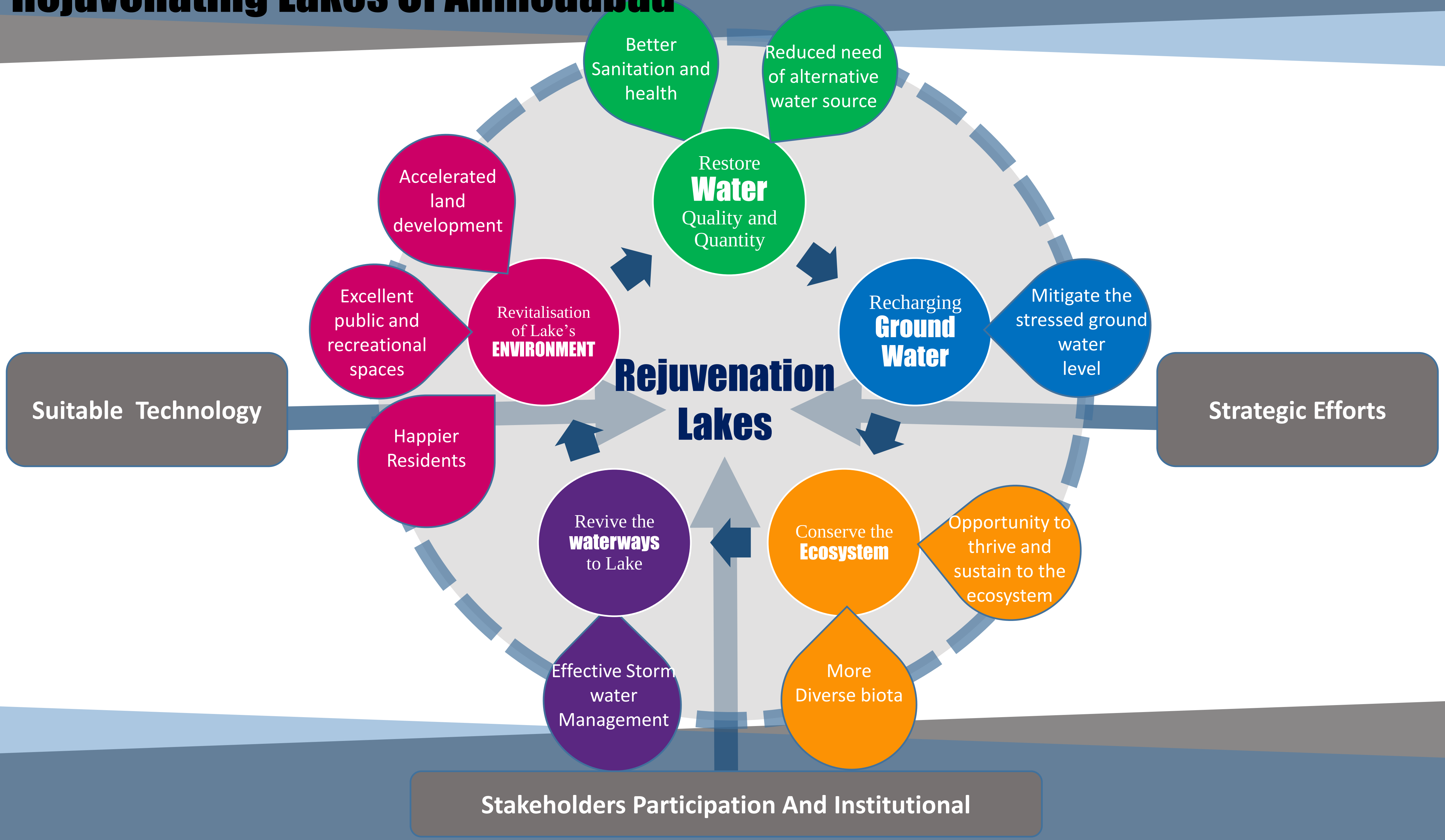
Health Department

Environmental Services(Central Laboratory)

Stand alone development of water bodies without integration of stakeholders and institution

Source: Primary study

Rejuvenating Lakes Of Ahmedabad



Water In The Lakes

- Urbanisation **reduced quantum** of water coming to lakes.

- Shallow Lakes, **High Evapotranspiration (2.3M/ Year)** losses.

- Need of alternative source, fresh water cannot be used in **water scarce scenario**.

"Reclaim The Waste Water to Recharge Lakes Of Ahmedabad"

Source:http://cwc.gov.in/main/downloads/Evaporation%20Control%20in%20reservoirs.pdf

EPA 2012 Guidelines for Water Reuse

- **<u>Fit for Purpose</u>**: choosing the right level of treatment should be dictated by the end application of the reclaimed water for achieving economic efficiency and environmental sustainability.

- Water Reuse-**<u>Impoundment</u>**:
- <u>Santee Lakes, San Diego</u>
  - Public Acceptance
  - Reuse of water as recreational impoundment(1960)
- <u>Arizona</u>
  - reclaimed water- recreational impoundments
  - must meet Class A requirements
  - secondary treatment, filtration, and disinfection
  - no detectable faecal coliform organisms
  - body contact is prohibited
- **<u>Wetland :</u>**
  - flood attenuation,
  - wildlife and waterfowl habitat,
  - food chain support, aquifer recharge
  - water quality enhancement
  - maintenance of wetlands in the landscape mosaic is important for regional hydrologic balance

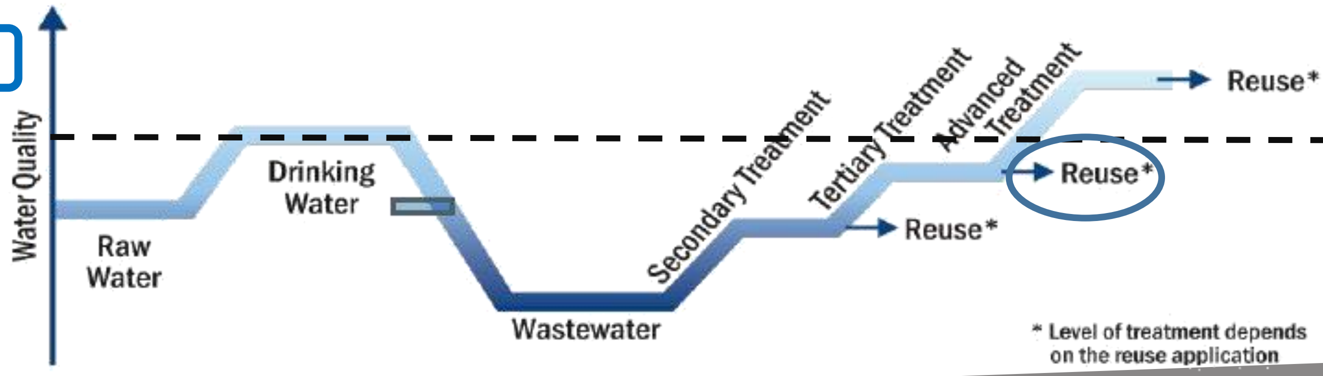


Figure 1-3
Treatment technologies are available to achieve any desired level of water quality

Source:http://water.epa.gov/aboutow/owm/upload/Water-Reuse-Guidelines-625r04108.pdf

Guidelines for Waste Water Reuse

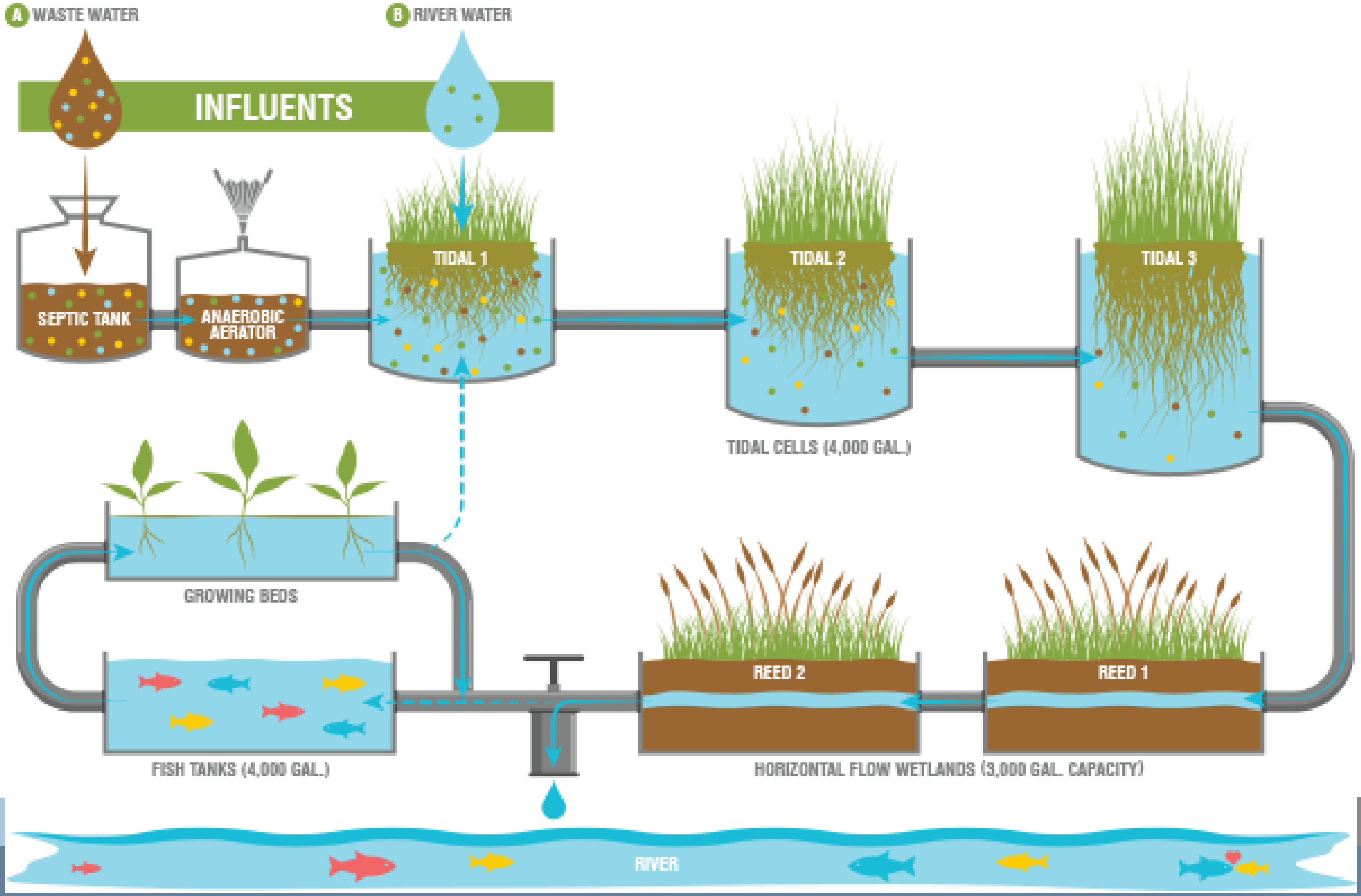
Guidelines	Recommended Extent Of Treatment
USEPA	• Secondary Treatment • Filtration • Disinfection
California Guidelines	• Disinfected Tertiary
CPCB Guidelines	• Secondary Treatment with Filtration

Environmental Building Guidelines for Greater Hyderabad

- **Discharge into lakes/ponds/water bodies -** Wastewater is full of nutrients, which can directly be used by algae, water plants and lower animals, which then could become fish feed. Hyderabad is famous for its beautiful lakes. In all, there were more than 150 lakes in Hyderabad Metropolitan Area. But due to the development most of the lakes disappeared. In the Draft Master Plan for 2020, it is proposed to increase the area of water bodies to 95.44 sq. km. from the existing 84.3 sq. km. One way of achieving this is by channelling all our treated water, storm water etc. into the closest lake in the vicinity.
- **Safe disposal** of the treated wastewater into lakes/ponds in the local vicinity would increase its water levels, enhance the recharge potential, nutrient water for growth of aquatic flora & fauna in water bodies, etc.

Source: Source-http://www.ultrawater.co.in/Sewage%20discharge%20standards.pdf
http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/RWregulations_20140618.pdf

"Restoring Healthy Coexistence With Nature"



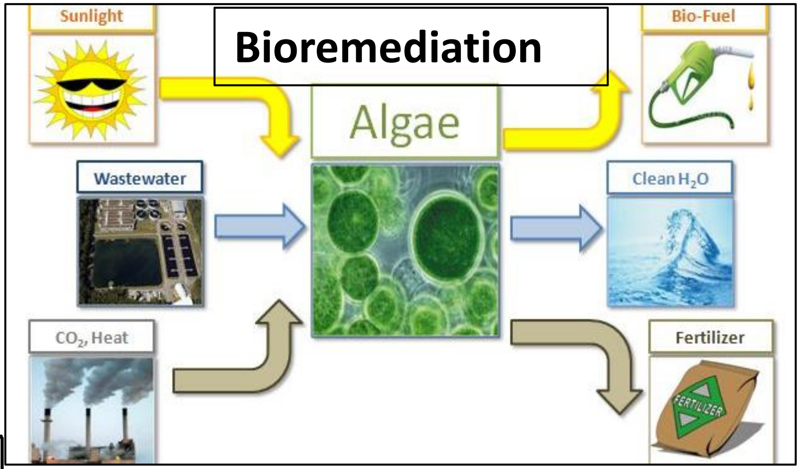
Source:http://the-looper.com/bioremediation.html

Techniques to clean water

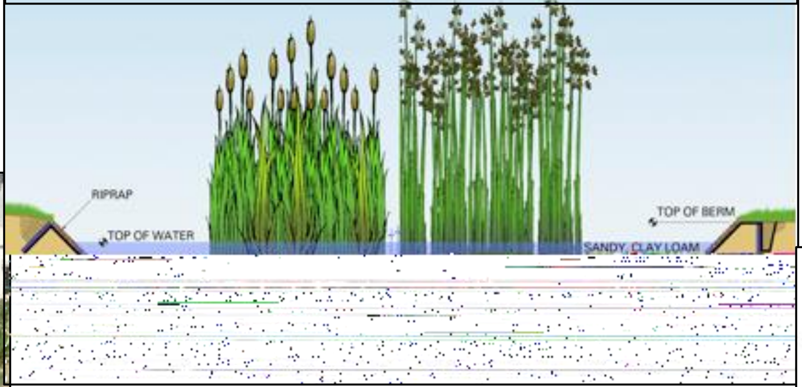
An Ecosystem based approach

Floating Wetland

Bioremediation

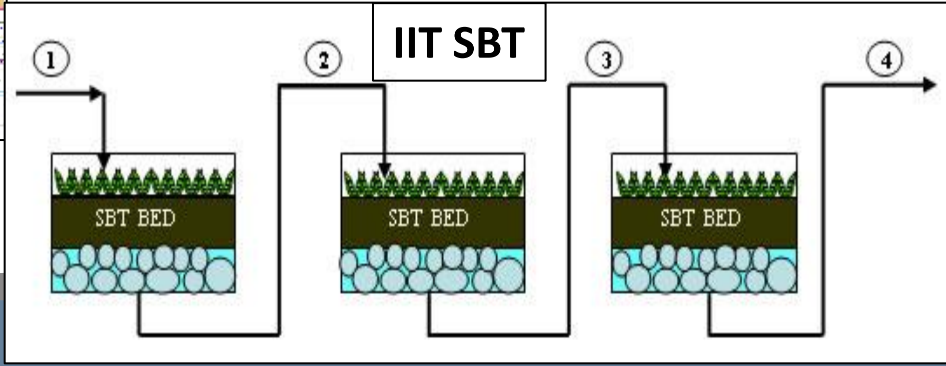


Constructed Treatment Wetland



Phytorid

IIT SBT



Source: http://cseindia.org/userfiles/shankar.pdf (IITSBT) http://www.environmentaljournal.org/1-3/ujert-1-3-9.pdf (Wetland) http://www.neeri.res.in/pdf/Phytorid.pdf (Phytorid)
http://www.aswcd.org/bioremediation_lakes_myths_and_realities.pdf

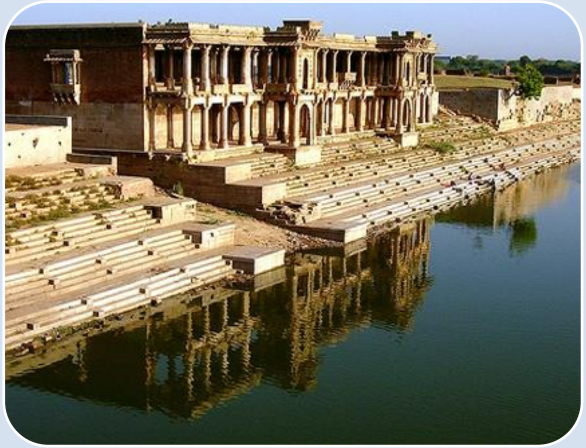
Techniques to clean water

An Ecosystem based approach

Technology	Treatment Quality	Area Required	Cost	Case Studies
Floating Wetlands	**Secondary Treatment**	-	• Construction Cost:30-40 Lakh Per Acre • O&M :30,000 Per Acre Per Year	• Kotitirtha Kunda, Mahakaleshwar Mandir, Ujjain.
Phytorid	**Tertiary Treatment**	• Area Requirement: 1.5-1.75 Per KLD	• Construction Cost:1.20 To 1.30 Lakh per KLD • O&M :Rs1000-2000/KLD/Year	• CIDCO, Panvel (20 M3/Day) • Mumbai University Campus, Kalina (25 M3/Day)
Bioremediation	**Tertiary Treatment**	-	• 2 To 4 Kg Per Acre/Foot Of Water • 3000 Per Cubic Meter	• Yamuna River At Agra • Agastya Lake, Badami, Karnataka
Constructed Wetlands	**Tertiary Treatment**	• 2-3 Sq. M Per KLD	• Construction Cost: Rs 1500-2000 Per M² • O & M :Rs 300 Per M²	• Jukkur Lake, Bangalore, Karnataka
DEWATS	**Tertiary Treatment**	-	• Rs 20-25 Per KLD Water	• Bandhwa Talav (Raipur)
IIT SBT	**Terti**	• 1.5 Sq. M For 1 KLD	• Construction Cost:14,000/	• Lake Near Mumbai,

Source: http://cseindia.org/userfiles/shankar.pdf (IITSBT) http://www.environmentaljournal.org/1-3/ujert-1-3-9.pdf (Wetland) http://www.neeri.res.in/pdf/Phytorid.pdf (Phytorid)

Potential Oriented Categorization Of Lakes



Biodiversity And Ecosystem

(Environmental Group &NGO)

- Ecological Restoration And Conservation With Various Interventions

Historical And Religious Importance

(Associated Institution)

- Heritage Restoration And Conservation
- Demonstration Of Historical Uniqueness And Story Of The Lake.

Recreational And Public Space

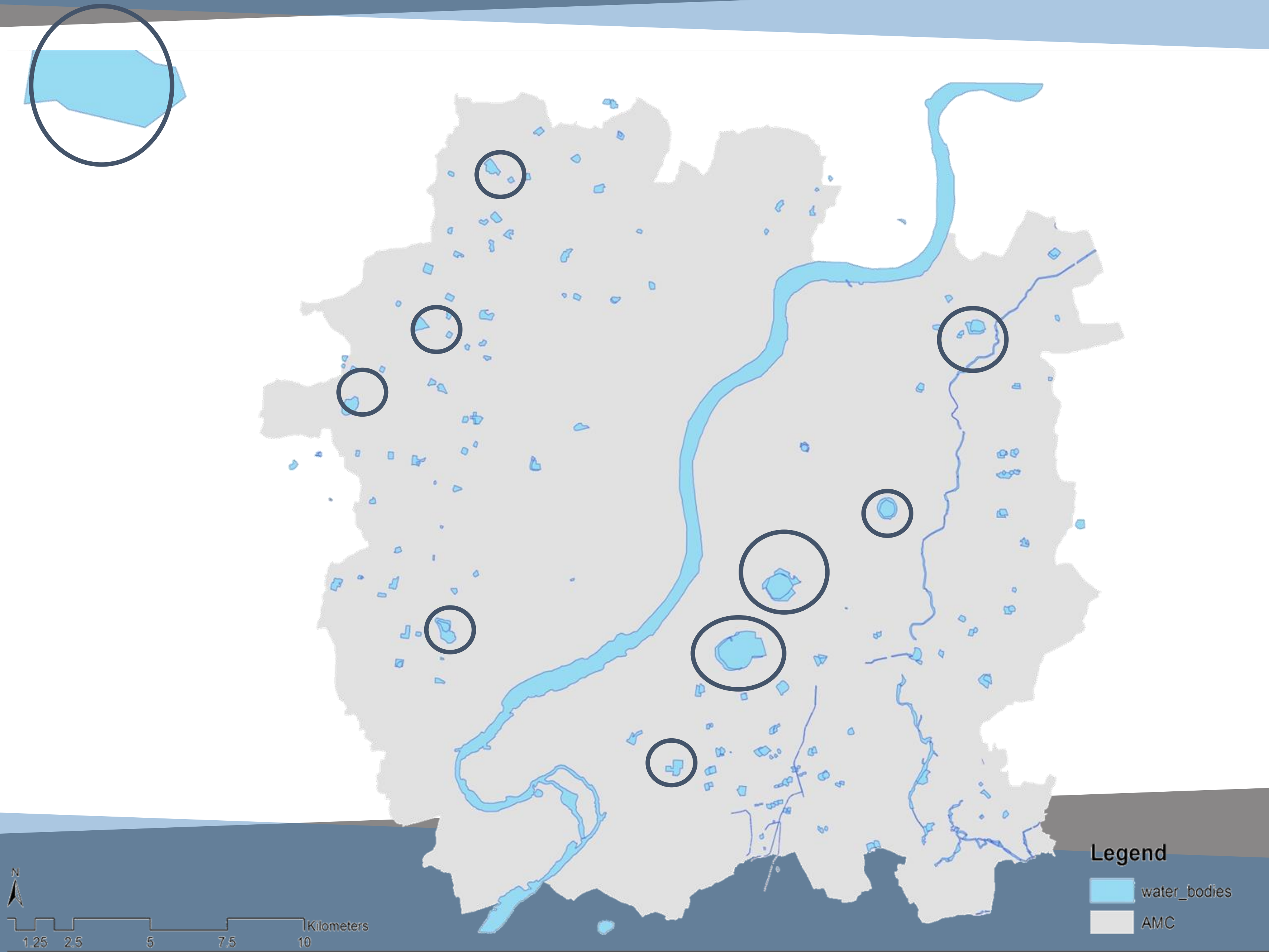
(AMC)

- Design Of New And Innovative Recreational Installations
- Water Rides And Sports.

Short listed lakes- According to size

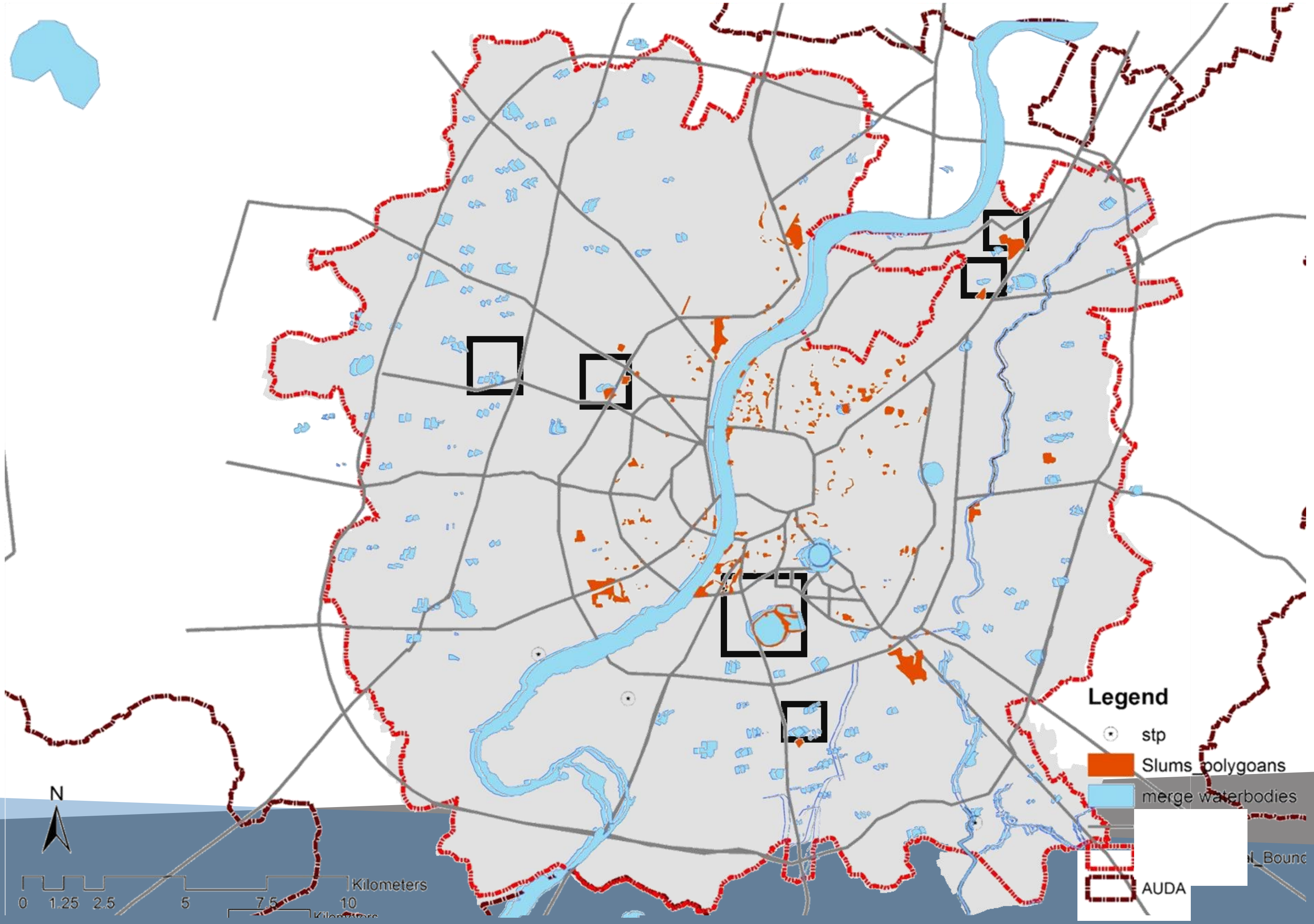
Short listed lakes(>0.1km²)

- Thol lake
- Naroda lake
- Lal Bahdur shastri lake
- Kankaria
- Chandola lake
- Sarkej lake
- Thaltej lake
- Sola lake
- Gota lake



Short listed lakes- According to location of slums

- Naroda lake
- Saijpur lake
- Chandola lake
- Memnagar lake
- Thaltej lake



Potential Oriented Categorization Of Lakes

Name of the Lake	Biodiversity And Ecosystem	Historical And Religious Importance	Recreational And Public space
Thaltej			
Chandola			
Sarkhej			
Thol			
Naroda			

Step by Step Methodology to Lake Rejuvenation

Cleaning Of Lake And Shoreline Treatment

- Chemical Process
- Mechanical Process for (**removal** of **water hyacinth** and
- weed)
- **Bioremediation**(Microbial treatment)

Physical Treatment

- Deepening of lake without harming natural ecosystem of the lake(Dredging And **Desiltation**)
- **Aeration** for DO
- **Sediment basin**
- Cleaning solid waste in the lake and on the shoreline

Design Of Engineering Measure

- Provision of **silt traps**
- Improvising inlet points
- Clearing the natural drainage of storm water to the lake.
- Provision of **recharge well**.

Source: http://www.moef.nic.in/sites/default/files/nlcp/Lake_Conserv-Manage_India.pdf

Step by Step Methodology to Lake Rejuvenation

Shoreline Management

- Rules and regulations for protection of lake and its buffer in DPR.
- Community toilets
- Fencing
- Peripheral roads and green belt
- Electrification
- **Promote eco-tourism(small birds sanctuary)**
- Administrative Office, Security Chamber,
- Food Court, Children's Park

Powai Lake, Mumbai

Peoples participation

- Active participation from **local community**, citizen groups, conservation organizations, **NGOs**, and media
- Awareness campaign

Roles of regulatory

- Inter-Agency Regulatory Body- LDA, Pollution Control Board, Forest Dept. City Corp., Development Authority
- Evolve effective wetland programs

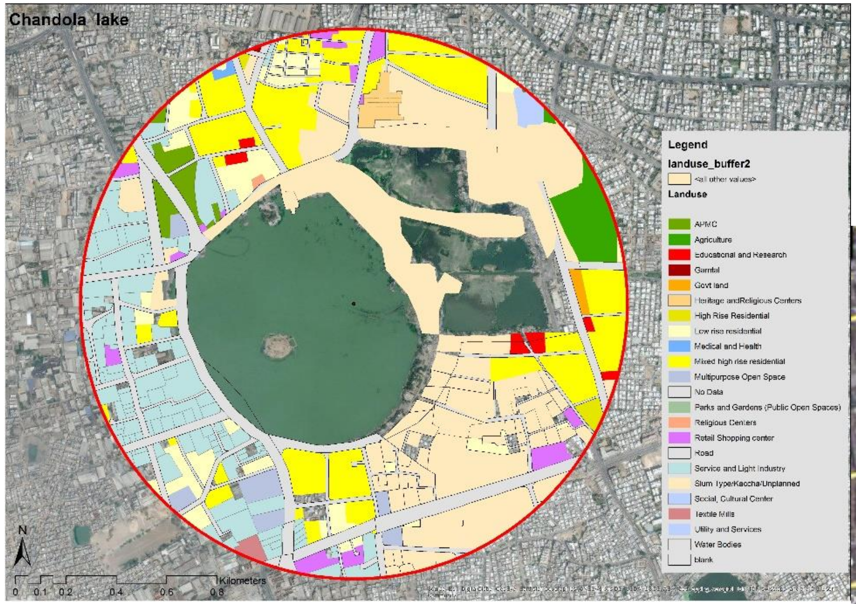
Kankaria, Ahmedabad

Source: http://www.moef.nic.in/sites/default/files/nlcp/Lake_Conserv-Manage_India.pdf

Detailed study of Shortlisted Lakes

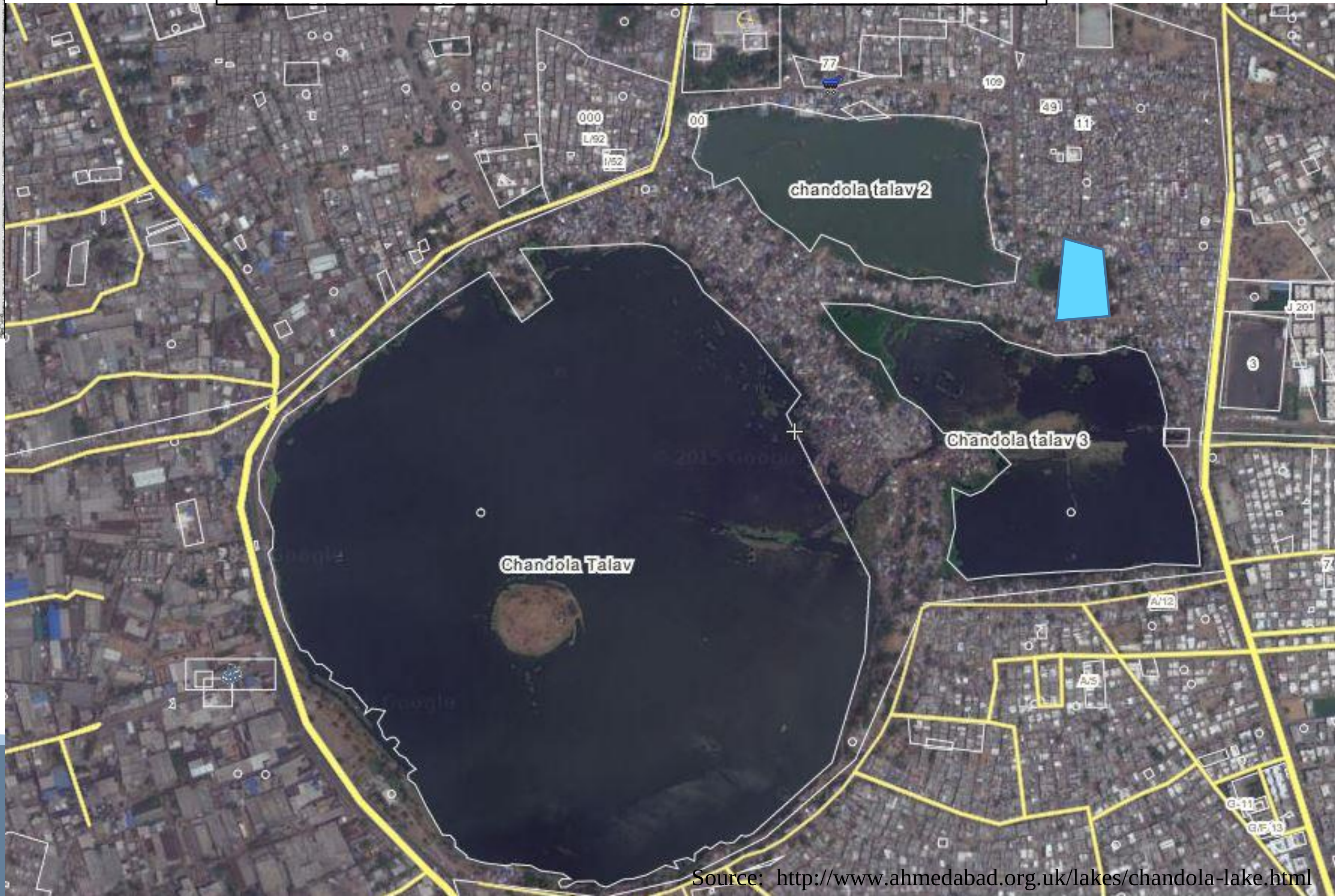
CHANDOLA LAKE

Area of Intervention:1.44 km²
Area under Lakes:1.20 km²
Area available for development :0.24 km²



Brief History

- Established by wife of Mughal sultan of Ahmedabad **Tajn khan nari ali**
- Manmade lake prepared as water reservoir near **To Tomb Of Shah Alam**
- **The Salt March had also reached Chandola**
- Water was used for irrigation purposes.



Source: http://www.ahmedabad.org.uk/lakes/chandola-lake.html

Detailed study of Shortlisted Lakes

CHANDOLA LAKE

Land use

- Slum settlements all around lake
- Mosque on the bank
- Vending activities along the road

Nuisance

- Waste water from slums and sewer diverted to lake
- Solid waste disposal

Water quality

- Totally polluted it cannot be used for any purpose
- For past 20 years the water is not used for any purposes

Water Quality	pH	DO(mg/l)	COD(mg/l)	TSS(mg/l)
Chandola	9.1	5.08	84	1224

Intervention Needed: The Intervention Will Be In The Context Of Historical And Religious Restoration.

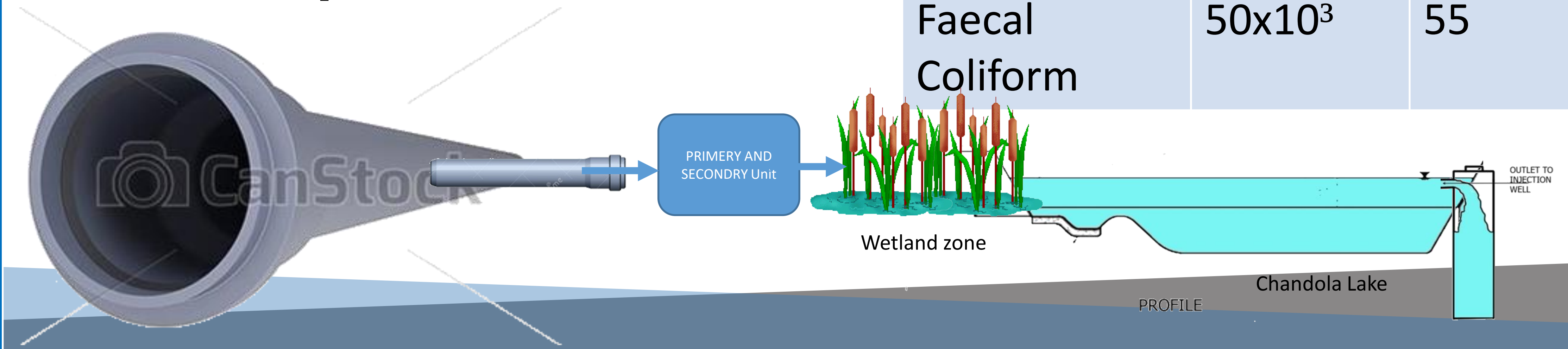
Source: Primary study, https://www.itc.nl/library/papers_2014/msc/upm/anand.pdf

Design Of Treatment Unit

CHANDOLA LAKE

- Capacity of lake: 129400 m^3
- Water losses from surface(4Months Period) :108696 m^3
- Losses:84%
- Regular Inflow required:905 m^3/day=900 KLD
- Technology Used : Wetland treatment
- Area required:1500-2000 Sq. m.
- Cost of Treatment : 2 Crores
- O&M : 2 Lacs per annum

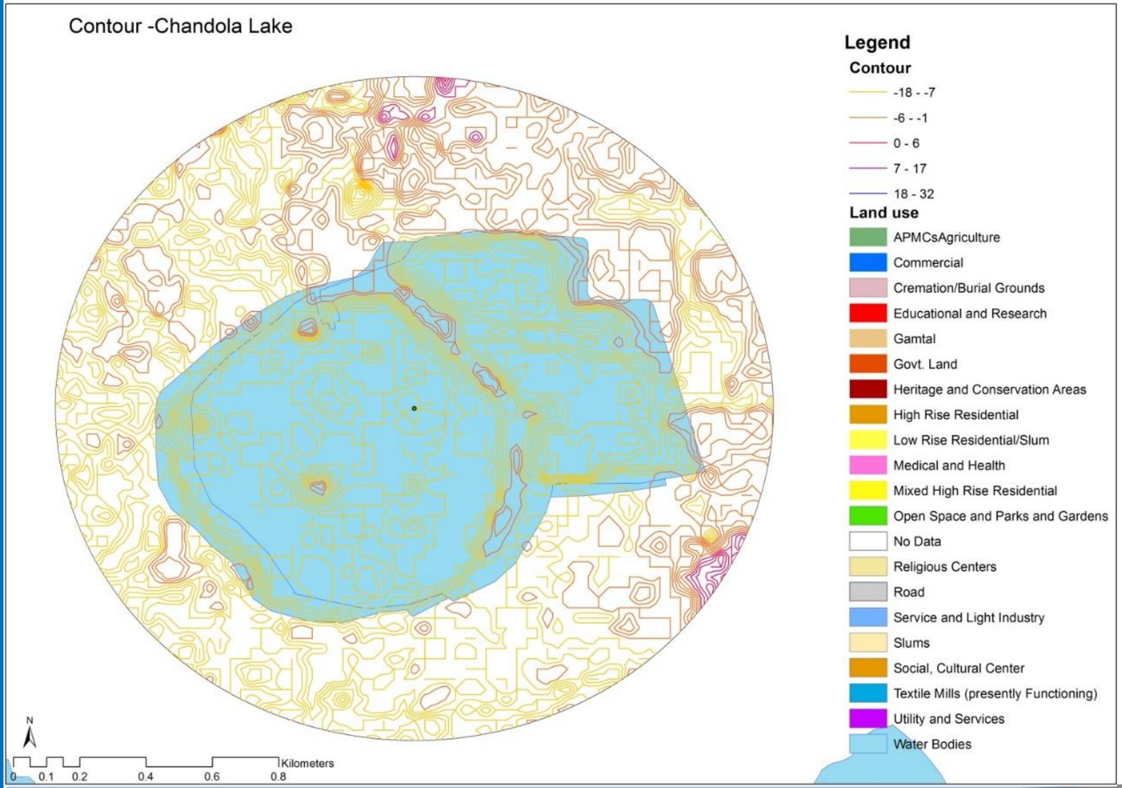
Characteristics	Inflow	Outflow
BOD	155	0.3847
COD	510	3.325
TDS	847	15
TSS	218	10
Faecal Coliform	$50x10^3$	55

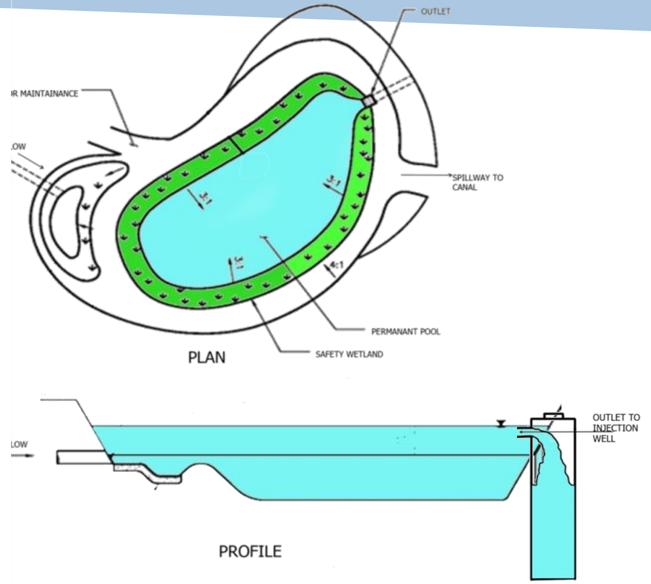


Source: http://www.environmentaljournal.org/1-3/ujert-1-3-9.pdf (Wetland)

Ground Water Recharge Potential

CHANDOLA LAKE





Catchment area of Thaltej:1120.86Acres(4.5km^2)

Water Recharge of Ground water: 0.4*6.95*10^3*10^3*0.797

Water recharge Potential per year = **22.15Lakh m^3**

Case study:

Haryana	1	Roof Top Rainwater Harvesting	2350 Cubic meter runoff water recharged in one year
	1	Combination of Recharge shafts and injection wells	3.50 lakh cubic meter runoff water recharged in one year. Declining rate reduced from 1.175 m/yr to 0.25 m/yr.

Source:http://www.itc.nl/library/papers_2014/msc/upm/anand.pdf

Lake Front Development

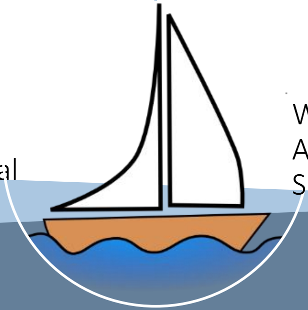
CHANDOLA LAKE

Components Of Lake Front Development

Recreational

Heritage Development

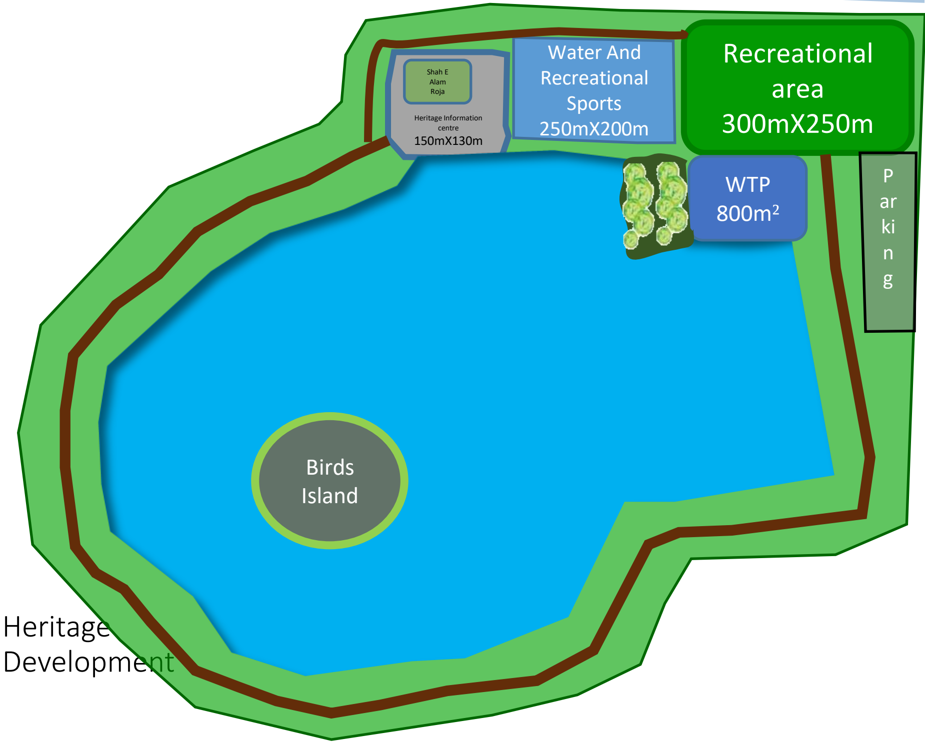
Parks And Recreational Spaces



Water Rides And Water Sports

Cultural Heritage Information Centre

Ecological Heritage



Funding The Lake Front Development

Cost Breakdown

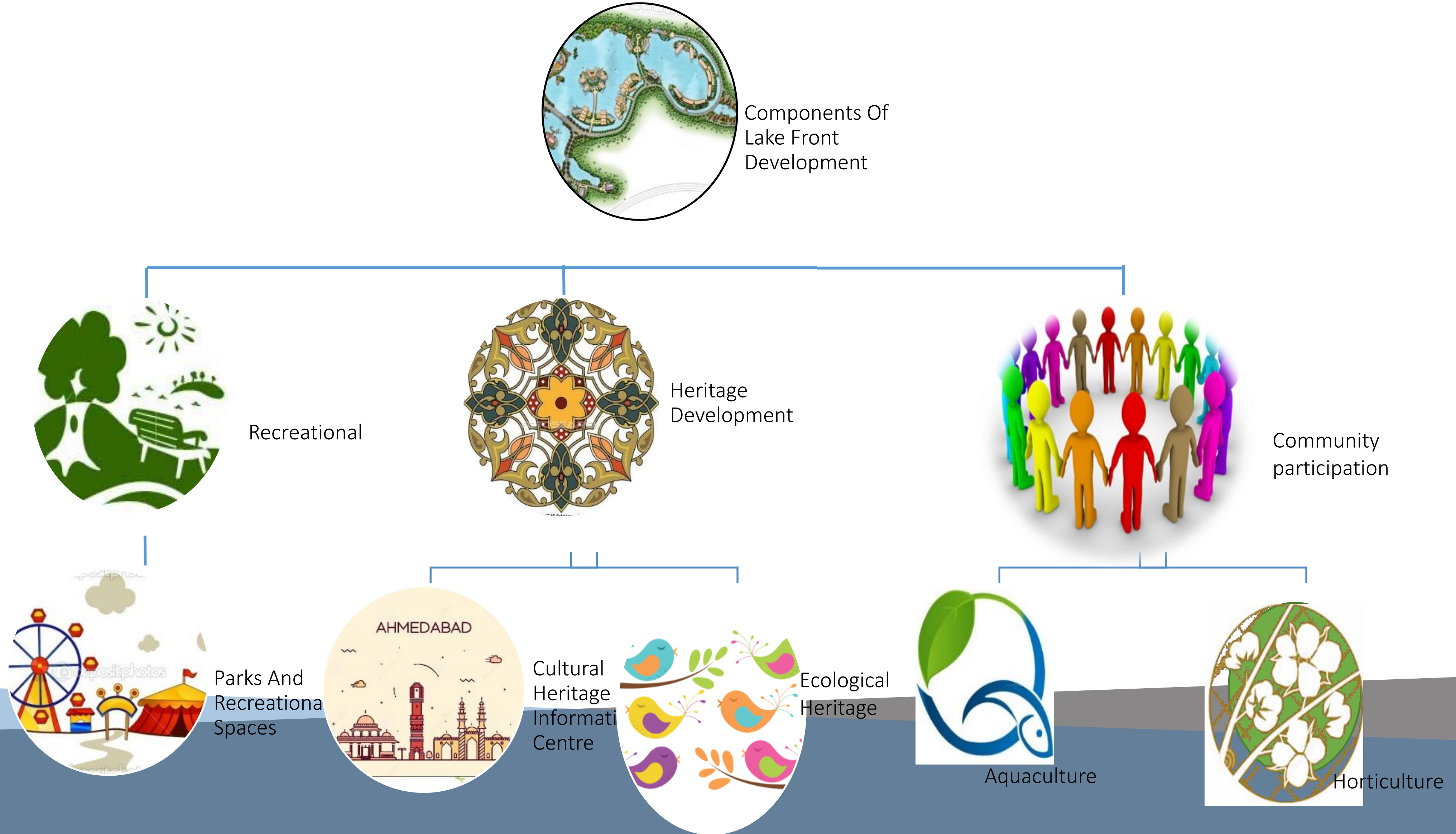
Civil Works	355 Acres
Desilting	219.4
Compound Wall	20.5
Chain Link Fencing	75.1
Culverts and Waste Weir	12.1
Jogging Track	45.6
B Electrical works	187.2
C Landscaping	387.0
D Miscellaneous works	0.0
Water Boat Jetty	22.0
Parking	36.2
Heritage Site development	166.8
Fountain	97.5
food kiosks (10 of 10 sqm each)	23.6
Project Specifics	2000.0
STP	200.0
Total Hard Cost	3493.1
Contingency Cost (2% of the hard cost)	29.9
Financing Charges (0.5% of the hard cost)	7.5
Total Project Cost	3530.5

Sources of Expenditure	Amount (Lakhs Rs.)	Sources of Revenue	Amount(Lakhs Rs./Year)
Lake Front Development	326	Water sports	51.7
STP	200	Entry Fees	322.7
Recreational Area	641	Revenue from shops	322.7
Heritage Site development	166.7	Parking	113.1
Total	**3530.5**	Total	**810.4**
O&M	304.3	%Profit	33%
Lease	235	%Expenses	67%

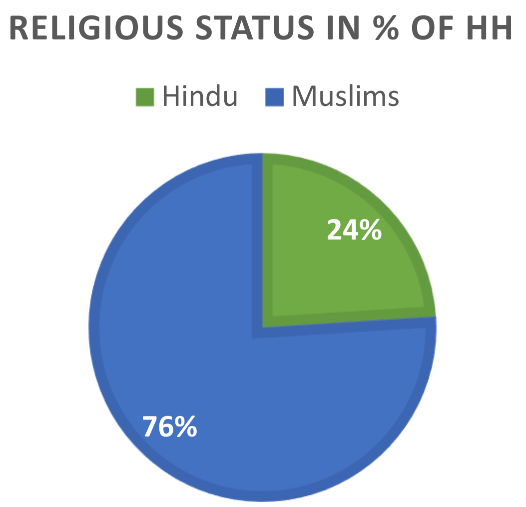
- Payback Period of project is Approximately 10-12 years.
- Funding can be done by **PPP mode.**
- Lease Amount: (Rs1.5 per Sq. feet) **2.35** Crore Per year

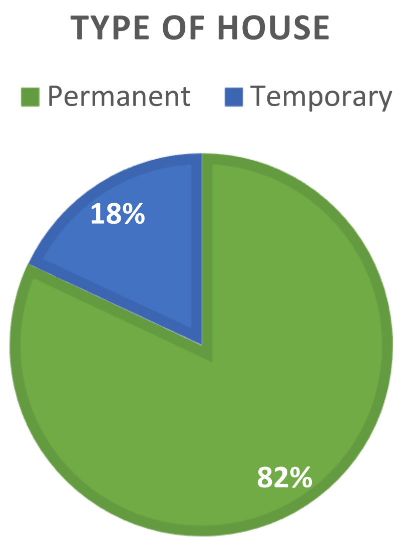
Sustainable Inclusive Lake Development

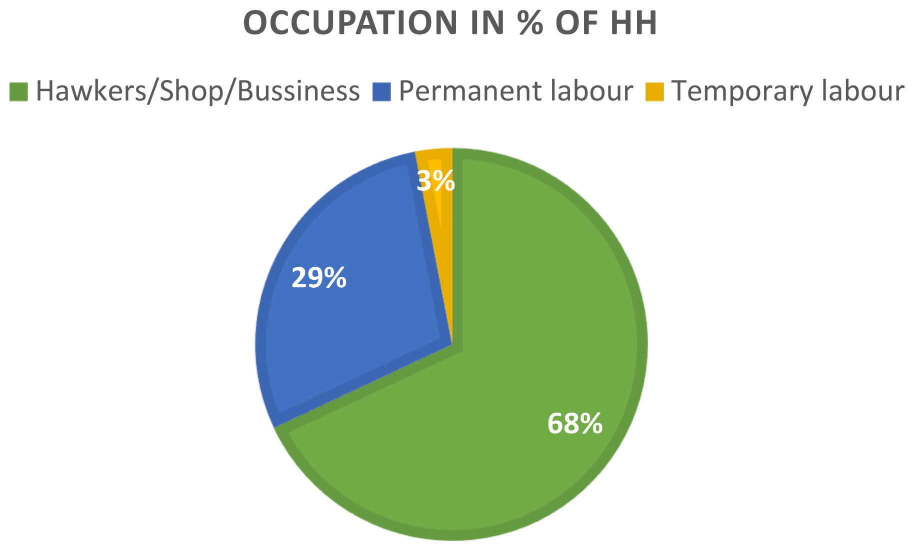
CHANDOLA LAKE



CHANDOLA LAKE

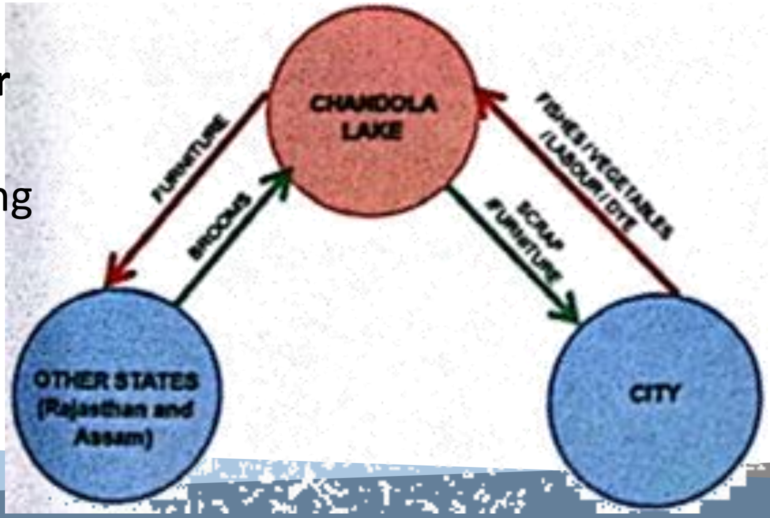


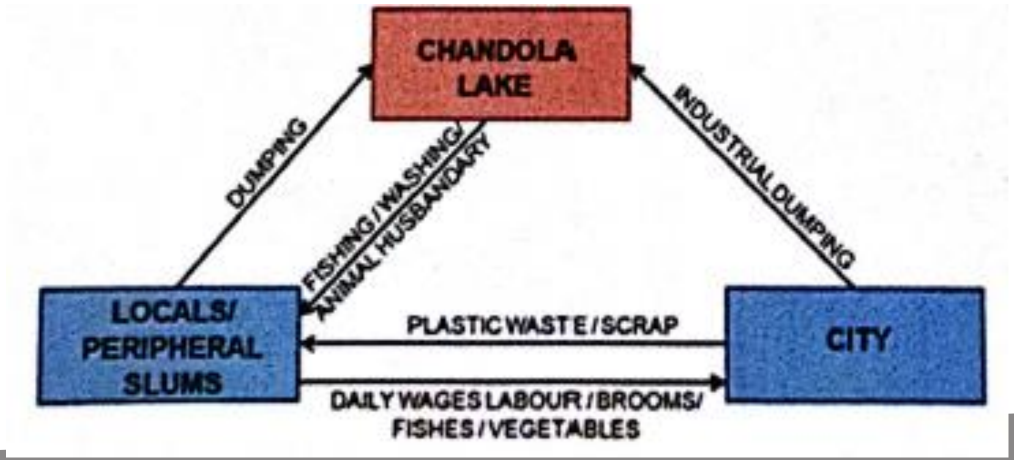




Cottage industries near Chandola lake

- Fishing, Cattle rearing
- Textiles
- Broom making
- Scrap
- Furniture





CHANDOLA LAKE

2001- Jan

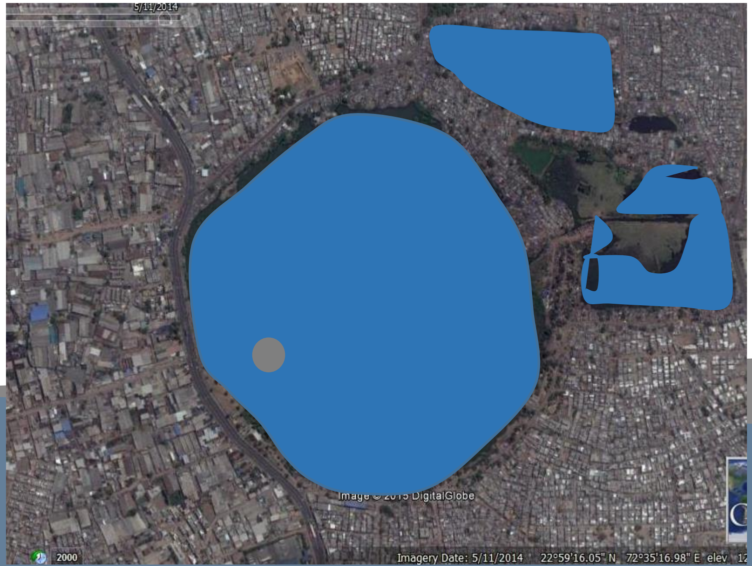
Water source- Rain water

Water Dependency-
Jan- Agriculture- wheat
Later on during Summer - Chota chandola was used for cattle rearing
Monsoon- Fishing etc

2001- August

2015- March

2015- August



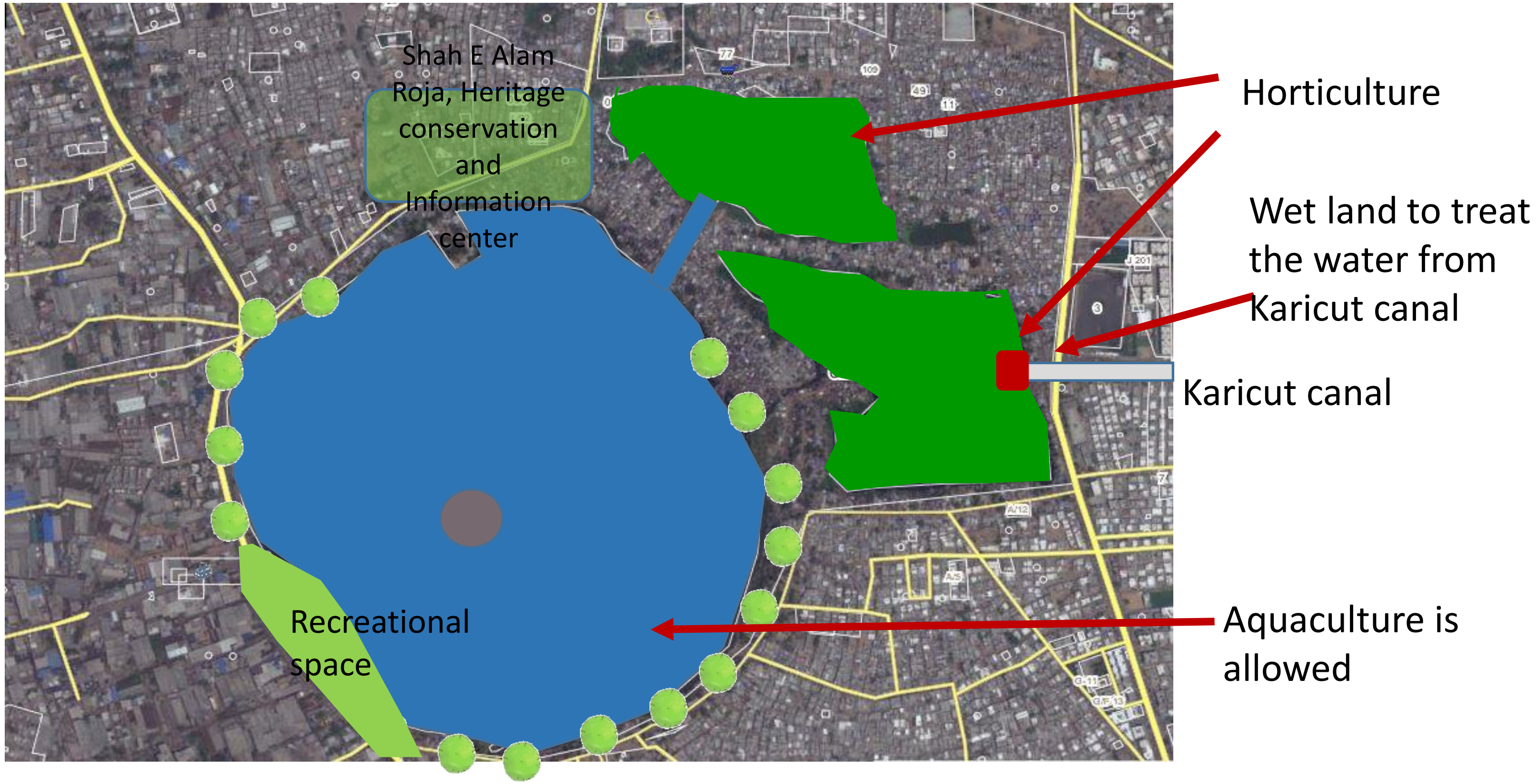
Water source- Rain water, storm water, karicut canal

Water dependency- Waste dumping, Fishing, Industrial dumping

Agriculture
Algae
Water

Sustainable Inclusive Lake Development

CHANDOLA LAKE



Cost Breakdown

Desilting	2196.385
Compound Wall	20.45345
Chain Link Fencing	774.0842
Culverts and Waste Weir	228.1346
Jogging Track	45.62692
B Electrical works	187.2277
C Landscaping	387.0421
D Miscellaneous works	0
Water Boat Jetty	22.02679
Parking	36.18687
Heritage Site development	166.7742
food kiosks (10 of 10 sqm each)	23.60013
D Pre-operative/Other Expenses	0
Wet land treatment	350
Total Hard Cost	4591.197
Contingency Cost (2% of the hard cost)	88.10715
Financing Charges (0.5% of the hard cost	22.02679
IDC	231.2813
Total Project Cost	4932.613

Detailed study of Shortlisted Lakes

THALTEJ LAKE

Location: Thaltej, Near SG highway, New Western part of Ahmedabad.

Area :0.109393 km²

Perimeter :1617m **Ownership:** AMC

Storing Capacity : 322Million Litters

Landuse(Settlement) : Slum settlement

Water Quality	pH	DO(mg/l)	BOD(mg/l)	Turbidity(mg/l)
Thaltej	8.28	8.10	7.40	38

Livelihood of the people: Most of people are working as municipal cleaners and household maids or servants.

Ecosystem: The lake has rich biodiversity with turtles , fishes and birds.

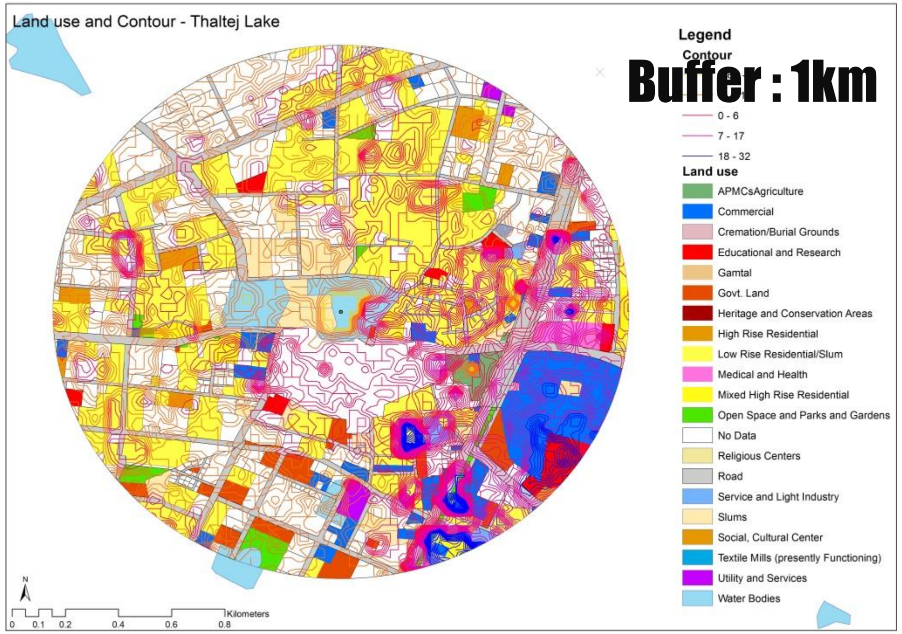
Present Condition: The water quality of lake is degraded to a higher extent with incoming storm drains water and sewers, which doesn't allow the lake to naturally restore its water quality.

Intervention needed: The intervention will be in the context of ecological restoration of lake.

Source: Primary study, https://www.itc.nl/library/papers_2014/msc/upm/anand.pdf

Detailed study of Shortlisted Lakes

THALTEJ LAKE



Area of Intervention:0.14 km²
Area under Lakes:0.040 km²
Area available for development :0.1 km²

305 m

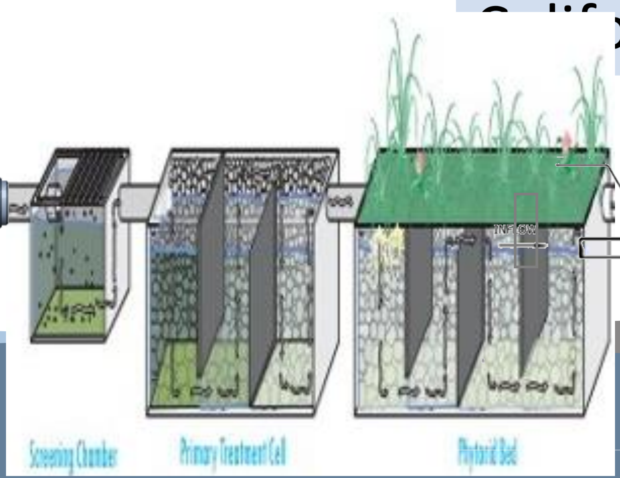
450 m

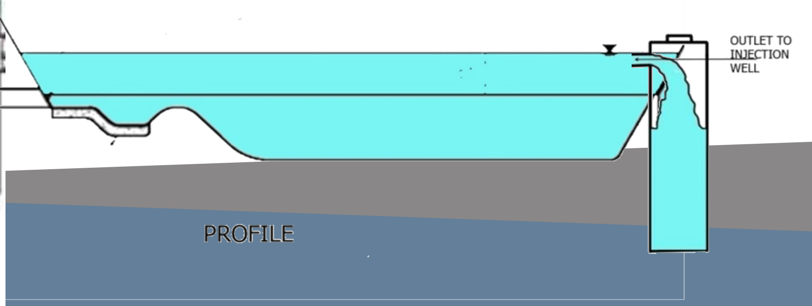
Design Of Treatment Unit

THALTEJ LAKE

- Capacity of lake: 322000 m^3
- Water losses from surface(12Months Period) :279499.11 m^3
- Losses:86%
- Regular Inflow required:700 KLD
- Technology Used : Phytorid Technology
- Area required:800-1000 sq. m.
- Cost of Treatment : 40 Lakhs
- O&M :10 Lakhs per year

Characteristics	Inflow	Outflow
BOD	155	0.3847
COD	510	3.325
TDS	847	15
TSS	218	10
Faecal Coliform	$50x10^3$	55

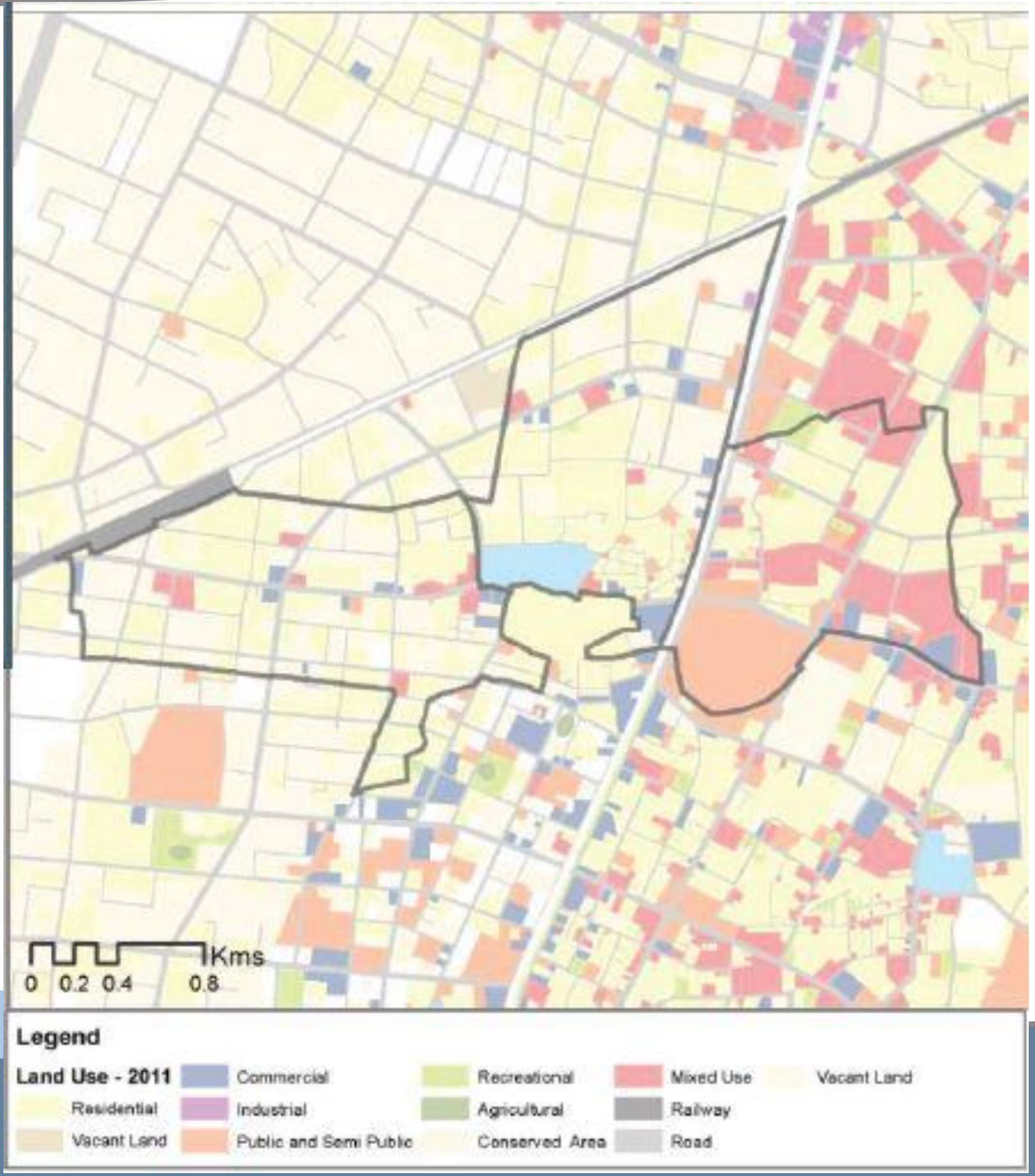


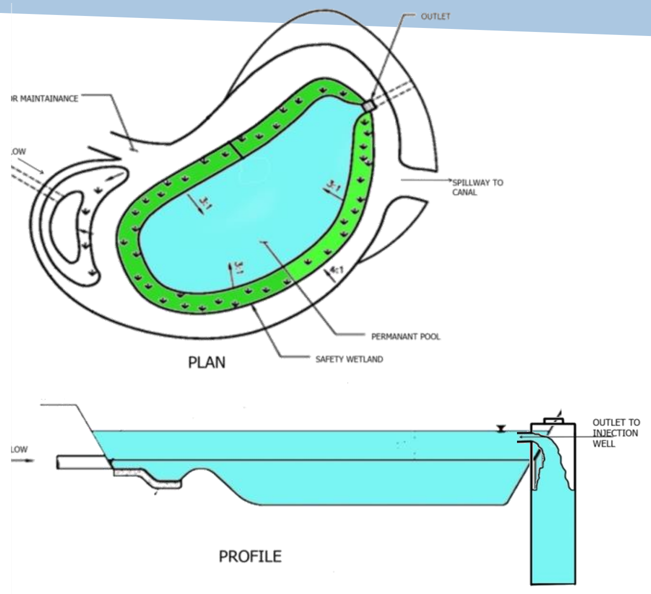


Source http://www.neeri.res.in/pdf/Phytorid.pdf (Phytorid

THALTEJ LAKE

Ground Water Recharge Potential





Catchment area of Thaltej:1120.86Acres(4.5km^2)

Water Recharge of Ground water: $0.4*4.5*10^3*10^3*0.797$

Water recharge Potential per year = **14.346 Lakh m^3**

Case study:

Haryana	1	Roof Top Rainwater Harvesting	2350 Cubic meter runoff water recharged in one year
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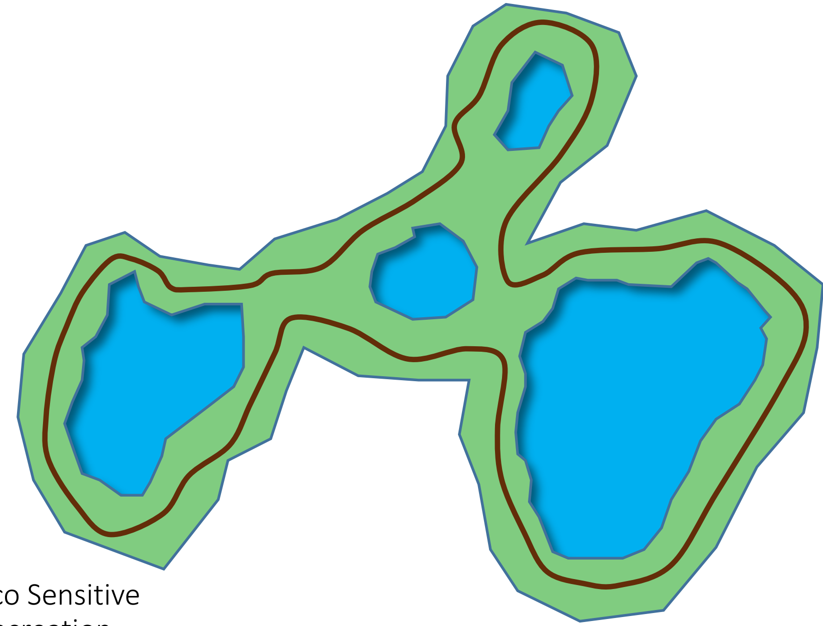
Source:http://www.itc.nl/library/papers_2014/msc/upm/anand.pdf

Thaltej Lake Front Development

THALTEJ LAKE



Components
Of Lake Front
Development

Eco
Conservation

Eco Sensitive
Recreation

Birds Island

Plantation of
Dense Trees

Lawns
And Park
Area

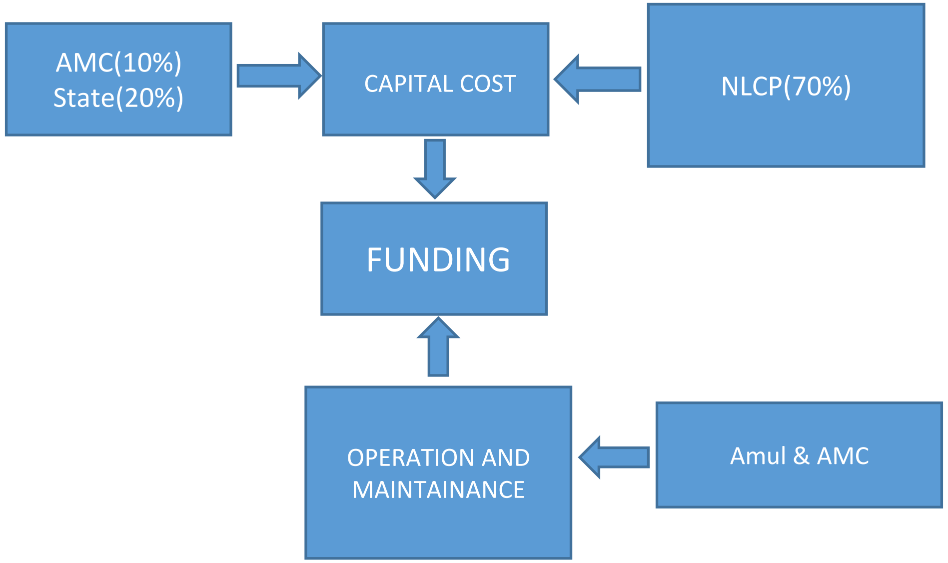
Walking track

Funding The Lake Front Development

Cost Breakdown

Civil Works	35 Acres
Desilting	216.0278
Compound Wall	2.01172
Chain Link Fencing	76.13587
Culverts and Waste Weir	22.43842
Jogging Track	4.487683
B Electrical works	18.41498
C Landscaping And Plantation	38.06793
Well Installation	5
Treatment Plant	40
Total Hard Cost	382.5844
Contingency Cost (2% of the hard cost)	4.54
Financing Charges (0.5% of the hard cost)	1.88
Total Project Cost	387

Funding Mechanism



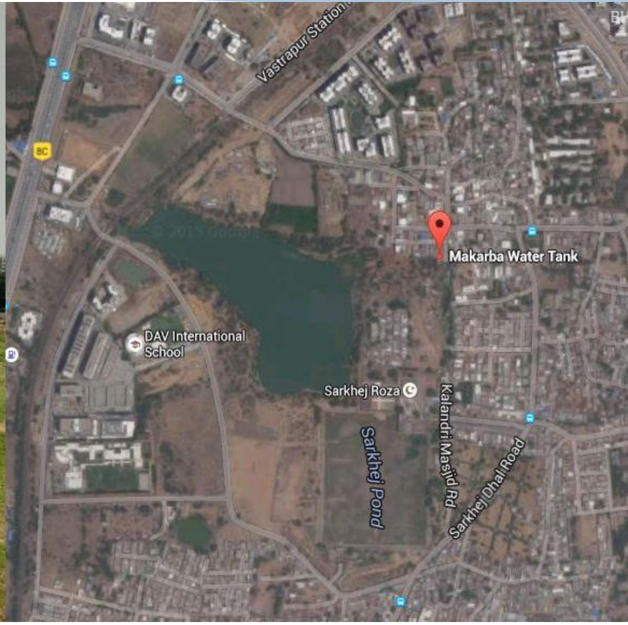
NLCP Guidelines:

- State Governments need to get perspective plans and proposal (**Detailed Project Reports**) prepared through consultants.
- NRCD/Government of India shall bear up to **70%** of the Project cost
- States shall bear **30%** of the project cost, of which the share of the local body would be up to **10%** to ensure public participation in the project
- Funding Provided Under NLCP: **Anasagar Lake, Ajmer(19 Cr),Pushkar Lake, Pushkar(50 Cr)**

Source: http://www.moef.nic.in/sites/default/files/nlcp/Lake_Conserv-Manage_India.pdf

Detailed study of Shortlisted Lakes

SARKHEJ LAKE



Location: Sarkhej, SG highway, New Western part of Ahmedabad.

Area : 1. Makarba:65138.5 m²

2. Sarkhej: 58143.5 m²

Perimeter :900m

Ownership: Sarkhej Roja

Depth: 2.5-3m

Storing Capacity : 125 Million Litters

Intervention needed: restoration of water level of the lake.

Water Quality	pH	DO(mg/l)	COD(mg/l)	Turbidity(mg/l)
Sarkhej	8.26	6.20	**47.7**	**23.30**

Source: Primary study, https://www.itc.nl/library/papers_2014/msc/upm/anand.pdf

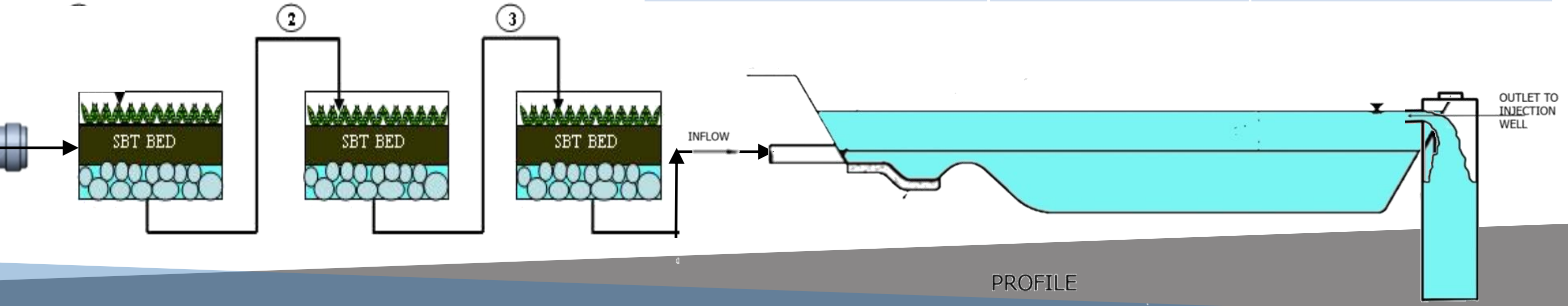
Design Of Treatment Unit

SARKHEJ LAKE

- Capacity of lake: 369843 m^3
- Water losses from surface(12Months Period) :314958.5m^3
- Losses:85%
- Regular Inflow required: 862.96KLD
- Technology Used : SBT Technology
- Area required:1000-1500sq m
- Cost of Treatment : 1.12 Crores
- O&M :11 Lacs per Year
- Recharge well : 5Lacs

Characteristics	Inflow	Outflow
BOD	155	7.04
COD	510	14.1
TDS	847	0.4
TSS	218	16
Faecal	$50x10^3$	55

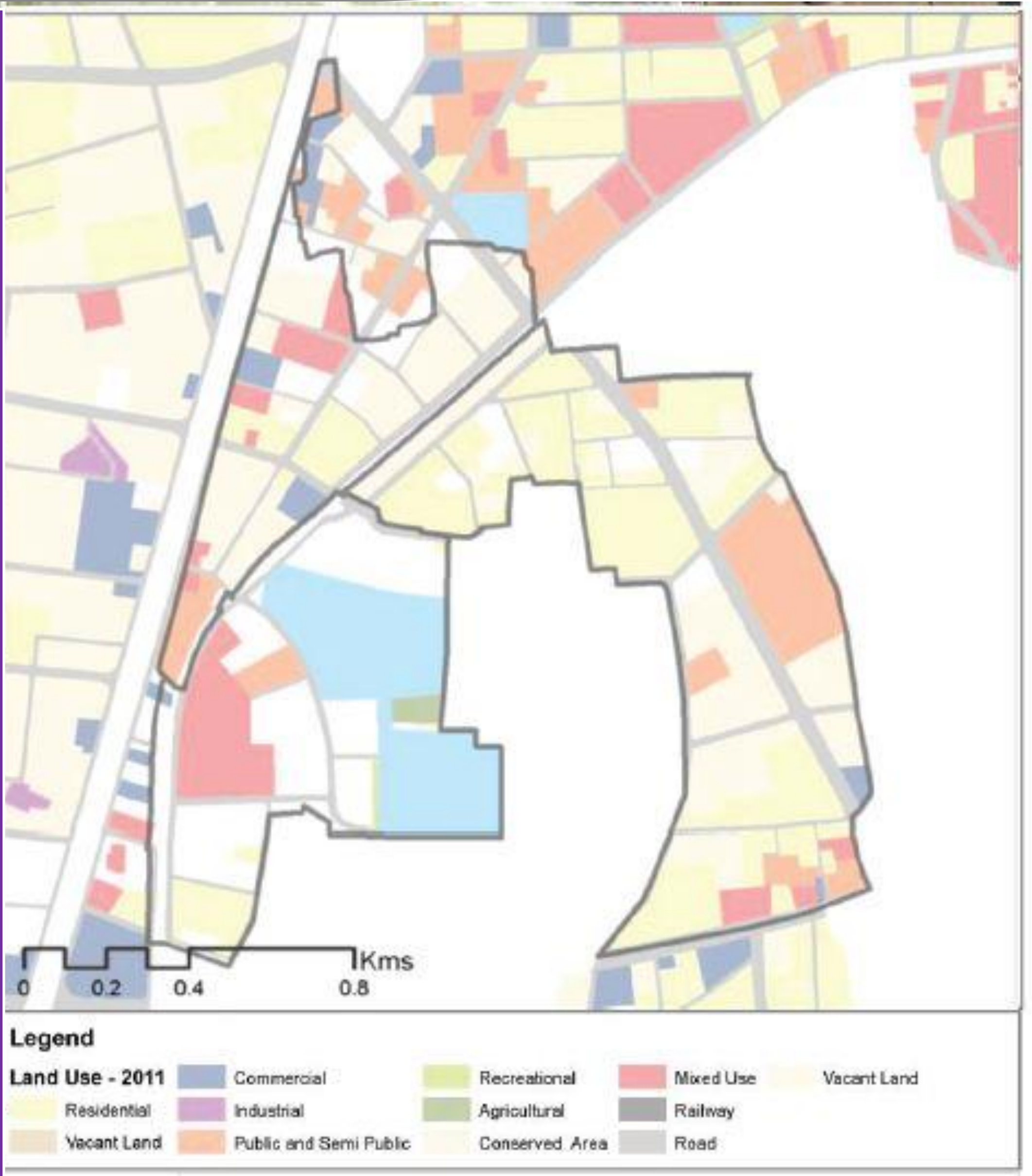
Funding For a treatment plant can be provided by Corporate Social Responsibility CSR

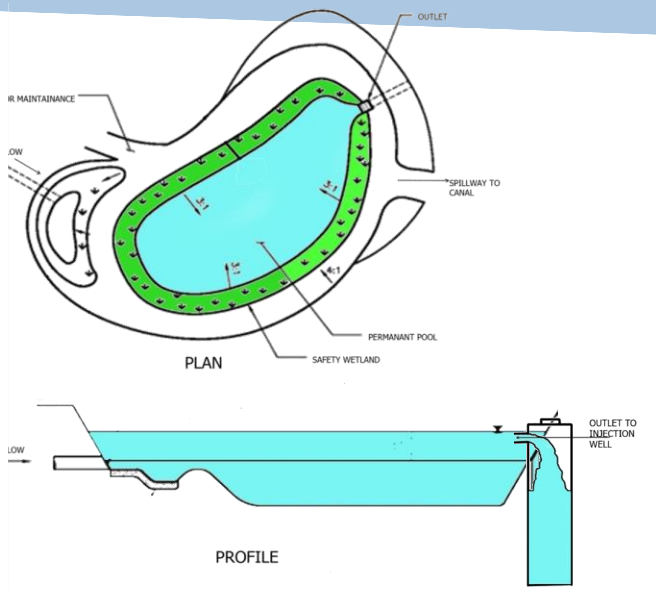


Source: http://cseindia.org/userfiles/shankar.pdf (IITSBT)

Ground Water Recharge Potential

SARKHEJ LAKE





Catchment area of Thaltej:432.15Acres(1.748km²)

Water Recharge of Ground water:

$0.4*1.748*10^3*10^3*0.797$

Water recharge Potential per year = **5.57Lakh m³**

Case study:

Haryana	1	Roof Top Rainwater Harvesting	2350 Cubic meter runoff water recharged in one year
	1	Combination of Recharge shafts and injection wells	3.50 lakh cubic meter runoff water recharged in one year. Declining rate reduced from 1.175 m/yr to 0.25 m/yr.

Source:http://www.itc.nl/library/papers_2014/msc/upm/anand.pdf

Funding Alternatives for Lakes Rejuvenation

Funding Mechanism	Stakeholder	Revenue(Sources) Or Non Revenue	Case Studies	Suitability
PPP with • Recreational revenue generation • Revenue with Advertisement rights	AMC, Private Player	Revenue	Hebbal Lake(Oberoi Hotels) Nagavara Lake	• Recreational Lakes • Historical Lakes
CSR	AMC, Corporate sector	Revenue/Non Revenue	Parimal Garden, Torrent	• Environmental Ecosystem Lakes • Historical Lakes
National Lake Conservation Programme	AMC, MoEF	Non Revenue	Anasagar Lake, Ajmer	• Environmental lake • Historical lakes
Revenue through Innovative financing • Organic Farming in the lakes periphery • Setting up a green house • Make your neighbourhood beautiful	AMC, Citizens,	Revenue/Non Revenue		• Detailed analysis of site should be required

Components of Institutional Framework Required

Rejuvenation of Lakes Steering Committee

- Urban Planner(Housing and Infrastructure)
- Representative of Housing Department
- Civil Engineers and Technical advisers
- Industrial Representative
- Researcher And Ecologist
- Tourism And Land Developer
- Municipal Representative
- Members of citizen group
- Environmental Engineer
- Water Quality Monitors & Managers

NLCP Guidelines

City Level Monitoring Committee: The Ministry of Environment and forest**(MoEF)** has asked all the state all the states to constitute City Level Monitoring Committees for all the Lake conservation Projects.

Planning And Policy Making
- Lakes Rejuvenation Committee

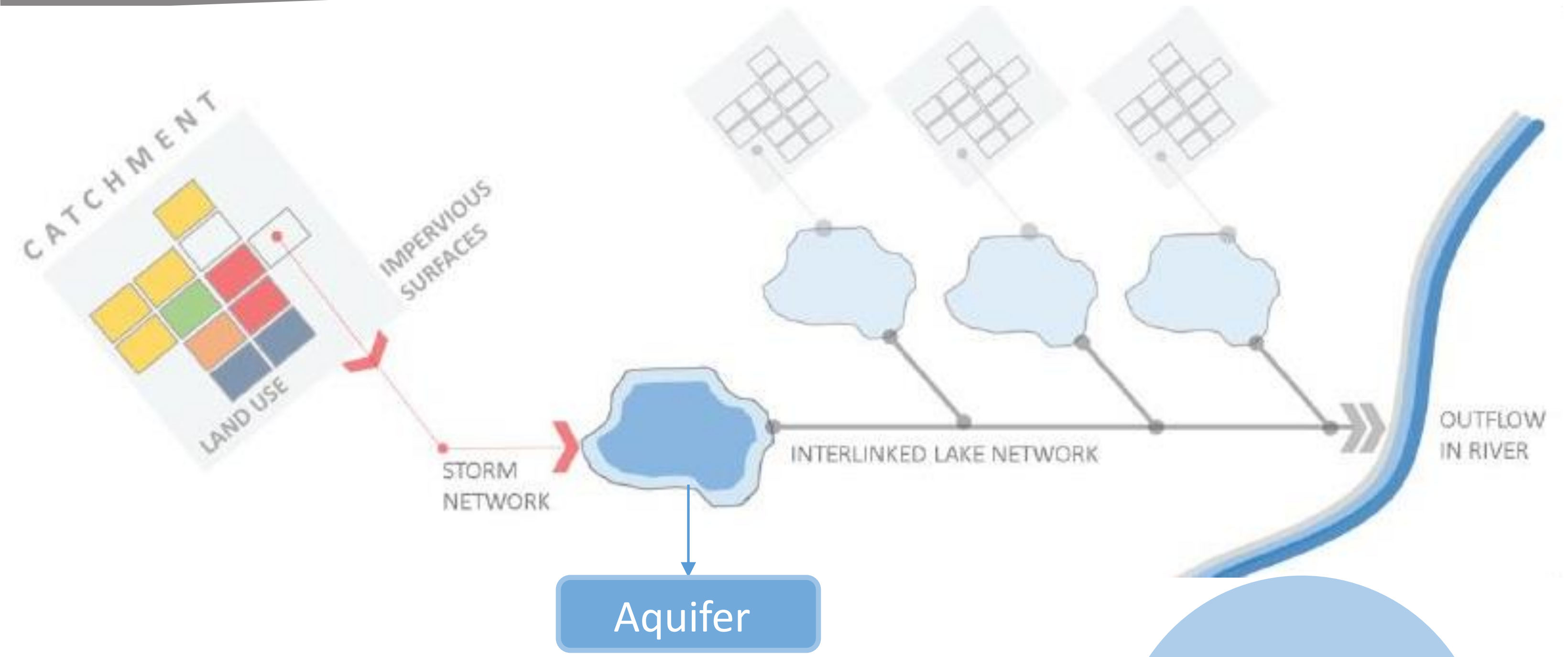
Execution
- Storm water & Sewerage Department
- Project Department
- Environmental Planning Department
- NGO, Citizens

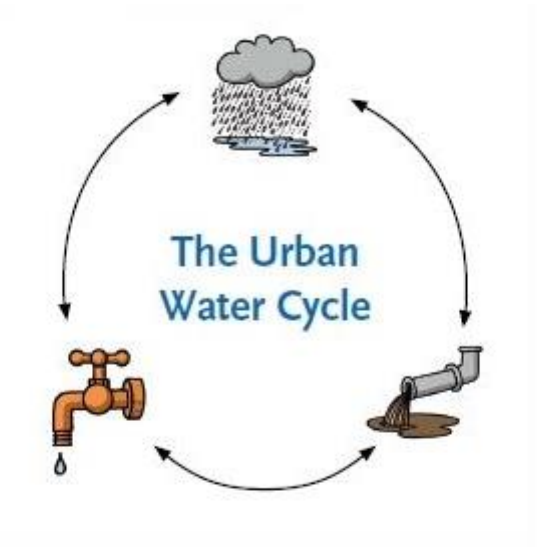
Monitoring
- Health Department
- NGO, Citizens
- Storm water and Sewerage Department
- Environmental Planning Department

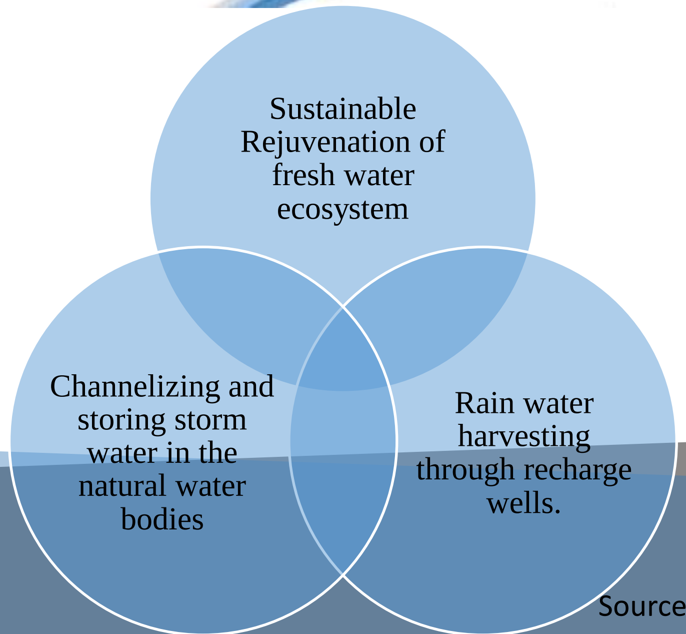
City Level Monitoring System

Source: http://www.moef.nic.in/sites/default/files/nlcp/Lake_Conserv-Manage_India.pdf

Weaving in The Integrated Urban Resource Management







Source: http://www.sswm.info/category/step-lg-usswm/urban-sswm

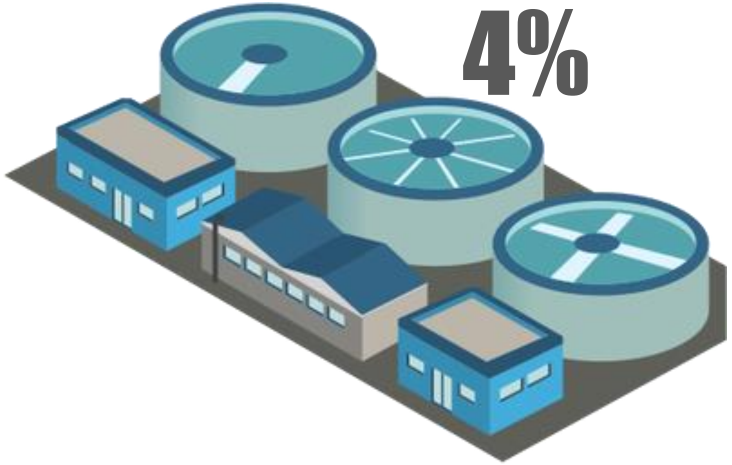
Benefits Of Lake Development Project

Higher Land Prices Due to Lake Development

- Vastrapur Lake: Municipal Land Was Sold for 55 Crores while the lake development took place in 5 Crores
- **Profit: 1100 %**

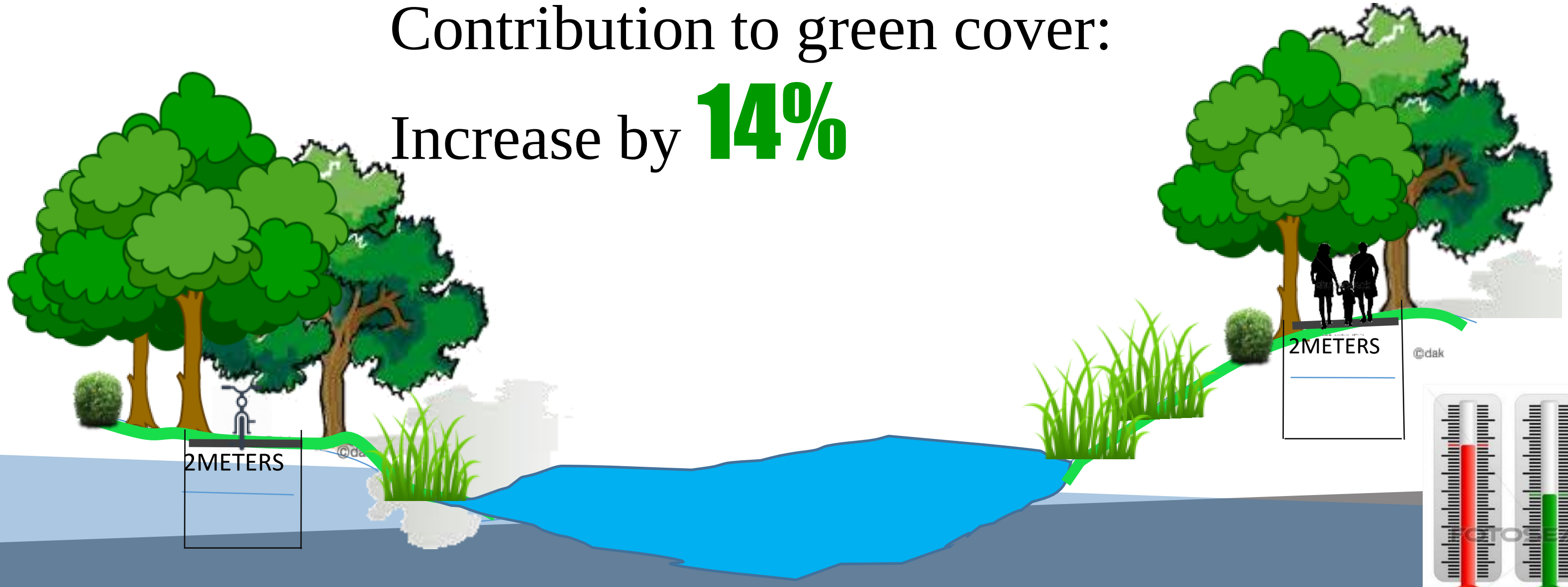
Reduced Load On STP : 30 MLD

4%

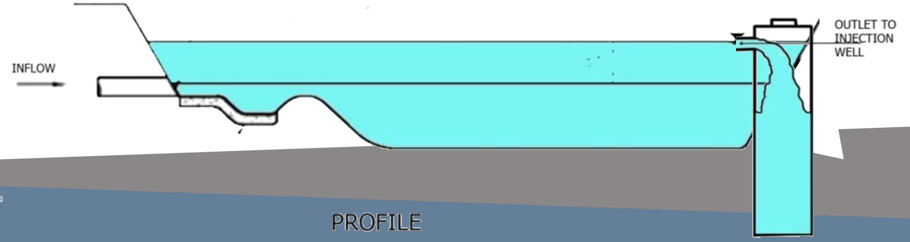


Contribution to green cover:

Increase by **14%**



Water Recharge Potential Through Lakes: **1000 Crore Litres**



Reduced Heat Island Effect by **10°C**

Comparison Between Lake Interlinking And Our Project

LAKE INTERLINKING

Aim

- Reduce flooding
- Maintaining water balance in lakes
- Sizeable reduction in storm water drains

Factors not considered

- Lake ecosystem
- Water quality

LAKE REJUVINATION

Aim

- Restore Water Quality
- Conserve the ecosystem
- Restoring identity of water body
- Alternatives to keep lake perennial

Strategies followed

- Categorization of lakes
- Developing suitable scenarios

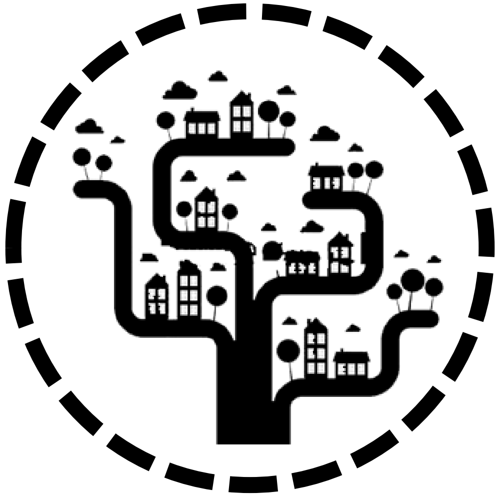
Water Availability	Ground Water Recharge	Cost Of the Project	Lake Rejuvenation
4 Months	✓	Lakes Interlinking (22Lakes):105 Crores	✓
Perennially	✓	Treatment Technology(3 Lakes):12.4 Corers	✓

Source: Draft *City Sanitation Plan, Ahmedabad Municipal Corporation*

Project Cost & Phasing

Name of the Lake	Cost (Crores)	Funding Pattern	Year 1	Year 2	Year 3	Year 4	Year 5
Chandola Lake	48	PPP					
Thaltej Lake	4	NLCP		20 Lacs	20 Lacs		
Sarkhej Lake	1.12	CSR					
Naroda(R)	10	PPP					
Isanpur Lake(E)	5	CSR					
Bareja Lake(H)	5	NLCP/CSR					25Lacs
Chharodi Lake(H)	6	PPP					

Total Cost Of the Project is estimated to be **300 Crores** for all the Lakes in Ahmedabad



Retain, Reuse, Recycle

Residential, Institutional

Existing Scenario

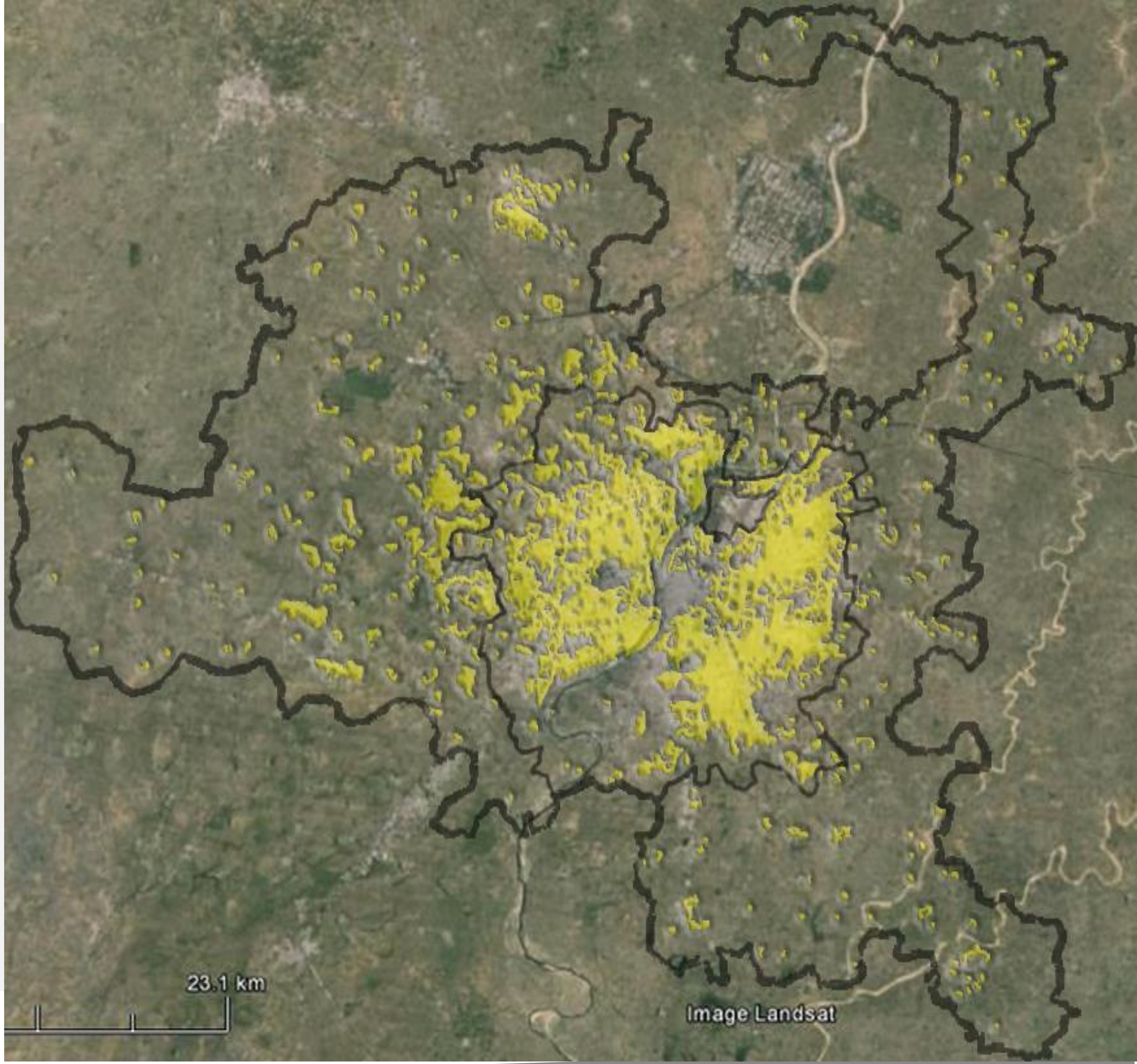
AMC - 464 sq. km^2

AUDA – **1866** sq. km^2

Existing Scenario

Developed Residential

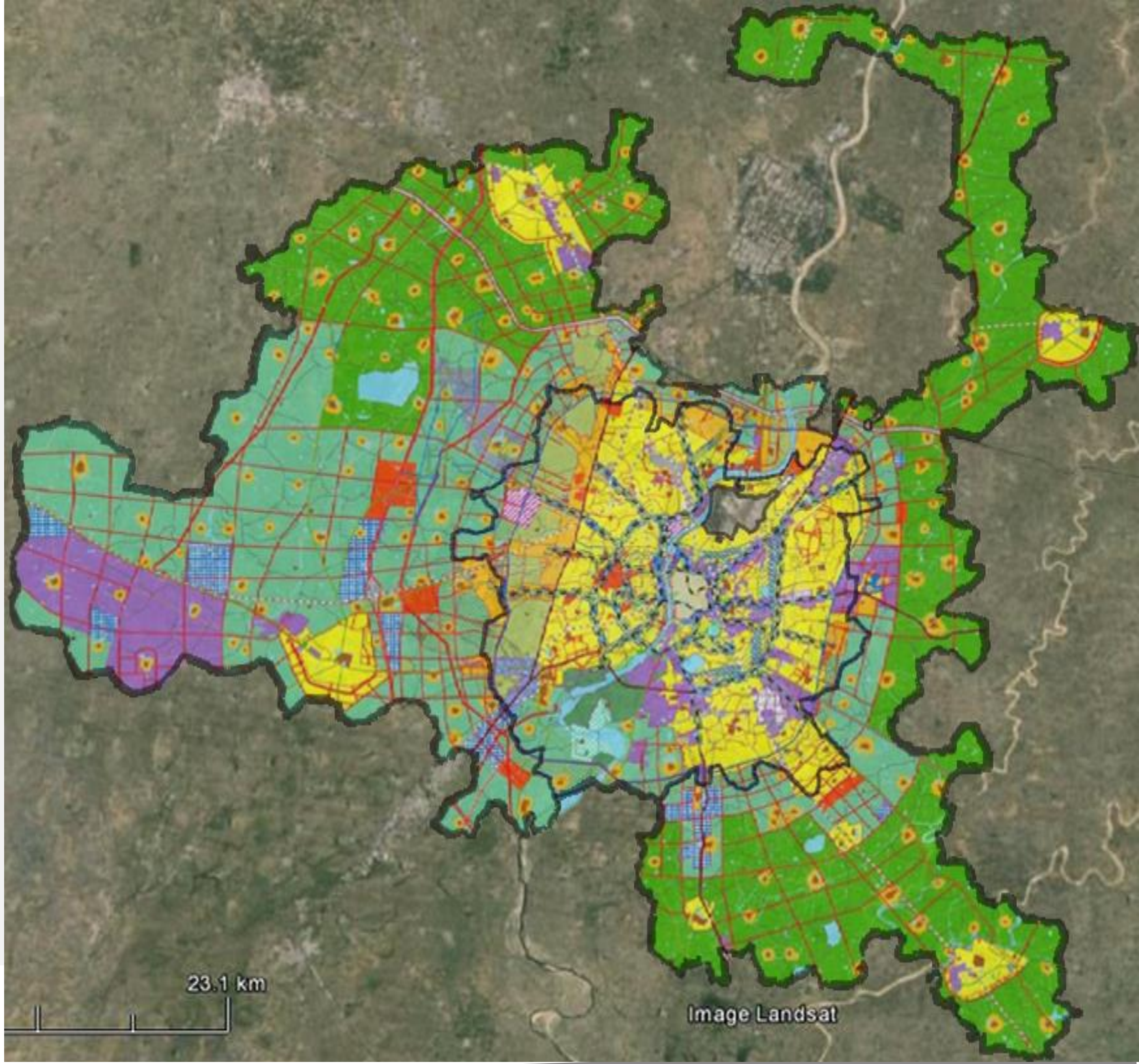
175 sq. km^2



Source: AUDA

Development Plan 2021

Residential – **418.7** sq. km^2



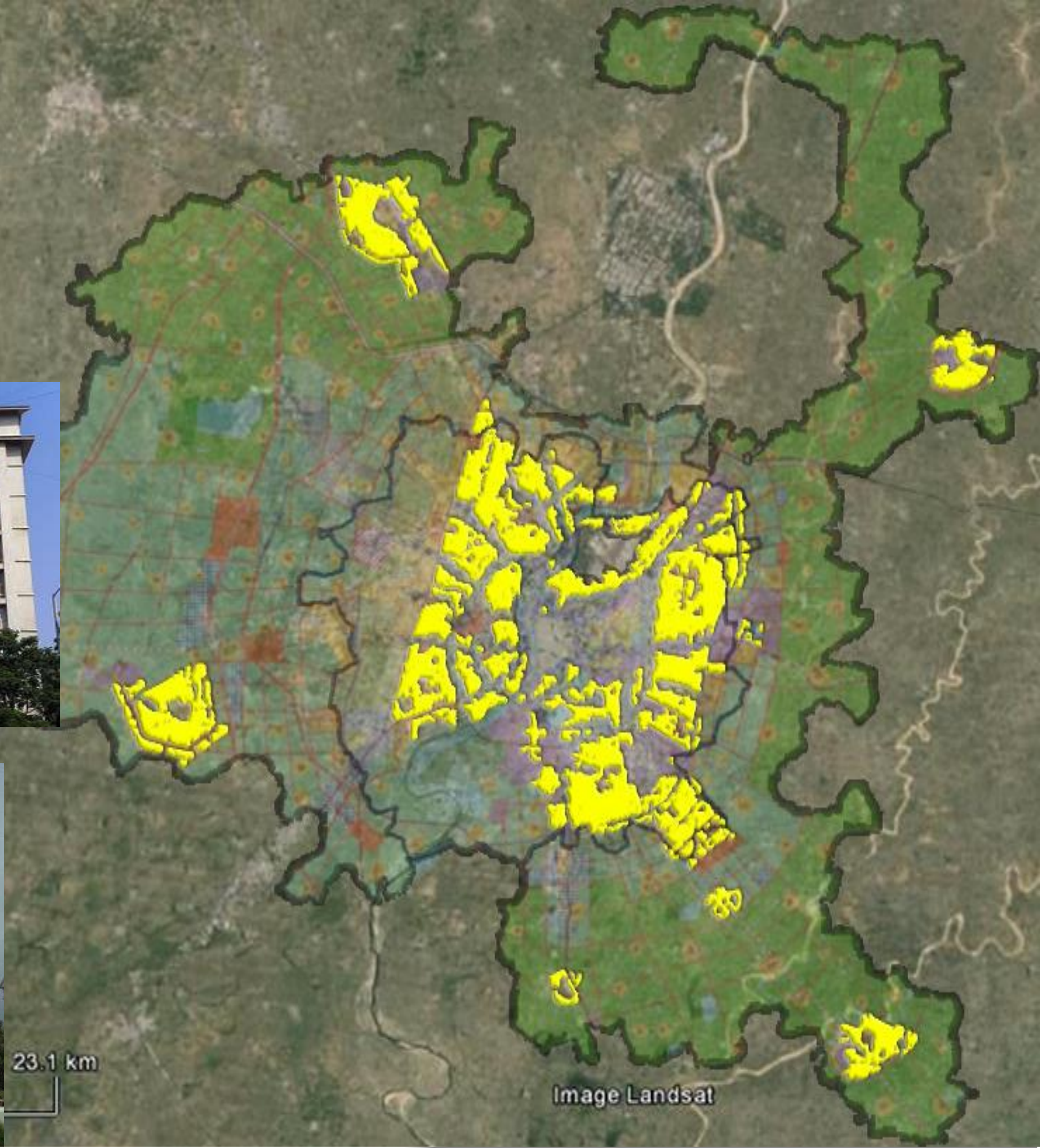
Source: AUDA

Development Plan 2021

Residential – **418.7** sq. km^2

R1 - 249.5 sq. km^2

28%



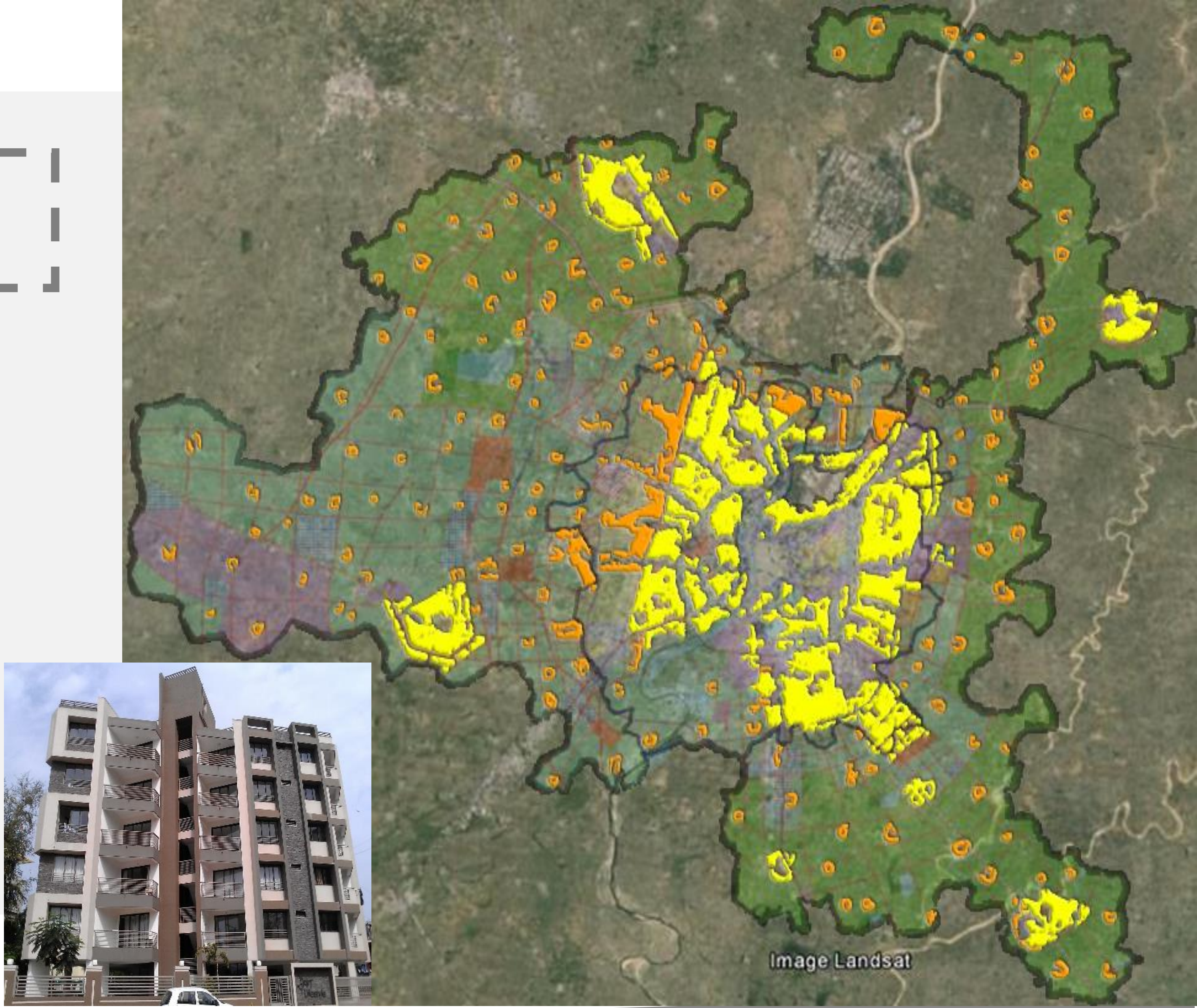
Retain, Reuse, Recycle

Source: AUDA

Development Plan 2021

Residential – **418.7** sq. km²

R1 - 249.5 sq. km²	**28%**
R2 - 44.3 sq. km²	**61%**

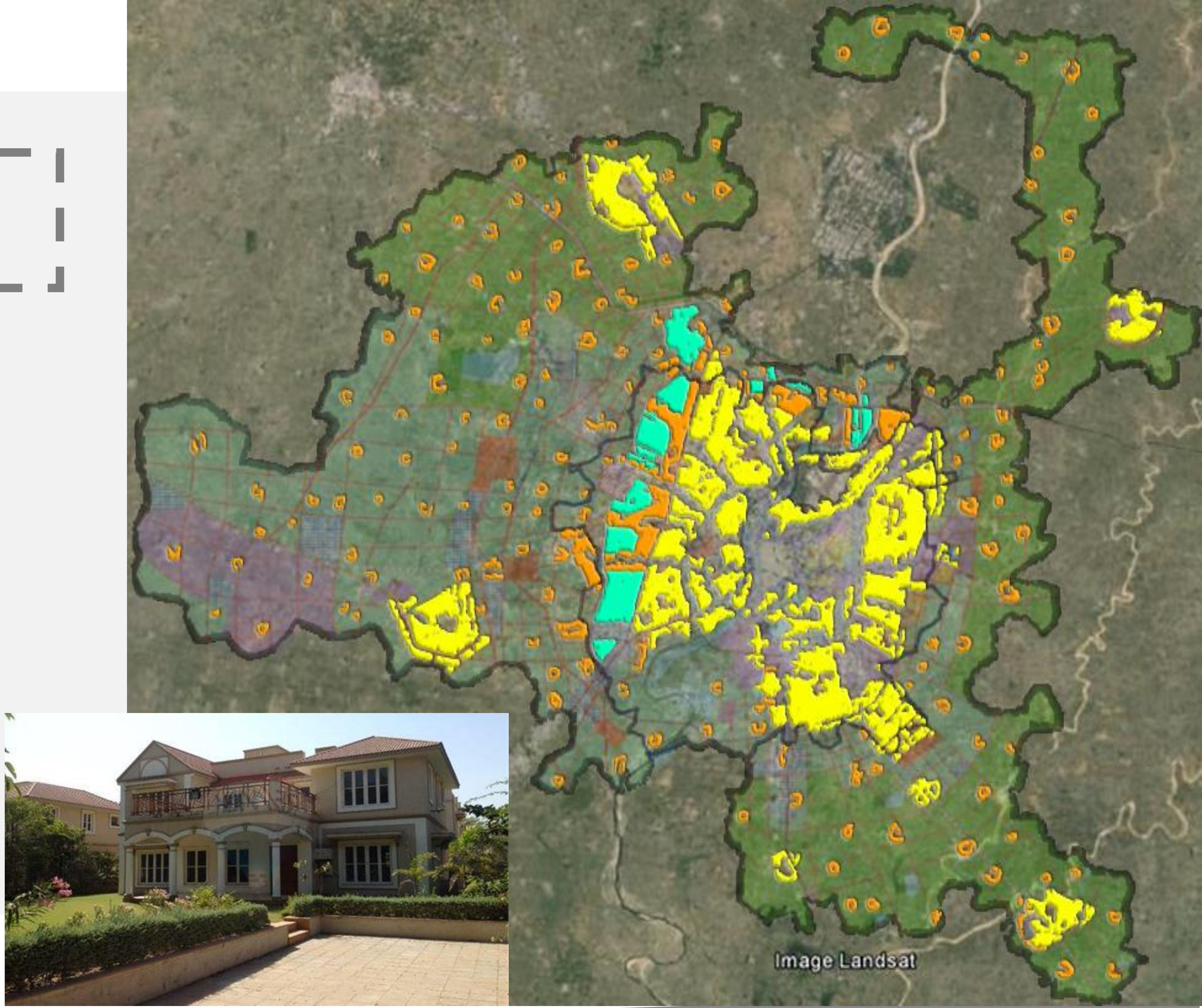


Source: AUDA

Development Plan 2021

Residential – **418.7** sq. km^2

R1 - 249.5 sq. km^2	28%
R2 - 44.3 sq. km^2	61%
R3 – 45 sq. km^2	81%

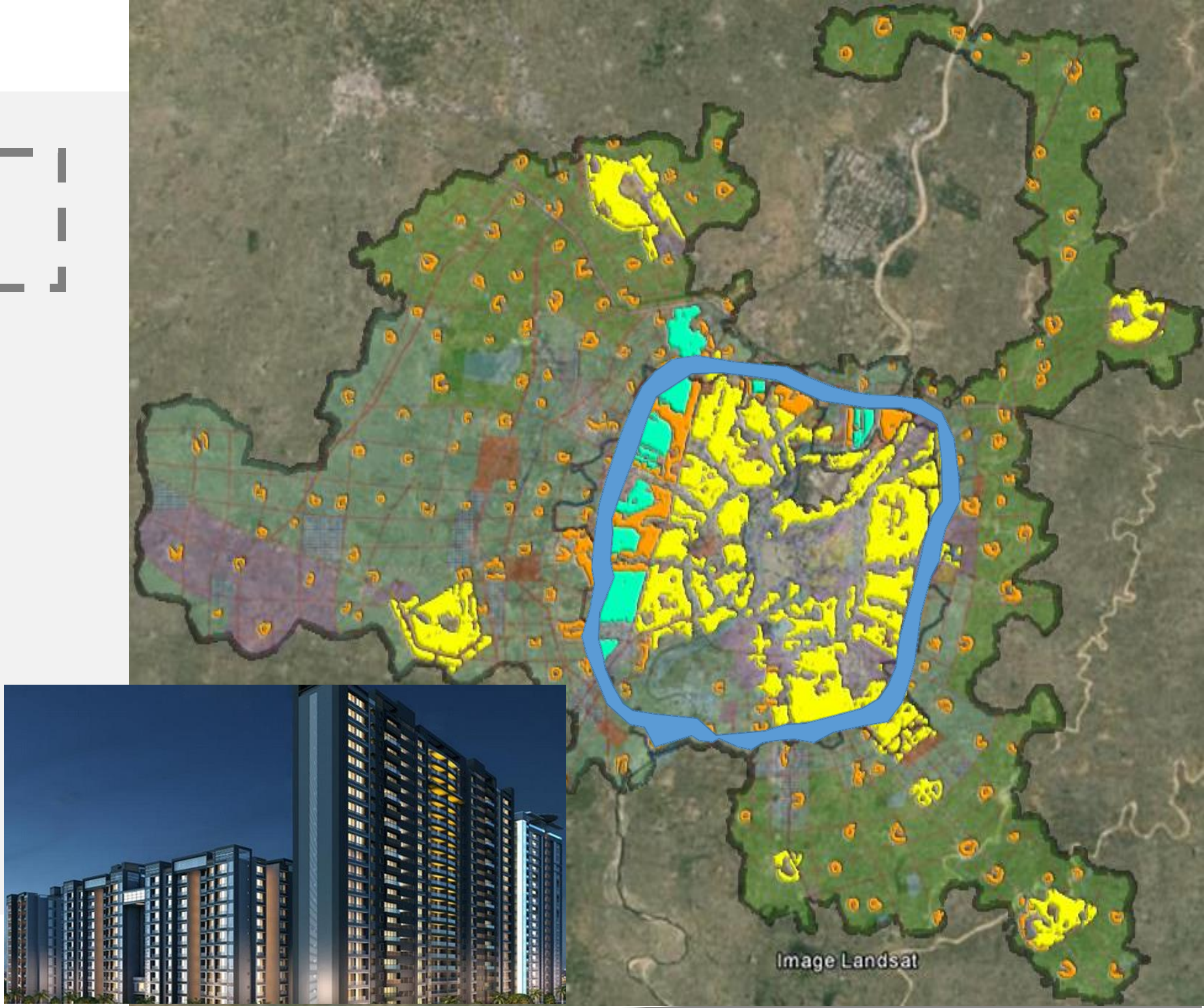


Source: AUDA

Development Plan 2021

Residential – **418.7** sq. km^2

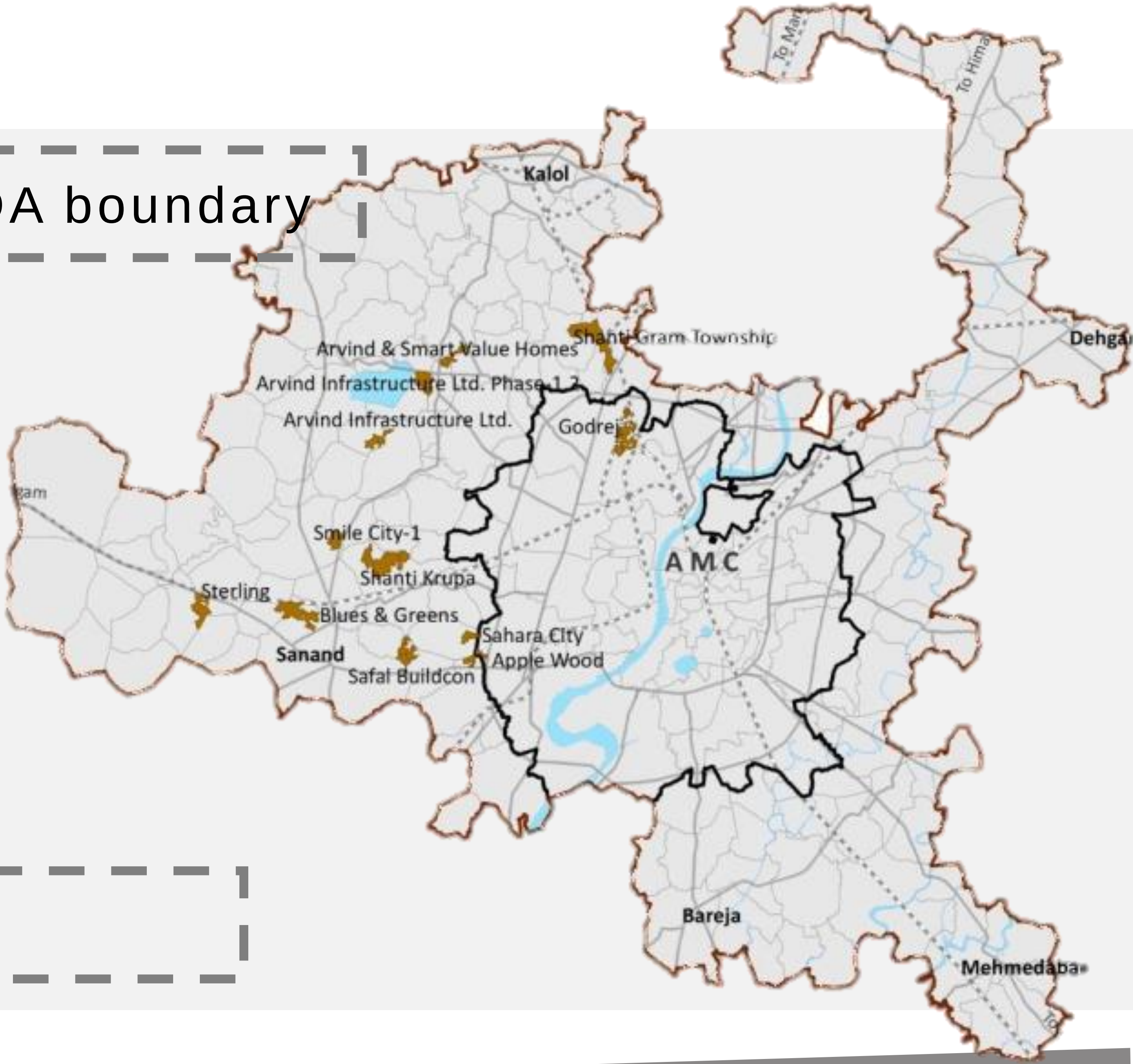
R1 - 249.5 sq. km^2	28%
R2 - 44.3 sq. km^2	61%
R3 – 45 sq. km^2	81%
RAH – 75 sq. km^2	> 90%



Source: AUDA

Townships…

14 upcoming Townships within AUDA boundary



Inclusive water-sanitation management

Retain, Reuse, Recycle

Source: AUDA DP 2021

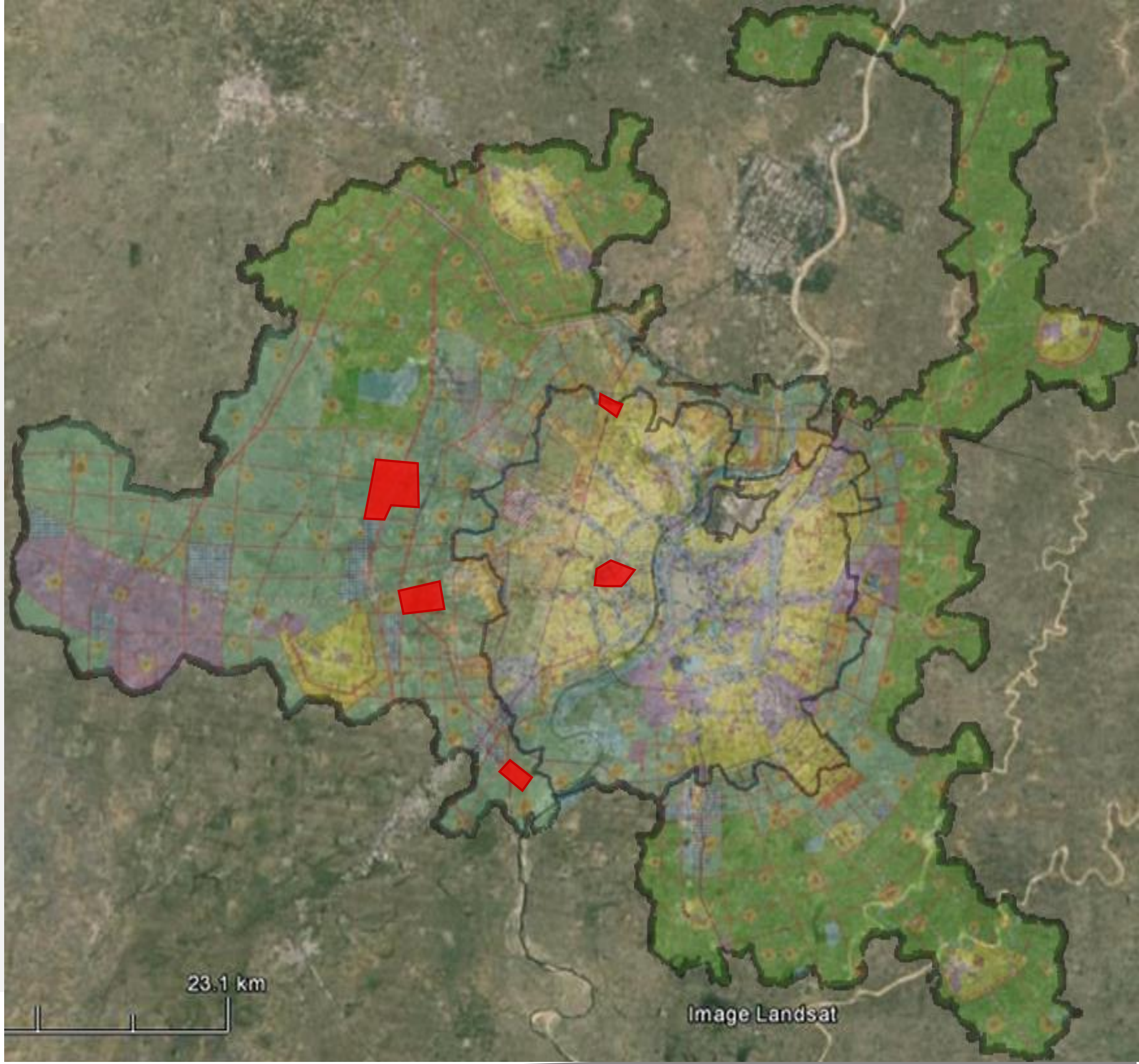
Knowledge Corridor

Educational Institutions

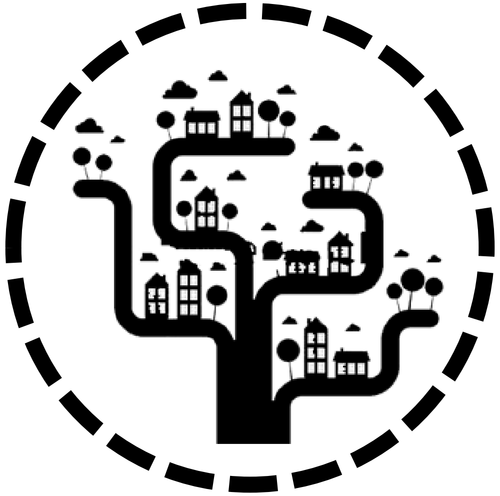
Max. Ground Coverage – 30%

Secondary School – 2000 m^2

College – 3000 m^2



Source: AUDA

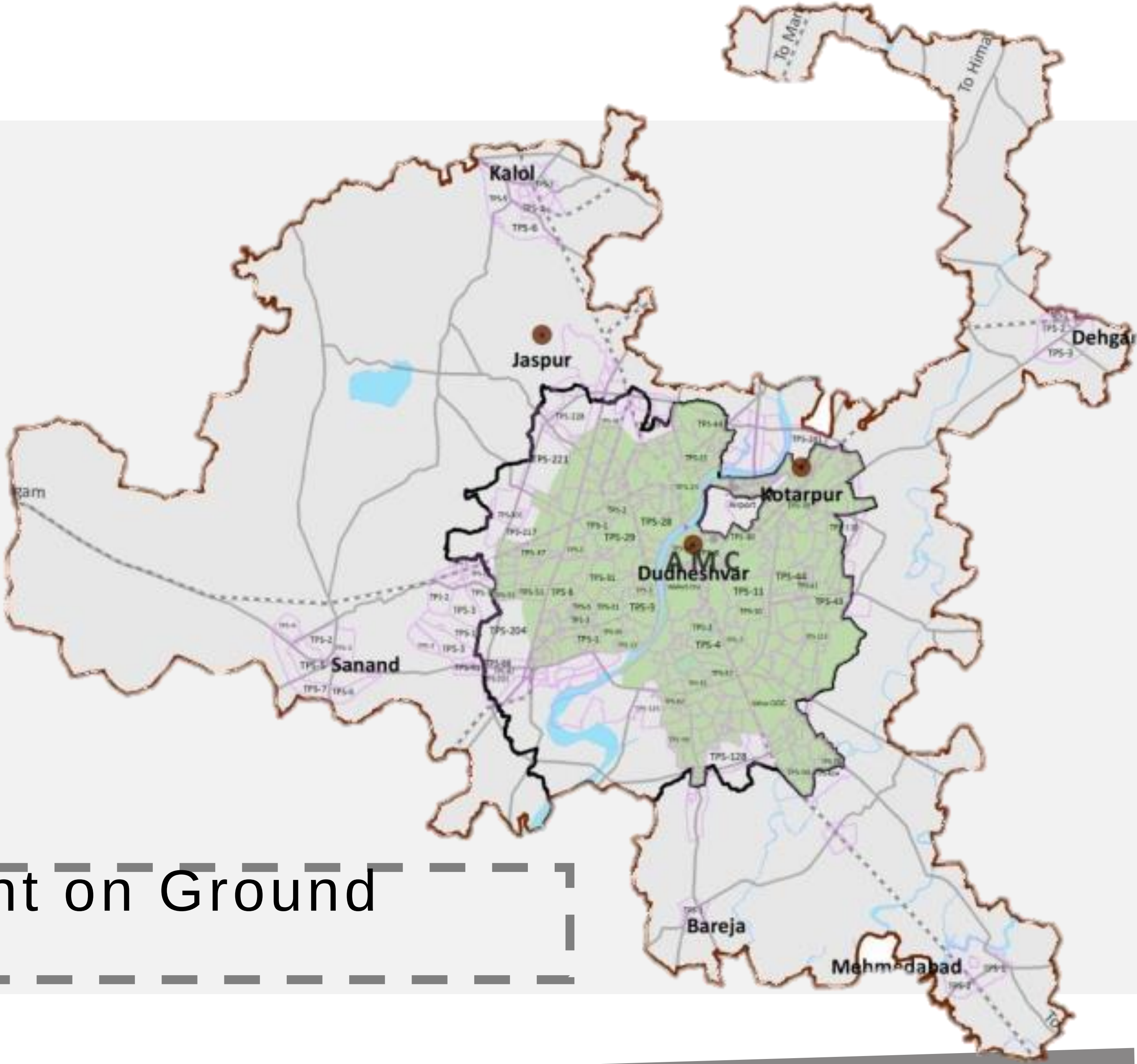


WHY SHOULD RAIN WATER BE HARVESTED & GREY WATER REUSED ?

Residential, Institutional

Water Supply

Avg. Water Supply – **2 hrs.**



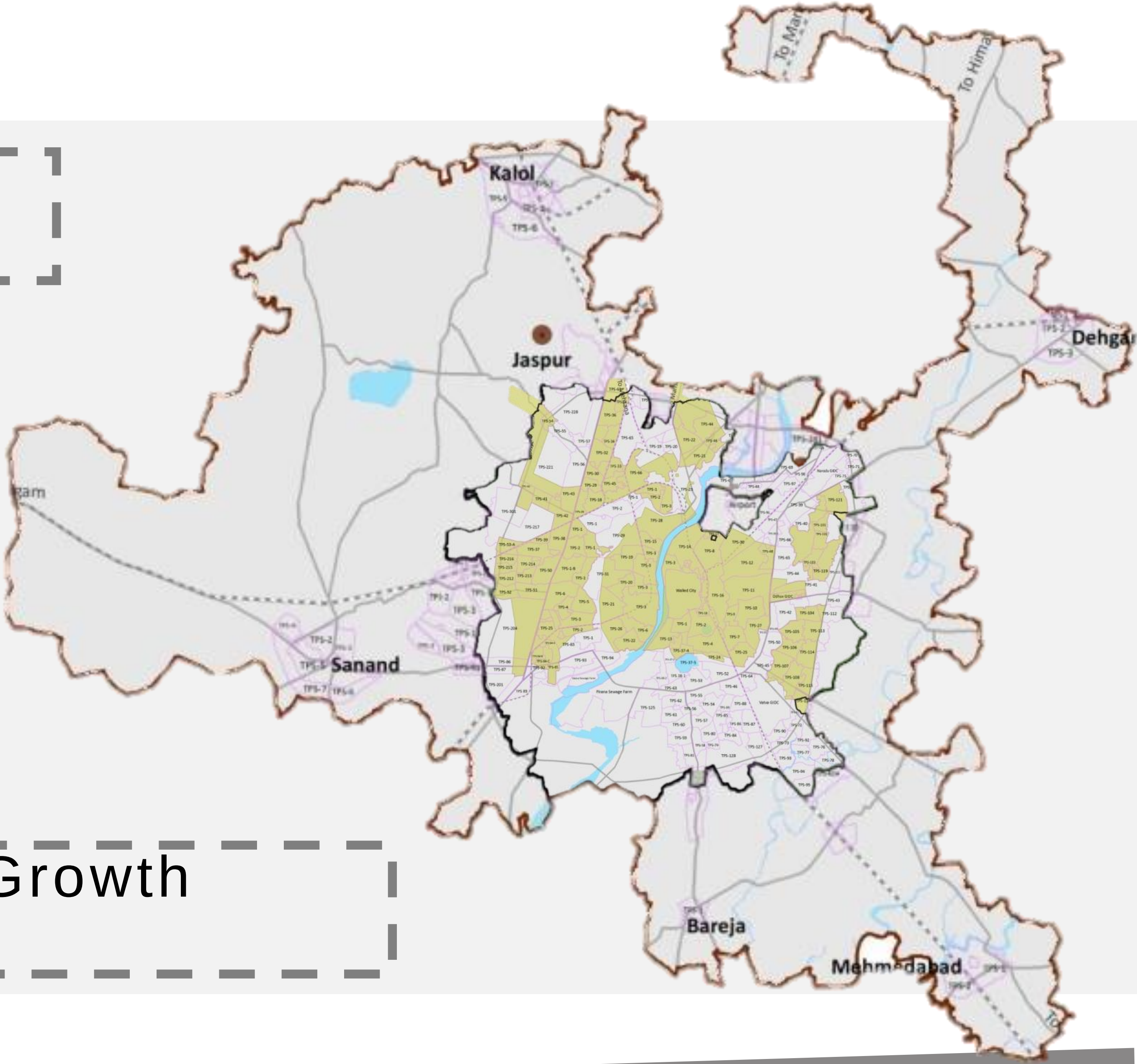
New Growth Areas – Dependent on Ground Water

Source: AUDA

Storm Water Network

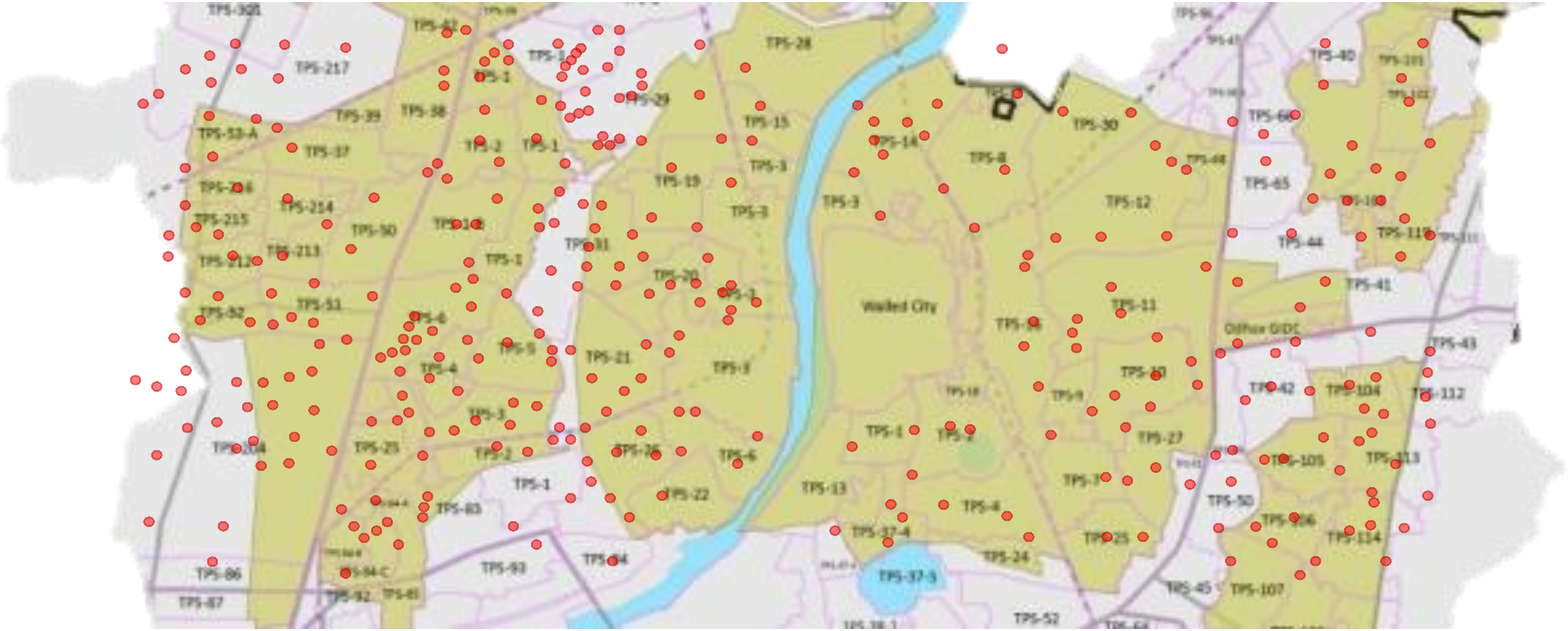
Inefficient During Peak Rainfalls

No Network Coverage in New Growth Areas



Source: AUDA

Water Logging Areas during Monsoon Showers

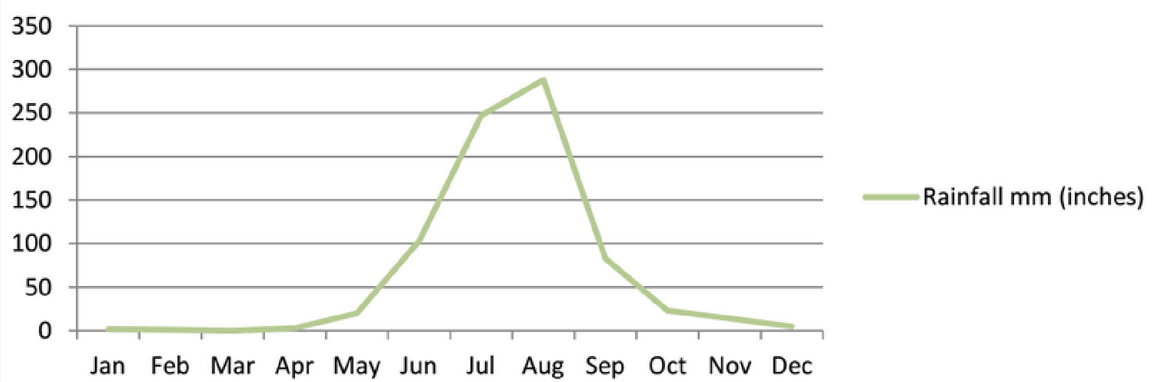


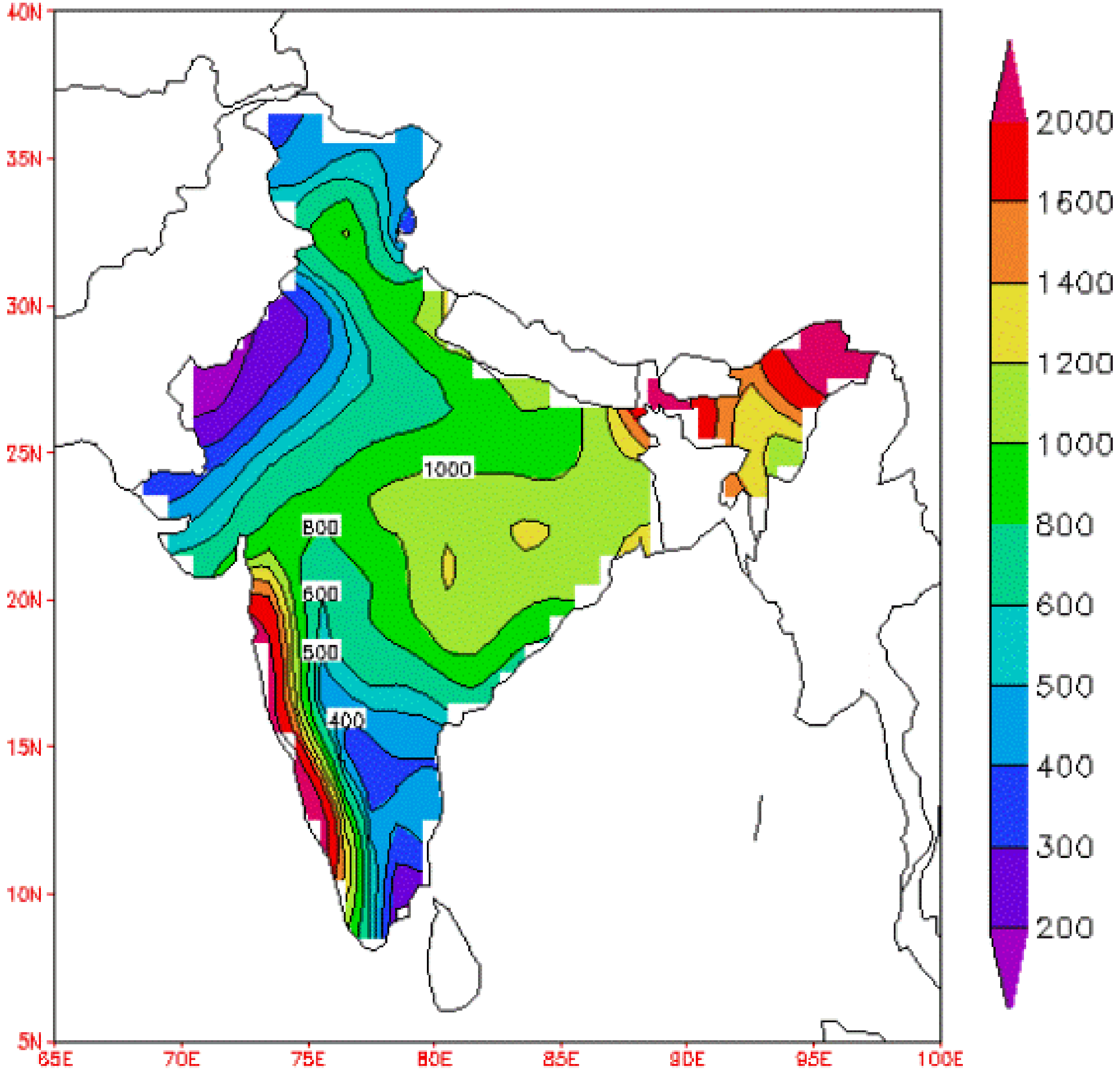
Advertise Rapid Conveyance - never the ultimate solution

Rainfall Distribution

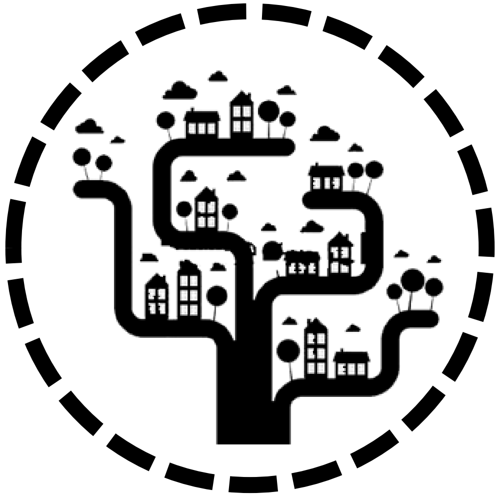
June	July	August	September	JJAS
81.1	249.3	209.7	119.2	659.3

Most of the rainfall received in 4 months





Source: Meteorology Department 2015, AUDA DP 2021



WHAT ? WHY ? HOW ?

Residential, Institutional

ISSUES

- **Scarcity** during dry season
- **Flooding & logging** during monsoon season
- Projected **physical scarcity** of water

OBJECTIVES

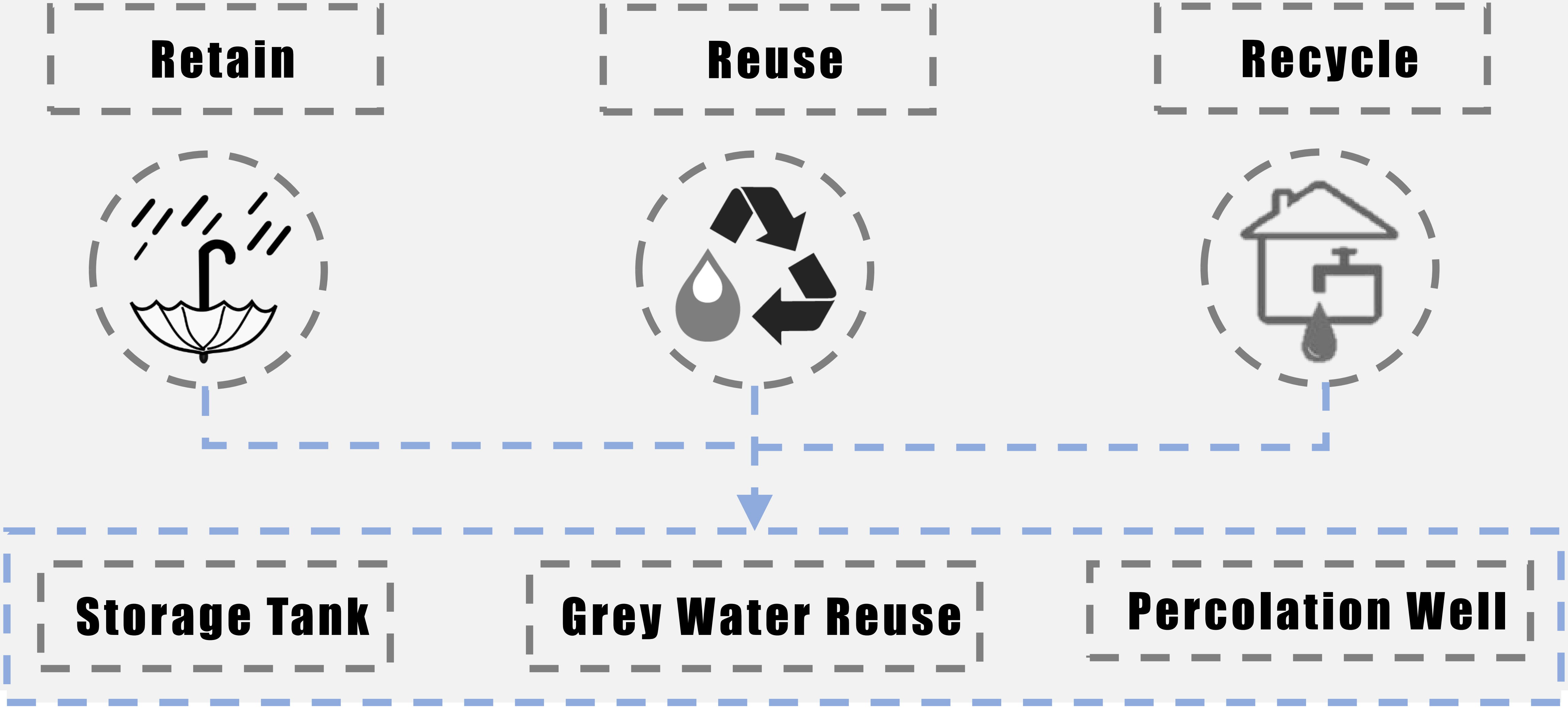
- **Reduce** runoff and peak flows
- **Rain water harvesting** at Dwelling unit / neighbourhood level & Institutional level
- Easy and Cost effective implementation of **grey water reuse**

TECHNIQUES

- **Retention**, infiltration and storage of storm water
- Use of vegetation for water **filtration**
- **Diverse** portfolio of water sources

Retain, Reuse, Recycle

Rainwater Harvesting



Rooftop Harvesting

Percolation into Aquifer

Grey Water Reuse

Rooftop Harvesting

No Regulation or Policy for retention and storage of storm water

Scope for Retention in **Newer Developments**

Need Large **Roof areas** and Low **densities**

Tankas are traditionally followed Best Practice in case of Ahmedabad

Source: GDCR 2014, AUDA RAH Regulation

Percolation into Aquifer

Regulations

- Rainwater harvesting mandatory for all buildings covering an area of **over 1,500 m^2**, **one percolation pit** is mandatory to ensure ground water recharge
- For every **additional 4,000 m^2** cover area, **another pit** needs to be built
- **All Govt. Buildings**, irrespective of their use, should have a percolation pit

Mandatory for all High Rise buildings due to minimum plot size

Source: AUDA DP 2021, GDCR

Grey Water Reuse

Regulation

All clusters in RAH zone with more than 100 units must have double plumbing system for waste water reuse for the purpose of flushing and gardening

Cost of Plumbing is **double** than the usual single plumbing system

Applicable only for **Green Field Developments**

Source: AUDA RAH Regulation

Residential

Rooftop Harvesting

Percolation into Aquifer

Grey Water Reuse

Building Type	Name of Building		Rooftop Harvesting	Percolation	Sample size
Low Rise Apartment		Sopan Lifestyle	7.5 %	14 %	30
Medium Rise Apartment		Riddhi Towers	4 %	7 %	30
High Rise Apartment		Sachet Allure	3 %	11 %	10
Individual Bungalows		Aryamaan Bungalow	Minimal	500 KL	30

Traditional Neighbourhoods…

Tanka system departing from Pols mainly due to **Adaptive Reuse and Reconstruction activities**

Building Type	Name of Building		Rooftop Harvesting	Percolation	Reuse
Low Rise Apartment		Sopan Lifestyle	7.5 %	14 %	30 %
Medium Rise Apartment		Riddhi Towers	4 %	7 %	30 %
High Rise Apartment		Sachet Allure	3 %	11 %	30 %
Individual Bungalows		Aryamaan Bungalow	Minimal	500 KL	60 %

Institutional

Rooftop Harvesting

Percolation back into the Aquifer

Grey Water Reuse

Institutions...

Building Type	Name of Building		Rooftop Harvesting	Percolation	Reuse
School – Day		St. Xavier Loyala School	9 %	4 times	Minimal
School – Hostel		SGVP International School	8 %	1.7 times	40 %
College – Day		CEPT University	5 %	64 %	Minimal

Comparison

Type of Building	Storage	Percolation	Reuse
Traditional Houses - Pols			
Low Rise			
Medium Rise			
High Rise			
Bungalow			
School – Non Residential			
School – Residential			
College - Non Residential			

Policy Comparison – State wise

Kerala	All New Buildings	Kerala Municipality Building Rules, 1999 Amended in 2004	Floor area – 100 m^2 Plot area – 200 m^2	KWA – 75 % Jalanidhi – 90 %
Enchanting Tamilnadu	All Buildings	Tamil Nadu Municipal Laws Ordinance, 2003	All Govt Buildings 3-storey and above	Disconnect water connection
Rajasthan	All New Buildings	Water Resource Vision 2045 State Water Policy 1999	Plot area – 500 m^2	Disconnect water connection
HARYANA	All New Buildings	HUDA & CGWA 2002	Irrespective of Roof or Plot areas	CGWA banned drilling of tube wells
HIMACHAL	All Buildings	Roof-top Rain Water Harvesting, 1999	Plinth area – 1000 m^2	No Objection certificate will be issued only after clearance
Karnataka	All New Residential Buildings	BWSSB, 2009	Plot area – 2400 ft^2	20 % Rebate on tax payment for 5 years
GUJARAT	All Govt Buildings All New Residential Buildings	GDCR, 2002	Covered area – 1500 m^2 Additional 4000 m^2 +1 Pit	Building permission only if RWH structures are provided

Source: rainwaterharvesting.com, State Tourism Icons

Policy Comparison – State wise

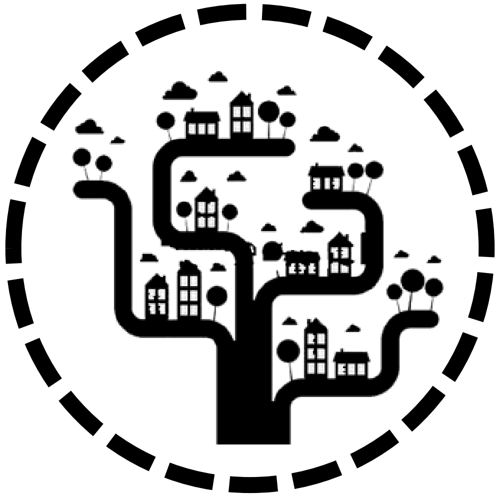
Kerala	Kerala Govt. Initiative	Awareness and Citizen Participation	Kochi
Enchanting Tamil Nadu	Tamil Nadu Govt. Initiative	Strict and Incentivised	Chennai, Coimbatore
Rajasthan	Rajasthan Govt. Initiative	Strict	Jaipur
HARYANA	Haryana Govt. Initiative	Awareness & Citizen Participation and Strict	Faridabad, Gurgaon
HIMACHAL	Himachal Govt. Initiative	Strict	Shimla, Solan
Karnataka	Karnataka Govt. Initiative	Strict and Incentivised	Bengaluru
GUJARAT	Gujarat Govt. Initiative	Strict	Surat, Ahmedabad

Source: rainwaterharvesting.com, State Tourism Icons

Policy Comparison – City wise

Indore	All New Buildings	Directives to Urban Local Bodies, 2004	Area – 250 m^2	6 % Rebate on Property Tax
Chennai	All Buildings	Tamil Nadu Municipal Laws Ordinance, 2003	All Govt Buildings 3-storey and above	Disconnect water and sewer connections
Mumbai	All New Buildings	Directive of MCGM, 2002	Plot area – 1000 m^2	Termination of water supply connection
New Delhi	All New Buildings	MoUD & CGWA 2002	Plot area – 1000 m^2	50 % cost of construction up to Rs.2 lakh
Hyderabad	All Buildings	Hyderabad Metropolitan Water Supply & Sewerage Board, 2001	Plinth area – 300 m^2	50 % subsidy on RWH structures
BENGALURU	All New Residential Buildings	BWSSB, 2009	Plot area – 2400 ft^2	20 % Rebate on tax payment for 5 years
RAJKOT	All Existing Buildings All New Buildings	General Development Control Regulations, 2002	Built up area – 1000 m^2 Built up area – 80 m^2	A moratorium of 6 years
SURAT	All New Buildings	Surat Municipal Corporation, 2013	Plot area – 4000 m^2	50 % subsidy max amount up to Rs. 2000

Source: rainwaterharvesting.com, State Tourism Icons



Cost – Benefit Analysis

Residential, Institutional

Regulation Reforms

One Policy will not work for all the housing types and zones

- Grey water reuse regulation has to be implemented for **All Green field Developments** in all other Residential as is being implemented in the RAH zone
- Minimum plot size for installation of Percolation Pit in **R3 zone** has to be revised for 1000 m^2
- TDR incentives has to be given for Tanka usage in **Traditional Neighbourhoods** similar to those given for Heritage buildings

Pricing Reforms

Along with regulation reforms, existing Water Tax (Pricing) structure has to be revised

- Tariff has to be revised from **Bulk tariff to Increasing Block Tariff**
- Price should also depend on the size of **municipal tap connection** provided for the building
- Buildings having **Bore wells** has to be taxed extra depending on their bore well pump HP
- Buildings reusing **grey water** has to be given rebate in the water tariff

Costing - Typologies & Methods…

Building Type	Name of Building		Rooftop Harvesting	Percolation	Reuse
Low Rise Apartment		Sopan Lifestyle	37,000	70,000	4,000
Medium Rise Apartment		Riddhi Towers	12,000	[illegible]	4,000
High Rise Apartment		Sachet Allure	14,500	30,000	15,000
Individual Bungalows		Aryamaan Bungalow	4.6 Lakhs	7 Lakhs	3.6 Lakh
School – Day		St. Xavier Loyala School	[illegible]	180	[illegible]
School – Hostel		SGVP International School	65	[illegible]	35
College – Day		CEPT University	890	174	-

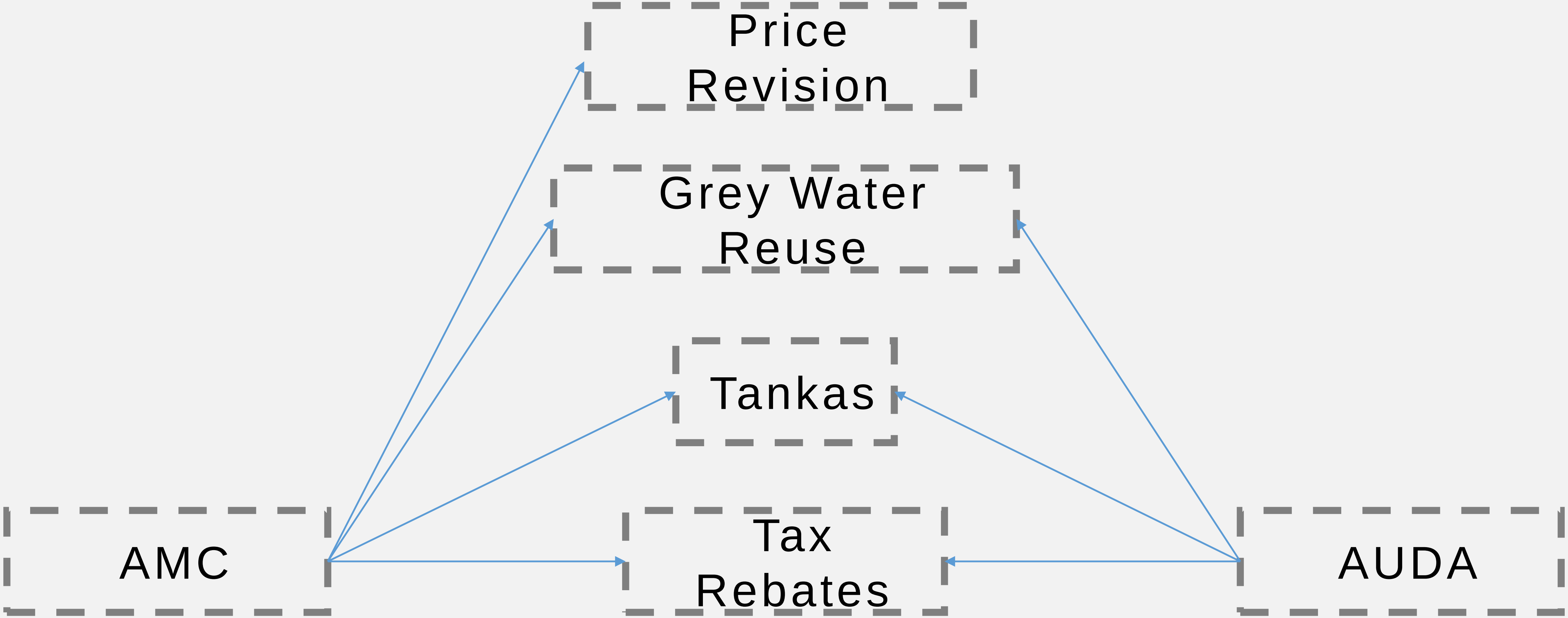
Cost of Plumbing + Storage Tank

Recharge Pit + Filtration Bed + Percolation Well

Double Plumbing + Storage Tank

Retain, Reuse, Recycle

Institutional Framework



NON-REVENUE WATER (NRW)

Why- NRW?

- 40 to 70 percent of more water can be available to the urban households without any extra cost by reducing financial and physical losses. (World Bank,2012)

- To increase the supply capacity, investment in NRW reduction will be much cost effective than investments in new capital projects. (Liemberger, 2010)

- The per unit cost of reducing leakages is significantly less than the cost involved in creating additional capacity (PwC, 2011)

Hence focus on NRW management may be a sustainable model of urban water management.

Types of NRW

Physical (or real) losses

Leakages from transmission mains, storage facilities, distribution mains or service connections. They are majorly caused due to poor operation maintenance and poor quality of underground materials (assets).

Commercial (or apparent) losses

Caused due to water theft and poor data holdings.

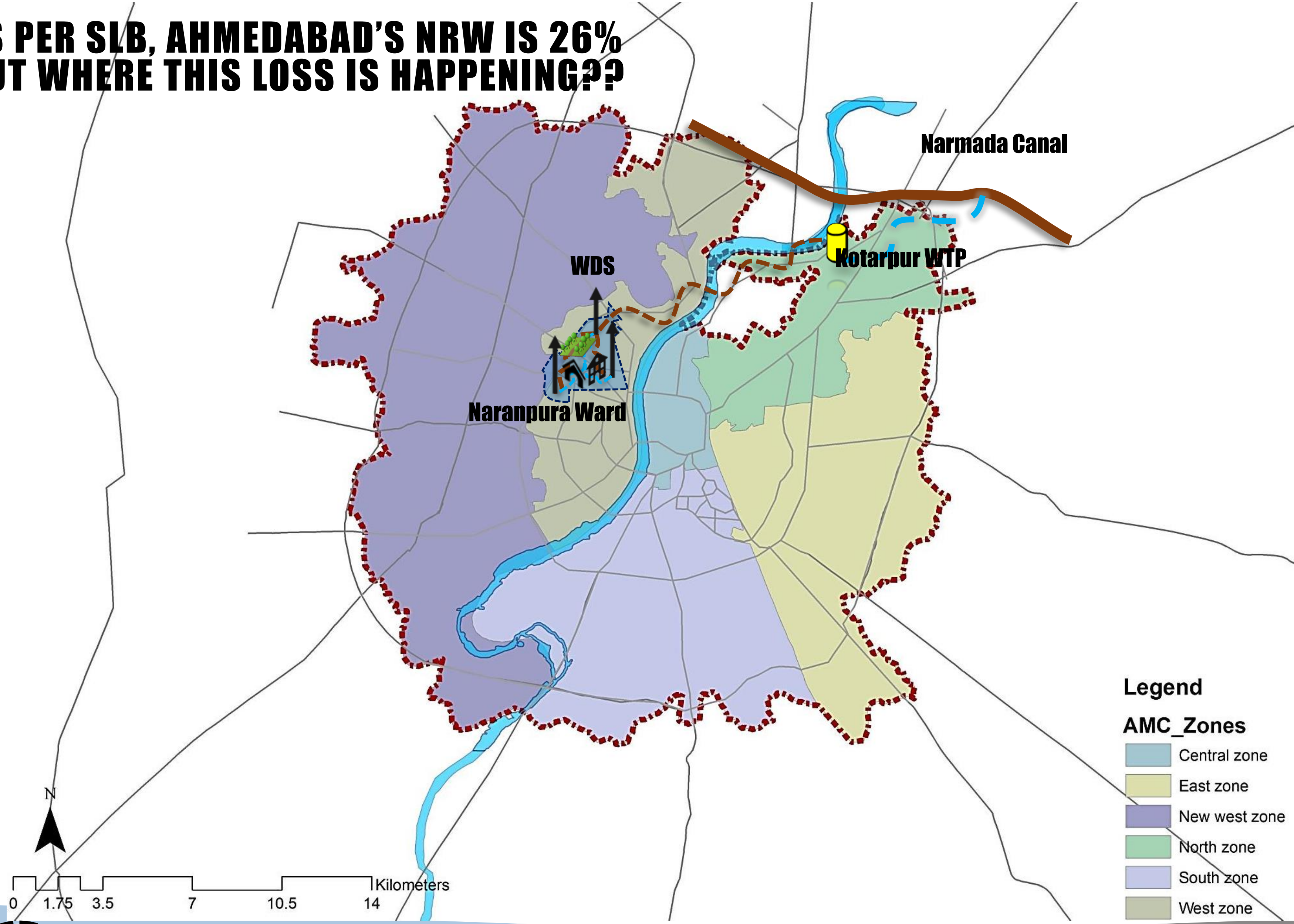
Unbilled authorized consumption

Water which cannot be billed like gardening purposes and free water services to certain groups.

NRW

Source: World Bank (2012). India: Improving Urban Water Supply and Sanitation Services. World Bank Publishing, Frauendorferc, R and Liemberger, R. (2010). The Issues and Challenges of Reducing Non Revenue Water. ADB publishing, PwC. (2011). Bringing Water to your door step: Urban Water Reforms for the next decade. PwC

AS PER SLB, AHMEDABAD'S NRW IS 26% BUT WHERE THIS LOSS IS HAPPENING??



Loss/Leakages from source to WTP

Loss/Leakages on transmission and / or distribution mains

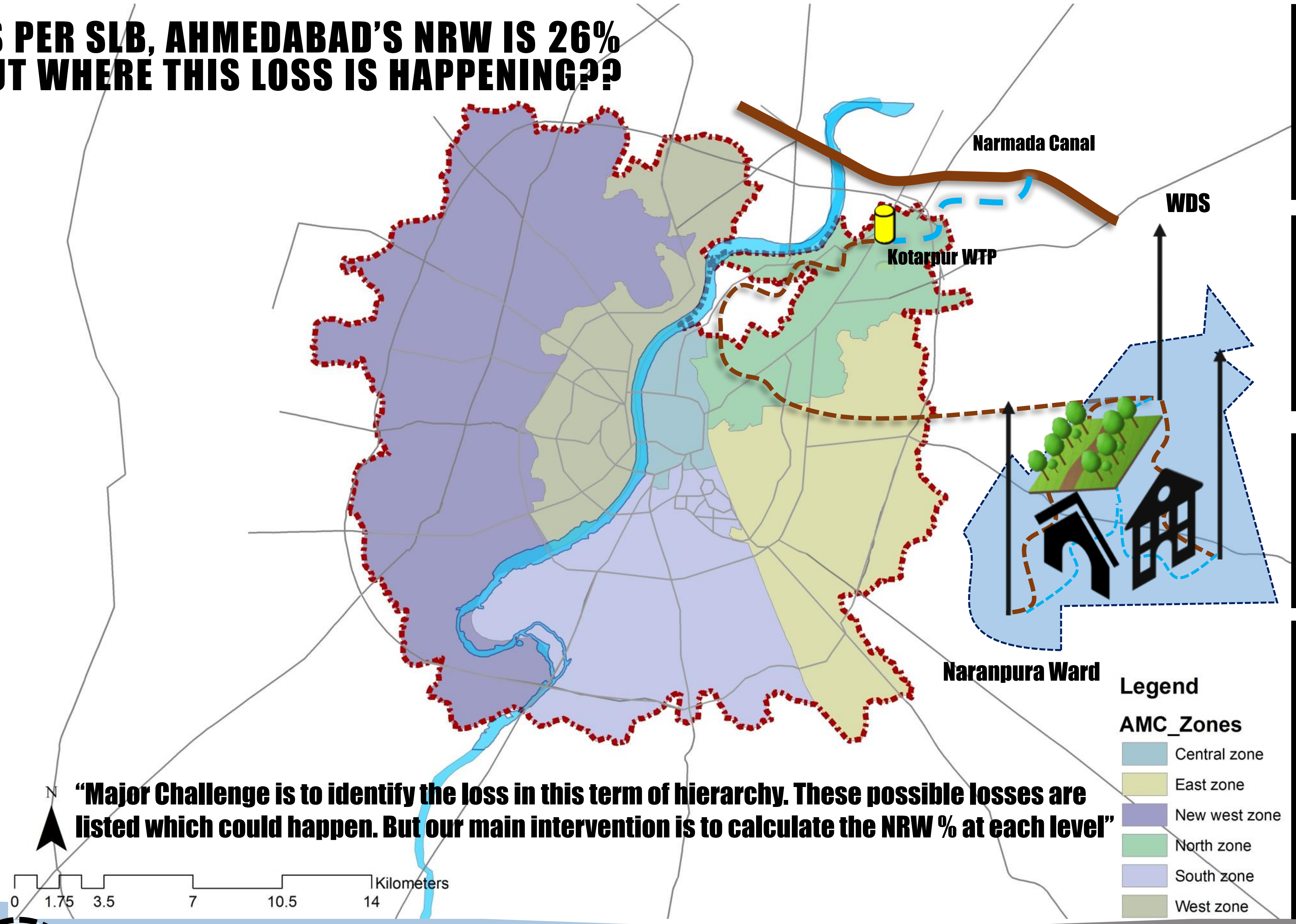
Loss/Leakages and overflows at Utility's storage tanks

- Unbilled un metered consumption
- Unbilled authorized consumption
- Leakage on services connections
- Illegal Tapping

NRW

Source : IWA Water Balance Chart

AS PER SLB, AHMEDABAD'S NRW IS 26% BUT WHERE THIS LOSS IS HAPPENING??



"Major Challenge is to identify the loss in this term of hierarchy. These possible losses are listed which could happen. But our main intervention is to calculate the NRW % at each level"

Loss/Leakages from source to WTP

Loss/Leakages on transmission and / or distribution mains

Loss/Leakages and overflows at Utility's storage tanks

- Unbilled un metered consumption
- Unbilled authorized consumption
- Leakage on services connections
- Illegal Tapping

NRW

Source :IWA Water Balance Chart

NRW : ISSUES

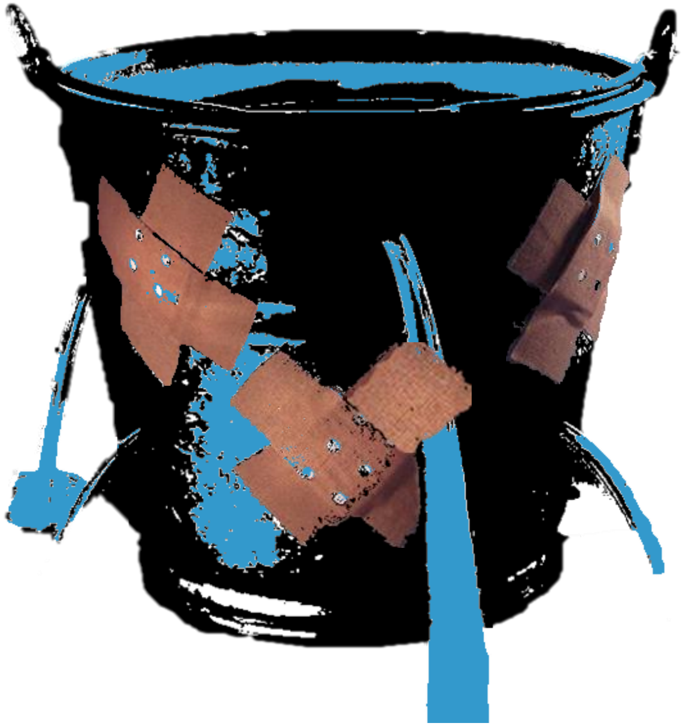
- × Lack of **data base management & monitoring**
  - ○ Water supply network distribution data unavailability
  - ○ Break Up of the losses at different stages not available

- × **Water charges** levied by ULBS are very low because of political interference and unwillingness of people to accept as an economic good resulting in poor collection even to get the operation and maintenance (O&M) of the service.

- × The ULBS are suffering from faulty and **inadequate metering/no metering**, rampant leakages and **illegal connections.**

- × With **operational inefficiencies, poor collection, and low tariff structure** practices by the water boards, resulting in low cost recovery of even O&M costs.

Measurement & Reduction



INSTITUTIONAL

Formation of Illegal Use Reduction Unit (IURU)/

Allocating Roles & Responsibilities

TECHNICAL

Proposing bulk metering to calculate actual losses occurring in the whole water distribution system from source to end

INTERVENTIONS

FINANCIAL

Revision in water tariff structure

Increasing Cost Recovery

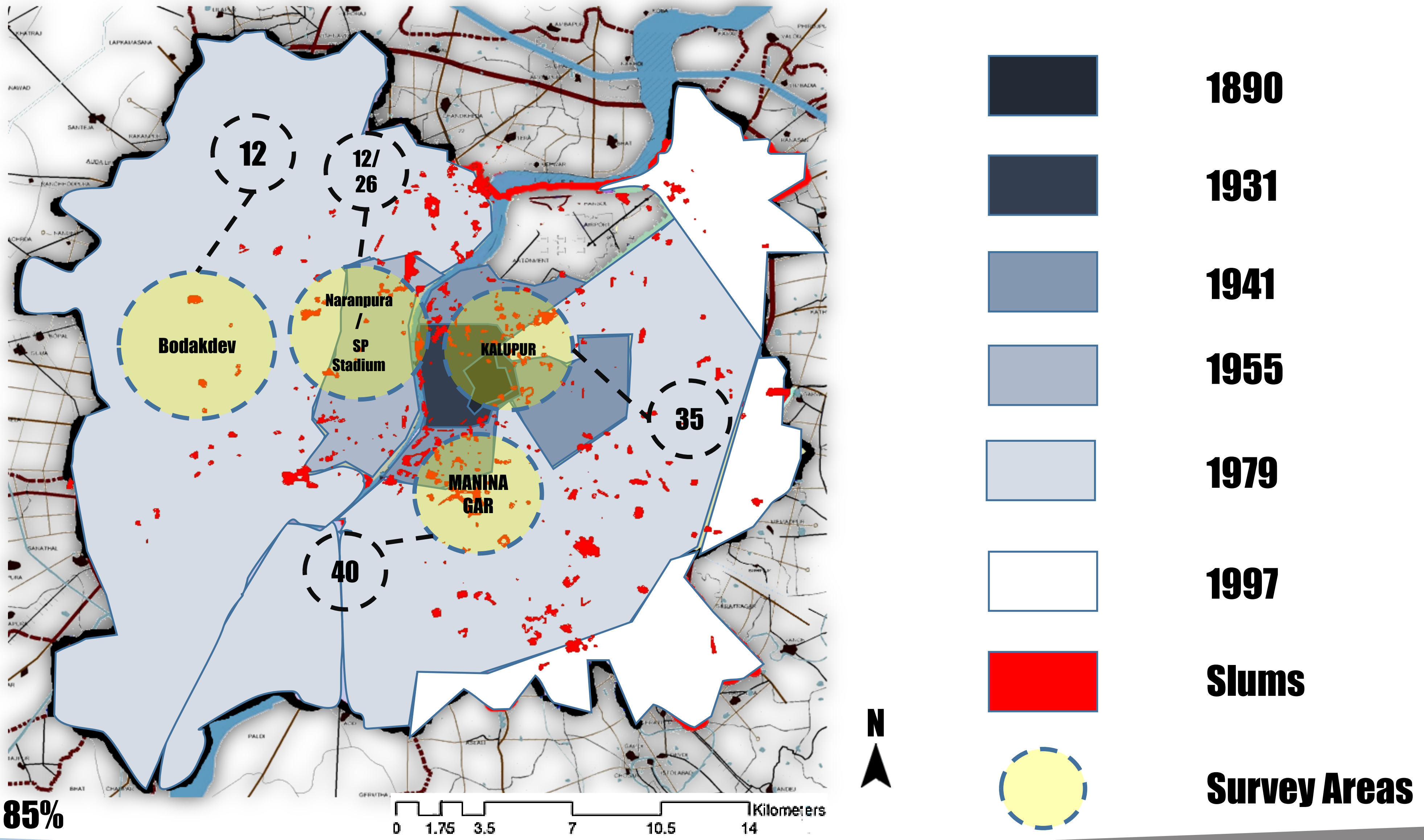
Enhancing collection efficiency

POLICY LEVEL

Reviewing policies related to water in context of Ahmedabad & Suggesting Policies

Defining Fines & Performance Indicators

NRW : INTERVENTIONS



Sample Size: 35

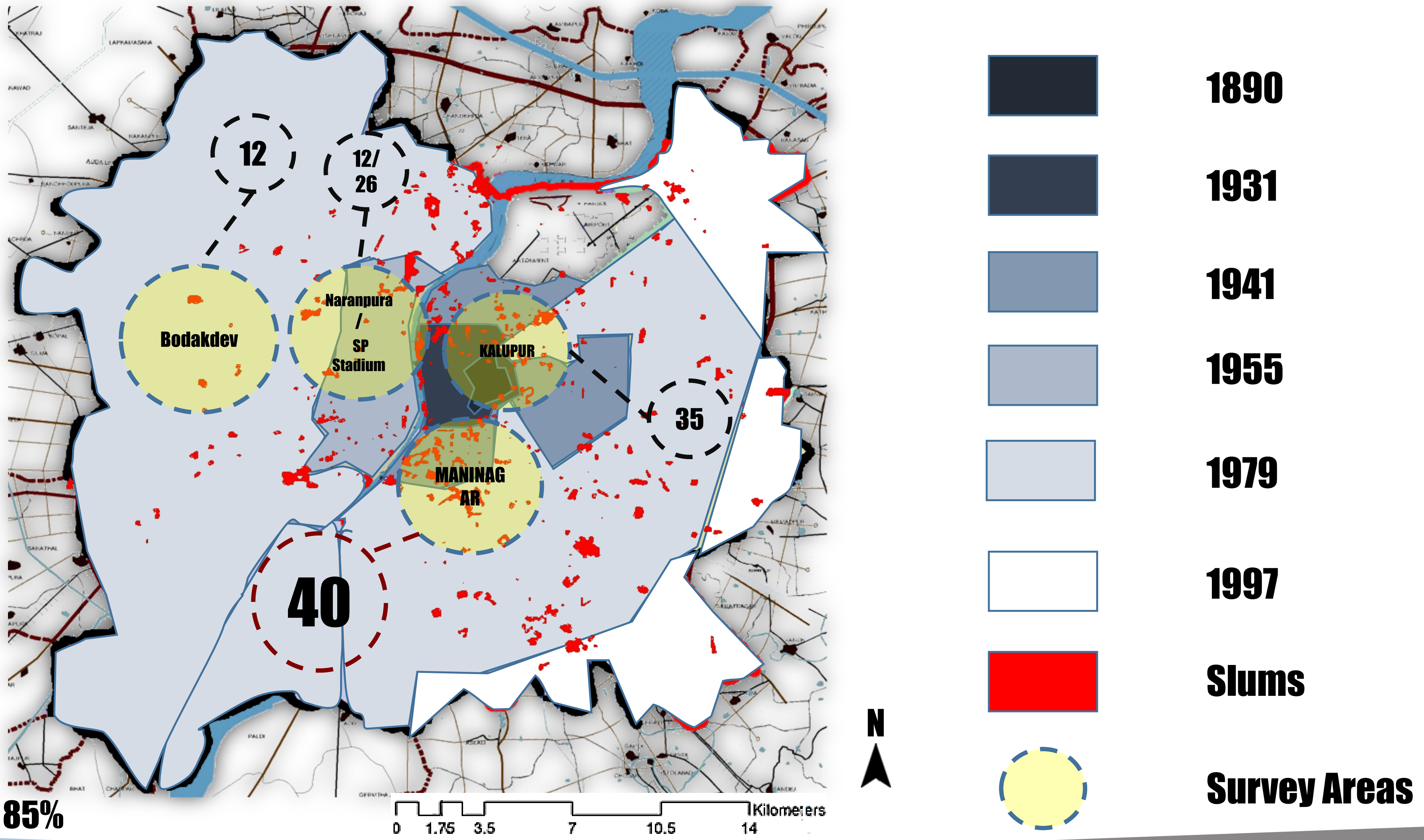
Error: 10%

Confidence level : 90%

Response distribution: 85%

NRW : SAMPLE SELECTION

Source: Ahmedabad CSP, RAOSOFT



Sample Size: 35

Error: 10%

Confidence level : 90%

Response distribution: 85%

NRW : SAMPLE SELECTION

Source: Ahmedabad CSP, RAOSOFT

- ✓ Data base management system
- ✓ Bulk metering at supply side (Source to WTP & WTP to WDS)
- ✓ Leak Detection
- ✓ Improving financial performance of ULB
- ✓ Identification of Illegal Consumption through institutional framework

NRW : ACTIVITIES

City Level

- DBMS
- Bulk Metering
- Improving Financial Performance of ULBs
- Identification & Reduction of Illegal Consumption through institutional framework

Ward Level

- Leak Detection
- Consumer Metering

NRW : ACTIVITIES

DATA BASE MANAGEMENT SYSTEM

WATER CONNECTION DATA BASE

INFORMATION RECORDED ON PAPER

- Zone
- Name of the owner
- Full address of property with survey number
- Type of building
- Ferrule size of connection to be given
- Details of existing connection: size, age, length.
- Date of application.

APPLICABILITY

- Only those who have drainage connection
- He/she should be a tax payer
- Approved by Dy. Engineer, additional deputy engineer & assistant engineer of respective ward

USE OF DATA

- To know the material used in case of corrosion/leakage for replacement of pipes
- To know whether an individual society has legal connections

Individuals apply to the zonal office → Field survey and verification of the plot size → Estate department of zonal office issues a resolution certificate to city civic centre → Checking of the plot size/to check if the supply network is available in the nearby areas or not → Application send to Dy.city engineer for confirmation and sent back to the concerned ward technical supervisor → Work allotted to the plumber

Procedure takes minimum of 10-15 days & can take long time if the total number of application are more than 14-15

NRW- DATA BASE MANAGEMENT SYSTEM

Source: Navrangpura & Vidhata ward office, pas report- what works in Watsan

ISSUES & INTERVENTIONS

ISSUES

- No data regarding total **no. of water connections** with increasing population
- Evaluation of information/issues done on basis of population of census 2011
- No information about the number of different **size of connections**
- All the data is **maintained on paper** rather than using software or just an excel sheet.

INTERVENTIONS

- Accounting all the data generated on any **designed software**
- Accounting it all on just an **excel sheet**
- Recording of the population data on basis of **water connections/Number of HH**

Source: Navrangpura & Vidhata ward office, pas report- what works in Watsan

ROLES & RESPONSIBILITIES

DEPARTMENT		OFFICERS	FUNCTIONS	RECORDS
Water production	**City level**	C.E Dy. CE A.C.E A.E	• Overall NRW is 2% • Have to keep a check on the total inflow, treatment of water, overflow from any reservoir tank(if) and total supply from all 4 WTP.	• Registers • SMS
Water project	**Zone level (CLASS I & II)**	ADDI C.E Dy. C.E A.C.E	Monitor if there is a major leaks in the mains, distribution channels	---
	Ward level (CLASS III)	A.E	Complete the formalities of new connections Check if there is a line break down, problems in pressure and leak and send a private contractor	---
		Tech. supervisor	To check areas where water is not reaching	Registers
		Non tech. supervisor	New connection formalities To check the leakage through customer complaints	Complaints in form of receipt
Water supply department	**W.D.S (CLASS IV)**	fitter	Repairing mains and old pipes if they are worn out	---
		operator	Problems of leakages has to be addressed to the upper level	Register (manual)

ISSUES

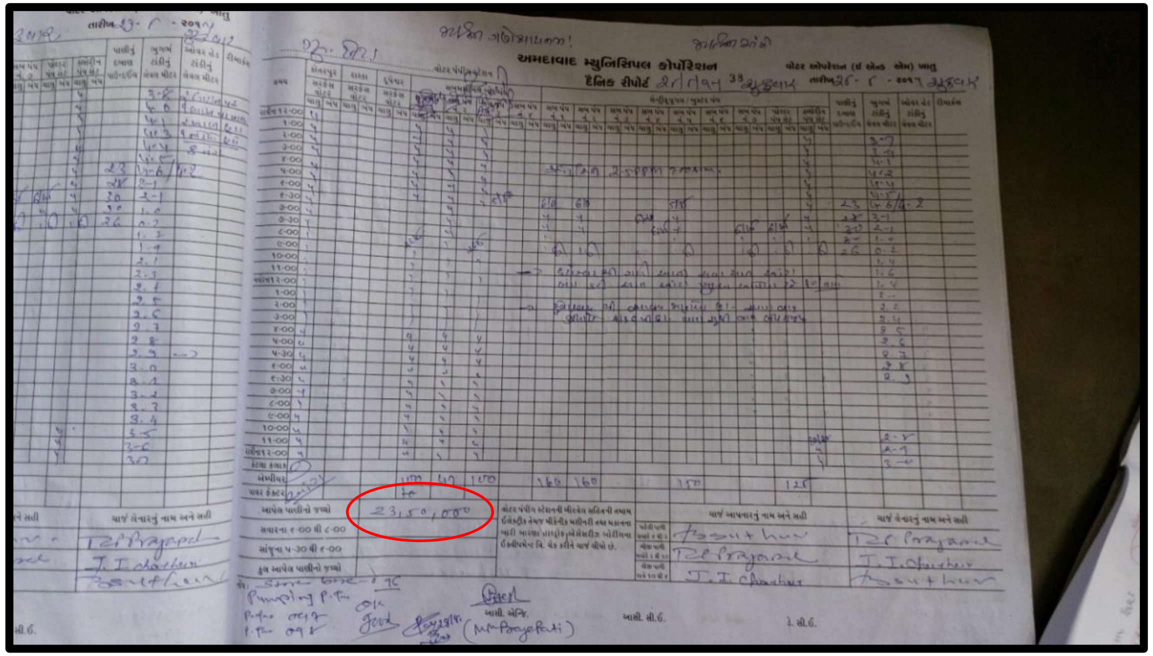
- Lack of adequate data
- Lack of instruments for calculating the supply from WTP.
- There is lack of up gradation of water network map
- Insufficient data pertaining to water loss and illegal tapping
- No data about the number of existing connections and new connections coming up.

Source: Navrangpura & Vidhata ward office, pas report- what works in Watsan

DATABASE ON WATER DISTRIBUTION STATION

DATA RECORDED IN REGISTER DAILY

- No. of threads of a valve opened for gravity intake (24*7) into sump of WDS
- Level of water in sump (hourly)
- Number of submersible bore pumps operated & its duration
- Number of booster pumps operated & its duration
- Number of hours of operation of chlorine pump
- Pressure during general supply hours(30 min interval)



ISSUES

- Ultimately at the end, the total quantity of water supplied is calculated manually & is hand written which seems **unreliable**
- No meaning of recording the **no. of threads** as it doesn't really depict the total intake.

INTERVENTION

- **capacity building of the staff**
- installation of **digital bulk meters** at the intake and discharge of WDS including a **column for recording** bulk meter readings.

NRW- DATA BASE MANAGEMENT SYSTEM

Source: Navrangpura & Vidhata ward office, pas report- what works in Watsan

DATA BASE AT WATER TREATMENT PLANT

- **Indirectly the total quantity of water** intake is recorded with help of pumping capacity of pumps and no. Of hours of pumping.
- It is being recorded manually and then sent **via SMS to city engineer** at Dudheswar water works(primary visit to Kotarpur WTP).

PARTICLUARS	MLD
Total intake per day (11/09/2015)	1121
Total supplied to all WDS (11/09/2015)	1100
Total NRW at WTP	2%

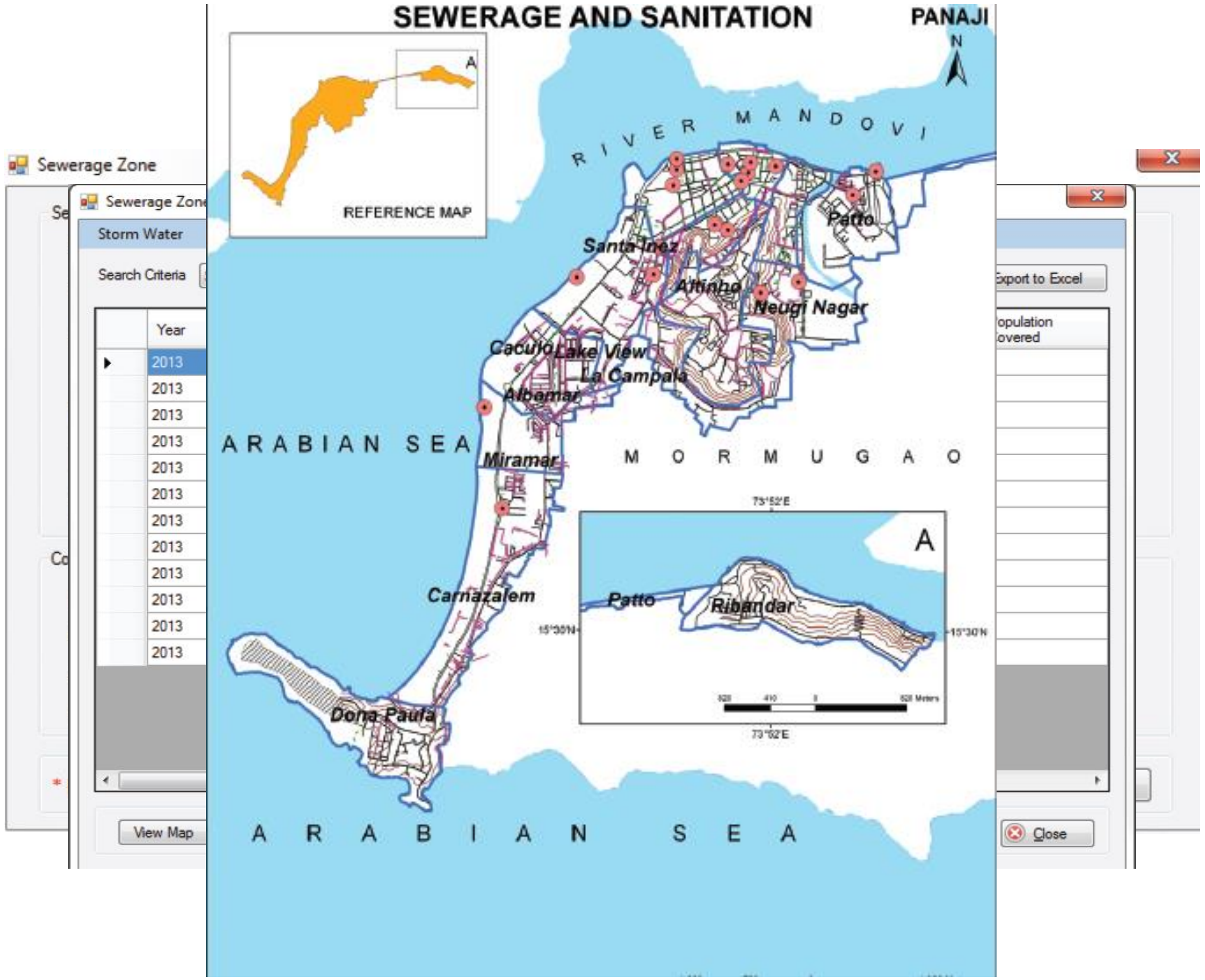
- **Low reliability** of data because its measured indirectly
- Also the data generated at WTP has nothing to do with data generated at WDS because no data is getting **synchronized** at a place via SMS.
- No information about losses from WTP to WDS.

INTERVENTION

- ✓ Installing **meter at WTPs and recording readings** of total intake & release.
- ✓ Setting up an arrangement such that a **designated person** gets all the data via **SMS** primarily and puts the data into designed software.

Source: Navrangpura & Vidhata ward office, pas report- what works in Watsan

DBMS:CASE STUDY OF PANAJI,GOA



The data collected was

- at one point in excel sheets,
- information was stored and the missing fields were updated to understand the gaps as well as populate the data in future.
- The inventory prepared was then developed into a Microsoft Access-based DBMS.

The information was mapped spatially using GIS and linked to the DBMS

Source: Navrangpura & Vidhata ward office, pas report- what works in Watsan

WHY IS PROPER DATA REQUIRED???

- With proper data of water connection following things can be found

a. **water supply and demand** can be calculated in all zones

b. **future projections** and demand can be estimated

- Illegal connections can be found out
- Leakages in the pipelines can be known
- With more leakage complaints in a zone, more NRW levels and repairs can be done
- **Proper functioning** of WDS and WTP, less NRW levels

BENEFITS OF STORING DATA MANUALLY /COMPUTERISED

- **Less labor** work
- Stored data can be **evaluated** quickly for finding information to solve the issues
- Obtaining the **real time** data by synchronization
- Maps can be created using software, through which accurate information can be obtained
- During floods, difficult to handle manual data such as registers, but computerized data is easily accessible

Source: Navrangpura & vidhata ward office, pas report- what works in Watsan

PHASING OF THE PROJECT

SHORT TERM	• Making provision of meter reading column in register at WDS and WTP • **Training the operator** for the same. • **Computerization** of water connection data	0-1 year
LONG TERM	• **Equipping the operators** of each WDS with an arrangement such that the data recorded is transmitted to the designated authority in real time; maybe **via SMS.** • **Synchronizing** all the WDS & WTP readings in real time via designed soft wares	1-3 YEARS

BULK METERING

Project : Bulk Metering At Supply Side

Need for bulk metering:

- Primary visit to WTP & WDS revealed that they **have no direct measurement** of water intake and supplied.
- No information about NRW in **different zones and stretches of AMC.**

Source: primary field visit to WDS & WTP

Project : Bulk Metering At Supply Side

Need for bulk metering:

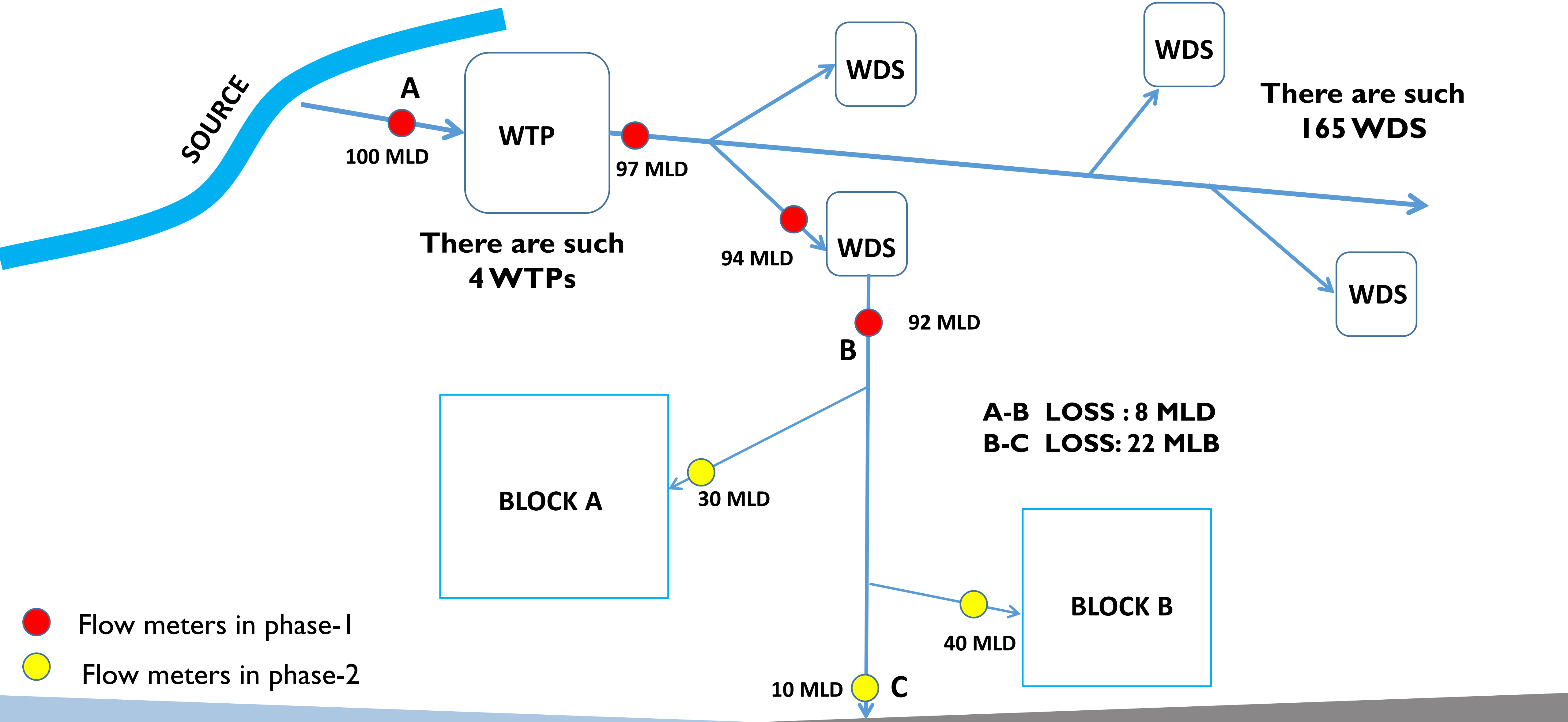
- Primary visit to WTP & WDS revealed that they **have no direct measurement** of water intake and supplied .
- No information about NRW in **different zones and stretches of AMC.**

Interventions:

Phase 1	Installation of bulk meters at WTP & WDS	0-2 years
Phase 2	Installation of bulk meters at strategic locations	2-5 years
Phase 3	Consumer end metering	After 5 years

Source : primary field visit

SCHEMATIC DIAGRAM OF WATER SUPPLY AND LOCATION OF FLOW METERS:



Source: AMC website , field visit to WDS & WTP

Project : Bulk Metering At Supply Side

Need for bulk metering:

- Primary visit to WTP & WDS revealed that they have no direct measurement of water intake and supplied .
- No information about NRW in different zones and stretches of AMC.

Interventions:

- Phase 1: Installation of flow meters at inlet and outlet of WTPs and the WDSs.
- Phase 2: Installation of flow meters at the strategic locations in the supply network from WDS.
- Phase 3: Consumer end metering (long term).

Outcomes of the project:

- We will have **water auditing** at WTPs & WDS; also for different stretches in network.
- It will **assist data base management system**
- It will aid **the leak detection project** as we will be knowing losses in different stretches.

Source : Primary field visit , Surat SCADA case study

Challenges

- Flow meters are needed to be **calibrated & serviced** at regular intervals.
- As in case of **Rajkot Municipal Corporation** where after installation of bulk meters, **no proper framework** was there so as to operate and maintain at regular interval. Hence whole rationale of project was not served.

Performance based contract for operating & maintaining the meters

Parameters	Desired Outcomes	Required Services	Performance Standards	Acceptable Quality Level(AQL)	Monitoring Method	Incentives/ Disincentives
Objective	Proper functioning of the bulk meters at the WTP & WDS	**Servicing & calibrating** the bulk meters at every 3 months	Servicing of all the meters be done **within 15 days** period	Maximum **Technical error of +/-0.5%** in measurement of flow	Fluent working of meters as per AQL throughout service period	For performance as per the standard **extra 5% of fee** will be credited & vice versa
		Providing service at the time of **breakdown** of meter	Incase of break down, meter will have to be **restored within 2 days**	Maximum float of 1 day in service delivery	Technical error will be checked by ultrasonic non destructive meter	

Source : Rajkot Municipal Corporation Website, Catalogue Of Eureka Meters, PBC of IT firm

Bulk Metering

Estimate:

Location of Meter	No. of meters needed	Capital cost per unit	Total capital cost	Installation cost	O&M cost	Total cost
			(Lakh)	(15% of capital cost)	(10% of capital cost)	(5 year)
WTP	8	15000	1.2	0	0	2.46 lakh
WDS	330	15000	49.5	7.42	4.95	81.67 lakh
Consumer metering (Maninagar)	21000	5000	1050	105	-	1155 lakh
						1240 lakh

Source : Catalogue Of Eureka Meters, AMC official website,

Upgrading Water Network, Water Audit and Leak detection

Major Concern for AMC and Amdavadians

•Increase in NRW to 26 %
• Inadequate data pertaining to water supply network of Ahmedabad
•No record of water thefts or any illegal connections

Advisory body

CEPT University → AMC →

Objective

The main objective of water audit is the preparation of leak detection and repair plan, the main objective is to reduce NRW through leaks etc

What all needs to be done?

Identification of water pipeline network in Zones with upgraded maps

Water Audit at the respective places where NRW is maximum on the basis of our Household survey

Filling up of water leaks

Source: Ahmedabad CSP2012

Models for the project

Model-1	Model-2
Consultancy A shall do all the projects as done in Nagpur (Shah Technical Consultants) Identification of water pipeline network in Zones with upgraded maps Water Audit at the respective places where NRW is maximum on the basis of our Household survey Filling up of water leaks	**Consultancy A** Identification of water pipeline network in Zones with upgraded maps **Consultancy B** Water Audit at the respective places where NRW is maximum on the basis of our Household survey Leak Assessment and Filling up of water leaks

Why Model-2

- Takes Less time
- Two projects could be started simultaneously at one time
- Consultancy B will be engaged in Water auditing so it will have a better understanding of leaks

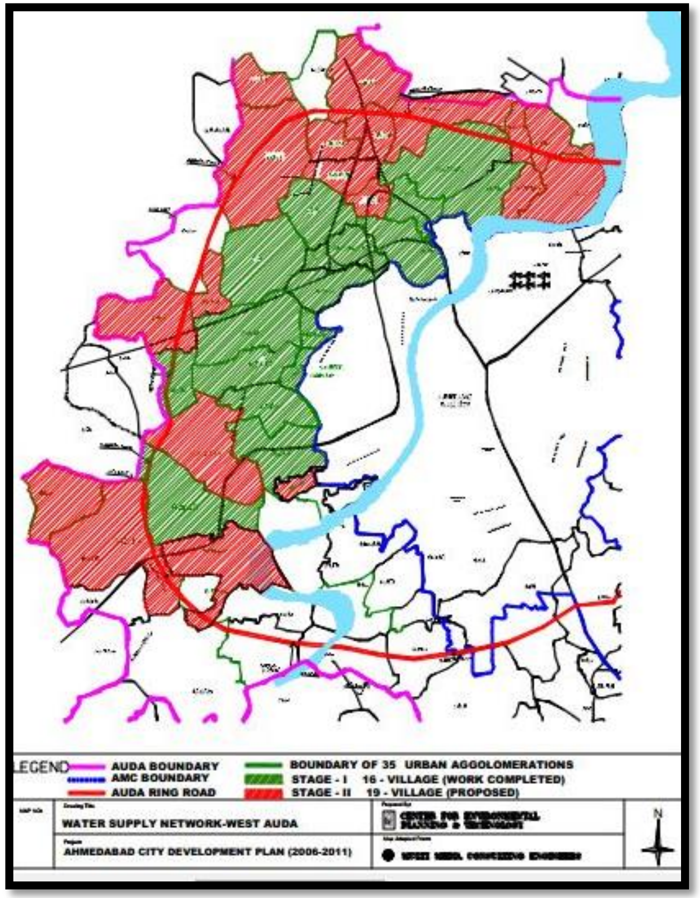
Nature of Contract:

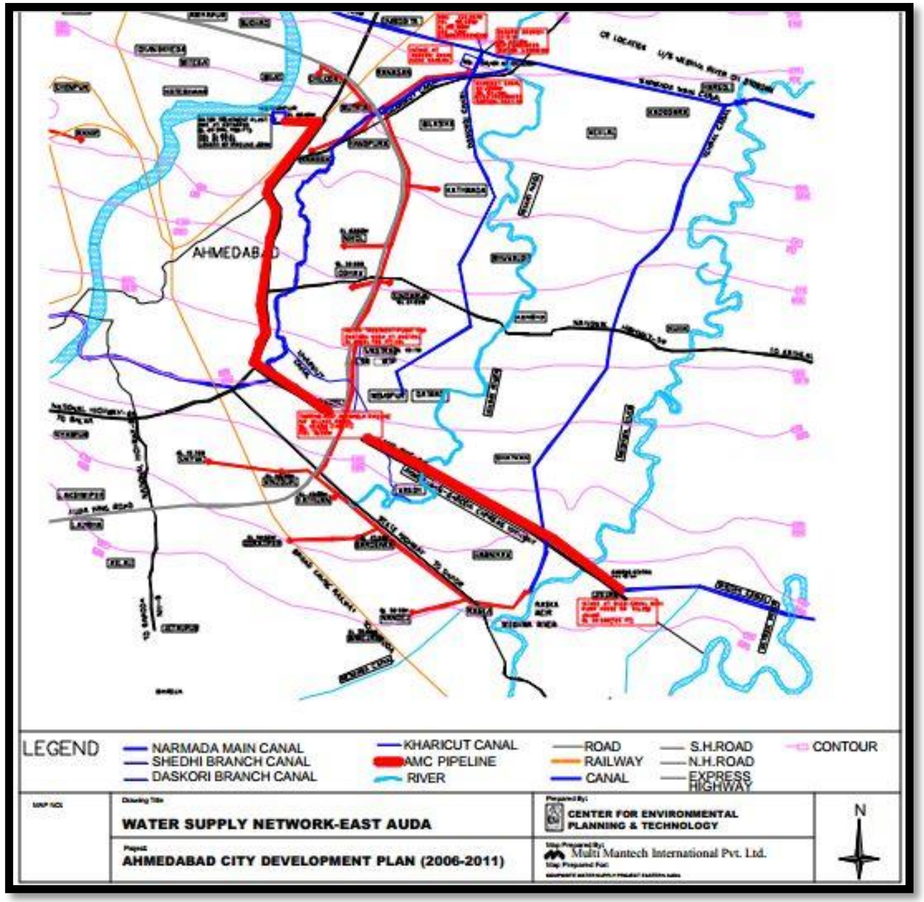
Performance based Contract

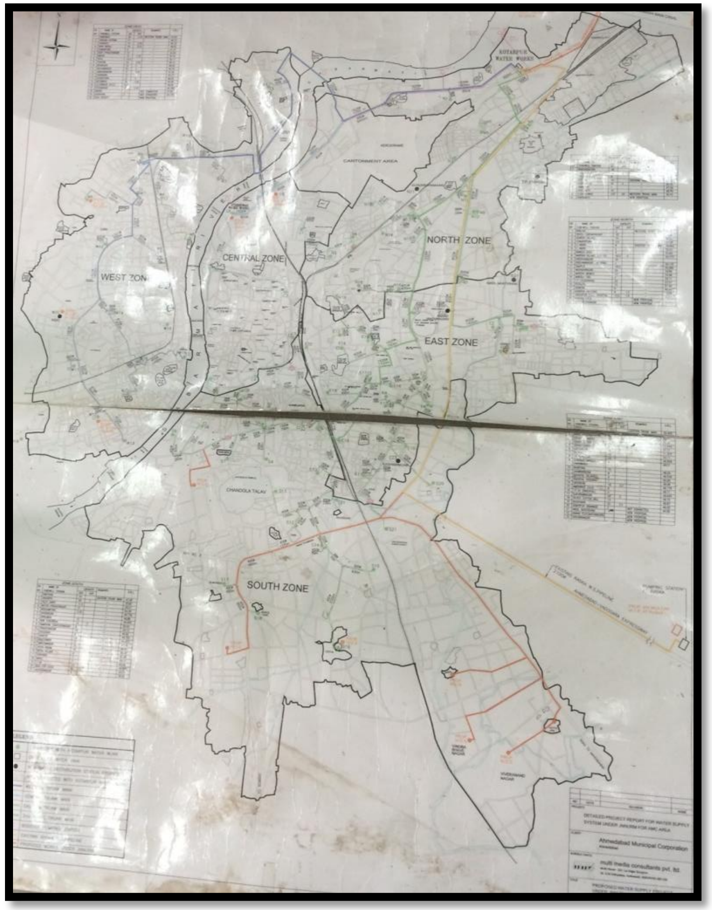
- Consultants should deliver the list of task with in the mentioned time.
- A time check shall be performed whether the consultant is on time or not
- If a consultants fails to identify the water pipeline network on time then its tenure may get terminated or project should be awarded to second shortlisted bidder
- If the service and performance is delivered efficiently more incentives would be provided to the consultants

For O & M Capacity building exercise shall be done and AMC will itself operate and monitor for any leakage in future as SURAT has done it quite efficiently

Maps related to Ahmedabad water distribution network







Source: *CDP2006, visit to Kotarpur water Works*

Meetings and Technology

Consultation

Meetings with AMC officials, plumbers. Linemen etc being employed by AMC from time to time so as to trace the pipeline

Ultrasonic Air and Water Leak Detector System

The equipment utilizes high-performance digital technology to identify precisely where water and air penetrates in applications

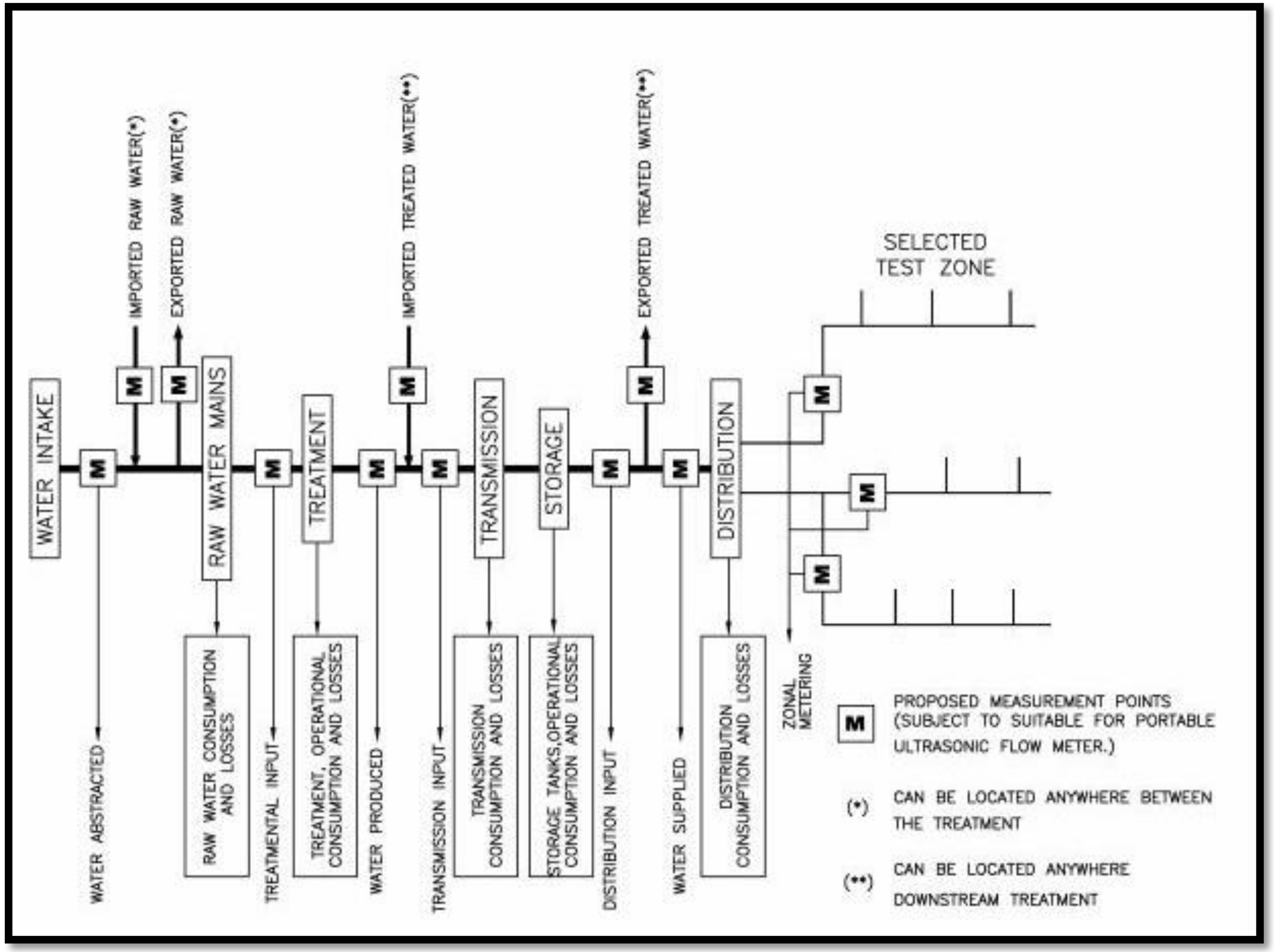
Schedule & Costing

Time required for upgrading of these maps=190 days
Information required for water connections to Households added after these maps were prepared
Cost for each day manpower =20000
Cost for 90 days week=38 Lakh

Cost of each Ultrasonic Air and Water Leak Detector System= 3000
Required Ultrasonic Air Detectors=1000
Pipe Locators=500
Leak Locators= 1000
Sounding Rods=1000
Overall cost=2 crore

Overall cost for upgrading water pipeline distribution=2.38 crore

Water Auditing including metering at various levels



This is a major step of water auditing

Instigating The leak

Installing Ultrasonic flow meter to get an idea

- How much is the water loss?
- What is the Hierarchy

Source: DPR on Nagpur water Audit, NMC

Methodology to study NRW through water auditing :

•Audible Leak Detection Using Electronic Equipment

•To know NRW at HH level .The Selection of Test Zone with maximum NRW like Maninagar etc according to our HH survey

HIG, MIG, LIG and Slum

- Availability of Isolation Valves
- Pipe and Valve Survey Pipe & Valve survey is required to identify and verify the alignment of mains, service connections, location of valves in distribution system
- checking of Existing Flow Checking of existing flow by installation of bulk flow meter and also using Ultrasonic Flow Meter in test zone during normal working hours
- Testing of Valves: The existing valves will be checked whether working or not.

Source: DPR on Nagpur water Audit, NMC

•Leak Detection Test- The leak detection using electronic equipments will be carried out during supply hours. Test generally lasts for about 2 to 4 hours.

During the test if the flow recorded is high then additional investigation are required like.

- Audible Leak Detection.
- Multiple Pressure Recordings.
- Visual Leak Detections

Equipments to be used During Test

Ultrasonic Flow Meters.

Pressure Gauges.

Pipe Locators.

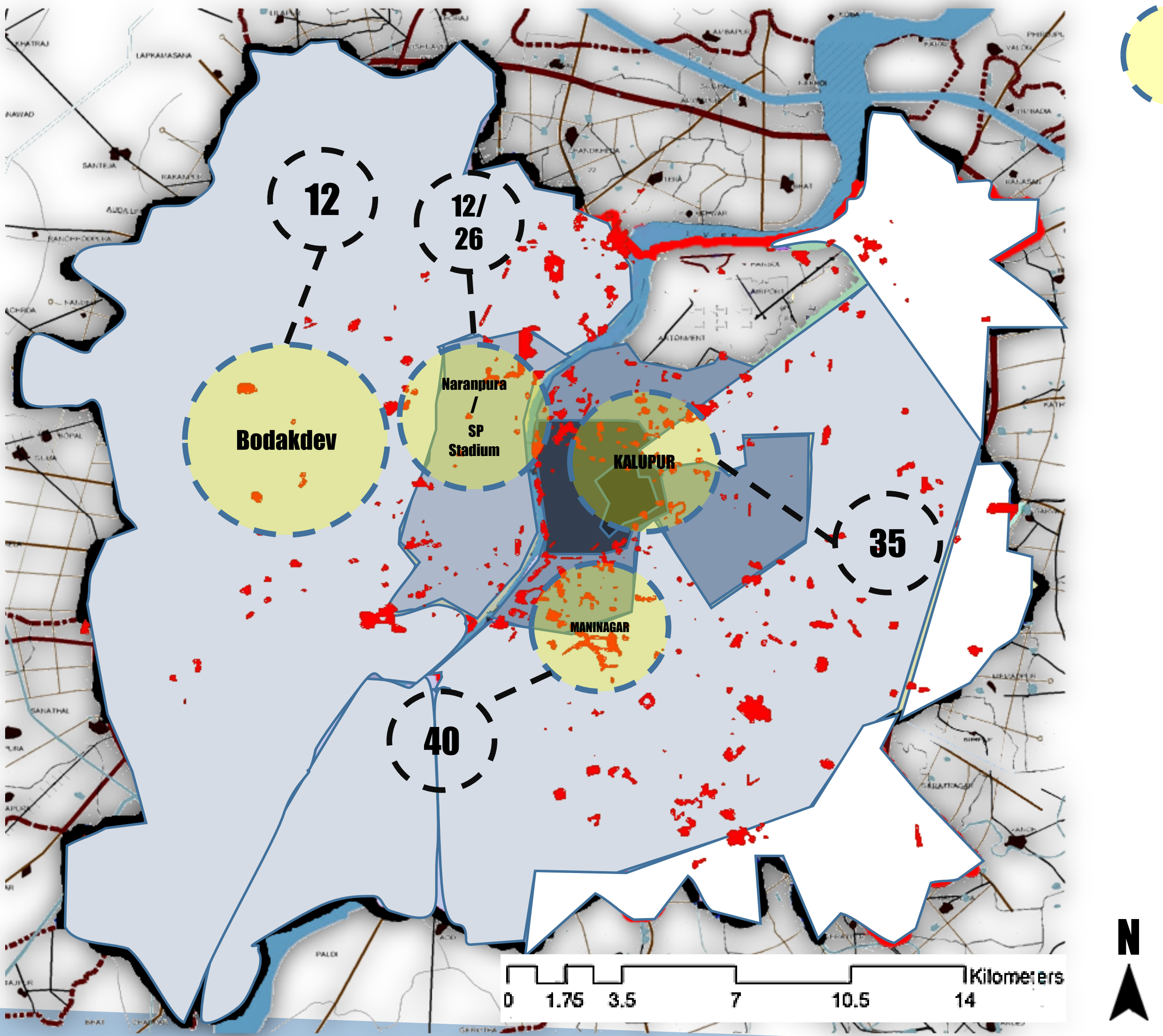
Leak Locators.

Sounding Rods.

Tanker and Pump unit (if required)

Source: DPR on Nagpur water Audit,NMC

Water Audit and Leak detection : Maninagar & Kalupur Ward



Survey Areas

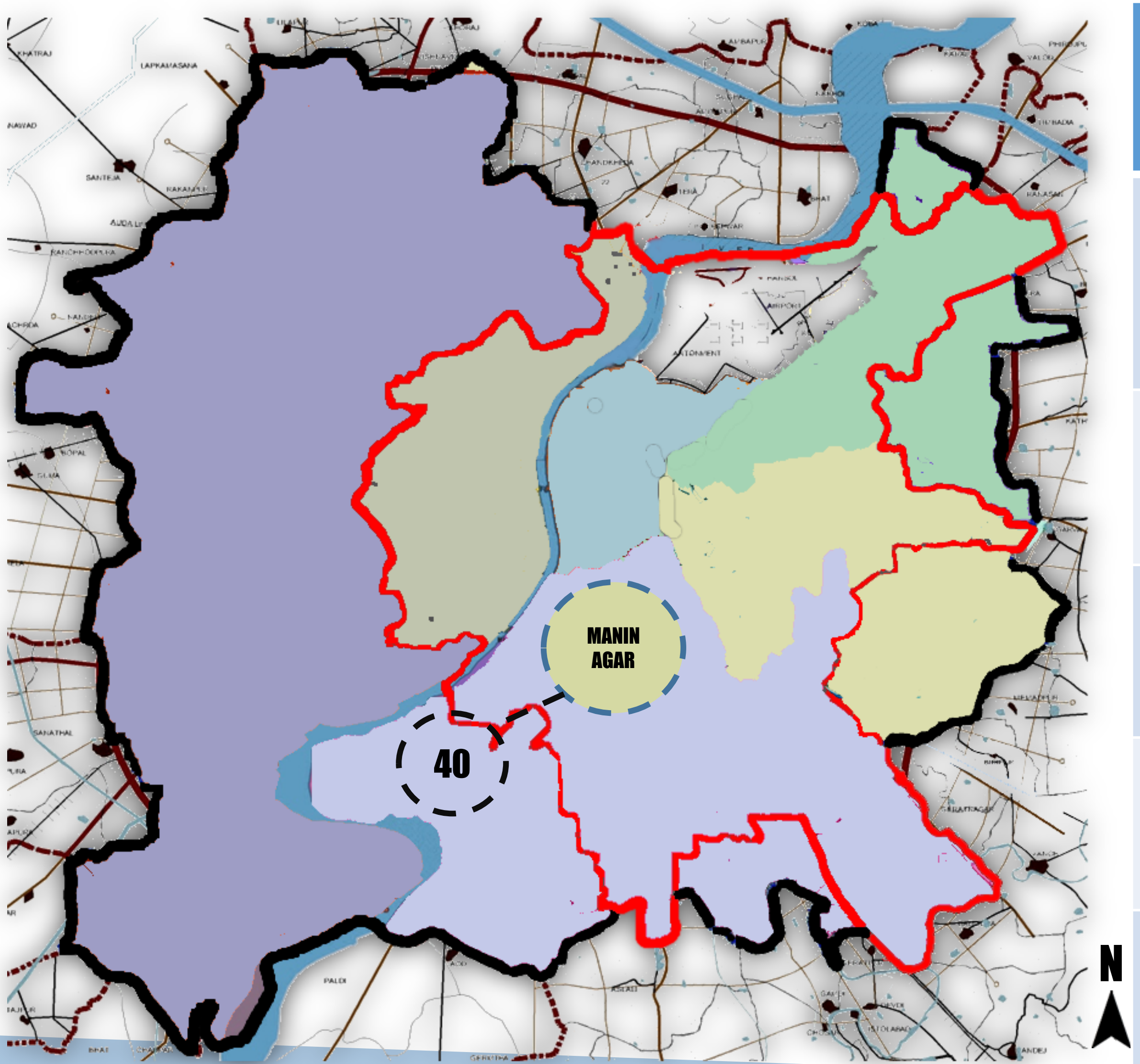
•Water Auditing and Leak detection survey in the areas of Kalupur and Maninagar where NRW is maximum

Ward	No of HH	Population
MANINAGAR	7339	33824
KALUPUR	11023	53630

NRW- Water Auditing and leak detection

Source: *Census 2011*

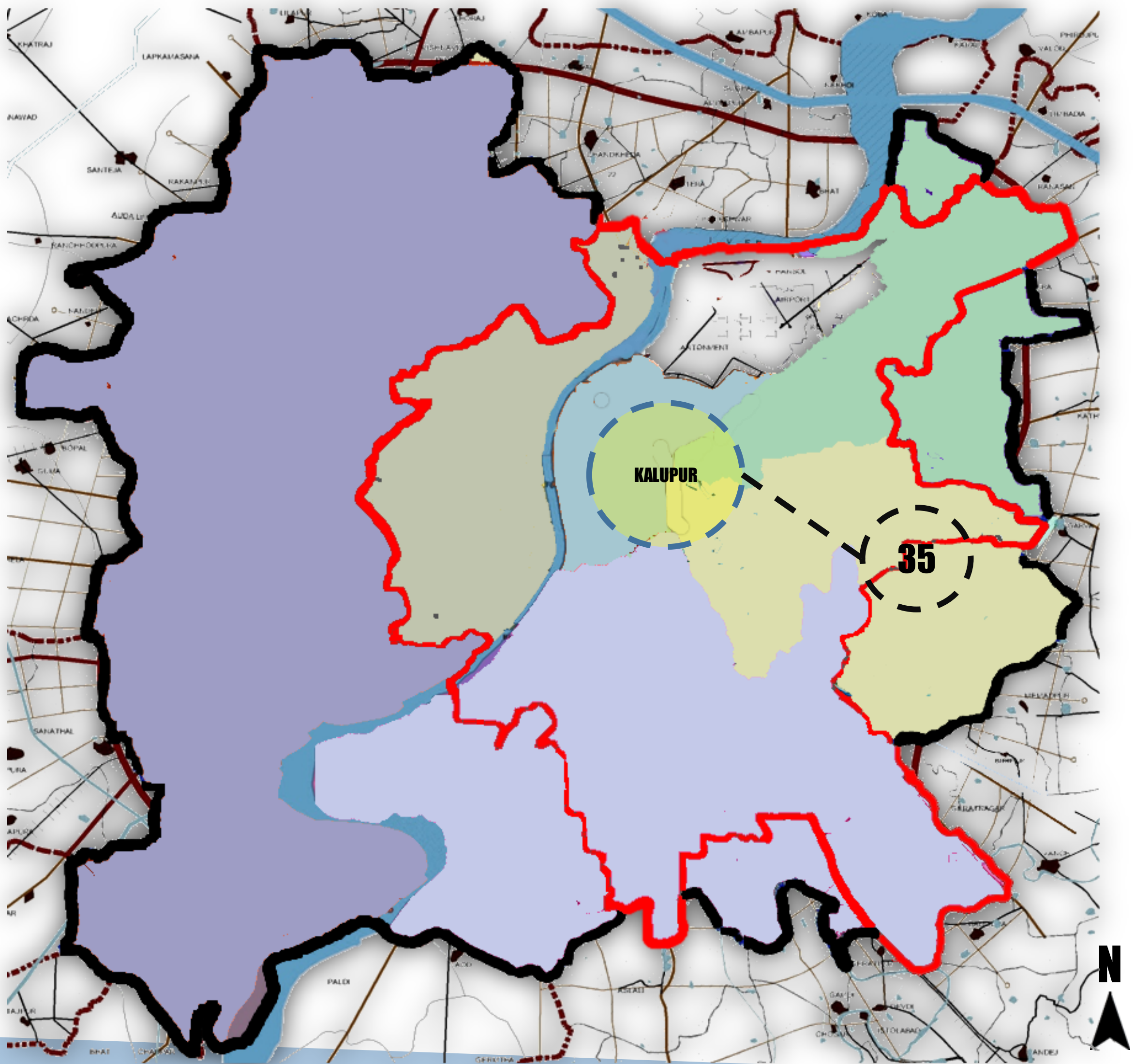
Water Audit and Leak detection : Maninagar Ward



Stages	Steps for Water Auditing	Days
Stage -1	Selection of samples from HIG, MIG, LIG and Slum	11
Stage -2	Availability of Isolation Valves	12
Stage -3	Pipe and Valve Survey Pipe & Valve survey	25
Stage -4	Checking of Existing Flow	7
Stage -5	Leak Detection Test-	20
	Overall days	75 days

NRW- Water Auditing and leak detection

Water Audit and Leak detection : Kalupur Ward



Stages	Steps for Water Auditing	Days
Stage-1	Selection of samples from HIG, MIG, LIG and Slum	14
Stage-2	Availability of Isolation Valves	16
Stage-3	Pipe and Valve Survey Pipe & Valve survey	29
Stage-4	Checking of Existing Flow	11
Stage-5	Leak Detection Test-	24
	Overall days	94

NRW- Upgrading Water Network maps

Costing for water Auditing at Kalupur and Maninagar Ward

Ward	No of HH	Population	Overall Project Cost
MANINAGAR	7339	33824	3.24 crore
KALUPUR	11023	53630	7.60 crore
Total cost			10.84

Overall cost= 13.2 Crore

Overall Project Cost includes

- Cost of Instruments
- Cost of Man power
- Cost of Ultrasonic Flow Meters.

Pressure Gauges.
Pipe Locators.
Leak Locators.
Sounding Rods.
Tanker and Pump unit

Source: *Census 2011*

Past Trends for Ahmedabad : Financial Assistance

Under Smart city Initiative

- 1 lakh crores sanctioned for ULB's
- 48000 crores
- 200 crore for Smart Ahmedabad
- 98 crores for three consecutive years

Looking at past trends, The contribution for the project

ULB:7 crores
GOG:2 crores
GOI:4.2 crores

Some past Trends under JNNURM

Approved Project cost for Ahmedabad=2390.7 crores

GOI share=836.6 crores
GOG share=358 crores
ULB share =1200 crores

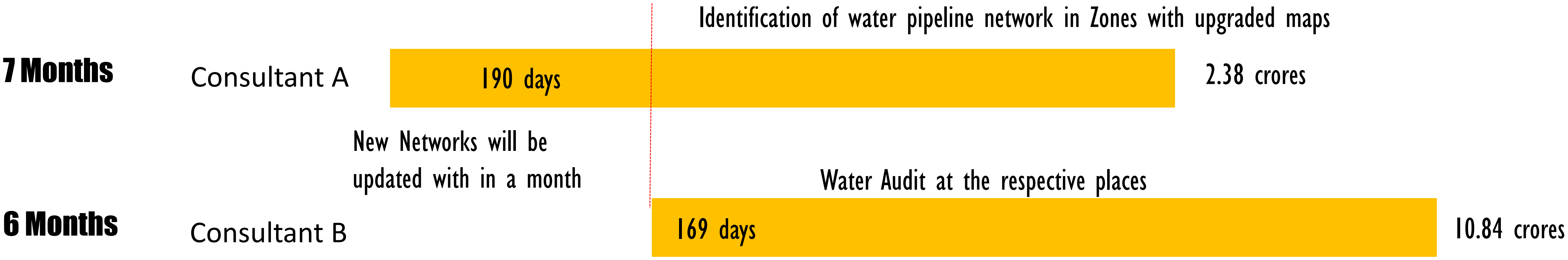
No of Approved Projects=26

Completed Projects(till sep 2013)=21

Overall Expenses on water sector of Ahmedabad=Nearly 500 Crores

Source: Smart city: MOUD, cse India.org

Scheduling of Projects



Monitoring of loss and management after water auditing through SCADA, manpower and capacity building exercise

Identification & Reduction of Illegal Connections through Institutional Framework

Why?

Overall 286 MLD loss @26% NRW

If reduced to **15%** NRW

121 additional MLD will be available without any additional capital cost

20 additional LPCD for supply will be available

15-20% of the total NRW

By Reducing Illegal Connections

21.2 MLD>>>>3.5 LPCD of water &

0.86 Lakh/day revenue expenditure will be saved (3.14 crore/year)

Water Supply Connections

Residential

Commercial

(Only if Adequate Pressure is Available)

Connections Provided

- 1.5 inch
- 0.75-1 inch
- 0.5 inch

HH Connections are provided based on the number of households & minimum force of water required; for Commercial- Based on the area; & for parks- 7 l/sq m/day

Residential Connection Fees- INR 250 (One time) + Digging Charges + Other
Commercial- One time fees based on the area + yearly Charges

Connection Criteria

- BU permission for new buildings
- Tax Bill & Legal Drainage Connection for Gamtal
- 0.5 inch connection for individual Buildings

Source: (AHO), AMC (New West Zone), (AHO) (ACE), AMC (North Zone)

Legal Connections

- The residential units are only provided water supply after getting a BU permission from the corporation
- The Gamtal houses are provided with connection on their property tax bill
- The Commercial Units are provided with a connection based on the BU permission & on the built up area, also they have to pay a yearly fees for the connection
- The Public Spaces under private contractor are not provided with

Illegal Connections

- The residential units without a BU Permission

-The Residential units connecting to the main line with the help of private plumbers

The consumer hasn't paid the tax

Source: (AHO), AMC (New West Zone), (AHO) (ACE), AMC (North Zone)

Present Actions

- There are no Patrols done for detecting the illegal connections
- There are no defined Fines or Punishments
- The illegal connections are only tapped after a complaint is made by a residential unit suffering from a low water pressure
- The illegal connection is sealed
- Very rarely the connection of a unit is sealed for not paying the tax
- No [illegible] actions [illegible] taken against the offender

Issues

- No Institutionalization/Allocation of responsibilities
- Lack of Human Resources
- No policy or reforms
- No fines or punishment for the offenders
- Lack of Awareness among the people
- No data management/record of number of illegal connections
- No scheduled maintenance or inspection
- Lack of network layout information

Rain Water Harvesting

Source: (AHO), AMC (New West Zone), (AHO) (ACE), AMC (North Zone)

Actions against illegal Connections In other Places

Case Study	Fines	Policy	Rules/ Regulations	Metering	Punishment	Institutionalization	Implementation-ULB/Pvt
Mumbai							ULB
Vellore							ULB
Delhi							ULB
Hyderabad							ULB
Goa							
Bangalore							
East African Region -LVV							ULB/Pvt
Bangkok							ULB/Pvt
Singapore							ULB/Pvt
Ahmedabad							

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Singapore							ULB/Pvt
Ahmedabad							

Proposed Framework

Institutionalizing
OR
Allocating New Roles & Responsibilities

Policy Formation

Define Fines

Publicity
&
Amnesty

Payment Agreement
&
Reward Mechanism

Water Network Patrols
&
Monthly Reports

Performance Indicators

Institutionalizing OR Allocating New Roles & Responsibilities

Formation of an Illegal Use Reduction Unit (IURU)

1 Unit for each Zone - 6 Total Units

Staff Required – Based on the Number of House Holds in the zone

Defining & allocating Roles & Responsibilities for:
-Periodic Maintenance
-Periodic Inspections
-Monthly Reports
-Imposing Fines & Collection
-Complaint Redressal

Policy Formation

Develop an Illegal Use Reduction Policy.
The top management together with the technical team should develop this policy / stand of the water supply system concerning illegal usage of water.

The **penalties** should as well be defined for instance if caught with any offence , in addition customers will pay additional charges

The policy has to be very **clear and practical.**

Define Fines

The **Fines or penalties** should as well be defined for instance if caught with any offence you will be charged a fine, in addition customers will pay **additional penalties;**

- **If the offence is an illegal connection,**
- **Reconnection offence,**
- **Tampered with or reversed the meter,**
- **Equivalent of 12 month average consumption if the offence is a meter by pass and**
- **An equivalent of 24 month of estimated average consumption if the offence is illegal connection**

Institutionalizing OR Allocating New Roles & Responsibilities		
>Formation of an Illegal Use Reduction Unit (IURU) 1 Unit for each Zone - 6 Total Units Staff Required – Based on the Number of House Holds in the zone **>Defining & allocating New Roles & Responsibilities for:** -Periodic Maintenance -Periodic Inspections -Monthly Reports -Imposing Fines & Collection -Complaint Redressal	**Institutionalizing** **Distribution of Roles and Responsibilities** **More human resource availability** **Additional Revenue Expenditure** **Management Issues**	**Allocating New Roles & Responsibilities** **Saving in Revenue Expenditure** **Less Management Issues** **More Burden on the current management system** **Lesser human resource availability**

Institutionalizing OR Allocating New Roles & Responsibilities

Formation of an Illegal Use Reduction Unit (IURU)

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- **An equivalent of 24 month of estimated average consumption if the offence is illegal connection**

Publicity & Amnesty

It is important to notify the public about our position as a water service provider on the issue of illegal use of water.
This can be done through all the modes of communication:

Radio announcements,
Public gatherings,
News papers
Distribution of fliers etc.

Amnesty

The number of people of illegal cases may be so many that dealing with each of them legally may be **uneconomical.**
Amnesty is therefore paramount at this stage. An amnesty period of **three month** is realistic, during which customers who declare that they have illegal connections will **not be penalized.**

Payment Agreement & Reward Mechanism For Informers

Where customers can not pay off fines at once, agreements can be signed with the culprits with clear **install payments on monthly basis.**

The date for the monthly payment (e.g. every **30th day** of the month) should be indicated as well in the **agreement for proper monitoring of the system**

Clear **reward mechanism** should be put in place. A **provision of funds** should be put in place preferably in form of replenish-able amount to facilitate quick payment of rewards

The reward can be either in the form of incentives or subsidies or cash payments (e.g. **30%** of the fine to the **informer** & **20%** to the **officer** who acts on it as an incentive)

Water Network Patrols & Monthly Reports

Areas where **mains intensification and extension** have been carried out

Follow up **suppressed accounts**

Revisit people **who once applied** for water and did not return

The IURU shall be required to keep **records** of **quantifiable performance indicators** to facilitate verification by the sub-committees

The evaluation of the performance of the IURI shall be carried out at the **end of each month** and each sub-committee shall highlight constraints experienced and proposed way forward

Performance Indicators

Define performance indicators for monitoring the efficiency of the system

Indicator	Unit
Investigation to unearth Illegal connection carried out	**No**
Illegal connections identified	**No.**
Total amount of fines invoiced to illegal consumers	**INR**
Amount of levied fines collected	**INR**
Percentage amount of levied fines collected	%
No. of disconnections of illegal cases effected	**No.**
No. of reconnections of illegal cases effected	**No.**

Cost

Benefits

Institutionalizing- 13.6 crore
Replenish-able Fund- 2.01 crore
O & M- 1.6 crore
Other- 0.30 crore

Total- 17.6 crore

A

Institutionalizing- 13.6 crore
Exemptions from revenue income- 4.02 crore
O & M- 1.8 crore
Other- 0.40 crore

Total- 19.82 crore

C

Pay Hike- 0.30 crore
Replenish-able Fund- 2.01 crore
O & M- 0.35 crore

Total- 2.7 crore

B

Pay Hike- 0.30 crore
Exemptions from revenue income- 4.02 crore
O & M- 0.5 crore

Total- 4.82 crore

D

- **Saving in Revenue Expenditure (21.2 MLD @ Rs 4/KL) = 3.1 crore**
- **Revenue generation** through **fines**
- **Reduction** in NRW (**15-20%** of total)
- **Extra water, 21.2 MLD/Day,** available for meeting the demand for a short term
- Improving the **quality** of the service
- Preventing water **contamination**
- **Better Planning** - reliable demand projections

Improving Financial Performance of water sector

Collection Efficiency

Cost Recovery-39% (SLB indicated it should be 100%)

Current Collection

69% Recovery

↓

31% ??

Arrears Collection

10% Recovery

↓

90%??

NRW-Improving Financial Performance of water sector

Source : pas.org.in, AMC budget, DCB Tables

Current Collection

69% Recovery

Why 31% ??

Reasons

- More than **15% of property** are **disputed and closed.**
- More than **10-15% duplicate property** billing has been generated.
- Online payment gateway is there but **right now its not working.**
- People are **not aware** of mobile collection van.

Arrears Collection

10% Recovery

Why 90%??

99 code property

- Property tax has been continuously added to arrears account of **sealed property**.

Source : pas.org.in, ,AMC Budget, DCB Tables, AMC west zone office

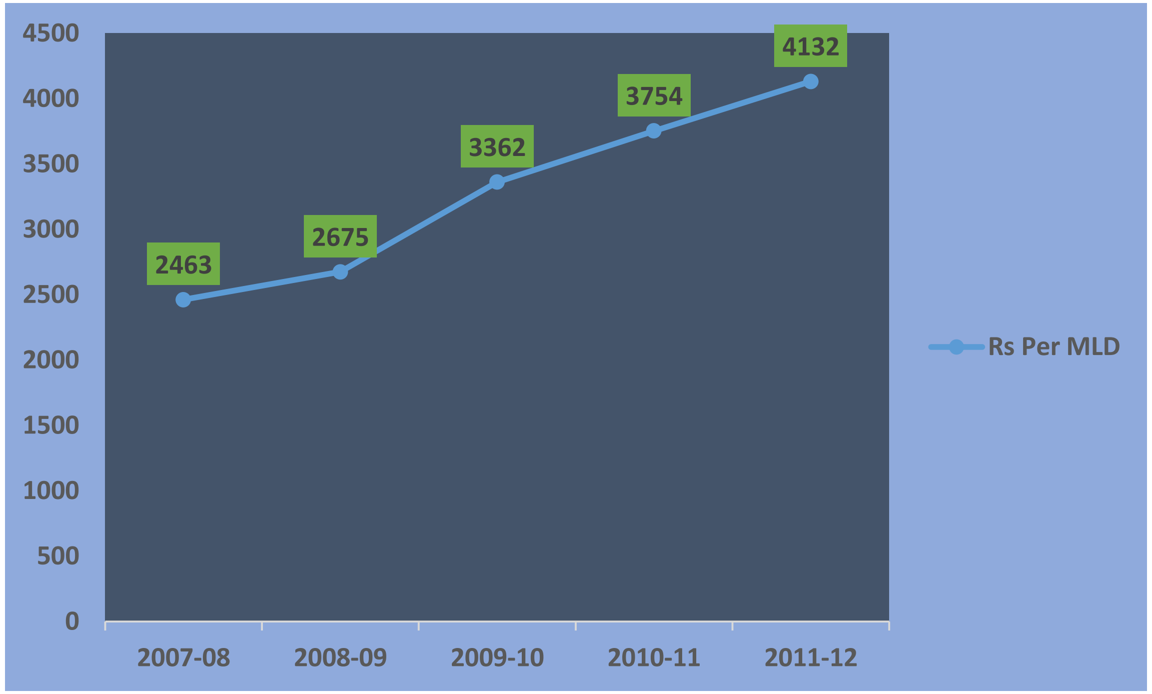
Proposal to Enhance Collection Efficiency

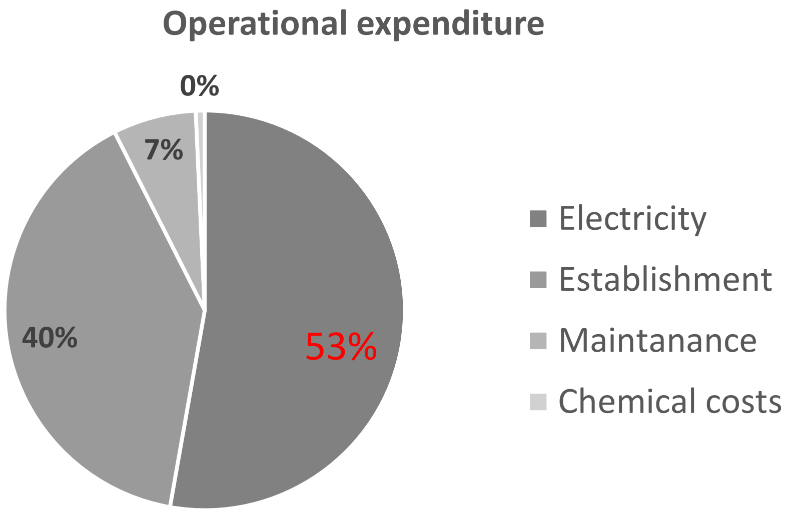
Collection Process	Current	Actions Reforms
▪ Presenting the bill	▪ Paper Bill	▪ Online ▪ Text message
▪ Responding to questions about the bill	▪ Public Service Walk in office	▪ Interactive online chat ▪ Smart phone applications ▪ Social media
▪ Processing debtor payments	▪ Manual paper check processing	▪ Non-traditional payment processors such as PayPal, Google Checkout, etc. ▪ Active online payment gateway
▪ Securing an involuntary payment	▪ Fines Levy ▪ Sealing the property	▪ Banking standards for automated e-levy transactions ▪ Electronic levies transmitted to banks.

Source : The next Generation of Government Debt Collection Practices by CGI Tax Collections Centre of Excellence

Increasing Cost Recovery

revenue expenses





Issues

Poor power quality

Deficit power supply

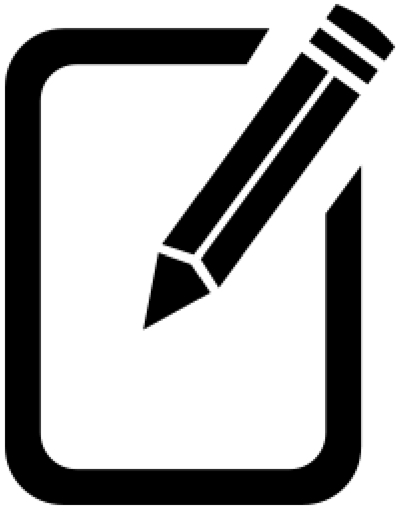
Single pump capacity

No provision of parallel pump.

NRW-Improving Financial Performance of water sector

Source : energy cost savings in municipal water pumping systems-need for web interactive tool by IJSST,AMC Budget, Student Thesis Shivnath Patil

Proposal to Reduce Electricity Cost



Energy Audit
(A performance based contract to measure potential savings in electricity)

Development of a Web Interactive Monitoring Tool.

Scope of work: **Measure potential savings in electricity.**

Area: **South Zone.**

Duration: **6 Months.**

Cost: **5 lacs.**

Particular	Instruments requirement	What to measure	Energy Cost Savings Parameters
A tender will float to measure potential savings in electricity.	Portable load manager	Transformer parameters	• Power factor. • Acting Power.(kW) • Apparent Power (demand, kVA). • Reactive Power (kVA). • Energy Consumption (kWh) • Frequency (Hz)
	Clamp on electrical power analyzers	Individual motor parameters	
	Ultrasonic water flow meter	Velocity and flow rate of water at the pump and in pipelines	
	Digital pressure sensor	Delivery head of the pumps	

Source : energy cost savings in municipal water pumping systems-need for web interactive tool by IJSST

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Particular	Instruments requirement	What to measure	Energy Cost Savings Parameters	Actions
A tender will float to measure potential savings in electricity.	Portable load manager	Transformer parameters	• Power factor. • Acting Power.(kW) • Apparent Power (demand, kVA). • Reactive Power (kVA). • Energy Consumption (kWh) • Frequency (Hz)	• **Installment of suitable sizing of pumps** • **Replacement of inefficient pumps.** • **Operating schedules.** • **Using parallel pump for supplying.** • **Penalties paid in lieu of maintaining low.**
	Clamp on electrical power analyzers	Individual motor parameters		
	Ultrasonic water flow meter	Velocity and flow rate of water at the pump and in pipelines		
	Digital pressure sensor	Delivery head of the pumps		

Source : energy cost savings in municipal water pumping systems-need for web interactive tool by IJSST

Duties of person at WDS	Duties of technical person
• Data entry of **Electrical system** and **pumps** and its configuration, specifications. • Also **operating hours** and **number of pumps** in use on daily basis.	• Analyze the **data monthly and daily basis.** • Look at the **expert services,** which can lead to pose questions to the **experts based on the data furnished.**

This will help the municipal staff to take necessary steps to **enhance the pumping system operating efficiency.**

Development of a Web Interactive Monitoring Tool.

Source : energy cost savings in municipal water pumping systems-need for web interactive tool by IJSST

Pump Manipulation
View Raw Water Pump
View Clear Water Pump
View Booster Pump
View Pump Station Details

Add Raw Water Pump
Add Clear Water Pump
Add Booster Pump
Add Water Pump Stations

Electrical Detail
Report

Web Based Energy monitoring System

User Name:
Password :
Submit

Pump House Details

Raw Water Pump

Total number of individual pumps in operation
Total number of parallel pumps in operation

Clear Water Pump

Total number of individual pumps in operation
Total number of parallel pumps in operation

Booster Water Pump

Total number of individual pumps in operation
Total number of parallel pumps in operation

Submit

Enter the following details the Water Pumping Station

Name of the scheme
Address
Location
Station-in-charge, Name
Contact Number
Year of Establishment
Installed Capacity, MLD
Operational Capacity, MLD
Add Pump Station

Source : energy cost savings in municipal water pumping systems-need for web interactive tool by IJSST

The rated details of clear water pump and motor

The Rated Details of the pump

Name of the pump
Make
Model
Flow
Head
Pump efficiency
Connected rotor
Speed

Submit

Pump Added Successfully
Pump Added Failed

Enter the Details of the motor

Make
Frame
Voltage
Current
Output Power
Motor Efficiency
Connected rotor
Power Factor
Speed

Electrical Demand Management

Station ID
Contract Demand, kVA
Minimum Billing Demand, kVA
Operating Demand, kVA
Power Factor
Other Loads
Assed peak Load

Parallel pump operation

The Measures Values for the Booster Pump
Pump ID
Flow, cubic m/hour
Discharge Head, m
Suction Head, m
Total Head, m
Power, kW
Operating Efficiency of this pump %
Assumed Motor Efficiency %
Evaluated Efficiency %

Submit

NRW-Improving Financial Performance of water sector

Source : energy cost savings in municipal water pumping systems-need for web interactive tool by IJSST

Water Pricing
(Tariff Revision)

Financial Cost	Economic Cost	Environment Cost
O&M Cost.	Resource Cost.	Over abstraction of Ground water.
Capital Costs.	Opportunity Costs.	Scarcity value of water.
Cost of Servicing capital		Pollution due to the utility.
Institutional capacity building and Skills training.		
Monitoring and Assessment.		

Source : Student Thesis (Juhi Gajjar EP0612)

Water Pricing
(Tariff Revision)

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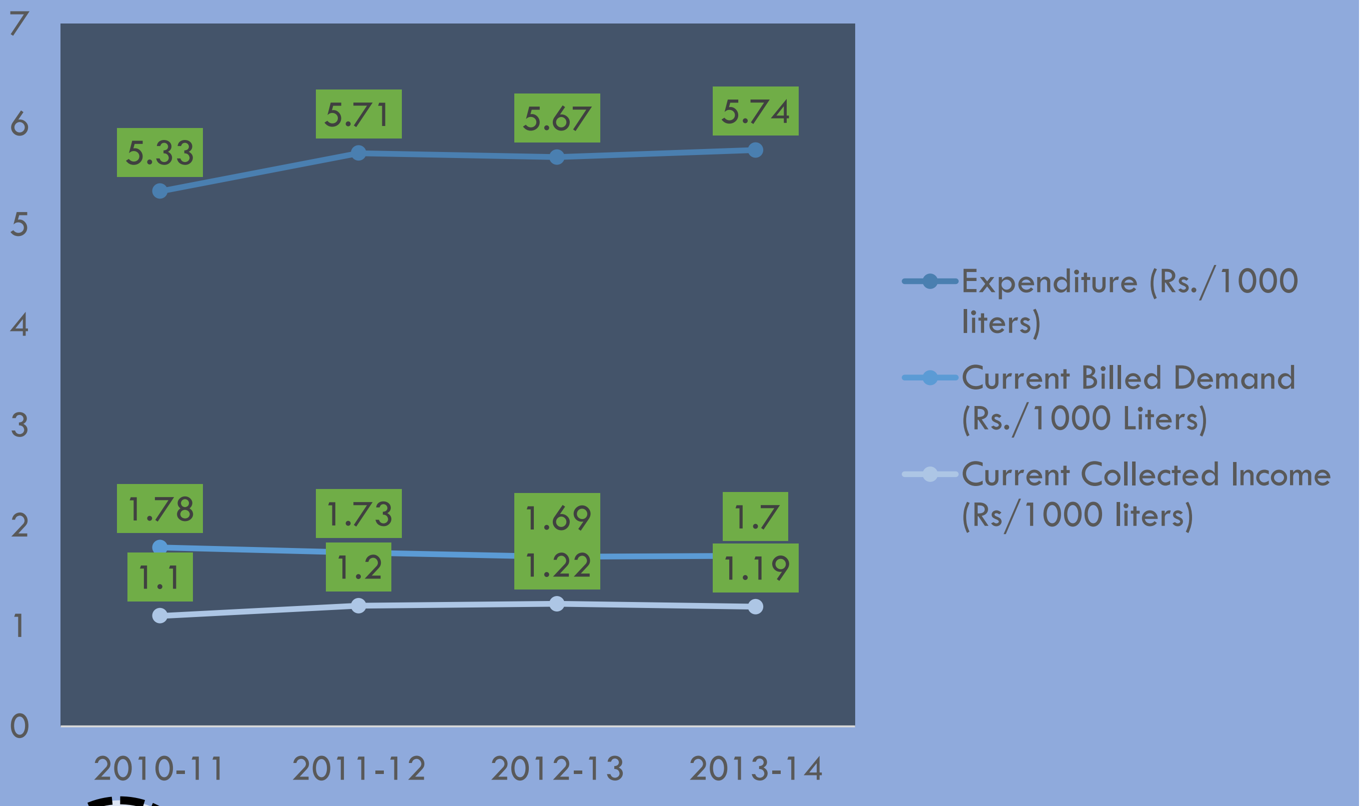
Water Pricing
(Tariff Revision)

Water Supply Budget Particulars	(2008-09) actual	(2009-10) actual	(2010-11) actual	(2011-12) actual	(2012-13) actual	Rs. In Crore (2013-14) actual
Revenue Receipts	80.52	112.40	127.10	136.81	150.71	201.94
Revenue Expenditure	117.76	147.96	166.14	171.59	206.98	214.66
Surplus/Deficit	-37.24	-35.56	-39.04	-34.78	-56.27	-12.72
Operating Ratio	1.46	1.32	1.31	1.25	1.37	1.06



NRW-Improving Financial Performance of water sector

Rain Water Harvesting

Source : AMC Budget

Current Water Tariff

CARPET AREA (Sq M)		Rate in Rs. Residential	Rate in Rs. Non-Residential
FROM	TO		
0	15	348	600
15.01	25	600	1080
25.01	50	960	1440
50.01	100	1440	2400
100.01	200	2100	3600
200.01	500	3750	6000
500.01	999999	7500	11250

Proposal Water Pricing

Rs In Crore

(Tariff Revision)

	Tariff Structure Revision	
	0-5 years	**After 5 years**
	A clause of **household size** will be added in current water tax which is linked to property tax	**Increasing Block tariff**
Rationale	It will help roughly to consider **water consumption pattern.**	**Consumption based pricing**

NRW-Improving Financial Performance of water sector

Rain Water Harvesting

Source : water policy 2014

Project Activities	Level of intervention: City	Zone	Ward	Duration	Capital Cost	Revenue Income/saving	Revenue expenditure	Other Benefits (Quality, Data, Monitoring, Augmentation)
Data Base Management System	✓ ✓	✓ ✓	✓	0-1--3 3-- >5	----	----	----	
Bulk Metering	✓ ✓	✓ ✓	✓	0------4	3.15	----	----	
Upgrading Water Network, Water Audit and Leak detection	✓			0--1 1-- --4	7	----	1.5	
Identification of Illegal Connection through Institutional Framework				0------- >5	----	>3.1	19.8	
Imp[illegible]g Fin[illegible] Perf[illegible]nce				0------- >5	2.24	----	----	

NRW- Summary

24x7 water supply in Ahmedabad

What is 24x7?

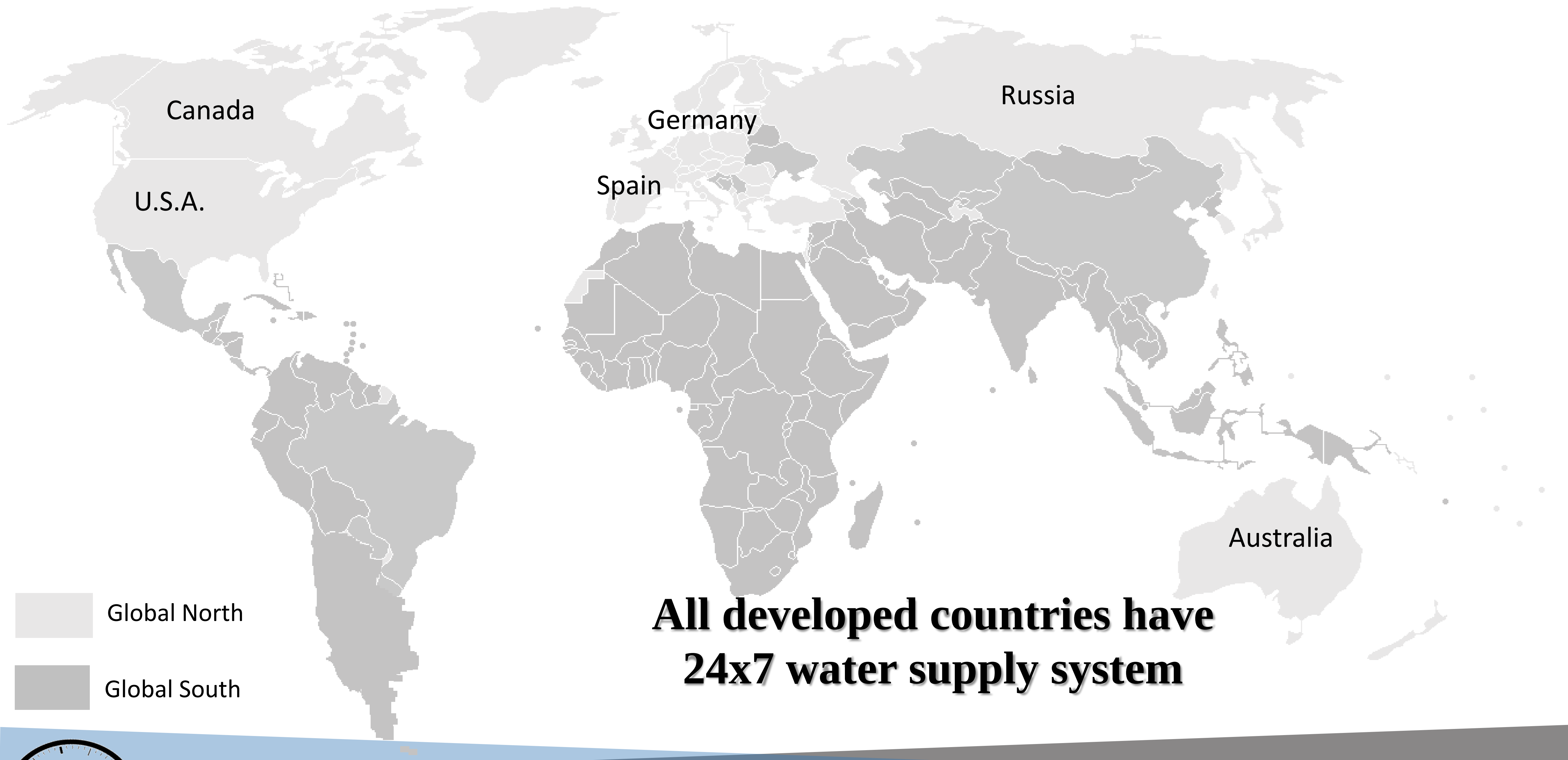
CPHEEO

"24x7 water supply can be achieved when water is **delivered continuously to every consumer** of the service **24 hours a day, every day of the year**, through a transmission and distribution system that is **continuously full and under positive pressure"**

MOUD,24x7 guidelines

"The **supply of potable water** to end users through a system of pipes – comprising interlinked bulk transmission and/or distribution systems – which are continuously full and under positive pressure throughout **their whole length**, such that the **end user may draw off water at any time of the day or night, 24 hours a day, every day of the year**".

Source :MOUD guidelines,Cpheeo manual, complied source



All developed countries have 24x7 water supply system

World wide scenario

SOURCE： http://www.targetmap.com/ThumbnailsReports/22317_THUMB_IPAD.jpg,

24X7 WSS DOES NOT DEPEND ON ECONOMY OF THE COUNTRY.

City,Countary Name	GDP (US $ Trillian)	GDP - per capita (PPP) (US$)
Kuala Lumpur, Malaysia	305033	15,800
Bangkok, Thailand	365966	9,500
Chengdu, China	8227103	8,500
Shanghai, China	8227103	8,500
Male, Maldives	2222	6,405
Colombo, Sri Lanka	59423	5,700
Jakarta, Indonesia	878043	4,700
Manila, Philippines	250182	4,100
India	1842321	3,700
Ho Chi Minh, Vietnam	155820	3,400
Tashkent, Uzbekistan	51113	3,300
Vientiane, Laos	9418	2,700
Phnom Penh, Cambodia	14038	2,200
Dhulikhel, Nepal	18963	1,300
Kampala, Uganda	19881	558

ASIA

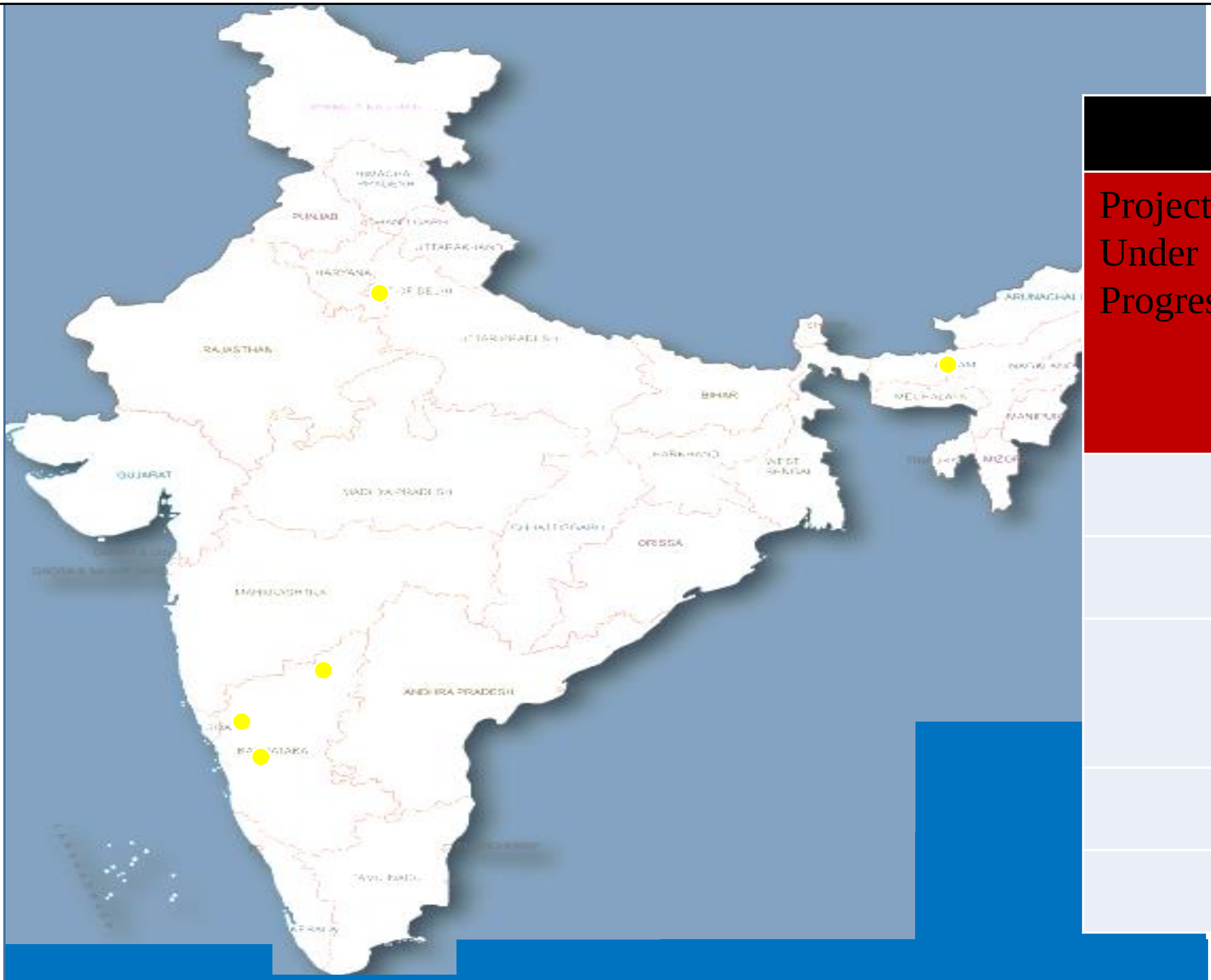
Asian country scenario

SOURCE : Asian Countries:(http://www.asci.org.in/asciicap/DAY1% 20ASCI% 20ICAP .pdf) V. Srinivasan Chary, ASCI (schary@asci.org.in)."Public Private Partnerships (PPP) in Urban Infrastructure and Service Delivery." 2009, Al Countries GDP and per capita GDP :http//data.worldbank.org/country,12,December,2012, http://data.un.org/CountryProfile.aspx?crName=Uganda , 12,December,2012
MAP:http://www.indexmundi.com/map/?t=0&v=67&r=as&l=en,21,January,2014

Indian Scenario of Implementation 24x7 Water supply System

2000

2003



24x7 Water Supply Project		
Project Under Progress	Project Preparatory Phase	Project Under Consideration
	Delhi	
	Gulbarga	
	Hubli-Dharwad	
	Belgaum	
	Guwahati	

SOURCE : K. E. Seetaram and Geoffrey Bridges. Helping India Achieve 24x7 Water Supply Service. Water Sector Technical Note 1. Bangalore: Asian Development Bank (ADB), 2010 , V. Srinivas Chary, ASCI (schary@asci.org.in). "Public Private Partnerships (PPP) in Urban Infrastructure and Service Delivery." 2009, Guideline notes for continuous water supply. Guideline. Delhi: Water and Sanitation Program, MOUD (2009), Ministry of Rural Development and Water and Sanitation Program. Towards Drinking Water Security in India: Lessons from the Field. Delhi, 2011. Literature Review

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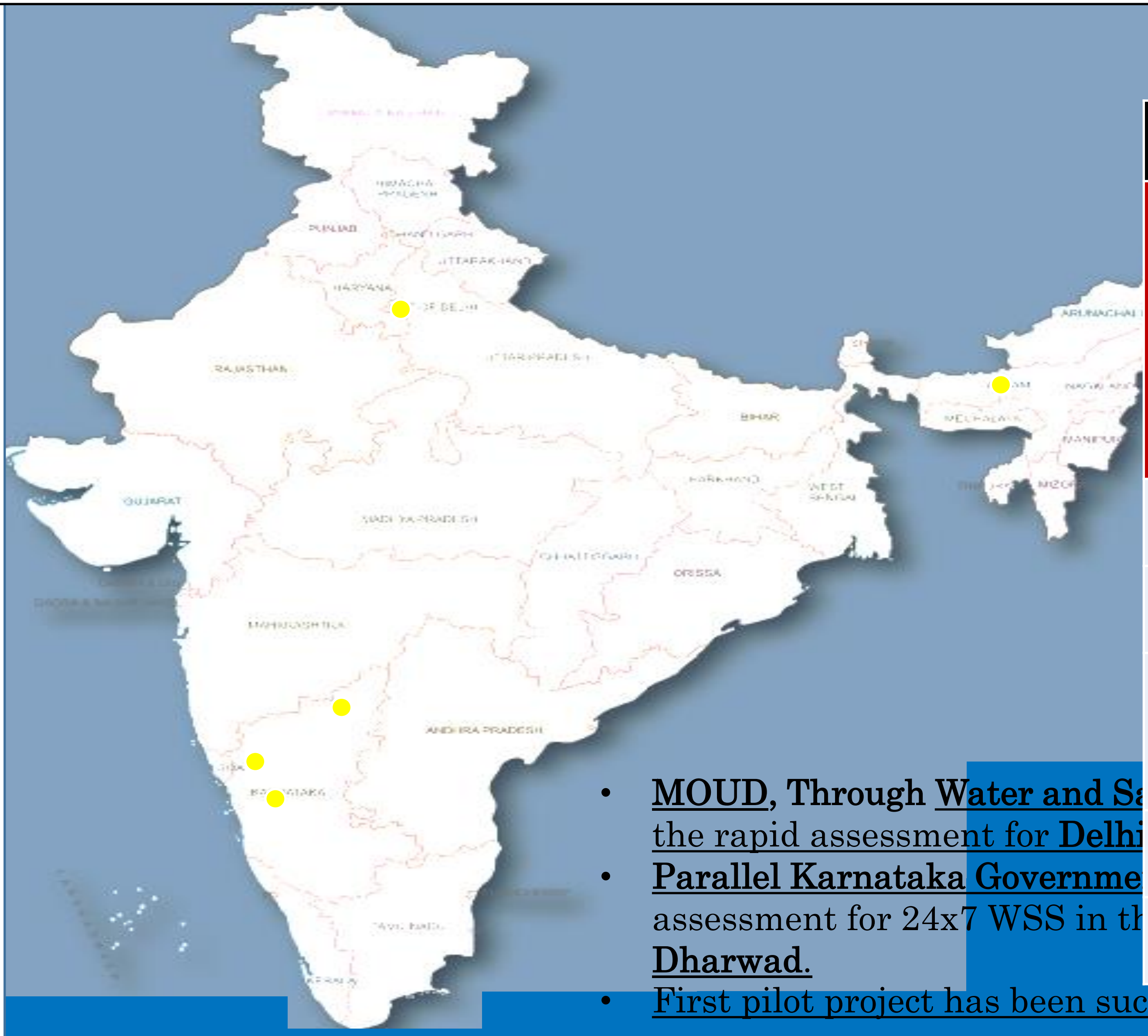

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Project Under Progress	Project Preparatory Phase	Project Under Consider ation
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	Hubli-Dharwad	
	Belgaum	
	Guwahati	

- **MOUD**, Through **Water and Sa**
  the rapid assessment for **Delhi**
- **Parallel Karnataka Governme**
  assessment for 24x7 WSS in th
  Dharwad.
- First pilot project has been successfully implemented in Karnataka

SOURCE : K. E. Seetaram and Geoffrey Bridges. Helping India Achieve 24x7 Water Supply Service. Water Sector Technical Note 1. Bangalore: Asian Development Bank (ADB), 2010 , V. Srinivas Chary, ASCI (schary@asci.org.in). "Public Private Partnerships (PPP) in Urban Infrastructure and Service Delivery." 2009, Guideline notes for continuous water supply. Guideline. Delhi: Water and Sanitation Program, MOUD (2009), Ministry of Rural Development and Water and Sanitation Program. Towards Drinking Water Security in India: Lessons from the Field. Delhi, 2011. Literature Review

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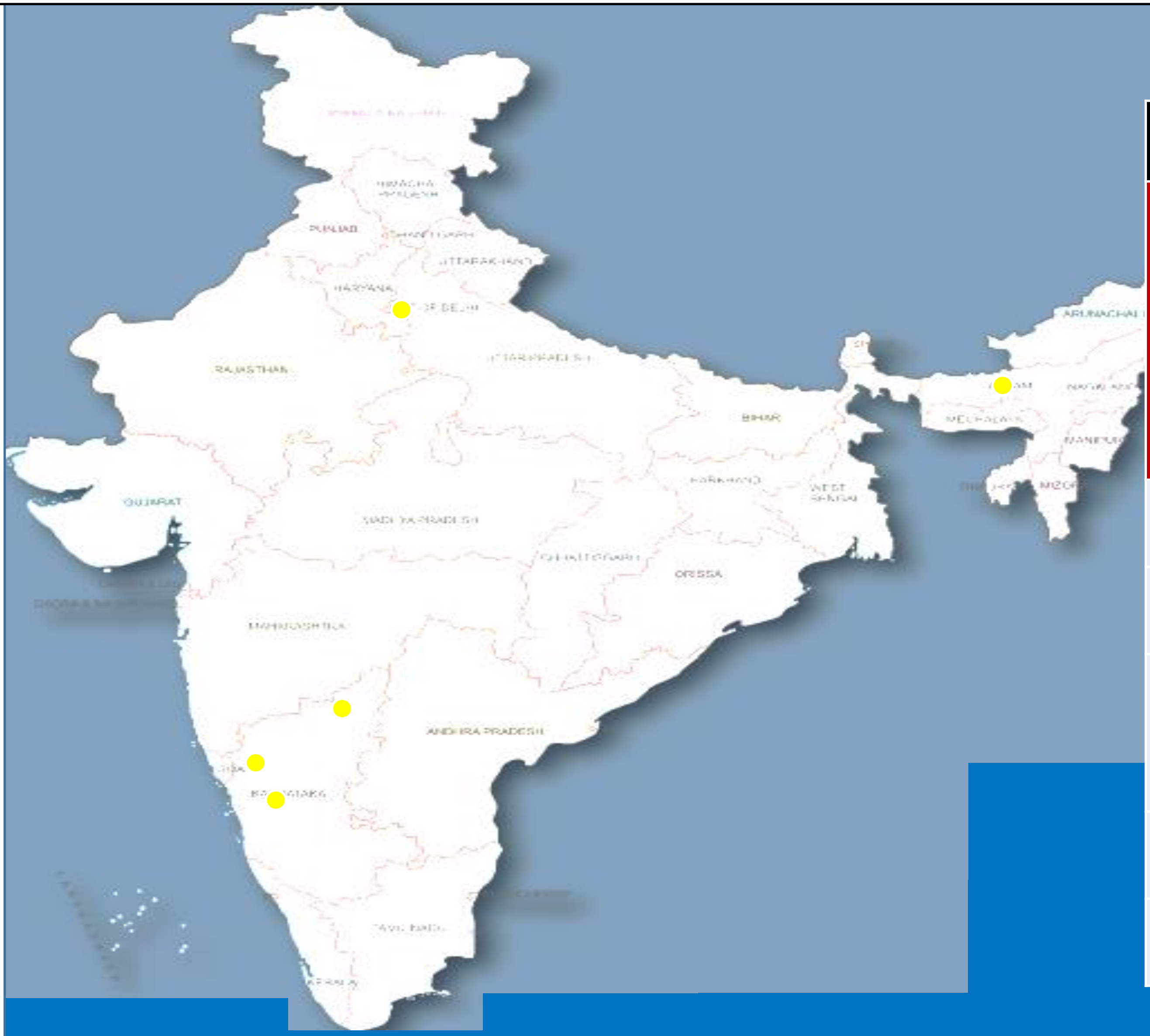

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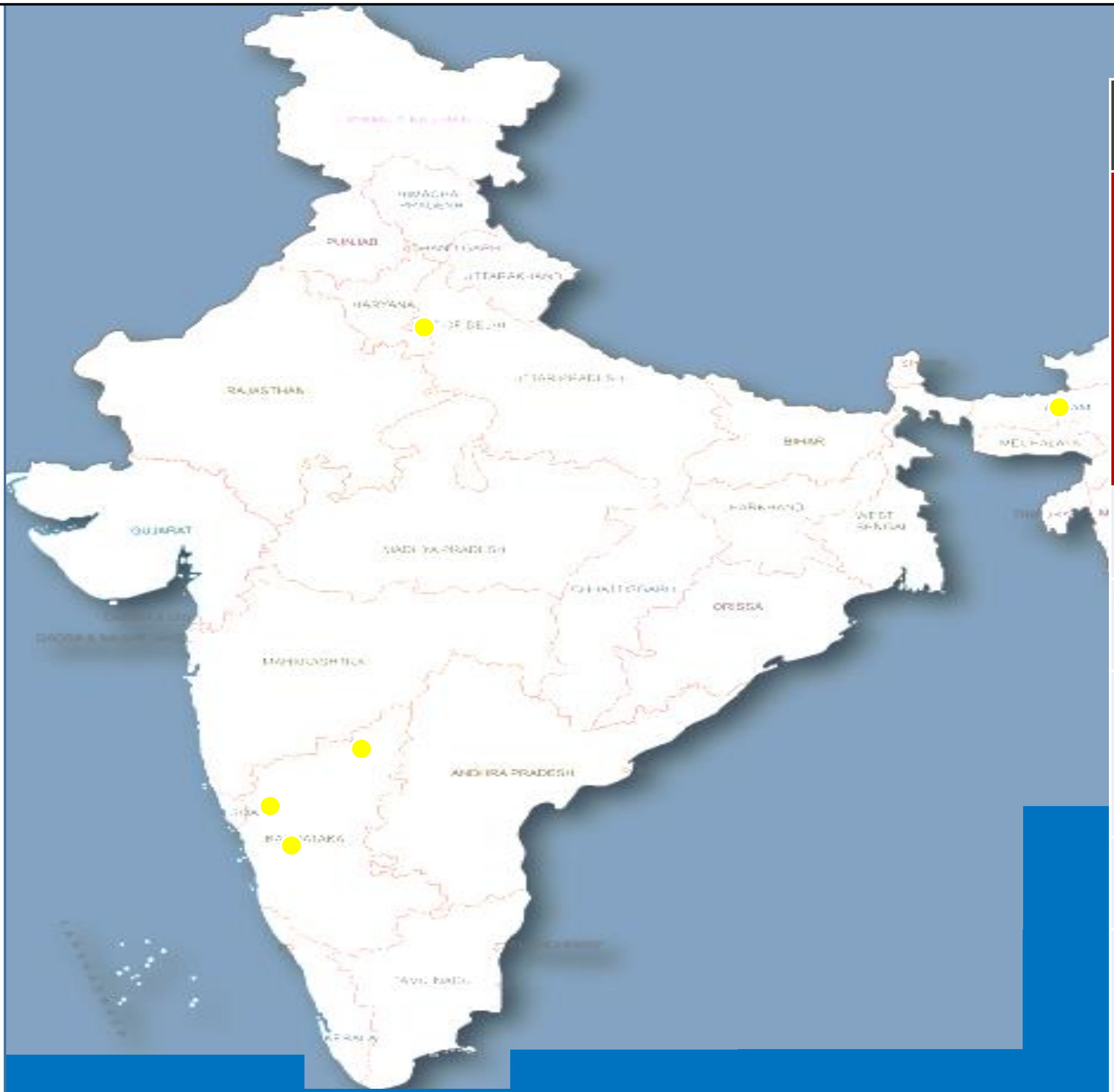

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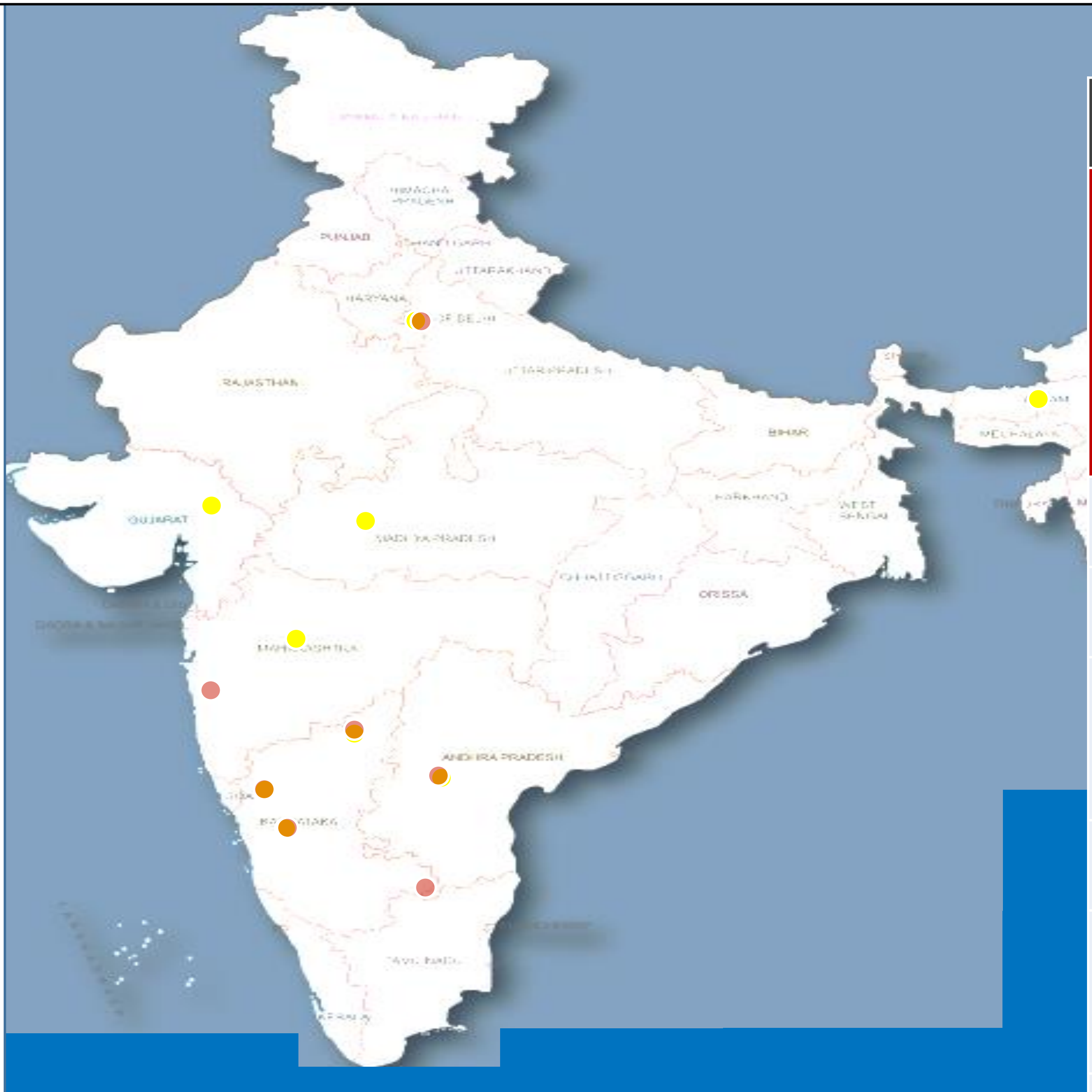

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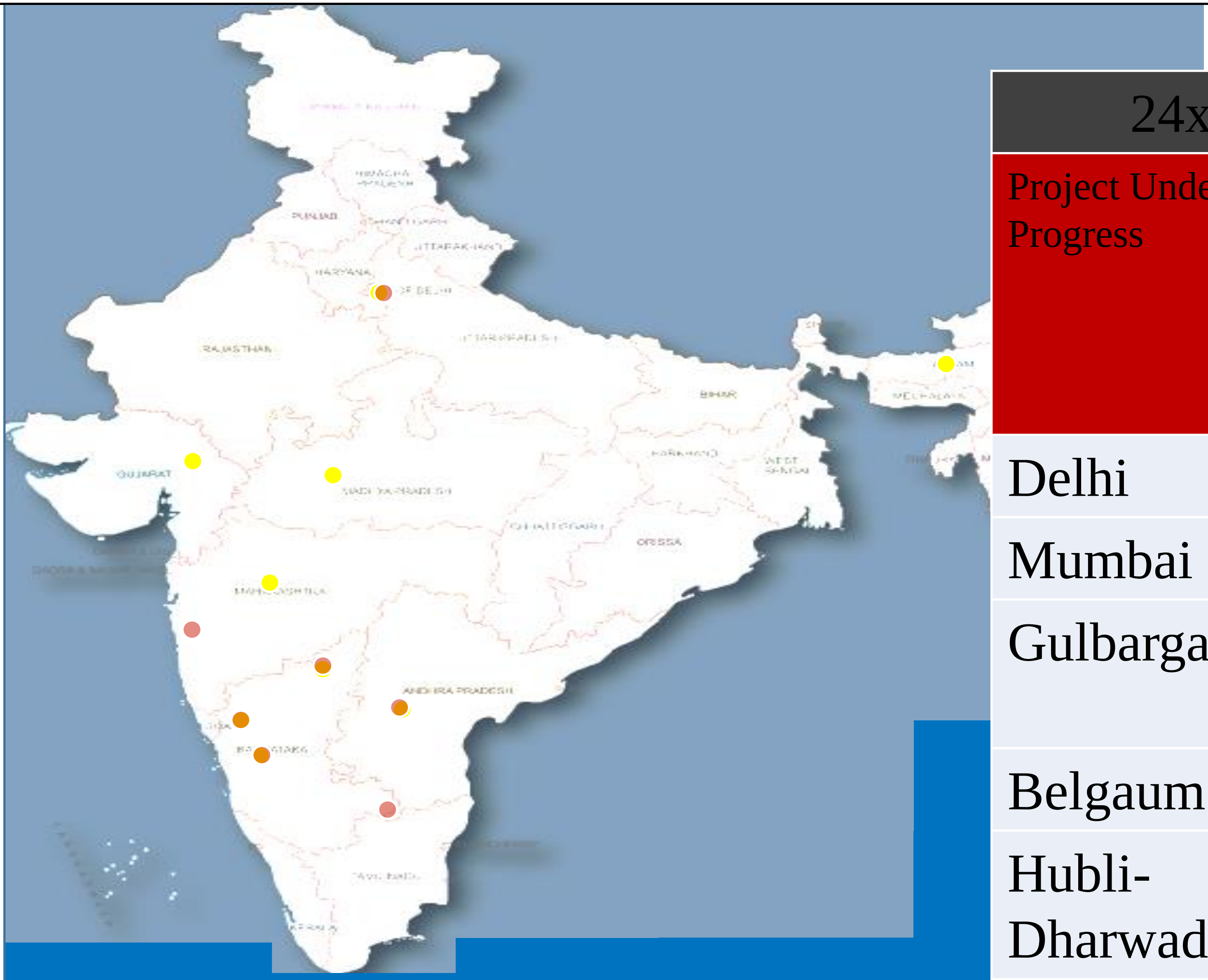

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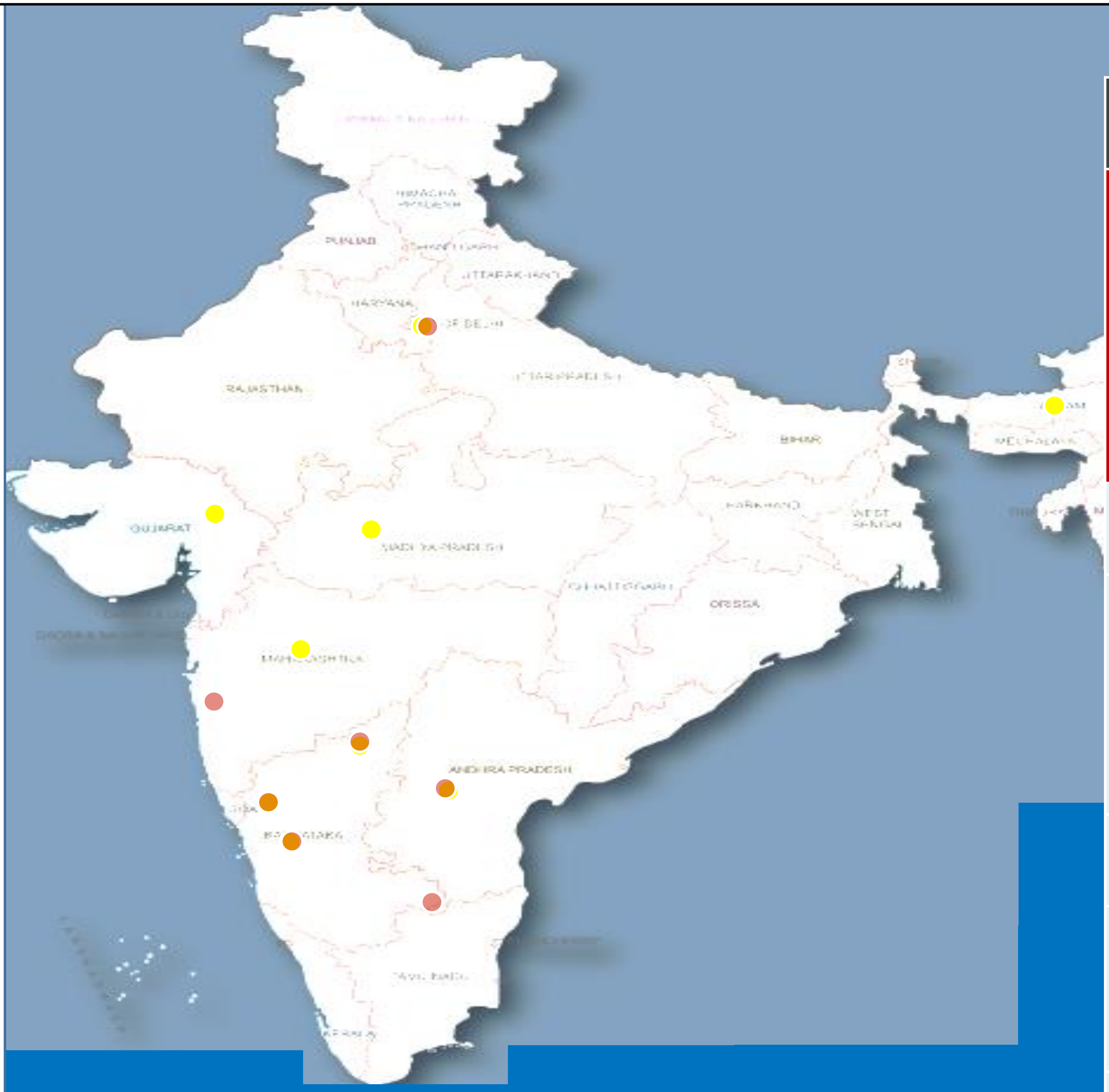

24x7 Water Supply Project		
Project Under Progress	Project Preparatory Phase	Project Under Consideration
Badlapur	Nagpur	Amravati
Pimpari Chinchwad	Hyderabad	Latur
Pavur	Vijayawada	
Chennai	tedepalligudem	
Cuddapah	Miryalaguda	

SOURCE : K. E. Seetaram and Geoffrey Bridges. Helping India Achieve 24x7 Water Supply Service. Water Sector Techni
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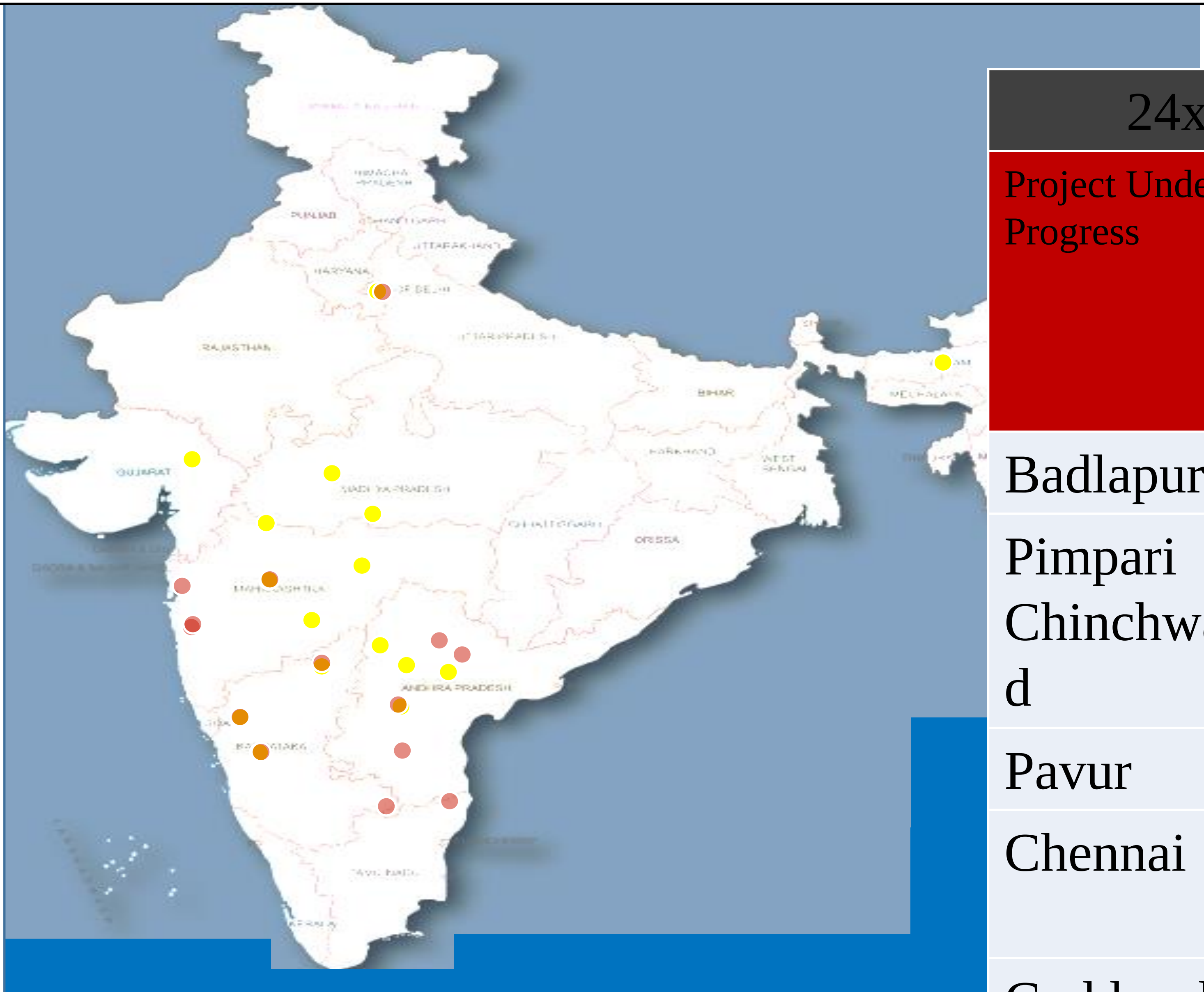
Indian Scenario of Implementation 24x7 Water supply System

2000

2003

2005

2007



24x7 Water Supply Project		
Project Under Progress	Project Preparatory Phase	Project Under Consideration
Badlapur	Nagpur	Amravati
Pimpari Chinchwad	Hyderabad	Latur
Pavur	Vijayawada	
Chennai	tedepalligudem	
Cuddapah	Miryalaguda	

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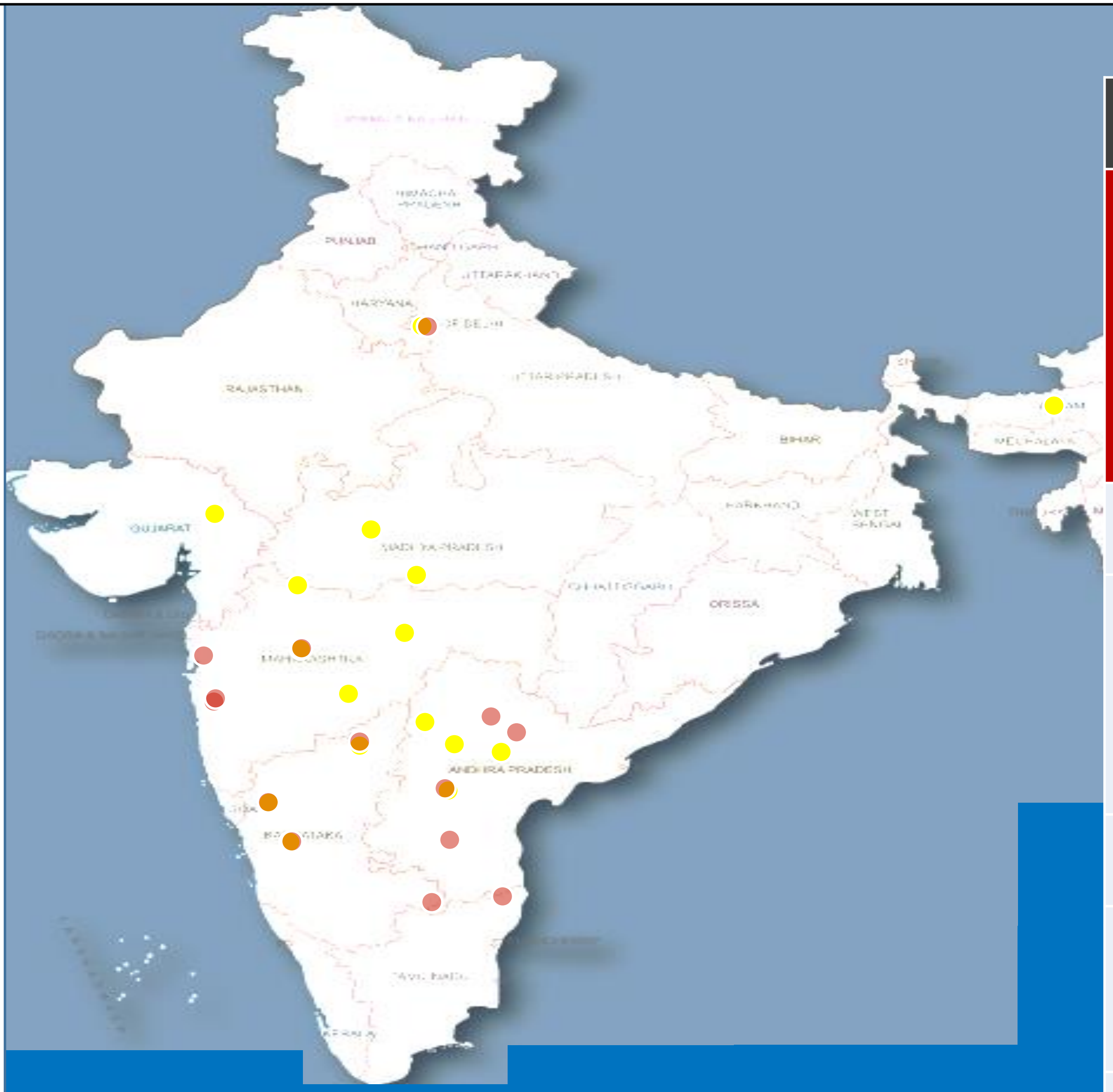

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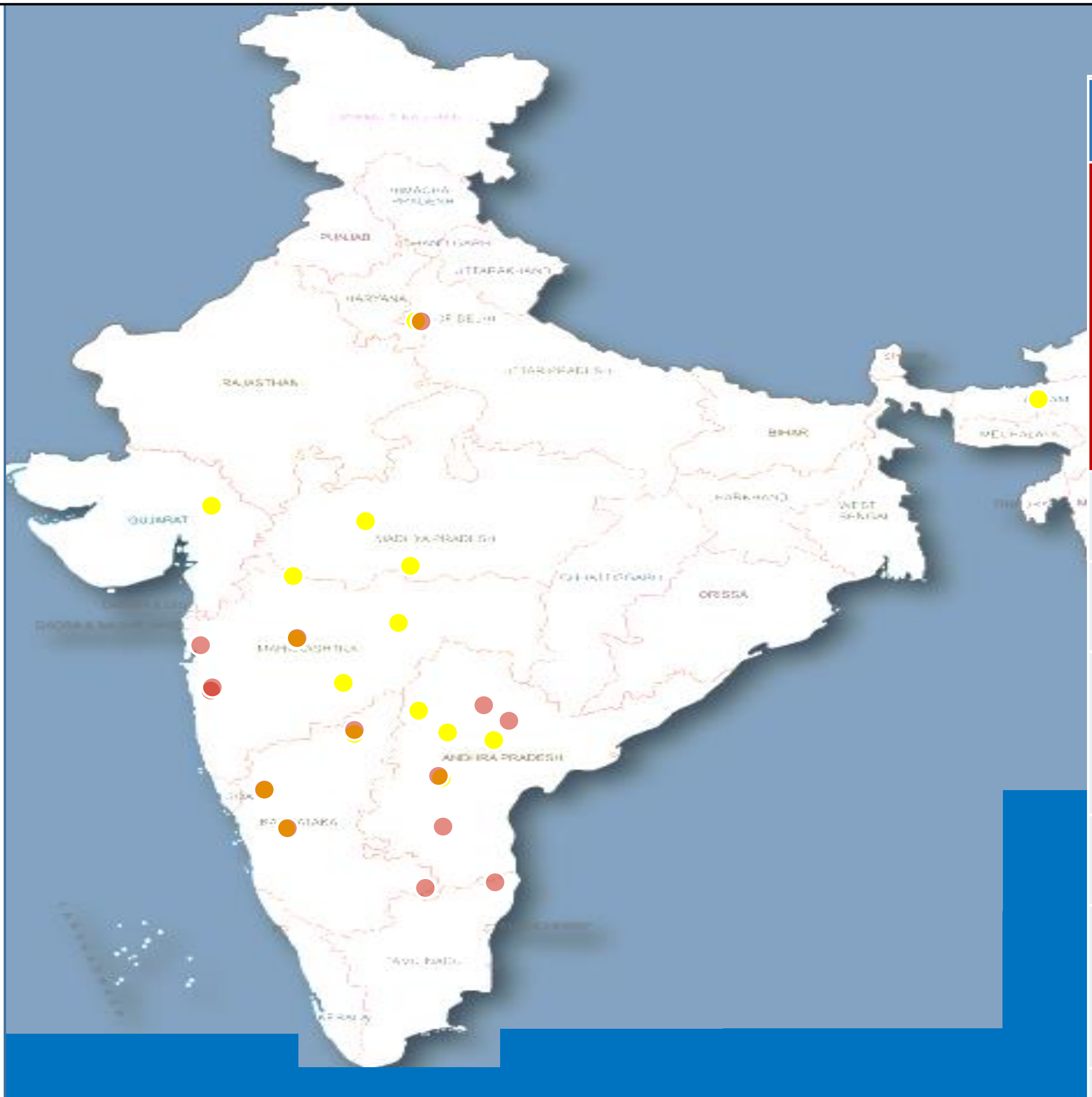

24x7 Water Supply Project		
Project Under Progress	Project Preparatory Phase	Project Under Consideration
Latur	Morbi	Panvel
Nagpur	Wardha	Jalna
Hyderabad	Ambarnath	Anchalapur
Vijayawada		Gondia
tedepalligudem		Ichalkaranji
Miryalaguda		

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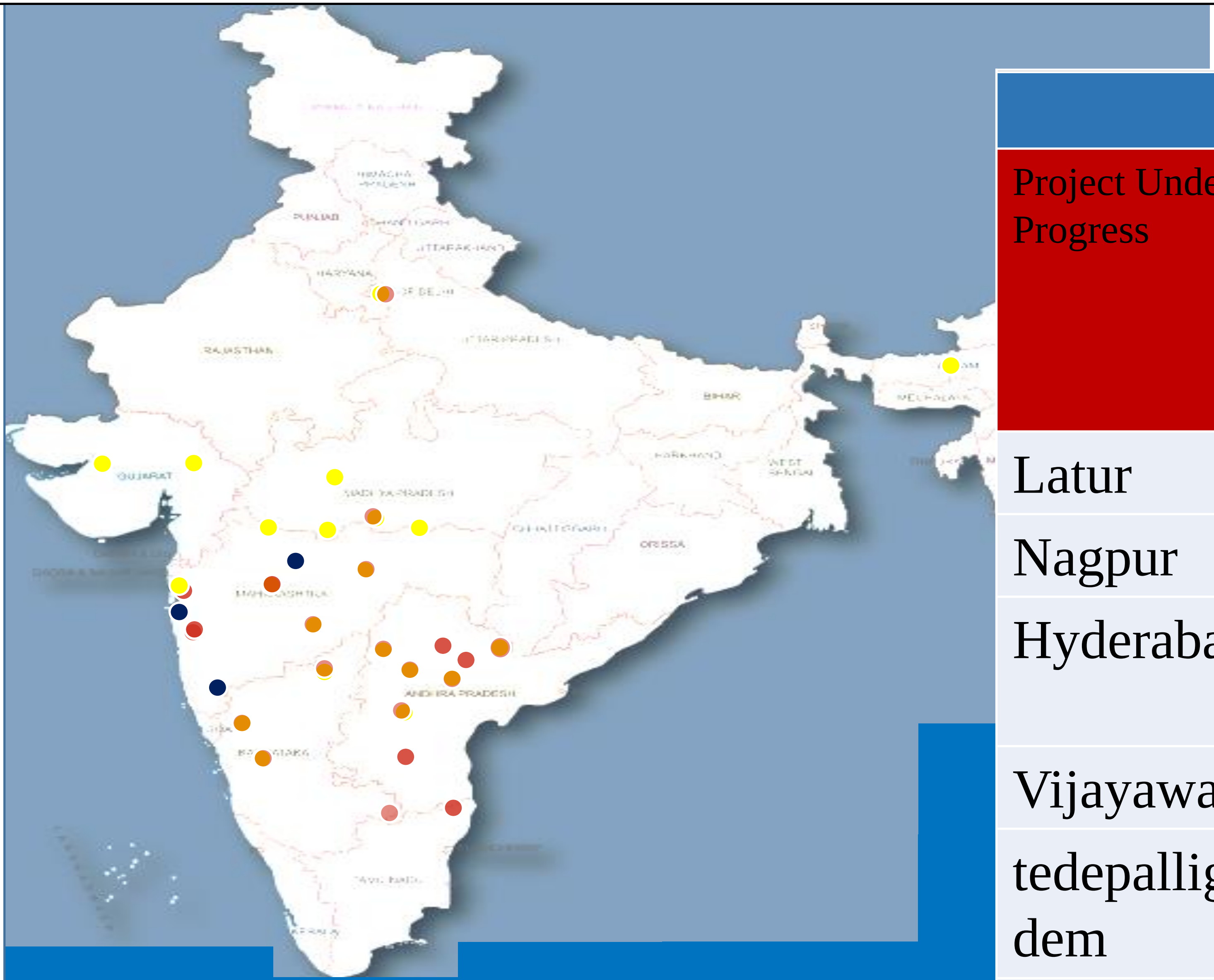

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SLB: Continuity of supply is measured as the average number of hours of pressurised water supply per day. Water pressure should be equal to or **more than a head of 7 metre (m) at the ferrule point/meter point for the connection**

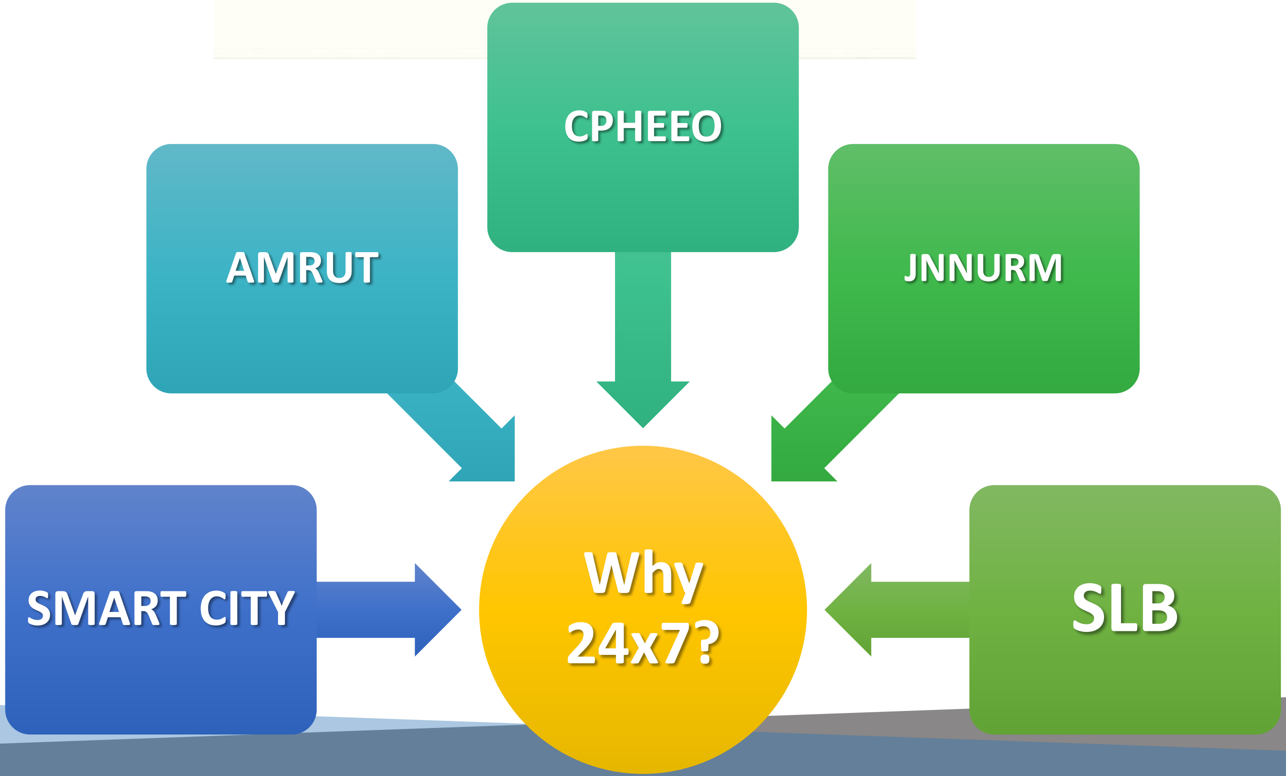
Smart City

MISSION TRANSFORM-NATION

CPHEEO & JNNURM: 24-7 supply is achieved when water is delivered **continuously to every customer of the service 24 hours a day,** every day of the year, through a transmission and distribution system that is continuously full and **under positive pressure** throughout all of its pipelines and networks.

अमृत

Atal Mission for Rejuvenation and Urban Transformation



JnNURM

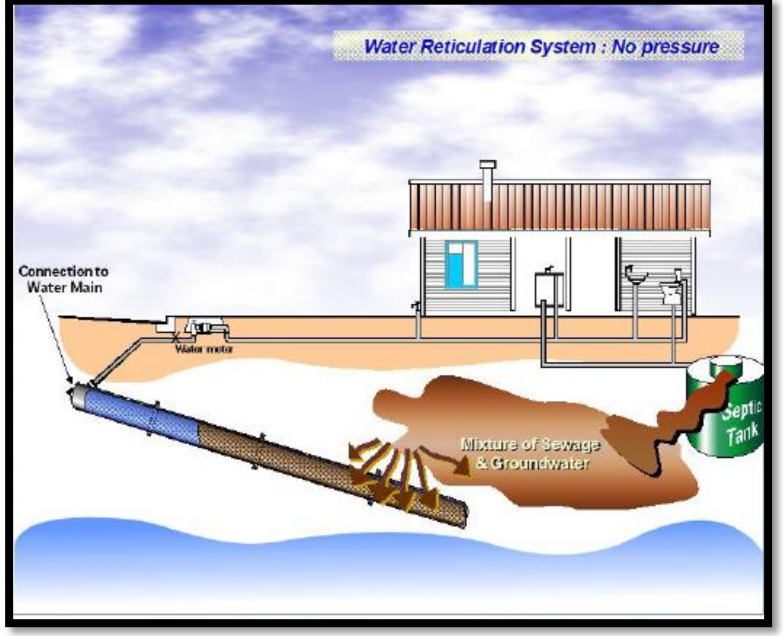
WHY 24x7?

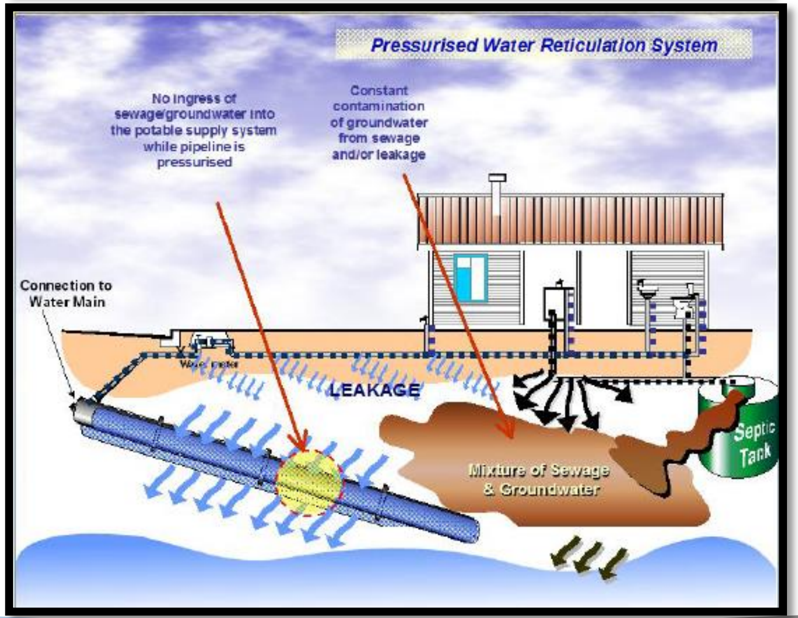
Source: SLB,CPHEEO manual, JNNURM reforms,Amrut guidelines, smart city guidelines

Advantages of 24x7 over intermittent water supply

- ✓ Continuous water supply at desired pressure.
- ✓ No Contamination of water
- ✓ Beneficial to poor-Better Service to Consumer
- ✓ Less storage & Reduction in wastage of water
- ✓ Better Accountability
- ✓ Sustainability of system

24x7

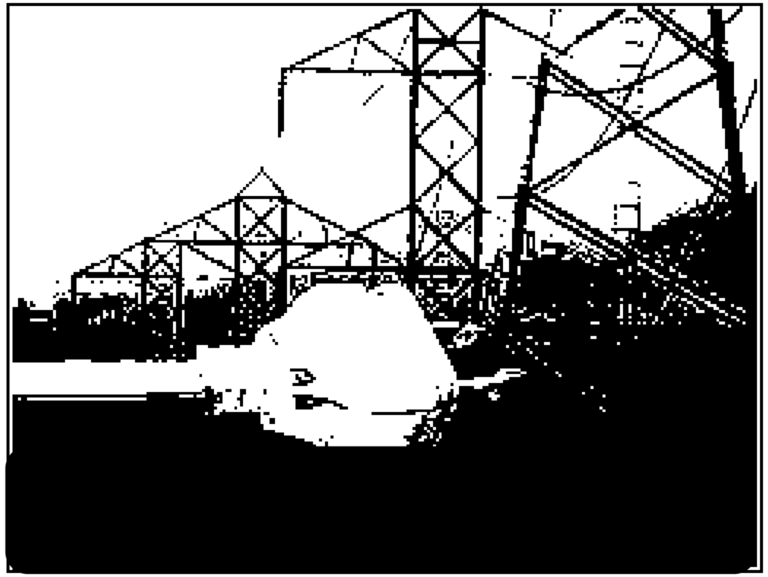




Intermittent water supply

- ✓ Time constrain
- ✓ Poor quality of water
- ✓ leads to increased pumping costs,
- ✓ Oversized pipes mains, underutilized reservoirs ,
- ✓ reduced lives of pipes and valves due to wide changes in pressure

Source: google.co.in



"Politicians don't want to charge people??" or "People don't want to pay??"

"We don't have enough water in a water-scarce country to supply continuous water"

"We have intermittent power supply so how can we expect to have continuous water supply?"

24x7 is always debatable

Cities	Pilot area (in wards)	Population	Connection		Consumption efficiency (lpcd)		Average pressure (meter)	Actual losses (%)	Cost recovery
Belguam	3	74,361	8,509	130	93	4	15	3.3%	60%
Gulbagra	2	62,982	3,810	95	67	3.5	12-15		97.7%
Hubli	5	82,337	12,327	120	107	5	25-40	15%	98.44 %
Dharwad				98	87	4	22		99%
Nagpur	4	1.2 lakh	15895	142	127	5	12	31% from 50%	100%

NRW reduction
6.5 mld
(Hubli dharwad)

Content (Hubli-Dharwad)	BEFORE	AFTER
Supply (mld)	13.04	6.4
Consumption(mld)	3.63	3.53
Average pressure(m)	2	8
NRW volume(mld)	9.41	2.89

Social Economic Benefits of 24 X 7 in Hubli

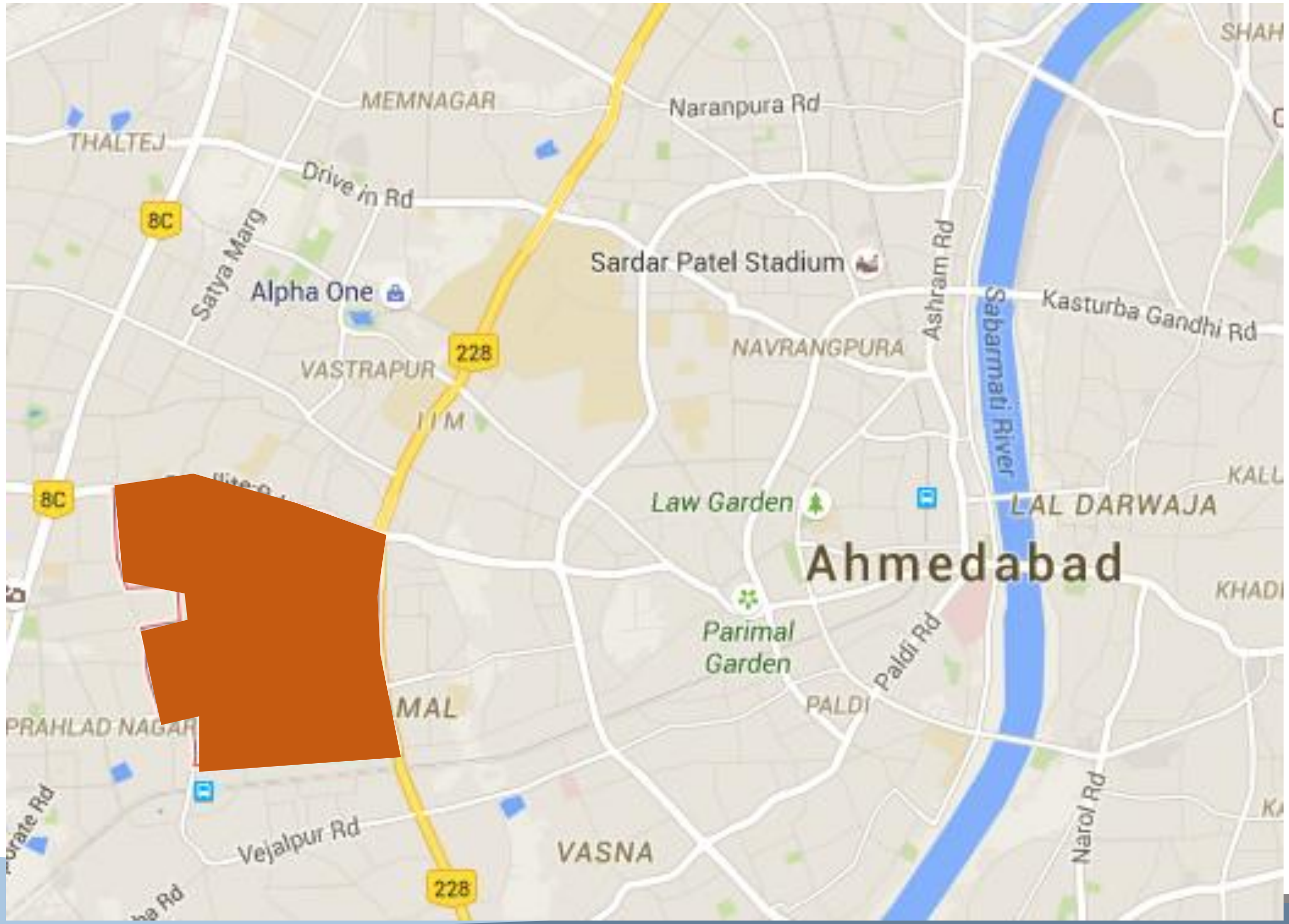
- Time saved 26-40 hrs per HH per month
- 43% respondent could attend social functions
- Negligible e.coli & coliform compared to 15% & 35% of intermittent samples
- Child diarrhea 11% lower

lemented cities

https://www.wsp.org/sites/wsp.org/files/publications/WSP_Karnataka-water-supply.pdf, nagpur development plant

24 X 7 Water Supply in Ahmedabad (Ghatlodiya)

Jodhpur 24x7 water supply



Area : 700 hectars
No of DMA : 5
DMA area : 1 sq.km
One DMA : One ESR
Where needed upgradation of network
Some part replacement of network

They proposed water tariff structure & new policies

Source :Multimedia consultant

Land use – **Mixed landuse**

Building typology- **G+1, G+2, high rise(mix)**

Population sample size – **10% of Ahmedabad**

Data availability

Area with **less illegal connections**

zone	sr no	ward	Nos of main WDS	HH(census)	hh % (census)	HH covered with tap connections	no of connection	Nos. of UGT	Capacity of UGT Lac Litre	Nos. of OHT	Capacity of OHT Lac Litre	Total Capacity Lac Litre
new west zone	1	Sarkhej	4	25891	84.40%	21852	24413	4	41	16	14.3	55.3
	2	Vejalpur	8	35579	84%	29886	33389	8	172	1	5	177
	3	Jodhpur	7	18030	95.20%	17165	19176	11	286.8	12	17.5	304.3
	4	Bodakdev	6	20182	86%	17357	19391	6	170.5	15	36.2	206.7
	5	Thaltej	2	27172	86.20%	23422	26167	2	172.7	7	16.3	189
	6	**Ghatlodiya**	**3**	**19205**	**90.90%**	**17457**	**19503**	**3**	**138**	**5**	**13**	**151**
	7	Chandlodiya	3	11173	98.40%	10994	12283	3	92.5	2	3	95.5
	8	Ranip	1	12053	98.40%	11860	13250	1	110	1	1	111
	9	Gota	5	11334	99.60%	11289	12612	6	164.4	10	19.3	183.7
	10	Kali	1	13340	97.50%	13007	14531	6	18.6	7	11	29.6

Selection criteria for study area

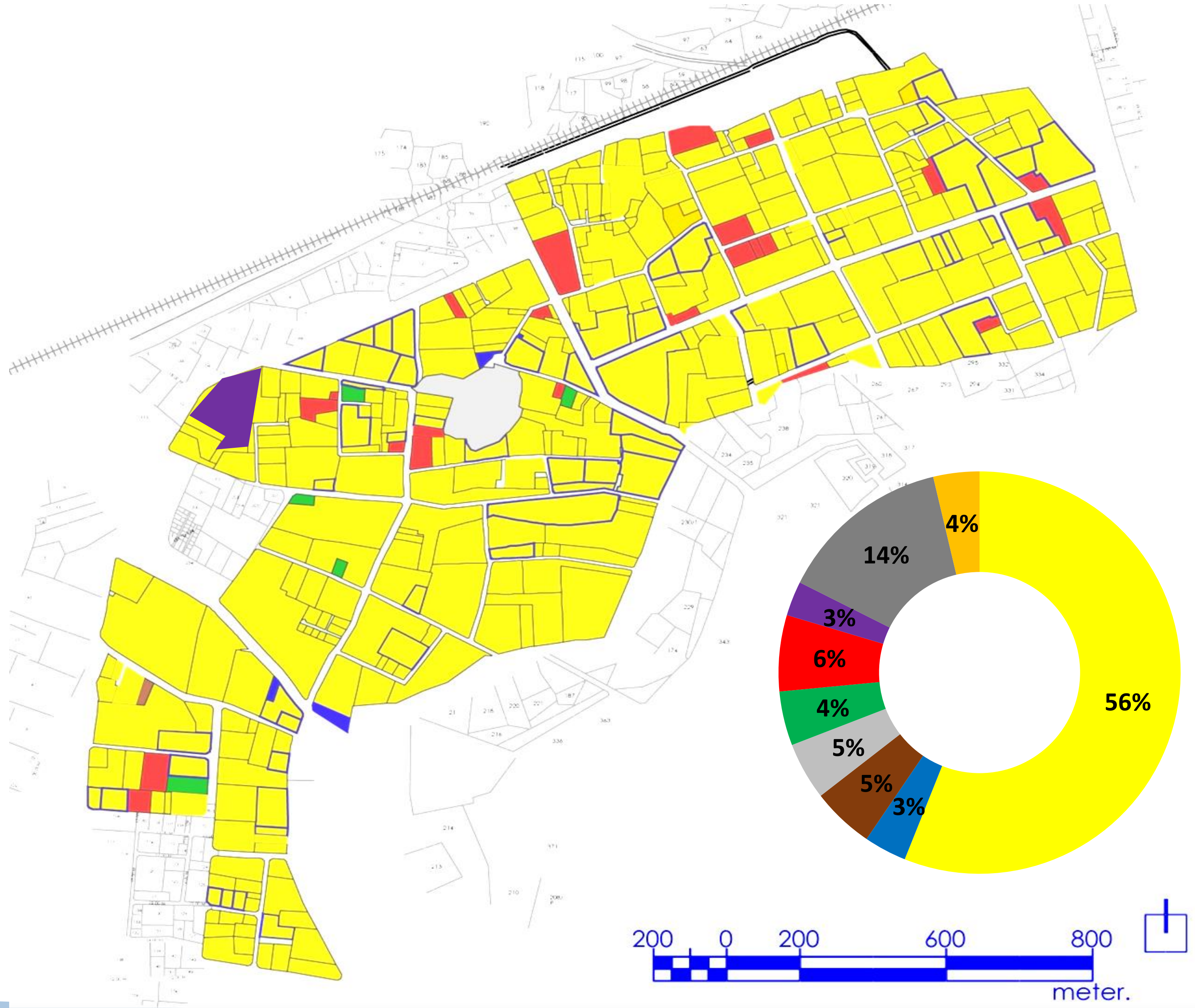
Source: hh from census

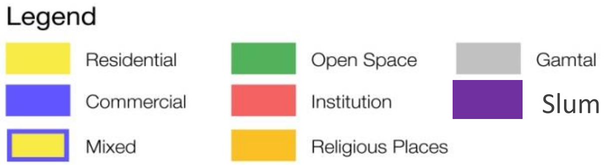
Demography

Ward No. : 7

Area: 4.45 sq. Km

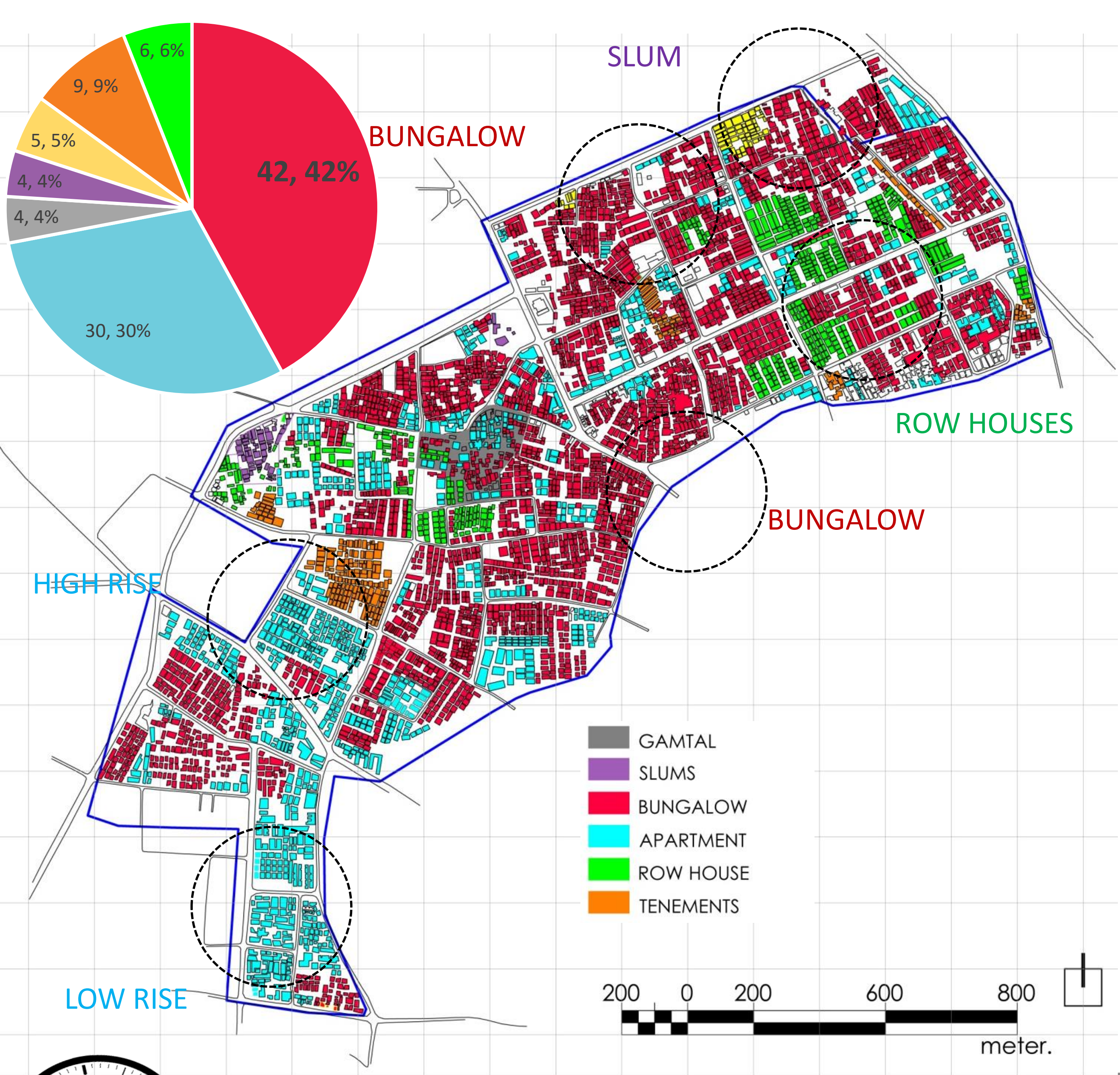
Population: 83,109

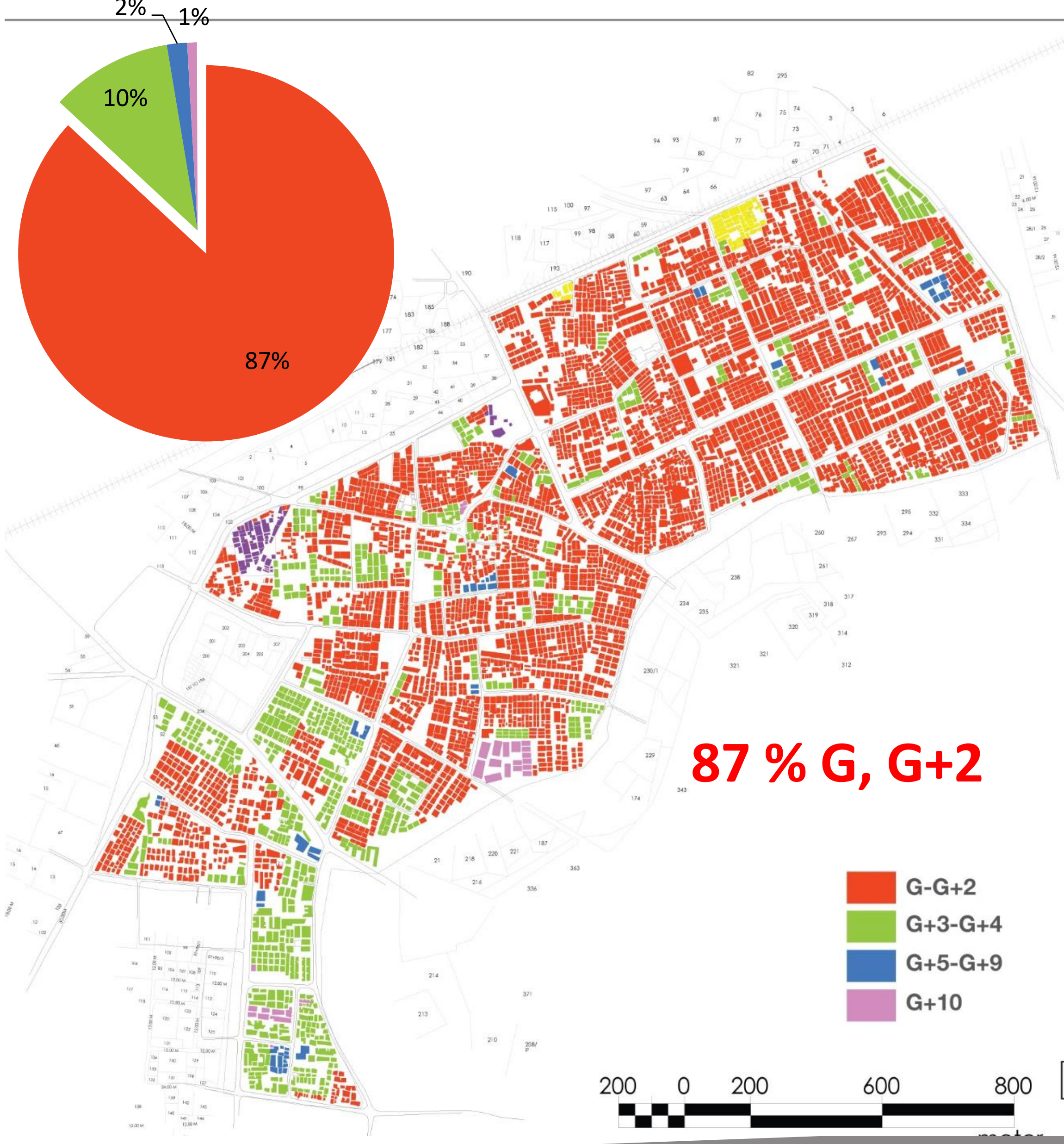




Ghatlodiya – Land Use map

Source: BPLAN 2013





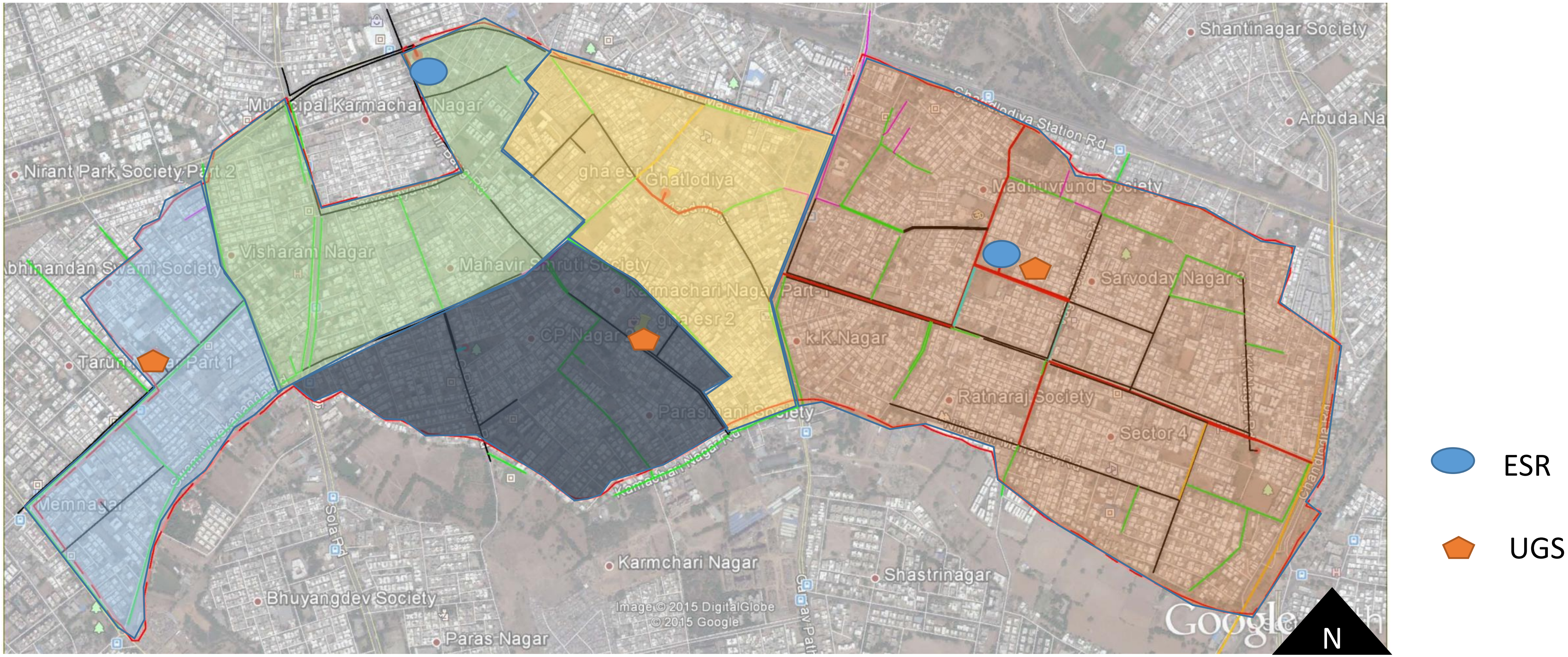
Ghatlodiya – Building typology

Source: BPLAN 2013

Sr. No.	Name of wds	No. of society	No. Of House	Req. of water as per 700 lit. (20% UFV)	Reqd. supply time	water supply at present	No. of pump	pump capacity	Qty. of water supply at present	Deficit
1	**Vidhata**	**150**	**12500**	**10.5 MLD**	**3.75**	**2.00**	**2.00**	**1400000.00**	**8500000**	**2 MLD**
2	Gamtal	45	7580	6.3 MLD	12.73	11.00	1.00	500000.00	4800000	**1.56 MLD**
3	Laxmangadh	142	12775	10.7 MLD	10.73	14.15	2.00	500000.00	6750000	**3.98 MLD**

7.54 MLD deficit in Ghatlodiya ward

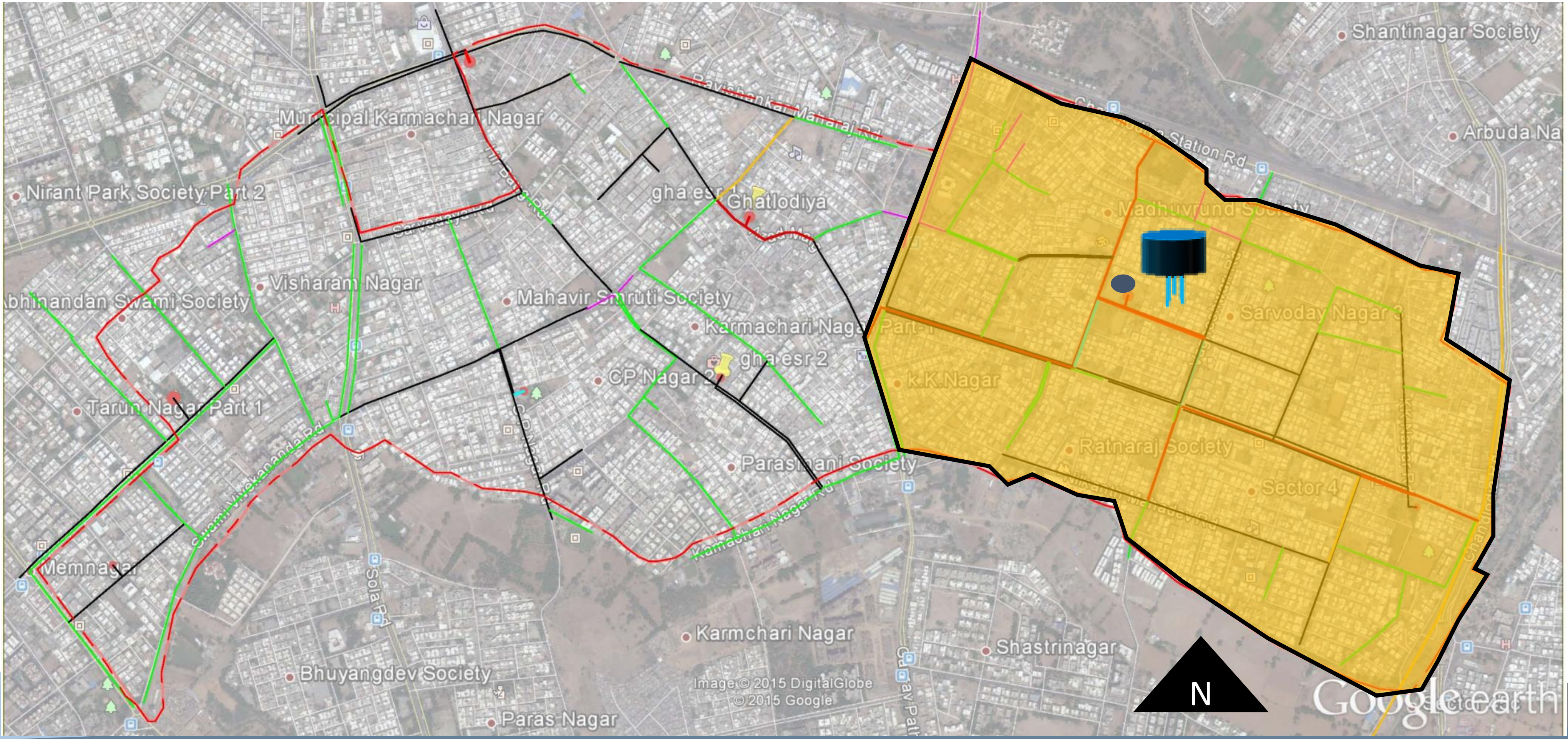
Ghatlodiya- water supply deficit



Ghatlodiya- water zones map

Source: AMC Ghatlodiya ward office

Selected area for DMA- VIDHATA Nagar



Vidhata nagar

Area :1.29 sq.km

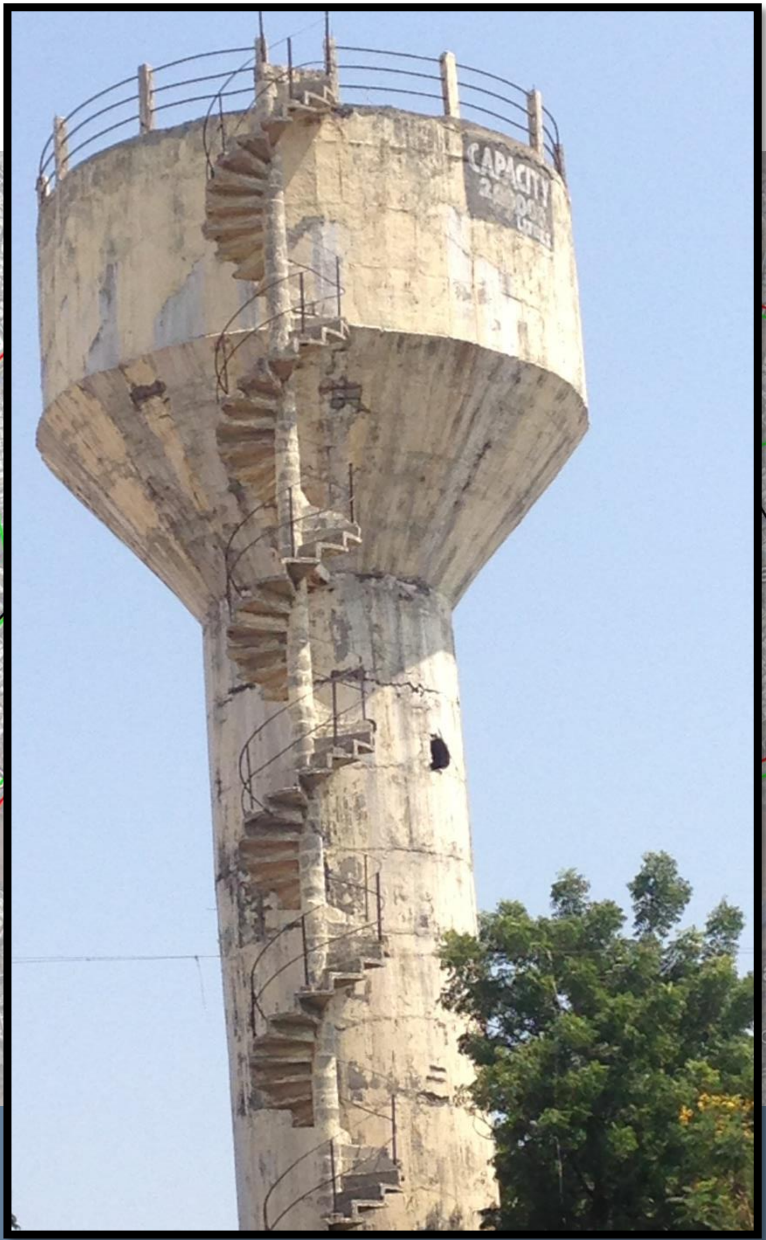
Population: 37,050

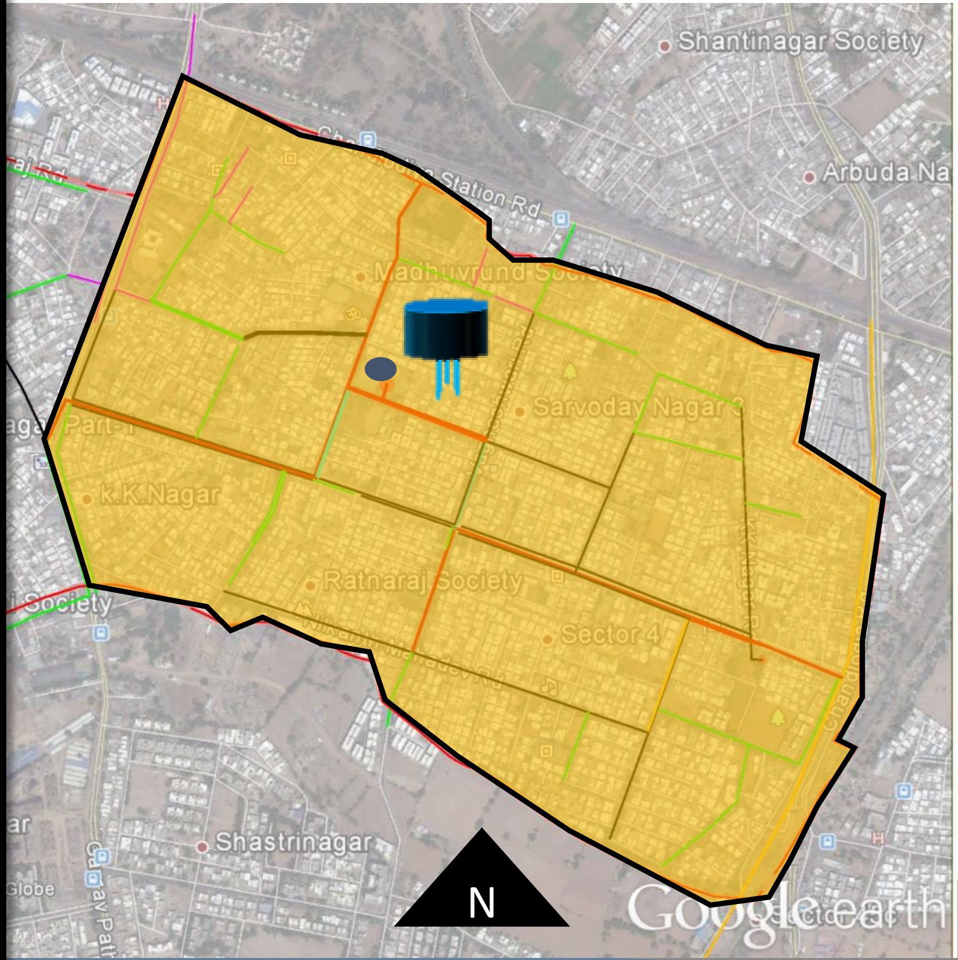
Density: 20445

Sump : 22 lakh gallon

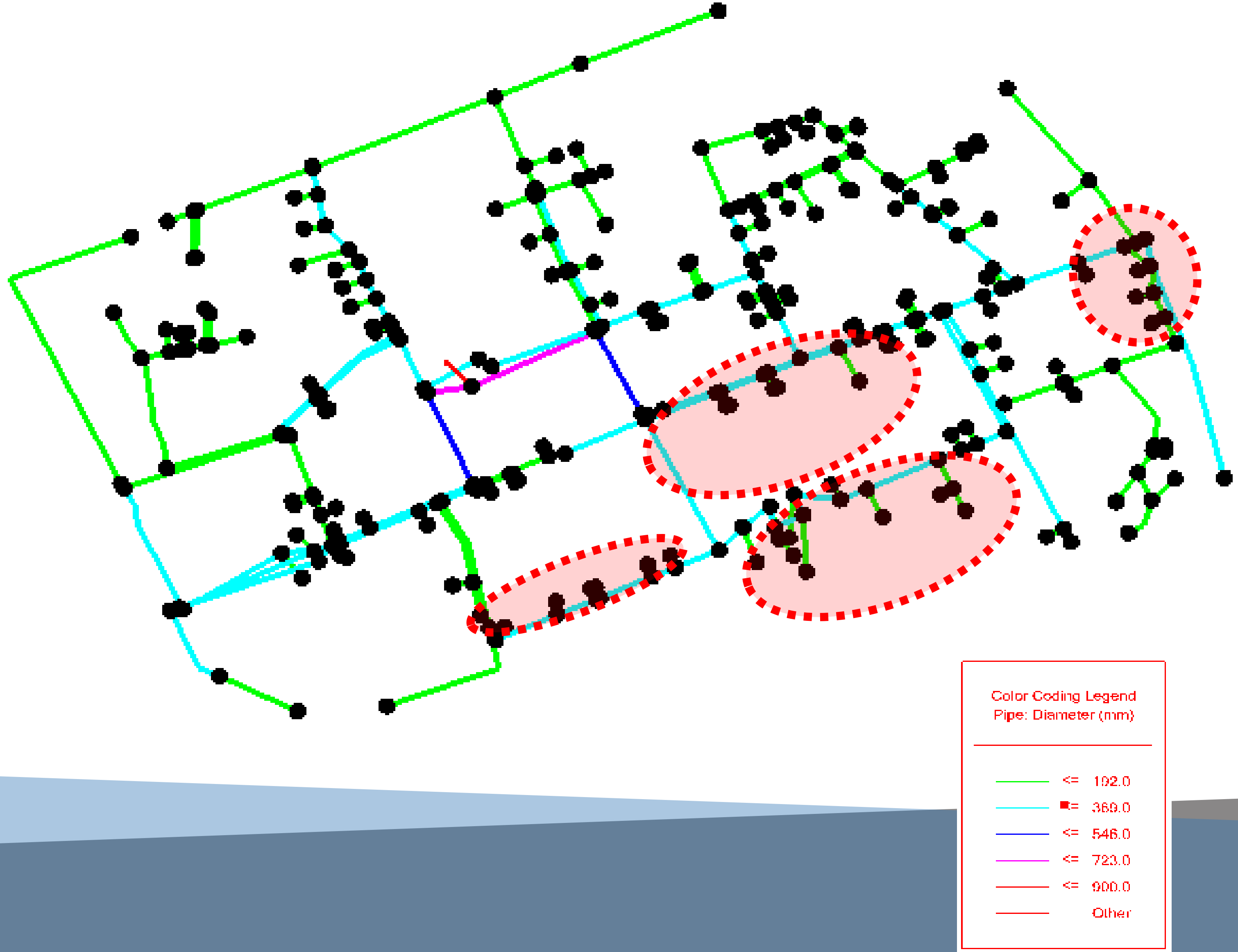
ESR: 3 MLD

Selected area for DMA- VIDHATA Nagar



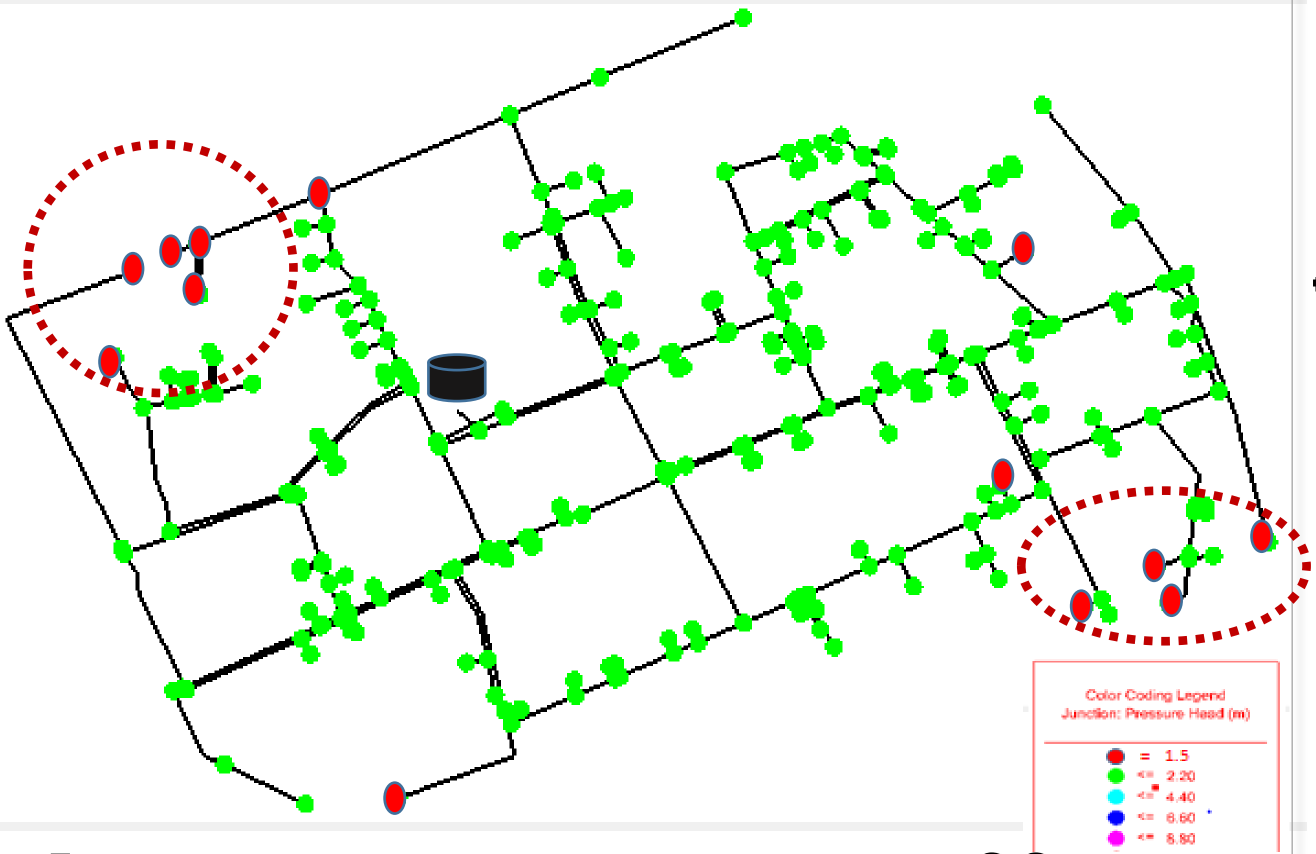


Issues in existing network



- Haphazardly installed pipe network
- Drastic variance in pipe diameter
- Pressure issues found in dead ends of pipeline
- ESR not in working condition
- Lack of data management

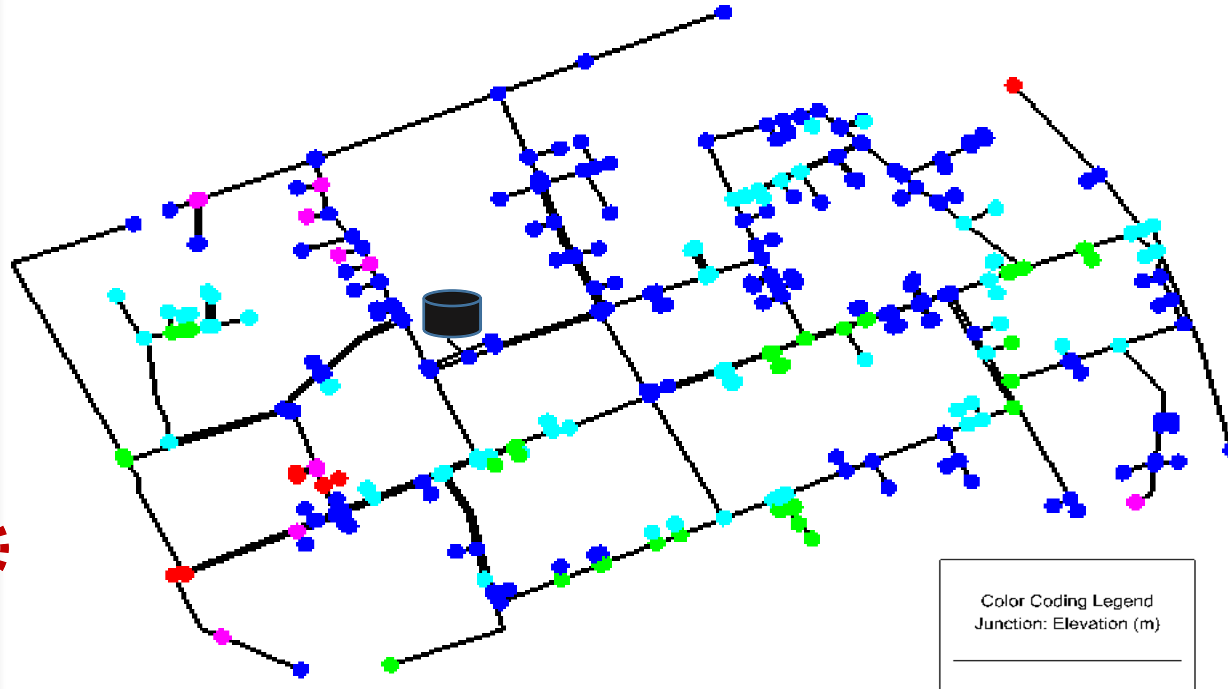
Pressure head in existing area

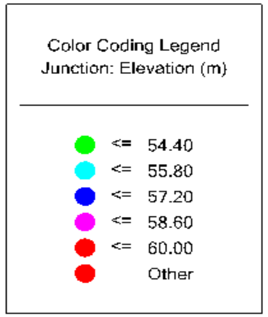


Average pressure across all the pipelines is **2.2 meter**

some junction have also recored **1.5 meter** pressure

Junction elevation in existing area





Elevation(mean sea level) variance is found between **54 m to 60 m**

Height difference between different junctions cases pressure difference

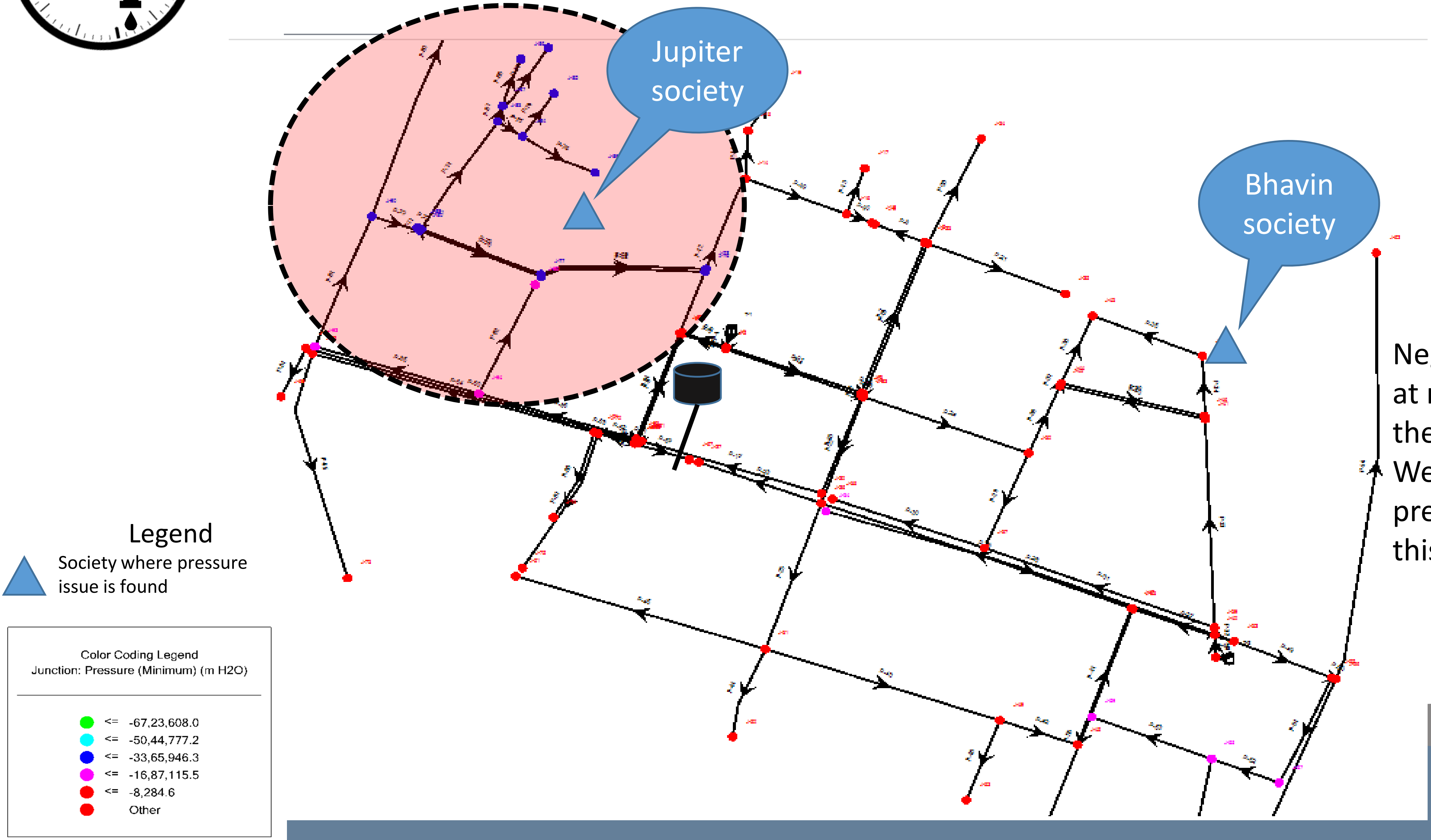
Existing analysis- Issues of present network

Source: AMC Ghatlodiya ward office

Pressure issues record in AMC

Ward	WDS	Particular society	Complaint	Solution	expenditure	remarks
Ghatlodiya	Vidhata tank	Giriraj soc.	These societies are located at the end of network system so there is an issue of low pressure	Issue can be solved by providing water from OHT located near K.knagar, Amul garden,so pressure problem can be solved.	50 lakh	Work will be done by “water project department”
		Bhavin soc.				
		Ishwarkaka soc.				
		Kanal tenement				
		Jupiter soc.				
Ghatlodiya	Vidhata tank	Anand nagar society	These societies are located at the end of network system so there is an issue of low pressure	By providing bore well issue can be solved. Water pressure can be maintained by bore water pressure	25 lakh	Work will be handled by "water operation & maintenance”
		Chhaya flat saame na chhapra(slum)				
					Date: 16/10/15	

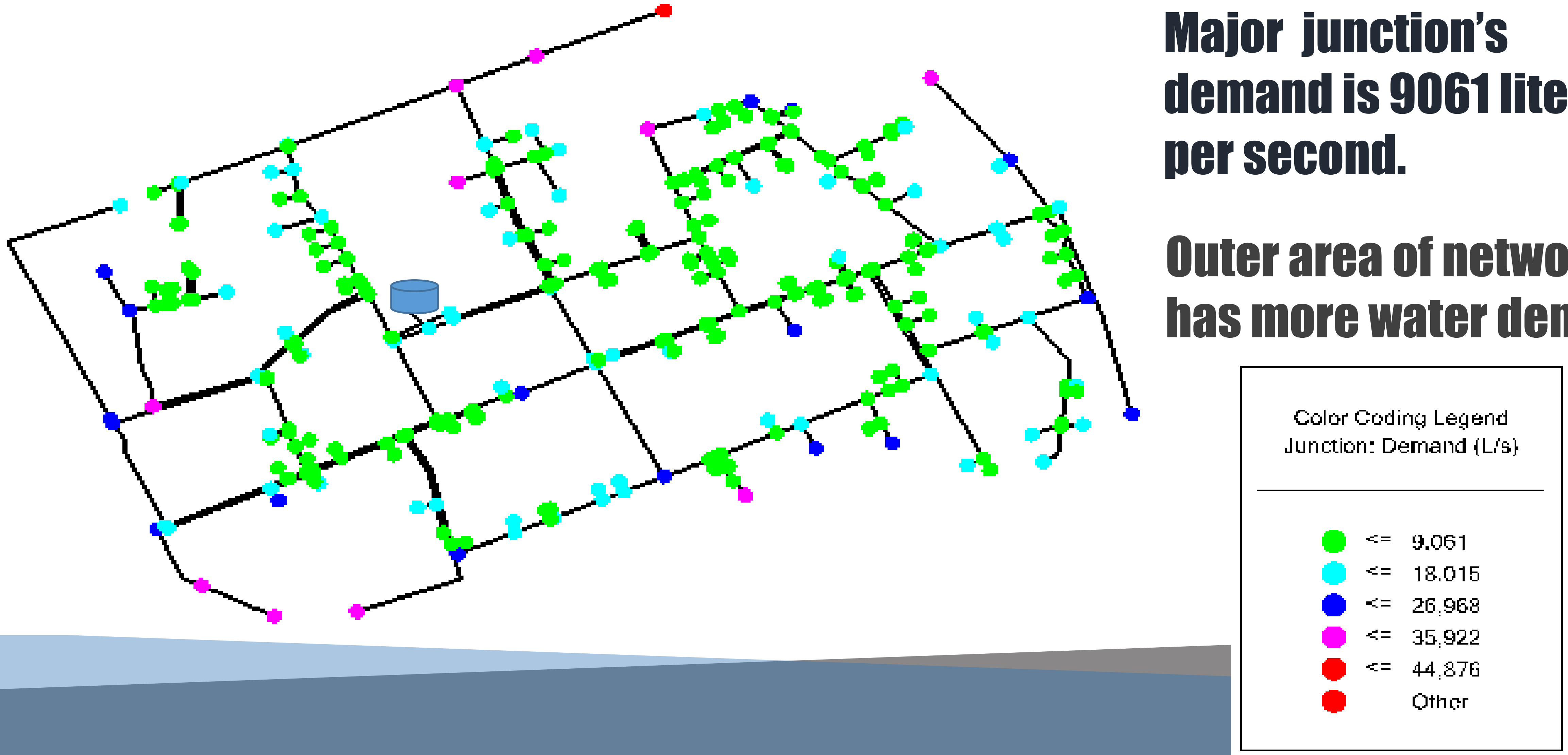
Low pressure issues recorded by AMC office



Negative pressure found at north western side of the ward

We also observed low pressure complaints in this area.

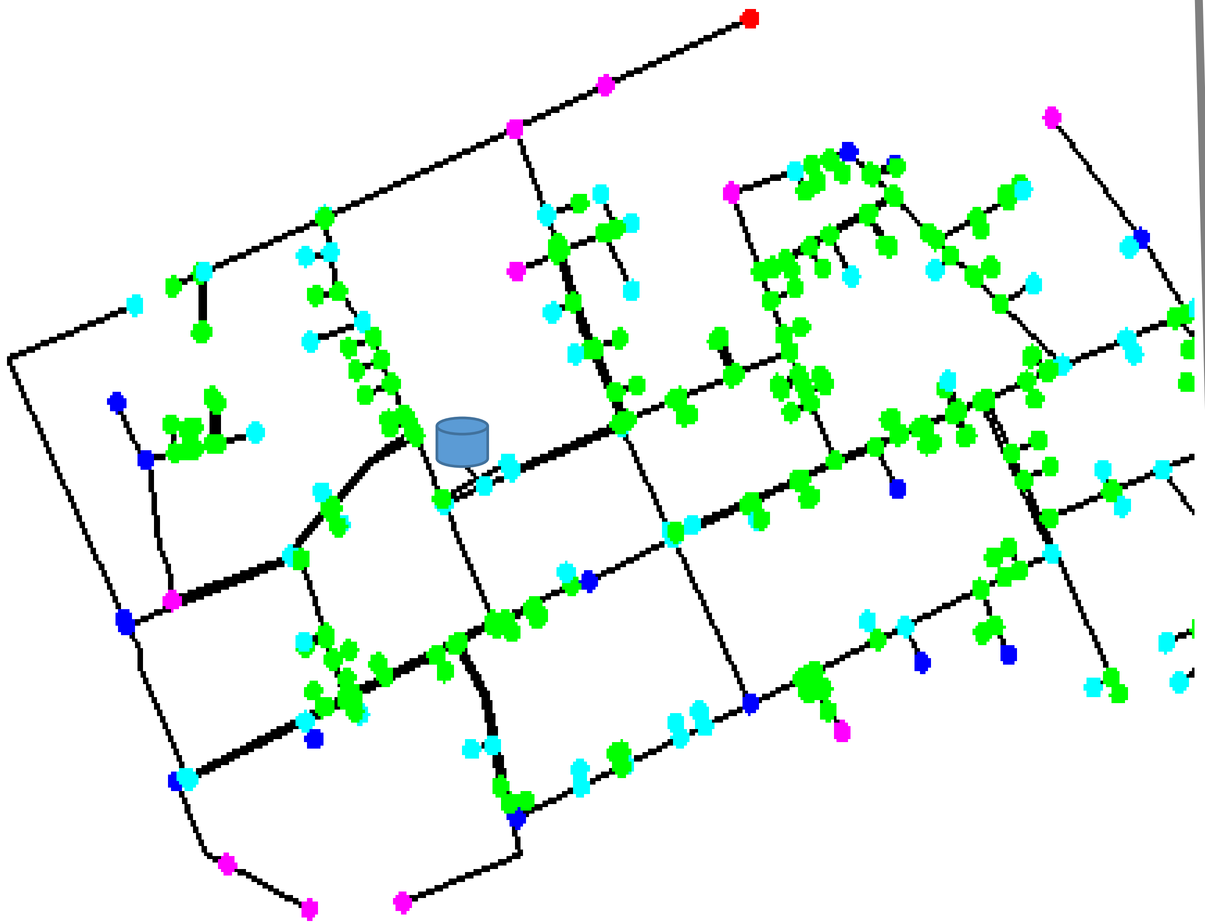
Water demand at junction level



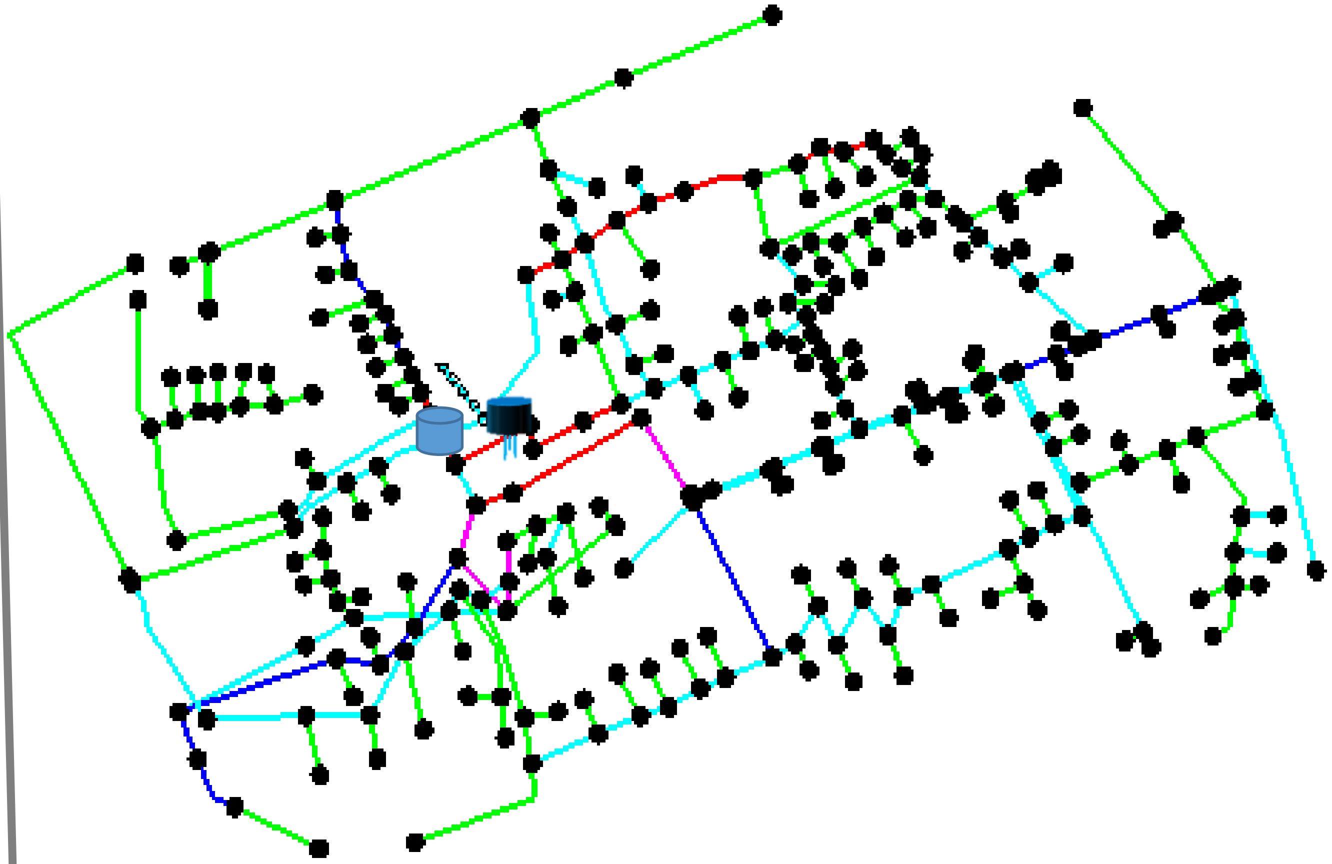
Major junction's demand is 9061 liter per second.

Outer area of network has more water demand

Proposed network for Intermittent water supply



Proposed upgraded network



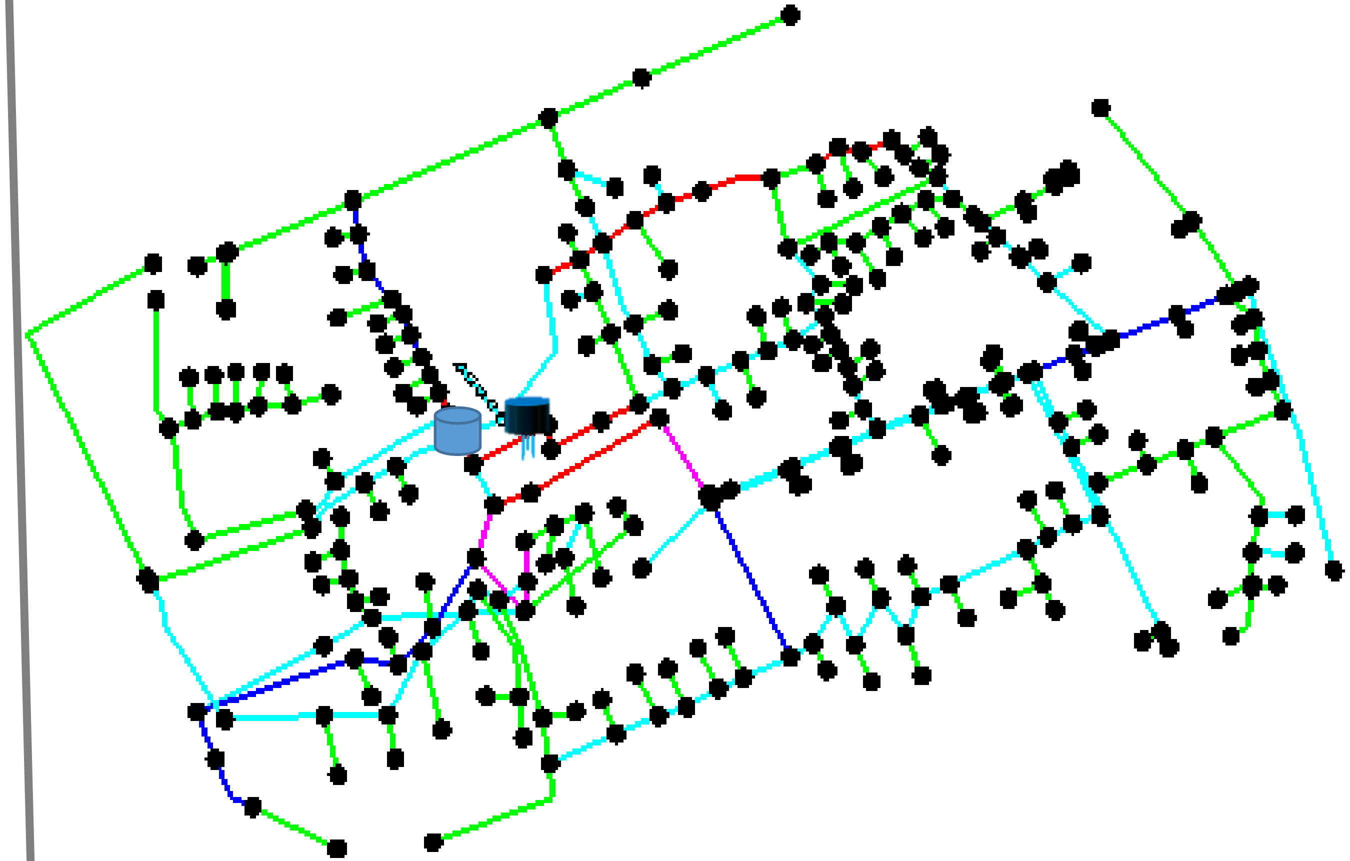
Proposed network for Intermittent water supply

Proposals for water supply network for intermittent water supply

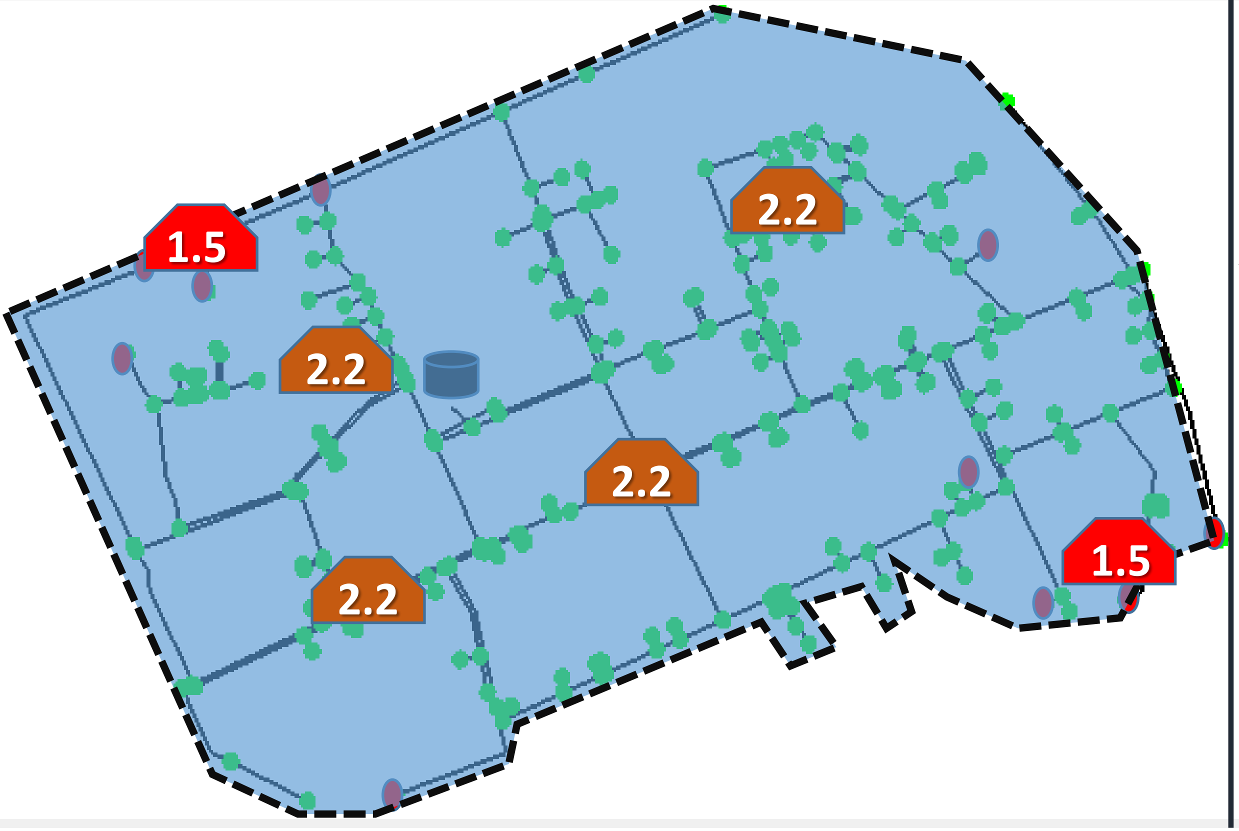
1. ESR **: to maintain pressure**

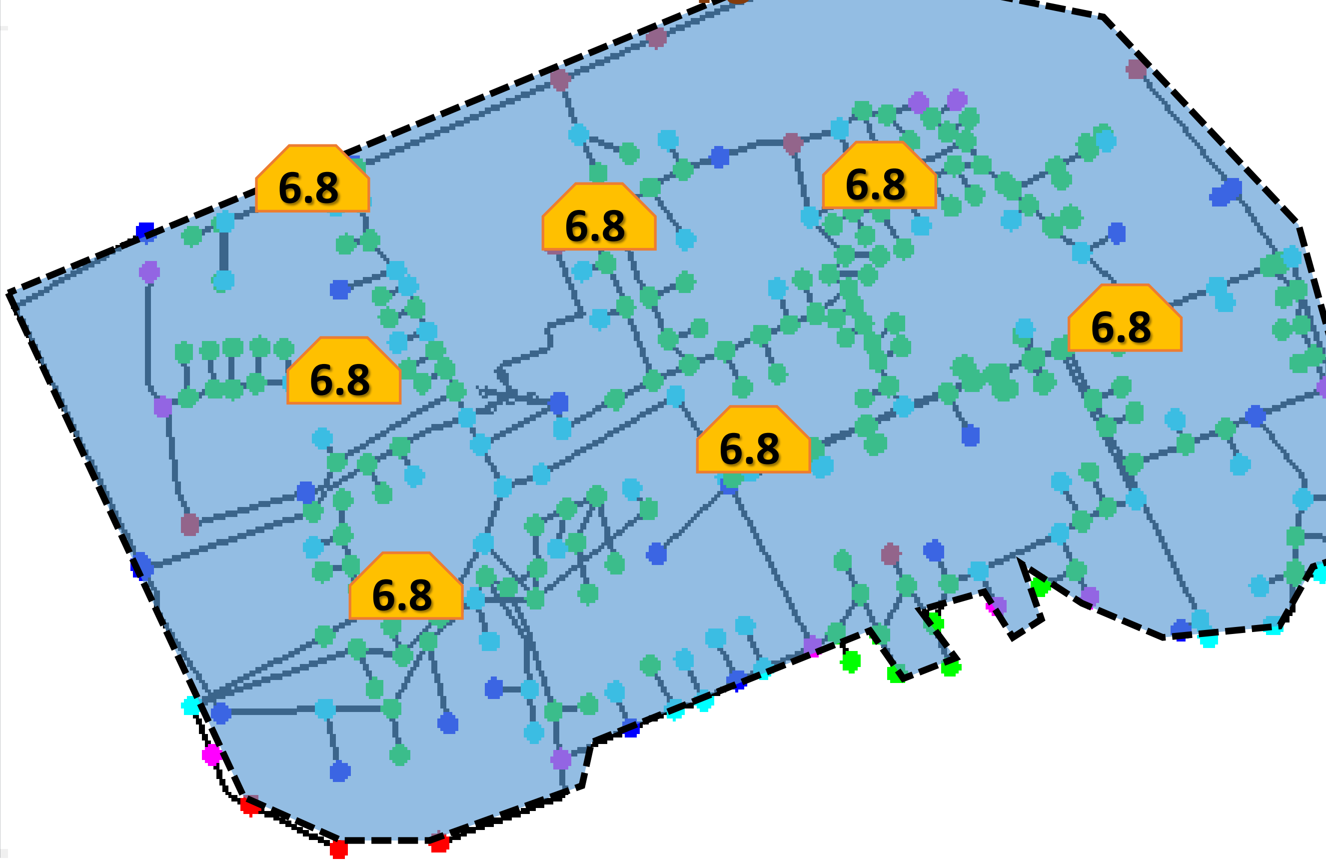
2. Three pumps **: for maintaining constant pressure during peak hours**

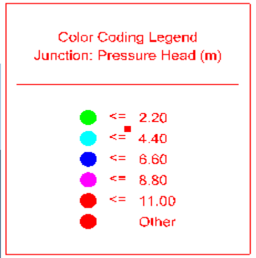
3. We have designed whole network such as that pipe diameter gradually decrease from main trunk lines to branch lines



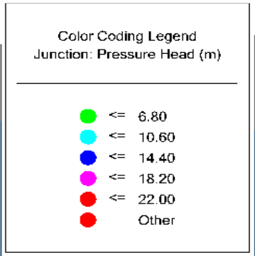
Pressure head for proposed intermittent water supply



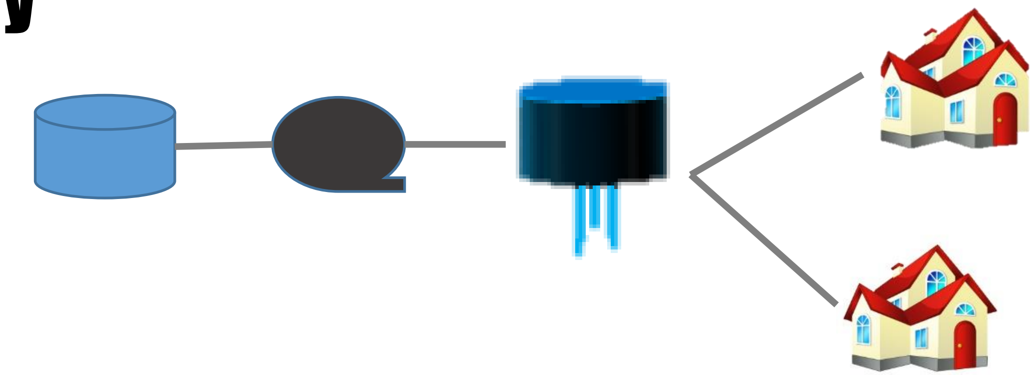


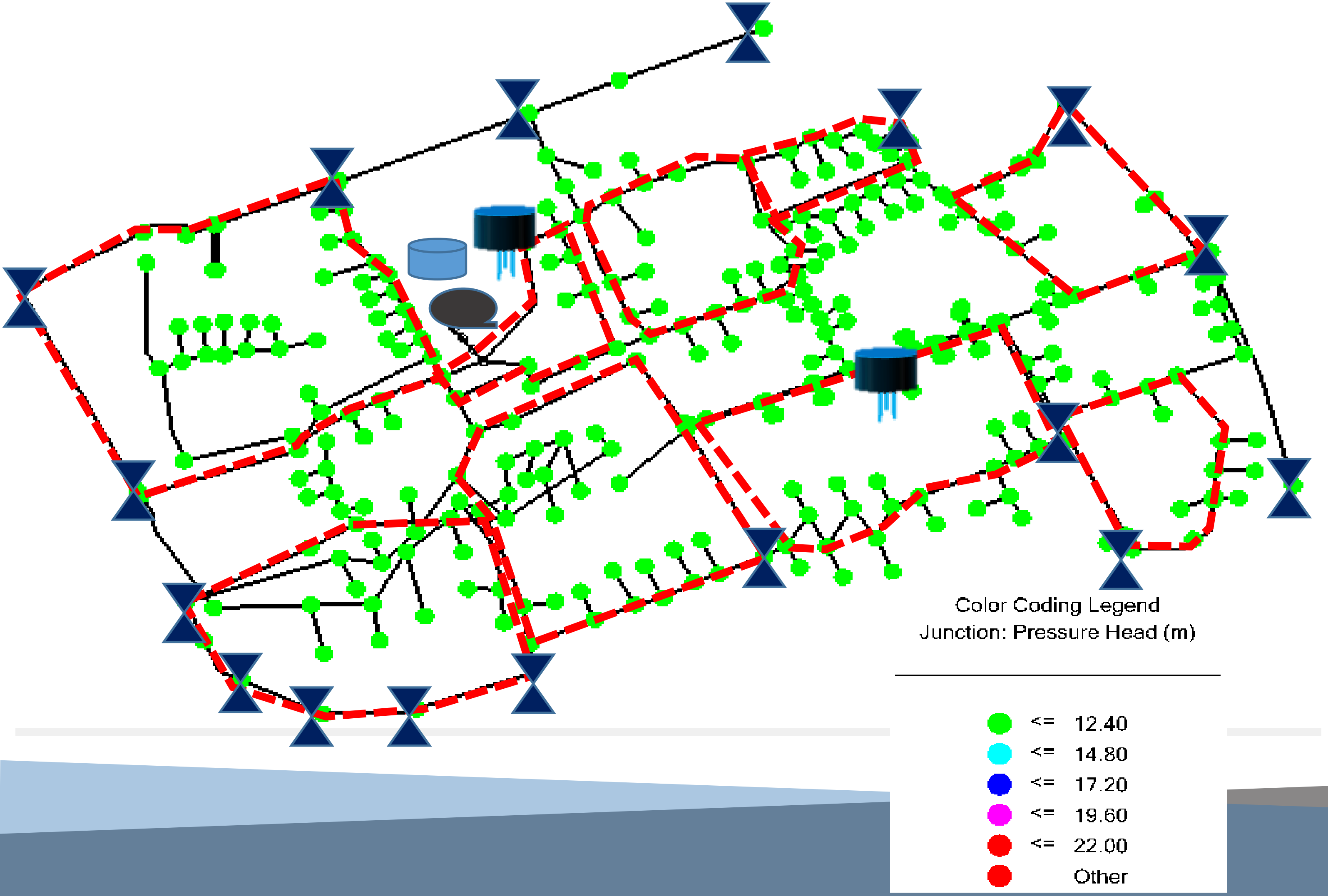


All junction have average 7 meter pressure after network upgradation



Proposed network for 24x7 water supply

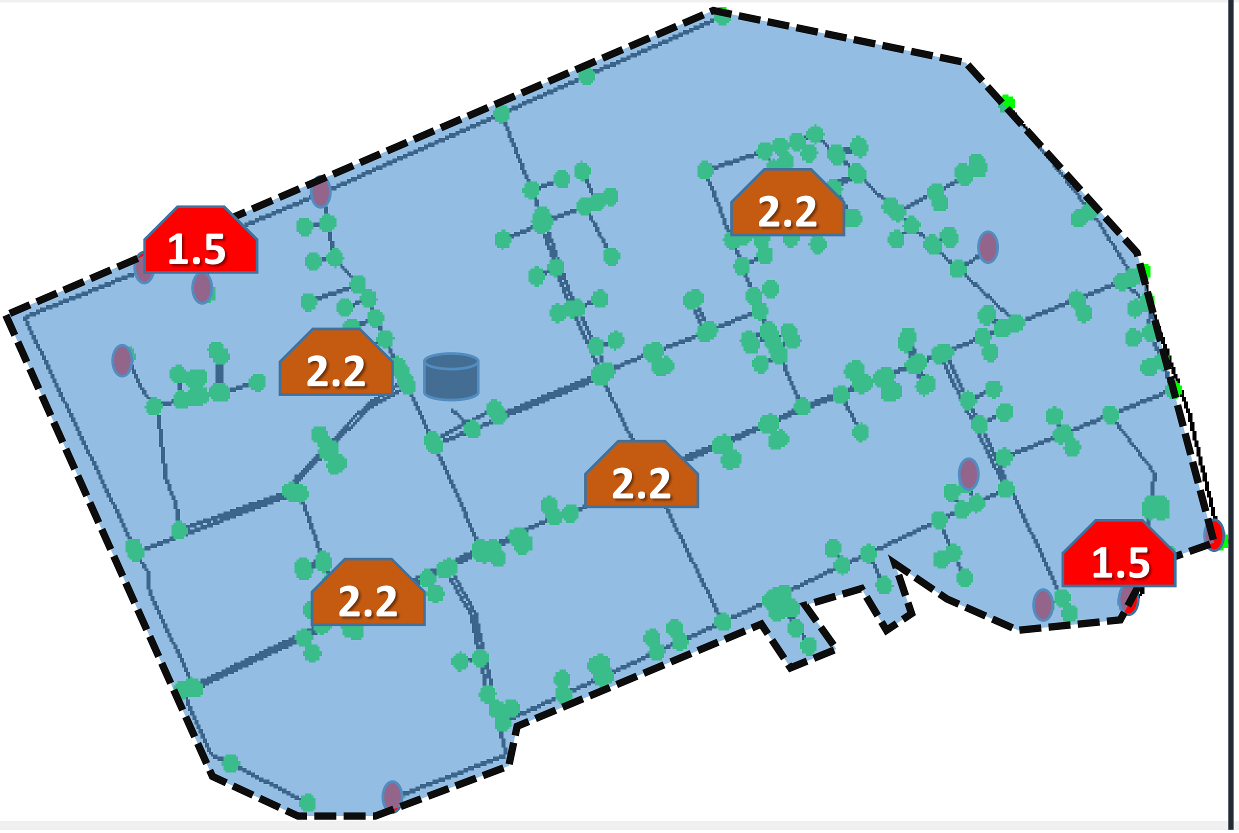




- **Proposed one ESR at sump location so we can maintain pressure head at each household**
- **Minimum pressure** will be served is **12 meter**
- we have made **closed loop** for **better pressure management**
- **If hydraulic pressure get greater than 64 m (mean sea level) then pump will get off automatically.**
- **Meters are provided at society level.**

Change in pressure head

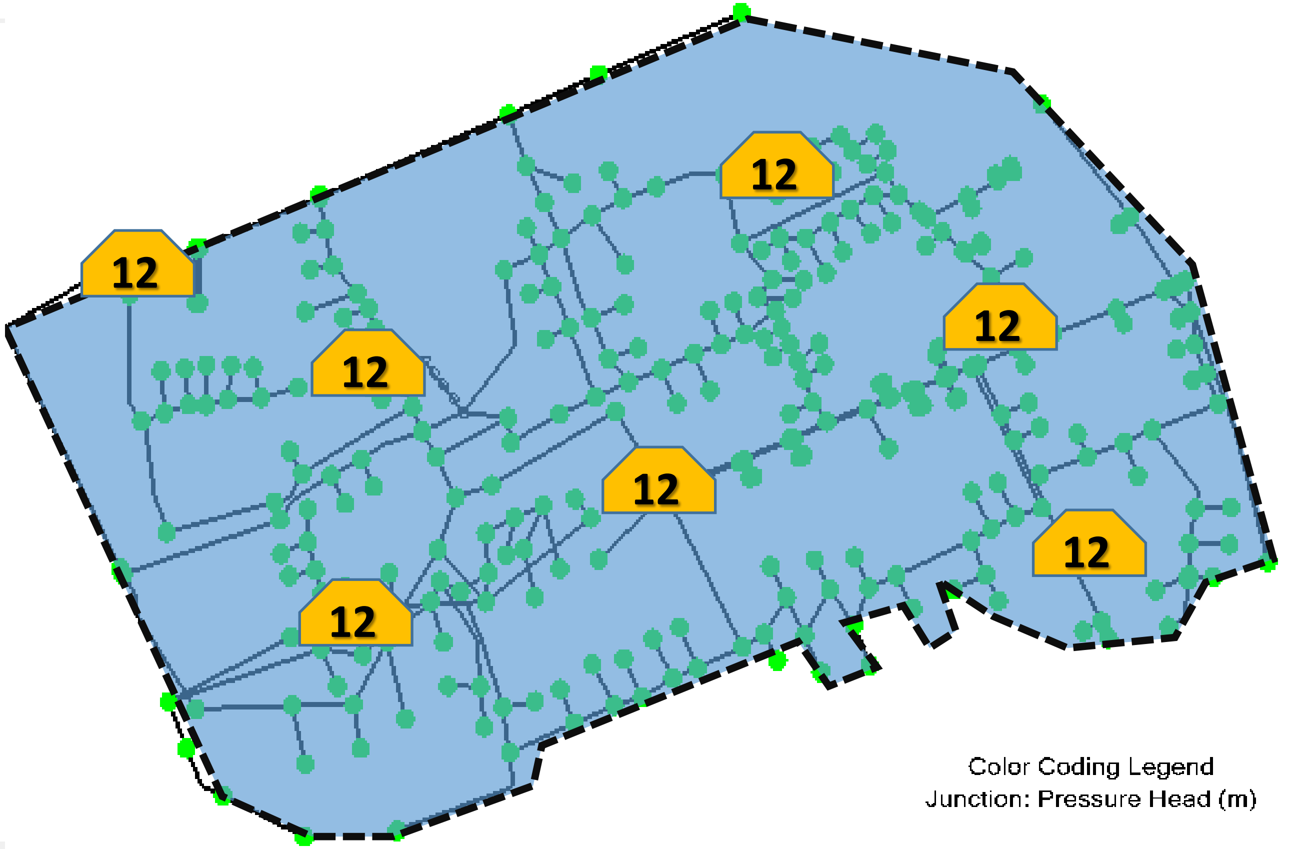
Pressure head **before** network upgradation



Color Coding Legend
Junction: Pressure Head (m)

<= 2.20
<= 4.40
<= 6.60
<= 8.80
<= 11.00
Other

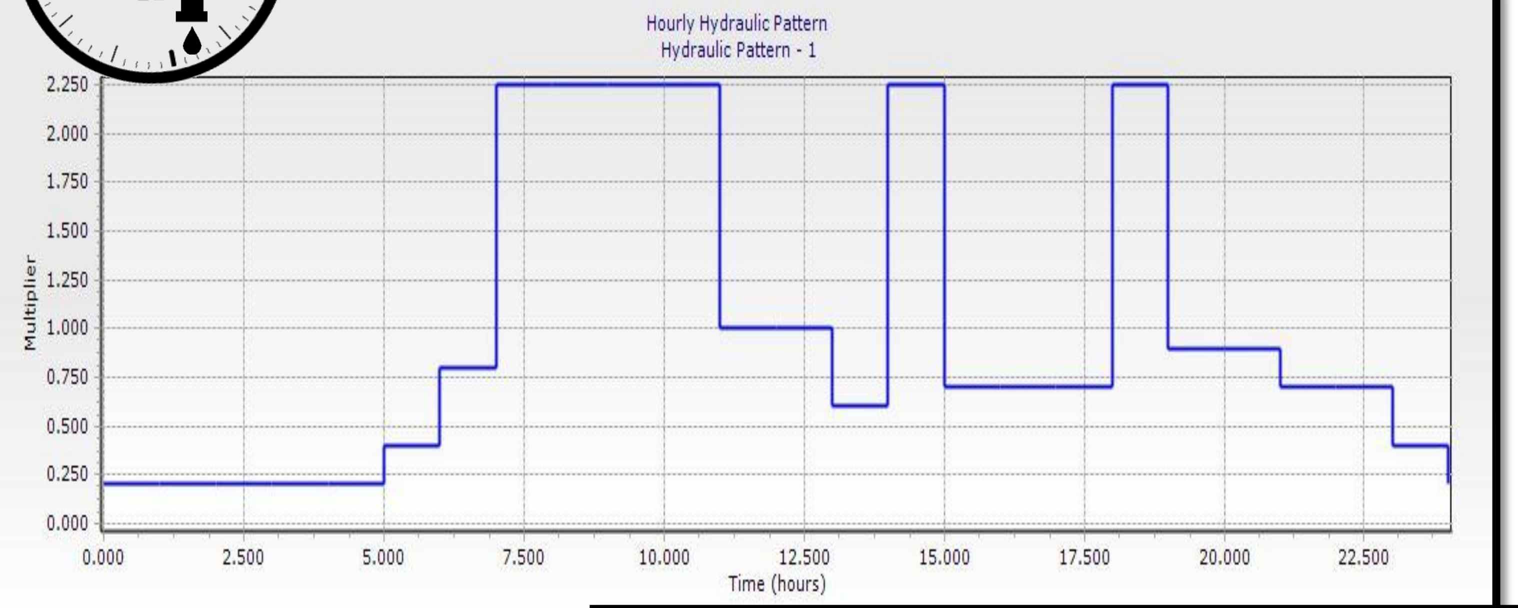
Pressure head **after 24x7** network upgradation



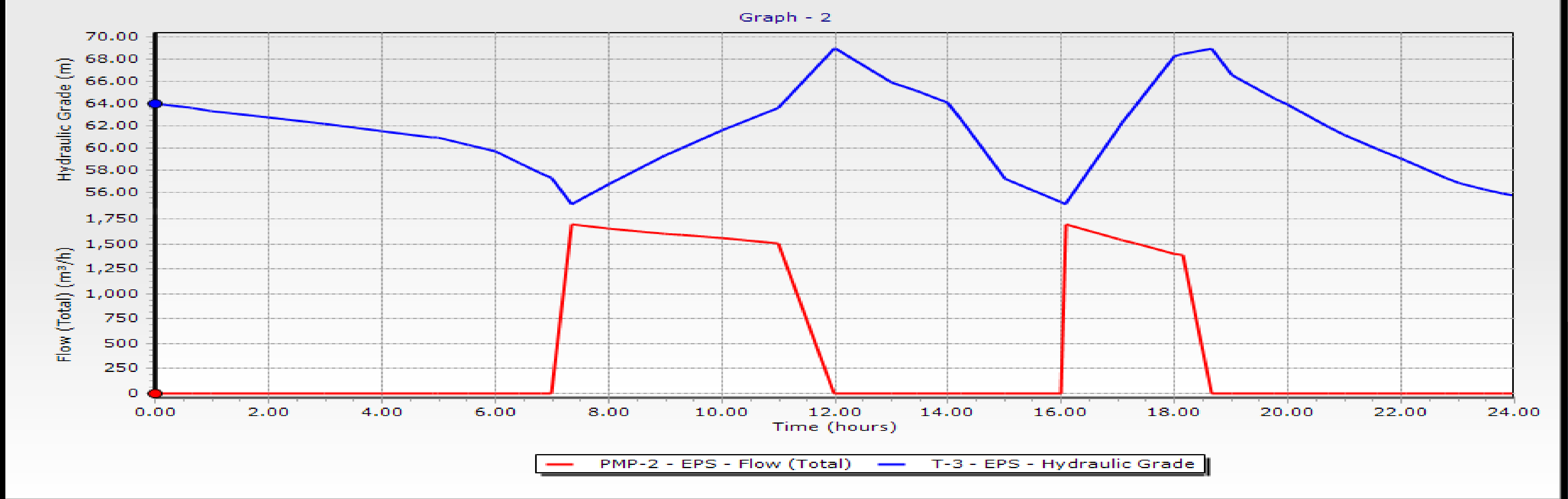
Color Coding Legend
Junction: Pressure Head (m)

<= 12.40
<= 14.80
<= 17.20
<= 19.60
<= 22.00
Other

Hourly Hydraulic Pattern



Tank Level

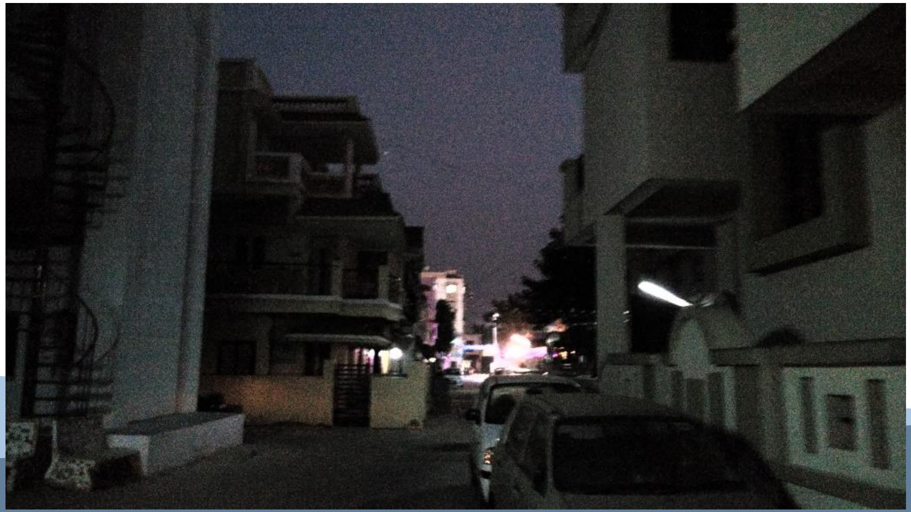


Household survey format

Objective :

- To check people's acceptability for 24x7 water supply
- To know people's willingness for metering system
- At what extent people want to pay for monthly water charges?

Metering in "Mandakini society"



Metering at Society Level in Mandakini Society, Ghatlodia

- 113 houses in the society
- 1 municipal connection and **1 bore well** for whole society
- Municipal water only caters the need of one hour
- In 2011 Society installed domestic **water meters** in all the houses
- Water tariff – **4 Rs / KL** (flat tariff)
- Frequency of collection – **4 Months**
- Average water charges – **100 Rs / Month**
- Water charges collected is used for maintenance of the society

Representative Survey Analysis

46 % of the people are facing pressure problems

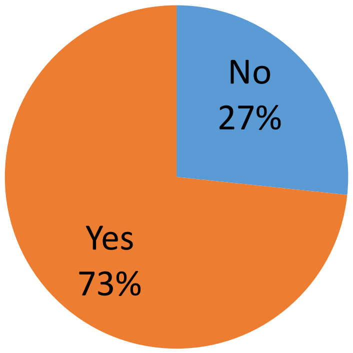
33 % of the households are having private borewell

On an average each household is paying Rs. 530 / month for private drinking water

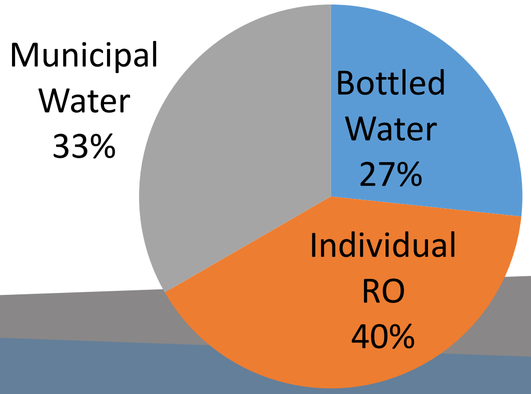
Where as for Municipal Connection it is Rs. 51 / Month

People acceptability for water charges for 24x7	
Water Bill Range (per month)	% of people willing to pay
0	26.6 %
0 – 100	6.6 %
100 – 300	**40 %**
300 – 500	20 %
>500	6.6 %

Willingness to accept 24x7 water with meter



Drinking water source



Source: Primary Survey

Costing

SCENARIO	DESCRIPTION	COST
1	Intermittent water supply replacing required pipelines	7.2 Crore
2	24x7 water supply replacing required pipelines	16.1 Crore
3	24x7 water supply replacing whole pipeline network	22.4 Crore

Flat Rate Water Charges (AMC) for Non Metered Connection to be paid annually

CARPET AREA (Sq M)		Rate in Rs. Residential	Rate in Rs. Non-Residential
FROM	TO		
0	15	348	600
15.01	25	600	1080
25.01	50	960	1440
50.01	100	1440	2400
100.01	200	2100	3600
200.01	500	3750	6000
500.01	999999	7500	11250

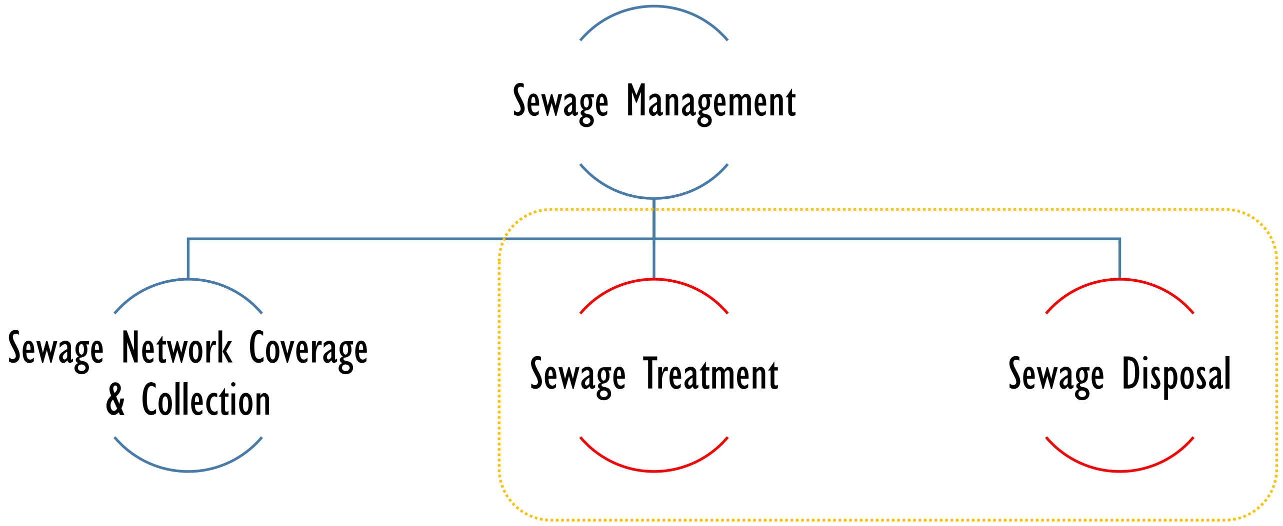
Note : Carpet Area shall be as assessed by the Property tax department of Ahmedabad Municipal Corporation.

Water Charges on Volumetric Basis for Residential Units

CARPET AREA (Sq M)		Water Rate (Proposed) Rs per kiloliter 0 – 20,000 litres per month	Water Rate (Proposed) Rs per kiloliter 20,000 -30000 litres per month	Water Rate (Proposed) Rs per kiloliter More than 30000 litres per month
0	15	1.00	1.50	3.00
15.01	25	2.00	3.00	6.00
25.01	50	4.00	6.00	12.00
50.01	100	4.00	6.00	12.00
100.01	150	6.00	9.00	18.00
150	200	8.00	12.00	24.00
200.01	500	12.00	18.00	36.00
500.01	1000	15.00	30.00	45.00

WASTE WATER REUSE

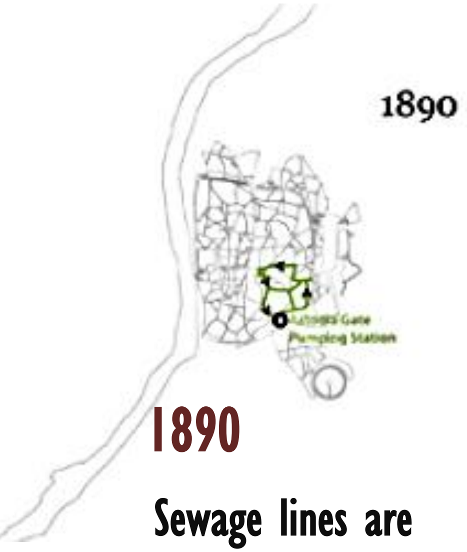
WASTE WATER REUSE



1. To achieve the SLB of **20% use** of **waste water** of total waste water generated.
2. With the increase in population, need for identifying **new sources** of water.
3. Reducing the discharge of **untreated water** into natural water bodies **disrupting** the ecosystems.
4. **AMRUT, Smart City** and **National Water Policy** are the programs encouraging the reuse of waste water by **incentivising** the local governments.
5. Water **conservation** and **efficient** use of alternative water resources to meet the **future water demand** of Ahmedabad.

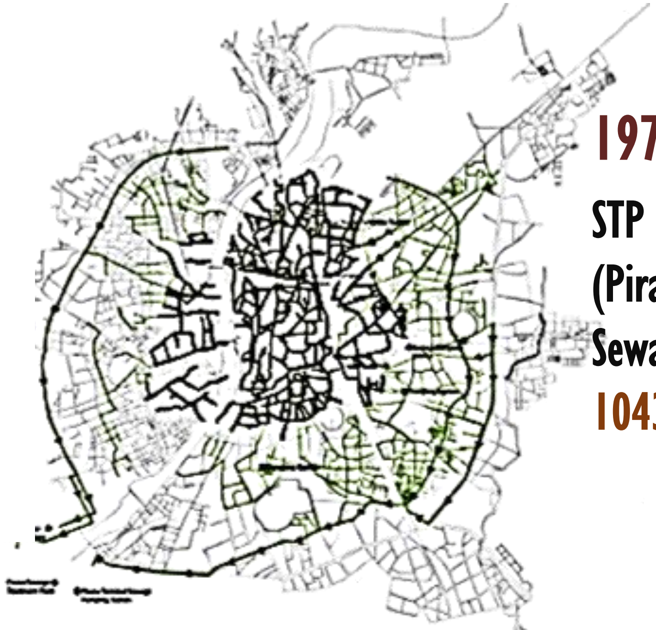
Source- Wastewater production, treatment and use in India - Report

A GLANCE THROUGH THE SEWER LINES IN AHMEDABAD



1890

Sewage lines are laid in walled city



1975

STP capacity- 317 MLD (Pirana and Vasana)

Sewage lines laid- 1043.66 Km

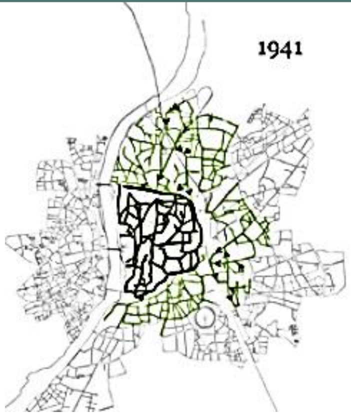
2012

Sewage gen-938 MLD

Treated-650MLD

Untreated sewage disposed- 288 MLD

Sewage lines laid-2172 Km (65 to 75 % coverage of AMC area)



1941

Sewage network expanded collected water transfer to the Pirana stabilization pond

1955

In western part of Ahmedabad water discharged into Vasna sewage farm around (54 MLd)

2006

Sewage generation-500MLD

Sewage treated-332MLD

Untreated sewage disposed directly- 168MLD

Sewage lines laid-1384 Km

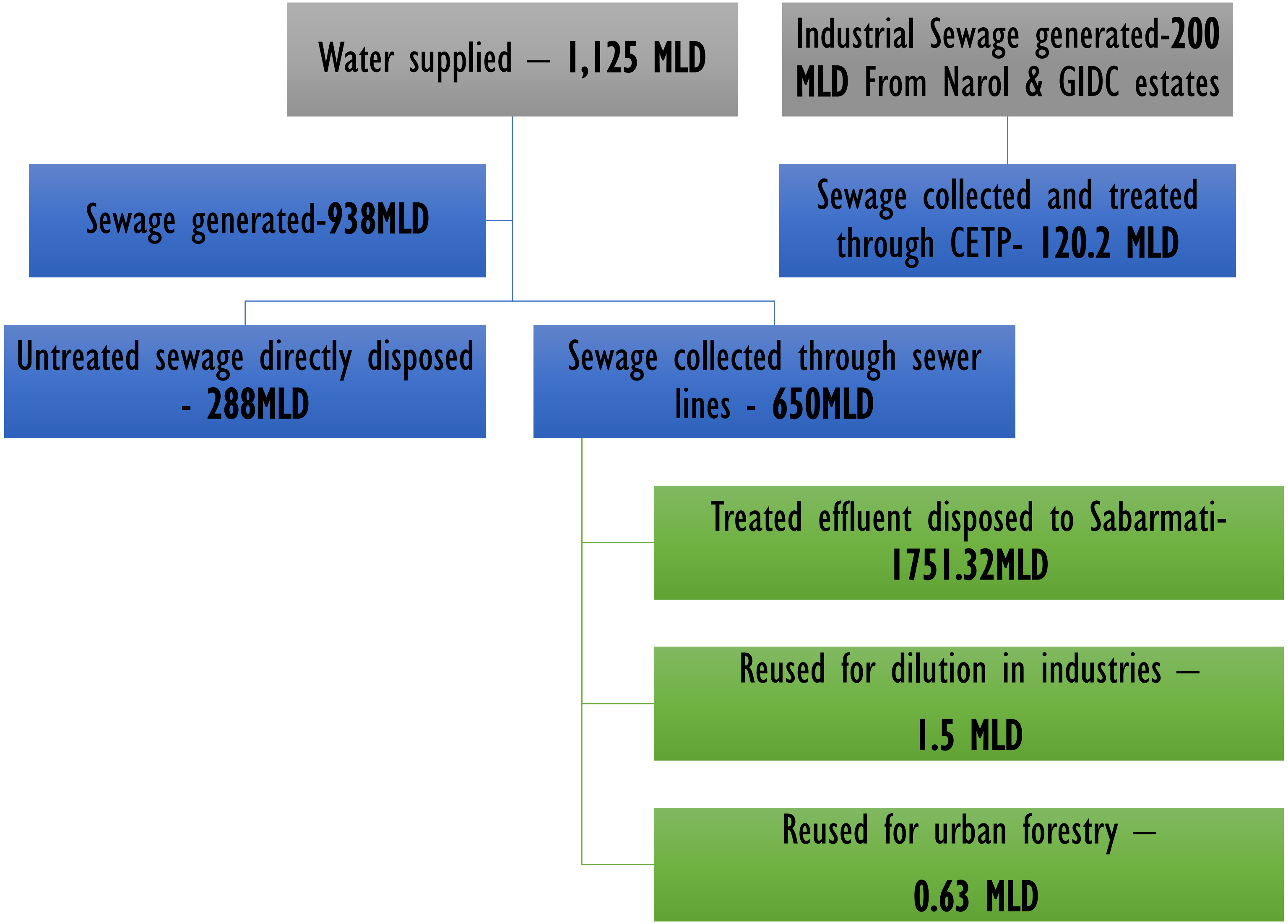
2021

Forecast generation- 1154MLD

Ongoing lines- 714km

Source- CSP Ahmedabad June 2012

Existing situation of wastewater treatment



Sources-CSP Ahmedabad JUNE 2012, Primary survey

HOW IS WASTE WATER GENERATED ?

Household sewage treated at centralized STP collected from **sewage lines**

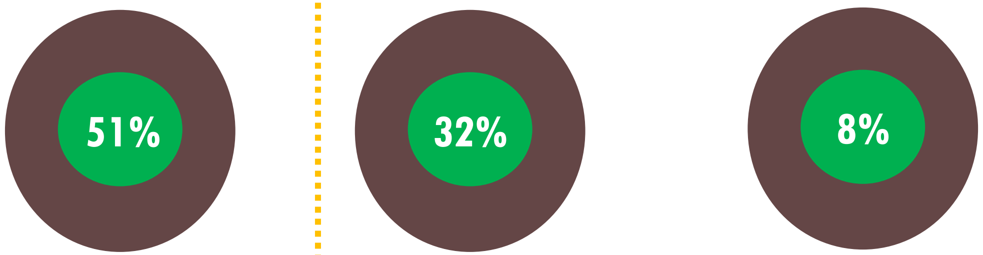
+

Rain water run offs, grey/black water from houses and industries collected from **septic tanks**

=

Waste water generated and disposed in water body

Metro above **10 lakhs**	Class I cities above **1,00,000**	Class II towns between **50,000- 1,00,000**



5040 MLD	11553 MLD	233.7 MLD
15644 MLD	35558 MLD	2696.7 MLD

■ Treatment capacity
■ Sewage generation

- In Ahmedabad, **industrial effluent** is channeled into the domestic system, complicating the process, and **exerting pressure** on existing infrastructure.
- The presence of **industries within residential** areas has an adverse effect on wastewater quality.

As per CPHEEO estimates about **70-80%** of total water supplied for **domestic use** gets generated as **wastewater**

AHMEDABAD

Waste water disposal in Ahmedabad

WW generated – 938 MLD

WW collected by sewer – 650 MLD

WW disposed untreated – 288 MLD

Ahmedabad: As per the MoUD National Sanitation Marking Scheme, cities with treatment capacity of **80-90%** will receive **6 marks** out of 9.

No separate grey water collection system in the city – **0 marks** out of 3.

- Sewage generation and treatment capacity in 498 class I cities and 410 class II towns in India (234 STP)
- Sewage Generated in major cities of India= **38354 (MLD)**
- The Sewage Treatment Capacity = **11786 MLD**
- Only **60%** of **Industrial Waste Water is Treated**

Source- Ahmedabad DP, 2021

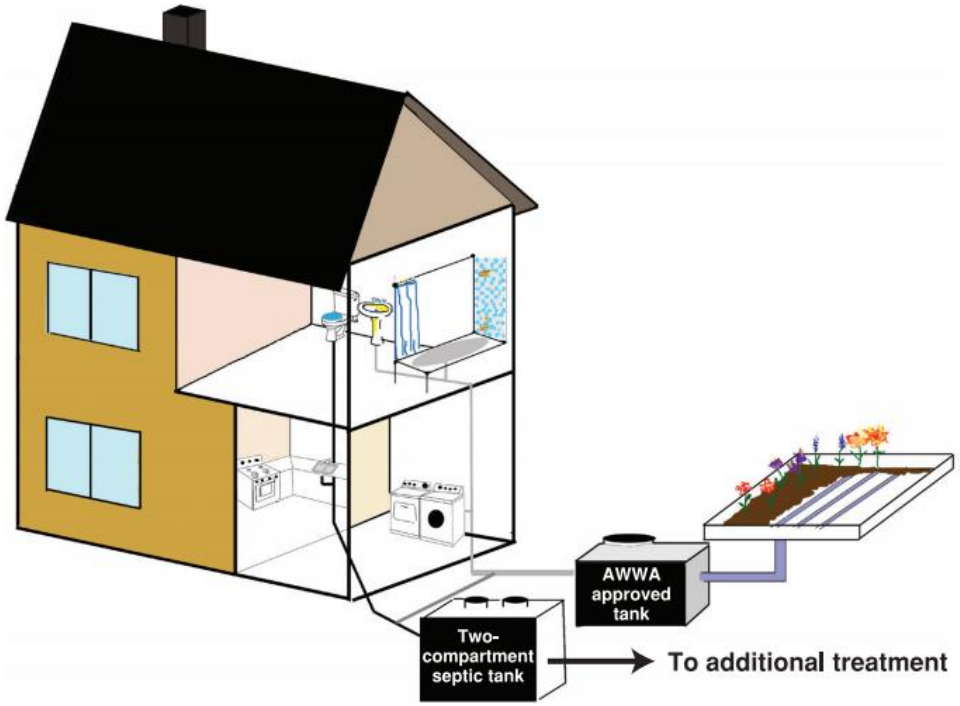
PROGRAM/MISSION (BY MOUD)	DURATION	BUDGET	WASTE WATER RELATION
SMART CITIES MISSION	5 years starting from 2015	48 thousand crore	Essential features of Smart cities proposal include waste water recycling
AMRUT	5 years starting from 2015	50 thousand crore	The mission focuses on sewerage facilities and septage management as one of the thrust areas. 1. In sewerage, Decentralised, networked underground sewerage systems, including augmentation of existing sewerage systems and sewage treatment plan 2. Rehabilitation of old sewerage system and treatment plants 3. Recycling of water for beneficial purposes and reuse of wastewater
NATIONAL WATER POLICY under MOWR			Efforts should be made to provide improved water supply in rural areas with proper sewerage facilities. Least water intensive sanitation and sewerage systems with decentralized sewage treatment plants should be incentivized.
NATIONAL URBAN SANITATION POLICY under MOUF			Promoting recycle and reuse of treated waste water for non potable applications wherever possible will be encouraged
SWATCH BHARAT	5 years starting from 2015	62 thousand crore	In the event that a sewerage system is not available within 30 meters from the proposed household toilet, in addition to the construction of the toilet superstructure, an on-site treatment system (such as twin pits, septic tanks, bio-digesters, or bio-tanks) should also be constructed for the collection, treatment and/or disposal off sewage at, or near the point of generation.
JNNURM	Initially 7 years starting from 2005 but then extended to 2014	1 lakh crore	The sectors and projects eligible for JNNURM assistance included 1. Water supply (including desalination plants) and sanitation 2. Sewerage and solid waste management 3. Construction and improvement of drains and storm water drains

TYPES OF WASTE WATER TREATMENT

CENTRALIZED SEWAGE TREATMENT SYSTEM

1. Irrigation, road way landscape 2. Cooling Water For Power Plants And Oil Refineries 3. Dust Control 4. Construction Activities 5. Concrete Mixing require disinfected secondary water	**Secondary Treatment**
Restricted Urban Reuse like – Toilet Flushing, Park/ Recreational area irrigation	**Tertiary Filtration**
Industrial **Non- Potable Reuse** (fire fighting)	**Tertiary Membrane Filtration**
Indirect Potable Reuse – 1. River 2. Stream 3. Surface water augmentation 4. Ground water Recharge 5. Aquifer storage & recovery	**Nitrogen&Phospharas Control**
Direct Potable or High Quality Process	**RO & Disinfection**

DE-CENTRALIZED SEWAGE TREATMENT SYSTEM



Issues of wastewater reuse in Ahmedabad

Treatment capacity **1075 MLD**

Treated water only

650 MLD

288 MLD

Untreated water **bypassed** from treatment plant

- All STP have

Secondary treatment

Less scope of water reuse.

- **Insufficient secondary treatment** for Pirana and Vinzol.

Tertiary treatment plant

- **Degradation** in **soil** quality for agriculture.
- **Negative impacts** on health and environment.

Recommendation of waste water reuse methods in agriculture and institutional framework

Maximum reuse in **urban landscape**, no wider use of treated water

Urban Landscape

Parks and Gardens

Agricultural lands

Industrial waste water treatment

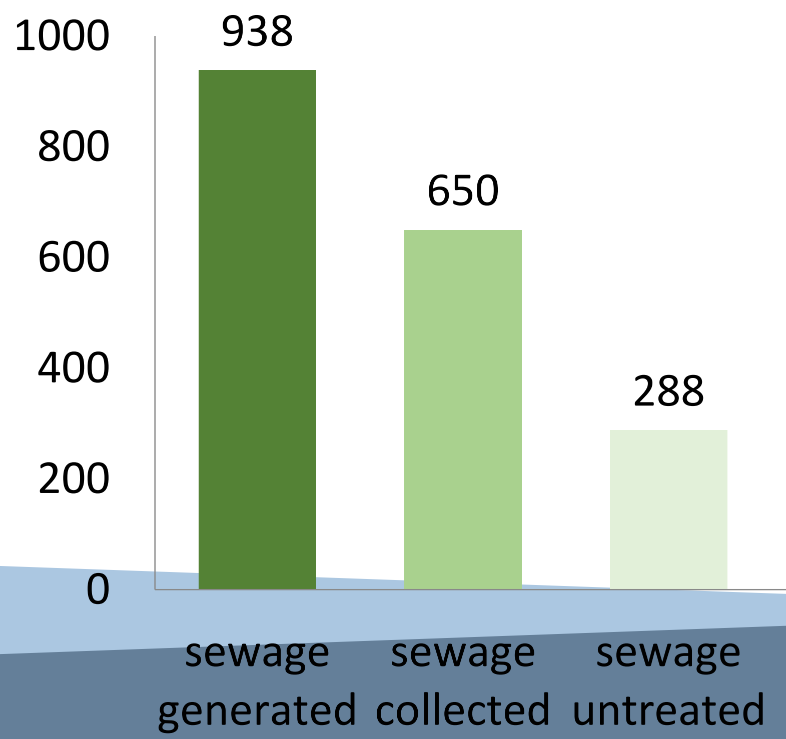
Sources- "waste water irrigation in Gujrarat"- IWMI, CSP Ahmedabad 2014

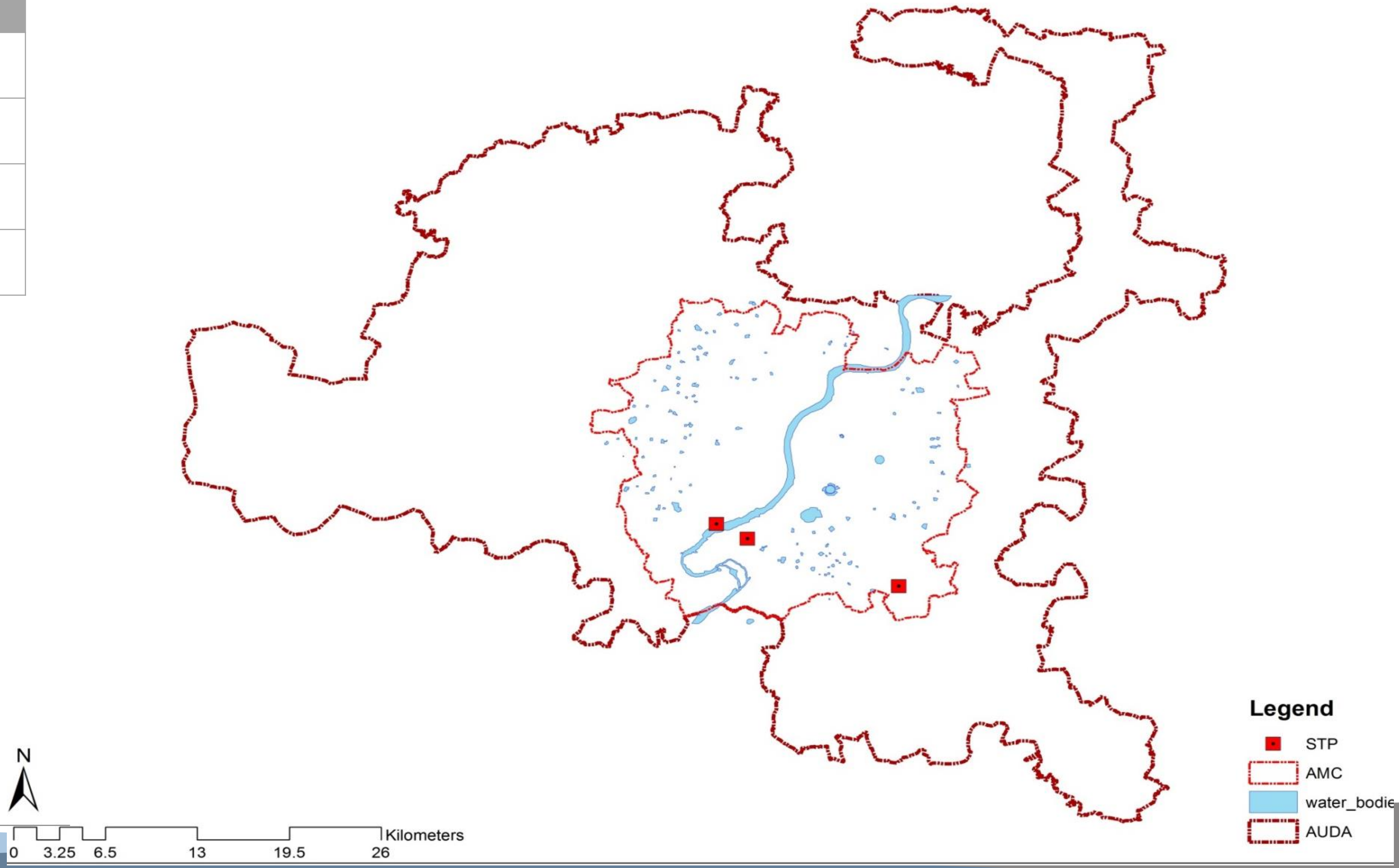
WASTE WATER REUSE IN AGRICULTURE

SANCY . TEENA

WASTE WATER TREATMENT

Pirana stp	Vasna stp	Vinzol
106	126	70-(120)
182-(45)	76-(58)	
180	35	
60	240-(45)	





Source- CSP 2021

Quality- Treated water

Parameters	Standard for effluent to be discharged	Effluent from Pirana
pH value	5.5 – 9.0	7.65
Suspended solids(mg/l)	100	26.65
TDS(mg/l)	2100	1131
COD(mg/l)	250	81.58
BOD(mg/l)	30	18.21

Source- Part-A of General Standards for discharge of Environmental Pollutants, GSR 801 (E) EPA 1993

Quality- Discharged effluents

Waste water Quality

GPCB results

River	Location	Parameters *			
		pH	D.O.	B.O.D.	C.O.D.
Sabarmati	Vasna - Narol Bridge	8.19	3.37	51.33	211.67
Sabarmati	Vautha village	8.04	Nil	49.00	202.00
Sabarmati	Miroli	7.86	0.0	67.00	213.00
Sabarmati	**Varsang(primary survey)**	2.5			

Gyaspur village

Parameters	Present level	Permissible limit
BOD(sabarmati, khari)	207mg/l,320 mg/l	150mg/l
As	0	0.1
Cd	0.01	0.01
Cr	0.9	0.1
Cu	1.6	0.2
Pb	0.2	5.0
Zn	0.1	2.0

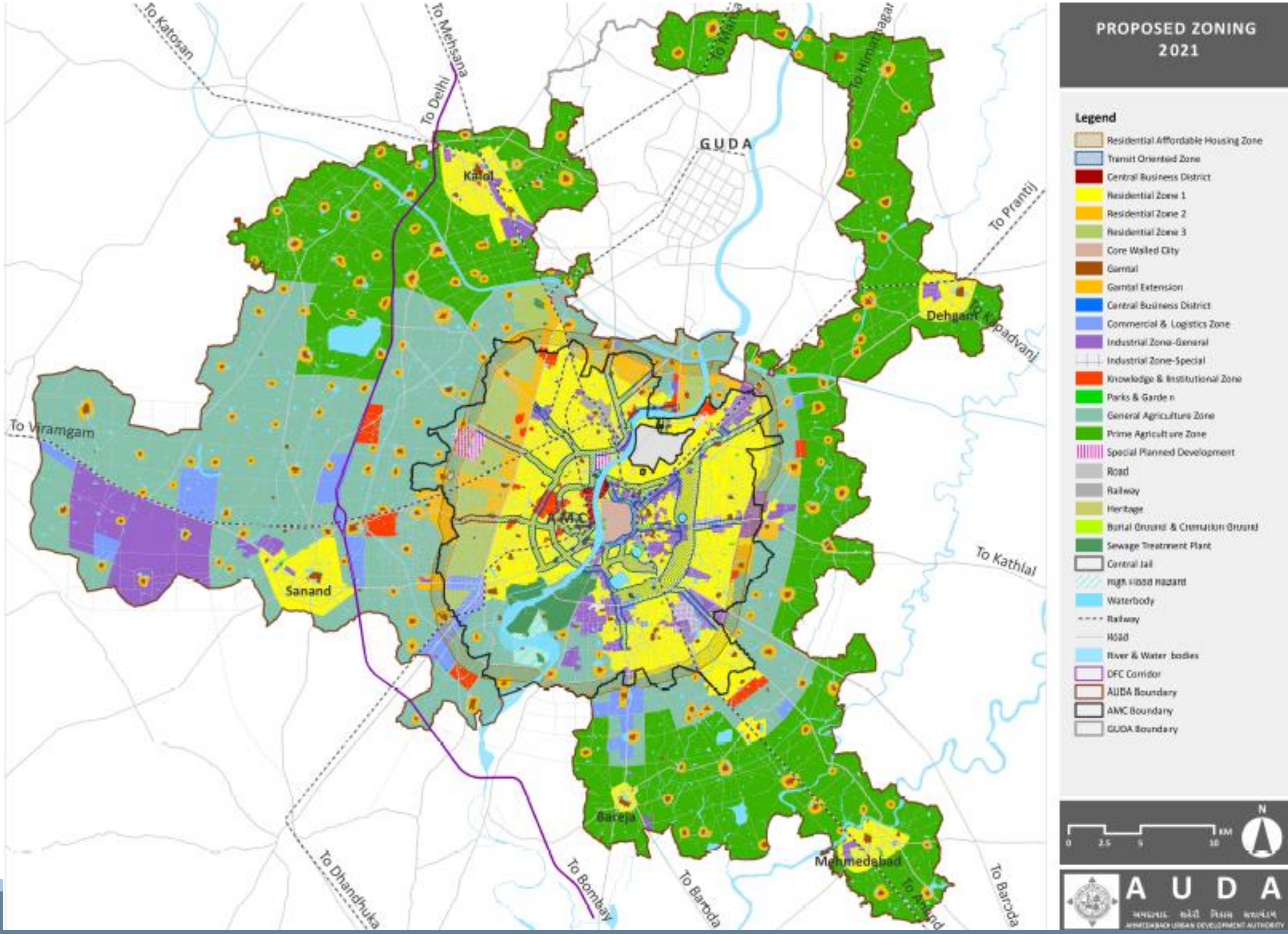
CAG Reports 2012

Parameters	
BOD	87
Fecal coliform	4300
Total coliform	24000

Source- Urban waste water and agricultural reuse challenges in India (IWMI)

Current waste water irrigation scenario

- Total AUDA area- 1866 sqkm
- % of agricultural area- 30.5%
- Total agricultural area in AUDA- 569.13sqkm
- Area irrigated using waste water- 336sqkm



Source- DP 2021

Current waste water irrigation scenario

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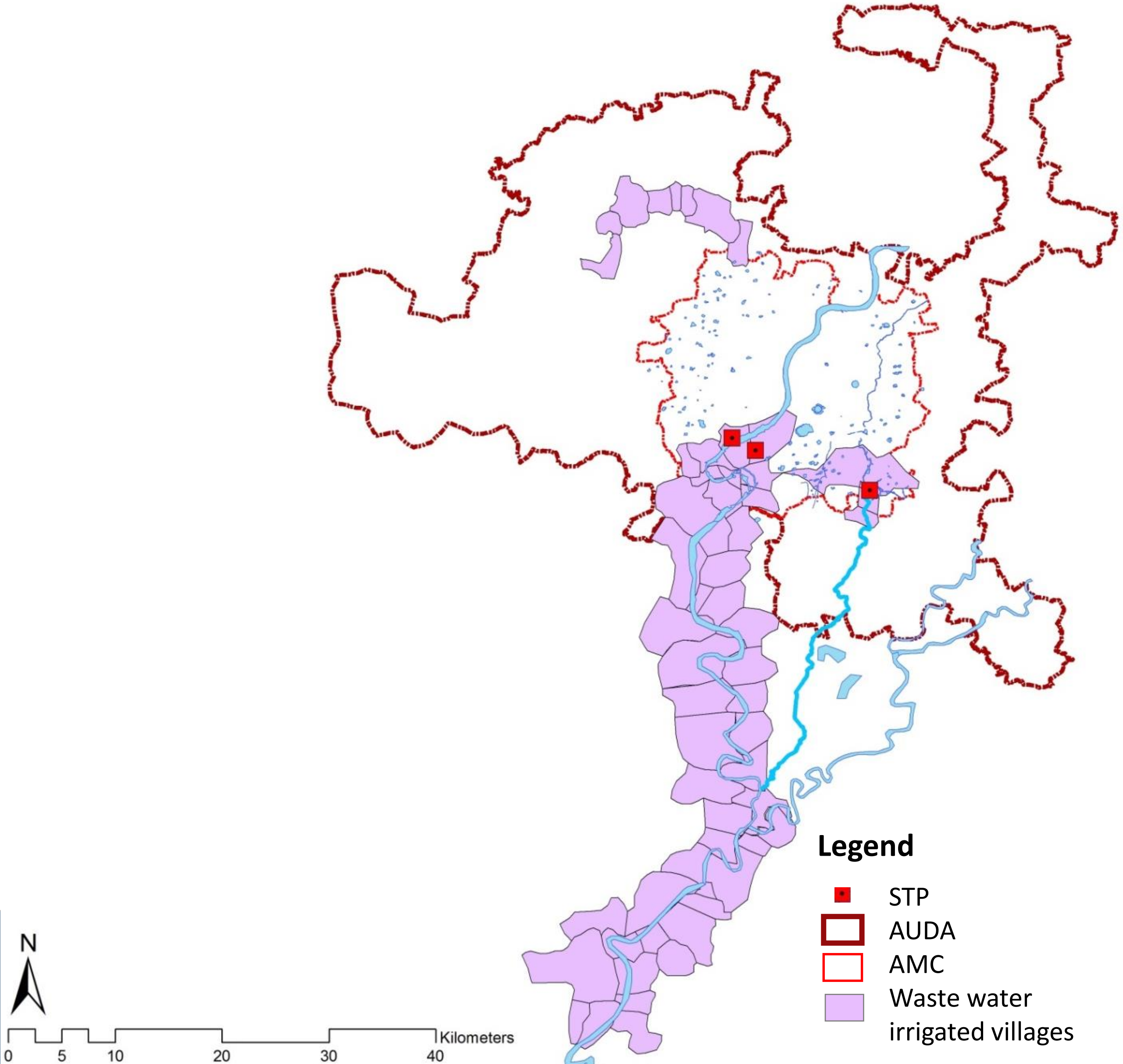
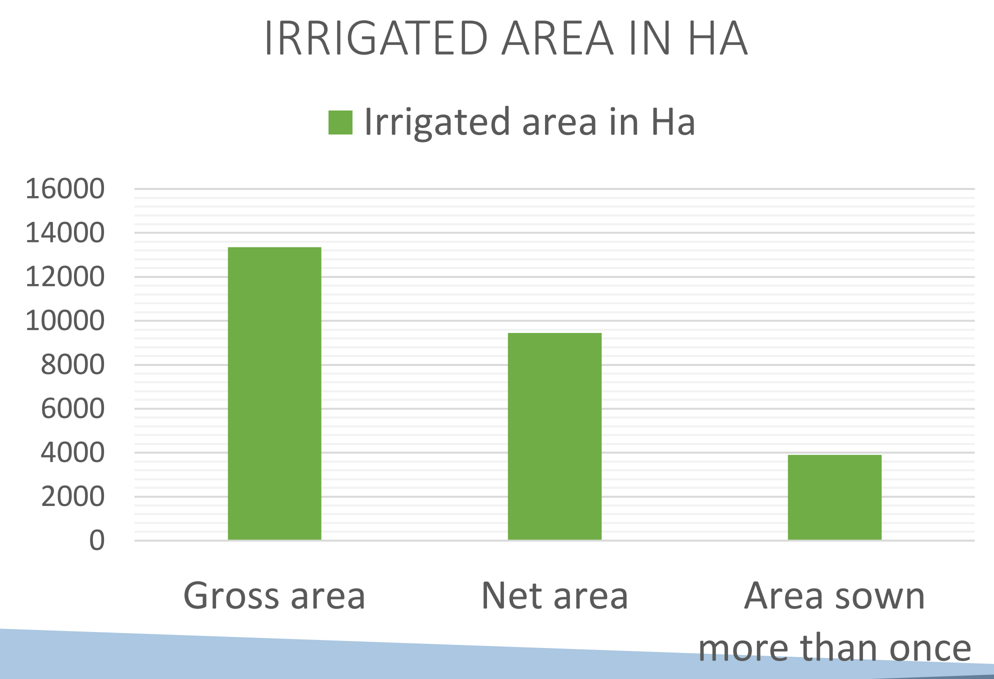
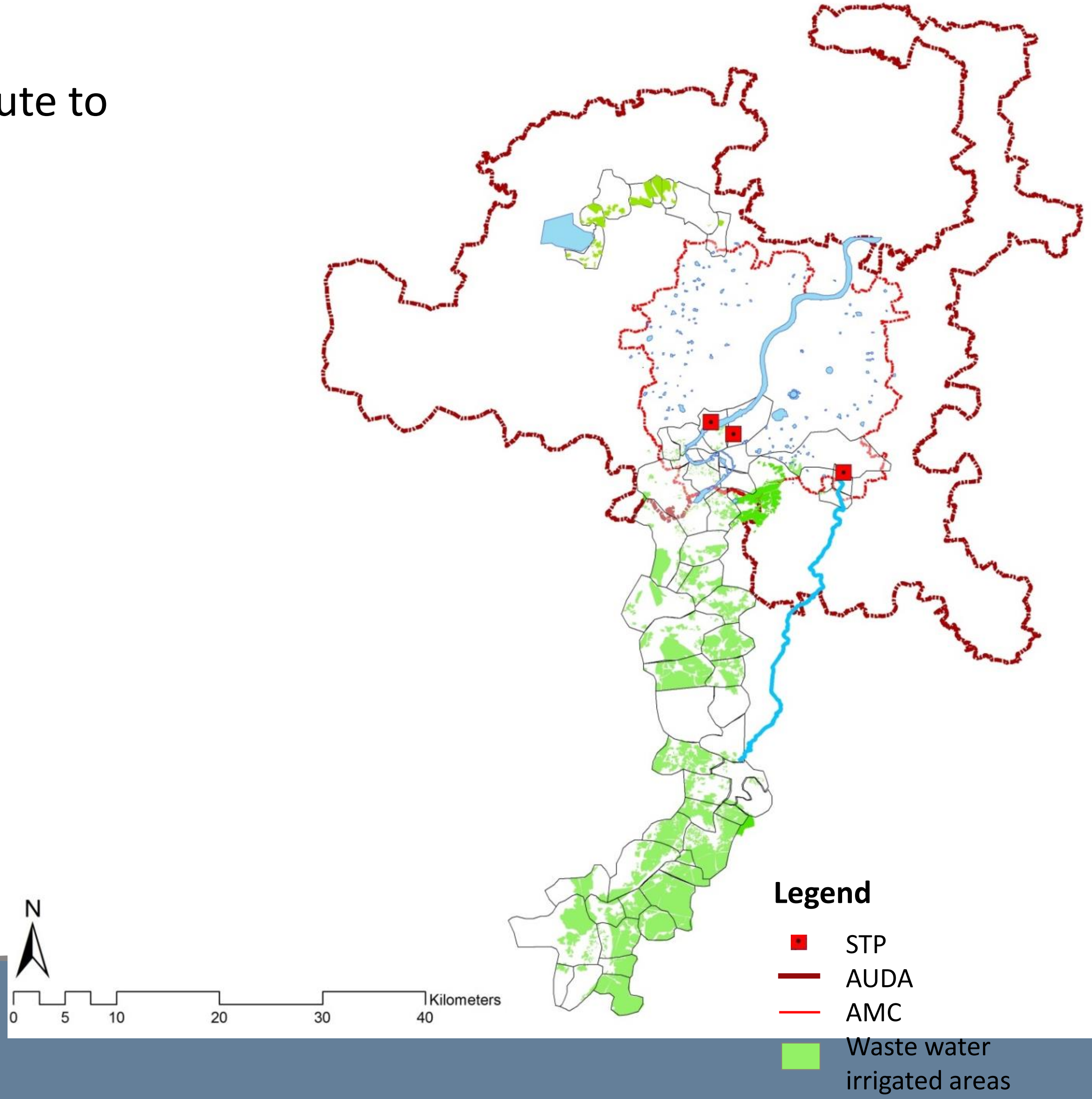


Source- DP 2021

Current waste water irrigation scenario

- 45 villages practice waste water agriculture contribute to 45% of total agriculture
- Mainly cotton ,paddy, vegetable and wheat

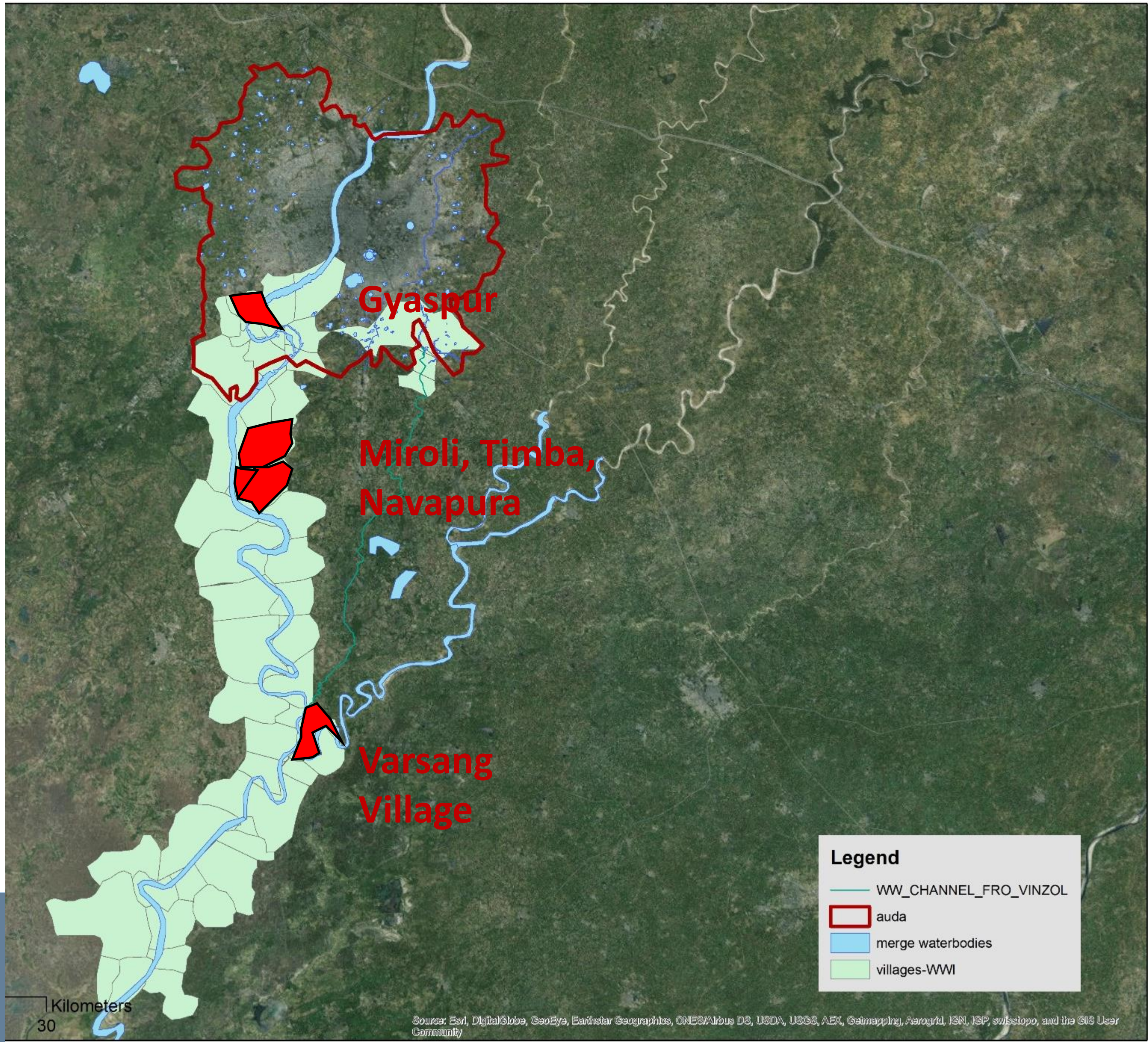




Source- IWMI report on Waste water policy research highlight

Samples

S.No	Village	Total net irrigated area	Net ww irrigated area	Farmers	Ratio of WW irrigated to total irrigated
1	Miroli,timba,Navapura	1083	1083	500	1
2	Varsang	281	141	300	.5
4	Gyaspur	219	100	150	.456



Source-Waste water ittigatiopn:alka parechas report

Profile of surveyed villages

GYASPUR

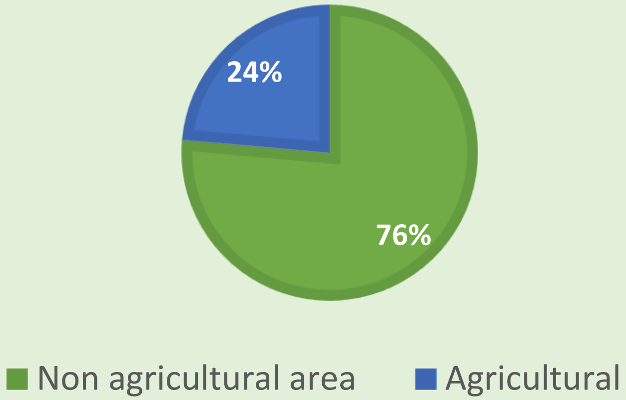
Total no of farmers- **150**

Area

Gyaspur- 709.08 Ha

Irrigation system-Flow irrigation

Crops grown-Rice,wheat



MIROLI,TIMBA,NAVAPURA

Total no of farmers- **500**

Area

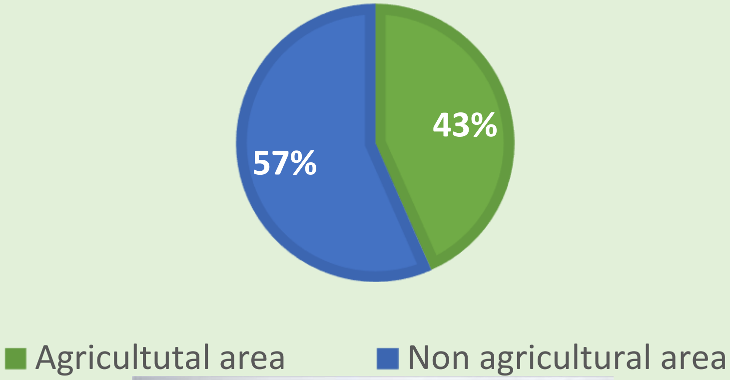
Miroli- 1153.27 Ha,Timba- 1034.1 Ha

Navapura- 307.83Ha

Total area- 2496 Ha

Irrigation system-Flow irrigation

Crops grown-Rice, wheat



VARSANG

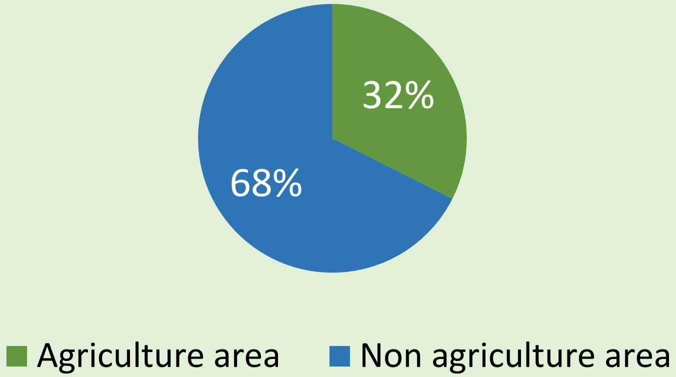
Total no of farmers- **300**

Area

Varsang- 141Ha

Irrigation system-Flow irrigation

Crops grow- Rice, wheat, dhivela, cotton

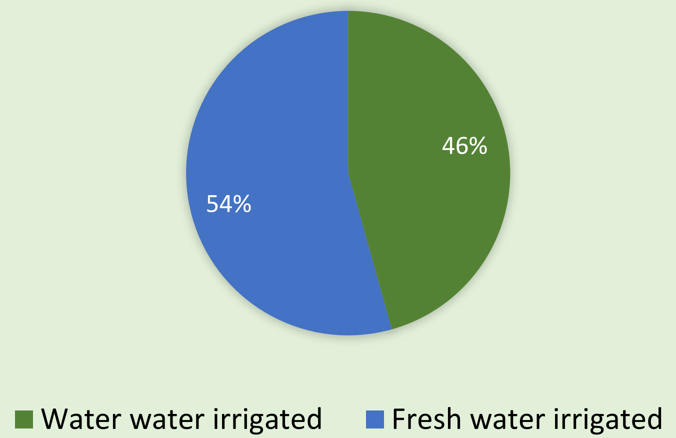


Source-primary survey

Profile of surveyed villages

GYASPUR

Total no of farmers- **150**

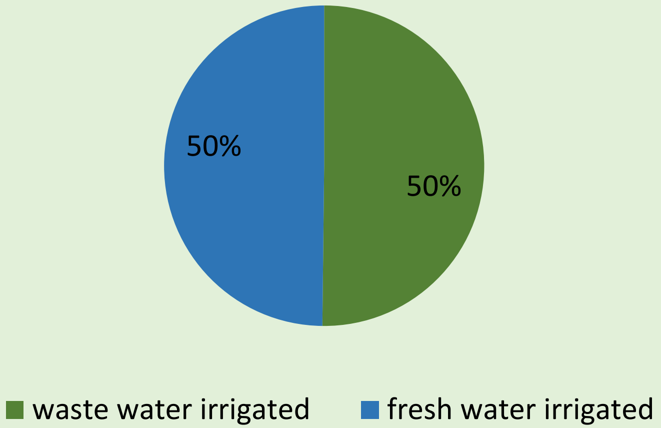


MIROLI,TIMBA,NAVAPURA

Total no of farmers- **500**

VARSANG

Total no of farmers- **300**

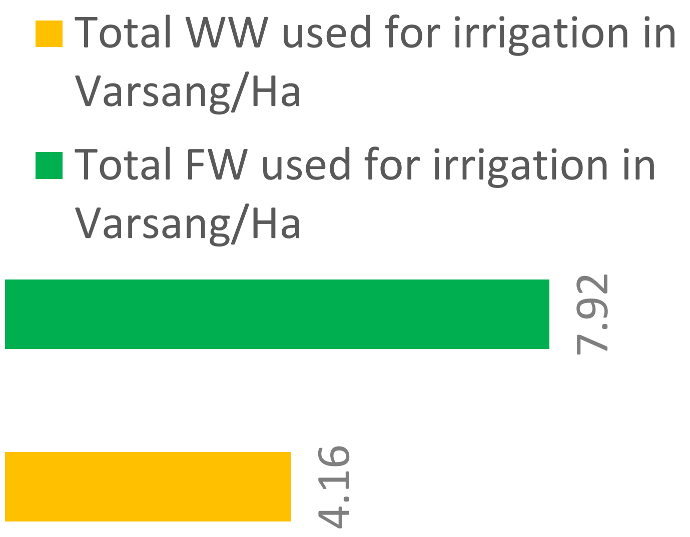


Source-primary survey

Irrigation waste water usage

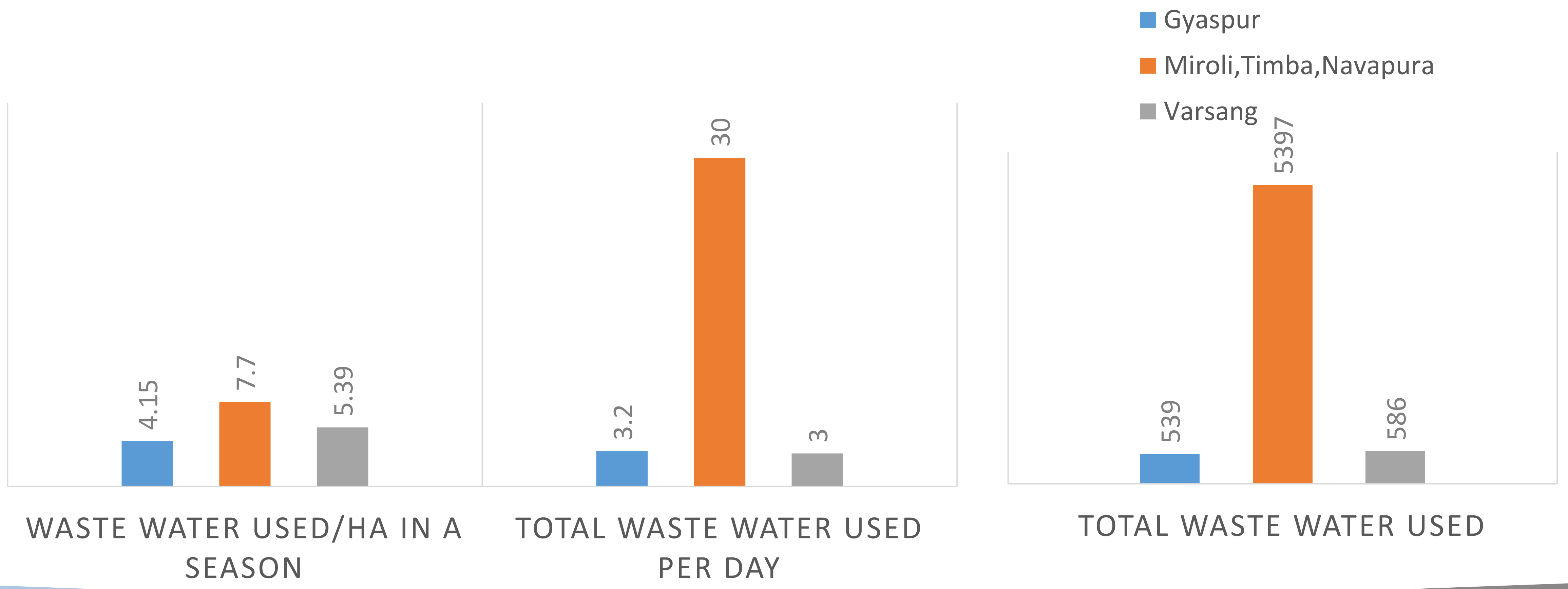
Villages	Gyaspur(ML)	Miroli, Timba and Navapura (ML)	Varsang (ML)
Total WW used for irrigation in a season	539	5396.46	586
Total WW used for irrigation in a season/Ha	5.39	7.71	4.15
Total WW used for irrigation in a Day	**3.0 MLD**	**29.98 MLD**	**3.25 MLD**
Total FW used for irrigation			1109
Total FW used for irrigation per Ha			7.92

Water usage Varsang



Source-primary survey

Waste water used



Source-primary survey

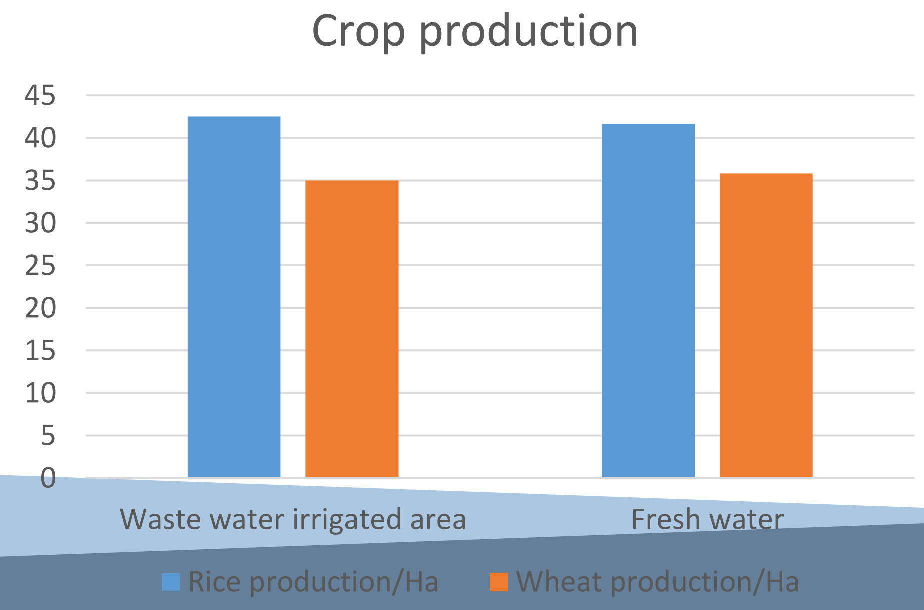
Comparison of fresh and waste water production (Varsang)

PH of Waste Water – 2.5

PH of Fresh water- 7.5

Crop production

- Average crop production of Rice- 50 qntl/Ha
- Average crop production of Wheat- 35 qntl/Ha



Source-primary survey

Institutional structure

Irrigational system

Miroli,timba,navapura

Sabarmati river → **D.P.H Seva Sarkari Canal** → **Agricultural feilds**

Bore well → **Agricultural feilds**

Source-primary survey

Miroli, Timba, Navapura village

Institutional structure

D.P.H Seva Sarkari Mandal

↓

Chairman

↓

Vice Chairman

↓

Secretary

↓

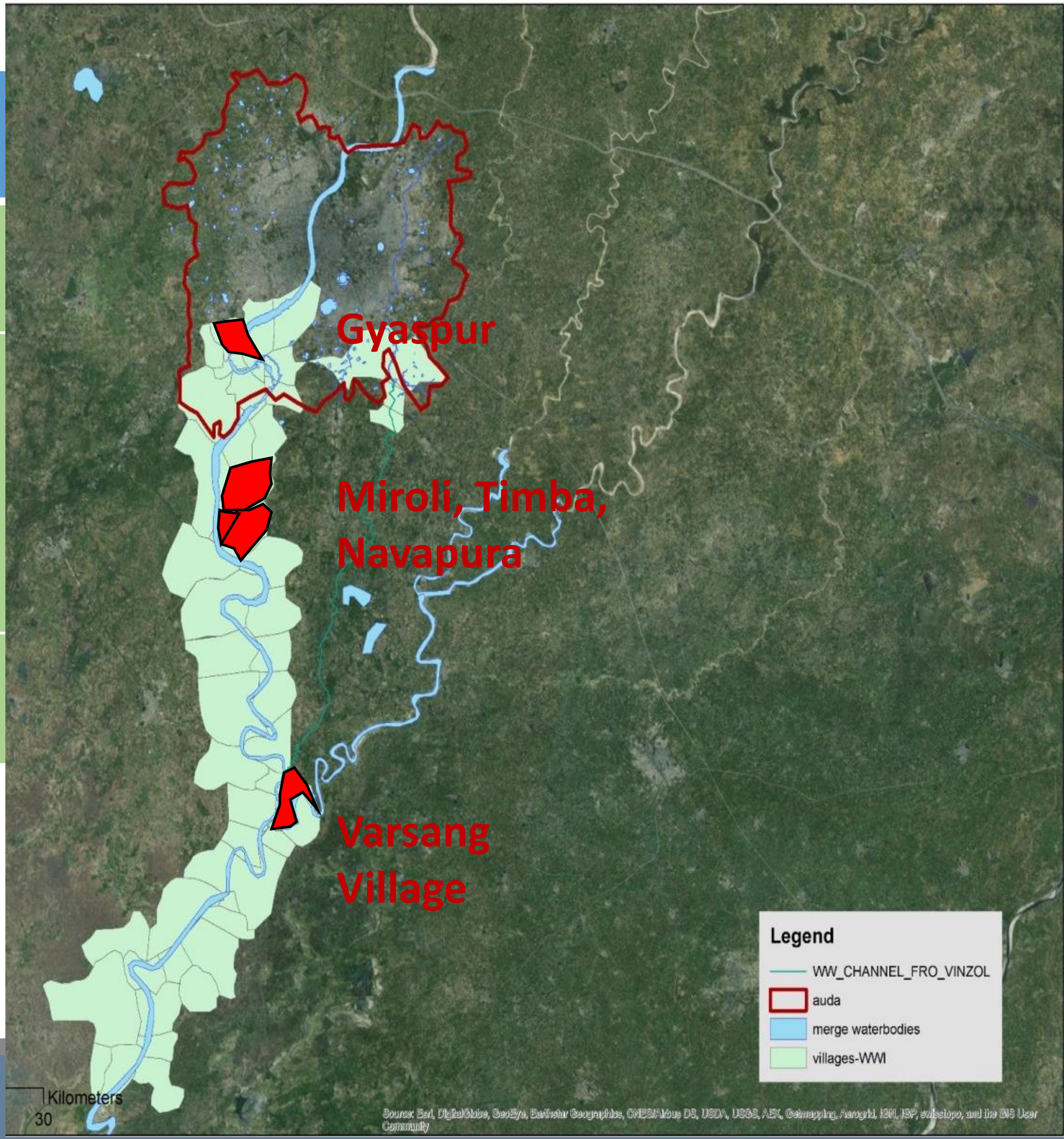
Members

TOTAL OF 500 FARMERS ARE THERE

Source-primary survey

Conclusion from survey

Impacts	Gyaspur	Miroli, Timba, Navapura	Varsang
Air	Acid and foul smell, Rusting- High	Acid and foul smell	Foul smell- Less intensity
Soil	High salt accumulation that most of them stopped their agricultural activities	Salt accumulation – But manageable by using Gypsum powder	Very less salt accumulation
Health	Skin Rashes Breathing problem	Skin Rashes	Nil



- **Reduction in health and Environmental impact**
- **Improved crop production**

Source-primary survey

Contribution of waste water to agriculture

Total Waste water consumed for agriculture every day is **36.23MLD** in **five villages**

i.e **5%** to total waste water collected & **25%** of reuse recommended by SLB indicator

Total Waste water consumed for agriculture every day is 36.23MLD in five villages

i.e. 5% to total waste water collected

Why it is still neglected ?

Absence of targeted approach National level

NO implementing or monitoring arm

NO guidelines or made a mandate

Quality impacts

Case study : Australia

- Presently 11.5% waste water generated in Australia is reused which is 103000ML/year

- In Northern Adelaide Plains one of the largest reclaimed water schemes in the southern hemisphere provide **108000ML** conveyed by **100km** pipeline.

Crops grown

A wide range of fruit and vegetables which are beans, broccoli, cabbage, capsicum, carrots, cucumber, eggplants, lettuce, melons, onions, parsnips, pears potatoes etc

Implementation body

Joint venture between the Virginia Irrigators Association (representing the growers), Water SA (the state water authority responsible for wastewater treatment) and a private company

Environmental impact

35 % water being recycled at Bolivar WWTP,reduces the discharge of harmful nutrients into the marine environment, reduces demand for groundwater extractions and contributes to reducing South Australia's dependence on pressured surface water systems

What is to be done ? Possible ways

GOVERNMENT LEVEL

- Water Conservation mainly focusing on waste water reuse practices by Ministry Of Water Resource
- Corresponding State Level Policy based on ground condition and future possibilities
- Guidelines formation

UNDER WASTE WATER IRRIGATION

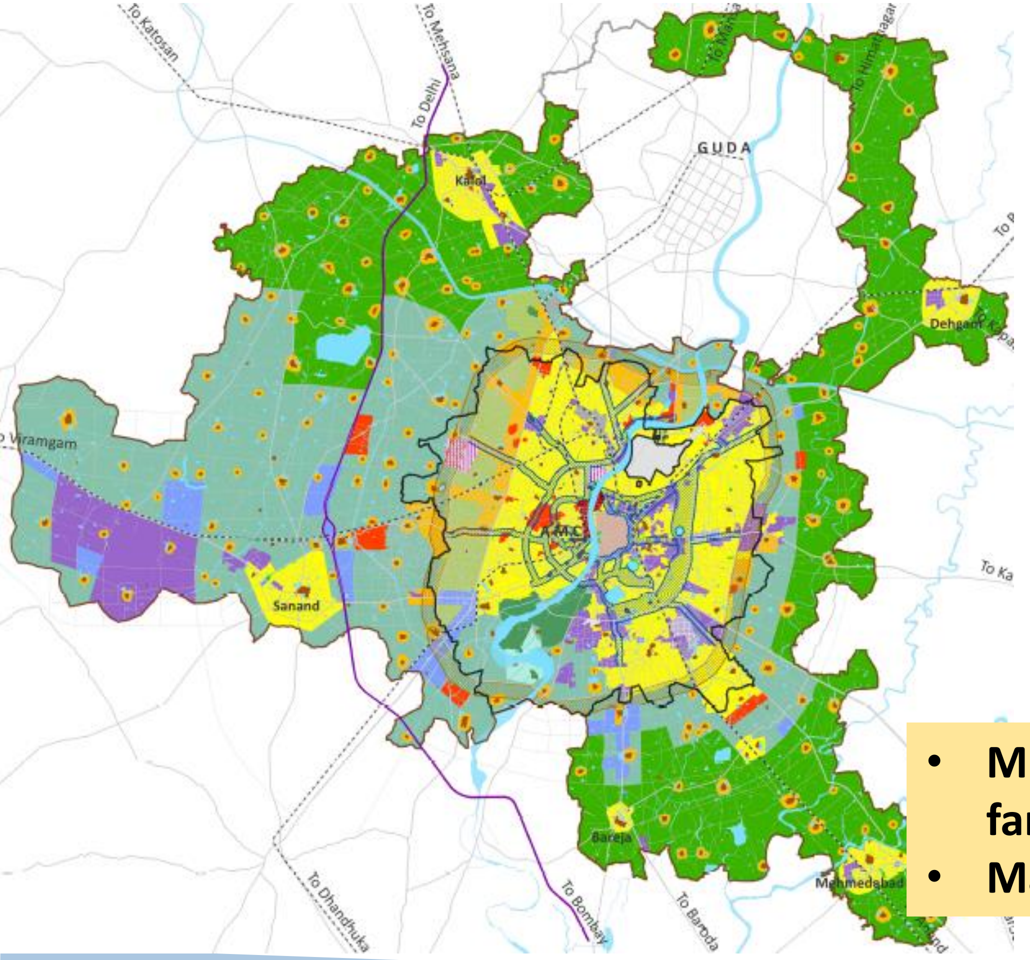
- Formation of data base
- Formation of waster water users group in each villlage

CRITERIA FOR FORMATION OF VILLAGE LEVEL WASTE WATER USERS GROUP

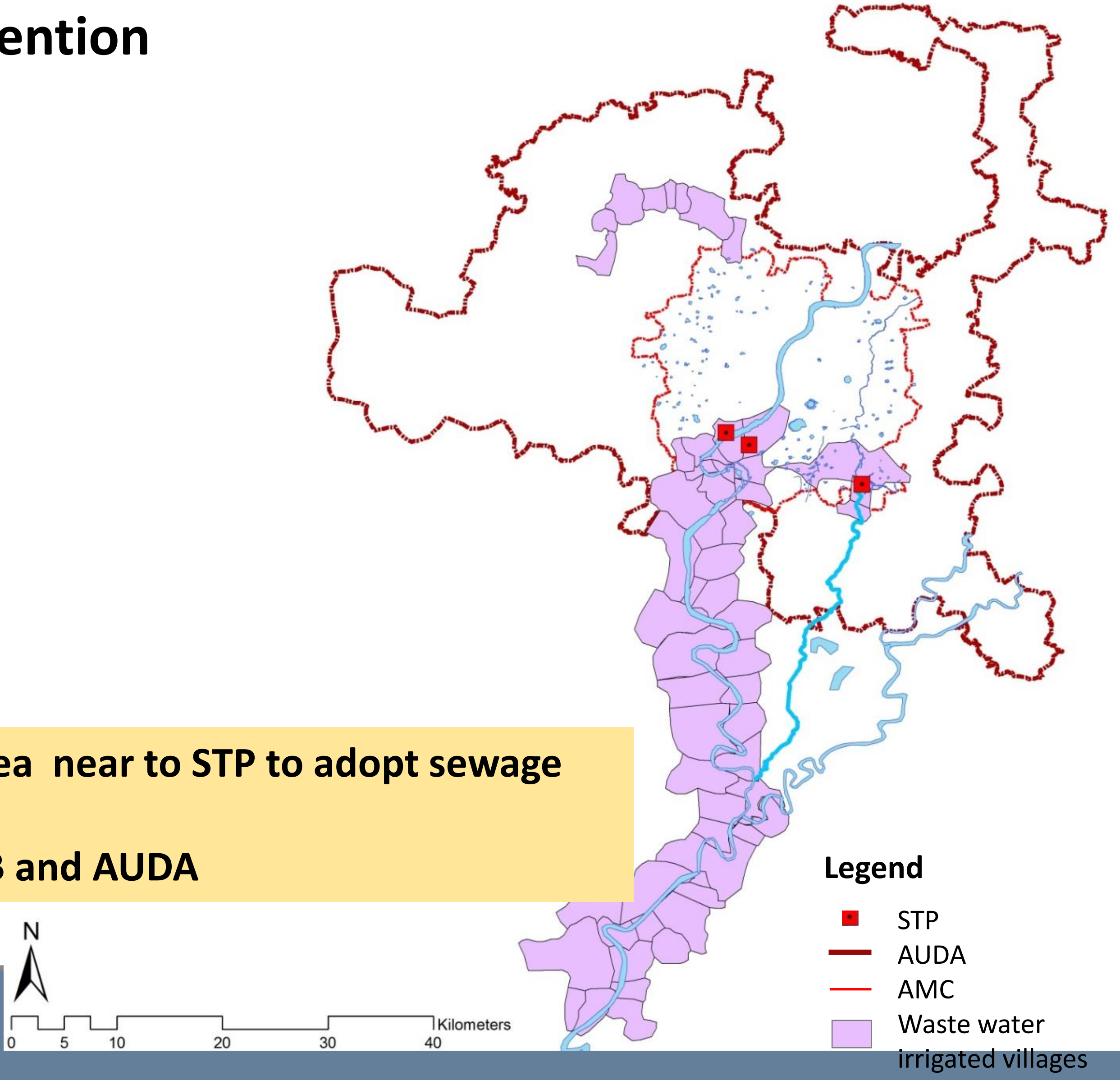
- Farmers with min Land holding of 0.3ha only depended on waste water
- Cluster of villages formed basis of irrigation facility made available

What is to be done Ahmedabad context?

DP level intervention



- **Min specified area near to STP to adopt sewage farming**
- **Managed by ULB and AUDA**



Source- DP 2021

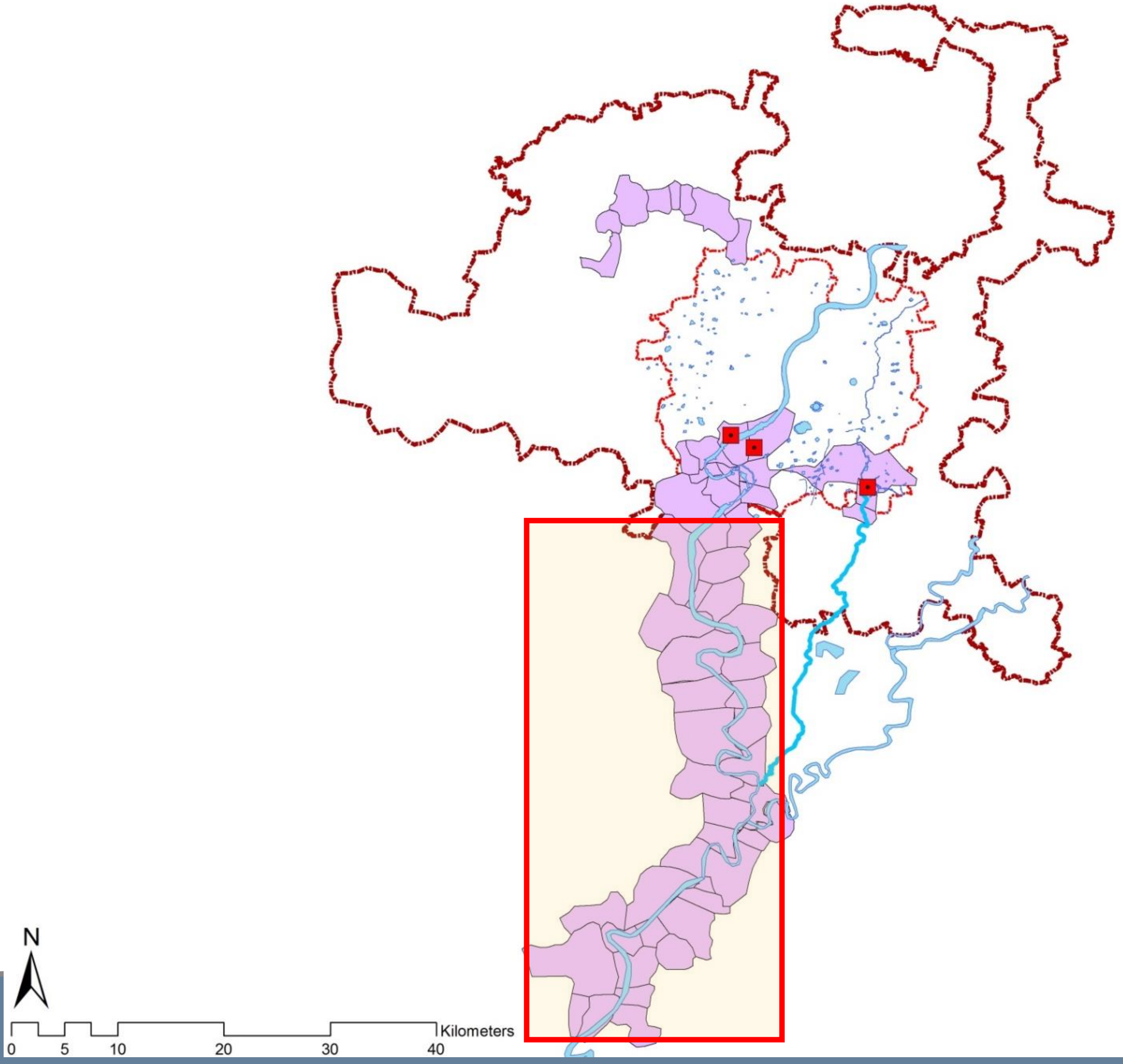
What is to be done outside jurisdiction AMC AND AUDA ?

State level body under water resource and irrigation department

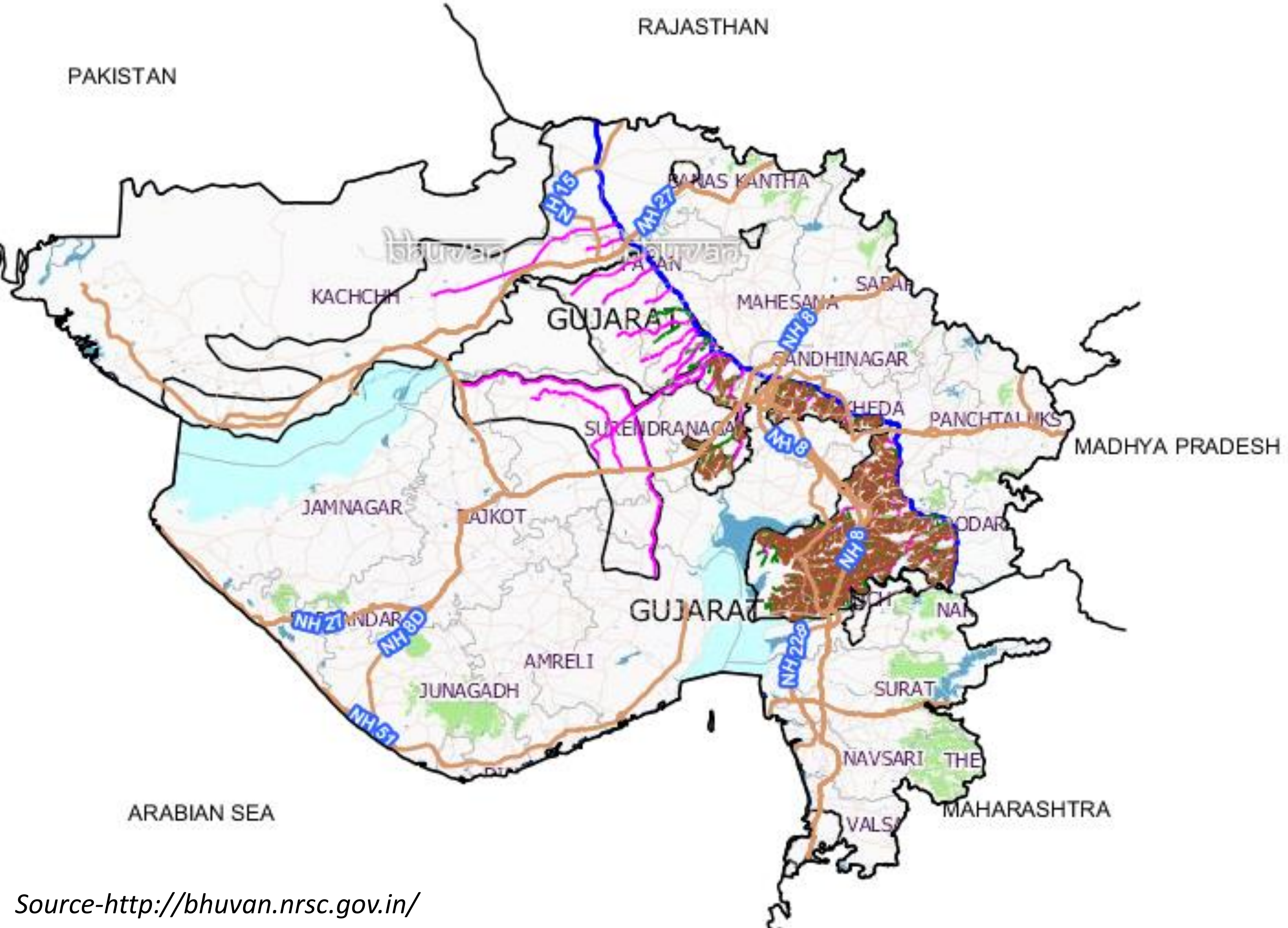
Headed by engineer

Co-opertaion formed by group of villages

Cluster of villages formed on basis of irrigation facility made available

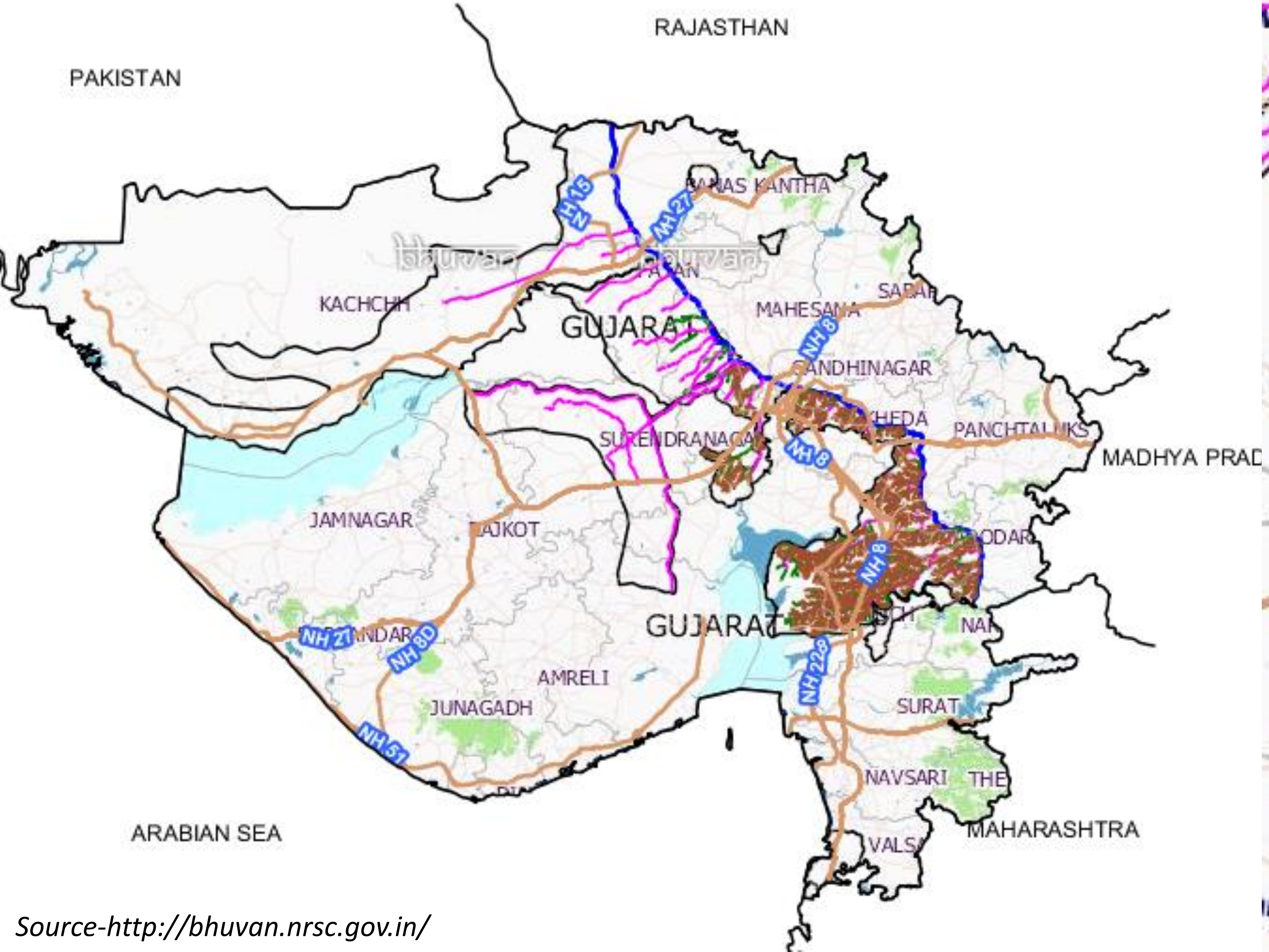


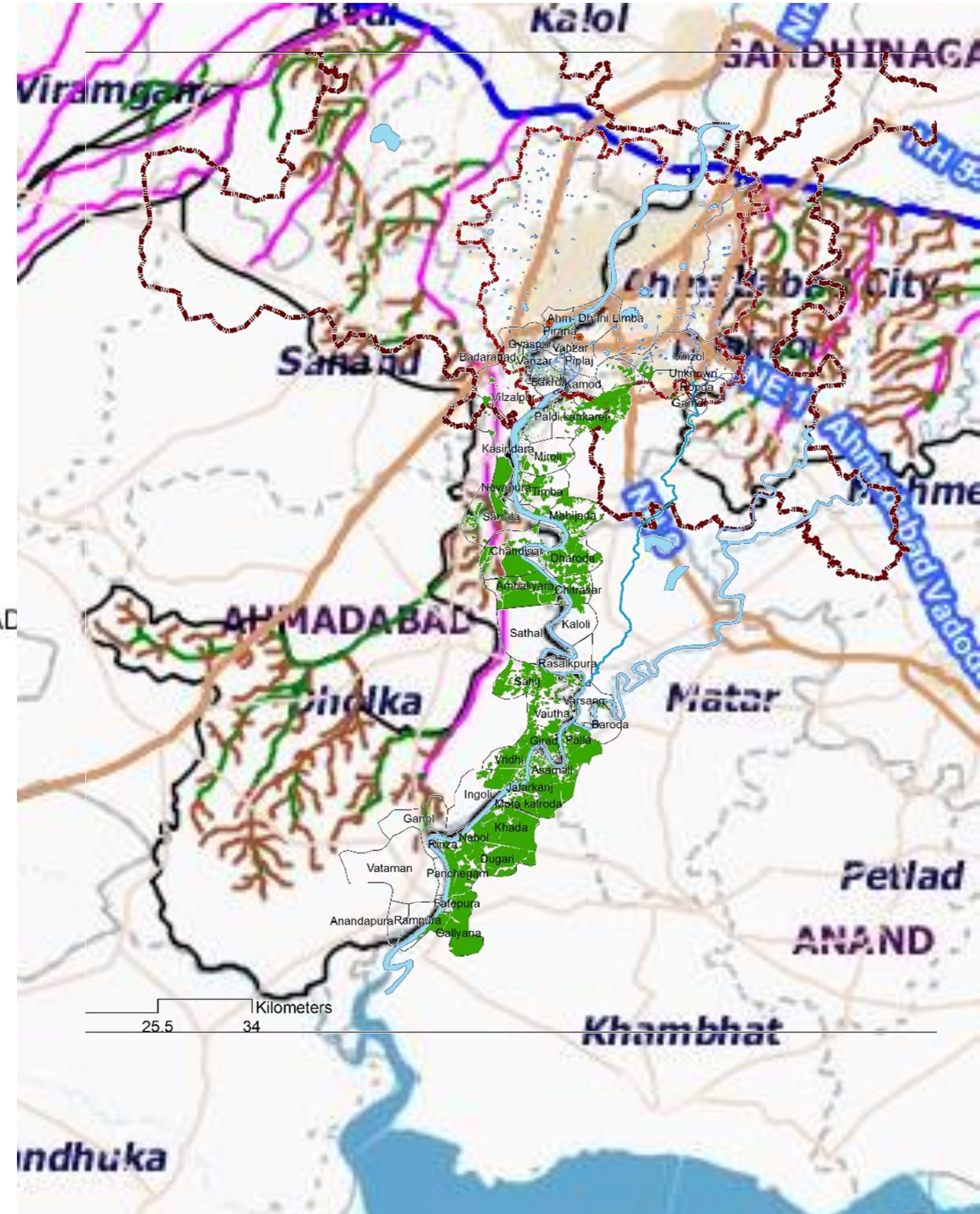
Present area under irrigation department



Source-http://bhuvan.nrsc.gov.in/

Present area under irrigation department





Source-http://bhuvan.nrsc.gov.in/

Suggested institutional components and their activities

GOG → Policy ,Regulation, guidelines

Agriculture dept.

Irrigation and environment dept.

Village level body

Farmers

AMC

STP

Monitoring at discharge and reuse points

DP level intervention

Waste water related crop pattern knowledge

Awareness (safety practices

Research department on waste water related agriculture

Awareness campaigns

Irrigation structures

Low cost onsite treatment technologies

Guidelines- Crop restriction and treatment

Treatment required				
Type of crops	**WHO**	**California**	**USAID**	**Recommended**
Food crops where recycled water contacts the edible portion of the crop, including all **root crop**	series of stabilization ponds	Disinfected Tertiary Recycled Water	Secondary Filtration Disinfection	**Tertiary**
Food crops where edible portion is produced above ground and not contacted by recycled water **(rice, wheat etc)**	Retention in stabilization ponds for 8-10 days	Disinfected Secondary	Secondary Filtration Disinfection	**Secondary Filtration Disinfection**
Orchards with no contact between edible portion and recycled water	Not less than primary sedimentation	Undisinfected secondary recycled water	Secondary Disinfection	**Secondary Disinfection**
Non-food-bearing trees	Not less than primary sedimentation	Undisinfected secondary recycled water	Secondary Disinfection	**Secondary Disinfection**

Source-WHO guidelines

- *California title 22*
- *USAID guidelines*

Guidelines- Crop restriction and treatment

Treatment required				
Type of crops	**WHO**	**California**	**USAID**	**Recommended**
Fodder crops (e.g. alfalfa) and **fiber crops (e.g. cotton)**	Not less than primary sedimentation	Undisinfected secondary recycled water	Secondary Disinfection	**Secondary Disinfection**
Food crops that undergo commercial pathogen-destroying processing before consumption by humans (e.g. sugar beets)	Not less than primary sedimentation	Undisinfected secondary recycled water	Secondary Disinfection	Secondary Disinfection
Ornamental nursery stock	Not less than primary sedimentation	Undisinfected secondary recycled water	Secondary Disinfection	**Secondary Disinfection**

Source-WHO guidelines

- *California title 22*
- *USAID guidelines*

Guidelines- Reclaimed water quality and onsite monitoring

Reclaimed water quality and onsite monitoring			
Type of crops	**Recommended treatment**	**Reclaimed water quality**	**Onsite Monitoring (GPCB)**
Food crops where recycled water contacts the edible portion of the crop, including all **root crop**	**Tertiary**	• 4 mg/l BOD • No detectable fecal coli/100ml3	• BOD - weekly • Coliform - daily
Food crops where edible portion is produced above ground and not contacted by recycled water **(rice, wheat etc)**	**Secondary** **Filtration** **Disinfection**	• 10 mg/l BOD • No detectable fecal coli/100ml3 • 1 mg/l Cl2 residual(min.)	• BOD - weekly • SS - daily • Coliform - daily • Cl2 residual -continuous
Orchards with no contact between edible portion and recycled water	**Secondary** **Disinfection**	• BOD- 30 mg/l • SS- 30 mg/l 200 • fecal coli/100ml • 1 mg/l Cl2 residual (min.)	• BOD - weekly • SS - daily • Coliform - daily • Cl2 residual -continuous
Non-food-bearing trees *Source-WHO guidelines* • *California title 22* • *USAID guidelines*	**Secondary** **Disinfection**	• BOD- 30 mg/l • SS- 30 mg/l 200 • fecal coli/100ml • 1 mg/l Cl2 residual (min.)	• BOD - weekly • Coliform – daily • Cl2 residual -Continuous

Guidelines- Reclaimed water quality and onsite monitoring

Reclaimed water quality and onsite monitoring			
Type of crops	**Recommended Treatment**	**Reclaimed water quality**	**Onsite Monitoring (GPCB)**
Fodder crops (e.g. alfalfa) and **fiber crops (e.g. cotton)**	**Secondary Disinfection**	• BOD- 30 mg/l • SS- 30 mg/l 200 • fecal coli/100ml • 1 mg/l Cl2 residual(min.)	• BOD - weekly • Coliform – daily • Cl2 residual - continuous
Food crops that undergo commercial pathogen-destroying processing before consumption by humans (e.g. sugar beets)	Secondary Disinfection	• BOD- 30 mg/l • SS- 30 mg/l 200 • fecal coli/100ml • 1 mg/l Cl2 residual(min.)	• BOD - weekly • Coliform – daily • Cl2 residual - continuous
Ornamental nursery stock	**Secondary Disinfection**	• BOD- 30 mg/l • SS- 30 mg/l 200 • fecal coli/100ml • 1 mg/l Cl2 residual(min.)	• BOD - weekly • Coliform – daily • Cl2 residual - continuous

Source-WHO guidelines

- *California title 22*
- *USAID guidelines*

Guidelines- Irrigation techniques

Irrigation technique	Factors affecting choice	Spatial measures for waste water application
Flood	Lowest cost Exact levelling not req	• Protection for fieldworkers, crop handlers and consumers like boots, shoes and gloves • Min dis of 50-100m from houses and roads • Anaerobic waste water should not be used because of odour nuisance • New technologies reduces crop contaminations like spray and drift but the maintenance is much higher • Localized irrigation- Selection of non clogging emitters, Filtration for clogging of emitters
Furrow	Lowest cost Exact levelling req	
Spray and springler	Medium water use efficiency Levelling not req	
Subsurface and localized (drip, trickle and bubber)	High cost High water use efficiency	

Source-WHO guidelines

Guidelines- Health

Exposed group	Health hazard	Health based target	Protection measures
Consumers, workers and local communities	Excreta-related diseases	Eradication of Excreta related disease (10-6 DALY)	• Wastewater treatment • Excreta treatment • Health and hygiene promotion • Chemotherapy and immunization
Consumers	• Excreta-related • Diseases • Foodborne trematodes • Chemicals	• Eradication of Excreta related disease (10-6 DALY) • Absence of trematode infections • Tolerable daily intakes as specified by the Codex Alimentarius Commission	• Produce restriction • Waste application/timing • Depuration • Food handling and preparation • Produce washing/disinfection • Cooking foods
Workers and local communities	• Excreta-related • Pathogens • Skin irritants • Schistosomes • Vector-borne • pathogens	• Eradication of Excreta related disease (10-6 DALY) • Absence of skin disease • Absence of schistosomiasis • Absence of vector borne disease	• Access control • Use of personal protective equipment • Disease vector control • Intermediate host control • Access to safe drinking-water and • sanitation at aqua cultural facilities and in local communities • Reduced vector contact (insecticide-treated nets, repellents)

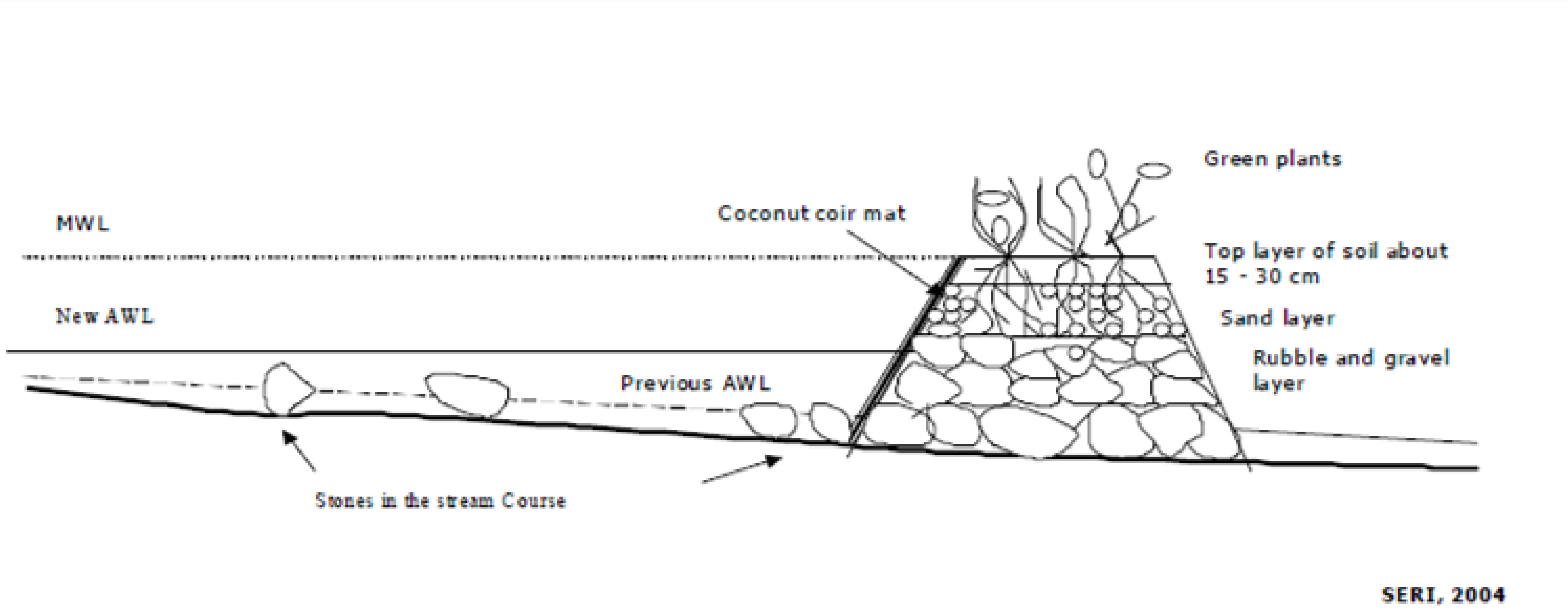
Source-WHO guidelines

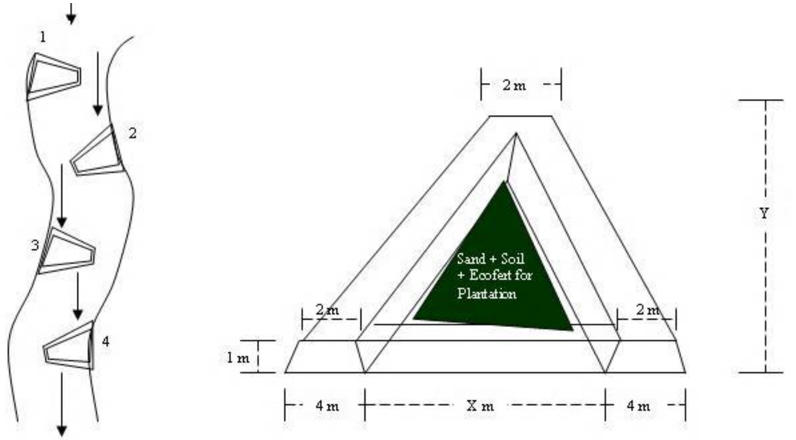
Recommendations- waste water quality improvement

Techniques-

- Green Bridge
- Detention Ponds

Schematic section of green bridge filter on stream





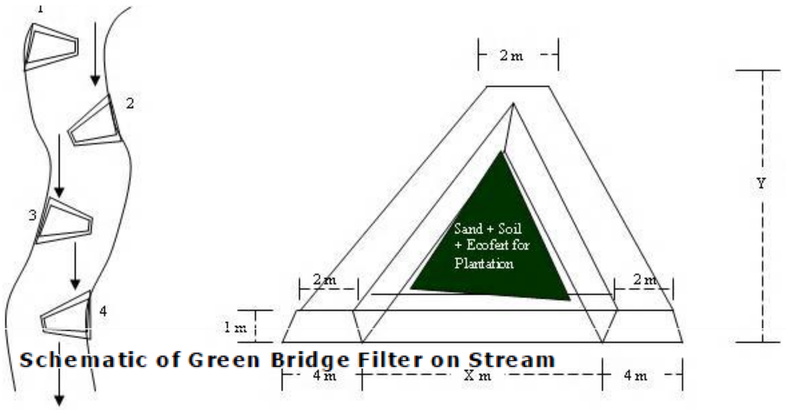
Plan of green bridge filter on stream

Source-ILBM Impact story by SERI

Recommendations- waste water quality improvement

Techniques-

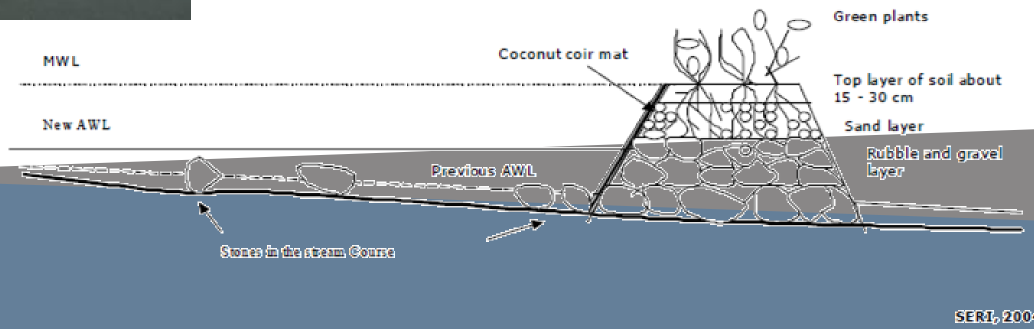
- Green Bridge
- Detention Ponds



Schematic of Green Bridge Filter on Stream

Before –Udaipur lake

After-Udaipur lake



Source-ILBM Impact story by SERI

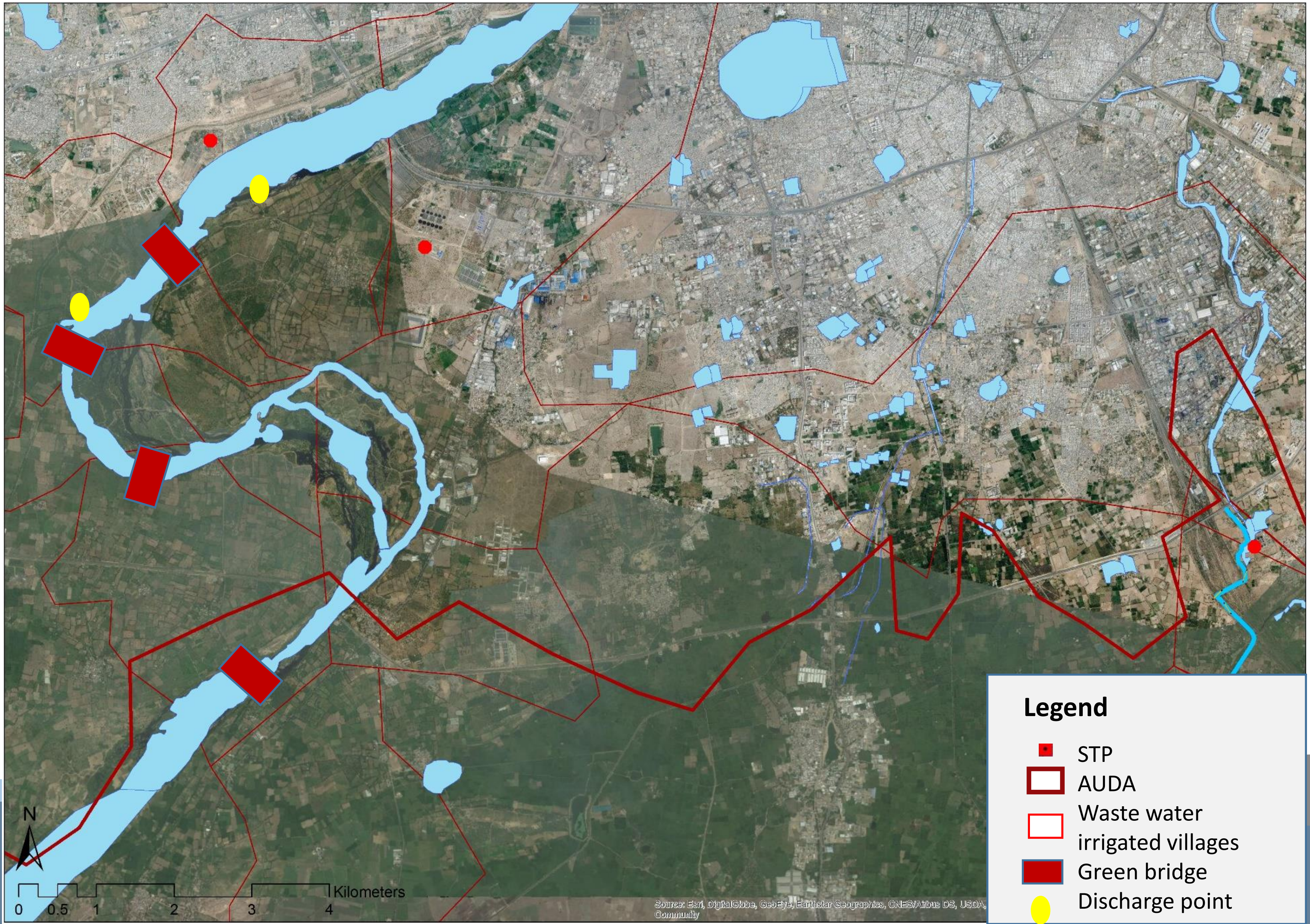
Recommendations- waste water quality improvement

Recommended position of the green bridge

- Basically 4 new green bridge is proposed, of area 10 -12 sqm
- First bridge is located next to the discharge points pirana
- Next green bridge is recommended next to outlet point near Vasana
- Green bridges are placed in a distance of 1.5 km

Recommended position of treatment downstream

- Detention ponds are recommended to wards the downstream.
- The position varies according to the organizational formation.



Recommendations- waste water quality improvement

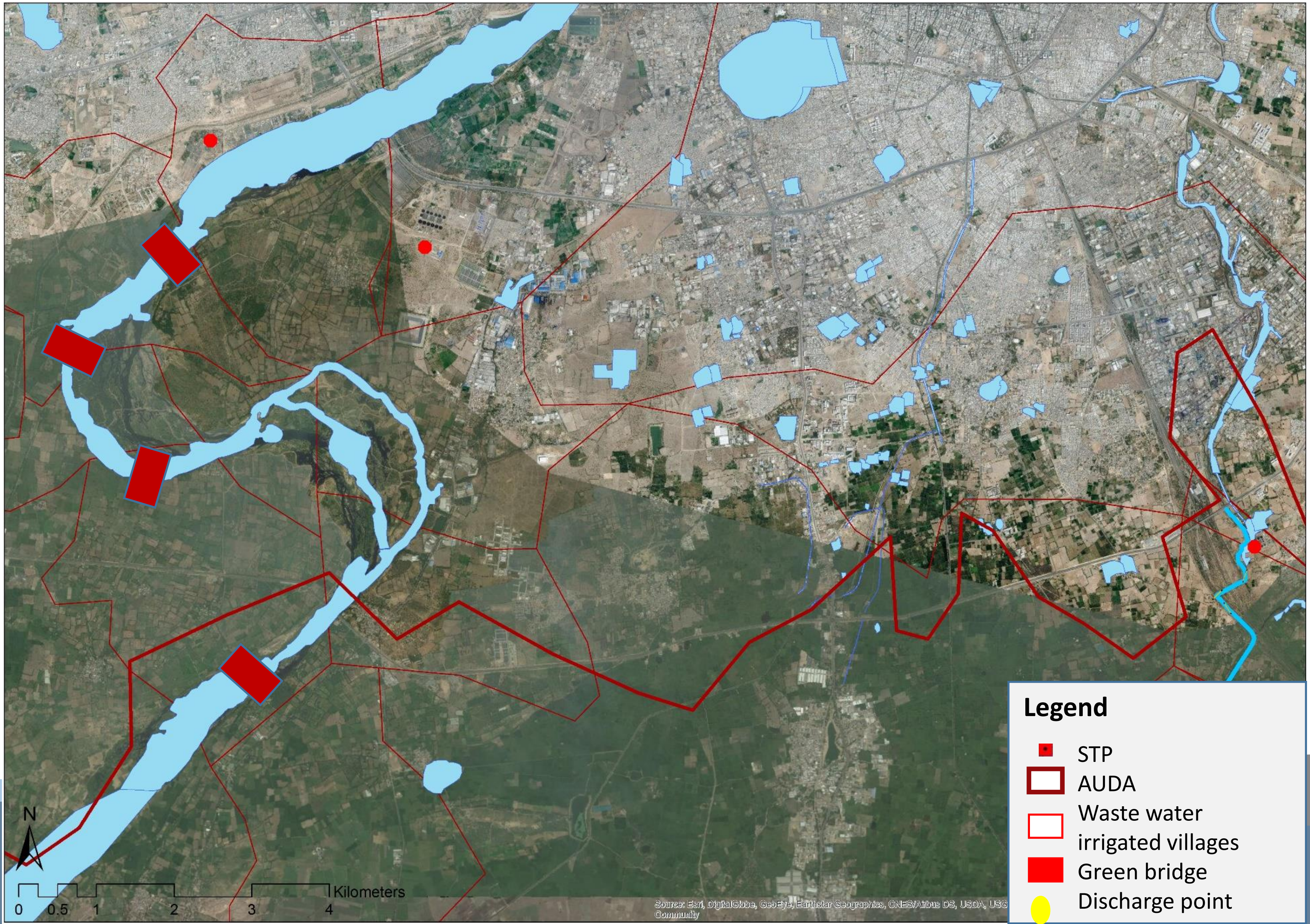
Expected results

•Increased level of dissolved oxygen150% - 1200%

•Eco toxicity will be reduced substantially

•Ambient air, improvement in water quality and substantial reduction in foam in the river

•Pollution-reduction facility without using a single unit of electricity



Green Bridge Costing and Probable funding options

- Each bridge of 1210sqm which can treat up to 242MLD of waste water
- Min area of bridge to treat 880MLD should be 4400sqm

Activity		Cost (lakh)	Funding agency
Green Bridge	Installation Cost	**880**	Irrigation department
	Operation & maintenance cost	11.11 per annum	Irrigation department
	water quality testing & supervision	32.12 per annum	Irrigation department
	Total O& M cost	**43.23 per annum**	Irrigation department

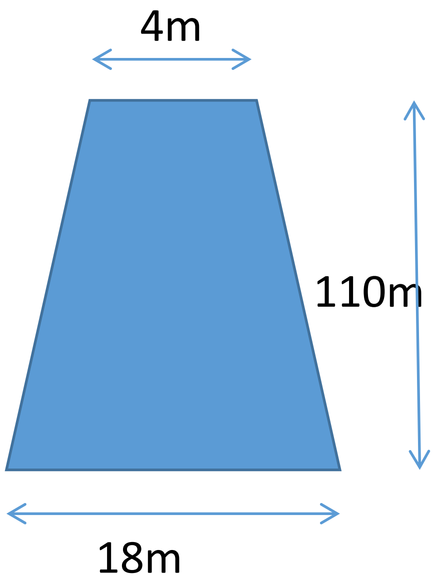


Fig. Plan of green bridge

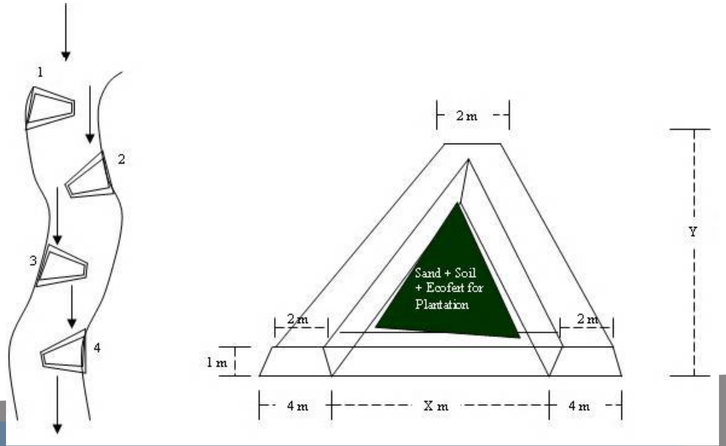
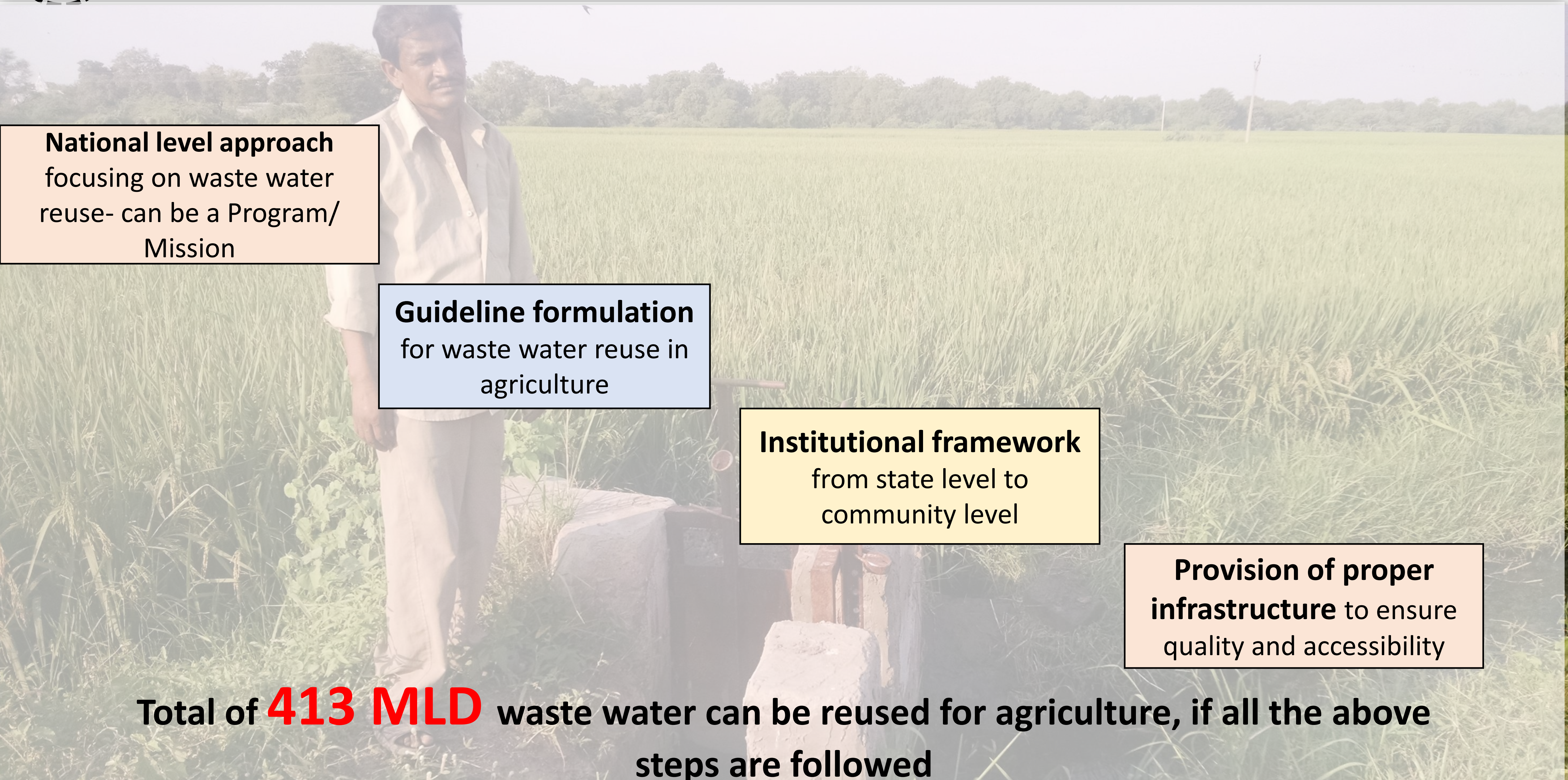


Fig. Plan of green bridge

Conclusion



National level approach focusing on waste water reuse- can be a Program/ Mission

Guideline formulation for waste water reuse in agriculture

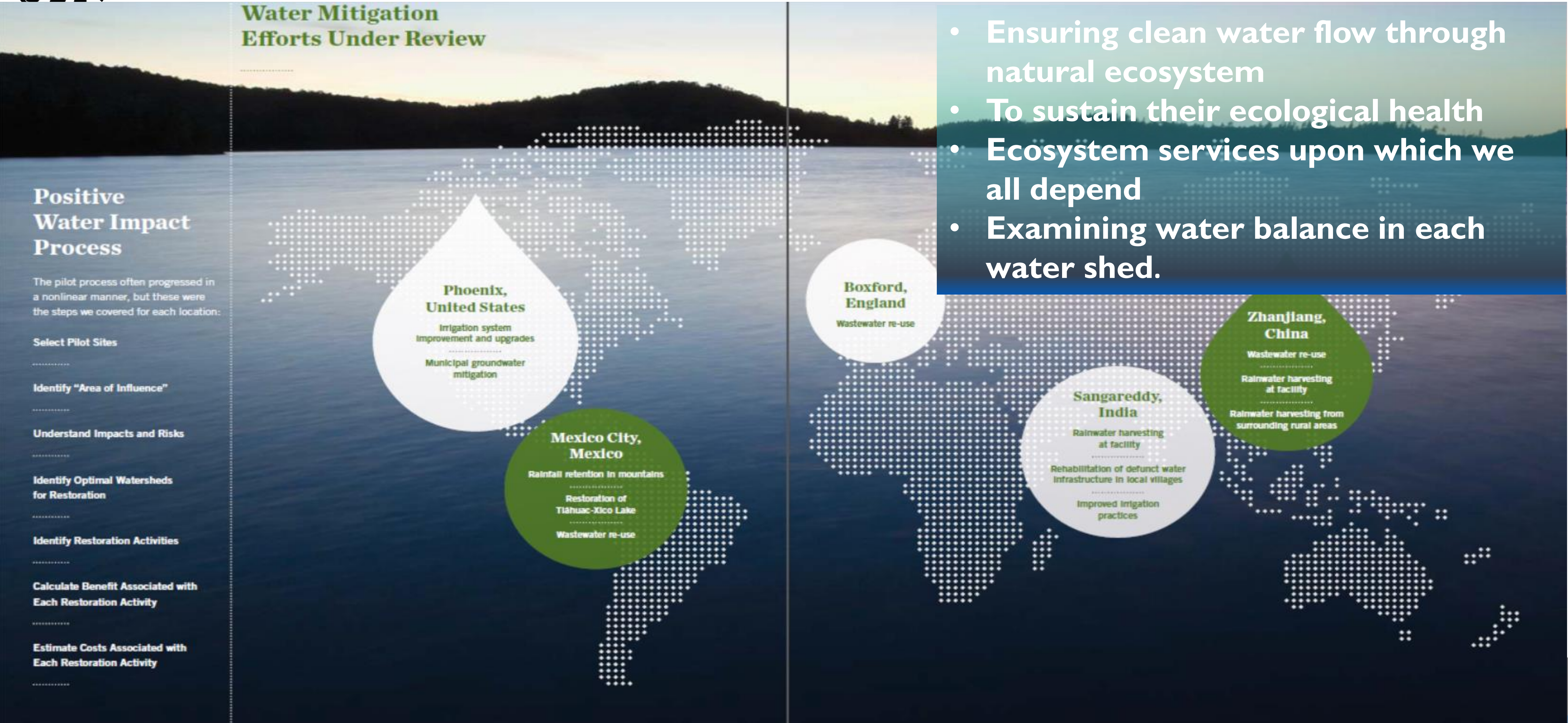
Institutional framework from state level to community level

Provision of proper infrastructure to ensure quality and accessibility

Total of 413 MLD waste water can be reused for agriculture, if all the above steps are followed

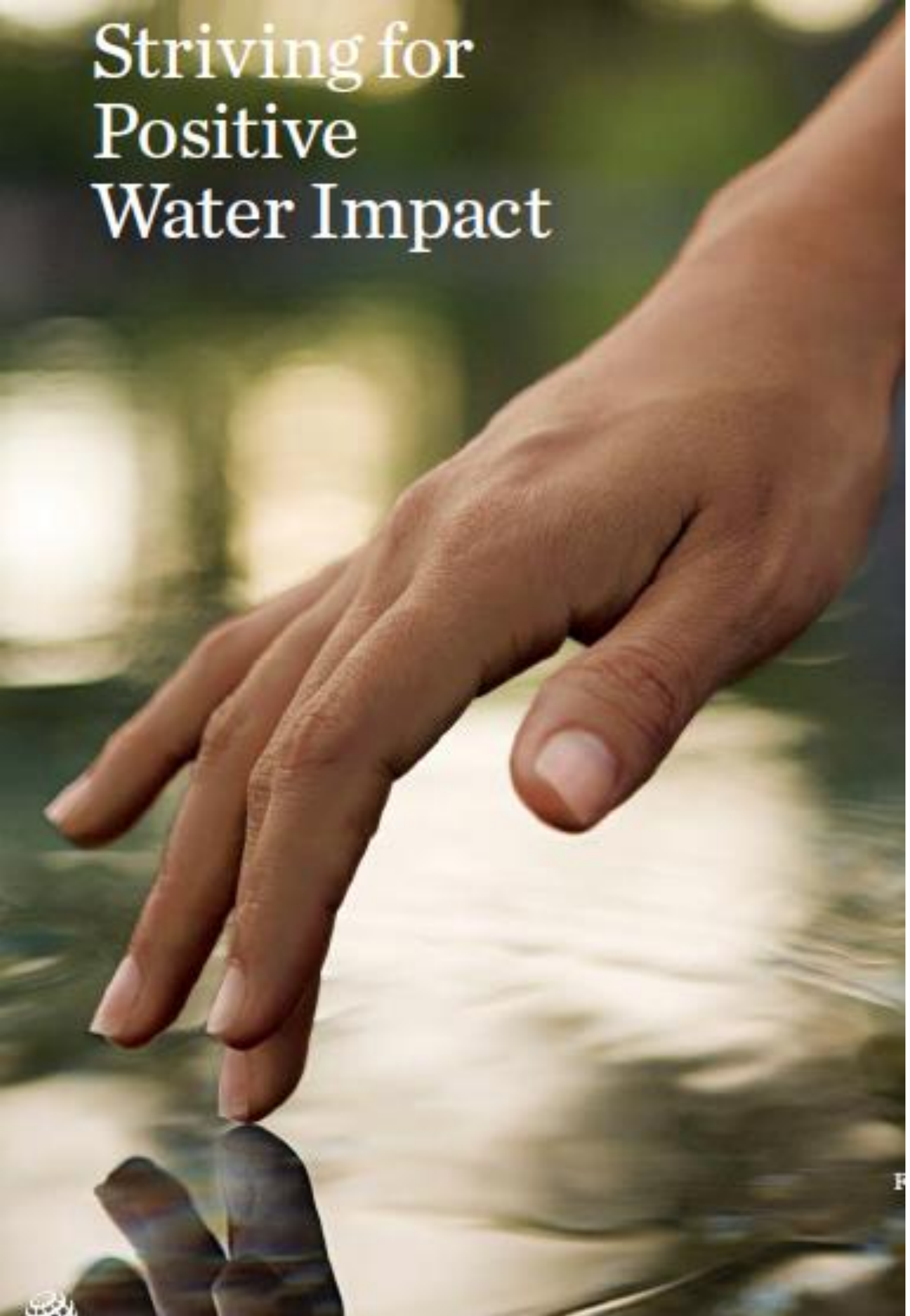
Water Positive

- Ensuring clean water flow through natural ecosystem
- To sustain their ecological health
- Ecosystem services upon which we all depend
- Examining water balance in each water shed.



Source- Strive for positive water impact

Source- Strive for positive water impact



Thank you

Wastewater reuse In industry

INDUSTRIAL USE OF WASTEWATER

Issues

1. Majorly all the industrial estates use **fresh water from ground** thus resulting in **stress** on **ground water resource.**

2. Less capacity of **CETP's** against waste water generated in industrial cluster causing **lower quality** of treated waste water which in turn pollutes Sabarmati river and Increase the **O&M cost** of CETP

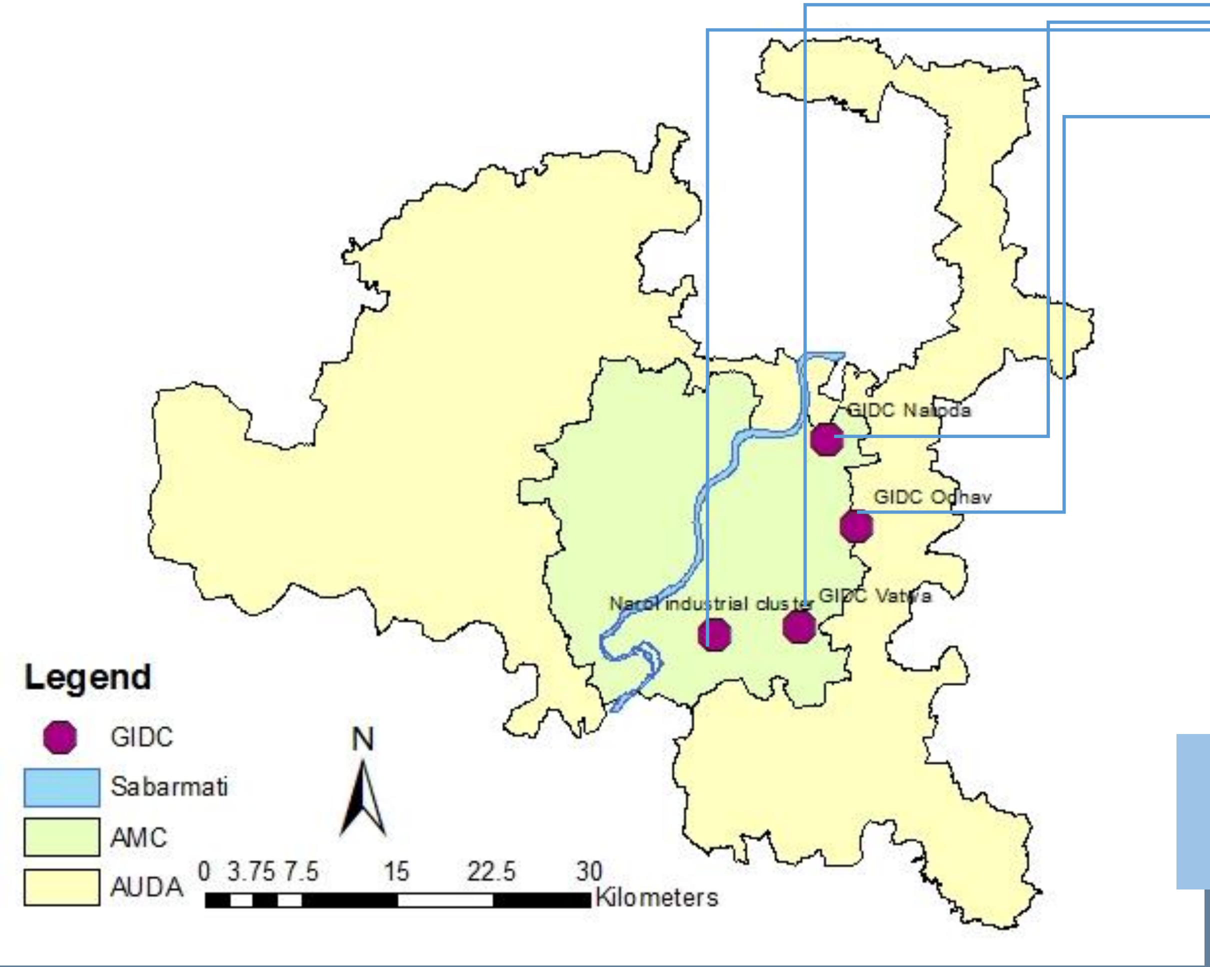
Need of Project

- To meet huge **water requirement** due to **industrial development**, recycle and reuse of water is essential

- **Saving Fresh water** that can be used for other **potable uses**

- To increase **non potable** use of waste water

OVERVIEW OF INDUSTRIAL ESTATE IN AHMEDABAD



INDUSTRY	AREA	NO OF INDUSTRIAL UNIT	Water Requirement and source	CETP Capacity
Narol industrial area	127	100+	150 MLD from ground directly	100 MLD

bore wells

Thus total water requirement by all the industrial cluster combined is **200 MLD**

Source: www.vavtvaassociation.org,Kinari Panchal-Incentives and disincentives of wastewater,www.narodaassociation.org

PROJECTS TO BE UNDER TAKEN

1. Supply of raw waste water/secondary treated water from Pumping station/STP to CETP for ***DILUTION***

Source:https://www.flickr.com/photos/worldbank/7342211606

PROJECTS TO BE UNDER TAKEN

2. Supply **treated waste water** from Sewage Treatment plant to **industrial estate**

Source:http://www.vatvaassociation.org/?page_id=1179

PROJECTS TO BE UNDER TAKEN

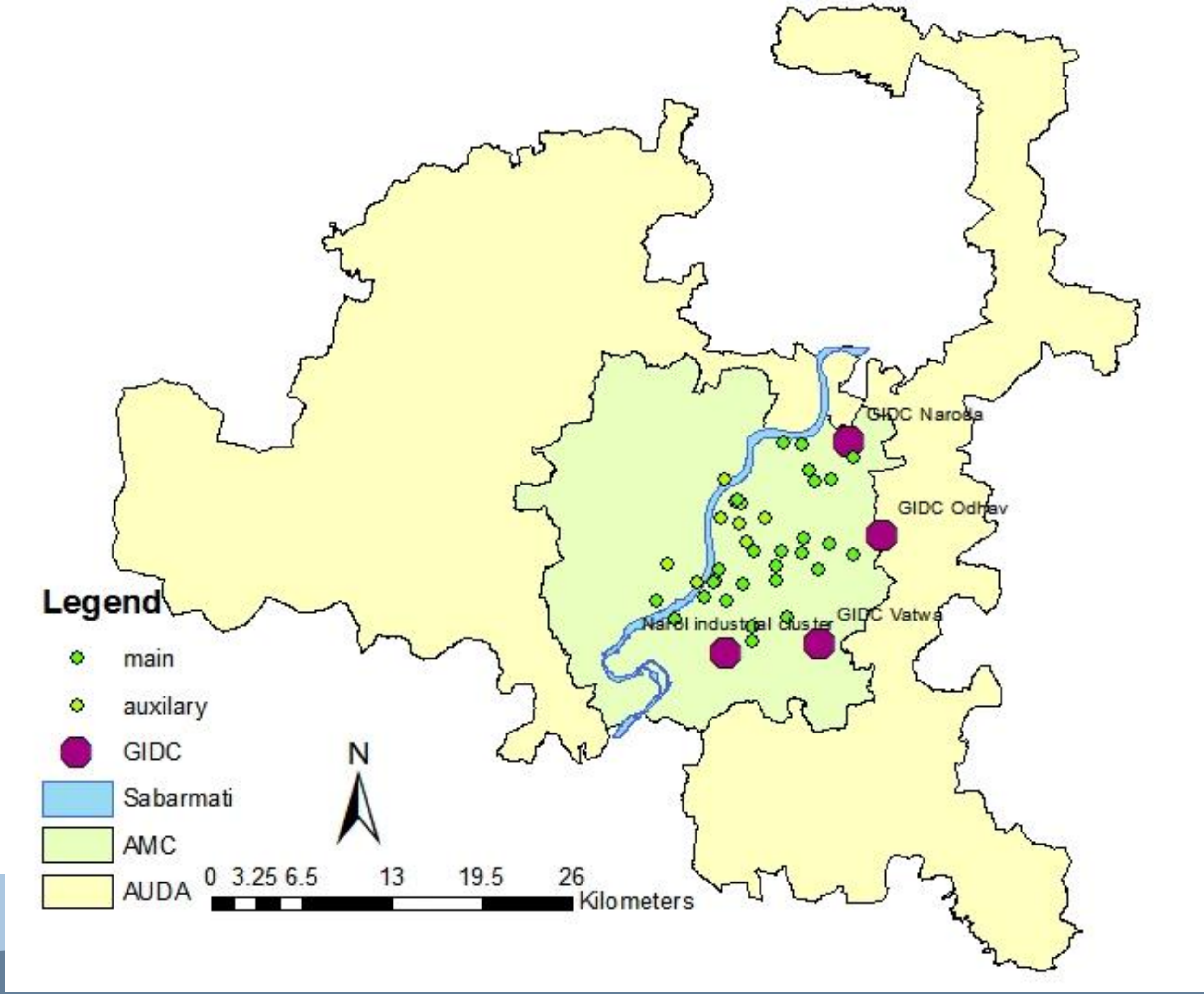
3. Waste water Reuse for **Power plant**

Source:http://www.vatvaassociation.org/?page_id=1179, https://www.linkedin.com/company/torrent-power

After successfully implementing all the projects we will be able to save 90 MLD fresh water

i.e 43 % of industrial water usage.

PROJECT 1 : SUPPLY RAW SEWAGE /Sec. TREATED WW FROM PUMPING STATION/STP to CETP FOR DILUTION



Locating the pumping station on the eastern side of river

In AMC 8 Main and 35 auxiliary station

Majorit…

…n north

…edabad

where industry are present.

Finding the potential industrial cluster that are ready to buy raw sewage from the pumping station

Finding the methods to supply sewage

PROPOSAL

Source: Primary survey,CSP Ahmedabad

PROJECT 3 : SUPPLY RAW SEWAGE /Sec. TREATED WW FROM PUMPING STATION/STP to CETP FOR DILUTION

Present Condition : Naroda

- Naroda GIDC estate is buying ***1.2-1.5 MLD raw sewage*** from near by pumping station from AMC at the rate of ***Rs 2.60/kl***
- AMC has provided a ***separate pipe line*** to supply raw sewage to Naroda.
- The waste water is mixed to the effluents produced from industries and then this mixed sewage enters into CEPT and is being treated.
- Because of this dilution the ***load on CETP reduces*** and it gives better result.
- New AUDA STP proposed near new Naroda will provides ***3 MLD secondary treated waste*** water for dilution purpose at the rate of ***Rs 2.8/KL***

Source: Primary survey,CSP Ahmedabad

Present Condition : Odhav

- 1.5 MLD CETP (Operational at 1 MLD)
- **0.6 MLD** industry and **0.4 MLD** domestic
- **Rs 50/KL** for running CETP (O and M cost)
- After addition of domestic sewage the **micro filters** used in CETP **last long** as **TDS** content in the industrial effluent **decreases**.
- Odhav GIDC estate **does not buy waste water** for dilution as it itself produces .4 MLD domestic sewage (due to presence of residential area within GIDC) which helps in dilution of the industrial effluents

Present Condition : Vatva

- Waste Water for dilution - **4 MLD** (pre-chlorinated) to **reduce TDS** from Vinzol STP
- **60000-70000 Rs** for pumping (RS 11/unit electricity)
- Pipe line laid by Vatva industrial association
- Rate - **Rs 4.73/KL**
- **Rs 30-35/kl** is treatment cost of CETP

Source: Primary survey

PROJECT 2 : Others instances of Resue of sewage for dilution in INDIA

CASE I

Two Cetp's in Andhra Pradesh uses domestic water for dilution of effluents i.e.

- The Patancheru cetp(1994),capacity of 7.5 MLD
- Jeedimetla in Ranga Reddy district (1989),capacity 5 MLD

Impacts - The Gteborg University study pointed out that the **industrial effluent is mixed with human sewage** within the plant **to improve biological treatment efficiency**. There is a **risk** that pathogens will be exposed to antibiotics for prolonged periods. Ciprofloxacin is genotoxic and induces horizontal transfer of resistance between different species of bacteria, effects that may be observed at concentrations as low as 5-10 g/l. Therefore, the recipient waters and the treatment plant itself may be spawning grounds for resistant bacteria," the study said.

CASE II

Tarapur CETP (Maharashtra): At the time of last inspection of the plant on 26/27.10.2004, the treated effluent was not meeting the standards in terms of COD, TSS, TDS, NH3-N and SO4. Inspecting team also suspected dilution of waste with fresh water by operating agency.

CASE III

One of the CETP in Delhi had a proposal to add 300m3/day of domestic sewage to the total effluents in order to dilute the TDS and provide continuous seeding of microorganism.

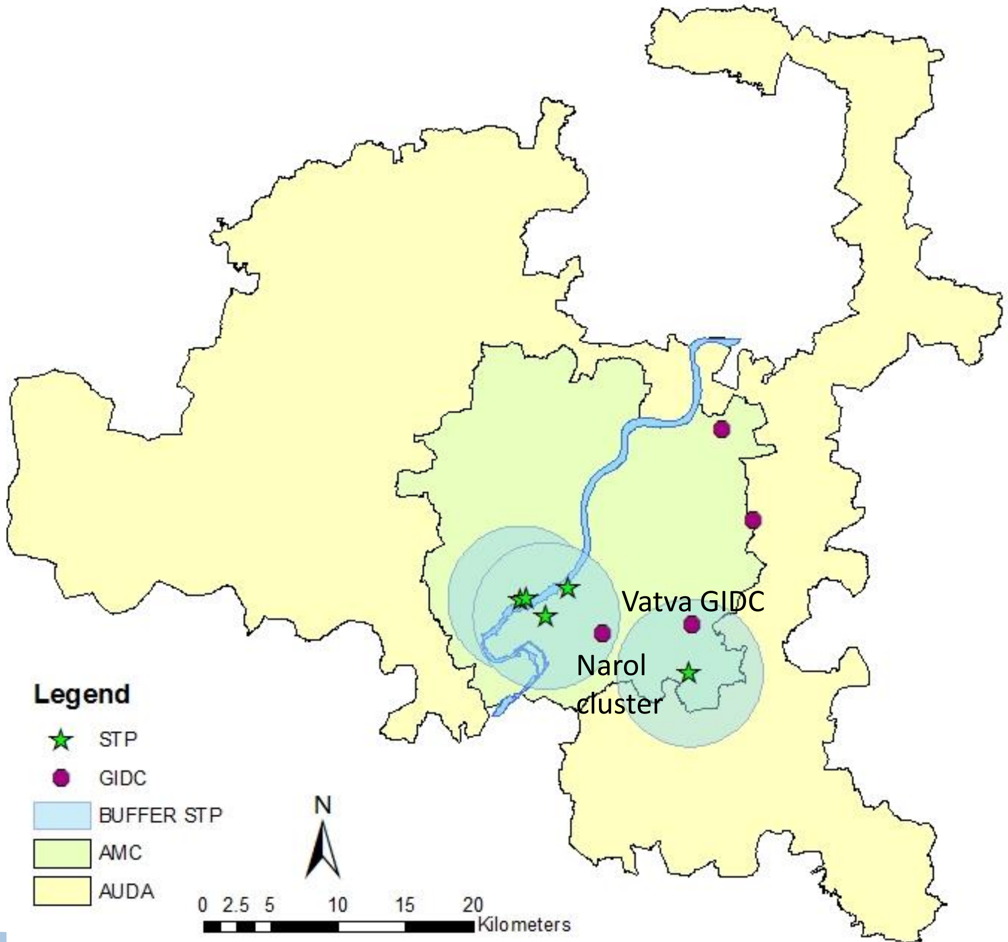
Source: http://www.downtoearth.org.in/coverage/what-treatment-6696, http://cpcb.nic.in/upload/Publications/Publication_24_PerformanceStatusOfCETPsIinIndia.pdf, https://books.google.co.in/books?id=psf56CPmZsYC&pg=PA281&lpg=PA281&dq=domestic+sewage+used+for+dilution+in+to+CETP&source=bl&ots=iXoUP7nF2h&sig=lBAmTH8NFTgUMsqZGgVKZy1J6Ps&hl=en&sa=X&ved=0CEYQ6AEwCGoVChMIkcCiqcHayAIVDEyOCh02_wBt#v=onepage&q=domestic%20sewage%20used%20for%20dilution%20in%20to%20CETP&f=false

As of now NO industrial cluster requires more sewage water for dilution

But the Dilution of effluent with the help of domestic sewage is not a good way to make reuse of water.

With the help of dilution ,the industries are encouraged to let go the treatment levels as they think dilution will help them reduce their hazardous effluent characteristics

PROJECT 2 : SUPPLY TREATED WATER FROM SEWAGE TREATMENT PLANT



According to the **location of STP** we would be taking up waste water reuse projects for **Narol and Vatva** industrial cluster

Also According to quantity of water the Narol and Vatva estates have the highest demand of water

We will also try to analyse the cost of treated waste water, if it is supplied to Naroda and Odhav GIDC estate

NAROL TEXTILE CLUSTER

Present Scenario of Narol Textile cluster:

- All the textile industries in Narol depend on ground water
- Each industry is having their separate bore wells
- The cost of water comes to be around **Rs 12 per kilo litre** (majorly electricity cost for pumping water from ground)

Thus the price of waste water should be such that it **should not differ much** from the **present fresh water cost** to make industry use this treated water

Source: Primary survey

NAROL TEXTILE CLUSTER

Water quality parameter for textile cluster

Parameter	Values
PH	6-8.5
hardness	2
turbidity	2
Colour(Hazen unit)	5

IS:201 1992

Total water requirement at Narol
150 MLD

Type of STP near by and outlet parameter

Sr no.	Outlet Parameter	unit	Plant output
1	BOD	Mg/L	20
2	COD	Mg/L	100
3	Total suspended solid	Mg/L	30
4	Fecal Coli Forms	No.s/100ml	1000-10000
5	pH	-	7-8.5
6	Residual chlorine	Mg/L	.5

Activated Sludge Process (ASP) type **180 MLD STP** at **Pirana**
Secondary treatment

Pirana STP has 3 stream of 60 MLD each

Source: Primary survey

TECHNOLOGY REQUIREMENT OF TEXTILE INDUSTRIES

First the existing STP of ASP type has to be ***updated*** to achieve the ***norms*** required to ***feed water in into the tertiary treatment plant***

Following **elements** have to be added to upgrade the ASP plant.

1. Installation of new Equalization tank

2. Addition of coagulant dosing system for removal of colour

3. Up gradation to Biological nutrient removal BNR(CHPEEO recommended)

To achieve the required organic matter /nutrient removal as per the required quality

4. Addition of Alum dosing system

To achieve the required organic matter removal as per the required quality

Source: Abstracted from Complied case studies,tender document

Minimum quality of treated sewage at biological treatment outlet (after augmentation) /UF feed

Sr no.	Parameter	Units	Values
1	pH	-	65.-8.5
2	BOD	Mg/l	20
3	Total Suspended solid	Mg/l	30
4	Total Nitrogen	Mg/l	<10
5	Total Phosphorous	Mg/l	<1

Quality of finally treated sewage after RO

Sr no.	Parameter	Units	Values
1	pH	-	7-8
2	BOD	Mg/l	<2
3	Total Suspended Solid	Mg/l	<1
4	Total dissolved Solid	Mg/l	<50

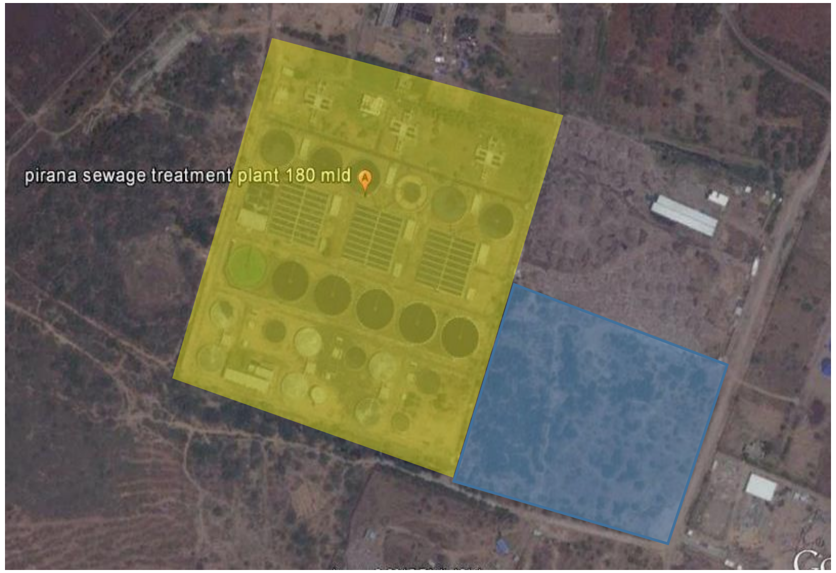
Tertiary treatment plant- *Elements….* casestudy.xlsx

- Ultra filtration(UF) feed tank
- UF system
- Ultra filtration permeate tank
- Reverse osmosis (RO) system
- RO permeate tank
- RO reject tank
- UF reject tank
- UF /RO building
- Treated water distribution tank with pump house.
- Other civil works

Source :Abstracted from Complied case studies, tender document Ahmedabad

Land requirement

- Existing Plant Area =115000 square meter.
- To set up tertiary treatment plant **approximately 30000 meter square area** will be required which is available in vicinity of the existing STP.



Cost

- Capital Cost for tertiary treatment – Rs **2 crore/MLD**
- O and M – Rs **7 crore/year**
- Total cost for upgradation of existing ASP and installing TTP and related infrastructure = Rs **163 crore**
- Transmission network cost =Rs **8.79 crore**
- Total Capital cost=Rs **171.79 Crore**

Business Model

- This project can be done either by **EPC or PPP model**.
- For these, compatibility both the models is done and most appropriate model will be selected.

Source: Abstracted from Complied case studies, tender document Ahmedabad

BUSINESS MODEL - PRICE OF WASTE WATER

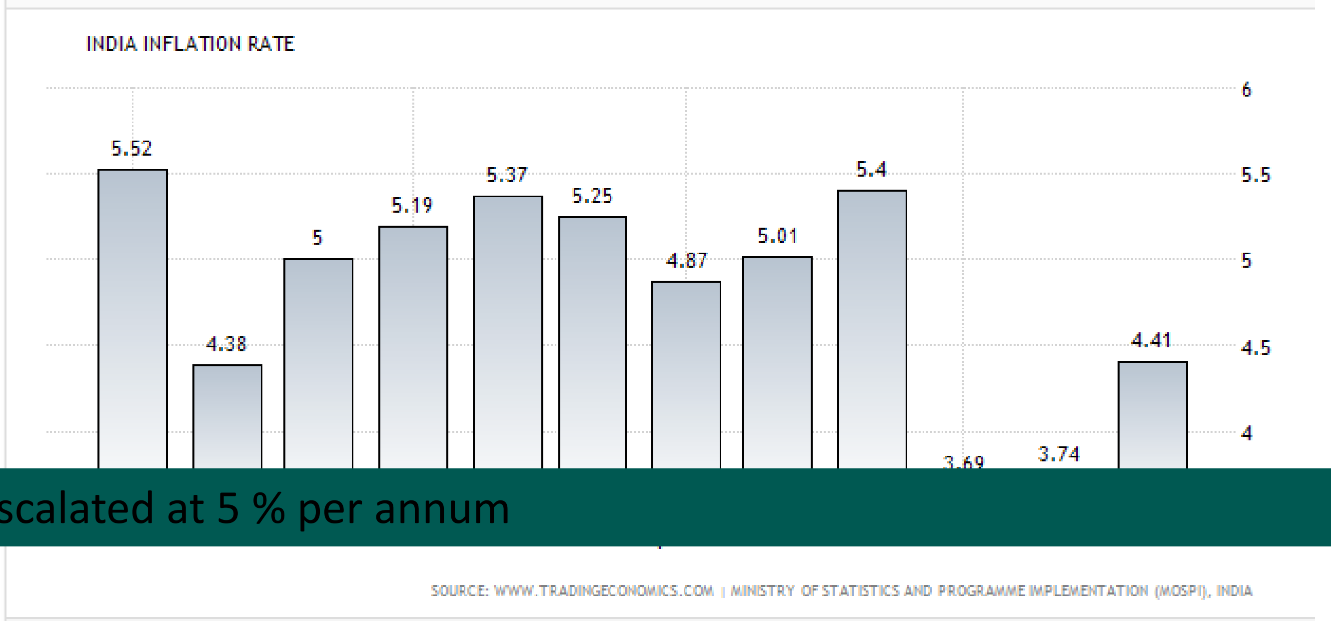
For arriving at a suitable treated waste water cost following assumptions were made

Sr no.	Heads	
1	Regular maintenance (% of hard cost pa)	4.05 %
2	Escalation in water expenses pa	10 %
3	WPI Inflation pa	7 %
4	Corporate Tax rate (% of Profit Before Tax)	35 %
5	Depreciation rate (Written Down Value)	0.15
6	Admin Expenses (% of revenue pa)	1 %

Sr no.	Heads	
1	Construction Begins	2016
2	Period of Construction (years)	2
3	Construction Ends	2018
4	Phasing of Construction	
	[Year 1]	0.5
	[Year 2]	0.5
5	Operation Begins on	2018
6	Period of Concession (years)	15
7	Operation ends on	2031

WATER PRICE ESCALATION USING WPI INFLATION RATE

Sr no.	Avg Inflation	%
1	2012	9.30
2	2013	10.92
3	2014	6.37
3	2015	5.76



Water price is escalated at 5 % per annum

FORECASTED WPI INFLATION RATE

Sr no.	Avg Inflation	%
1	2016	6.1
2	2017	5.8
3	2018	4.46
3	2019	5.6

FORECAST BY EUI

Sr no.	Avg Inflation	%
1	2016	4.47
2	2017	4.49
3	2018	4.46
3	2019	4.46

FORECAST BY OECD

Sr no.	Avg Inflation	%
1	2016	5.7
2	2017	5.6
3	2018	5.2
3	2019	5

FORECAST BY IMF

BUSINESS MODEL - PRICE OF WASTE WATER

Arriving at a suitable treated waste water cost and Business Model -

Sr no.	Heads	Project IRR	Equity IRR
1	Equity 100 %, Debt 0	12%	12%
2	Equity 0 %, Debt 100 %	14%	0
3	Equity 75 %, Debt 25%	12%	13%
3	Equity 25 %, Debt 75%	13%	19%
4	Equity 50 %, Debt 50 %	13%	15%

For Equity 25 %,Debt 75 %			
Cost of water	Project IIR	Equity IRR	Intrerest rate on loan is 12 %
RS 10	4%	-5%	
RS 11	5%	-1%	
RS 12	7%	2%	
RS 13	8%	5%	
RS 14	9%	8%	
RS 15	10%	11%	
RS 16	11%	14%	
RS 17	12%	16%	
RS 18	13%	19%	
RS 19	14%	21%	
RS 20	15%	24%	

Thus from above table we can see that if a private player puts Equity of 25 % and AMC would take loan for rest of 75 %

WE WOULD GET THE MOST SUITABLE PPP MODEL FOR THE PROJECT

Waste water cost has to be Minimum **Rs 17** if the interest on loan has to be paid

Thus selecting **Rs 18** as the cost of fresh water to be on safer side

Other Risk in project (as discussed with industrial representative)

- Industry are ***not*** having facility to ***check the quality*** of water they are using.
- Thus industry are ***concern*** with the quality of the treated water that will be produced ***after tertiary treatment.***
- Industries also want a ***buffer of 2-3 days*** of water so that in case of ***sudden failure*** of the system ,they can still continue production.

Probable Solution

- ***Strong monitoring system*** should be proposed which will look after the quality of treated water and update the industries for the same
- Otherwise a ***online monitoring meter*** can be installed which will check the quality and forward the results to industries. For this ***TOC meter*** can be installed
- Some ***storage mechanism for water*** have to be constructed in order to mitigate the risk of failure of the system to provide water.

Source: Primary survey

ISSUES IN PROJECT : INFERENCE

- Narol is **not a GIDC cluster** ,it is **not** having a **piped network** through which treated waste water can be supplied to industries.

  - **Extra cost** has to be incurred to supply waste water, thus constructing piped network in whole of Narol

  - This will increase the treated waste water cost to **More than Rs 18** and fresh water cost is only **Rs 12**

- This Rs 12 of fresh water is mainly the electricity charge occurred due to pumping. The cost of electricity is only **Rs 8.46/unit** which increases **16 Paise** in around **6 months.** Thus the fresh water cost will have a very gradual increase.

- So industries **will not at all be willing** to buy treated waste water until **restriction on ground water usage** is implemented and fresh water cost becomes higher.

PRESENT POLICIES FOR GROUND WATER EXTRACTION

Revised Model bill (2002) for ground water used by the Ministry of Water Resources (MoWR)

- The salient features of the Bill was State Governments were to **acquire powers** to restrict the **construction of ground water abstraction structures** (including wells, bore wells, tube wells etc.) by individuals or communities for all uses except that of drinking water.
- The Gujarat State Govt. informed that the draft Bill is **under process of finalization** and suitable legislation will be enacted shortly

AMC policy on Ground water extraction

- If a industry wants to dig bore well then they have to take permission from AMC to do so.
- If a industry is having existing bore, first it has to seal that bore well and then only it can dig new bore well

Source:http://cgwb.gov.in/gw_profiles/st_Gujarat.htm

Vatva GIDC

Present Scenario of Vatva GIDC estate:

- Present fresh water cost to industries in Vatva estates depends on the size of connection and type of industries
- For ex. engineering base industry having connection size of **.5 diameter = Rs 500/month**
- Thus approximate cost of water comes up to **Rs 10/KL**
- Vatva industrial Association claims that it is **suppling cheapest fresh water** as compared to all the GIDC estates in Gujarat

Source: Primary survey

VATVA GIDC ESTATE

Water Based industry is listed below

Type of industry	NO.	% water requirement
Intermediate	100	10
Dyes	500	40
Textiles	13	40
Ices	75	5
other	12	5

Water Demand at Vatva GIDC 20 MLD

Vatva GIDC estate has total 2500 industrial unit

Water quality standard of Potable water

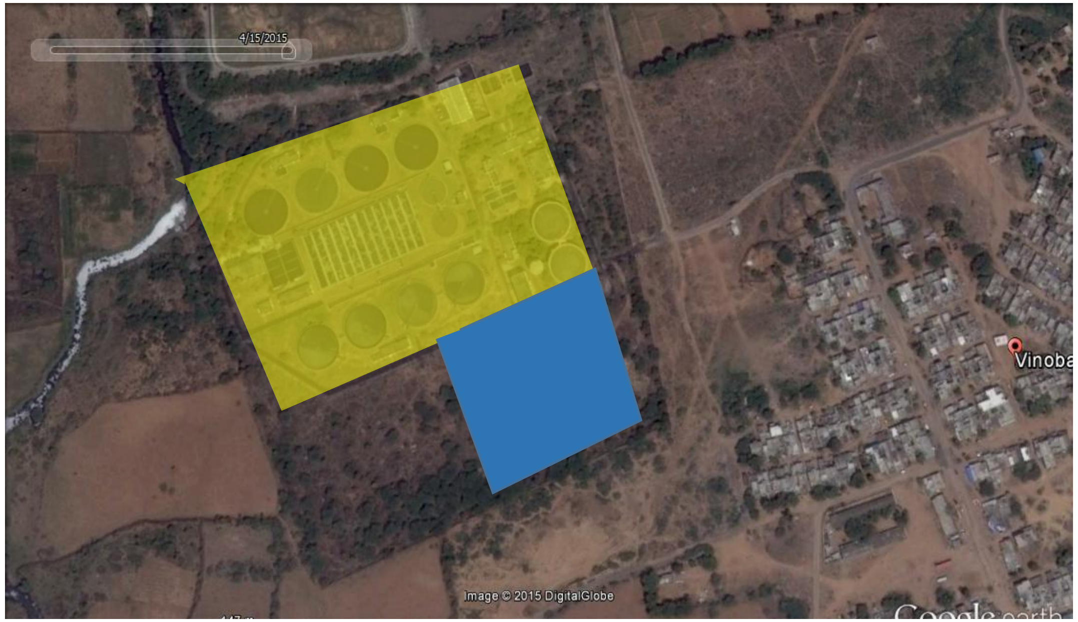
parameter	Unit	Value
PH	-	6.5 to 8.5
Colour	Hazen	5
Turbidity	NTU	5
BOD	Mg/l	2 mg/l

Activated Sludge Process (ASP) type **70 MLD STP** at Vinzol
Secondary treatment

Source:CPHEEO,kinari Panchal-incentives and disincentives of waste water(Thesis CEPT),CSP AHMEDABAD

Land requirement

- Existing Plant Area= **40,500 square meter.**
- To set up tertiary treatment plant **approximately 15000 meter square** area will be required which is available in vicinity of the existing STP.



Cost

- Capital Cost for tertiary treatment – Rs **2 crore/mld**
- O and M = Rs **3.5 crore/year**
- Total cost for upgradation of existing ASP and installing TTP of **30 mld** and related infrastructure = Rs **81.5 crore**
- Transmission network cost = Rs **5.5 crore**
- Thus Total Cost = **Rs 87 crore**

Highest quality of water is used for Textile and ices industry water i.e. Potable water . Thus installing 30 MLD TTP **(20MLD for industry + 10MLD for power plant**)

Source: Abstracted from Complied case studies, tender document Ahmedabad

Business Model

Sr no.	Heads	Project IRR	Equity IRR	Cost of water
1	Equity 100 %, Debt 0	8%	8%	Rs 18 with escalation of 5 % per annum
2	Equity 0 %, Debt 100 %	11%	0	
3	Equity 75 %, Debt 25%	9%	9%	
3	Equity 25 %, Debt 75%	10%	11%	
4	Equity 50 %, Debt 50 %	9%	9%	

Thus from above table we can see that if a private player puts Equity of 25 % and AMC would take loan for rest of 75 %

Then project IRR IS COMING TO 10 % and Equity IRR is coming to 11 % and interest itself is 12 % thus its not feasible to do project .

To make this project feasible either we have to either increase the capacity of the treatment plant or increase the treated waste water cost

Case 1: If tertiary treatment plant is made of 40 MLD instead of 30 MLD then

Heads	Project IRR	Equity IRR
Equity 25 %, Debt 75%	12%	15%

Case 2: If cost of treated waste water is increased to 20 Rs/KL from 18 Rs/KL

Heads	Project IRR	Equity IRR
Equity 25 %, Debt 75%	12%	15%

Inference

This project will not at all be feasible if the fresh water cost is not increased and rules and regulation against ground water extraction are not implemented

Future Scope : Cost of treated waste water if supplied to Odhav GIDC estate

Present Scenario

- 4 bore wells
- 9 individual bore(charged and metered)
- 5.5 MLD water supplied
- Cost of fresh water is Rs **17/kl**

Future Proposal

AMC tie up with Odhav GIDC to provide 5.5 MLD Narmada water

- Rs **14/kl** will the cost of fresh water
- Pipes already laid for Rs 15 crore
- **10 % increment every year** (causing failure for project) as the association is not ready to accept that price

If treated waste water provided by Vinzol STP

Heads	Cost of water	Project IRR	Equity IRR
Equity 25 %, Debt 75%	45 Rs/KL	11%	12%
	47 Rs/KL	12%	14%
	48 Rs/KL	12%	15%

The treated water cost is to much as compared to fresh water cost

Future Scope : Cost of treated waste water if supplied to Naroda GIDC estate

Present Scenario:

- Present fresh water cost to industries in Naroda depends on the size of connection and type of industries
- For ex. engineering base industry having connection size of **.5 diameter = Rs 500/month**
- Thus approximate cost of water comes up to **Rs 20/K**
- After all this GIDC is gaining profit of **Rs 8 /KL**
- Total water requirement is 10 MLD

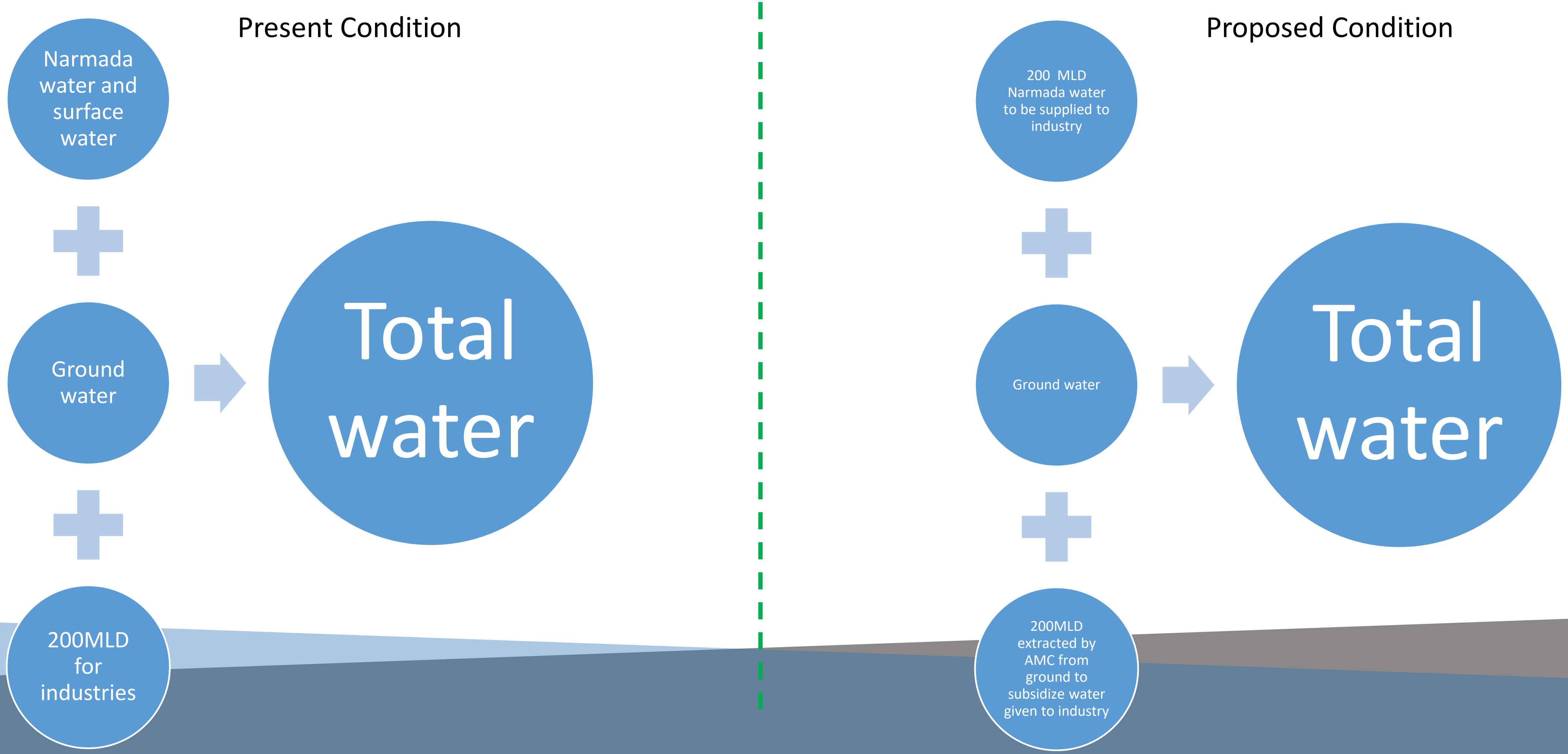
If treated waste water provided by Vinzol STP

Heads	Cost of water	Project IRR	Equity IRR
Equity 25 %, Debt 75%	38 Rs/KL	11%	14%
	39 Rs/KL	12 %	15 %
	40 Rs/KL	12%	16 %

The treated water cost is to much as compared to fresh water cost

WHAT IF ???????

Scenario 1



WHAT IF ???????

Scenario 1

Present Condition

Narmada water and surface water

Ground water

200MLD for industries

Tot
wa

Thus banning Ground water extraction of industries and supplying Narmada water to them

Proposed Condition

200 MLD Narmada water to be supplied to industry

200MLD extracted by AMC from ground to subsidize water given to industry

Total water

- AMC Narmada water rate = Rs 6.25 /KL
- Rate of extracting ground water = Rs 8 /KL
- Therefore cost of 200 MLD Narmada water = 0.12 Crore
- Cost of 200 MLD water if extracted from ground = 0.16 Crore

AMC selling these water at 14rs/kl to industry = 0.28 Crore
Net profit = 0.16 Crore

Treated waste water cost at 5 % Escalation

Year	0	1	2	3	4	5	6	7
Rate	18	18.9	19.85	20.84	21.88	22.97	24.12	25.33

Narmada water cost at 10 % Escalation

Year	0	1	2	3	4	5	6	7
Rate	14	15.4	16.94	18.634	20.49	22.54	24.80	27.28

Thus after 4 years the Cost of Narmada water and Treated water will be approximately same. Then industry themselves will shift to treated waste water.

WHAT IF ???????

Scenario 2

Present Condition

Narmada water and surface water

Ground water

200MLD for industries

To

wa

Thus banning Ground water extraction of industries and supplying only treated waste water

Proposed Condition

200 MLD Narmada water to be supplied to other urban center

200MLD extracted by AMC from ground to subsidize water given to industry

Total water

WHAT IF ???????

	Current		Proposed
Narmada	400		200
Other surface	300		300
Ground water (domestic)	300		500
Ground water (industries)	200		0
Reuse of waste water	0		200
TOTAL	1200		1200
Total fresh water sources (including Narmada and gr water)	1200		1000
Fresh water saved/ can be used for ither users			200(MLD)

This has to be accomplished by increase in electricity charges for industries for any connection used with bore wells

Electricity cost	
PRESENT	PROPOSED
Rs 8.46 /unit	Rs 15.46/unit

OR

Prohibiting use of electricity for water

Cost on Narmada water saved = 0.12 crore
Cost of extracting ground water= 0.16
Loss = 0.4 crore

This loss can be compensated by selling of waste water

Thus question should be raised that

Whether AMC should Supply Narmada water to industries???

Or

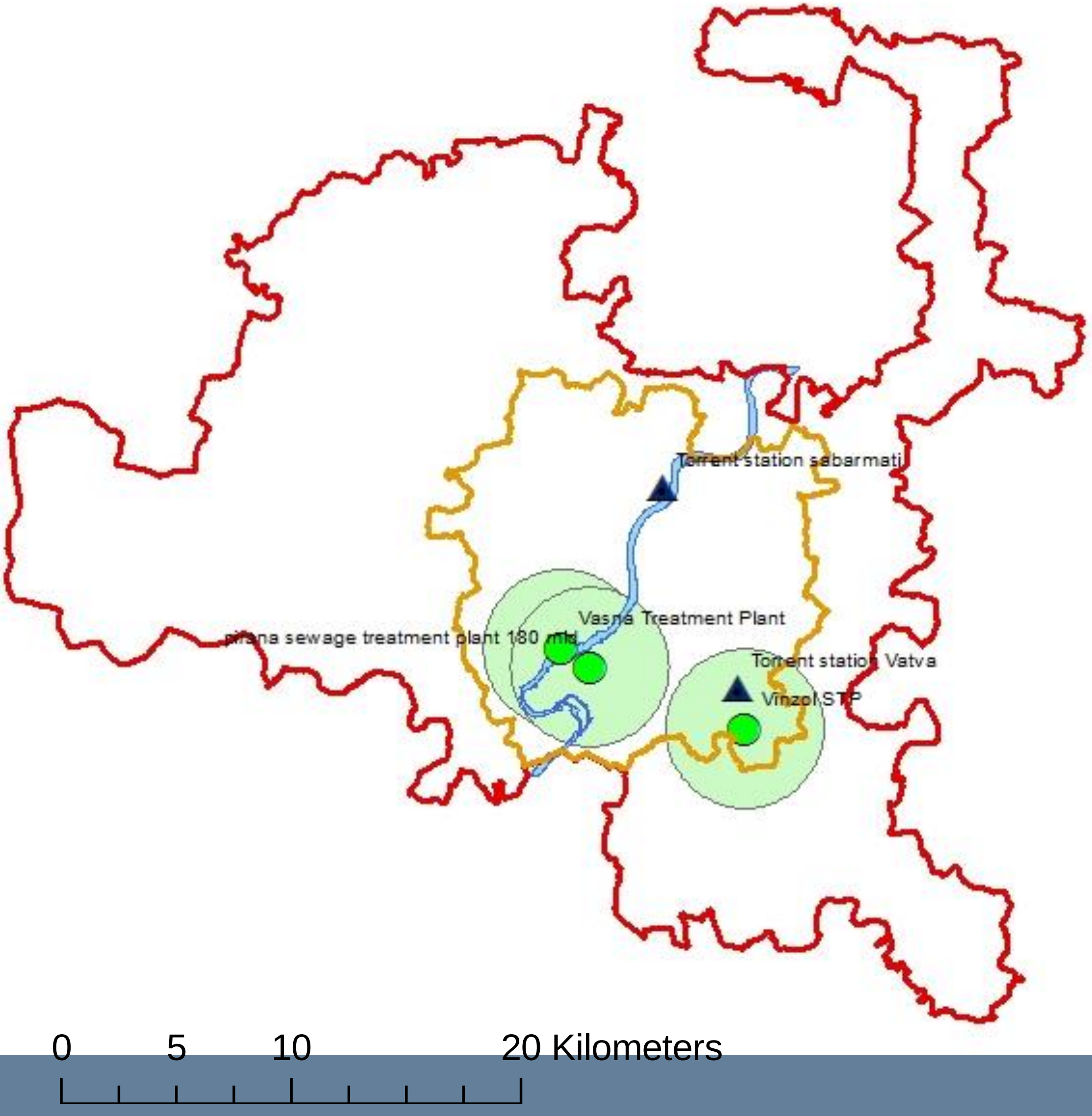
Whether Narmada water should be Supplied to Other urban centre???

There is no one Answer to this and question should be raised to AMC and State Authority

The most Important thing to notice in Ahmedabad is that Water is not at all being termed as a resource and this can be clearly seen in water prices as the cost of water is only the **cost of electricity** that is required to extract the water from ground.

Water itself has no price in Ahmedabad

Project 3 : WASTE WATER REUSE IN COOLING/BOILER FOR TORRENT POWER PLANT



Legend

- AMC
- AUDA
- STP
- Sabarmati
- BUFFER STP
- torrent_station

Torrent Power has a 100 MW Combined Cycle Dual Fuel Power Plant located at Vatva.The station consists of two gas turbines each of 32.5 MW and a **steam turbine of 35 MW** capacity.

Source:http://www.torrentpower.com/

TORRENT POWER PLANT

- Water requirement : 11 MLD
- Distance from the Vinzol STP plant : 7.9 km
- Treatment requirement for the cooling tower : Lime softening or RO
- Treatment require for the Boiling water : Demineralization
- Water to be provided directly from the proposed tertiary treatment plant at Vinzol

Thus Selecting RO Technique

Parameter for cooling water

Sr No	unit	value
pH	-	6.8-7
BOD	Mg/l	<5
Chloride	Mg/l	<175
TDS 3000 mg/l 1000 mg/l 500mg/l	Mg/l	2 3.5 6

Source:CPHEEO CHAP 7,Compiled case studies

Water quality standard for the boiler water

Parameter	unit	value
Total hardness	mg/l	1
PH value		8.5-9
Dissolved Oxygen	Mg/l	.1
Silica	Mg/l	5

Treated waste water from Vinzol STP **(tertiary treated using RO)** will only be used for cooling purpose as the water quality required for boiler grade water requires higher level treatment.

Cost

- Cost of tertiary treatment has ***already being calculated*** in industrial use of water.
- The cost of treated water to be supplied to torrent would come up to Rs *29/KL* because of more distance from STP

Source:CPHEEO CHAP 7

In case of torrent also the fresh water cost is very low as compared to the waste water treated cost thus making the project un feasible unless and until the fresh water cost is increased

Inference

Thus looking towards the present condition of Ahmedabad reuse of waste water for industrial use don't seem to be feasible at all because of the free ground water extraction by industries resulting in low cost of water.

If the reuse has to be made feasible following things have to be implemented

1. Ban on ground water extraction with the help of policy
2. Increase in electricity cost to make fresh water cost high
3. Otherwise directly put ban on use of electricity for water
4. Assurance of treated water quality by AMC

END

Source:https://www.capetown.gov.za/en/Water/Pages/Control-of-industrial-effluent-discharge-.aspx

WASTE WATER REUSE IN GARDENS

AHMEDABAD GARDENS

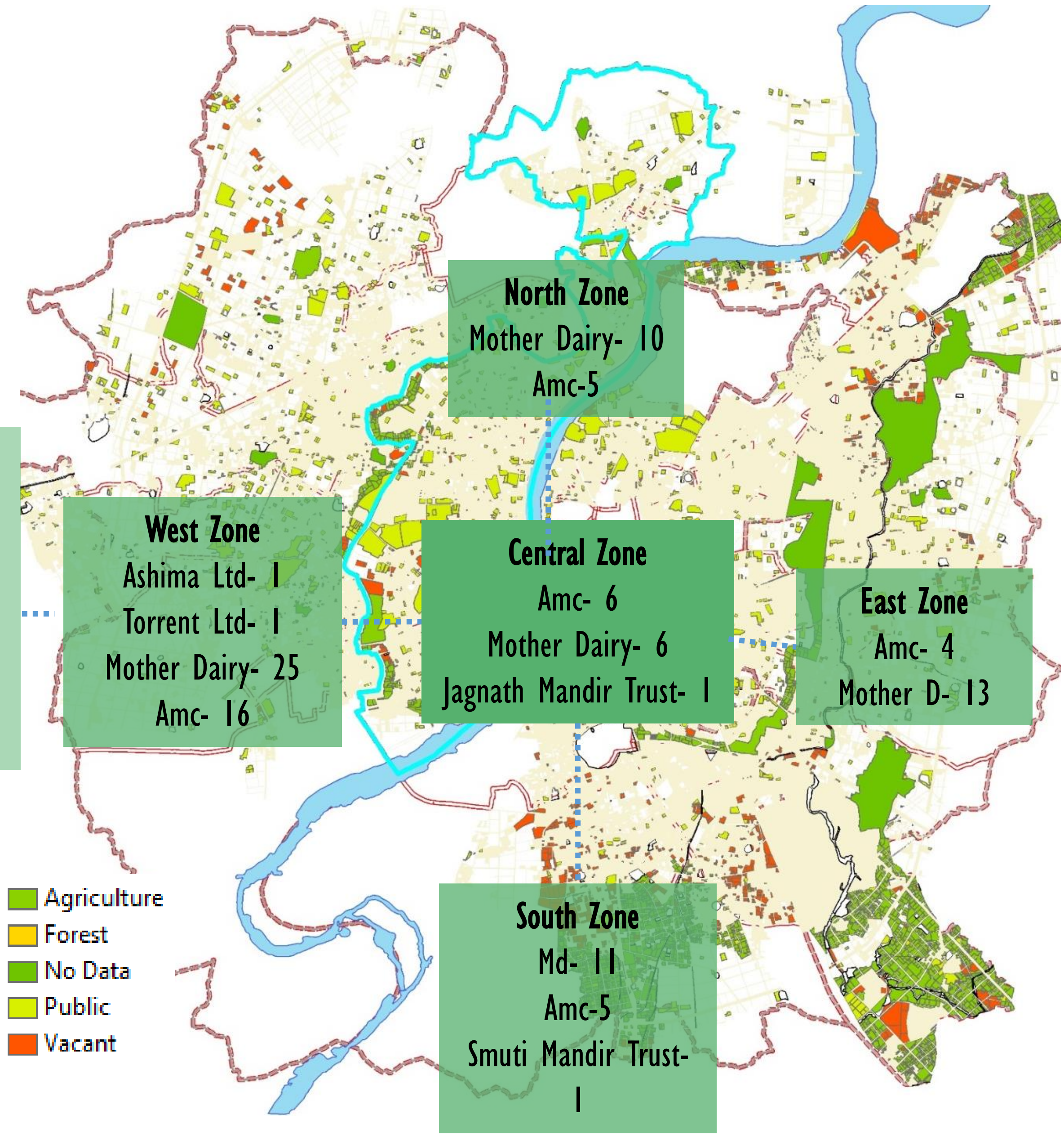
Developed open green spaces are **7.99 %** of total land use.

219
Ahmedabad Gardens
272.15 Ha

201
AMC gardens
182.76 Ha

18
AUDA gardens
89.39 Ha

New West Zone
Reliance Ltd.- 1
Open Plt- 3
Possession With Auda- 1
Civil Works Comp N Garden Development Work Remain- 7
Amc- 14



Source : AUDA DP, 2021 and CSP, 2012

FUNCTIONING OF GARDENS

Sanctioning Authority

Municipal Commissioner, Deputy Municipal Commissioner, Recreational, Cultural & Heritage Committee and Standing Committee.

Program Implementation

Subsidiary programs are implemented by Director of Parks & Garden

Work supervision

Works are supervised by Section Officers, Garden Inspectors and Supervisors.

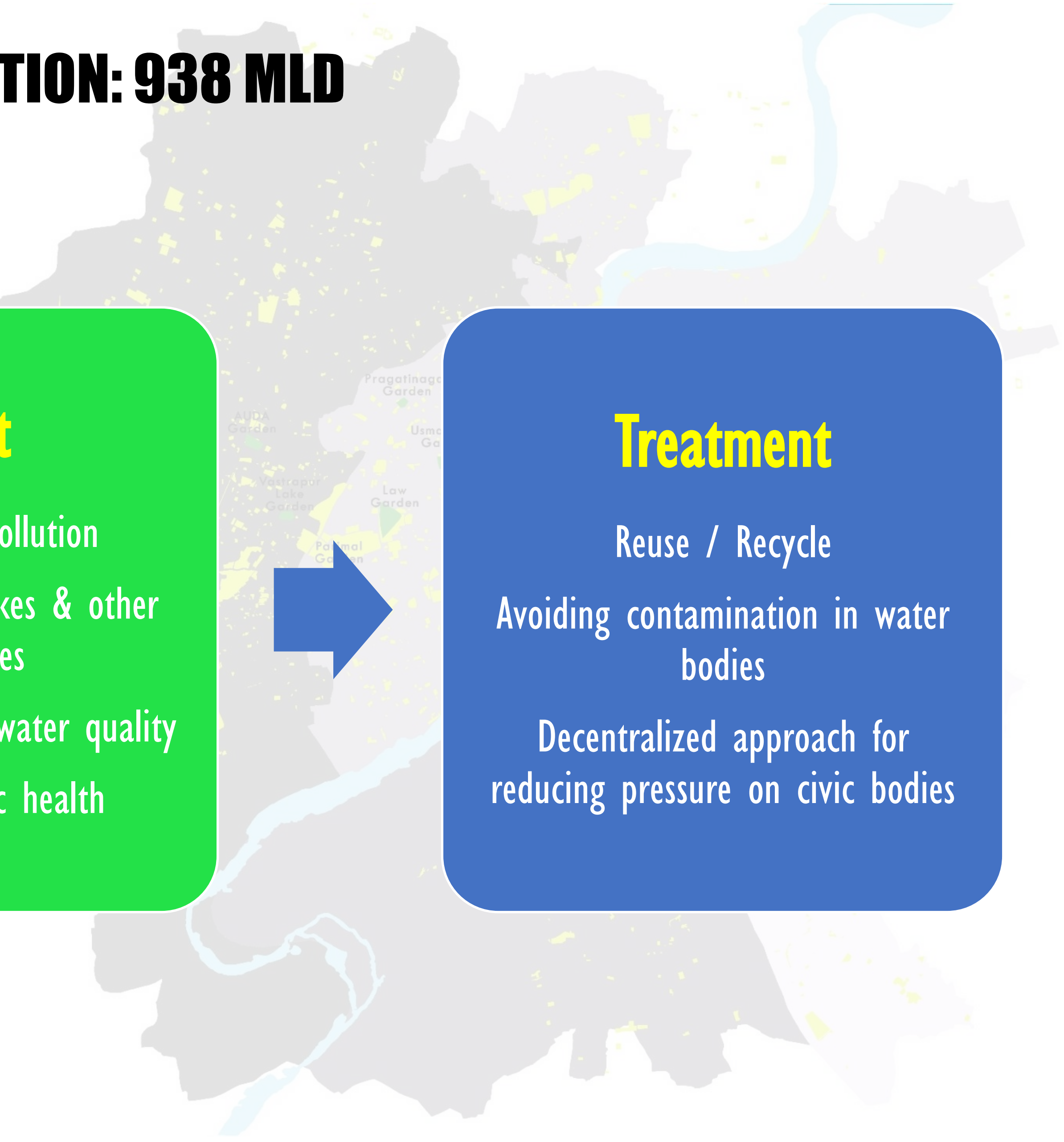
Work execution method

Works are executed departmentally as well as by Tender/ Offer/ Quotation through contractors.

Revenue generation

from auction of fallen trees wood & grass etc

WASTE WATER GENERATION: 938 MLD



Sources

Municipal / Domestic waste water

Storm water discharges

Hotel & Offices

Agricultural runoffs

Landfill leachates

Industrial waste water

Impact

Ground water pollution

Eutrophication of lakes & other water bodies

Degradation of river water quality

Impact on public health

Treatment

Reuse / Recycle

Avoiding contamination in water bodies

Decentralized approach for reducing pressure on civic bodies

Source : AUDA DP, 2021 and CSP, 2012

Parimal Garden
Private Management: Torrent Power Ltd


- Area of the garden – 36421 Sqm
- **Bore well used for all water usages**
  - Irrigation, 1 drinking water fountain, 2 toilets
- **10'x12' water tank size**
- Refill of tank 3-4 times / day
- Maintenance 7 days a week
- 22 workers
- Cleaning between 12pm – 2pm
- 4am – 10pm working hours
- Garbage taken early morning by 1 truck/day

LAW GARDEN
Private Management: Ashima Ltd.


- Area of garden – 41012 Sqm
- **Bore well used for all water usages**
  - Irrigation, 1 drinking water fountain, 2 toilets
- **Water pumped 1 in 2 days**
- Refill of tank 2-3 times / day
- **5000 L** quantity of tank in 2 days = **2,500L** in 1 day
- Maintenance 7 days a week
- All electricity charges borne by Ashima
- 20 workers
- Cleaning between 12pm – 2pm
- 4am – 10pm working hours
- Garbage taken early morning by 1 truck/day

Source : Primary survey

Gul Bhai Tekra Garden

AMC Garden

- **AMC water supply pipelines**
- 2 tank- one for toilet
- 650 l per tank
- 2 hr supply
- Tankers for water supply in case of lack of water
- Aftr 10-15 days, officers come
- 3 men workers
- 2-10 kaka work there for park
- AMC electricity
- 5.30- 6= opening timing

Vijay Char Rasta

Mother Dairy Garden

- Mother dairy
- **Municipal water supply**
- **Amul contract- maintain and provide salary** to the workers
- Morning and evening- 6-8 hr
- 1 toilet
- Drinking- 1000 l – mother dairy
- 5-6 workers, 2 main gardeners
- Compost pit- 6 by 4 feet, 3 feet deep
- After that manure is used for plants.

Source : Primary survey

TECHNOLOGY ANALYSIS

PROJECT	Packaged STP (MBBR)	Phytorid Technology	DEWATS Technology
COMPONENTS	• Air Blower Unit • Electrical Control Console • Flow Proportioning Chamber • Service Walkway/Grating • Secondary Clarifier With Chlorination	• Sewage Collection Tank • Settler/ Sceen • Phytorid Bed • Treated Water Storage	• Settler • Anaerobic Baffled Reactor • Anaerobic Filter • Planted Gravel Filter
CAPACITY	3,000 To 500,000 Gallons Of Wastewater Per Day	1 kld Per Day	3 Kld Per Day
AREA	30 Sq.M	1-2 sqm/KLD	8 sqm/KLD
PARAMETERS	**Inlet Parameters** BOD: 300-400 mg/lit COD: 600-800 mg/lit TSS:300 mg/ lit **Out-let Parameters** BOD: < 5 mg/ lit COD: < 20 mg/lit TSS: < 5 mg/lit	• PH: 7.1 TO 7.5 mg/lit • BOD: 40 to 130 mg/lit • COD: 130 to 350 mg/lit • TSS: 80 to 90 mg/lit	• Bod: 80- 95% • Cod: 80-90 % • Total Suspended Solids: 75- 95 %
LANDUSE	• Remote Housing Developments And Neighborhoods • Schools • Apartment Complexes • Industrial Facilities • Parks	• Parks • Residential Houses And Neighborhood • Slaughter Houses	• Parks / Lawns • Residential Houses And Neighborhood • Slaughter Houses
BENEFITS	• Fast Process Recovery • Easy Of Operation • Small Footprint Required • Lower Competitive Investment And Operating Cost	• No Waste Water At Surface-reduced Odour • Propagation Of Insects Is Also Controlled. • Works on gravity • No electric power requirement • Cost effective	• Cost effective • O n m expenses are negligible • Minimum electric requirement • Smaller footprint • Facilites recycle and reuse of wate • No foul odor and no mosquito nuisance

Case studies

PACKAGED TREATMENT PLANT (MBBR)

PROJECT	**Decentralized STP at Navrang garden**	**Leh-ladakh's first sewage treatment plant**	**Harbauer india pvt. Ltd. (Seaterra-program/)**	**Anna university**	**Packaged STP**	**Packaged STP**
LOCATION	Ahmedabad, Gujarat	New delhi	Mcloughlin point site in esquimalt.	Chennia, Tamil Nadu	Kolkata, west bengal	Navi mumbai
Tech. TYPE	MBBR sewage treatment plant	Tertiary treatment	Secondary treatment	MBBR sewage treatment plant	Tertiary treatment	
IMPLEMENTING ORGANIZATION	Ahmedabad Municipal Corporation	Biotic water solutions pvt ltd	Core area wastewater discharge	Aqua revolutions	Unitech water technologies pvt. Ltd.	Alaknanda technologies pvt. Ltd.
DESIGN CAPACITY	10 KLD	30 mld	124 MLD	0.5 - 20 ton / hour		
AREA	**200 sqm**	**500Sq.mt**	**1400 sq.mt**	**700 sq.mt**	**1000 sq.mt**	**800 sq.mt**
CAPITAL COST		Rs 1,400 crore	Rs. 179 million.			Rs. 9600.0 Crore

Inferences

- Less Footprint Required
- Compact Space
- Less Excess Sludge
- Treat High Bod Waste Water

Case studies
PHYTORID TREATMEN PLANT (Constructed Wetland Technology)

PROJECT	**Premier Auto Ltd.**	**Lonar Lake, Maharashtra**	**Telibandha Lake**	**Kalian Campus University**	**Panjabrao Krishi Vidyapeeth, (COA)**	**Matheran hill station**
LOCATION	Maharashtra	Maharashtra	Raipur	Mumbai	Nagpur	Maharashtra
TYPE	Commercial	Lake	Lake	Institutional	Institutional	Hotel, Commercial
IMPLEMENTING ORGANIZATION	NEERI, Nagpur	NEERI, Nagpur	NEERI, Nagpur	Council Of Sceintific And Industrial Research	NEERI, Nagpur	NEERI, Nagpur
DESIGN CAPACITY	**150 KLD**	**500 KLD**	**2 MLD**	**50 KLD**	**8-10 MLD**	**20 KLD**
AREA		30,000 sqm	110,000 sqm	35 sqm	35 sqm	





Inferences

- Good Quality Of Treated Water
- Produce Recyclable Water.
- Reduce Disinfection Cost.
- Solution To Sludge Bulking Problem

Case studies - DEWATS

WASTEWATER TREATMENT PROJECT	**Adarsh College**	**Friends of Camphill**	**Bankers Colony**	**Kachpura village**	**Aravind Eye Hospital**	**Constructed wetland for wastewater treatment at Indian Agriculture Research Institute**
TECHNOLOGY USED	DEWATS	DEWATS	DEWATS	DEWATS	DEWATS	DEWATS
LOCATION	Maharashtra	Bangalore	Bhuj, Gujarat	Agra, UP	Pondicherry, Chennai	New Delhi
TYPE	Institutional	Individual/ Residential	Community	Community	Institutional	Institutional
IMPLEMENTING ORGANIZATION	Kualgaon Badlapur Municipal Council, GTZ (now GIZ), Ecosan Services Foundation and funded by Mumbai Metropolitan Regional Environment Improvement Society.	CDD Society, Bangalore	Hunnarshala Foundation, Municipality of Bhuj and Kutch Navnirman Abhiyan, funded by American India Foundation and Care today group.	Centre for Urban and Regional Excellence (CURE), Agra Nagar Nigam (ANN) and USAID.	CDD Society, Bangalore	Water Technology Centre, Indian Agricultural Research Institute (IARI), Pusa, New Delhi
DESIGN CAPACITY	**7 KLD**	**9KLD**	**30KLD**	**50KLD**	**320 KLD**	**2.2 MLD**
AREA	**57 sqm**	**110 sqm**	**300 sqm**		**2690 sqm**	**1.42 Ha**
OPERATIONAL SINCE	2008	2003	2006	2010	2003	2012
CAPITAL COST	Rs 4 Lakhs	Rs 5.5 lakhs	Rs 14-15 lakhs	Rs 10-11 lakhs	1.12 crore	1.2 Crores
O & M	Rs 60000-80000 per year	Rs.5000-8000 per year	Rs 1-1.5 lakhs/year	Rs 70,000-80,000/year	2.5-3 Lakhs per year	Rs. 1,335 (annual)





OVERALL SCENARIO

GARDENS

SEWAGE NETWORK: Covers most garden areas

EXISTING PUMPING STATIONS: 27 in no.

INDIVIDUAL GARDENS

54 in no.

Neighborhood lvl. gardens:

<4,000 sqm

24.64 ha

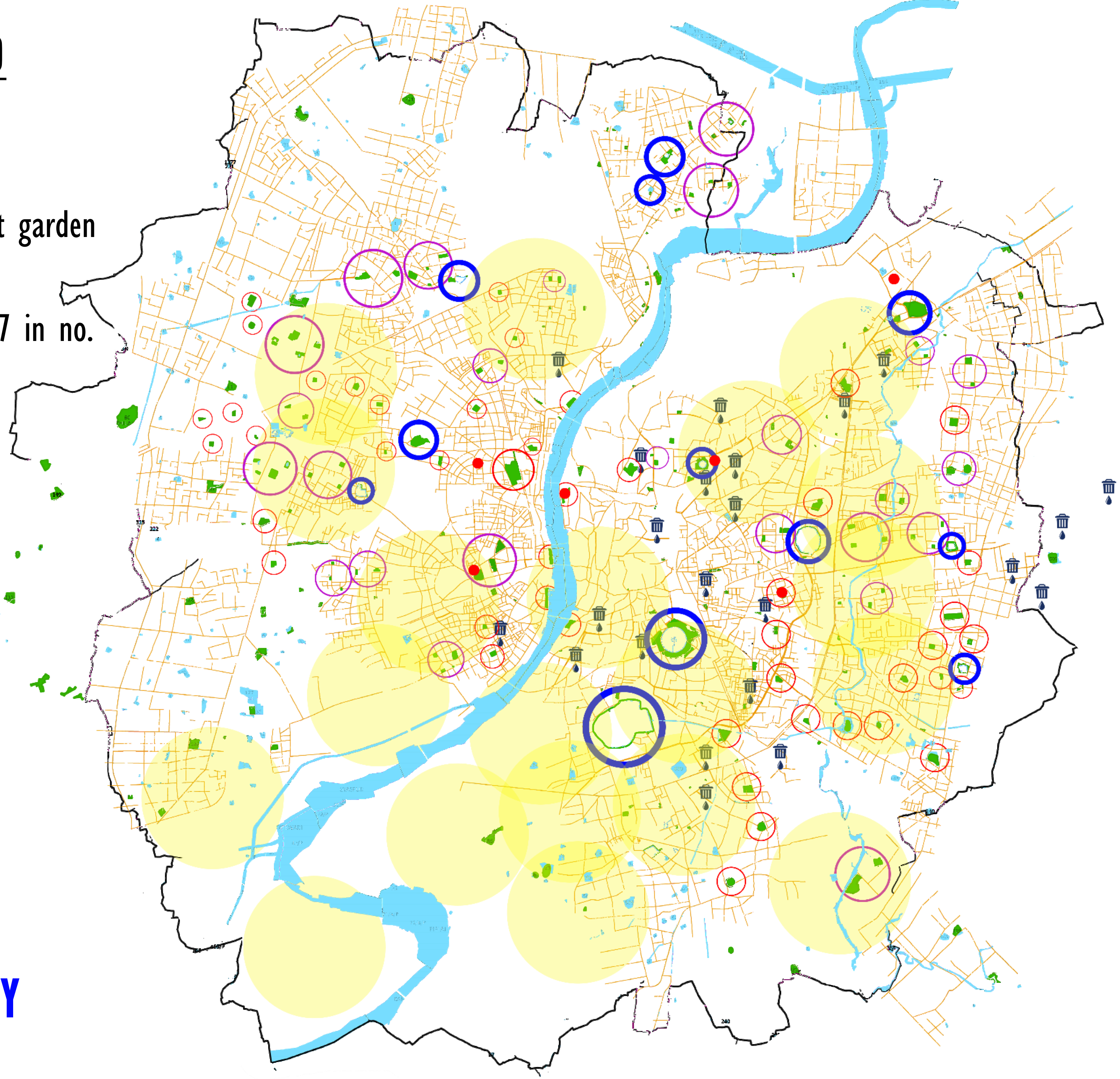
CLUSTERED GARDENS

27 in no. (57 gardens)

City lvl. gardens:

4,000 – 20,000 sqm

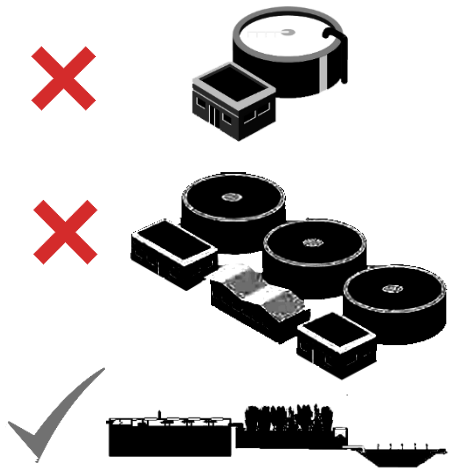
PHYTORID TECHNOLOGY



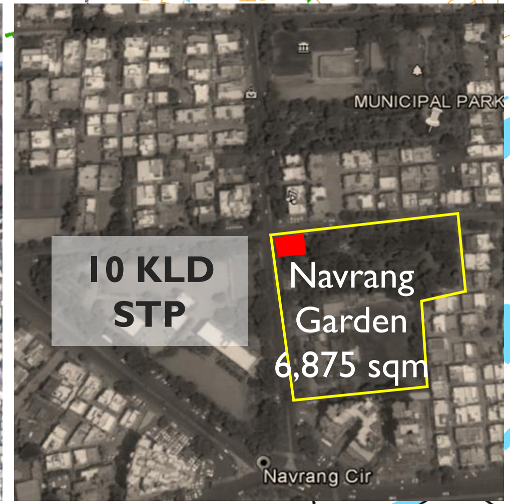
AREA & PROXIMITY

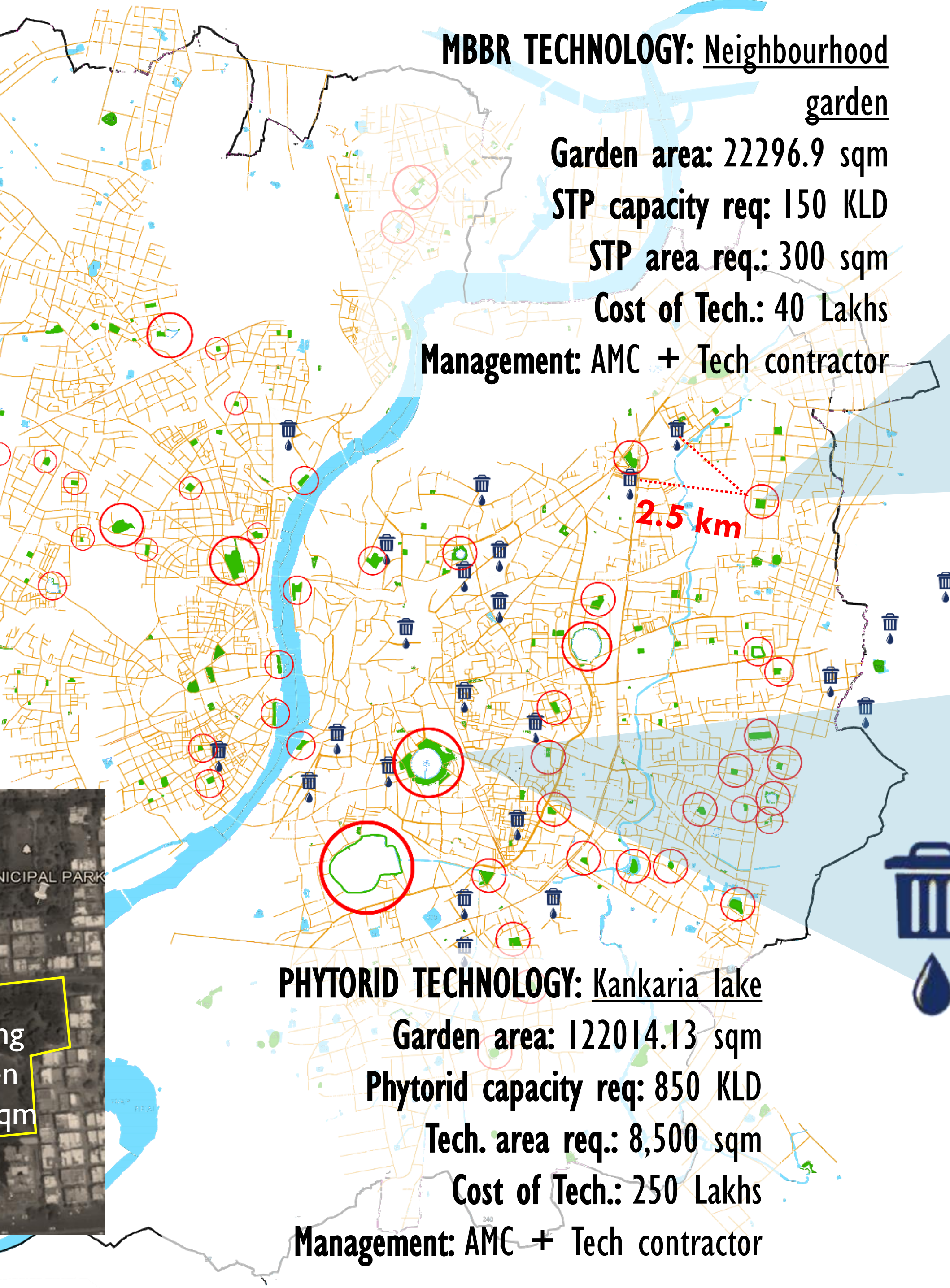
PROPOSED PUMPING STATIONS

NURSERIES

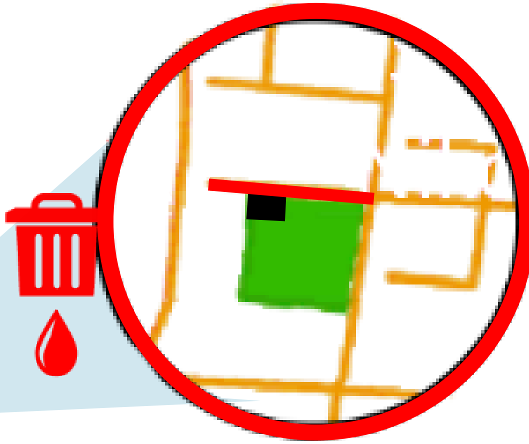


INDIVIDUAL SYSTEMS IMPLEMENTATION



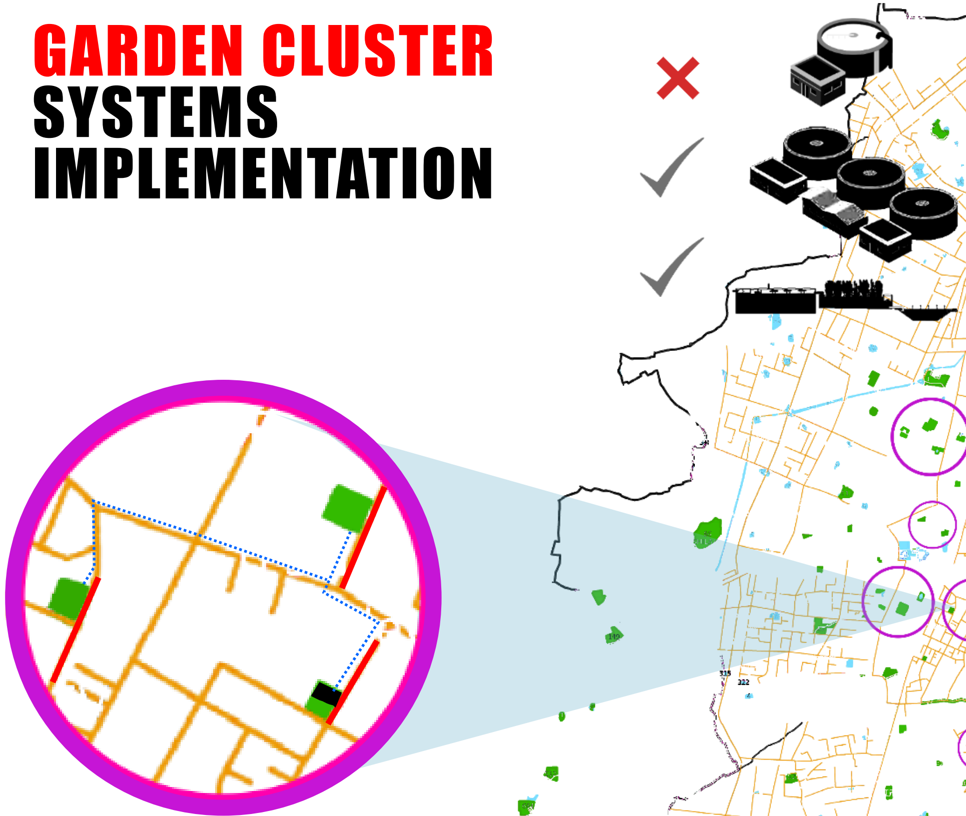


MBBR TECHNOLOGY: Neighbourhood garden
Garden area: 22296.9 sqm
STP capacity req: 150 KLD
STP area req.: 300 sqm
Cost of Tech.: 40 Lakhs
Management: AMC + Tech contractor



PHYTORID TECHNOLOGY: Kankaria lake
Garden area: 122014.13 sqm
Phytorid capacity req: 850 KLD
Tech. area req.: 8,500 sqm
Cost of Tech.: 250 Lakhs
Management: AMC + Tech contractor

GARDEN CLUSTER SYSTEMS IMPLEMENTATION



MBBR TECHNOLOGY: Neighbourhood gardens

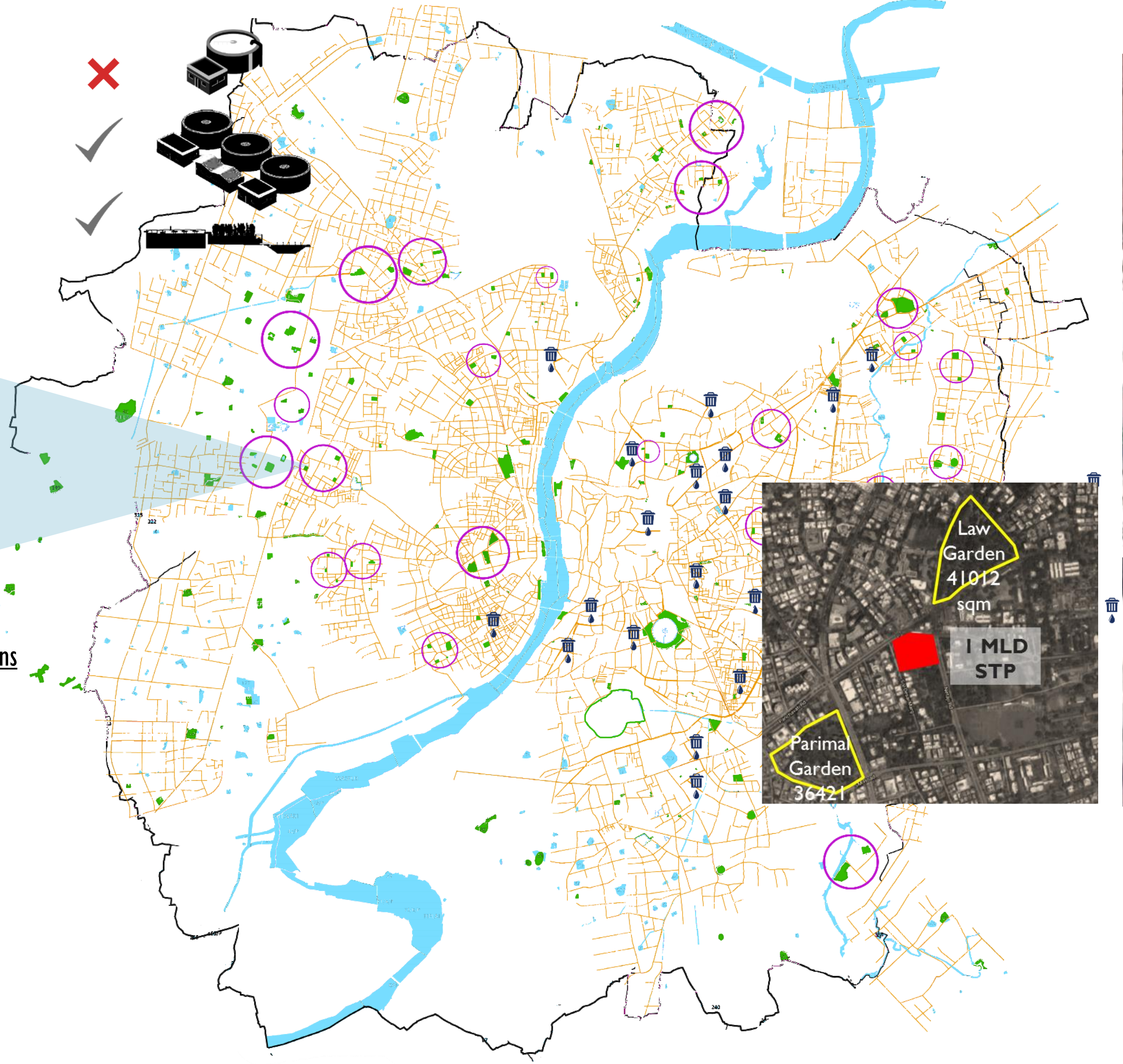
Garden area: 17592.8 sqm

STP capacity req: 120 KLD

STP area req.: 240 sqm

Cost of Tech.: 30 Lakhs

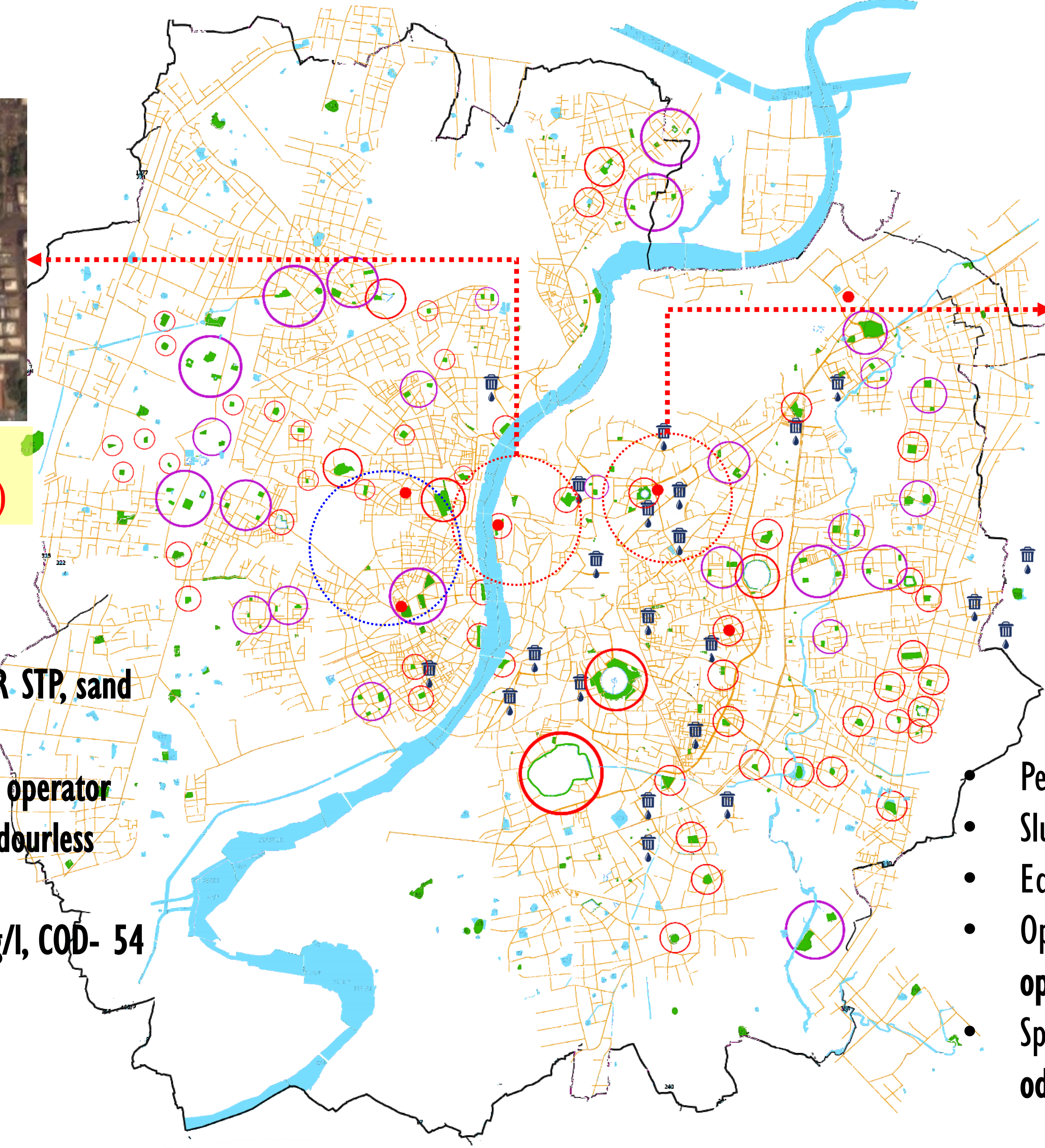
Management: AUDA + Tech contractor



STP (MBR) SAMPLES

Lal Darwaza Garden water requirement:
32375 sqm x 7 L = **2,26,625 KLD (STP: 200 KLD)**

- Performance BOD Removal: **80-95%**
- Sludge: **Negligible**
- Equipment Requirement: **Pump, MBBR STP, sand filter, carbon filter, water storage**
- Operational Characteristics: **Unskilled operator**
- Special features: **Plant species and odourless operations**
- Impurity removal rates: **BOD- 21 mg/l, COD- 54 mg/l**



PHYTORID SAMPLES

Anand Park & Lake water requirement:
9239 sqm x 7 L = **64,673 KLD**
(Phytorid: 65 KLD)

- Performance BOD Removal: **80-95%**
- Sludge: **Negligible**
- Equipment Requirement: **Gravity Flow**
- Operational Characteristics: **Unskilled operator**
- Special features: **Plant species and odourless operations**

IMPLEMENTATION PROCESS – 1 MLD STP

Navrang Nursary

Packaged type: pre fabric- rasala nature park (nursery) by Shivam and corporation

- Treatment of sewage treatment plant of 45, 000 lph of 1 mld to be manufactured.
- 10 yeas capex and opex with electricity billing = 4.13 crore
- 625 sq.mt – plot area
- Huge space, less power
- Inside the nursery, close to sewer line
- Sludge storage - filter press, back filters
- Total Project Cost – 4.37 Cr.
- 2.12 Cr- Capex, 2.1 Cr- Opex
- Civil Cost: 5-10 %
- Except Civil Works, **Everything Fabricated**
- **4 Months** Time To Complete The Project.

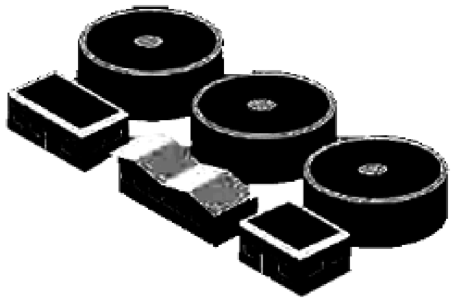
Aeration Tank

Storage Tank For Treated Water

4 BLOWERS

Source : Primary survey

STP (MBR) COST ANALYSIS



MBBR STP

Land requirement per MLD in ha: **0.04 ha**

Capex per MLD (INR): **6.5-8.1 /MLD**

O&M cost: **0.86 mil/yr/MLD**

Total Garden Area: 24.64 ha

Total Capacity required: 1.7 MLD

Total no. of STPs: 43 (individual)

26 (clusters-55 gardens)

Total Cost: 1.3 cr x 98 = INR 127.4 cr.

Source : Draft URDPFI guidelines, 2014 (Vol. I)

PROJECT COSTING

Total costing	INR
Technology Cost STP (69 gardens)	127.4 cr.
Technology Cost Phytorid (12 gardens)	66.3 cr.
Total cost of technology for 111 gardens (Capital Expenditure)	**193.7 cr.**
O&M cost STP (15 Rs./L) (Individual + Clustered gardens)	(15,000 X1.7X365)= 93 lacs
O&M cost Phytorid (50-100 KLD): 1,000-2,000	(34,000X12)=4.08 lacs
Total cost of O&M for 111 gardens (Revenue Expenditure)	**97.08 lacs 0.97 cr. For 10yrs.**
Total Expenditure (for 10 yrs)	**194.6 cr.**
Electricity saving on bore well pumps **(Revenue Income)**	(3.2 X Rs. 8000 X 365) = **93.4 lacs (0.93 cr. For 10 yrs)**

Total water treated at 111 gardens:

3.2 MLD (0.5% of total treated water)

PHYTORID COST ANALYSIS

Phytorid Technology

Capacity: **25 KLD**

Land requirement: **3 sqm**

Civil costs: **INR 11,41,334**

Solar pump, pipes etc.: **INR 50,000**

Plantation cost: **11,116**

O&M cost: **INR 72,000 /yr**

Total cost: INR 12,74,450 /yr

Total Garden Area: 22.41 ha

Total Capacity required: 1.5 MLD

Total no. of STPs: 11 (individual)

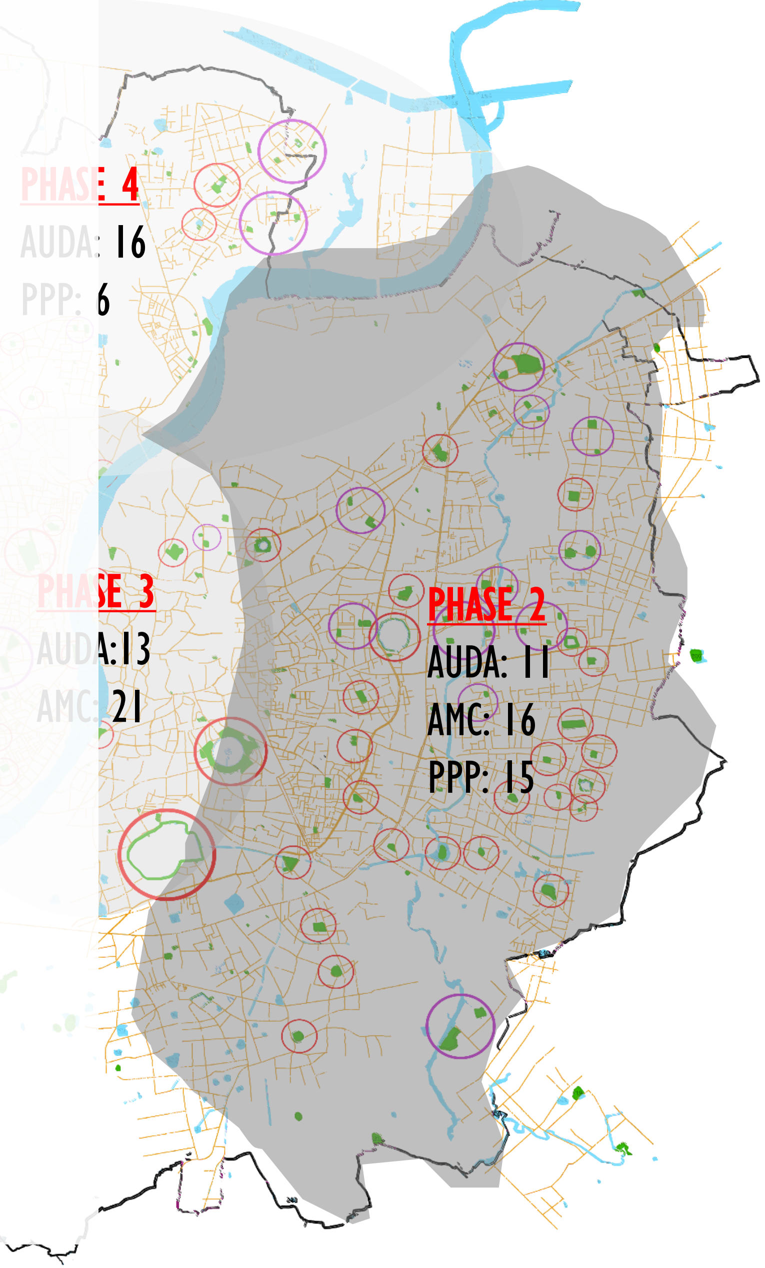
1 (clusters-2 gardens)

Total Cost: 5.1 cr. x 13 = INR 66.3 cr.

Source : NEERI & CSIR, Ministry of Drinking Water & Sanitation, Government of India, 2015

PROJECT PHASING

Management	AMC	Amul	Other Private	Total Cost
Phase 1	5	8		1360
Phase 2	19	10	5	2160
Phase 3	16	11	15	1360
Phase 4	7	9	6	590



PHASE 3 & 4

Ecology of rivers, streams ponds can be effectively managed by letting better treated waters incrementally along their length.

PHASE 2

Lesser investment is required for the **sewer pipelines** because maximum area is having sewer lines.

Phase 1

To Handle Waste Water Firstly So That It Does Not Gets Mix With **Agriculture Area** And To Avoid soil Pollution.

Source : AUDA DP, 2021

MANAGING THE GARDENS

AMC Functions

Providing garden space

Water supply for AMC and Private gardens

Solid waste collection from all gardens

Granting permission to conduct activities in AMC gardens

Providing new trees and plants to all gardens

Renovating the existing condition of AMC gardens

- Providing **decentralized packaged** small scale STP
- Providing **waste water** to parks for **non-potable uses**
- **Supervising STP** on site and check on **ground water use.**

Private Contractor

Torrent Power Ltd.

Ashima Ltd.

Relience Ltd.

Adani Power

Amul Mother Dairy

Vadilal Ice-cream

Civil Works Comp & Garden

Real estate companies

- Contracting out small STPs to Industries and **Central STP**
- Reduction in electricity consumption with removal of bore well
- Efficient and environmentally feasible watering system

Duties of Private Contractor

Garden plants maintenance

Providing staff for maintenance

Operation of garden amenities

(water features, landscape features, toilets, drinking water fountains)

Repair works

Maintaining STP/Phytorid

- **Reuse of waste water** for gardening
- Using waste water in **toilets** and water features
- All maintenance of garden **except STP**

Source : AUDA DP, 2021 and Draft CSP, 2012

POSSIBILITIES OF FINANCIAL SAVING

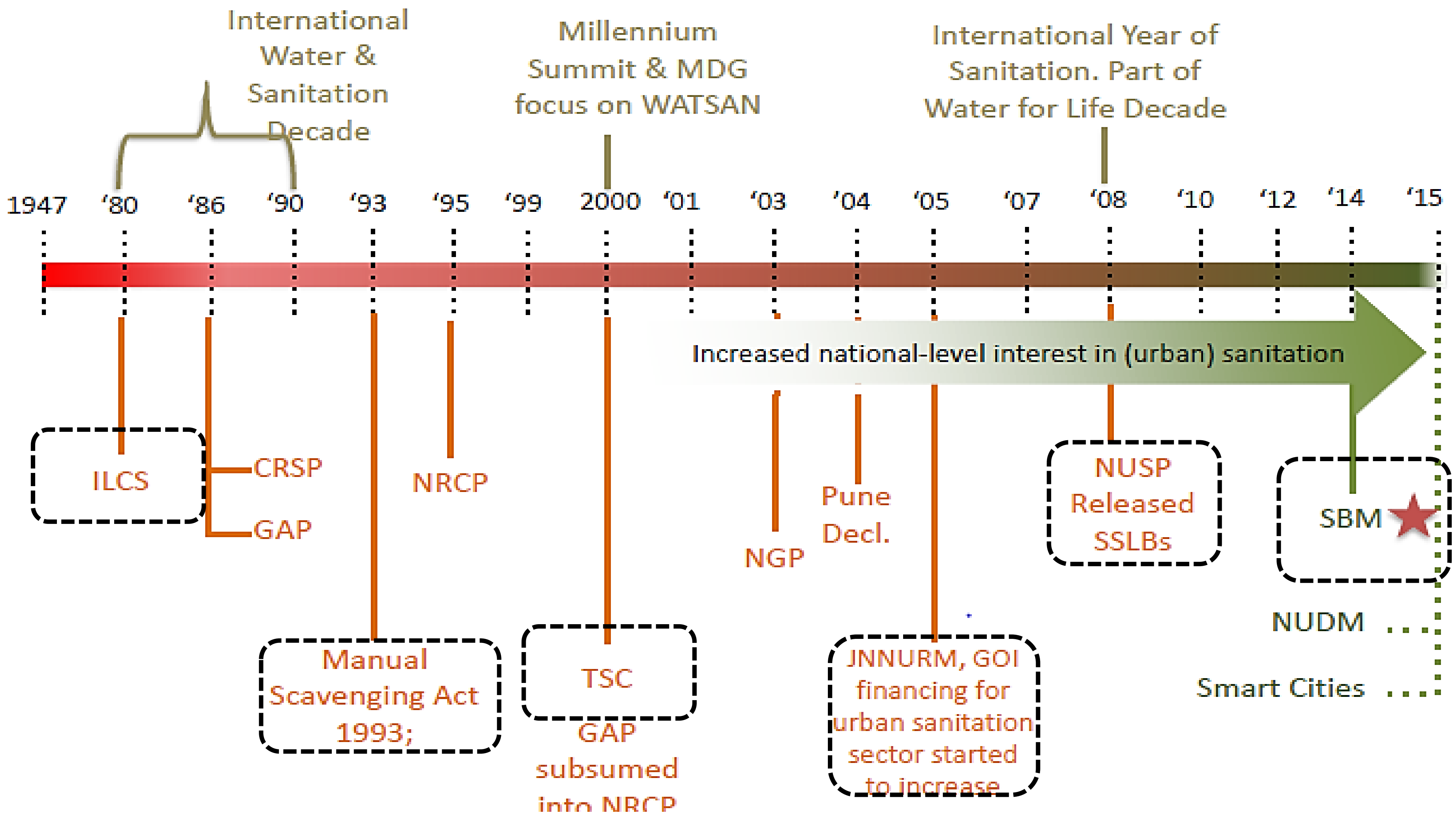
- Saving on ground water pumping cost by **removing** the use of **bore well** by 30%
- Reduction of **pipeline layout & maintenance** reduces with increase in **on-site sanitation** system
- Reducing the **sludge amounts** at main STP at Pirana, Vasna and Vinzol, hence **reducing** the **treatment cost**
- **Policy level intervention** to make the waste water reuse **mandatory** at city level through AMC
- Though there is **no scarcity** of **fresh water**, yet there is a need to provide abundant **clean treated water** to the consumers
- Introducing the **concept** of waste water **reuse** as a social awareness in order to **practice** it successfully in cities

SANITATION

Sanitation Condition of a city makes an impression on one’s mind as the image of a city.

With the nation focusing towards **CLEAN INDIA** this sector plays a major role in it.

So with time, the provision and management of these facilities should increase.



Policy and Programs

Source: http://waterfund.go.ke/safisan/Downloads/Sanitation%20Policies%20and%20Programs%20in%20India.pdf

National Urban Sanitation Policy

Awareness generation and behavioural change about sanitation

Open defecation free cities.

Integrated city wide sanitation

Strengthening national, state, city and local institutions to accord priority to sanitation, its implementation and O&M.

Excess to proper sanitation facilities for poor communities.

Sanitary and safe disposal.

Service Level Benchmark Standards

Coverage of Toilets: 100%
This indicator denotes the extent to which citizens have access to a toilet (whether individual or community) in a service area.

Coverage of Sewage Network Services: 100%
This indicator denotes the extent to which the underground sewage (or sewerage collection) network has reached out to individual properties across the service area.

CPHEEO & URDPFI Guidelines

Talks about sanitation regarding its planning, design and management

Policy and Guidelines

Source : NUSP, 2008, Service Level Benchmarks, CPHEEO guidelines, URDPFI guidelines

Integrated Low Cost Sanitation	MGSM	JNNURM	SWATCH BHARAT	SMART CITIES MISSION
• To stop manual scavenging and promote sanitation • To convert 6 lakh dry laterines to low cost pour flush toilets	• Open Defecation Free Community	• Reform based project funding grants with state shares. WatSan ~ 70% funding and sanitation • all urban poor access to toilets. • In-house toilets linked to sewerage / septic tank • Community toilets	• Elimination of open defecation • Eradication of Manual Scavenging • Individual toilets • Community toilets • Public toilets	• Main component of sanitation in smart cities project is treatment of waste water. • No specific comment is present on public toilets or individual toilets

Programs and Missions

Source : JNnURM Report, SBM Report, ILCS Report, Smart City Guidelines, MGSM Guidelines

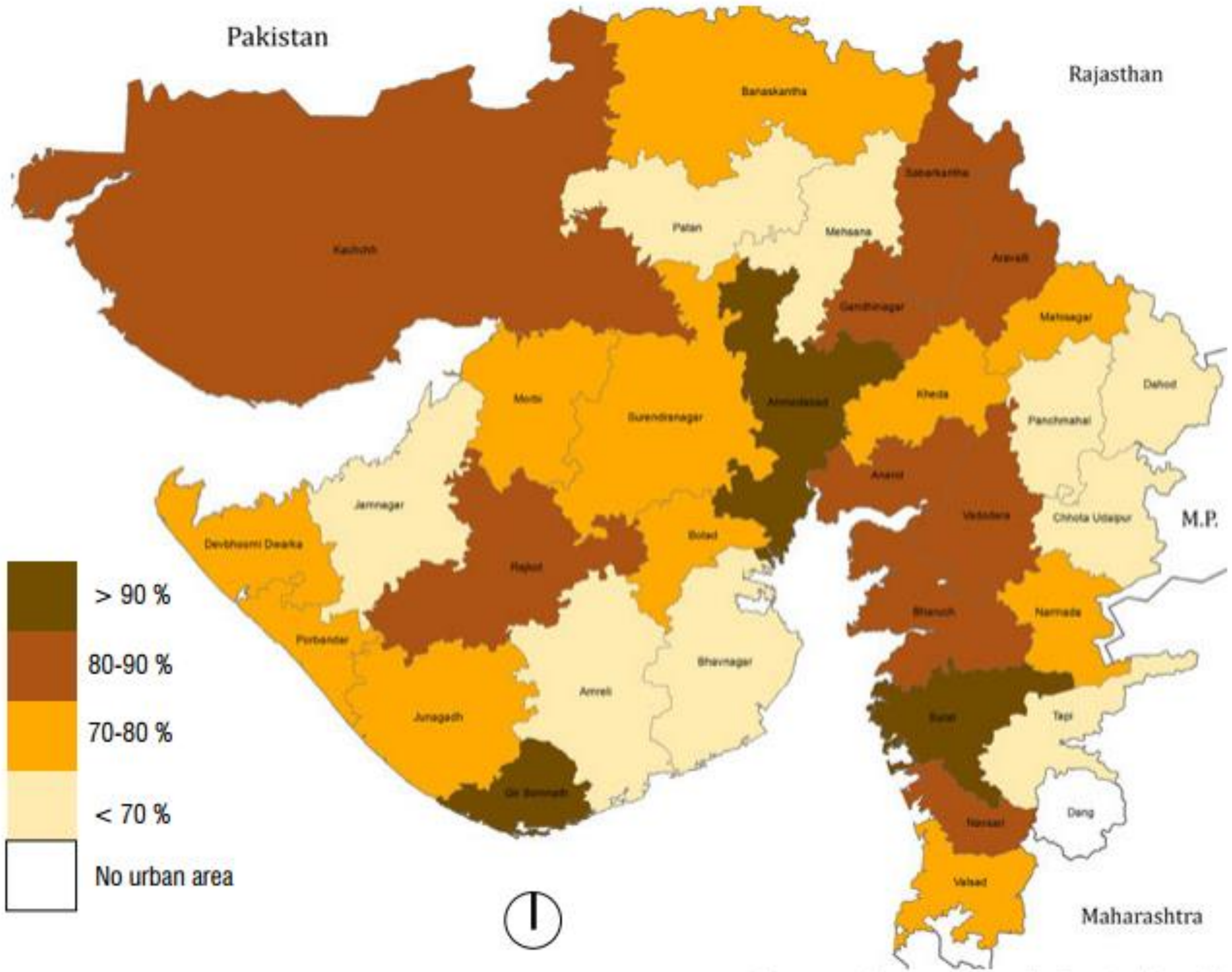
Sanitation

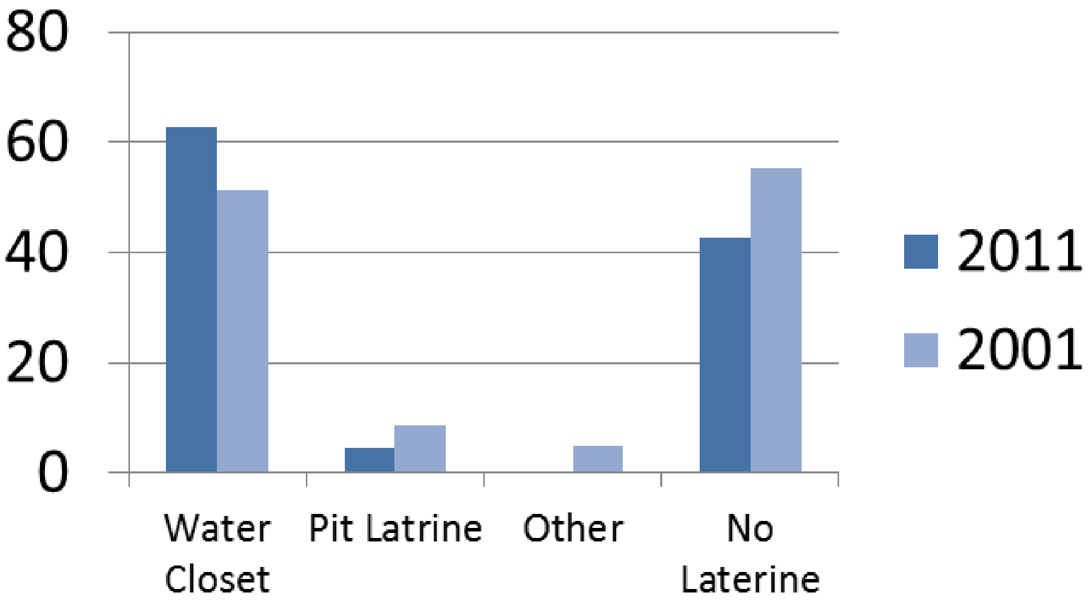
- Access to toilets
- On site sanitation

Our Approach

Coverage of Toilets by District

(PAS Data, 2013)





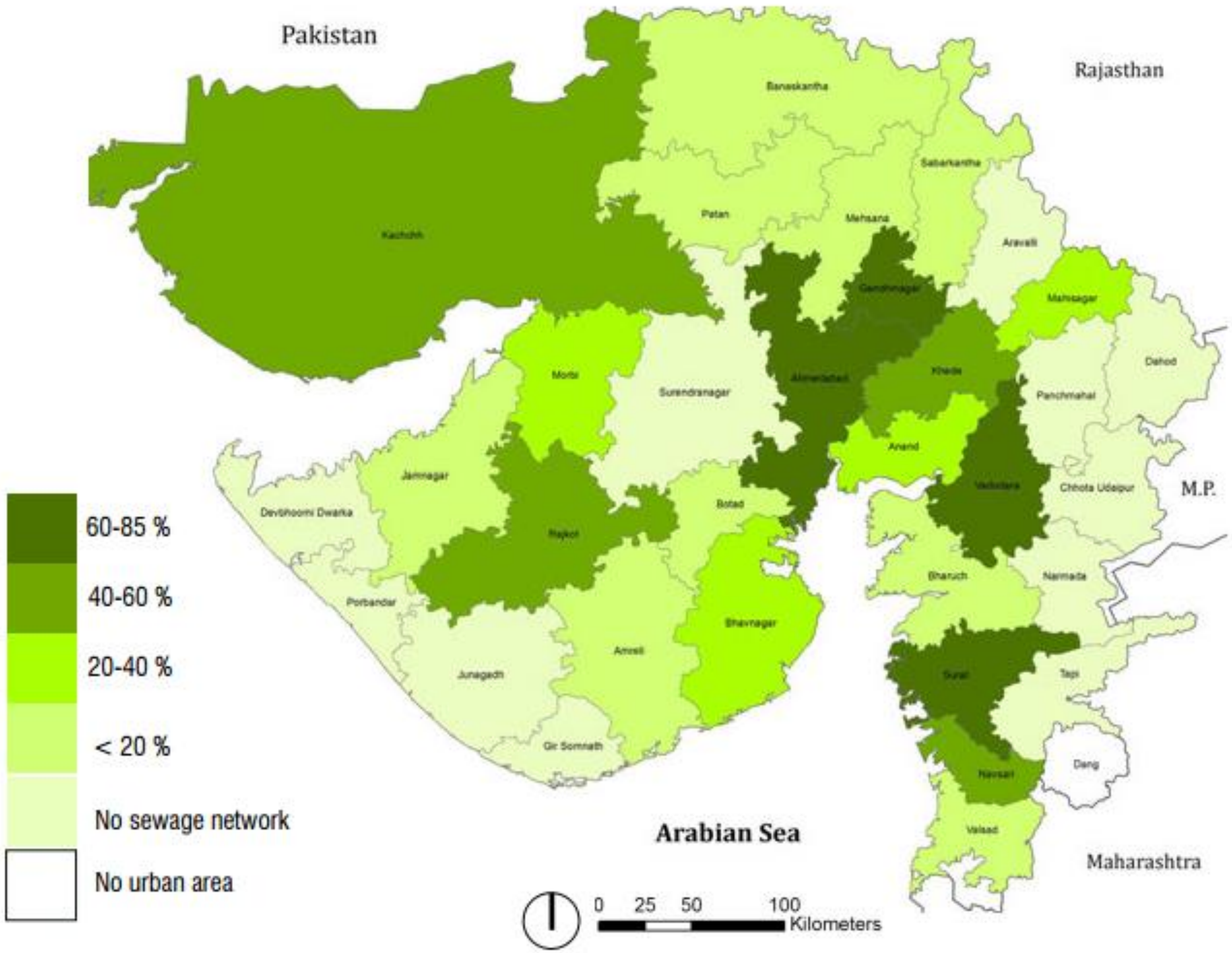
In Gujarat 64.4 per cent slum households have toilet facility within the premises, but 21.26 per cent slum house holds defecate in open and 14.33 per cent public facilities

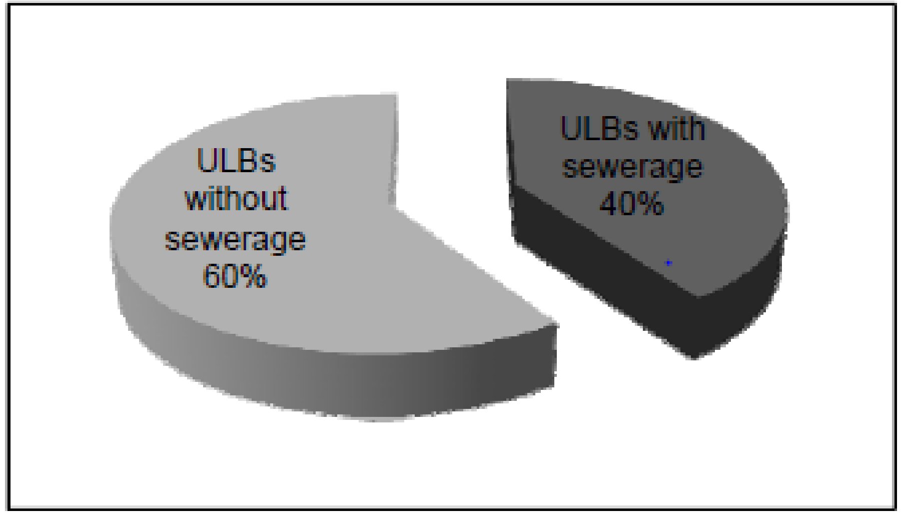
Toilet Coverage in Gujarat

Source : PAS Mapbook, 2013, Census Data,2011

Coverage of Sewage Network in ULBs by District

(PAS Data, 2013)



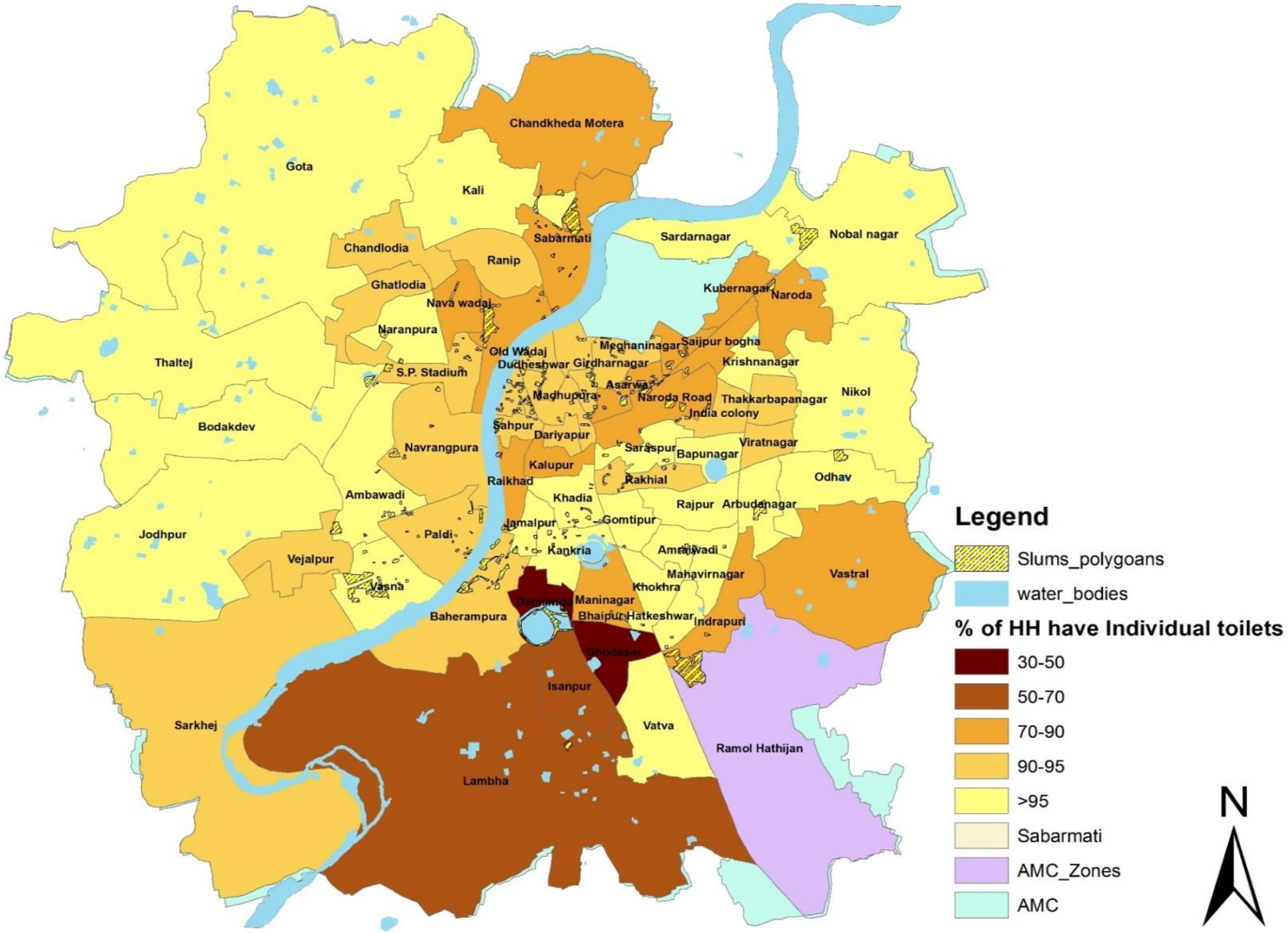


Sewerage Coverage

Network Coverage in Gujarat

Source : PAS Mapbook, 2013, Census Data,2011

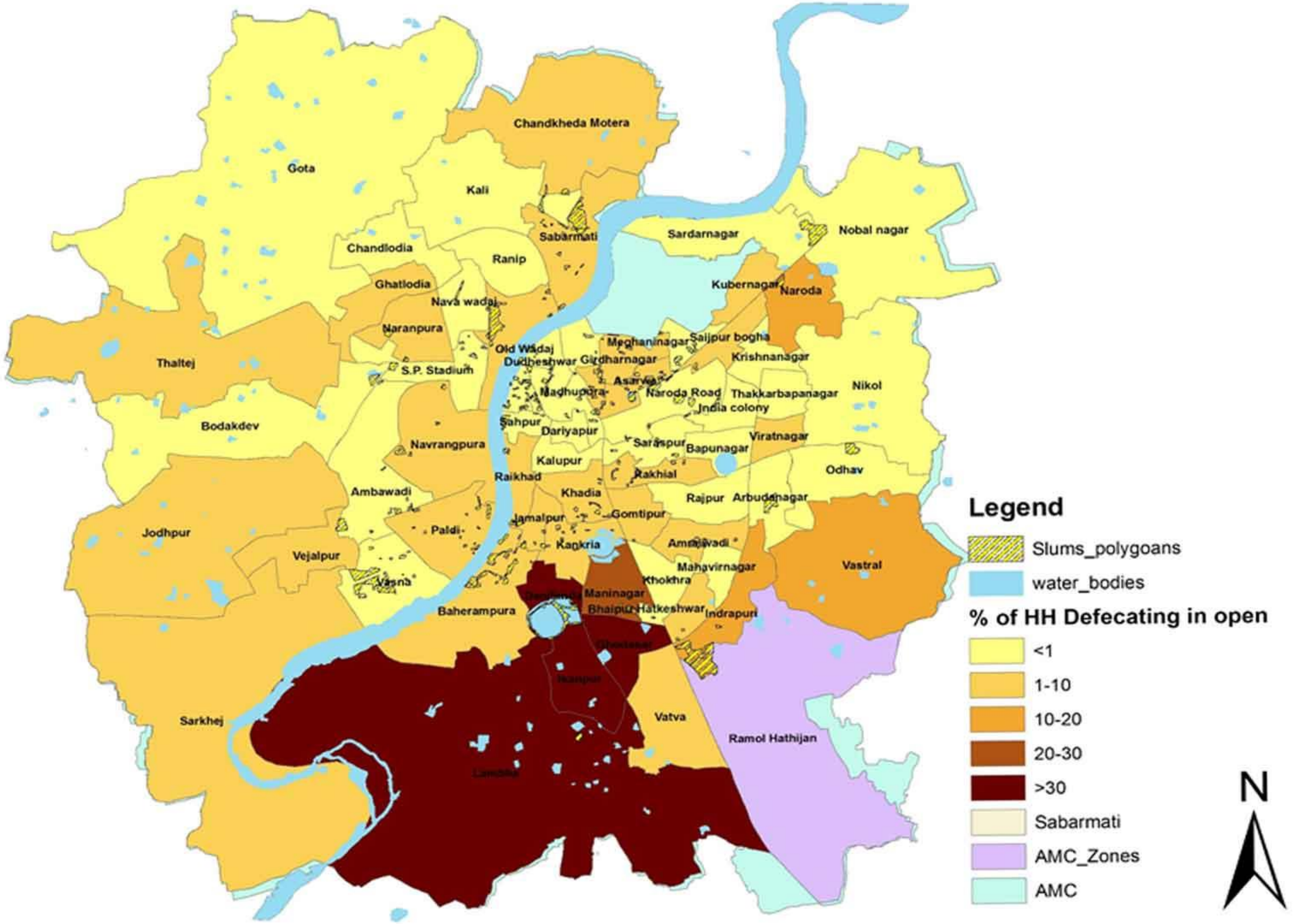
Present Scenario of Ahmedabad



Total 93.4% HH have individual toilets in the city.

Individual Toilet

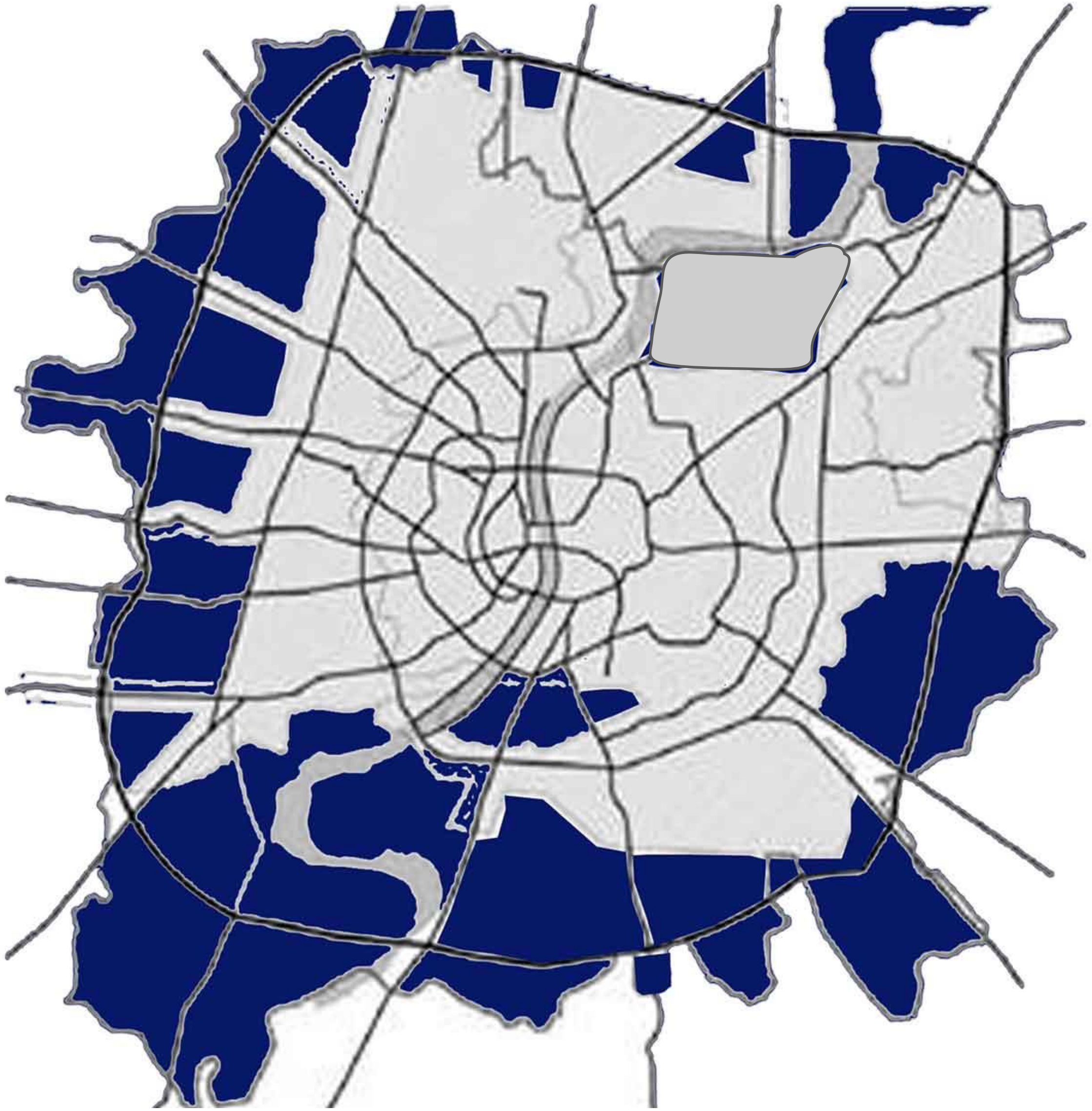
Source Census Data, 2011



Total 28300 HH are defecating in open

Open Defecation

Source : *Census Data, 2011*



88.6% Households have access to sewerage system

10% Households use On Site Sanitation

On site Sanitation

Source : *City Sanitation Plan, Ahmedabad, 2012*

Initiatives include provision of individual toilets to households, provision of community and pay & use toilets in the city, measures for cleaning and removal of open defecation spots and preventing their resurfacing

Sr No.	Description	Proposed Improvement		Block Cost
		2016	2021	(lakhs)
1	Construction of Individual Toilets	51946	-	2078
2	Refurbishment of existing public/pay and use toilet	4750	-	2969
3	Construction of new toilet seat	1784	972	3445
4	Refurbishment of existing men's urinal	1182	-	369
5	New Urinals women	975	162	711
	Total			9572

Ongoing Initiatives by AMC

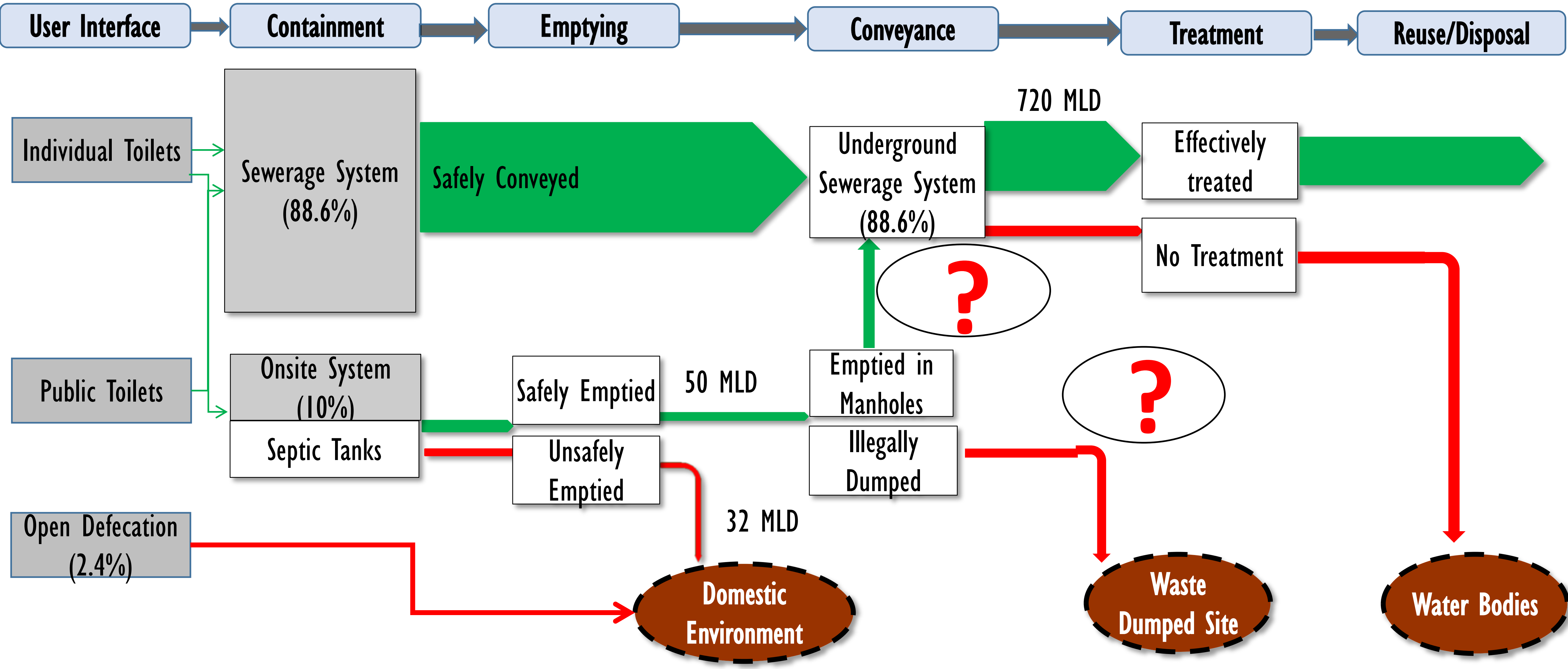
Source : *City Sanitation Plan, Ahmedabad, 2012*

AUDA prepared a detailed project report (DPR) for expansion of sewerage network in western and eastern extensions of Ahmedabad city.

NO.	Description	Proposed Improvement		Unit	Block Cost
		2016	2021		(lakhs)
1	Refurbishment of existing sewerage network	337	-	km	12516
2	Provision of Sewerage Connection	564053	305075	No.	-
3	Provision of Sewerage connections in slums	64975	-	No.	-
	Total				12516

Ongoing Initiatives by AMC

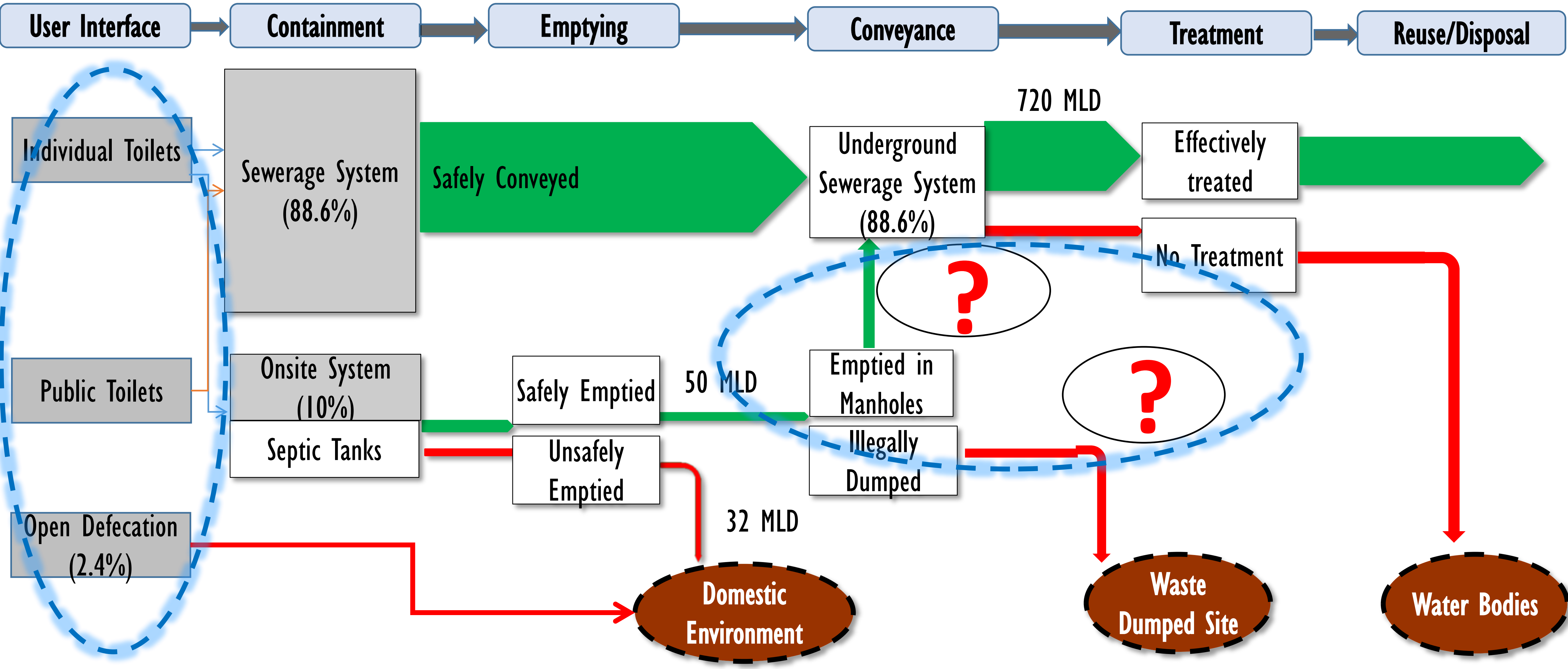
Source : *City Sanitation Plan, Ahmedabad, 2012*



Waste Flow Diagram of Ahmedabad

Rain Water Harvesting

SOURCE: CENSUS DATA, 2011, CITY SANITATION PLAN, 2012, AHMEDABAD, SUSANA



Waste Flow Diagram of Ahmedabad

Rain Water Harvesting

SOURCE: CENSUS DATA, 2011, CITY SANITATION PLAN, 2012, AHMEDABAD, SUSANA

Lack of Public Toilets

Hygiene Problems due to Open Defecation in Slums

Lack of Regular Operation and Maintenance of Public Toilets

Weak Institutional Capacity for providing Suction Emptier Vehicles

Improper Design of Septic Tanks

Issues

Lack of Public Toilets

Hygiene Problems due to Open Defecation in Slums

Lack of Regular Operation and Maintenance of Public Toilets

Weak Institutional Capacity for providing Suction Emptier Vehicles

Improper Design of Septic Tanks

Open Defecation Free Ahmedabad

Slum Upgradation

Projects Identified

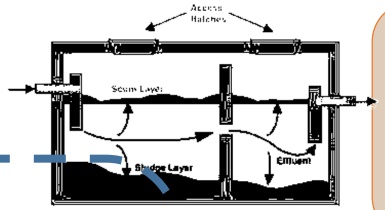
Lack of Public Toilets

Hygiene Problems due to Open Defecation in Slums

Lack of Regular Operation and Maintenance of Public Toilets

Weak Institutional Capacity for providing Suction Emptier Vehicles

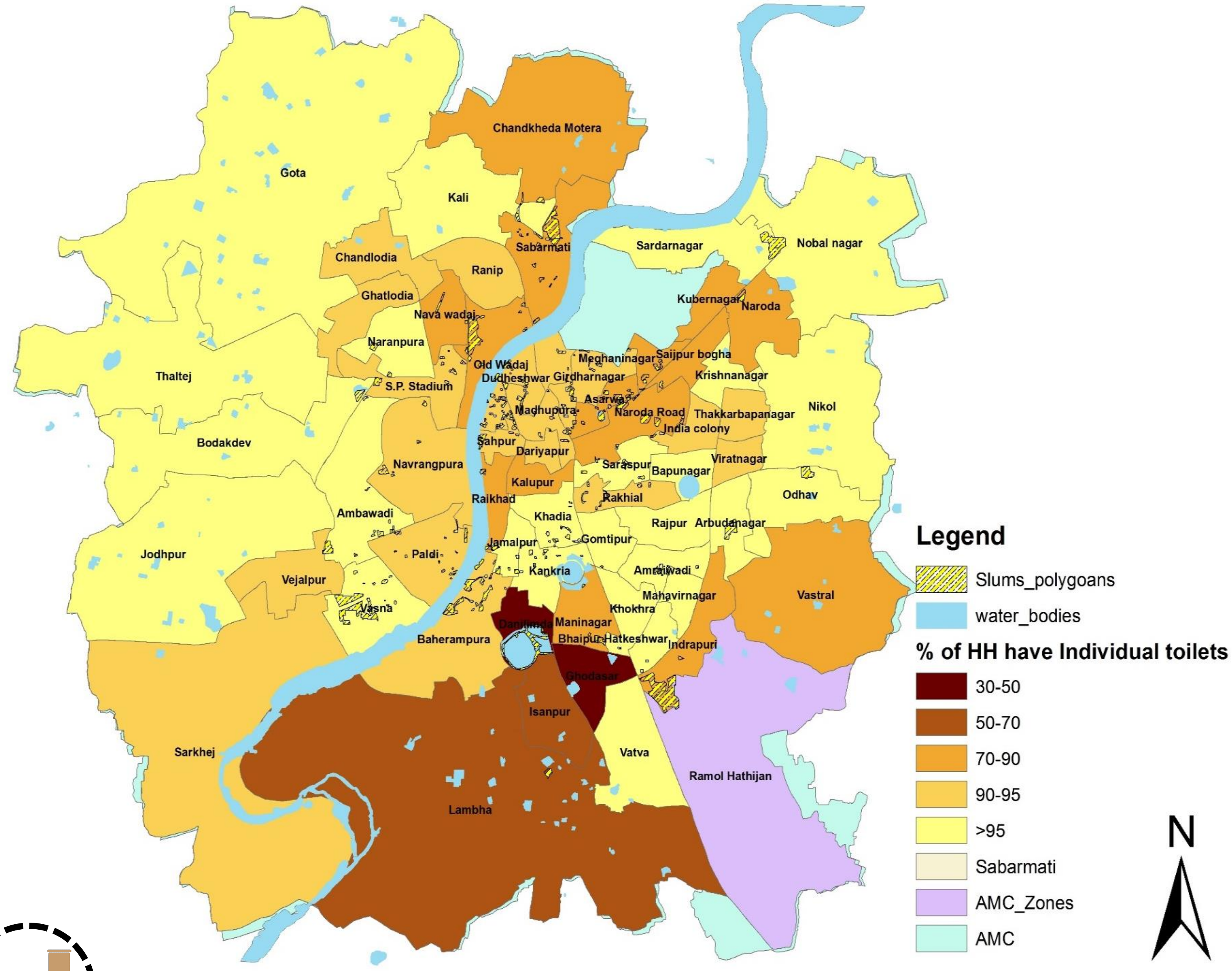
Improper Design of Septic Tanks



Improving Onsite Sanitation

Projects Identified

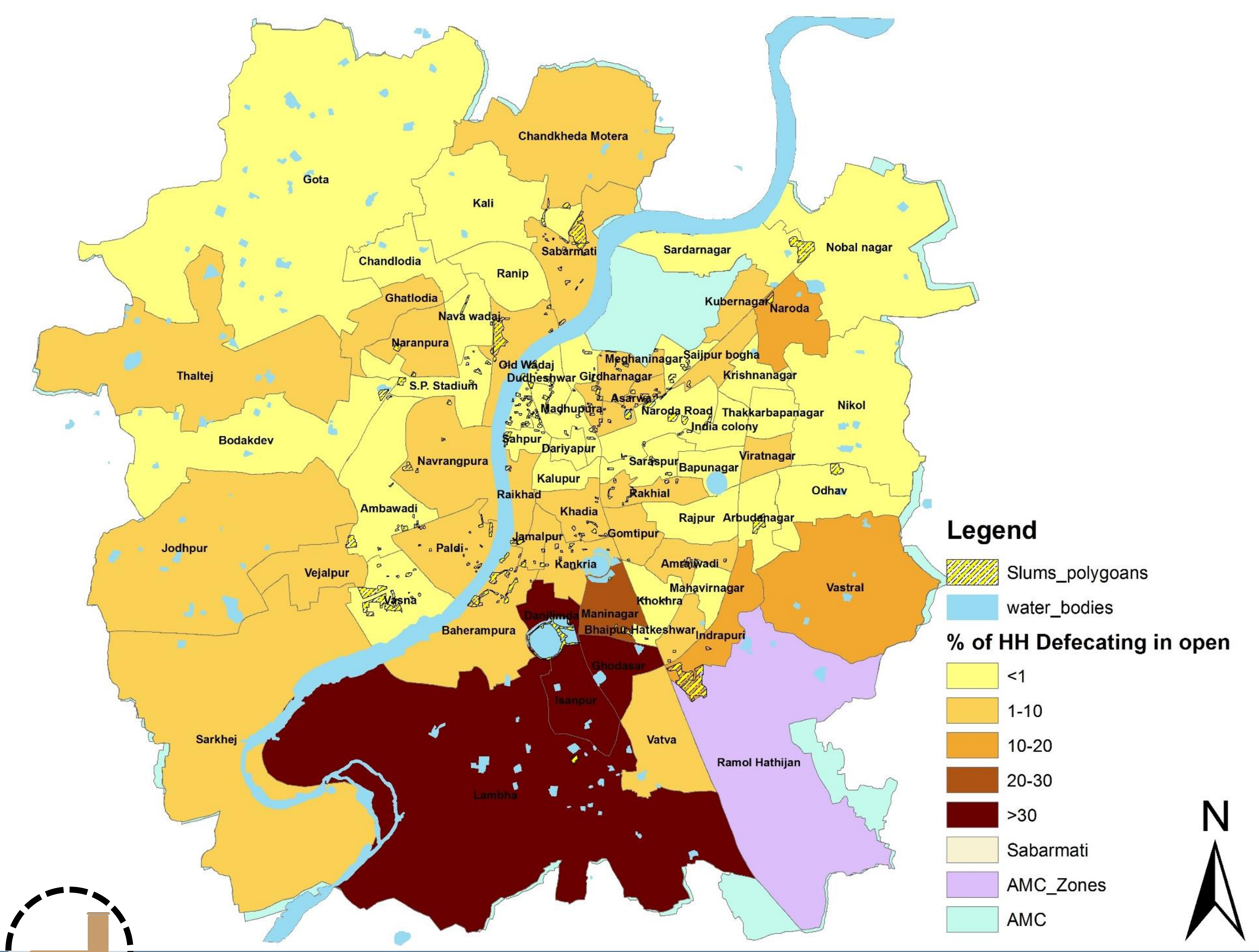
OD FREE CITY...



- Total 93.4% HH have individual toilets in the city.
- Ward Danilimada and Ghodasar have least individual toilets at HH level which is less then 50%.
- New west zone have maximum % of Individual toilets.

Household with Individual Toilet -Map

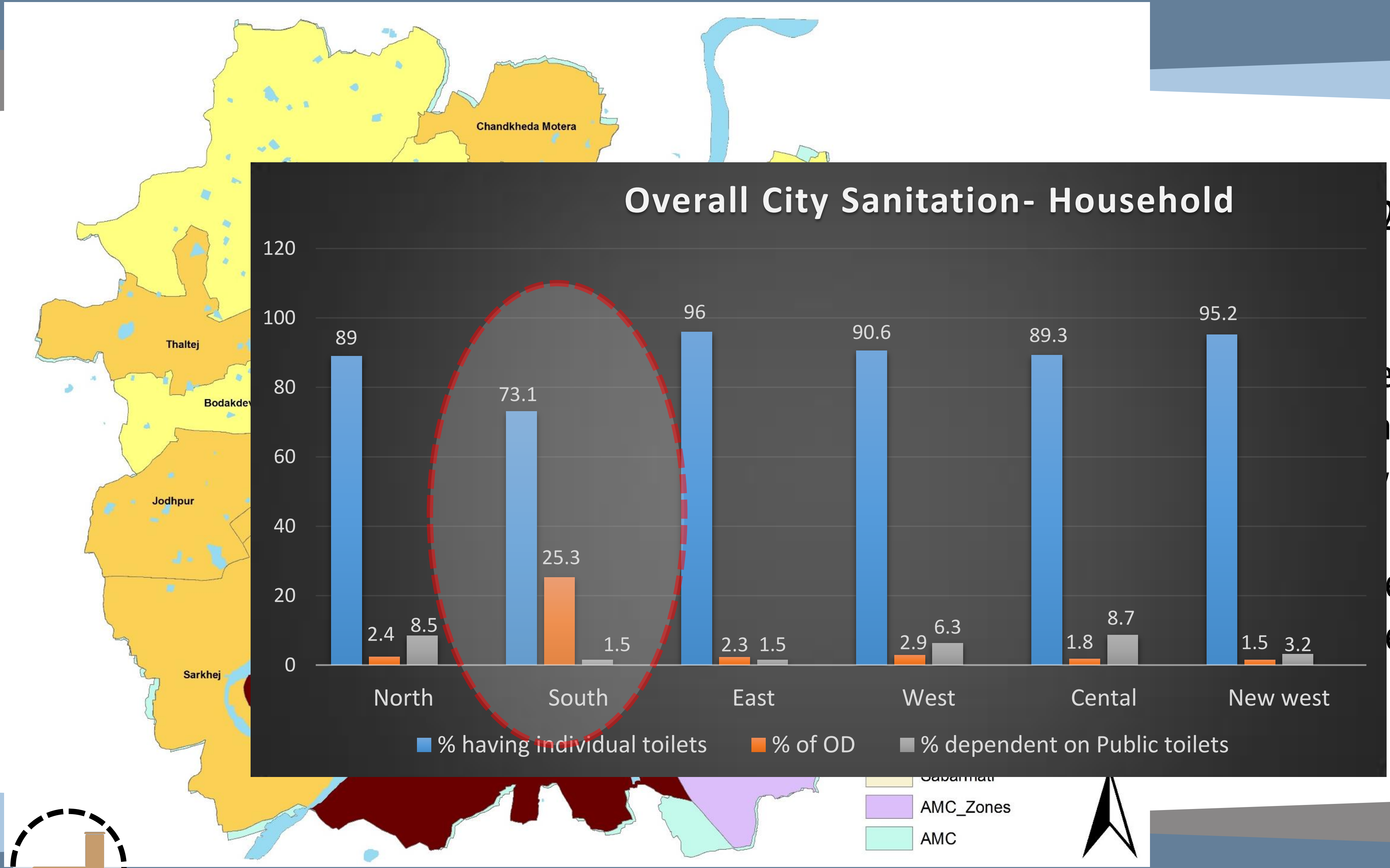
Source : *CENSUS-2011*



- Total 2.4% (28,335) HH are defecating in open
- Maximum open defecation occurs in, ghodasar, lambha, Isanpur & Danilimada wards
- Gota, Bodakdev, Ambawadi have least % of open defecation which is less then 1%.

Households Defecating in Open- Map

Source : *CENSUS-2011*



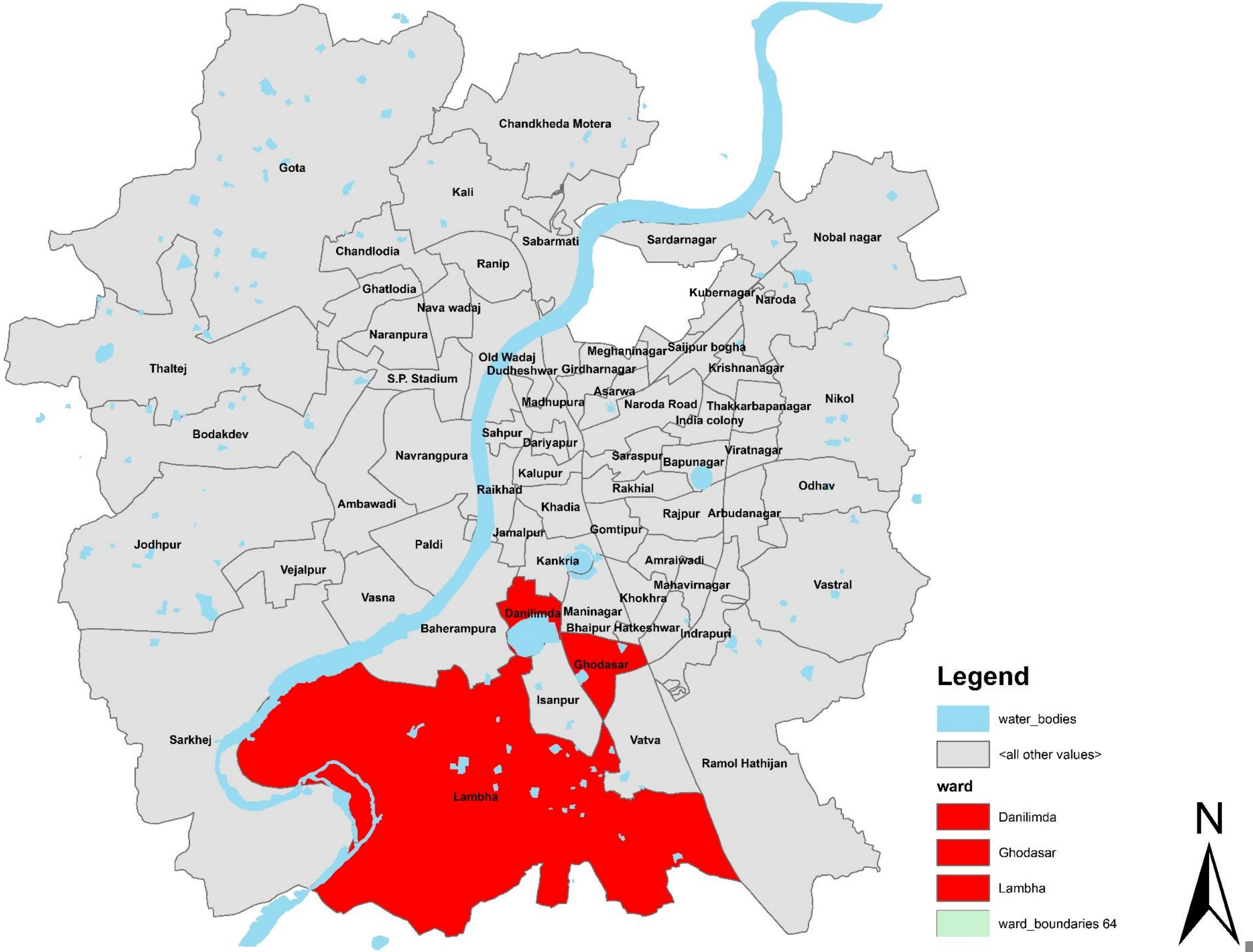
28,335) HH are
open

en defecation occurs in,
bha, Isanpur &
ards

ev, Ambawadi have least
efecation which is less

Households Defecating in Open- Map

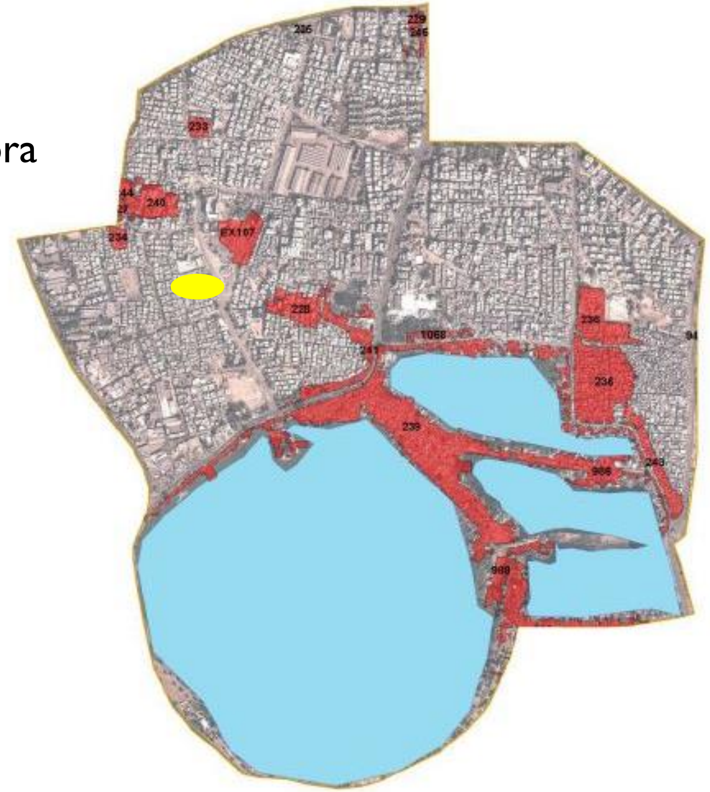
Source : *CENSUS-2011*


Chandkheda Motera
Gota
Kali
Sabarmati
Sardarnagar
Nobal nagar
Chandlodia
Ranip
Ghatlodia
Kubernagar
Naroda
Nava wadaj
Naranpura
Old Wadaj
Meghaninagar
Saijpur bogha
Thaltej
Dudheshwar
Girdharnagar
Krishnanagar
S.P. Stadium
Asarwa
Nikol
Madhupura
Naroda Road
Thakkarbapanagar
India colony
Bodakdev
Sahpur
Dariyapur
Navrangpura
Saraspur
Viratnagar
Bapunagar
Kalupur
Odhav
Raikhad
Rakhial
Ambawadi
Khadia
Rajpur
Arbudanagar
Jodhpur
Paldi
Jamalpur
Gomtipur
Kankria
Amraiwadi
Vejalpur
Mahavirnagar
Vastral
Vasna
Khokhra
Danilimda
Maninagar
Baherampura
Bhaipur Hatkeshwar
Indrapuri
Ghodasar
Isanpur
Sarkhej
Vatva
Ramol Hathijan
Lambha
Legend
water_bodies
<all other values>
ward
Danilimda
Ghodasar
Lambha
ward_boundaries 64
N

Study Area

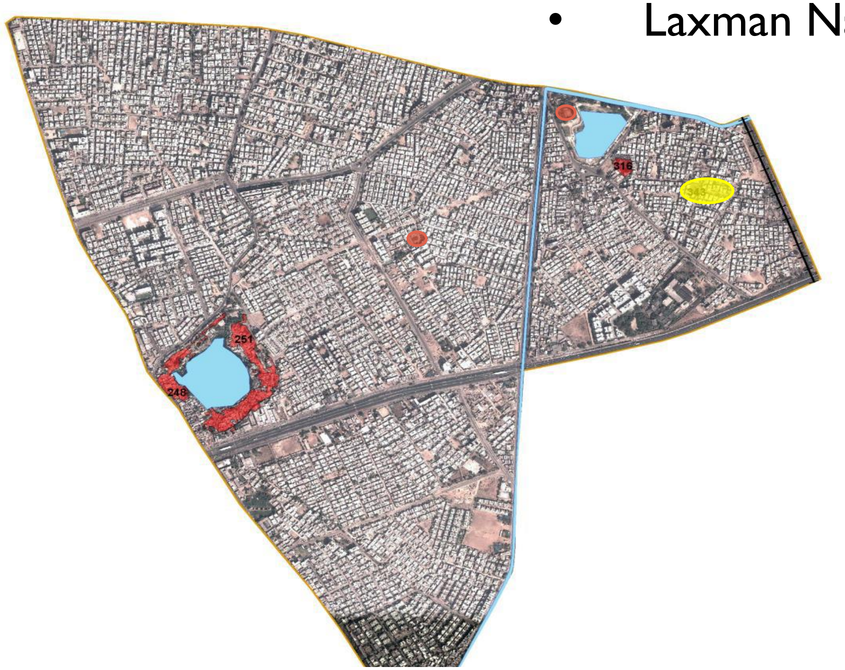
Danilimda

- Bhakt Vallabh
- Dhola Na Chapra
- Bhandariya Kuva Ni Chali
- Bharvad Vas
- Bhil Vas Na Chapra
- **Sojatwala Ni chali**
- Gajanand Na Chapra / Kanu Bechar Na Chapra
- Govindbhai Ni Chali
- Millat Nagar
- Navabkhan Na Chapra
- Patel Vas Na Chapra
- Shah Nagar Na Chapra
- Suryanagar Na Chapra
- Thakor Vas Na Chapra
- Vadivas
- **Tirkarvas**
- Musa Miya Ni Chali
- Ektanagar



Ghodasar

- Kantinagar
- Ramwadi
- **Bhilwas**
- Laxmanbapa Ni Chali
- Laxman Nagar Ni Chali



Total Chalis

Source : AMC, **Slum Free City Action Plan Under Rajiv Awas Yojana**

Danilimda

Tirkarvas

Population	**110**
No. of households	25
HH with ind. toilet	21
HH dep. On community toilet	2
HH resorting to OD	2

Sojatwala Ni Chali

Population	**121**
No. of households	31
HH with ind. toilet	23
HH dep. On community toilet	5
HH resorting to OD	3

- Land ownership- Own
- 100% water connection but 0% in toilets
- Have **no space** to built individual toilets

Ghodasar

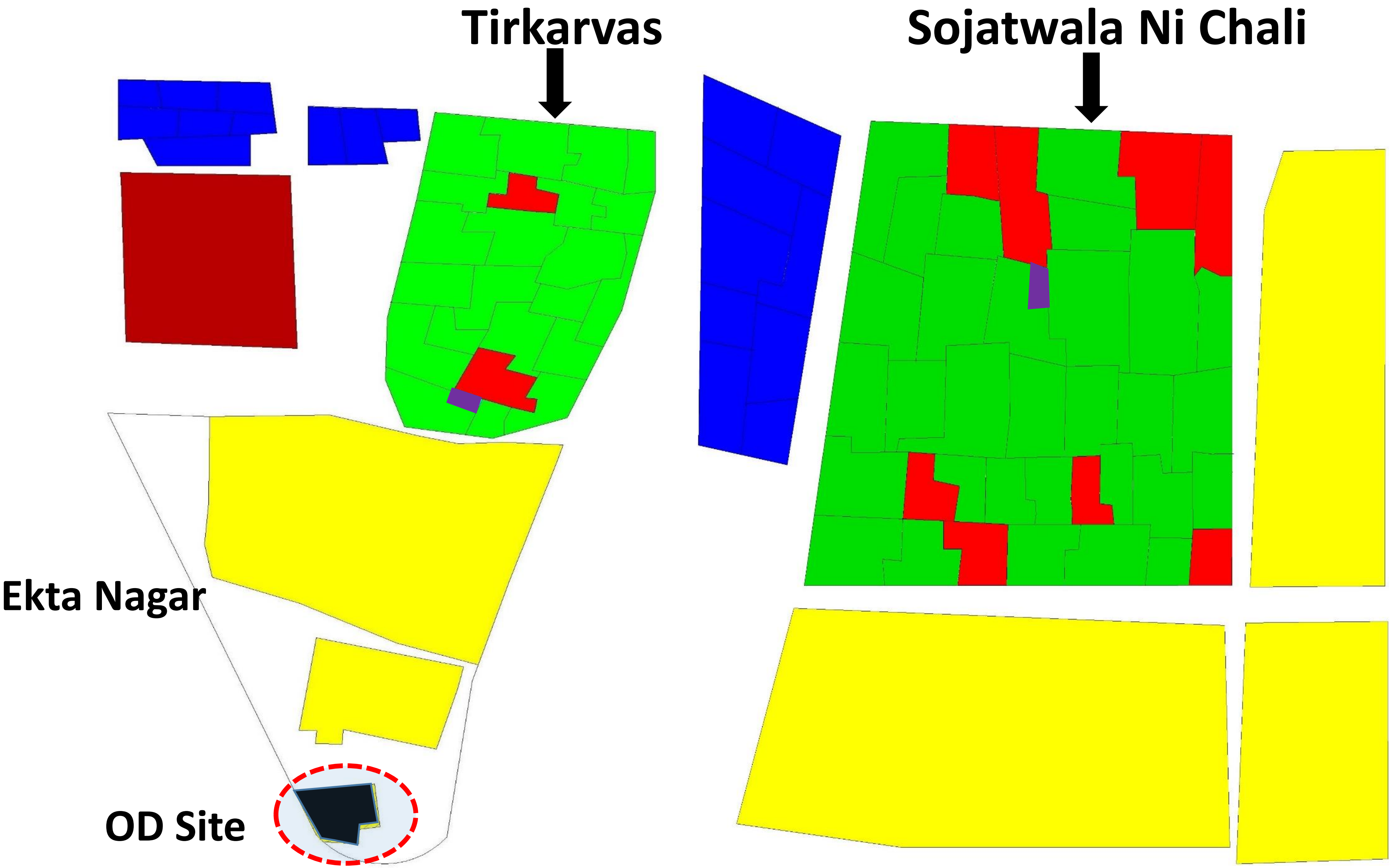
Bhilvas

Population	**71**
No. of households	17
HH with ind. toilet	12
HH dep. On community toilet	4
HH resorting to OD	2

- Land ownership- Own
- 100% water connection – 0% in toilets
- **Have space** to built individual toilets

Analysis of Chalis

Source : *Primary survey*



Layout - Chali

Source : *Primary survey*

Tirkarvas

No. of Seats	8 (4 each)
No. of users	30-40/day
User within the community- 7-8/day Maintenance	7-8/day **AMC**
Reason for Open Defecation:	• Lack of **space** and for individual toilets • Mainly done by **children** • No daily cleaning • No water connection • Worst condition of CT

Sojatwala Ni Chali

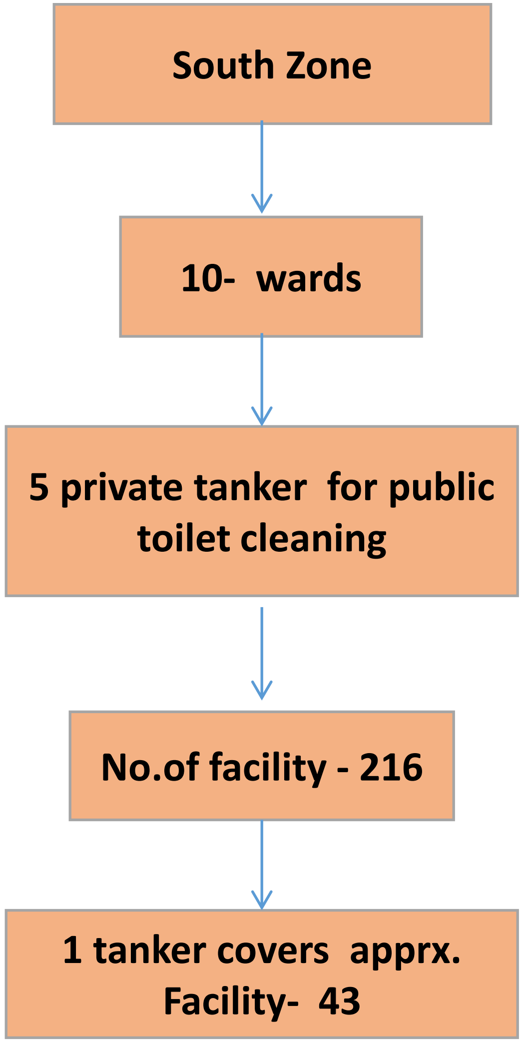
No. of Seats	3 (No section for female)
No. of users	20/day
User within the community- 7-8/day Maintenance	7-8/day **AMC**
Reason for Open Defecation:	• **Non-functionality** of CT • **Lack of space** and **money** for individual toilets • Mainly done by **children** • No daily cleaning • No water connection

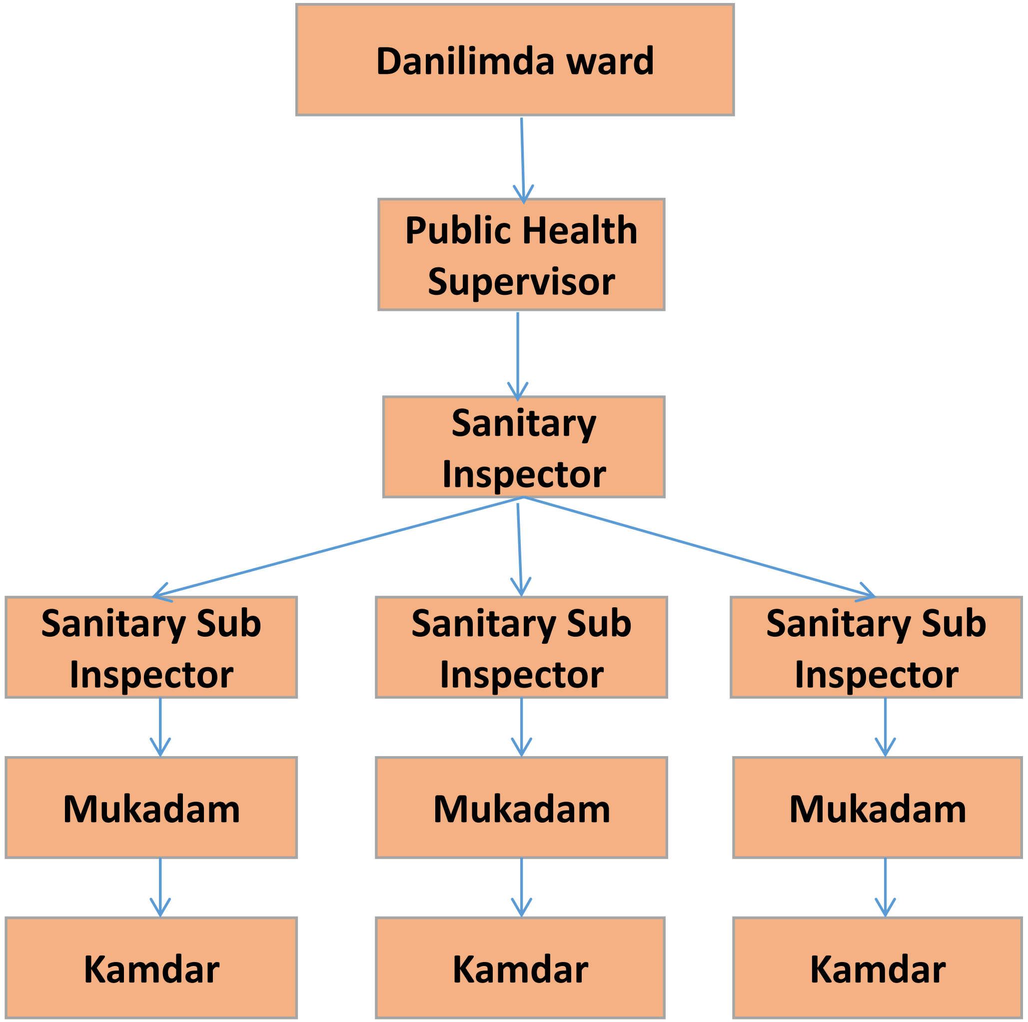
Bhilvas

No. of Seats	4 (2 each)
No. of users	15-20/day
User within the community- 7-8/day Maintenance	12-15/day **AMC**
Reason for Open Defecation:	• lack of **money** for individual toilets • **Poor condition** of CT • No daily cleaning • No water connection

Community Toilets

Source : *Primary survey*





Institutional Framework

Source : Ward office- Danilimada

- There are total 43 Community Toilets in the Ward.
- Municipal corporation constructs it, maintains and handle the complains regarding it.
- There is only one Nuisance Tanker (1 driver and 2 cleaners), for the entire ward. Driver carries the log sheet which is reviewed and signed by the Sanitary Sub Inspector daily.
- The Nuisance Tanker is given on contract basis.
- No Daily monitoring and supervision is done by the Sanitary Inspector.

Community Toilets

Danilimda- Analysis

Source :AMC, primary survey

Construction

Land	100% by corporation
Design & Estimation	By NGO
Building Structure(Capital cost)	100% by corporation
Water supply, Electricity Bill & Drainage	Bill pay by NGO
No. of Seats	8

Years	Capital expenditure (Rs)
Year-1	8,00,000
Total	**8,00,000**

O & M

100 % maintenance of sanitary block done by NGO
Maintenance include cleaning ,repairing and collection of user charges.

Years	O & M (Rs)	Receipt(Rs)
Year-1	-	-
Year-2	1,85,760	1320
Year-3	1,95,048	1386
Year-4	2,04,800	1455
Year-5	2,15,040	1528
Year-6	2,25,792	1604
Year-7	2,37,082	1685
Year-8	2,48,936	1769
Year-9	2,61,383	1857
Year-10	2,74,452	1950
Total	**20,48,295**	**14,555**

- salary of cleaner
- salary of care taker
- cleaning material
- electricity bill
- water supply bill

Construction & Maintenance- Pay & Use

Source :Ward office, primary survey

Construction

Land	100% by corporation
Design & Estimation	By Engineering Department
Building Structure(Capital cost)	100% by corporation
Water supply, Electricity Bill & Drainage	Bill pay by corporation
No. of Seats	8

Years	Capital expenditure (Rs)
Year-1	5,00,000
Total	**5,00,000**

O & M

100 % maintenance by corporation
Maintenance include cleaning ,repairing and collection of user charges.

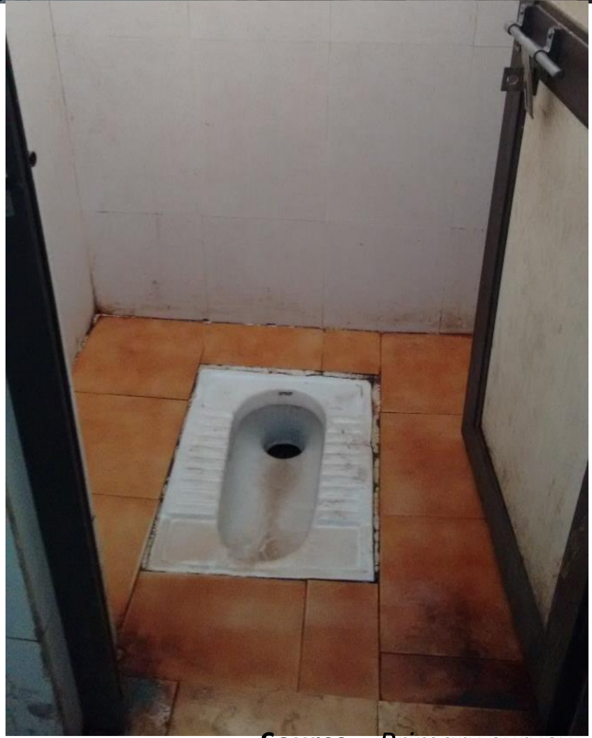
Years	O & M Expenditure(Rs)
Year-1	-
Year-2	96,000
Year-3	1,00,800
Year-4	1,05,840
Year-5	1,111,32
Year-6	1,16,689
Year-7	1,22,523
Year-8	1,28,649
Year-9	1,35,082
Year-10	1,41,836
Total	**10,58,550**

- salary of cleaner
- cleaning material
- electricity bill
- water supply bill

Construction & Maintenance- Community Toilet

Source :Ward office, primary survey

Difference



Source : *Primary survey*

Private Toilets

Individual Toilets	Shared Toilets
Can be provide where there is space for that.	Can be provide **(3-4 HH)** where there is no space for indi toilets
Possibility	**Possibility**
Bhilwas- All 5 HH have space to built indi toilet	It can be provide in **Tirkarvas** & **Sojatwala Ni Chali**

- As per **NGSP** with the cost of **10,000** Rs./ HH

- As per **Community** participation & NGSP.

Solution

Tendering system:

- There should be qualifying criteria for O&M contract of public toilets. Which is very less at present.
- Equal emphasis given to financial & technical qualification, which is not there.
- Due to this, experienced & large size agency will get O&M contract.

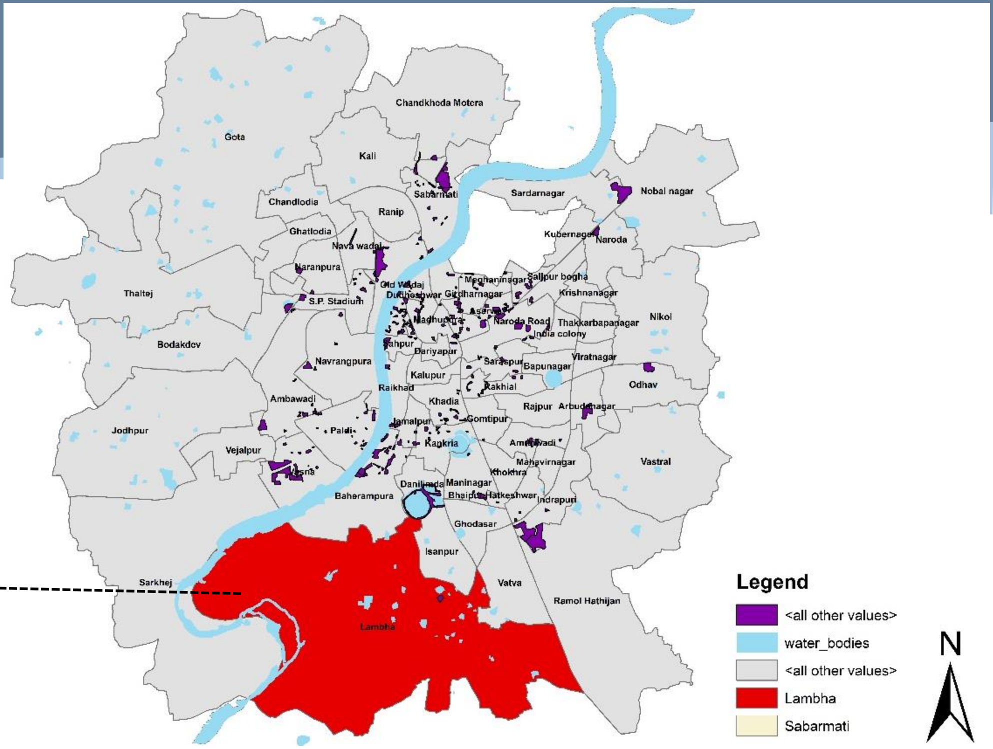
Contract system:

- Specification of cleanliness standards
- The contract documents should specify the cleanliness standards which the agency has to achieve.
- Provision of accountability & penalty for bad cleanliness and mis-management of toilet.

Centralized information system

Solution- Tendering & Contract

Source : *AMC*



Total HH	359	
HH with ind. toilet	196	54%
HH dependent on public toilets	11	3%
HH resorting to OD	152	42%
No. of Community Toilets	2	
No. of Pay & Use toilets	1	

Lambha

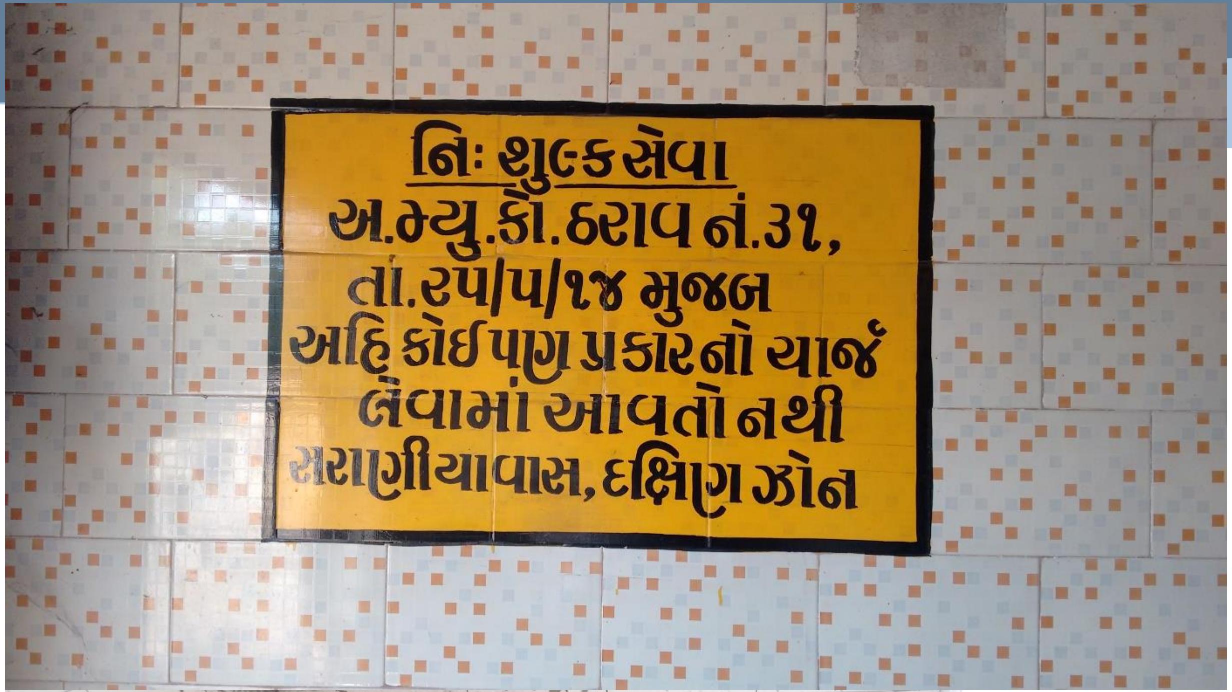
Source : Census-2011, Slum Free City Action Plan Under Rajiv Awas Yojana

- No. of Huts- **700**
- Land ownership- Govt.
- Source of water- **Tanker(4-5)**
- No sewer lines
- **110** HH have ind. Toilets as per NGSP
- No. community toilet- **1**
- More than **70%** are defecating in open

Saraniyavas

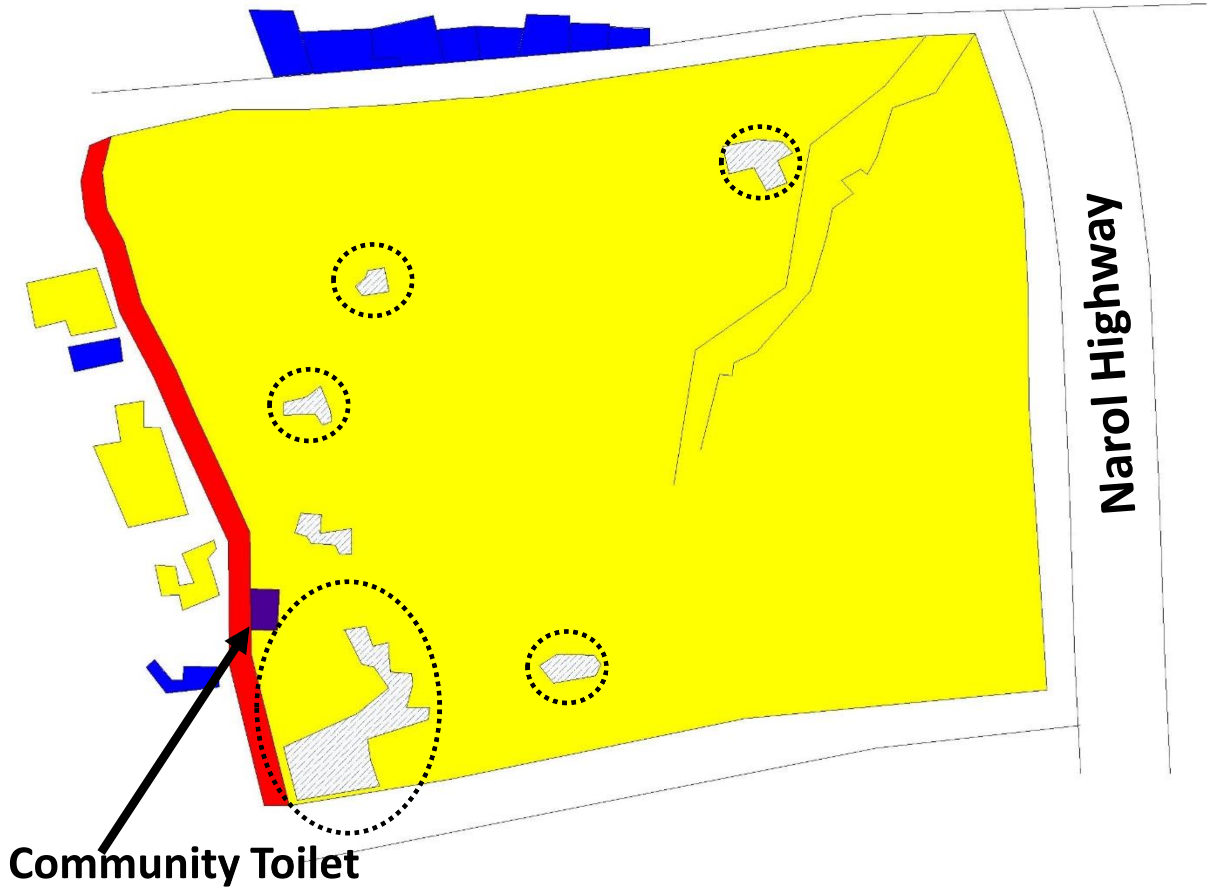
Source : *Primary survey*

- No. of Seats-10 (5 each), 2 Bathrooms
- No. of users- **300/day**
- Maintenance- by **Private**
- **Chargeable**
- Timing- **6 am – 6pm**



Community Toilet

Source : Primary survey



Reason for open defecation:

- No individual toilets
- Only 1 community toilet for more than 300 users
- **Timing** issue
- Community toilet is chargeable

Source : *Primary survey*

Option-1	Option-2	Option-3
• 100% individual toilet	• 100% Community toilet	• 50% individual • 50% Community

- **Option-1**:- In this each HH will have individual toilet connection.
- **Option-2**:- All the HH will have access to community toilets with sufficient seats
- **Option-3**:- some of will have individual facility and some of will have community toilets

Solution

Source : *Primary survey*

Option-3

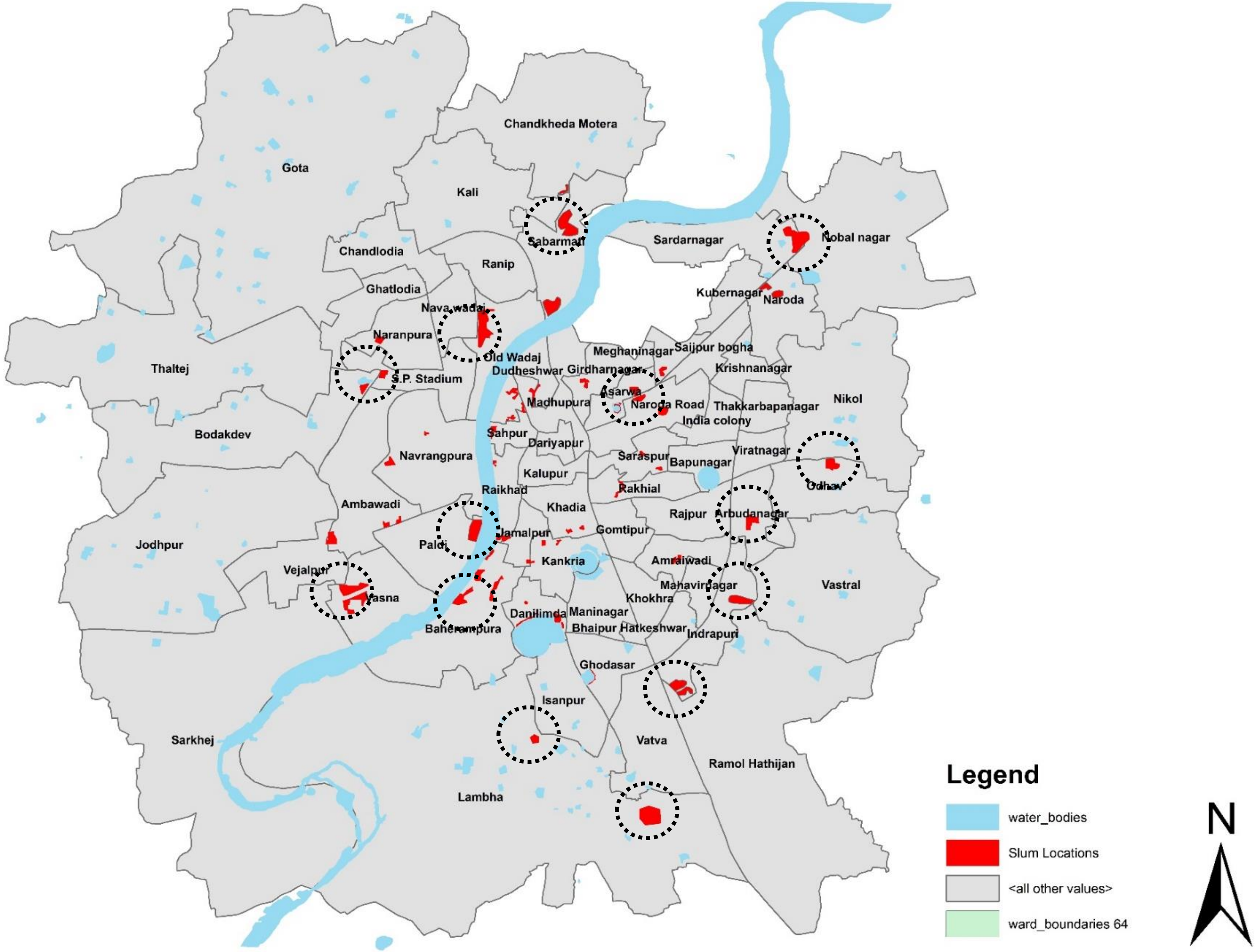
- 55% individual
- 45% Community

- In Sarinyavas 55% HH have space for individual toilet
- For rest of 45% will be provided by new community toilets
- There will be provision of 4 new community toilets.
- Timimgs-24*7
- Free of cost
- Community will keep the key of that toilet

- Total no. of users for community toilets= **200**(No space to built indi. toilets)
- For proper maintenance better to provide small but more than one community toilets within the community.
- Users will be fixed for each toilet
- For each Block no. of users will be **50**
- So will have **4** new community toilets

Description	Unit cost Rs.	Total Lakhs
Construction of New Community toilet (Septic tank + Soak pit)	3,25,000	3,25,000*4 = 13 lakhs
Construction of New Individual toilets	15,000	15,000*200 = 30 lakhs

Source : *Swachh Bharat Mission Guideline*



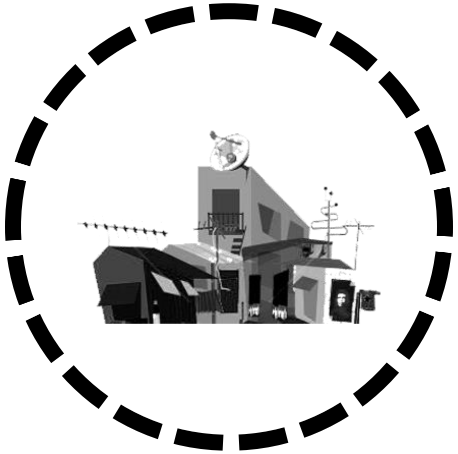
Implementation for Similar Slums

Source : Slum Free City Action Plan Under Rajiv Awas Yojana

Sr. No	Description	2015-16	2016-17	2017-18	2018-19	2019-20	Total
1	Restoration of Existing Public & Pay & Use Toilets						28 .3Cr.
2	Construction of individual Toilets-						51.4 Cr.
3	Construction of new Public & Pay & Use Toilets-						22.3 Cr.
							102 Cr.

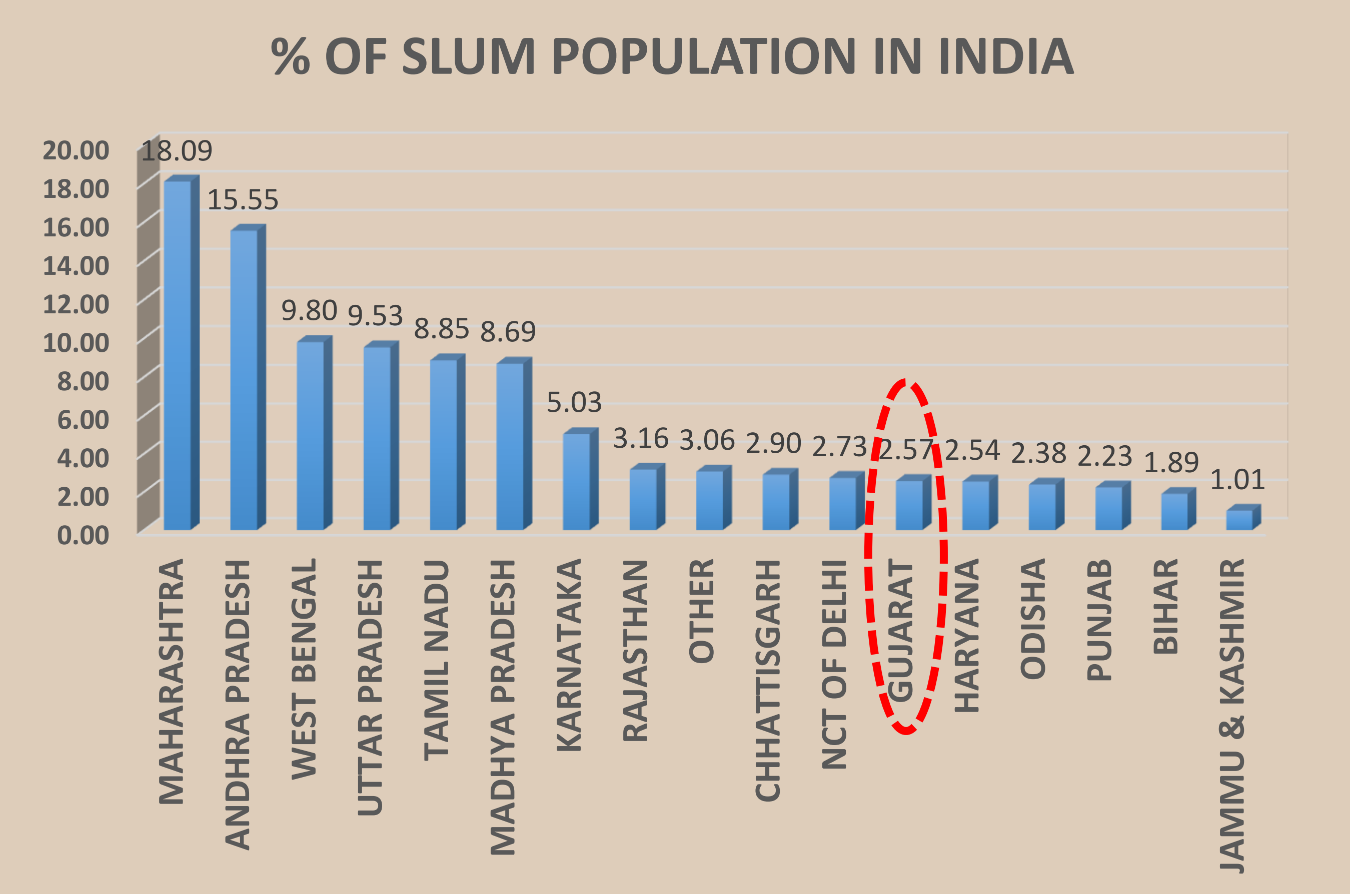
Costing

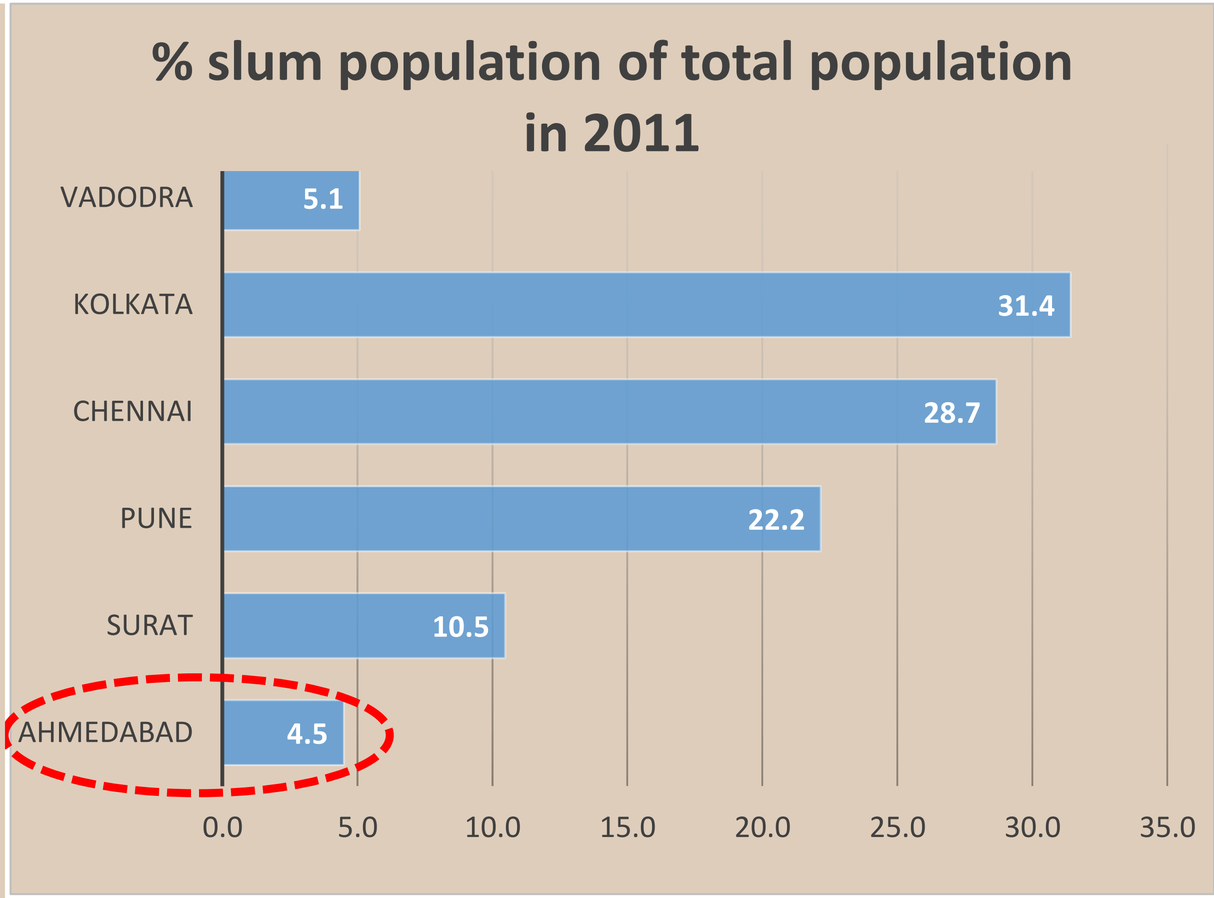
Source :Amc, Csp- Ahmedabad



SLUM SANITATION

SLUM SITUATION





- In total population, rank of Gujarat is 9th in India with **5%** of total population.
- In slum population, rank of Gujarat is 12th in India with **2.57%** of total slum population.
- Ahmedabad holds 1st rank in total population (9.22%) share and 2nd in slum population (14.92%) surat is 1st

SLUM UPGRADATION

Source CENSUS INDIA 2011, , Slum Free City Action Plan: Ahmedabad Municipal Corporation

SLUM CONDITION IN AHMEDABAD

ACCORDING TO CENSUS

- Census defines, slum as a residential areas where dwellings are unfit for human habitation by reasons of dilapidation, overcrowding, faulty arrangements and design of such buildings, narrowness or faulty arrangement of street, lack of ventilation, light, or sanitation facilities or any combination of these factors which are detrimental to the safety and health
- A compact area of at least **300** population or about **60-70** households.
- With this definition and criteria **2.5** lakh peoples of Ahmedabad are living in slum.
- Slum contains **4.5%** of total population of Ahmedabad.

Source : *census India 2011,* Slum Free City Action Plan: Ahmedabad Municipal Corporation

ACCORDING TO AMC STUDY

- A slum is a compact settlement of at least **10** houses that are built mostly with non-durable materials and poor construction, temporary nature, crowded together with inadequate sanitary and drinking water facilities.
- According to this definition there are **691** slum settlement and **7.27** lakh slum population.
- Slum contains **13.11%** of total population of Ahmedabad.

Source : Slum Free City Action Plan: Ahmedabad Municipal Corporation

ACTIONS TAKEN IN AHMEDABAD

1971 1981 1991 2001 Present

Slum survey (1974)

- Slum census carried out in 1976
- Family card was issued to all the slum dwellers.
- No of pockets – 1200
- No of huts – 82177
- Resolution all these slum dwellers are eligible for legal individual services.

Resolution

Later on AMC has taken 1976 slum census as cut off date. Hence, eligible for alternative provision in case of eviction

Toilet scheme (1980-81)

- 80:20 individual toilet scheme was introduced
- State/AMC contribution 80% and 20% by beneficiaries
- Scheme reaches to approx. 3000 families in slum over 10 years of period due to rigid specification and complex procedure

Individual toilet scheme (1990)

- 80:20 scheme was modified and introduces 90:10 scheme
- AMC contribution 90% and 10% by beneficiaries
- Scheme reaches to approx. 14000 families till date

Slum Networking Project (1996)

- Objective: integrate slums with city & city infrastructure
- Main component: Physical infrastructure, land tenure for 10 years, community development etc.
- Scheme reaches to 47 slums with 10000 families over 13 years.
- Won Dubai International Award

AMC-NGO Slum Survey (2001)

- Pocket level survey carried out for all slums.
- Service level: Water Cons:35% & toilet: 34% in slums

NOC Scheme (2002)

- To reach slums where services not provided due to slums develop after 1976 or SNP covered slums (High court order)
- Unique scheme to overcome the issue of tenure and ownership

Nirmal Gujarat Scheme Program & USP (2006 onwards)

- With the goal of becoming open defecation free city, this scheme was introduced by state under urban year Nirmal Gujarat
- Approx. 80000 individual toilets has been constructed in 6 years

BSUP under JnNURM (2005-12)

- Construction of 18976 new housing unit for urban poor

RAY- Prepare of Slum free city Action Plan

- Carry out city wide HH level biometric total station survey for all slums
- DPR preparation for Slum Free City Action Plan

SLUM UPGRADATION

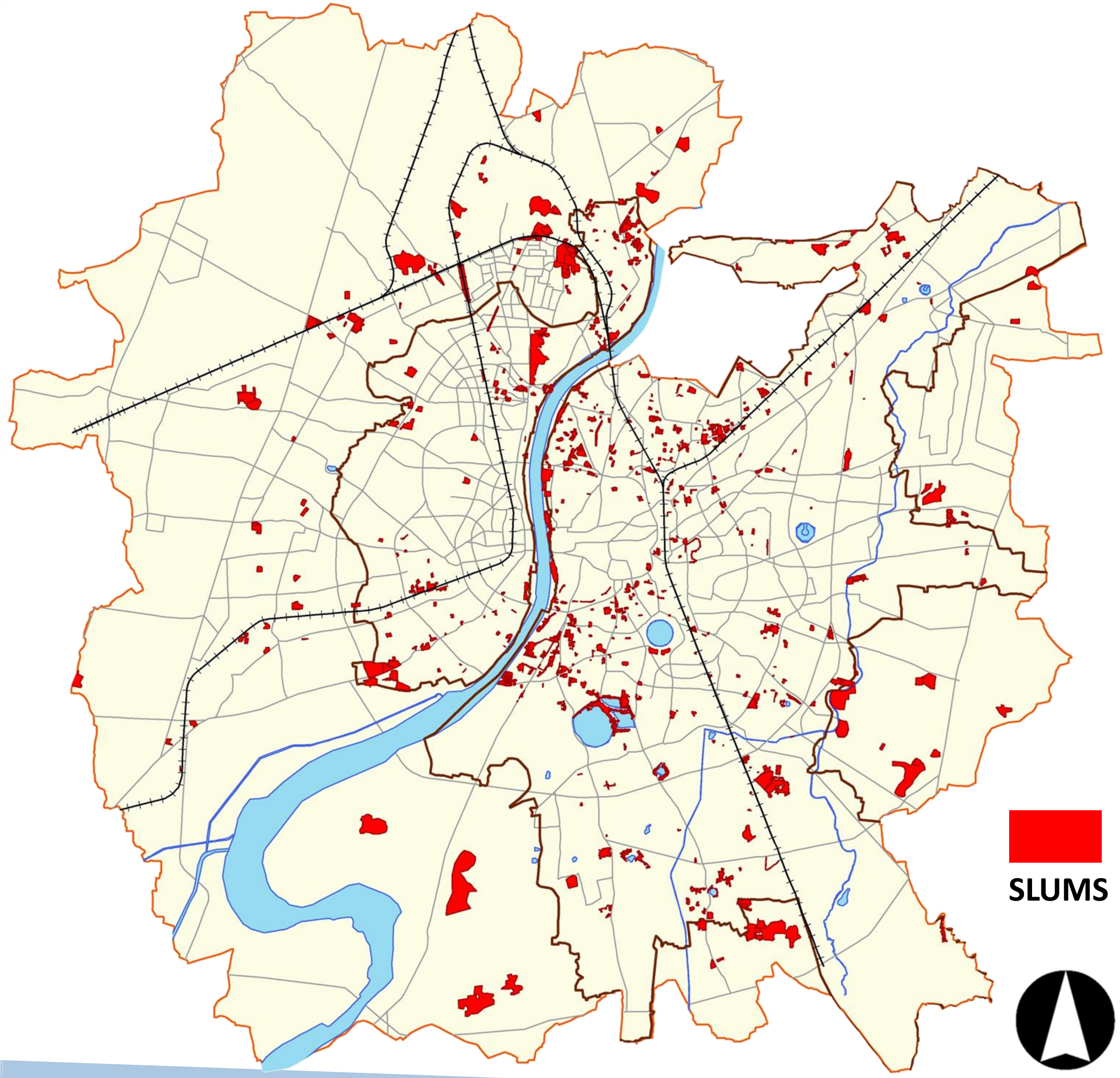
Source : *AMC diary,* Slum Free City Action Plan: Ahmedabad Municipal Corporation

S.No	Name of the program/ Scheme	Implementing Agency	Remarks
1	Slum Clearance (unofficial name)	Gujarat Slum Clearance Board	Implementing formal housing programs for low-income groups and upgrading slums area
2	Environmental Improvement of urban slums **(EIUS)**	AMC	
3	Urban Community Development Program	AMC	UCD runs different activities related to public health, education, employment and public awareness. In collaboration with different Government Sponsored NGOs.
4	Slum Improvement Partnership **(SIP)**	AMC	Comprehensive up gradation through improved health, education, skills upgrading, access to final mechanisms and physical infrastructure
5	Deen Dayal Upadhyay Antodaya Yojana **(SNP)**	AMC	Upgrading/improving infrastructure in slums in partnership with local residents, NGOs , private sector, etc. along with integration of the slums with the city's infrastructure within a finite period.
6	500 **NOC** Scheme	AMC	The scheme aims at providing slum residents with a No Objection Certificate (NOC) that allows them to apply for legal individual sewage and water connections for their house. "500" relates to the amount the applicant has to pay to get the NOC."
7	JnNURM	AMC	Under JnNURM scheme BSUP & IHSDP were related to slum development
8	Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana (SJMMSVY)	AMC	Garib Samruddhi Yojana, Rajiv Awas Yojana (RAY), Water Supply, and Drainage

SLUM UPGRADATION

Source : *Bhatt, M (2003), the case of Ahmedabad*

ABOUT THE PROJECT



- According to AMCs definition of slum there are **691** Slums pockets in AMC boundary.
- Out of them **176** slums are on government land which contains 31% of total slum HH and 18.5lakh sqm land.
- Project objective is provision of basic services like water and sanitation in case of slums located on government land and peripheral area.

Project life

Expected life of project is 4 years.

SLUM UPGRADATION

Source : *census India 2011,* Slum Free City Action Plan: Ahmedabad Municipal Corporation

WHY IS THE PROJECT REQUIRED?

- Out of Total 12.71lakh HH in Ahmedabad 1.68lakh HH are living in slum.

- Total 1.68lakh HH are living slum and out of them 19% HH are defecating in open.

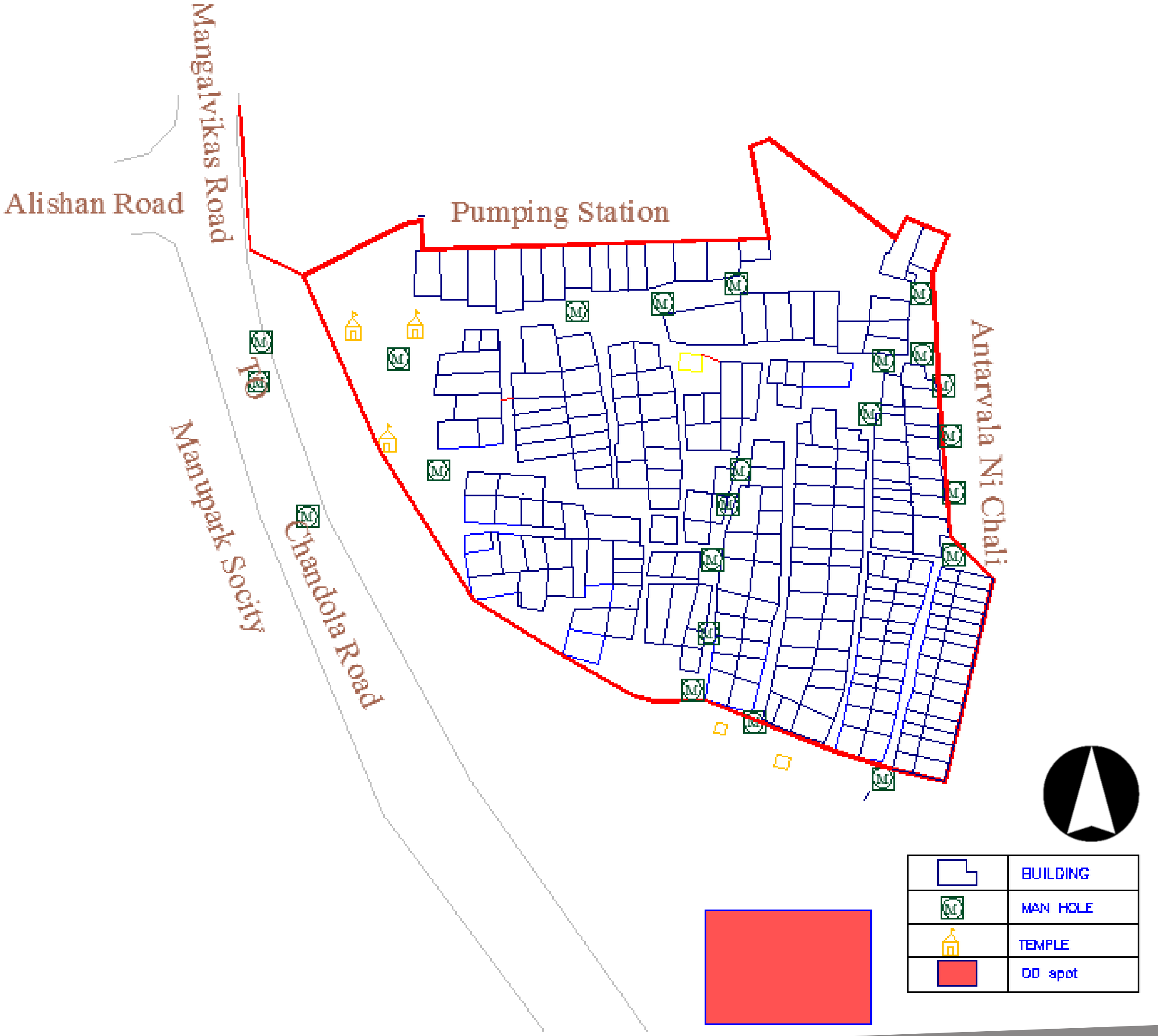
- 125 slums doesn't have water supply connection
- 319 slums doesn't have individual water connection
- 145 slums doesn't have under ground sewerage in vicinity.
- 124 slums doesn't have 100% coverage of under ground sewerage network.

- Slums which are located on government land are considered as illegal settlements and location of those land are too important for government strategically as well as financially.

Source : *census India 2011,* Slum Free City Action Plan: Ahmedabad Municipal Corporation

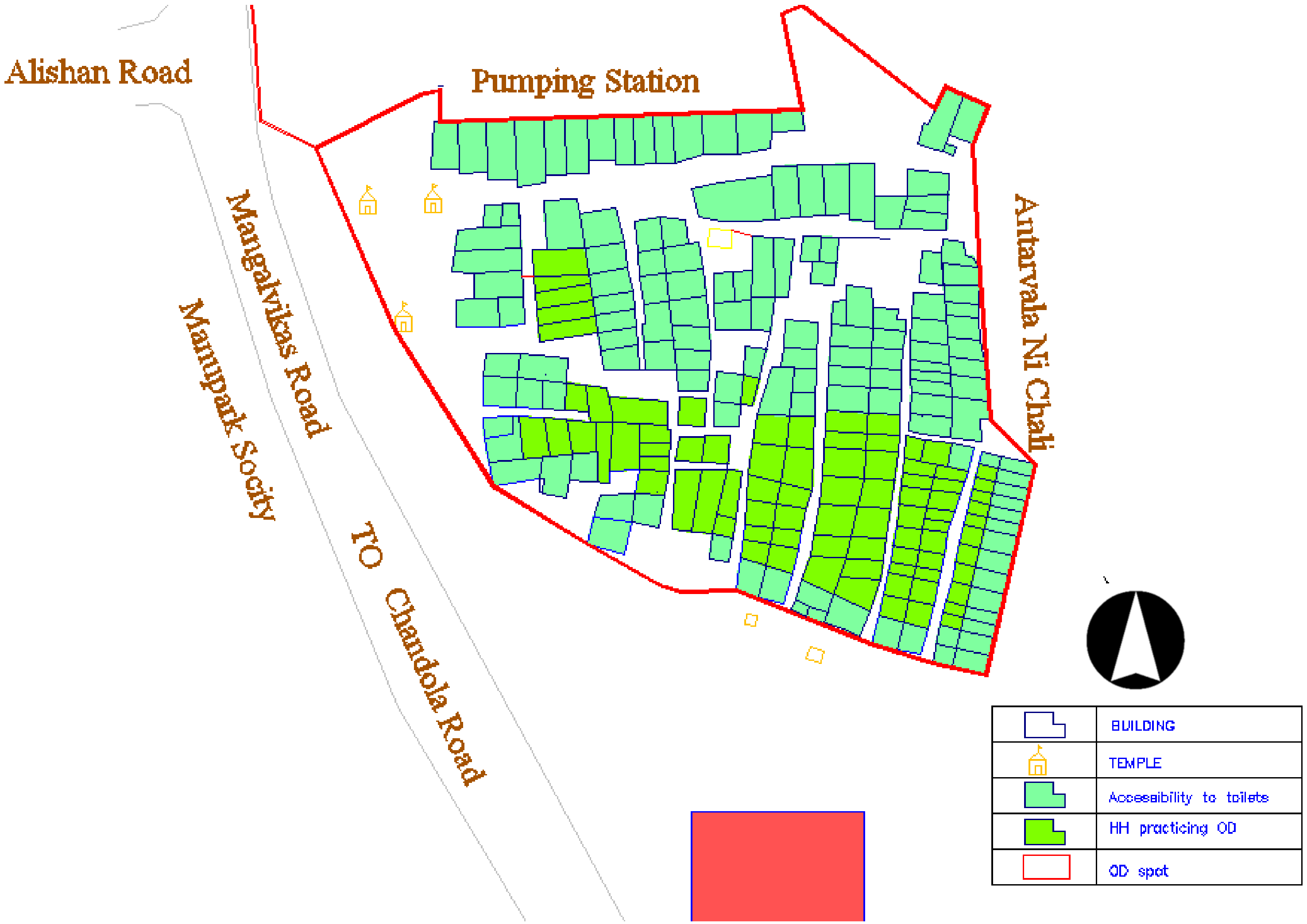
CASE : 1 EKTA NAGAR

- Ektanagar is an 50 to 60 year old slum settlement located in Danilimbda ward having the area of 0.6 hectare.
- There are 221 huts in Ekta nagar.
- Population of the slum is nearly about 1100.
- Population density is 1833 person/hectare.
- The land of the slum is owned by government.
- Government had declared that land is reserved for ESR.
- The residents are mainly engaged with labour work.
- Some of them are also engaged in illegal work.



Source : primary survey

TOILET COVERAGE



- Existing situation
    1. 60 toilets are constructed under NGSP scheme
    2. Approx. 100 HH are defecating in open
- Problems
    1. Defecation spot is 100m away
    2. Women safety
    3. Some toilets are not connected with sewerage line.
    4. Low mentality of sharing.
- Proposals
    1. Provide share toilets where possible
    2. Provide community toilet
    3. Provide individual toilets.

Source : *primary survey*

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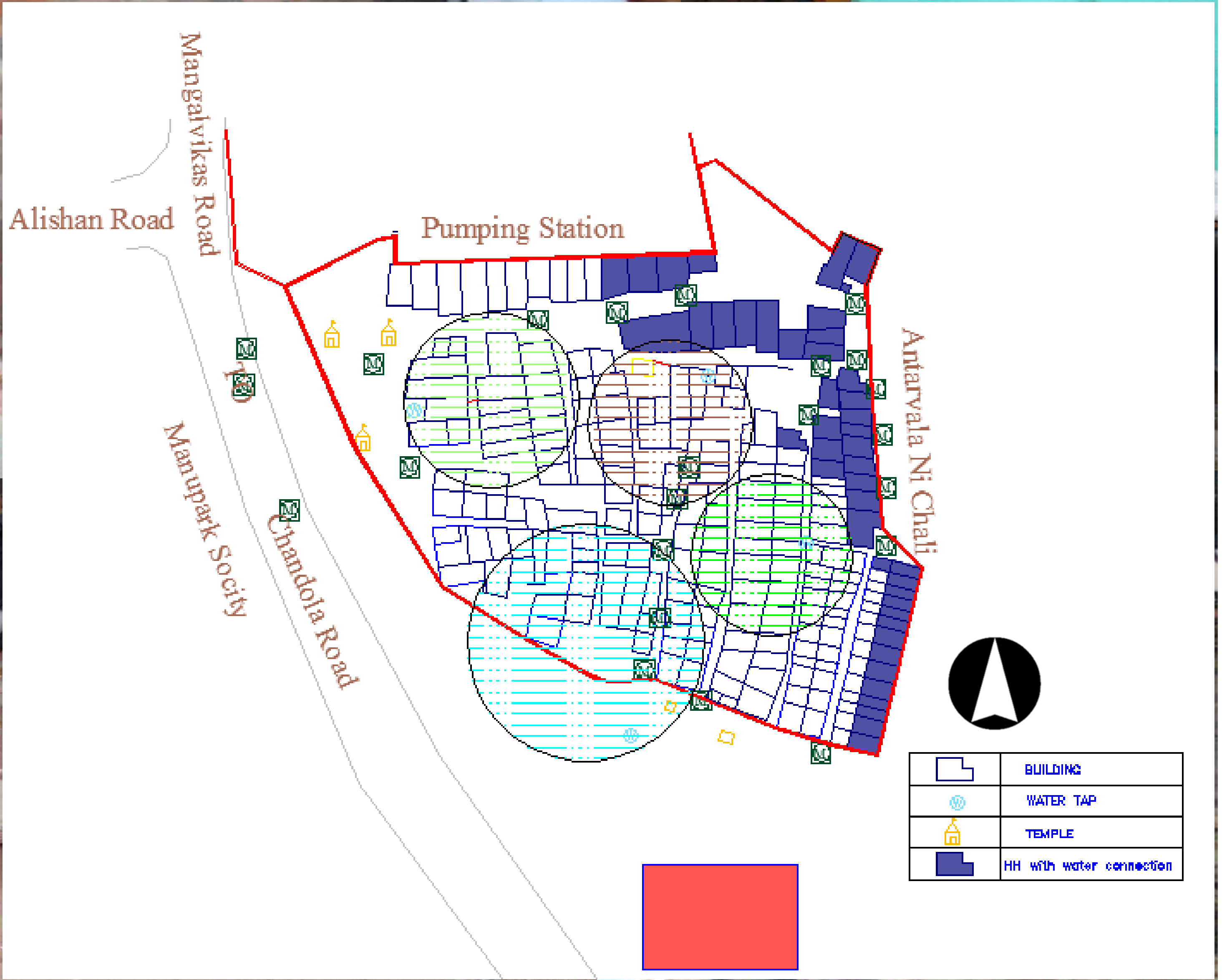
Source : *primary survey*

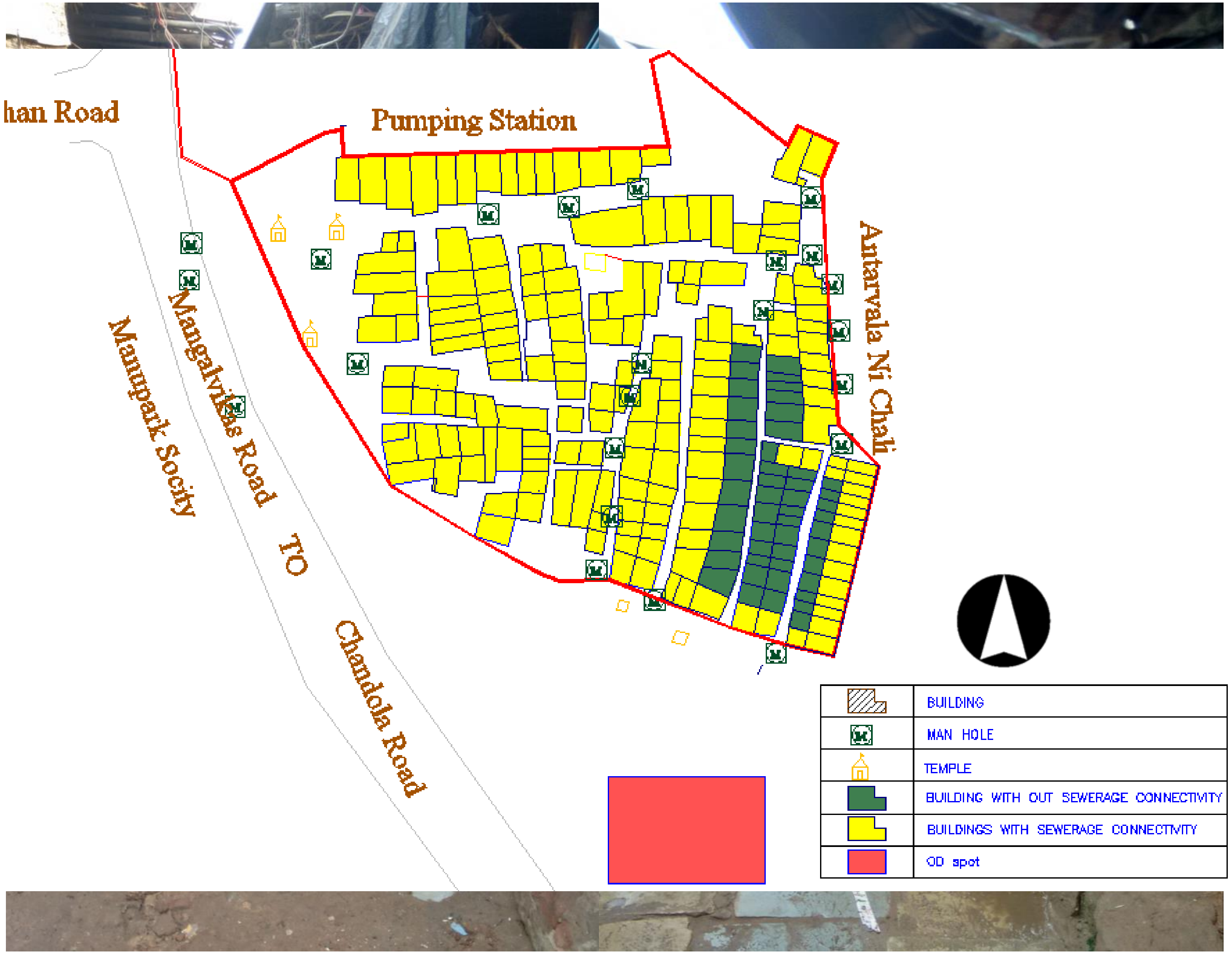
ABOUT WATER SUPPLY



- Existing situation
  1. Main source of water supply is municipal water.
  2. 25 water connection with 4 stand post (6 taps).
  3. Daily 90 mins. Water supply.
  4. Average 800 liter water from every tap.
  5. Extra water fetched from DHOBI GHAT (150m away)
- Problems
  1. Daily supply of water < 25 lpcd
  2. Existing connections are illegal
  3. Illegal connection decrease the pressure and so the discharge.
  4. Usage of motorized pump causes pressure problem

Source : primary survey,

ABOUT SEWERAGE



- Existing situation
  1. Most of houses have accessibility to sewerage.
  2. Main line passes through many streets.
  3. In case of connected HH only toilets are connected with it.
- Problems
  1. Some streets are too narrow to laid down sewage network.
  2. Only toilet connection with sewerage can not provide sufficient velocity to flow.
- Solution
  1. Remove encroachment from streets.
  2. Connect the bathrooms (chokdi) with sewerage network.

***Source :** primary survey*

OPTIONS FOR WATER SUPPLY

Options	Intervention	Advantages	Disadvantages	Cost
Make encroached stand post public	• With current discharge rate and supply of timing 137 more taps will be required. • But by making encroached connections public we can increase 69 more taps.	• No additional capital cost will required • Eliminates usage of pumps.	• Beneficiaries can not be charged. • It will create conflicts between users. • Possibility of encroachment. • Maintenance of stand post will be on ULB. • It will creates naissance point	• It will increase revenue expenditure.
Provide individual water connection	• Requires additional pipe network of 500 meter.	• Water charges can be implemented on users. • No conflicts between users. • Removes possibility of encroachment.	• Requires high capital cost. • Using of pump can causes damage to pipelines and contaminate the water.	• 400000 for laying pipe line network.

Requirement in sanitation sector

- Connect the toilets with sewerage line which are not connected.
  - 9 toilets are not connected with under ground sewerage network.
  - Narrow streets are the main reason for it.

- Provide share toilets
  - There are 81 huts having space problem for construction of toilet.
  - For those houses provide share toilets between two houses.

- Construction of individual toilets
  - There are 46 huts have space for toilet construction.
  - Construct individual toilet in those houses.

- Construction of sewerage network
  - Central part of slum is not connected with sewerage network..

Source : primary survey

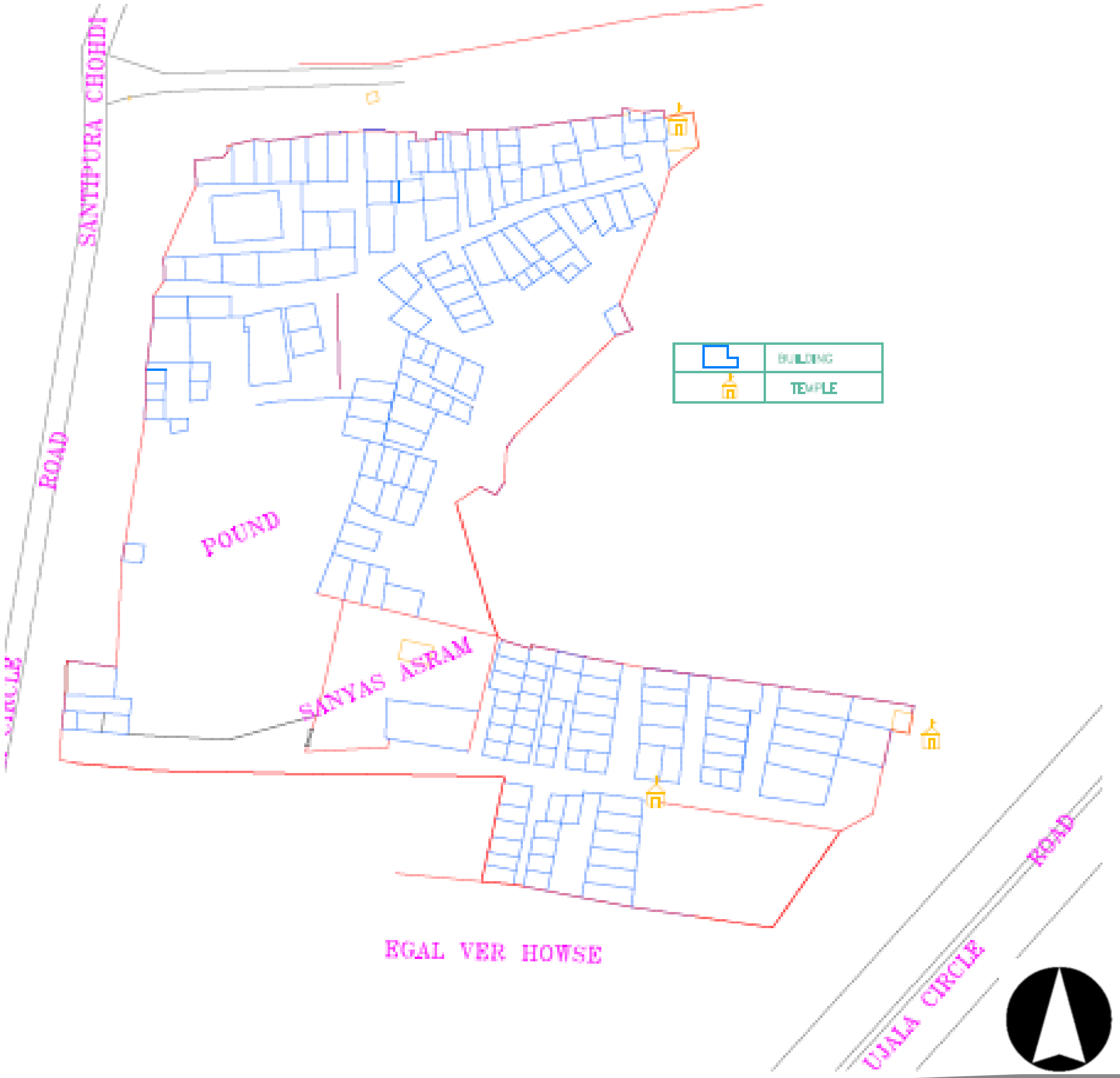
COST ESTIMATION

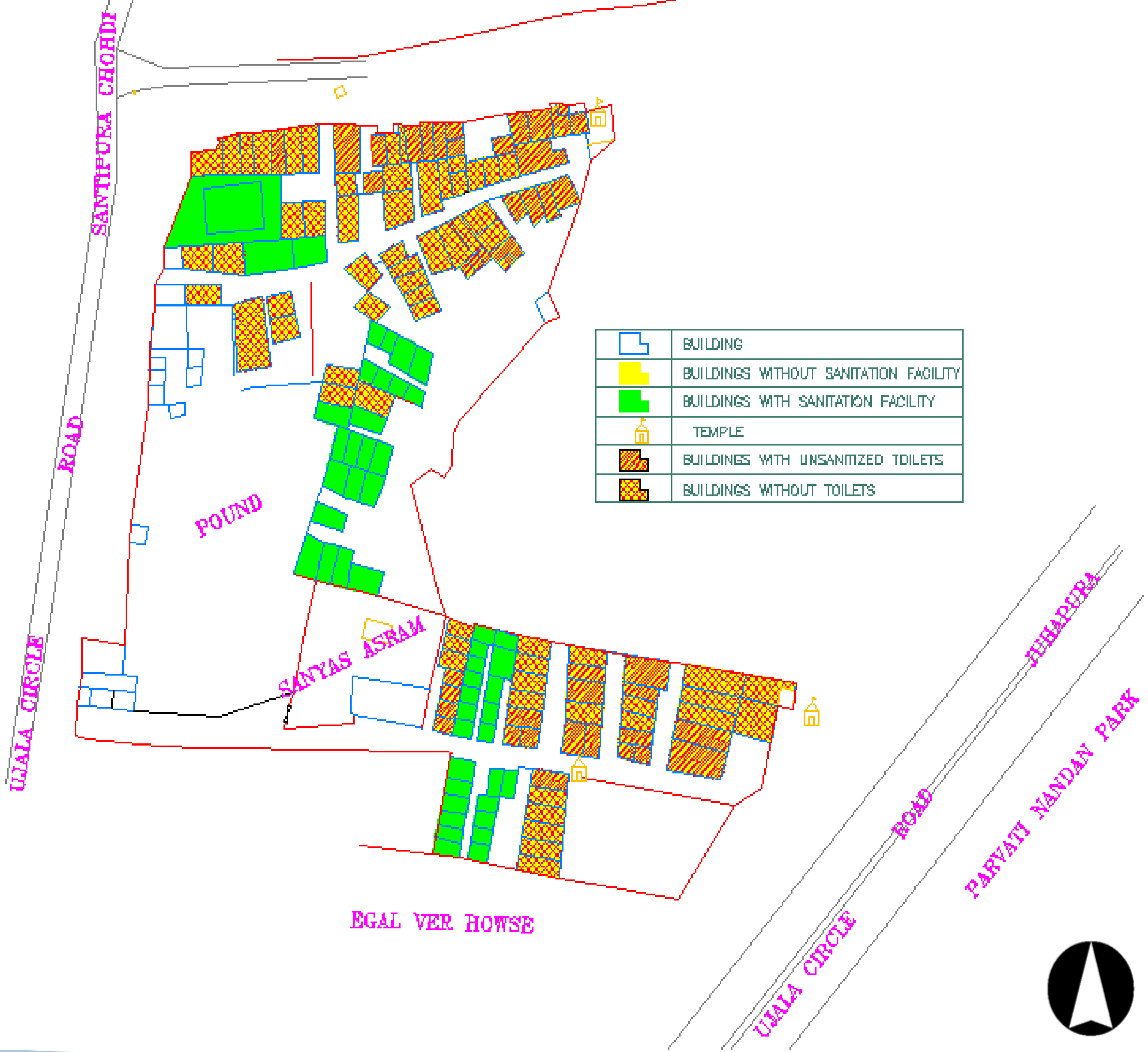
PROVIDE SEWERAGE NETWORK & CONNECT THE TOILETS WITH SEWERAGE LINE		
TOILET		9000
UNITS	9	
UNIT COST	1000	
Sewerage line		120000
Units	100 meter	
Unit cost	1200 per meter	
PROVIDE SHARE & INDIVIDUAL TOILETS		
TOILET		664000
UNITS	83	
UNIT COST	8000	
TOTAL	664000	
PROVIDE INDIVIDUAL WATER CONNECTION		
Units	500 m	400000
Unit cost	800 per meter	

SECTOR	PROPOSAL	ESTIMATED COST
WATER SUPPLY	Provide individual water connection	400000
SANITATION	Provide sewerage network of 100 meter	120000
	Construction of 46 individual and 37 share toilets.	664000
TOTAL		1184000

CASE : 2 SHANKARPURA

- Shankarpura is a 30 year old slum settlement located in Sarkhej ward having the area of 1 hectare.
- There are 173 huts in Shankarpura.
- Population of the slum is about 900.
- Population density is 900 person/hectare.
- The land of the slum is privately owned.
- The slum is authorised as they are getting municipal tax receipt.
- The residents are mainly engaged with labour work.



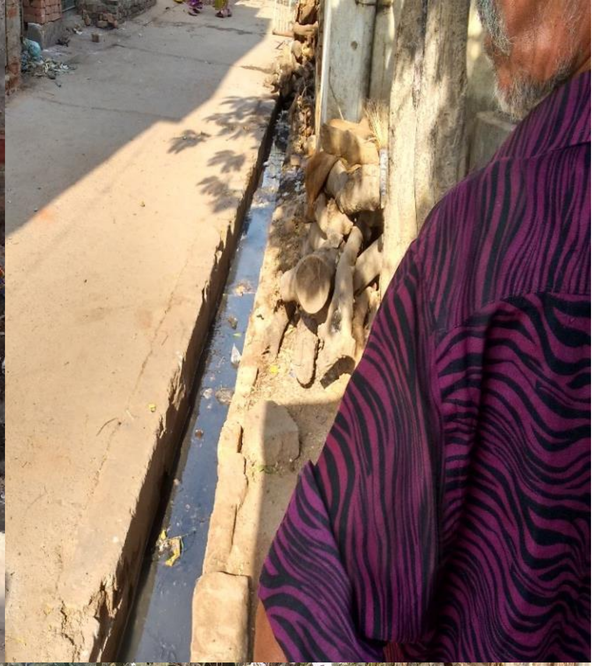


ABOUT TOILET

- Existing situation
  1. 26 toilets are constructed under NGSP for free.
  2. 20 toilets are constructed 3 years ago under 90:10 scheme.
  3. There is pay & use toilet.
- Problems
  1. Residents are not using pay & use toilet because of charges taken by them.
  2. Toilets are not connected with sewerage network.
  3. There is no sewerage network in vicinity.

ABOUT WATER SUPPLY

- Existing situation
  1. No municipal water supply.
  2. 3 private tube wells.
  3. Charges 300rs/month and gives water from 8am to 11am.
  4. Many people fetches water from peripheral areas 0.5km from their houses for free.
- Problems
  1. There is no water supply network in vicinity.
  2. For most of residents water charge is not affordable.
  3. Water of one tube well is saline.
  4. After paying charges they are not getting sufficient water.



ABOUT SEWERAGE

- Existing situation
  1. There is no under ground sewerage network
  2. They are releasing the brown water in open .
  3. They are releasing their waste water in nearby pond through open drain.
- Problems
  1. There is no main sewerage line in vicinity.
  2. Slum is located on lower level then road network.

OPTIONS FOR WATER SUPPLY

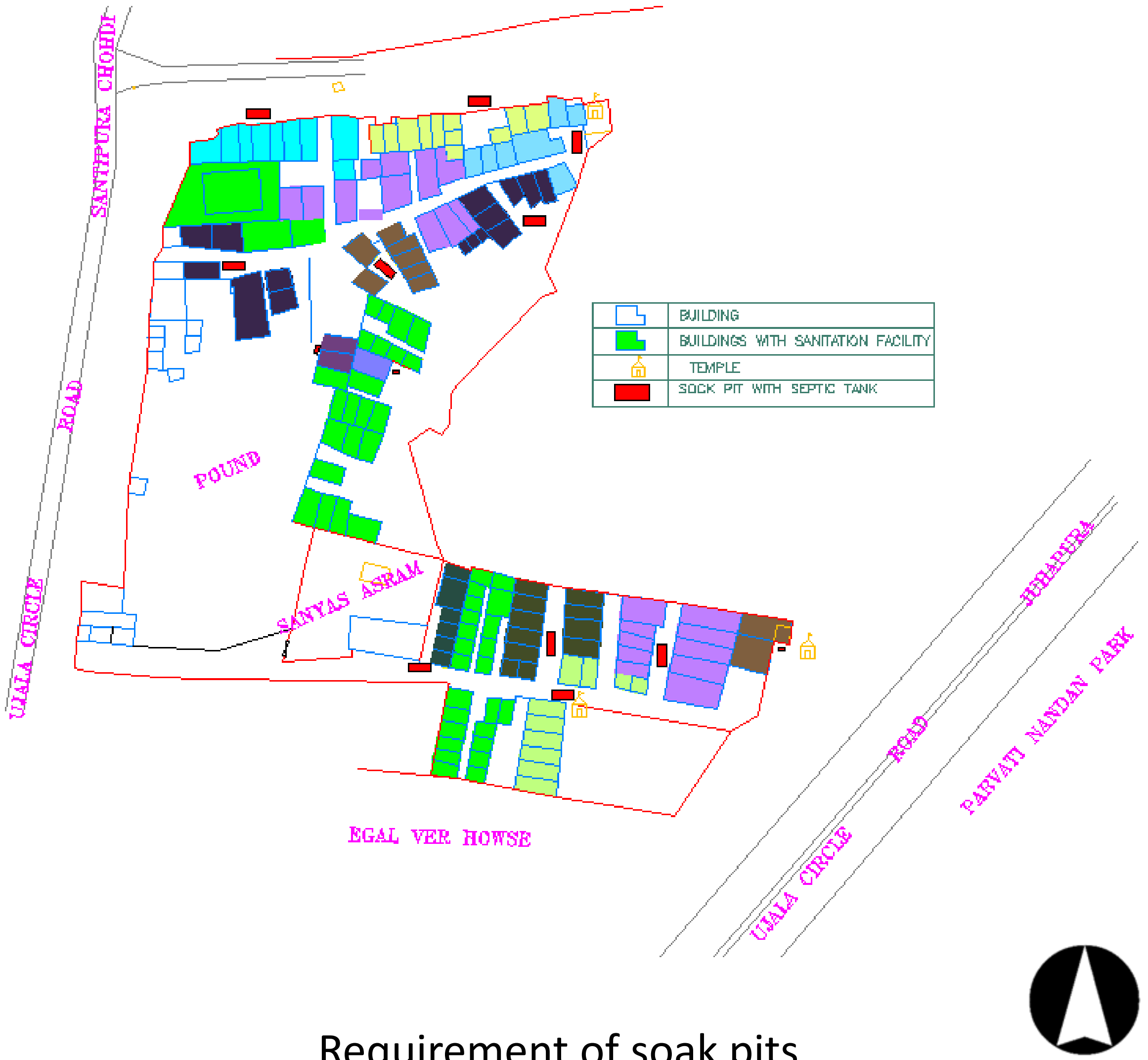
Possible options	Advantages	Disadvantages	Future intervention	Cost
Water supply to individual HH from tube wells	• Settlement will have network ready for future • Supplied water can be charged to beneficiaries.	• Capital cost will be high. • O&M should be done by ULB.	• Laying of water supply network. • Provision of tube wells with sufficient pumping capacity.	7,80,000
Water supply to stand post from tube well	• Low capital cost compared to other options.	• Beneficiaries can't be charged. • Causes chaos on the stand post.	• Provision of tube well with pumping machinery	6,25,000
Water supply to community toilets from tube well	• Low capital cost compared to other options.	• O&M should be done by ULB.	• Provide a tube well with pumping machinery	1,25,000

OPTIONS FOR SANITATION

OPTIONS	ADVANTAGES	DISADVANTAGES	FUTURE INTERVENTION	COST
INDIVIDUAL TOILET WITH SOAK PITS AND SEPTIC TANK	• O&M will be done by users	• Higher initial cost • Requires individual water connection	• Construction of 64 individual toilets and 110 soak pit with septic tank	18,32,000
PROVIDE INDIVIDUAL TOILETS WITH SHARE SOAK PITS AND SEPTIC TANK	• O&M will be done by users • Lowe initial cost then other option	• Requires individual water connection	• Construction of 64 toilets and 11 soak pits with septic tank	10,62,000
PROVIDE COMMUNITY TOILET	• No additional water supply will require.	• Community participation became must for O&M. • Existing toilets will be of no use.	• Construction of 2 pair toilets each with 8 toilet seats including tube well with machinery	15,80,000

INDIVIDUAL TOILETS WITH SHARE SOAK PITS AND SEPTIC TANK

- There are 46 HH having individual toilets but not connected with sewerage system and 64 HH doesn't have toilets too.
- For that we have to provide individual toilets and share soak pits with septic tanks.
- It will require 64 toilets and 11 soak pits.
- 8 big size tanks in between 10 HH and 3 for in between 5 HH.
- Dimensions (in meter) of soak pits for 50 users = 5*2*1.24
- Dimensions (in meter) of soak pits for 20 users = 2.3*1.1*1.8
- Septic tanks will require cleaning at interval of 3 year.



Requirement of soak pits

SLUM UPGRADATION

Source :Manual on Sewerage and Sewage Treatment Systems, 2013, Part A: Engineering

PROJECT FINANCE

For financing this project the main sources of fund are grants from central and state government.

SECTOR	WORK	GRANTS	PUBLIC PARTNERSHIP IN CapEX	PUBLIC PARTNERSHIP IN OpEX
Water supply	Laying water supply network	• 70:20:10 scheme • AMRUT	-NIL-	-NIL-
	Tube well with machinery	• AMRUT • Swarnim Jayanti Mukhyamantri Shaheri Vikas Yojana	-NIL-	
sanitation	Individual & share toilets	• Swachh Bharat Mission • Mahatma Gandhi Swachhata Mission. • Swarnim Jayanti Mukhyamantri Shaheri Vikas Yojana	-NIL-	
	soak pits with septic tanks	• AMRUT • MGSM	-NIL-	

PROJECT FINANCE

	Per HH expenditure	HH	TOTAL
Water supply in case 1	3000	14713	4.41
Sanitation in case 1	11000	10711	11.78
Water supply in case 2	5000	9751	4.88
Sanitation in case 2	14000	9167	12.83
		44342	33.91

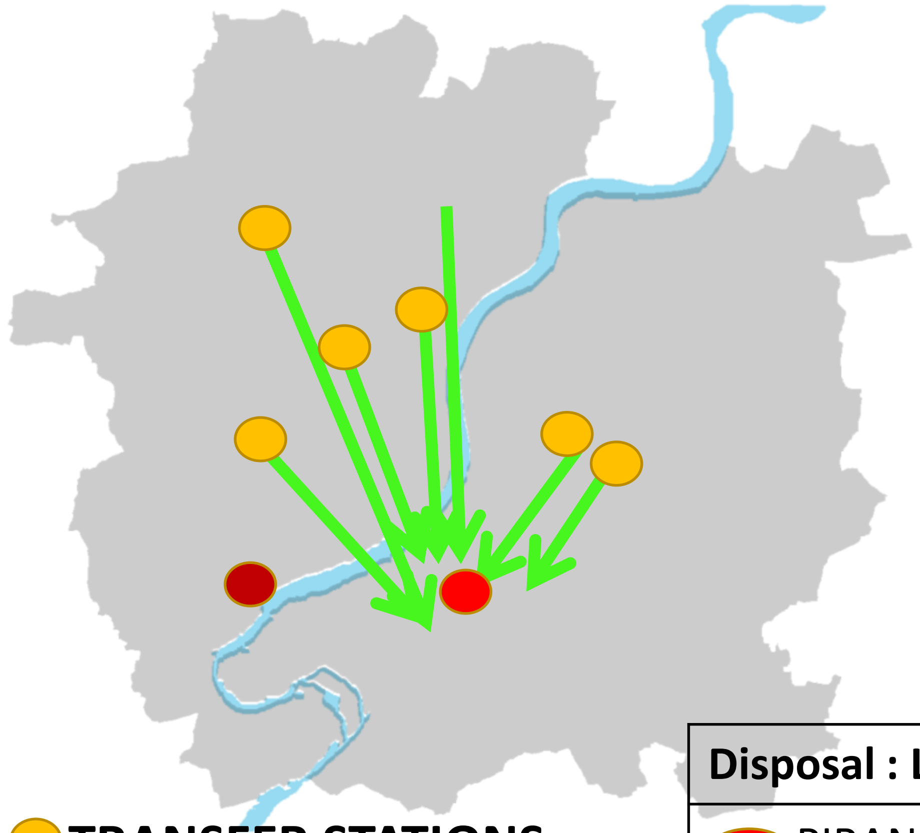
	ULB	State	Center
Water supply in case 1	0.44	0.88	3.09
Sanitation in case 1	0.80	8.57	2.41
Water supply in case 2	0.49	0.98	3.41
Sanitation in case 2	1.38	7.33	4.13
	3.11	17.76	13.04

- Based on an amendment to the Bombay Municipal Corporation Act 1949 in 1970s,AMC is obligated to spend at least 10 percent of its annual budget for improving basic services in slums
- According to case study applying it to rest of the slums by taking per HH expenditure.
- Project will get it’s major funds through grants of state and center under various schemes initiated by them, which is 50% from state government and 40% from central government.

Source : Slum Free City Action Plan: Ahmedabad Municipal Corporation

RECLAIMING DUMP SITE

PIRANA DUMPING SITE



TRANSFER STATIONS
PIRANA DUMPING SITE
GYASPUR NEW DUMPING SITE

PIRANA , Ahmedabad Dumping Site

Around **4000 Metric Tons** of Municipal Solid Waste generated in Ahmedabad city. **3200MT** of waste in dumped every day without any treatment disposed by AMC at Sewage farm dumpsite located near Sewage Farm Road, Pirana

SIZE: 84 Acres

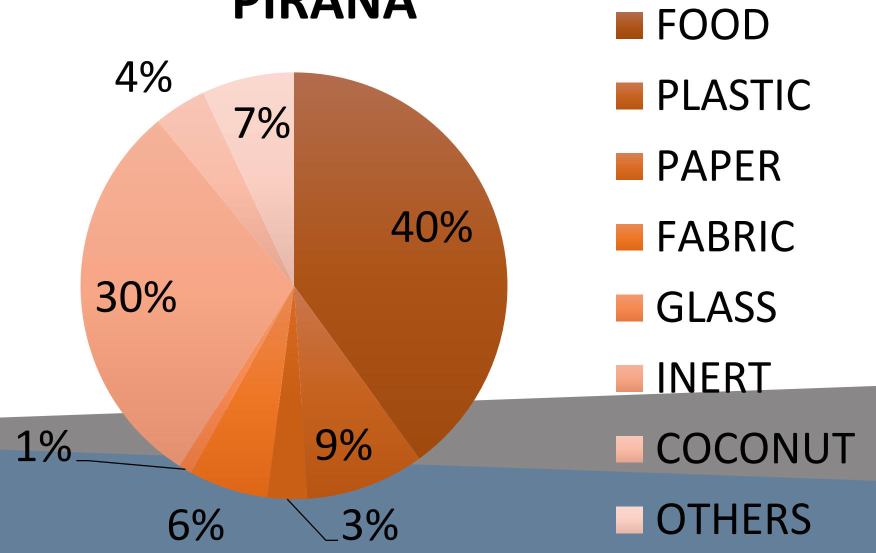
LANDFILL: Since 1980

WASTE ON SITE: 20.16L

Disposal : Landfill sites and area	
PIRANA(Old)	84 Acres (67 used for dumping)
New at GYASPUR	12.88 Acres

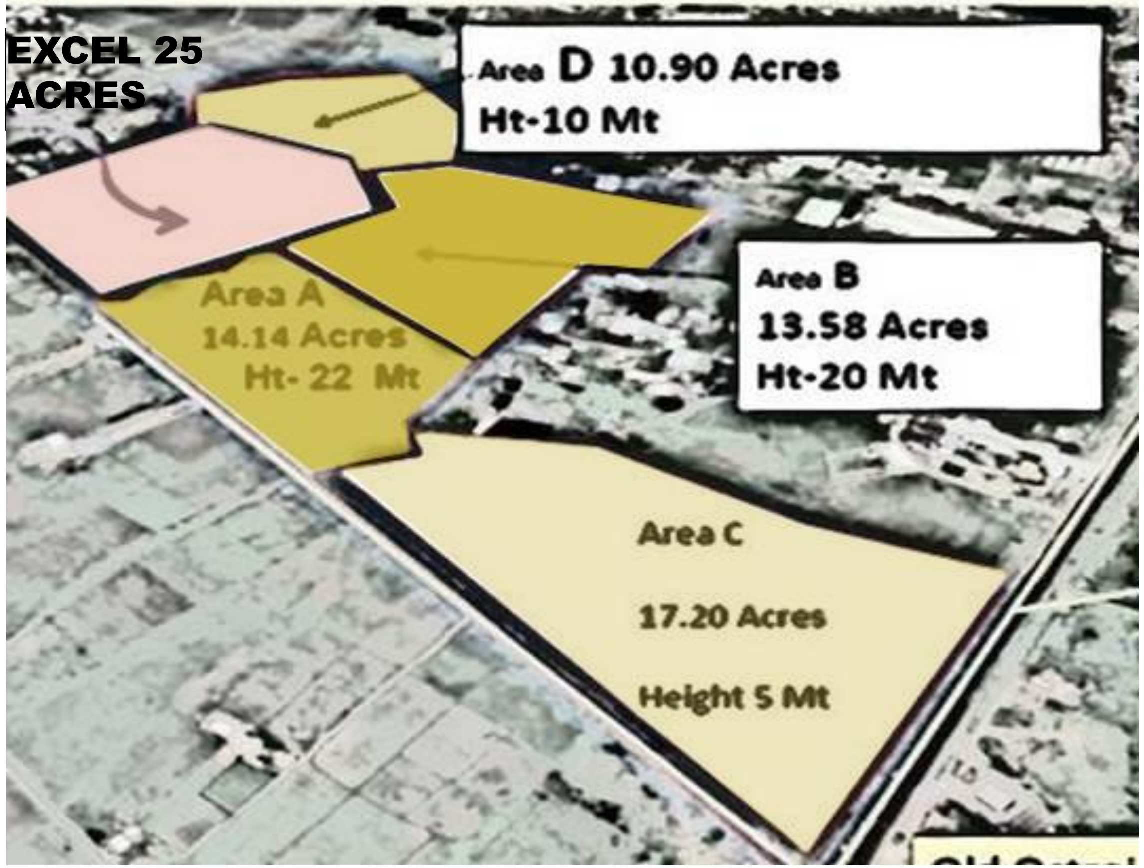
ORGANIC
56%
INORGANIC
44%

COMPOSTION OF WASTE AT PIRANA



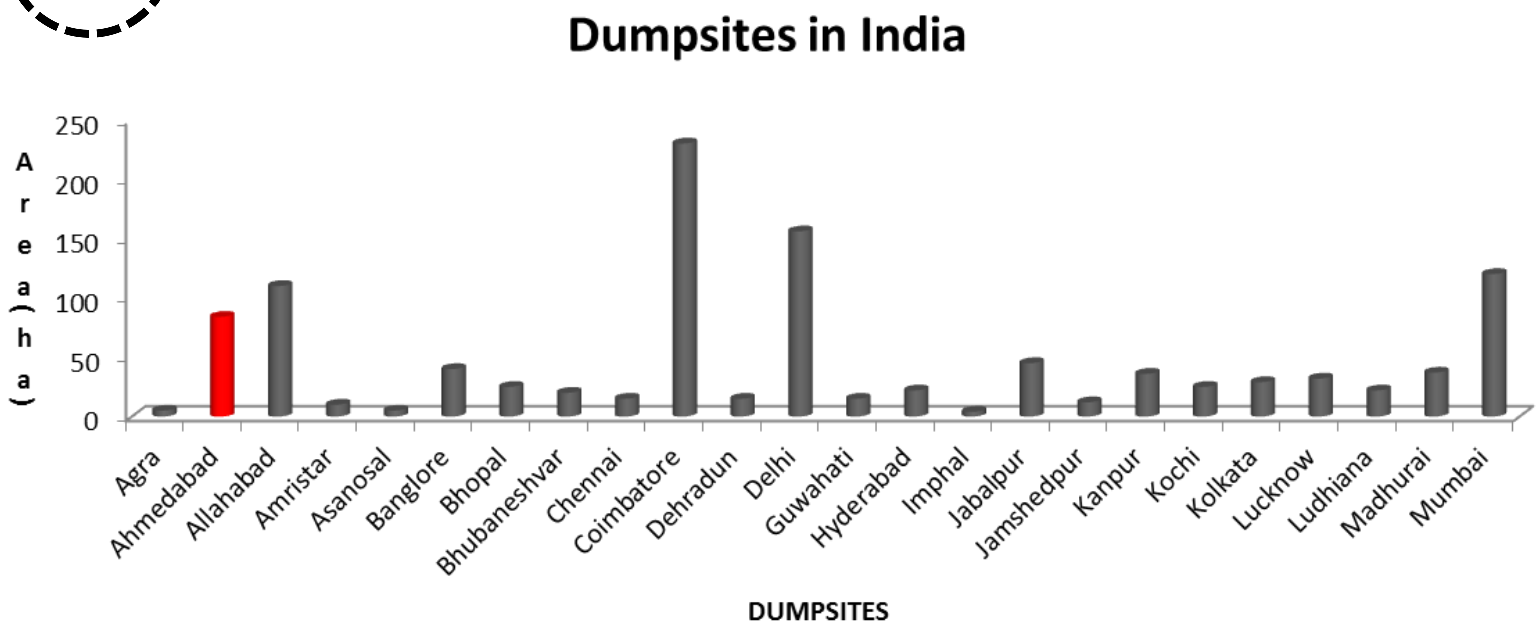
Source : CDP Ahmedabad, CSP Ahmedabad

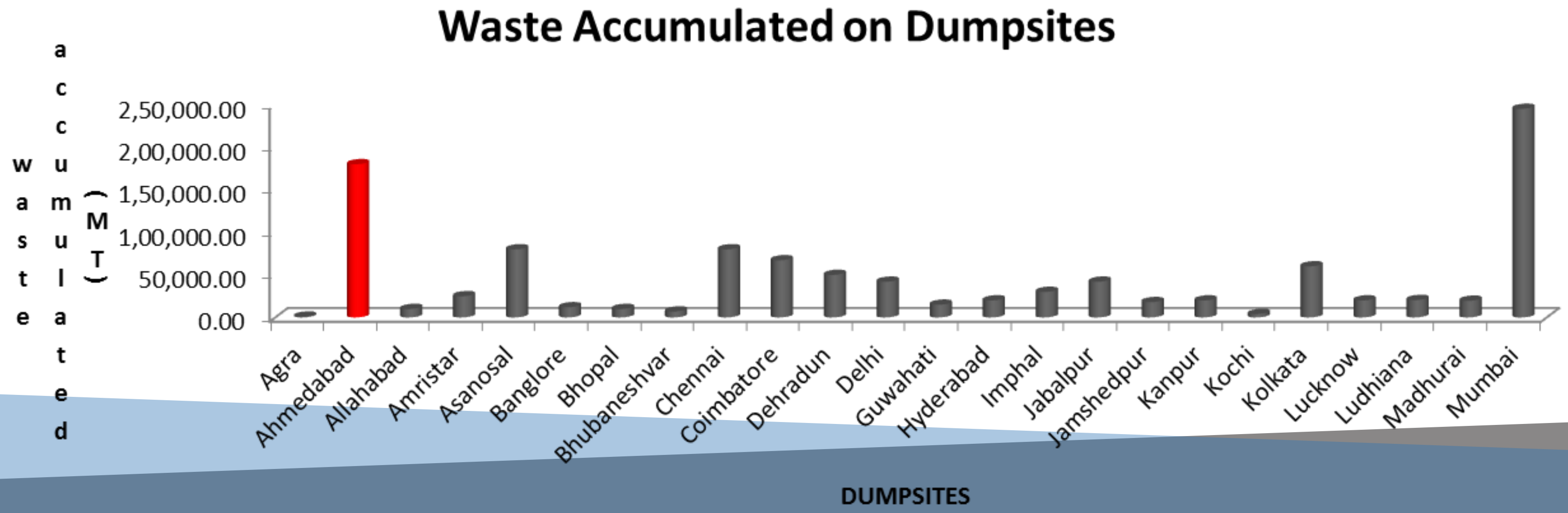
OVERVIEW OF PIRANA DUMPING SITE



Source : SELF, SCIENTIFIC CLOSURE OF PIRANA DUMPSITE 2010

WHY CLOSURE?





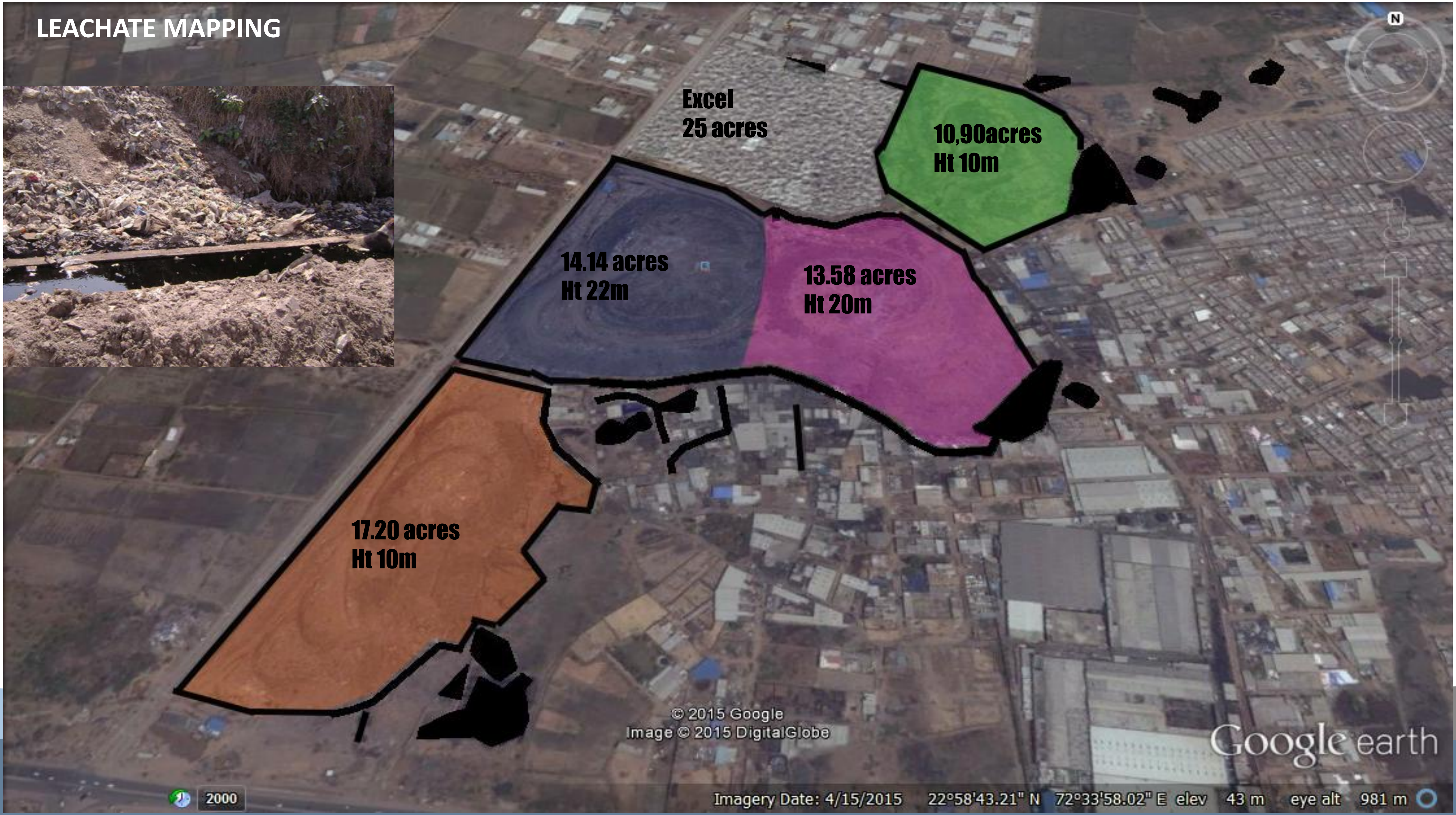
TOTAL WASTE DUMPED TILL 28-02-2015 : **20.16 LAKH MT** (COLLECTED **21.58 LAKH MT**)

3200 MT/ DAY OUT OF 3700 MT/ DAY COLLECTED

- 90% waste being dumped
- Nuisance to surrounding
- Leachate level – SOIL POLLUTION
- GW pollution
- annually 1406 Gg yr-1 methane emissions occur from solid waste landfill in Ahmedabad.
- Methane emission – 10 times to 1 ton CO2
- A step towards Zero Waste

***Source : Greenhouse Gas Emissions and Reduction Strategies Related to Solid Waste Management** thesis report by Nishant Pandya, ABELON 2010, DEVANSU PANDIT GUIDED THESIS BT0475*

LEACHATE MAPPING



AMC'S PROPOSALS SO FAR..

Consultant	USEPA REPORT	Cargo	DNP
Year	2007	2011	2012
Proposal	(a) Landfill gas Collection & Utilisation (b) Landfill Mining & Reclamation	Landfill Mining with Screening	Capping & Gas Extraction
Technology	(a) Gas extraction well (b) LFG utilization plant (c) Power plant (d) Treatment plants	W TO E plant Composting, Eco bricks, RDF	(a) Multri Well Gas Extraction (b) Capping mineral linear
End product	(a) 1:Electricity n 2: Sale of LPG (b) Nature/ Park: RDF, Bricks, compost	Reclaimed land: hospital, malls, institutional, commercial	Green Belt / Housing/ Commercial Development
Expectations/suggestions from AMC	Sale of LPG highly recommendable. High NPV, IRR &CER	**C & A** **No finance help** **75% reclaimed land Lease 99yrs**	**Revenue for AMC from 25 Acres front Land**
Expense in Cr	8.41	Capital: 125	138

Source :CLOSURE OF SCIENTIFIC DUMPING SITE AHMEDABAD

AMC'S PROPOSALS SO FAR..

Consultant	JITF	Innovative	Clean Energy
Year	2013	2013	2013
Proposal	Ground zero by waste to Energy power plant (DBOO MODEL)	Landfill Mining with SPV with technical, financial, power generation capabilities.	No clear proposal
Technology	Mass Burn Technology	(a) Waste Treatment: Bio-mining & Brick Production (b) Power Generation: Plasma Gasification	
End product	Sale of Power to TORRENT	(a) Bricks (b) Power generation	
Expectations/suggestions from AMC	Clearances & approvals Guidance in study un-Interrupted old & fresh waste Treated wastewater from STP 20 Acres land Single window Service Support in PPA with TORRENT	**Support in Study: Clearances** **Storm water paths** **Earth moving equipment**	
Expense in RS Cr	250	135-140/ 1000MT	

Source :*CLOSURE OF SCIENTIFIC DUMPING SITE AHMEDABAD*

AMC'S PROPOSALS SO FAR..

The feasibility study was carried out on 2013 by various companies like Cargo, DNP, Innovative, Jindal, Clean Energy.

IL& FS In MAY 2015 has been give work Order for Project Management Consultancy for Assessment, Evaluation, Management & Rejuvenation / Reclamation & Post Scientific Closure Management I Resource Extraction of existing Landfill site at Pirana, Ahmedabad

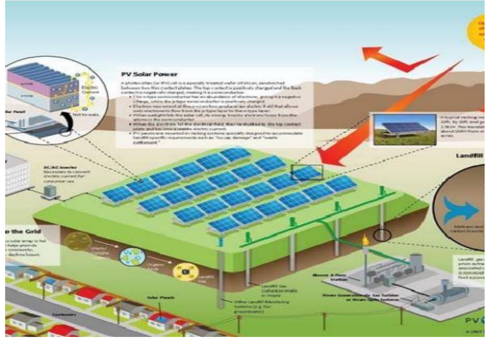
IL& FS offer of **Rs. 5 Lacs + 1.75%** of the Total Project Cost (Service Tax extra) to undertake the work of Project Management Consultancy for Assessment, Extraction existing Landfill site at Pirana, Ahmedabad is sanctioned dated 22/07/15.

Scope of work

A. Project Development Phase
B. Approvals
C. Detailed engineering projects
D. Tender documentation and Appraisal of tender and Award of Contract:
E. PMC of the Project during construction of the Project (2 years)
F. Periodical Supervision during O & M of the project for 3 years

Source :*WORK ORDER CLOSURE OF SCIENTIFIC DUMPING SITE AHMEDABAD*

ACROSS THE GLOBE




Case Studies	California	Hong Kong	(Seoul, Korea)	N.Y.
Area (acres)	24	24	856	2500
Landfill	1974-2015	1974-2015	1972- 2005	1948- 2001
Closure Technique	Capping & Gas Emission	Ground Zero by Mining & Reclamation	Capping & Gas Flaring	Ground Zero by Mining & Reclamation
Waste Dumped	-	1.6 million Tonnes	-	2900 Tons/ Day
Conversion	Solar Farm	Recreational Park	World cup Park	Recreational Park Nature Preserve
Organisation	Govt. Collaboration 19 Agencies	GOVERNMENT	GOVERNMENT	GOVERNMENT

Source : http://www.supercompressor.com/culture/15-landfills-that-are-now-stunning-parks-wastelands-converted-into-parks, http://www.waste-management-world.com/articles/2015/05/landfill-site-in-california-to-be-converted-into-solar-energy-farm.html, ttp://www.vbgov.com/government/departments/parks-recreation/parks-trails/city-parks/Pages/mount-trashmore-park.aspx, www.florafab.com

ACROSS THE GLOBE

Case Studies	Mount Trashmore, Virginia Beach	Singapore	PeeksKill, Manhatton
Area (acres)	165	350 ha	11
Landfill	1967- 1972	1999- 2045 11 CELLS- 4CLOSED	1955- 1970
Closure Technique	Capping	Mining & Reclamation	Capping
Waste Dumped	60ft high 800ft long	1400 M Tons/ Day	-
Conversion	Recreational Park	Incineration Plant	Commercial Development
Organisation	PPP	GOVERNMENT	PPP

Source : *A landfill ll reclamation project: an observatory of the self, November 4, 2005 Alexandria, Virginia, http://www.supercompressor.com/culture/15-landfills-that-are-now-stunning-parks-wastelands-converted-into-parks, Fresh kills Park report, Columbia University, , Waste Management and Waste to energy in Singapore,, http://www.nytimes.com/2007/08/01/realestate/commercial/01hudson.html?*

ACROSS INDIA

ACROSS INDIA

Case Study	Mumbai : Turbe	Mumbai : Mindspace	Mumbai : Ghorai	New Delhi: Ghazipur	Hyderabad
Area (acre)	**5**	**20**	**46**	**10**	**60**
Year	2011	2001	2008	2012	2013
Proposal	**Scientific Closure**	**In- Situation**	**Scientific Closure**	**Scientific Closure**	**Scientific Closure**
Technology	Capping & Gas Extraction	**Mining & Reclamation**	Capping & Gas Extraction	Capping & Gas Extraction	Capping & Gas Extraction
Present Use	Still under Reclamation	**Commercial Development**	Not specified use	Not specified use	Not specified use
Owner	Navi Mumbai Municipal Corporation	Mumbai Municipal Corporation	Mumbai Municipal Corporation	New Delhi Municipal Cooperation	Hyderabad Municipal Cooperation
Model	PPP	PPP	PPP	PPP	PPP

SOURCE: *Ahmedabad scientific closure project, DEVANSHU PANDIT GUIDED THESIS BT0475, ARPET REPORT, PIRANA PROJECT REPORT*

ACROSS INDIA

Case Study	Pune: Pimpri Chinchwad	Coimbatore: Ondipudur	Kolkatta: Dhappa	Chennai: Kodungaiyur
Area (acre)	**2.75**	**1.89**	**20**	**200**
Year	2012	2011	2014	2014
Proposal	Scientific Closure	Scientific Closure	Scientific Closure	Scientific Closure
Technology	Capping & Gas Extraction	Capping & Gas Extraction	Capping & Gas Extraction	Capping & Gas Extraction
Present Use	Segregation unit	Not specified use	Not specified use	Not specified use
Owner	Pimri Chichwad Municipal Corporation	Coimbatore Municipal Corporation	Kolkatta Municipal Corporation	Chennai Municipal Cooperation
Model	PPP	PPP	PPP	PPP

SOURCE: *Ahmedabad scientific closure project, DEVANSHU PANDIT GUIDED THESIS BT0475, ARPET REPORT, PIRANA PROJECT REPORT*

REMEDIATION TECHNIQUES

- Dumping remediation techniques
  - In-situation
    - Mining & rehabilitation
    - In- situ Verification
    - Sub- Surface Cut Off Walls
  - Scientific closure
    - Capping & gas extraction
    - Capping & post Recreational use

EXPLORE

EXPLORE

Source : *DEVANSHU PANDIT GUIDED THESISBT0475, PIRANA PROJECT REPORT*

ACROSS THE GLOBE

WHERE?	New Zealand (2001)	BOSTON (1997)	UK (2004)
WHO?	**Ministry for the environment**	**Republic of Botswana**	**Northern Ireland Environment agency**
WHY?	Closure: depending on the area and waste received; **level of assessment is recommended .** INITIAL HAZARD ASSESSMENT RISK ASSESSMENT RISK ANALYSIS RISK EVALUATION RISK TREATMENT AND MANAGEMENT	To close a landfill, the Licence Holder must inform the DSWM of this intention. END-USE REQUIREMENTS CLOSURE REQUIREMENT AND ITS IMPACT **CLOSURE PLAN**	Waste management licencing regime under PPC, **landfill directive recommendations** RISK ASSESSMENT ENIRONMENT IMPACT
HOW?	**CLOSURE** • **Final cap design** • **Assessment of cap** • **Vegetation cover**	**CLOSURE PLAN** • Design: **Restoration** • **Final Cover** • **Storm Water Diversion** • **Anti-erosion Measure** • **Vegetation Cover**	**DESGIN CAPS** • **Control Infiltration** • **Control of LFG migration** • **Stability** **RESTORATION DESIGN (AFTERUSE)** • **SW, GW, SOIL SUITABILTY**
POST?	**MANAGEMENT SYSTEM & MONITORING:** • Landfill discharges monitoring(L, GW,SW, LFG)& TRIGGER LEVELS • Nature and frequency of monitoring	**MANAGEMENT SYSTEM & MONITORING:** ONGOING: **(L, GW,SW GAS)** INTEGRITY: **(COVER, DRAINAGE, FIRE, VEGETATION)**	**AFTERUSE**: character and quantity of available soils; type of waste and associated operational constraints; size, location and access; the development plan or framework; the aspirations of local residents, interest groups, etc.; scheme economics; long-term management requirements.

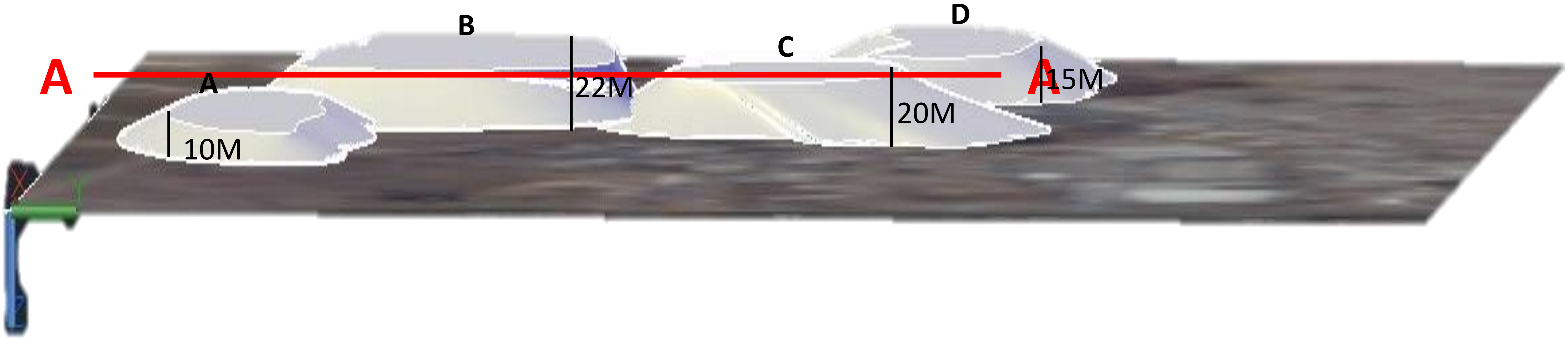
ACROSS THE GLOBE

WHERE?	NEW JERSEY (2015)	SYDNEY (2015)	PHILIPPINES (2001)
WHO?	**Department Of Environmental Protection**	**Environmental Protection Agency Edition-2**	**UNEP & DENR PHILIPPINES (Training Module)**
WHY?	Landfill site investigation: **Preliminary Assessment** • Visual inspection: seepage, slope, waste, erosion, drainage path, landfill Control features, Natural Resource, • Lateral & Vertical Delineation od LF • soil delineation beyond LF limits • **Geophysical survey** • **Subsurface investigation: soil, GW, leachate, SW, gas, waste characteristics** • **EE, ERA, ESNR** • **Vapour intrusion, gas** • **Radiation survey**	All completed landfill cells must be capped and vegetated within 6 months of the final delivery of waste to the cell. • Reduce infiltration • Reduce suspended contaminated runoff • Minimise untreated gas • Stabilise surface	•geology of the site, depth of groundwater, volume and types of wastes disposed, reports, studies, historical records concerning the dumpsite • map of the dumpsite and its surroundings, topographical, geological, hydrogeological, etc.; • **Interview with those directly involved with the operation of the dumpsite, waste pickers, and residents near site;** • Inventory of existing settlements, structures, surface water bodies, water wells, etc.; • Determine points of **leachate seepage** and ponding within and beyond the disposal facility; • **Identify existing land uses** around the area; • Conduct **topographic survey** of the dumpsite, extending some distance from its boundaries; • Conduct geotechnical investigation to determine **stability of slopes**;
HOW?		**CLOSURE PLAN** • Design cap: soil selection • **Re-Vegetation :** vegetation selection	
POST?		**AFTERCARE:** Management & Monitoring • Leachate, Storm water, Landfill Gas, Odour, Dust, Litter And Final Cap Integrity QUALITY ASSURANCE PLAN	

ACROSS INDIA

WHERE?	CPHEEO(2000)	CPCB (2008)	CPHEEO(2015)	ARRPET
WHO?	**MOuD**	**MOEF**	**MOuD**	**CES, CHENNAI**
WHY?	Leachate estimation LFG quantity & quality estimation Slope Stability: 1:3-temporary over 1:5 -final cover Site infrastructure **Environment monitoring system:** •SW, GW,, Leachate & gas within and around, air quality.	**Assessment of a Report for Closure of an Existing Waste Dump or an Existing Landfill Without Liner :** 1. Condition and Impact of the Existing Waste Dump or Landfill (without liner) 2. Selection of Methodology for Closure 3. Details of Closure Methodology 4. Stability Aspects 5. Cover System 6. Cut-off Walls 7. Leachate Collection and Management 8. Gas Collection and Management 9. Surface Water Drainage System 10.Environmental Monitoring 11.Post Closure Maintenance 12.Construction Quality Control	• Site selection • Environmental Impacts And Its Minimization • Types Of Municipal Solid Waste To Be Accepted At Landfills ▪ Planning &Design Of A Landfill : leachate management Drainage system Gas management system Soil stability Final slopes Not less than 1:4 and not greater than 1:20 ▪ Sanitary Landfill Operation ▪ Plantation At Landfill Site	Review of data such as the geology of the site, depth of groundwater, volume and types of wastes disposed, reports, studies, historical records concerning the dumpsite (operations, unusual events such as fires, dumping of hazardous wastes, etc.) • Review of available maps (map of the dumpsite and its surroundings, topographical, geological, hydrogeological, etc.) • Interview with those directly involved with
HOW?	**Landfill closure phase system:** Cover, leachate collection, surface drainage system, gas collection system			
POST?	(a) Leachate Management System; (b) surface water management system; (c) environmental monitoring			

EXISTING DUMP AND SECTION



DESGIN DETAILS

Receiving, Relocating, Levelling, Reformation and dressing of existing MSW

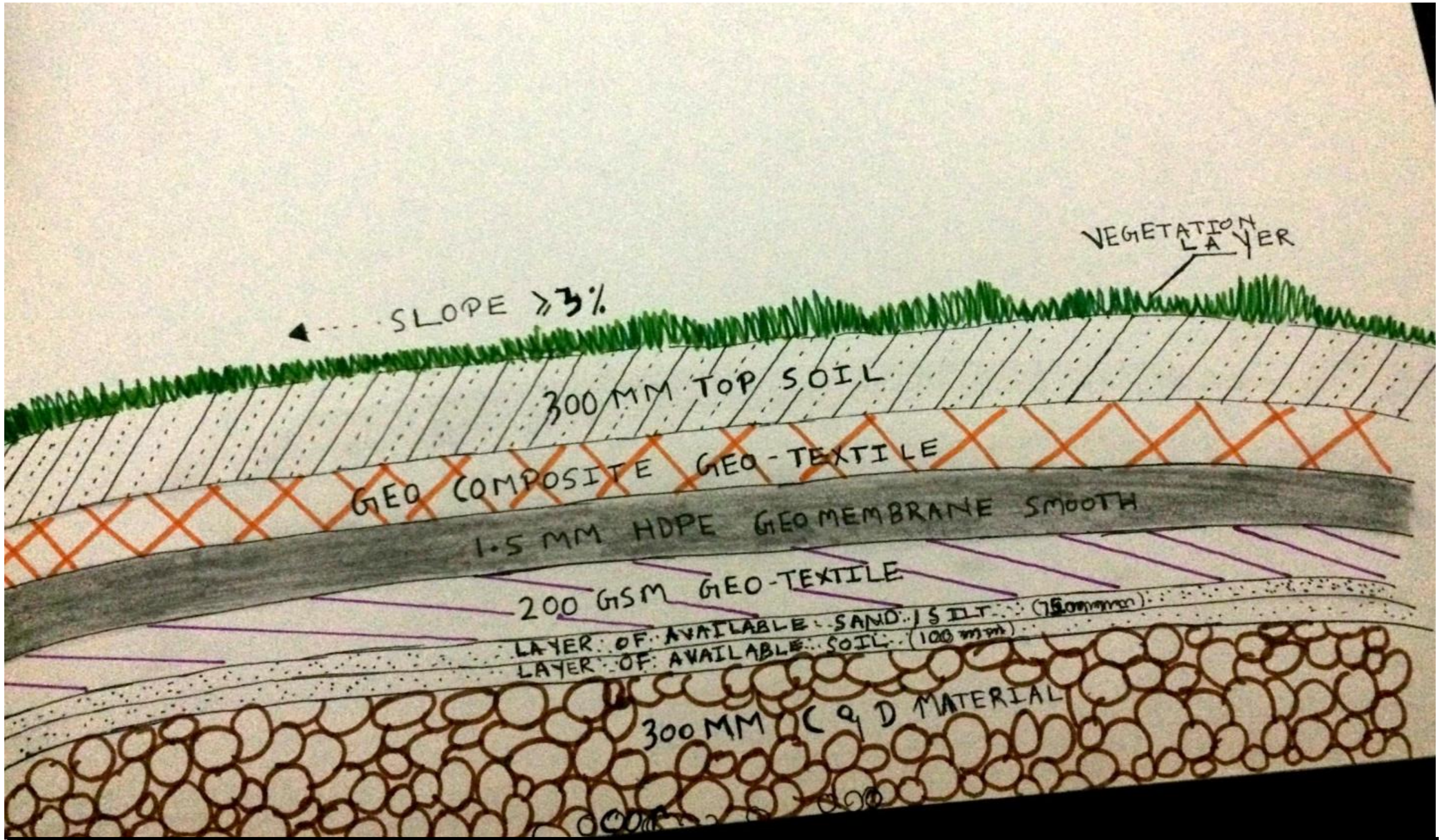
- Laying of Cover Layer(s) which includes laying of 300 mm thick C & D layer
- 400/200 gsm Geotextile layer
- 1.5mm thick textured/non textured HDPE Geomembrane
- Geo composite layer
- 300mm thick Top Soil layer
- Vegetation Layer (green landscape)

- Boundary Wall, Storm Water Drain, Construction of Gas and Leachate Collection Wells and sumps

After completion of closure, extraction of landfill gas will be carried out, this would involve installation of a landfill gas recovery syst comprising of: a) Collection System b) A transportation pipeline network c) External leachate system d) Condensate collection and treatment system e) Extraction system f) Up gradation – This is done by using Pressure swing adsorption process g) Flare system

Source: https://www.globalmethane.org/expodocs/india10/postexpo/landfill_rajeev.pdf

DESIGN SECTION

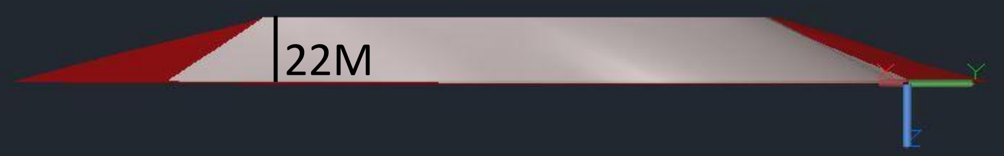


COMPACTED MSW

DUMP MODEL

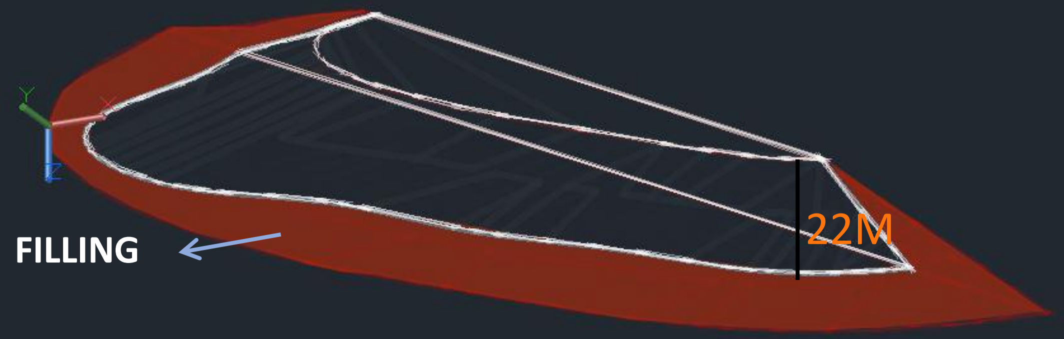
EXISTING DUMP
STABLE DUMP (SLOPE 1:3)

DUMP SECTION

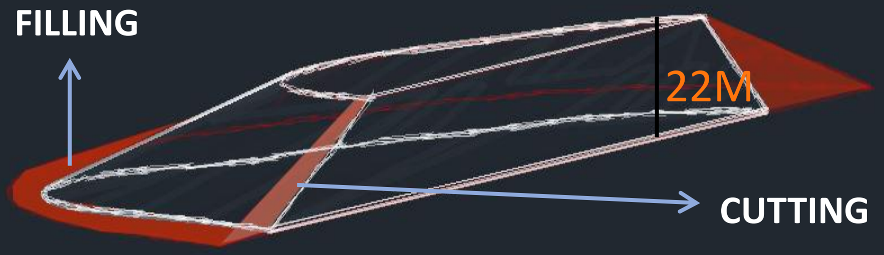


3D SECTION VIEW OF DUMP B

3D SECTION VIEW OF DUMP B



SECTION SHOWING FILLING AREA OF DUMP B



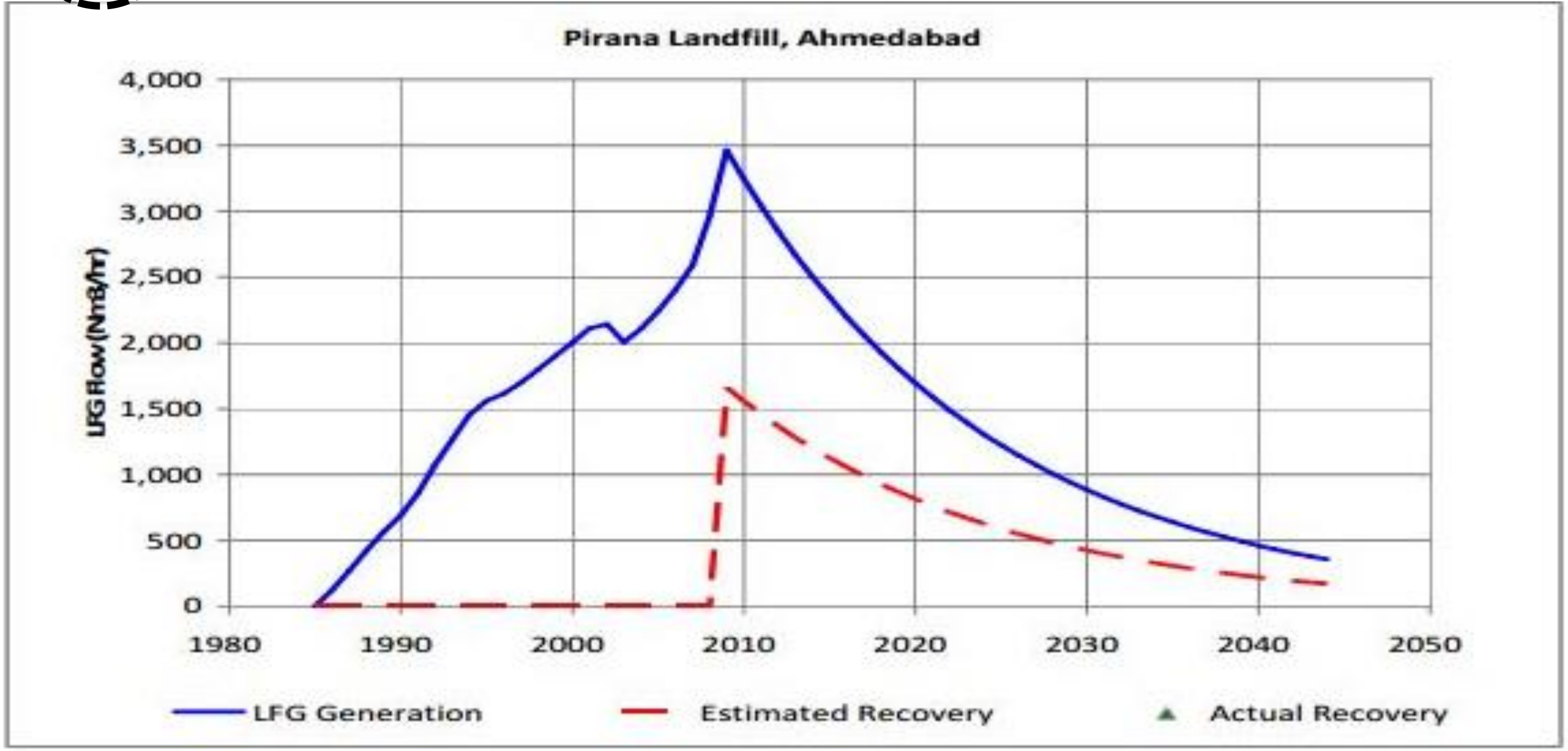
SECTION SHOWING CUTTING-FILLING AREA OF DUMP B

DESGIN DETAILS

COLUMN1	VOLUME EXISTING	VOLUME IDEAL	CUTTING	FILLING	VOLUME
DUMP A	239194.88	517353.10			278158.23
DUMP B	1648068.35	2470346.78			822278.43
DUMP C	923242.58	848545.02			74697.56
DUMP D	678538.59	501598.76			176939.83

STABLE DUMP	VOLUME’	SURFACE AREA	C& D MATERIAL (M3)	SOIL (M3)	SAND (M3)	HDPE LAYER (M2)	GEO-TEXTILE (M2)	GEO COMPOSITE (M2)	TOP SOIL (M3)	VEGETATION COVER (M2)
DUMP A	517352.8	161372.4	48411.7	16137.2	12102.9	242.0	161372.4	242.0	72.6	72.6
DUMP B	1648068.3	229088.3	68726.5	22908.8	17181.6	343.6	229088.3	343.6	103.0	103.0
DUMP C	848542.2	134552.7	40365.8	13455.2	10091.4	201.8	134552.7	201.8	60.5	60.5
DUMP D	501598.7	96722.2	29016.6	9672.2	7254.1	145.0	96722.2	145.0	43.5	43.5

Post closure: Methane Estimation



Projected LFG Generation and Recovery for Pirana Landfill Site

The projected LFG generation and recovery for Pirana landfill site is given in Figure. As is evident from the graph, the peaking value of LFG was in the year 2008. If the gas recovery is starts in the year 2011 assuming a collection efficiency of 60% and waste mass utilization of 80% approximately 1,500 m3/hr of LFG can be recovered.

According to calculations using FOD METHOD given by IPCC, THE METHANE EMISSION IN 2015 IS 2330263.03 m3/ year i.e. 266m3/ hour

USEPA MODEL REPORT (2008): **Gas recovery decline to 688 m3/ hour after 8 years** (2016)

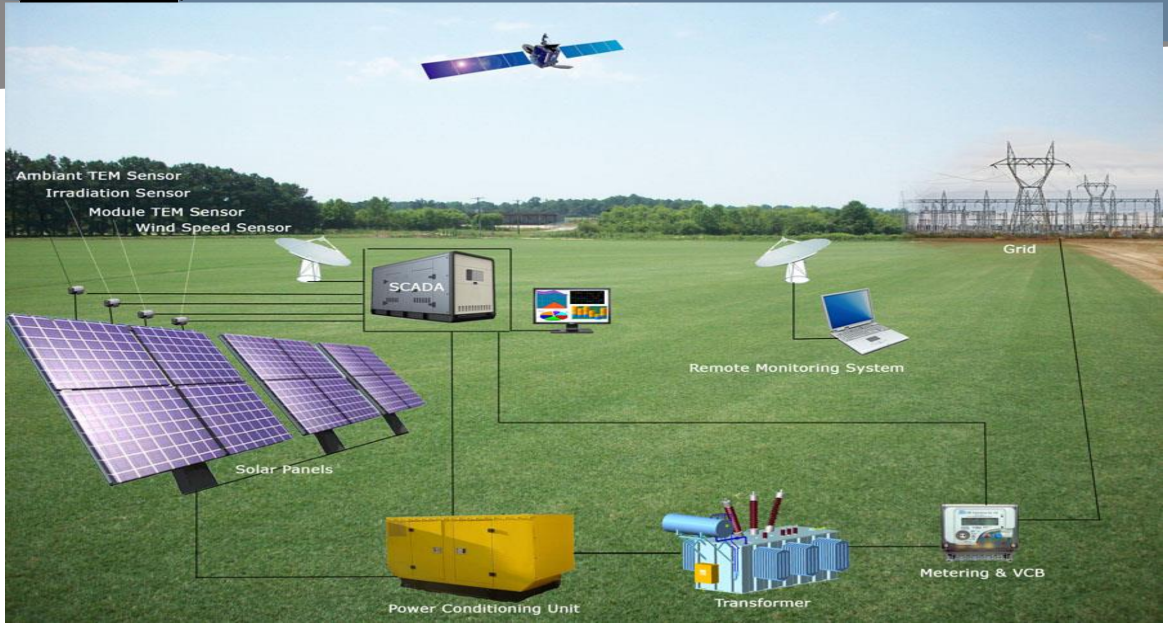
source: Report on Landfill gas recovery and its utilization in India: Current status, potential prospects and policy implications , 2011, USEPA report 2008

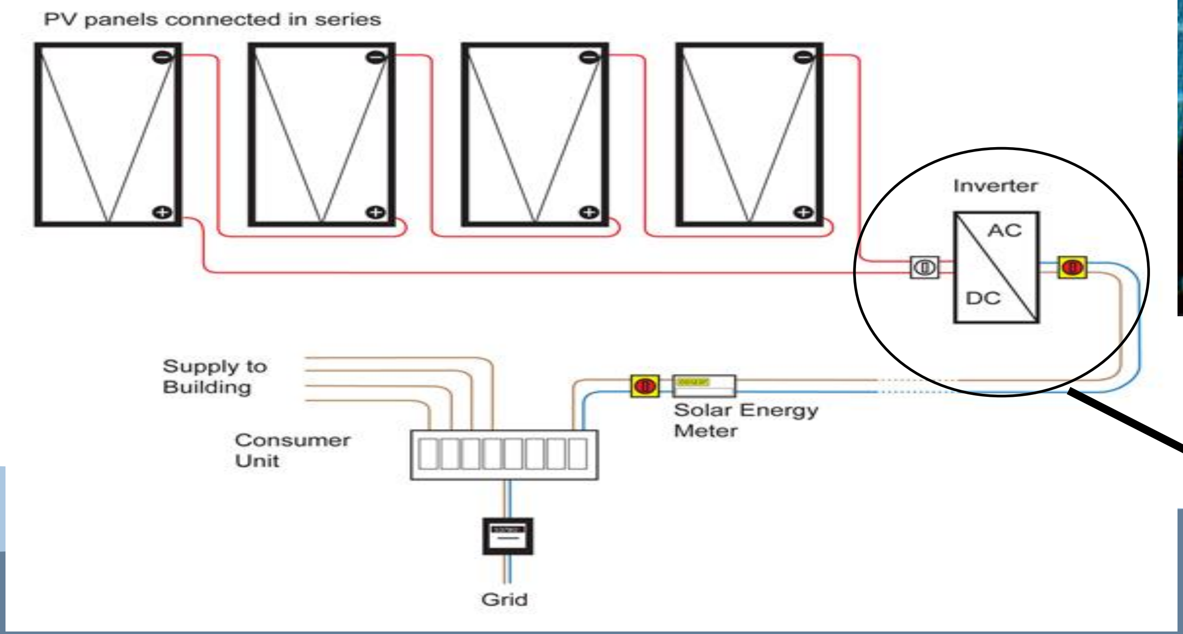
Post closure: Methane Estimation

THUS CAPTURING AND FLARING THE LFG WILL REDUCE:
Emissions equivalent to 20,662 cars.
Planting 29 acres of forest.
Offsetting the use of 528 railcars of coal.
Preventing the use of 250 barrels of oil.

source: Report on Landfill gas recovery and its utilization in India: Current status, potential prospects and policy implications , 2011, USEPA report 2008

Post closure: Solar Panels: Grid Supply To Torrent Power Station





Solar grid on the top of the dump to supply as raw material to Torrent

Post closure: Solar Panels: Grid Supply To Torrent Power sub Station

Flexible solar panel installation.

Cost: 10 acres
1 megawatt
Rs. 4 Crores

In contrast to these rigid solar systems, the laminate solar panels used in these projects are flexible strips less than ¼-inch thick, or roughly the height of two nickels stacked one on top of another. Each solar collection strip is approximately **15 inches wide by 18 feet long.**

The large arrays are typically located on the landfill's southern and western facing slopes to maximize the hours of sunlight exposure throughout the year. The resulting solar system, which can be designed to cover 10 to 20 acres or more on the site, is sleek, flexible, aesthetically pleasing, efficient and economical.

Source: http://waste-management-world.com/

Project Finance

EARTH WORK

COLUMN1	VOLUME EXISTING	VOLUME IDEAL	CUTTING	FILLING	VOLUME	COST (in Lakhs)
DUMP A	239194.88	517353.10			278158.23	84
DUMP B	1648068.35	2470346.78			822278.43	248
DUMP C	923242.58	848545.02			74697.56	17
DUMP D	678538.59	501598.76			176939.83	41

CAPPING

DUMP	CAPPING COST Cr
DUMP A	9.03
DUMP B	12.8
DUMP C	7.5
DUMP D	5.4

Refrence : http://www.dnaindia.com/, http://www.egujarat.net/gg/technical_details.html

Project Finance

SOLAR PANELS INSTALLATION

Area sq ft	Solar panel	Panel cost	Units/ day	Power generated/ day	Selling cost of grid/ day
150	1	1.25L	4-5	1KW	15 Rs

SOLAR PANELS INSTALLATION

DUMP	AREA (Sq. Ft)	NO OF PANELS	POWER GENERATED KW/ DAY	ELECTRICTY UNITS/ DAY	EXPENDITURE Cr	REVENUE annum Cr
DUMP A	296771.77	1978	1385	9892	40	4
DUMP B	493858.97	3292	2305	16462	66	7
DUMP C	2392246.8	15948	11164	79742	319	36
DUMP D	197679.21	1318	923	6589	26	3
					₹ 451	₹ 51

Refrence : http://www.dnaindia.com/, http://www.egujarat.net/gg/technical_details.html

Project Finance

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Project Finance

CLOSURE & CAPPING COST		POST CLOSURE		
			GAS FLARING	SOLAR PANELS
EARTH WORK	34.7 Cr	COST	25 CR	451 CR
CAPPING	38.6 Cr			
TOE WALL	0.87 Cr	REVENUE	0.25 CR	51 CR

Refrence : http://www.dnaindia.com/, http://www.egujarat.net/gg/technical_details.html

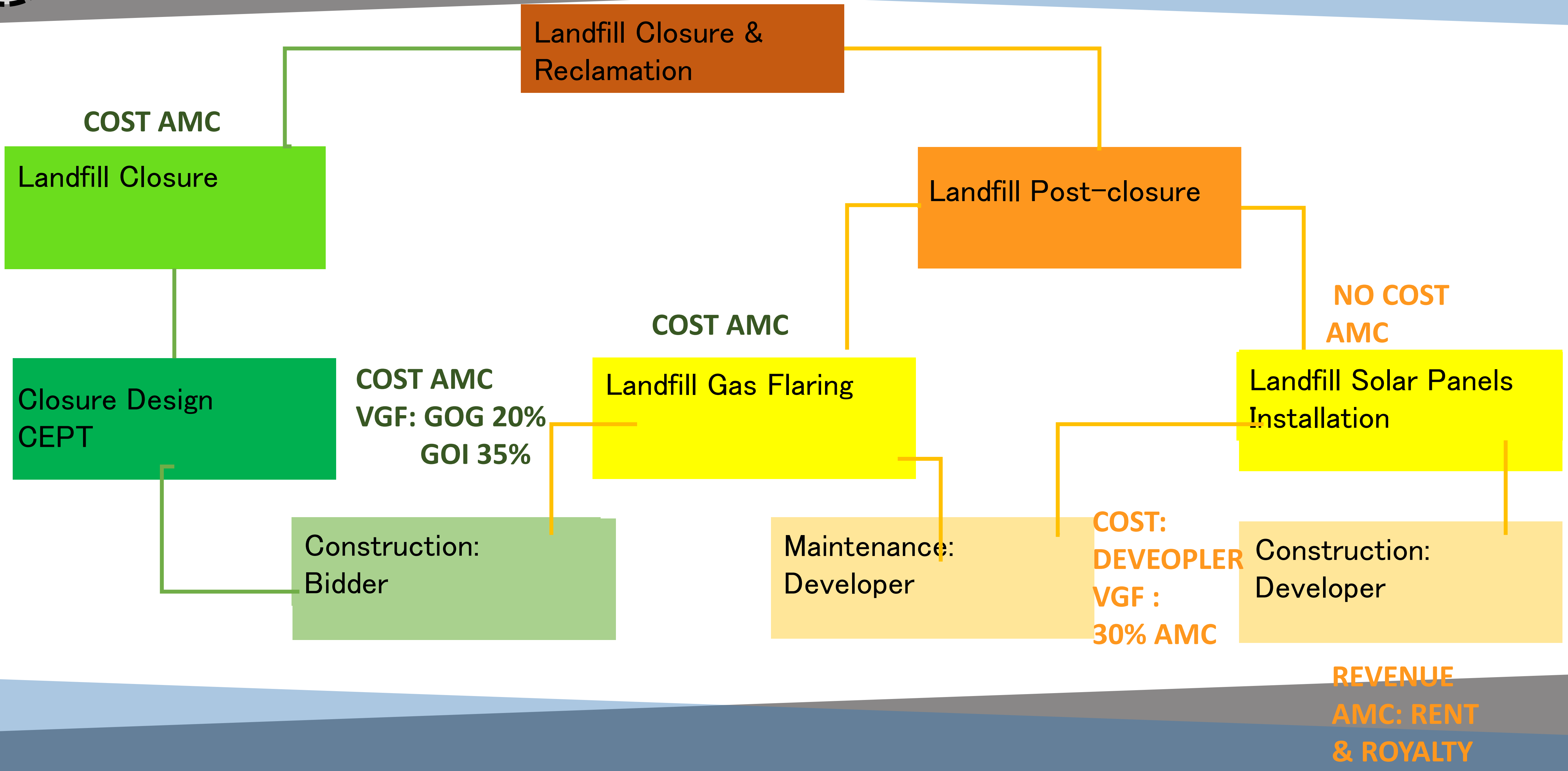
Project Revenue

REVENUE BY SELLING ELECTIRCITY TO TORRENT: **45 Crore (annum)**

CARBON CREDIT: **Estimated CER = 2.5 Million (in 15 years)**

Source: kryto protocol, www.solarmango.com

Implementation



Grants & Subsidises

.

-SWM projects : 20% Grant / VGF for each project.

-Projects of **waste to energy,** the central government Grant / VGF/ Incentive for **power** generated

Jawaharlal Nehru National Solar Mission

SOLAR POWER POLICY 2010

Solar Energy Projects

30% Subsidy

CONCLUSION

Project Life: 20 years

Project Cost: 150 Cr

Project Revenue: 51 Cr annually

Project Finance: GOI- 35%
GOG-20%
AMC- 45%

Project Economic Valuation:

a) environmental benefits from the capture and combustion of LFG, and potential revenues from methane emissions reduction.

b) environmental benefits from the capture of renewable source of solar energy by solar panels installation

d) environmental & Social benefits from the addition of Green Space of 60 Acres

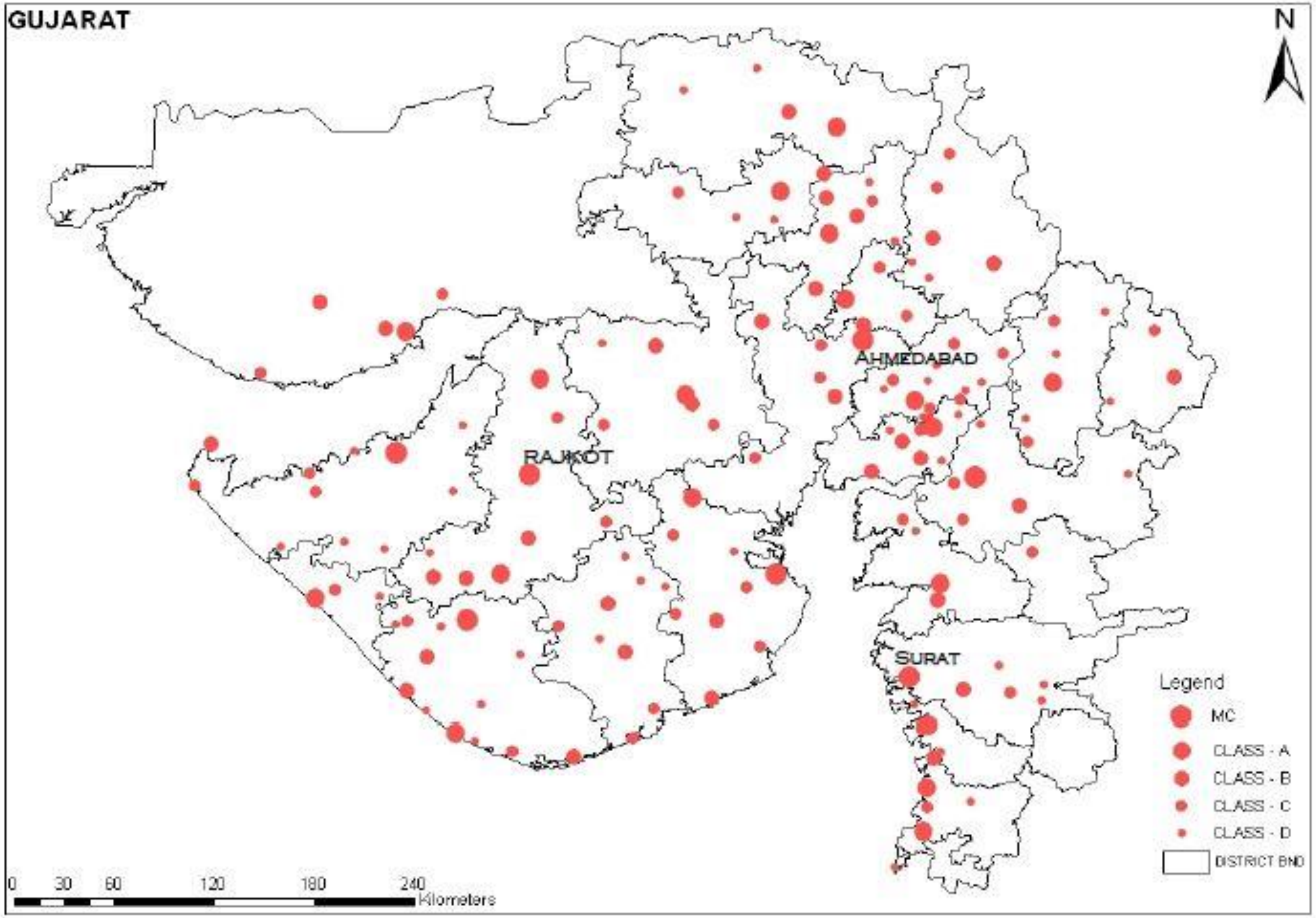
e) Social Benefits from moving A Step towards Zero Waste: Scientific landfill site operation

Execution: Major Head- AMC
Consultant- IL & FS
Execution- Contractor

Project Benefit: Environmental & Social appraisal

FINANCE

Figure 1.1: Location of Urban Local Bodies in Gujarat



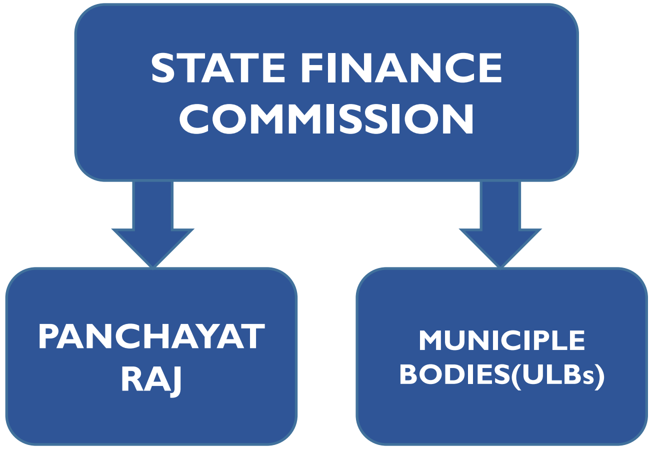
Gujarat: **4th Most Urbanized State**

- State Population: 60.3 Mn
- Urban population: 25.7 Mn
- % Urban Population : 42.6

Source: Provisional Population, Census 2011

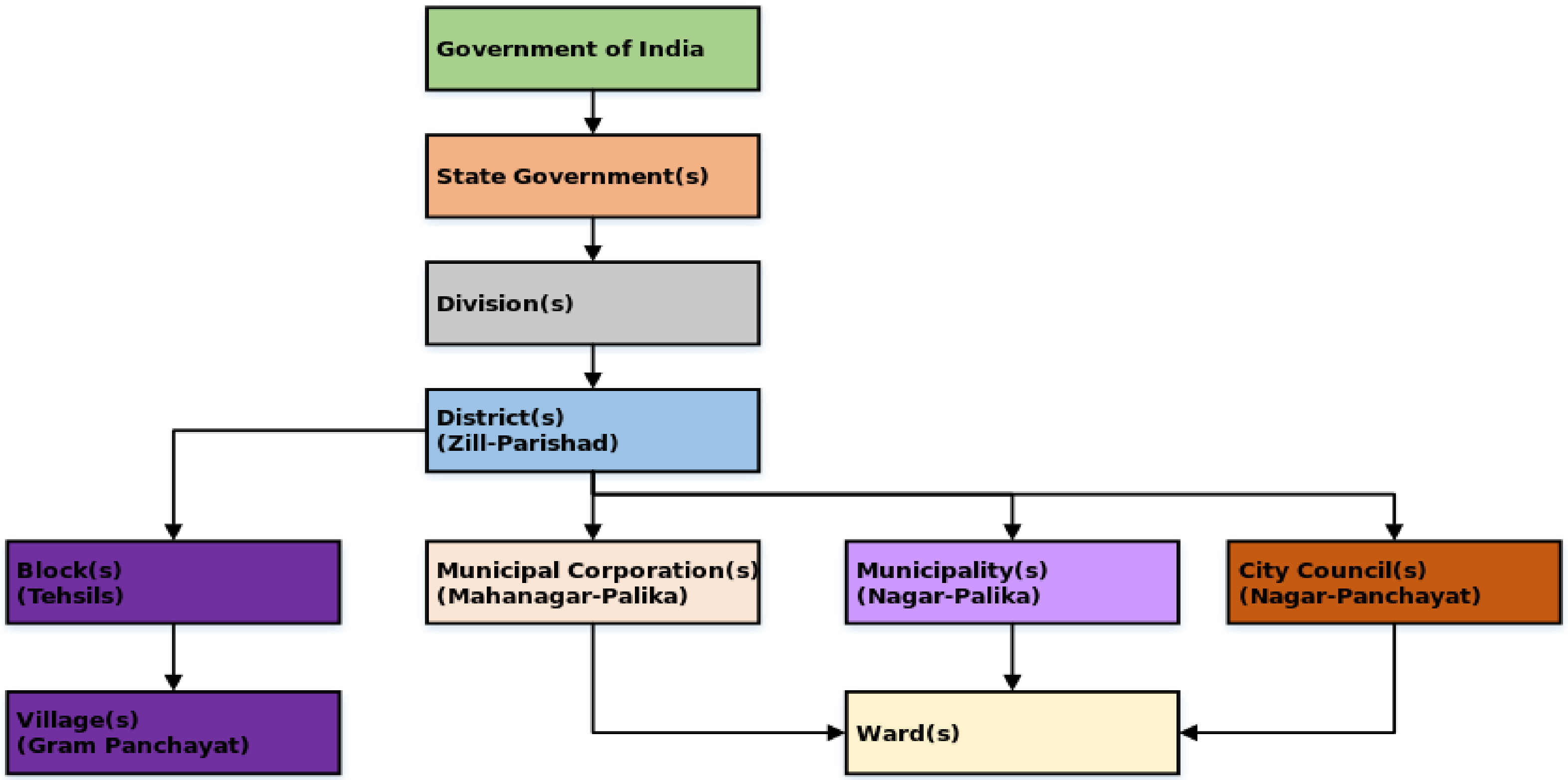
Finance

Source: Financing and Monitoring Urban Water Supply and Sanitation In Gujarat ,CEPT University, June 2011.



Type of Governance System	Population
Municipal corporation	Equal To Or More Than 3lacs
Municipality Or Municipal Councils	Up To Or More Than 1lacs
Nagar Panchayats	Between 30,000 to 10,000
Gram Panchayats	More than or equal to 500

Administrative structure of India

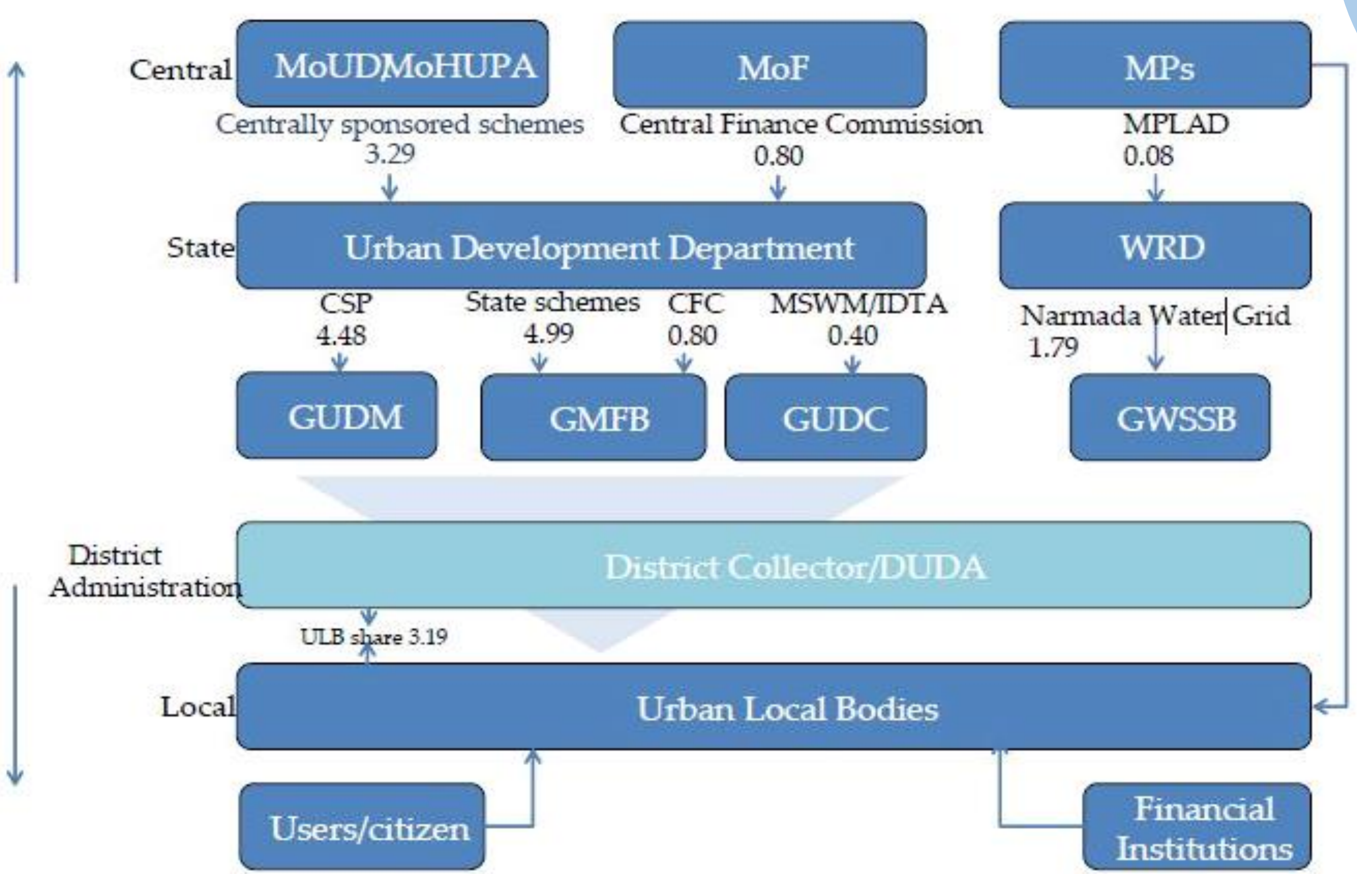


Finance

Source: State Finance Commission, Gujarat

FUND FLOW DIAGRAM

gure 1: UWSS Fund Flows Arrangements, 2008–09 (in Rupees billion)



10th five year plan**2002-2007**(Outlay:**47,000 Crores**)

2003: Vibrant Gujarat

2005: JNNURM

11th five year plan**2007-2012**(Outlay:**1,28,500 Crores**)

2007:Consolidation Of Different Programme(eg. GSY,Umeed,NGC

12th five year plan**2012-2017**(Outlay:**2,83,623 Crores**)

2015: Sabka Saath Sabka Vikas, Gatisheel Gujarat

2005-2011
UDD share in Budget is
Avg5.7%`

Of Which
56% is
used for
UWSS

Finance

Source: Financing and Monitoring Urban Water Supply and Sanitation In Gujarat ,CEPT University, June 2011.;Directorate of Economics and Statistics, Gujarat ;www.gujecostat.gujarat.gov.in

Programs affecting Water and Sanitation of Gujarat

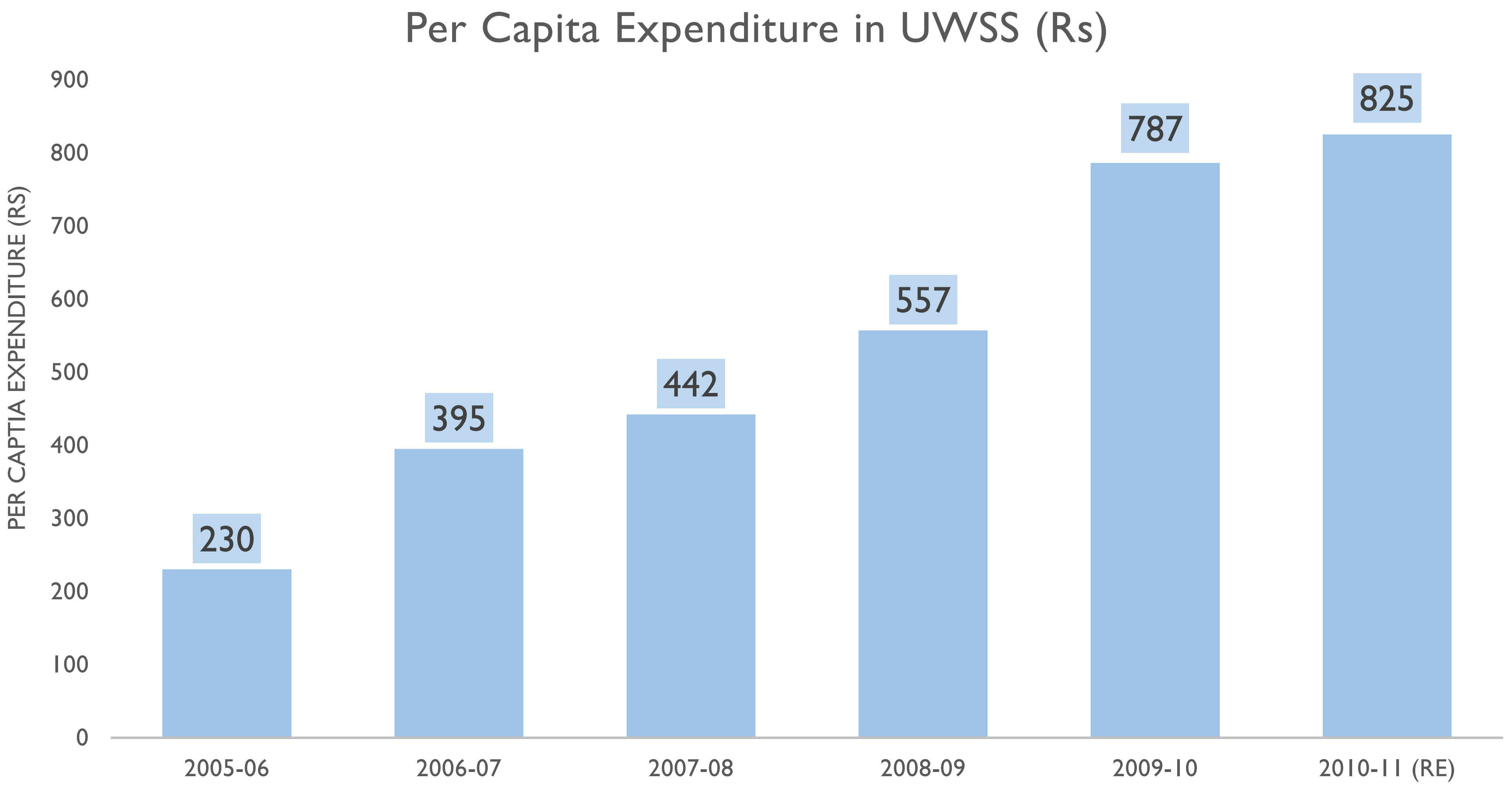
	PROGRAMME	DURATION	OBJECTIVE	URBAN / RURAL	SPONSORING AGENCY
1	**Nirmal Bharat Abhyan: Nirmal Gujarat**	2002-present	**Toilet facilities** to all the families (BPL/APL) are being provided who do not have this facility in **urban areas** with unit cost of Rs. 6000/- in the beginning.	**Urban**	State Govt. (to corporations and municipalities)
2	**Integrated Housing and Slum Development Programme (IHSDP)**	2005-present	To facilitate the construction and **upgradation of the dwelling units** for the slum dwellers and to provide health and enabling urban environment through **community toilet**.	**Urban**	Central & State govt., ULBs, NGOs
3	**Jawaharlal Nehru National Urban Renewal Mission (JNNURM)**	2005-2014	Make efficient and increase **self-sustaining capabilities** of cities as per the sector proving **infrastructural services** by securing the linkages between asset creation and asset management	**Urban**	Central Govt.
4	**Water, Sanitation and Hygiene Advocacy and Communication Strategy Framework**	2012-17	To change social norms making **open defecation unacceptable** and promoting the practice of safe disposal of child faeces, handwashing with soap and safe storage and handling of **drinking water** among all.	**Urban & Rural**	UNICEF

Source: UWSS reforms

PROGRAM/MISSION by MOUD	DURATION	BUDGET	THRUST AREAS
SMART CITIES MISSION	5 years starting from 2015	48 thousand crore	• Adequate water supply • Sanitation, including solid waste management • Sustainable environment • Waste water
SWATCH BHARAT	5 years starting from 2015	62 thousand crore	• Elimination of open defecation • Eradication of Manual Scavenging • Modern and Scientific Municipal Solid Waste Management
AMRUT	5 years starting from 2015	50 thousand crore	• Water supply • Sewerage facilities and septage management, • Storm water drains to reduce flooding,

Finance

Source: Guild lines of smart cities, swatch bhaarat, AMRUT

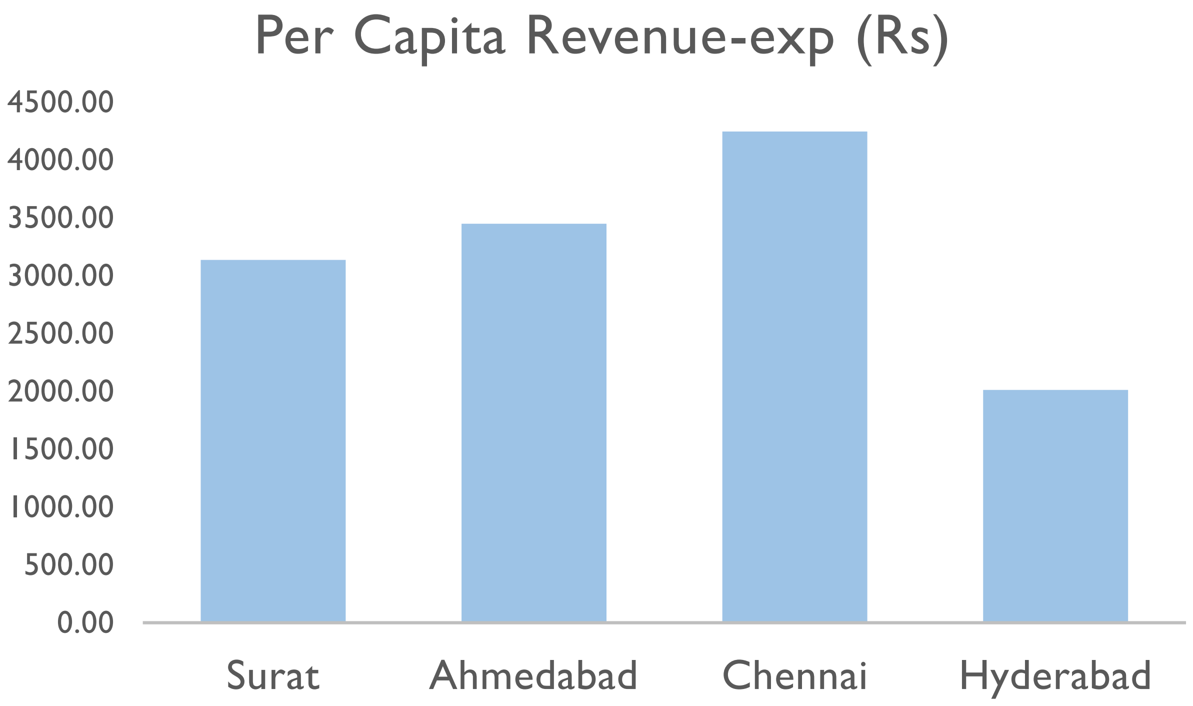


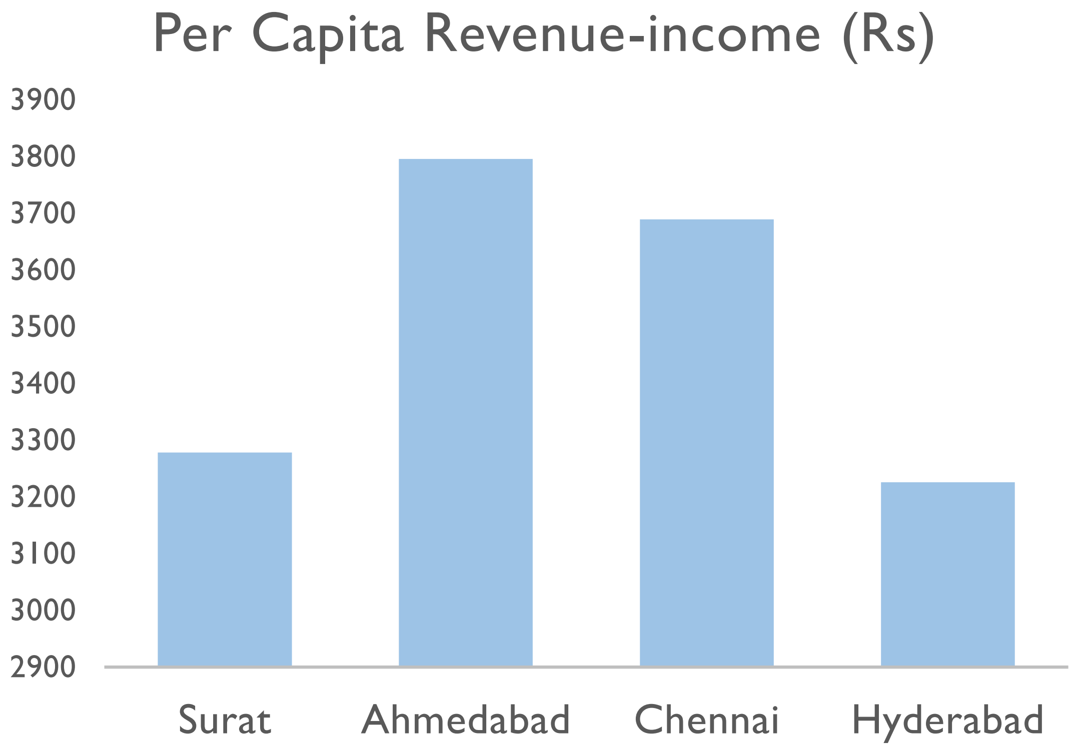
•Average Per capita expenditure in UWSS for Gujarat : **Rs. 540**

Finance

Source: Financing Urban Development By Prof. Meera Mehta,CEPT University, June 2014.

Comparison with different cities





Year 2010-11 (actual)

Revenue budget	=	1899.77 cr
Capital budget	=	1143.94 cr
Total budget	=	**3043.71 cr**

Year 2011-12 (actual)

Revenue budget	=	2142.11 cr
Capital budget	=	1368.74 cr
Total budget	=	**3510.85 cr**

Year 2012-13 (actual)

Revenue budget	=	2117.16 cr
Capital budget	=	1442.5 cr
Total budget	=	**3559.66 cr**

Year 2013-14 (actual)

Revenue budget	=	2538.16 cr
Capital budget	=	1841.21 cr
Total budget	=	**4379.37 cr**

Year 2014-15 (revised)

Revenue budget	=	3738.19 cr
Capital budget	=	2101 cr
Total budget	=	**5839.19 cr**

Year 2015-16 (estimated)

Revenue budget	=	4015 cr
Capital budget	=	2967.5 cr
Total budget	=	**6982.5 cr**

Finance-AMC Budget

Source : AMC Budget 2011-12 to 2015-16

Sr no	Item	2010-11	2011-12	2012 -13	2013-14	2014-15 (estimated)
Amounts in Rs Crore						
1	Revenue Account					
A	Revenue Income	1899.57	2142.12	2117.16	2538.16	3738.19
B	Revenue Expenditure	1322.79	1563.83	1760.55	1923.72	2473
C	Surplus/Deficit	576.78	578.29	356.61	614.44	1265.19
2	Capital Account					
A	Capital Income	1143.94	1368.74	1442.5	1841.21	2101
B	Capital Expenditure	1269.91		1574.33	1829.26	2101
C	Surplus/Deficit	-125.97	142.25	-131.83	11.95	0

Finance-Summary Of Municipal Finance

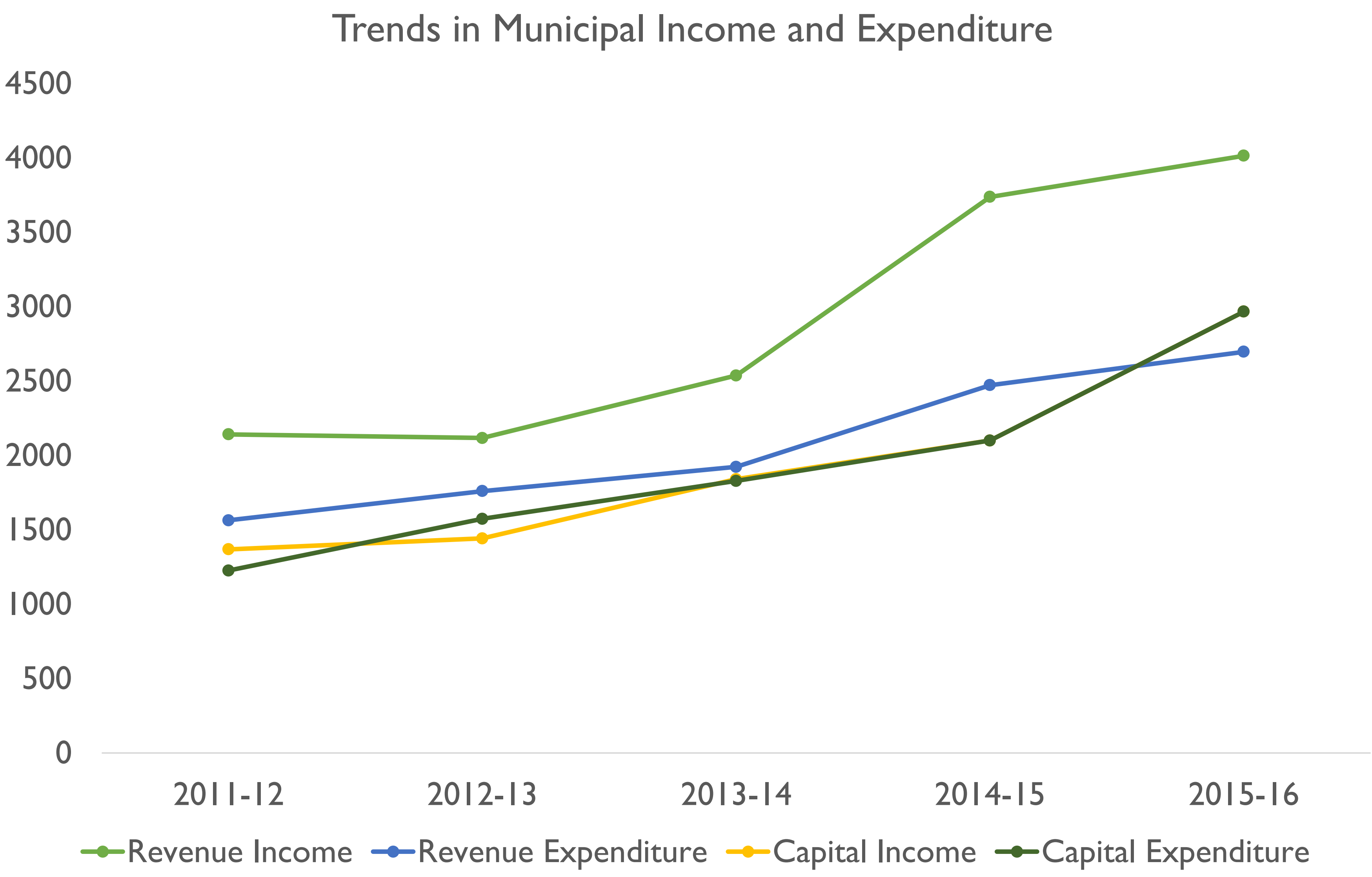
Source : AMC Budget 2011-12 to 2015-16

Sr No	Item	2011-12	2012-13	2013-14	2014-15
INCOME					
A	Revenue Income				
1	Own Sources				
	Grant in lieu of Octroi	826.73 (38.59 %)	826.62 (39.02 %)	826.63 (32.56 %)	909.37 (24.32 %)
	Taxes	531.34 (24.8 %)	531.17 (25.07 %)	702.11 (27.66 %)	996 (26.64 %)
	Non-taxes	334.85 (15.63 %)	285.41 (13.47 %)	452.72 (17.83 %)	970 (25.94 %)
	Others	91.01 (4.24 %)	89.03 (4.26 %)	113.17 (4.45 %)	641.19 (17.15 %)
2	Grants & Subsidies	358.19 (16.7 %)	385.93 (18.22 %)	443.53 (17.47 %)	221.63 (5.92 %)
	Total Revenue Income-A	2142.12	2118.16	2538.16	3738.19
B	Capital Account				
	Transfer of revenue surplus	580.3 (42.39 %)	356.6 (24.72 %)	614.5 (33.37 %)	957 (45.54 %)
	Grants	617.82 (45.13 %)	927.4 (64.29 %)	1064.89 (57.87 %)	1126 (53.59 %)
	Loans	163.38 (11.93 %)	148.89 (10.32 %)	150 (8.14 %)	0
	Others	7.2352	9.62	11.81	18
	Total Capital Income-B	1368.74	1442.51	1841.2	2101
	Grand Total Income (A+B)	**3510.86**	**3560.67**	**4379.36**	**5839.19**
EXPENDITURE					
A	Revenue Account				
1	Establishment Expenditure	723.99 (46.30 %)	762.8 (43.33 %)	837.2 (43.52 %)	869 (35.14 %)
2	Administration & General Expenses	41.29	40.1	54.92	71.6
3	Repairs & Maintenance	121.72	138.51	165.11	230
4	Power, Fuels & Consumable Stores	120.76	180.33	183.55	213.63
5	Service & Programme Expenses	88.8	193.5	213.53	285.59
6	Grants,Subsidy,Distribution	427.41 (27.33 %)	422.1 (23.98 %)	430.69 (22.39 %)	752.31 (30.42 %)
7	Loan Charges (Debt)	36.96	21.86	38.18	37.1
8	Other Expenses	2.86	1.32	0.54	13.77
Total Revenue Expenditure-A		1563.79	1760.52	1923.72	2473
B	Capital Account				
1	Total Capital Expenditure-B	1226.49	1574.33	1829.26	2101
Grand Total Expenditure (A+B)		**2790.28**	**3334.85**	**3752.98**	**4574**

Finance-Summary Of Municipal Finance

Amounts in Rs Crore

Source : AMC Budget 2011-12 to 2015-16



Finance-Summary Of Municipal Finance

Source : AMC Budget 2011-12 to 2015-16

Sector Finance for UWSS

32.11 % of Total revenue Expenditure budget

8.89 % of Total revenue Income budget

21.82 % of Total capital expenditure budget

21.48 % of Total capital income budget

Finance

Sector Finance for UWSS

		2010-11	2011-12	2012-13	2013-14
Waste Water	Revenue income	7.44	8.21	6.33	7.08
Storm water		0	0	0	0
SWM		67.32	72.67	84.43	110.33
Water		75.09	80.4	84.16	107.68
slum and Sanitation		0.11	0.09	0.21	0.15
Total		**149.96**	**161.37**	**175.13**	**225.16**
Waste Water	Revenue Expenditure	51.54	58.77	84.75	90.81
Storm water		1.61	1.94	2.71	2.55
SWM		183	220.41	267.95	301.65
Water		164.31	170.53	206.46	214.84
slum and Sanitation		5.05	5.13	6.7	8
Total		**405.51**	**456.78**	**568.57**	**617.86**
REVENUE DEFICIT		**-255.55**	**-295.41**	**-393.44**	**-392.7**

Finance

Amounts in Rs Crore

Source : AMC Budget 2011-12 to 2015-16

% SHARE OF THE UWSS IN AMC BUDGET

		2010-11	2011-12	2012-13	2013-14
Waste Water	Revenue income	0.39	0.38	0.3	0.28
Storm water					
SWM		3.54	3.39	3.99	4.34
Water		3.94	3.75	3.97	4.24
slum and Sanitation		0	0	0	0
Total		**7.87**	**7.52**	**8.26**	**8.86**
Waste Water	Revenue Expenditure	3.90	3.76	4.81	4.72
Storm water		0.12	0.12	0.15	0.13
SWM		13.83	14.09	15.22	15.68
Water		12.42	10.90	11.73	11.17
slum and Sanitation		0.38	0.33	0.38	0.42
Total		**30.66**	**29.21**	**32.30**	**32.12**

Finance

Source : AMC Budget 2011-12 to 2015-16

Sector Finance for UWSS

		2010-11	2011-12	2012-13	2013-14
Waste Water	Capital Income	129.20	80.64	70.73	75.34
Storm water		55.43	7.54	2.94	0.91
SWM		19.99	33.29	48.85	44.3
Water		33.31	15.49	264.29	215.04
Sanitation		106.42	65.97	62.46	175.69
Total		**344.35**	**202.93**	**388.5**	**395.9**
Waste Water	Capital Expenditure	169.60	132.63	132.31	151.88
Storm water		55.43	7.54	2.94	7.62
SWM		21.26	35.31	49.82	51.63
Water		136.22	71.5	144.96	103.16
Sanitation		122.32	78.84	73.45	84.9
Total		**504.83**	**325.82**	**403.48**	**399.19**
CAPITAL DEFICIT		**-170.18**	**-122.89**	**14.9**	**3.29**

Amounts in Rs Crore

Finance

Source : AMC Budget 2011-12 to 2015-16

SECTOR	PROJECTS	ULB	PPP	STATE	CENTRAL	TOTAL	
Water	Rain water harvesting	51	----	----	----	51	175.31 (13.07 %)
	WSUD	----	----	----	----	----	
	NRW	9.36	----	1.37	1.65	12.39	
	24*7	22.8	----	----	----	22.8	
	Lakes	4.65	76	2.8	8.3	94.12	
Waste water	Agriculture	----	----	8.8	----	8.8	461.29 (34.4 %)
	Industry	194	54.69	----	----	258.79	
	Garden	87.16	106.53	----	----	193.7	
Sanitation	OD free	30.6	----	15.3	56.1	102	138.93 (10.36 %)
	Slum sanitation	3.11	----	17.76	13.04	33.90	
	Septage	3.03	----	----	----	3.03	
Solid waste	Treatment plant	7	85	----	15	107	577.87 (43.1 %)
	Dump site reclamation	387	----	15.74	68.13	470.87	
FINAL TOTAL		794.71 (59.26%)	322.22 (24.02%)	61.77 (4.6%)	162.22 (12.09%)	1340.91	

Finance

Amounts in Rs Crore

Source : AMC Budget 2011-12 to 2015-16

		EXPENDITURE			
SECTOR	PROJECTS	Capital Exp. Past trend	Future capital requirement	Revenue Exp. past trend	Future Revenue exp. requirement
Water	Rain Water Harvesting	----	46	-	0.5
	WSUD	----	----	----	----
	NRW	30.48	12.39	15.97	21.3
	24*7	80.7	20.6	6.15	2.2
	Lakes	4	1	3.1	.2
Waste water	Agriculture	----	----	----	----
	Industry	10.1	97	5.68	7.87
	Garden	2.92	19.37	11.81	.97
Sanitation	OD free	4.23	2.04	2.41	5
	Slum	85	1.47	.3	----
	Septage	----	3.03	3.68	----
Solid waste	Treatment Plant	0	6	0	0
	Dump Site Reclamation	0	100	0	4.5
	FINAL TOTAL	217.43	308.9	49.1	42.54

Amounts in Rs Crore **Source :** AMC Budget 2011-12 to 2015-16

		INCOME			
SECTOR	PROJECTS	Capital income Past trend	Future capital income	Revenue income past trend	Future revenue income
Water	Rain water harvesting	----	----	6	----
	WSUD	----	----	----	----
	NRW	4.5	4.5	42.07	3.1
	24*7	46	----	47.71	----
	Lakes	----	2	3.5	6
Waste water	Agriculture	----	----	----	----
	Industry	75	----	.06	15
	Garden	----	----	.2	.93
Sanitation	OD free	----	----	----	----
	Slum	35.5	----	----	----
	Septage	----	----	.14	.13
Solid waste	Treatment plant	0	15	.37	.34
	Dump site reclamation	0	60.5	0	51
FINAL TOTAL		161	82	100.05	76.5

Amounts in Rs Crore **Source :** AMC Budget 2011-12 to 2015-16

Though all our projects seem to be having higher capital cost, but if Ahmedabad has to become smart, sustainable, safe and liveable city(our vision) these projects should be implemented


PHASING
NATURE
FUNDING
EXECUTION
BENEFITS

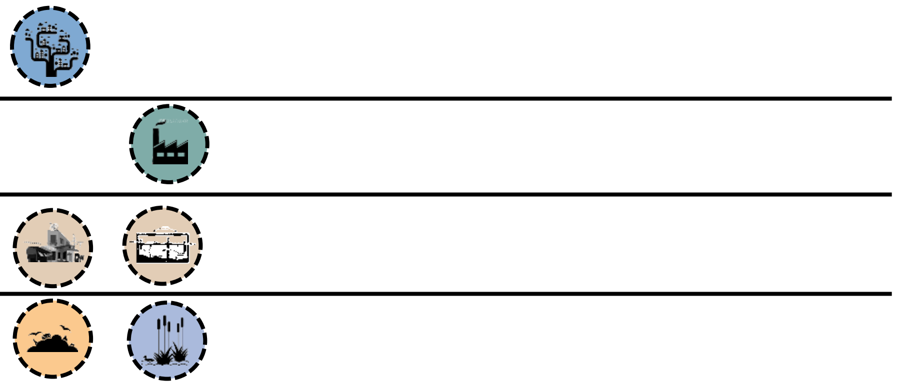
PHASING					NATURE	FUNDING	EXECUTION	BENEFITS
2015	2020	2025	2030	2035	POLICY : PHYSICAL	AGENCIES	OPERATORS	TYPES
					50 : 50	AMC / AUDA, PPP / PRIVATE	AMC , PRIVATE	E F E S
					40 : 60	AMC, AUDA	AMC, AUDA	E E
					20 : 80	SMART CITIES, AMRUT, AMC,PPP	AMC, PPP	E F
					0 : 100	SMART CITIES, AMRUT, AMC,PPP	AMC , PPP	E S
					0 : 100	GOG. PPP	CONSULTANTS, AMC	E
					20 : 80	AMC,PPP	AMC	E F E S
					50 : 50	AMC,PPP	CONSULTANTS, AMC	E S
					30 : 70	PPP	AMC, PPP	E E
					0 : 100	PPP	AMC, PRIVATE	E S
					0 : 100	CENTRAL AND STATE FUNDING	AMC, NGO	E E S
					20 : 80	AMC, PPP	AMC, PPP	E E S
					30 : 70	SWACH BHARAT, AMC, PPP	AMC, AGRI DEPT., GPCB,PVT	E S
					30 : 70	GOI, GOG, AMC, PPP	AMC	E

COST	FUNDING	FINAL COST
Rs 50.4 CR + 0.5 CR	50% AMC, 50% PRIVATE / 40% AMC, 60% PRIVATE	Rs 175.31 Cr
	AMC +AUDA	
Rs 73.22	100% AMC Funds	
Rs 6Cr (full) , Rs 3 Cr (partial)	100% AMC Funds	
Rs 8.59	10% AMC, 90% NLCP/PRIVATE & 100% CSR	Rs 8.59 Cr
Rs 420	AMC, AUDA, AMUL	Rs 461.29 Cr
Rs 8.8 Cr		
Rs 260 Cr	75% debt by AMC, 25 % equity by private player	
Rs 1.1 Cr	100% AMC Funds	Rs 138.93 Cr
Rs 26 Cr	2% State, 25% AMC, 50% Beneficiary	
Rs 80 Cr	80% AMC, 15% State + Central grants, 5%community participation	
Rs 100 Cr	AMC	Rs 577.87 Cr
Rs 120 Cr	35% Central , 30% State, 45% AMC	

GOVERNMENT OF INDIA

- Special grants/ subsidies
- Central driven policies
- Missions

CENTRAL LEVEL



- Swacch bharat Abhiyan
- Smart cities
- AMRUT
- Integrated Housing and Slum Development Programme (IHSDP)
- Water, Sanitation and Hygiene Advocacy and Communication Strategy Framework

GOVERNMENT OF GUJARAT

- State grants/ subsidies
- State driven policies
- Missions

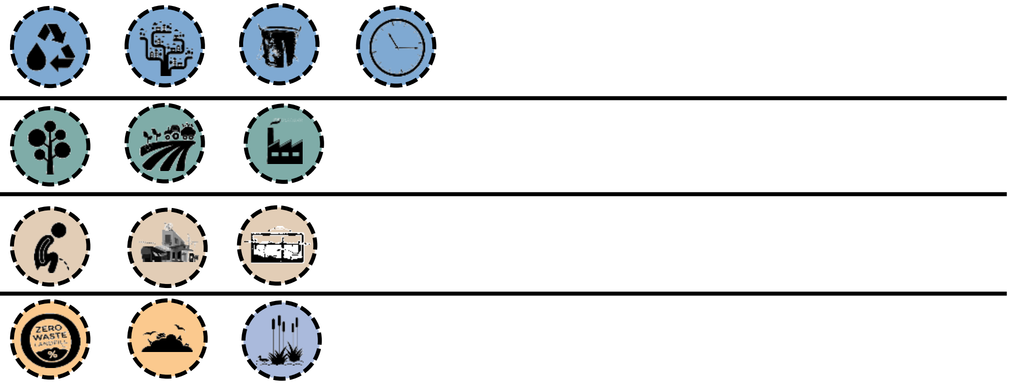
STATE LEVEL

- Nirmal Bharat Abhiyan
- Swacch bharat Abhiyan
- Smart cities
- AMRUT
- Integrated Housing and Slum Development Programme (IHSDP)

AHMEDABAD MUNICIPAL CORPORATION
AHMEDABAD URBAN DEVELOPMENT AUTHORITY

- Reorganizing the municipal budget
- New local policies
- Private investors/ contracting & sub contracting

LOCAL LEVEL



WATER SANITATION

AHMEDABAD

निर्मल Amdavad

1341 CR

GoI

+

GoG

+

AMC / AUDA

PRIVATE PUBLIC

THANK-YOU

निर्मल Amdavad

A livable city with clean, safe, sufficient water and no sanitation issues!