

Citywide Inclusive Sanitation

Martin Gambrill

Tokyo, September 27th 2017



WORLD BANK GROUP

Water

The Sustainable Development Goals: higher expectations

The SDGs go further than the MDGs

SDG Goal 6: to ensure sustainable WSS management for all by 2030, including:

6.1: **universal and equitable access** to safe and affordable drinking water

6.2: access to adequate and equitable **sanitation and hygiene for all**, and an end open defecation

6.3: **improve water quality** by halving the proportion of untreated wastewater, and increasing recycling and safe reuse

6.4: substantially increase **water-use efficiency** across all sectors

6.5: implement **integrated water resources management** at all levels, including through transboundary cooperation

6.6: **protect and restore water-related ecosystems**, including mountains, forests, wetlands, rivers, aquifers and lakes

The Sustainable Development Goals: three shifts from MDGs to SDGs

Universal coverage:

From... halving those without access => universal access

Comprehensive coverage:

From... focusing on WSS => focusing on the water cycle holistically

Sustainable coverage:

From... focusing on basic access => focusing on sustainable services...
=> for sanitation, that means SAFE MANAGEMENT along the service chain

2000

2015

2030

**Millennium Development Goals
(MDGs)**

**Sustainable Development
Goals (SDGs)**



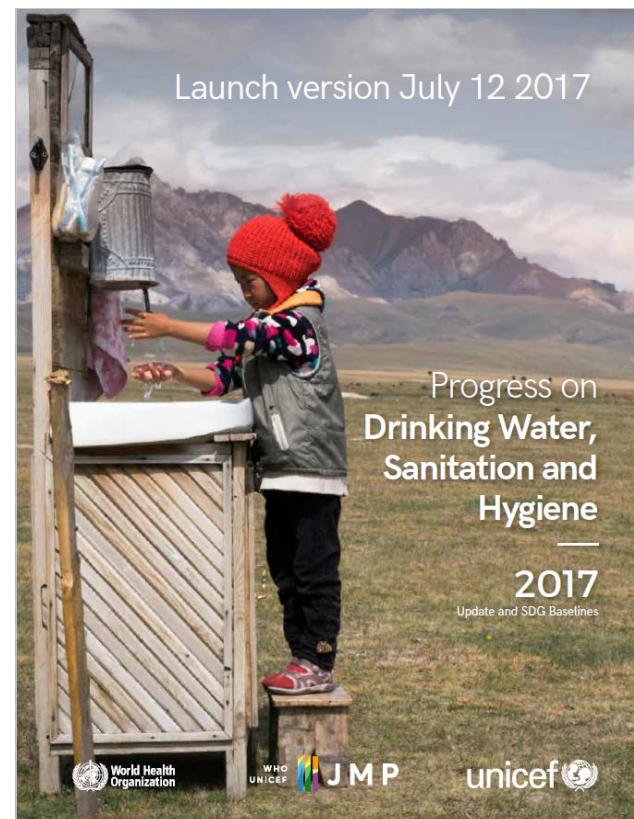
This drastically affects JMP coverage numbers...



JMP's SDG baseline figures

The UN estimated in the 2015 SDG baseline that:

- 4.5 billion people in the world don't have access to safely managed sanitation
- 57% of people living in urban area do not have toilets which provide a full sanitation service
- 16% don't have a basic sanitation service



Sanitation impacting other SDGs

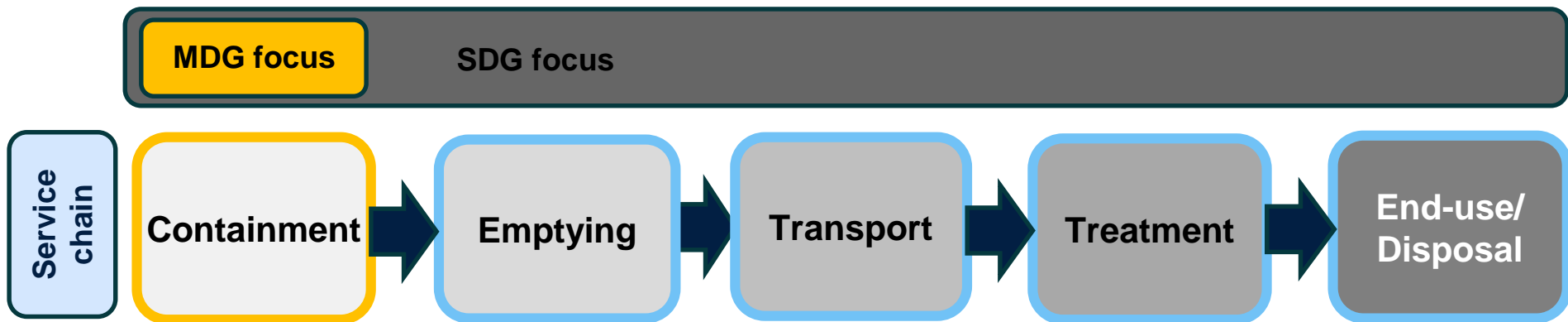
- **SDG11: *Sustainable Cities and Communities***
inclusive, safe, resilient and sustainable cities
- **SDG 3: *Good Health and Wellbeing***
ensure citizens' health and wellbeing
- ...and other SDGs (reduced inequality, gender equality, education...)

Can we achieve these without sustainable urban sanitation provision?



SDGs: considering the whole sanitation service chain

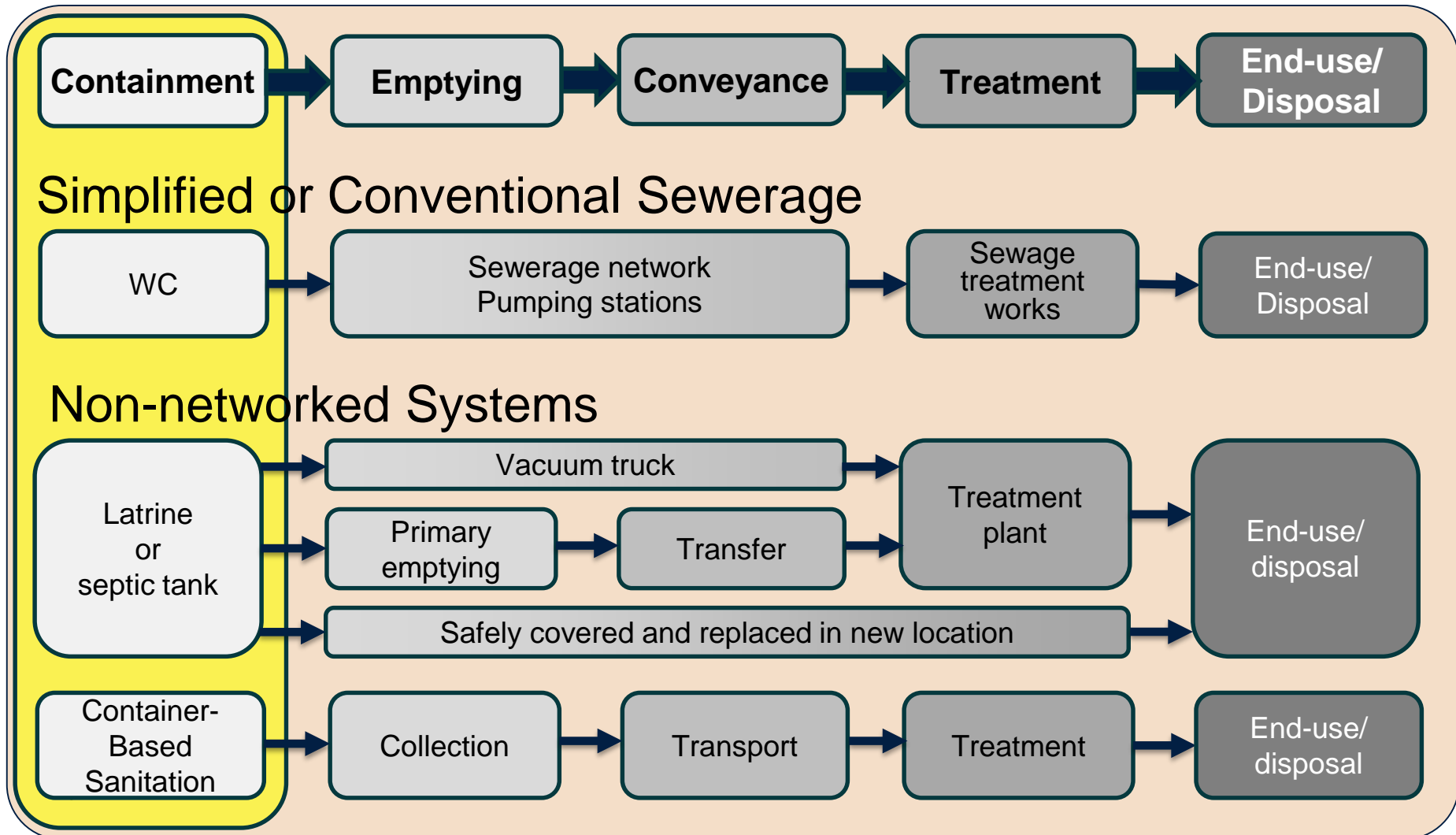
Universal, comprehensive and sustainable coverage of sanitation services,
with focus on safe management along the sanitation service chain



The Sanitation Service Chain

MDGs

SDGs



Growing cities, growing sanitation problems



Urbanization trends

CITIES ARE GROWING FAST!

More than half of the world's people live in cities



Global population

2014

54% urban

Half of urban dwellers live in towns with fewer than 500,000 people



...by 2050

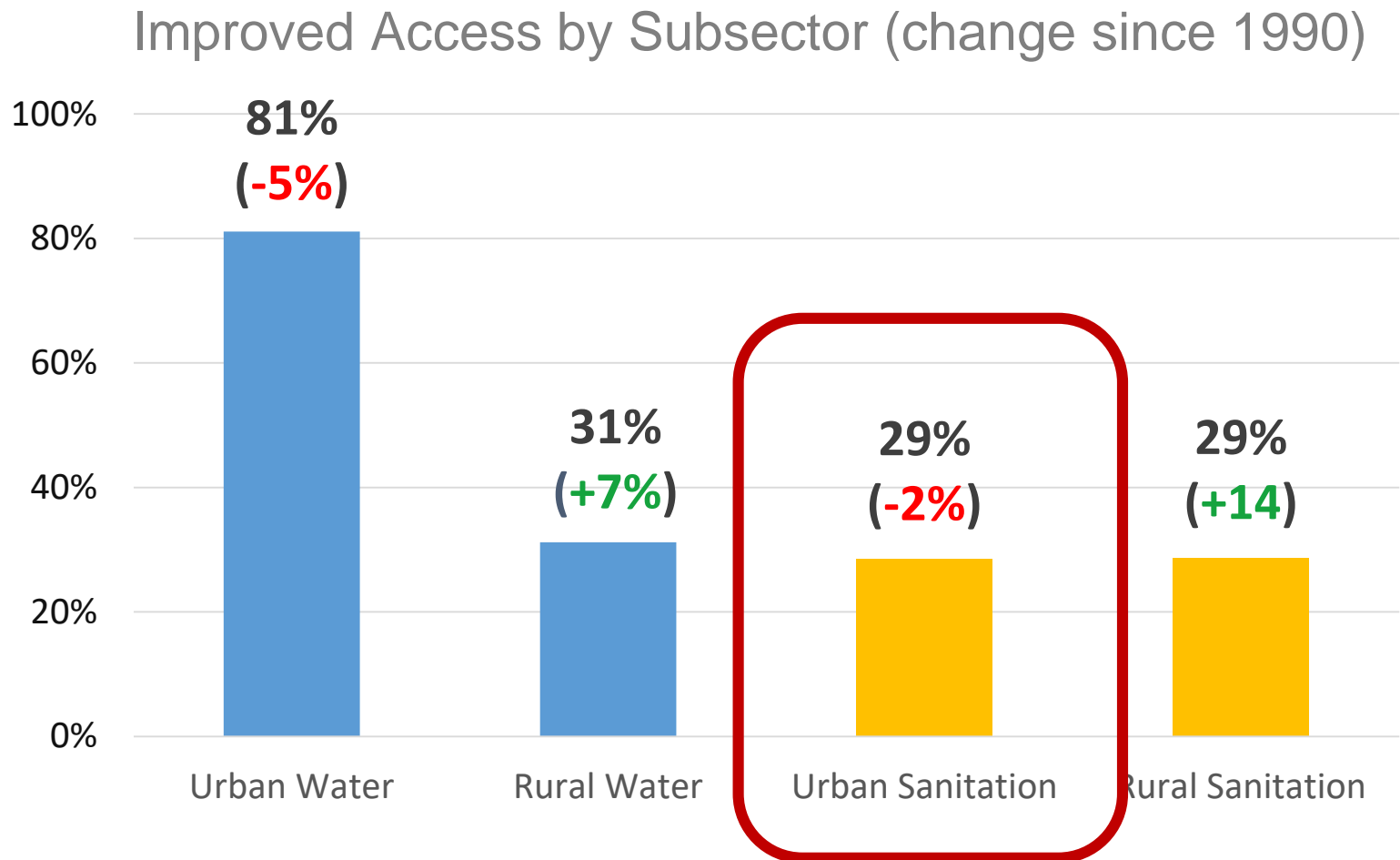
66% urban
(+2.5 billion people!)

Africa: 56% urban
Asia: 64% urban

- 600 urban centers generate some 60% of global GDP
- Space constraints and terrain
- Uncertain land tenure

Formal service providers are losing ground

Examples of trends in DRC



In a city everything is interconnected!

...what does it mean for

sanitation?

More people and increased density means higher risk of exposure to fecal pollution.



Consider this...



1/3rd of the developing world's urban population is living in slums



700 million urban dwellers don't have access to sanitation



About 2.5 billion more people are predicted to live in cities by 2050



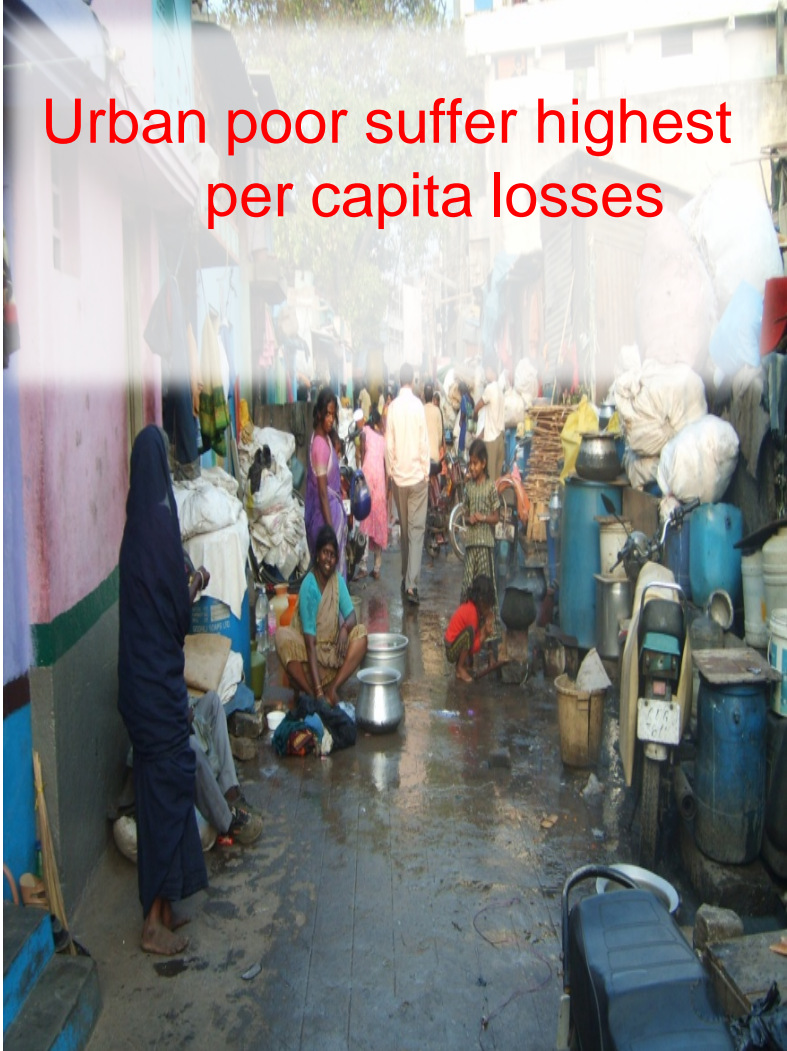
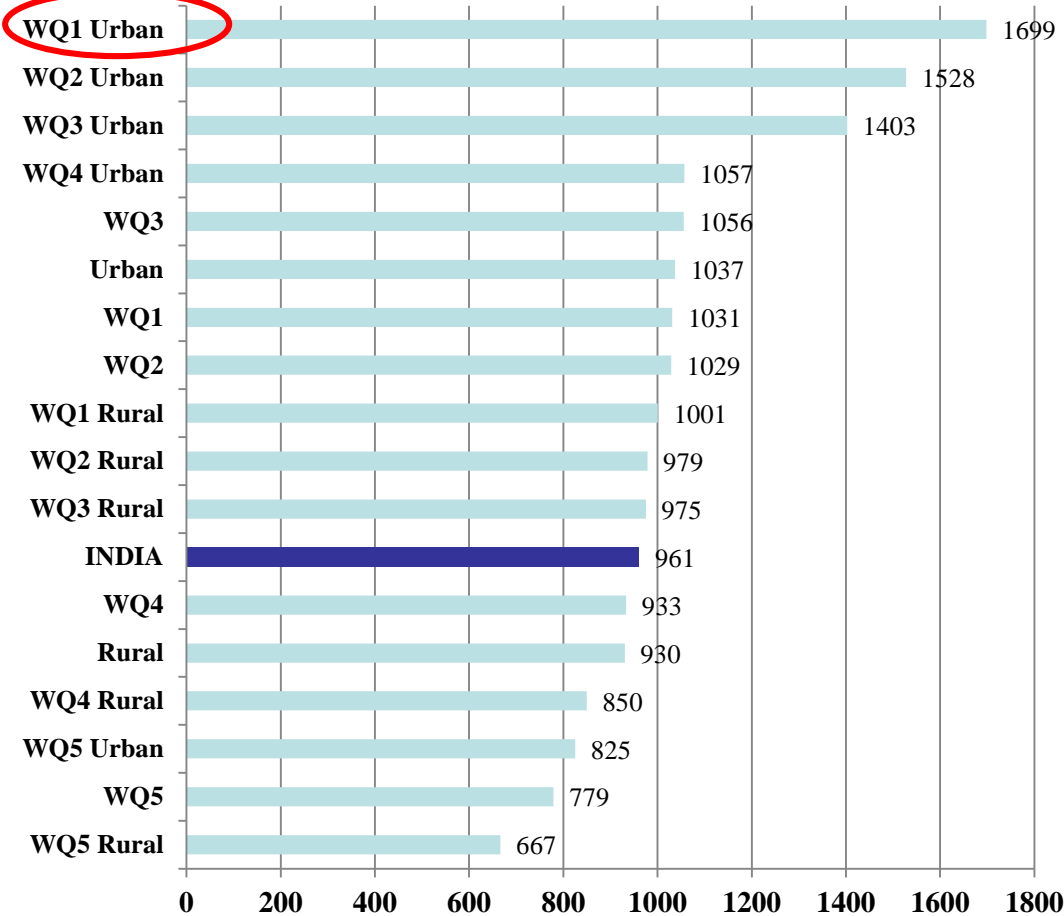
In the last 25 years, sanitation coverage increased by only 3%

The results?

- Environmental degradation
- Endemic disease leading to mortality and morbidity, especially among children...
- ...and stunting
- Low productivity
- Poor school attendance and performance, especially for girls
- A vicious cycle affecting/impacting delivery of other key urban services (housing, water, solid waste, drainage)
- And, ultimately, limitations on economic growth, urban development and city competitiveness

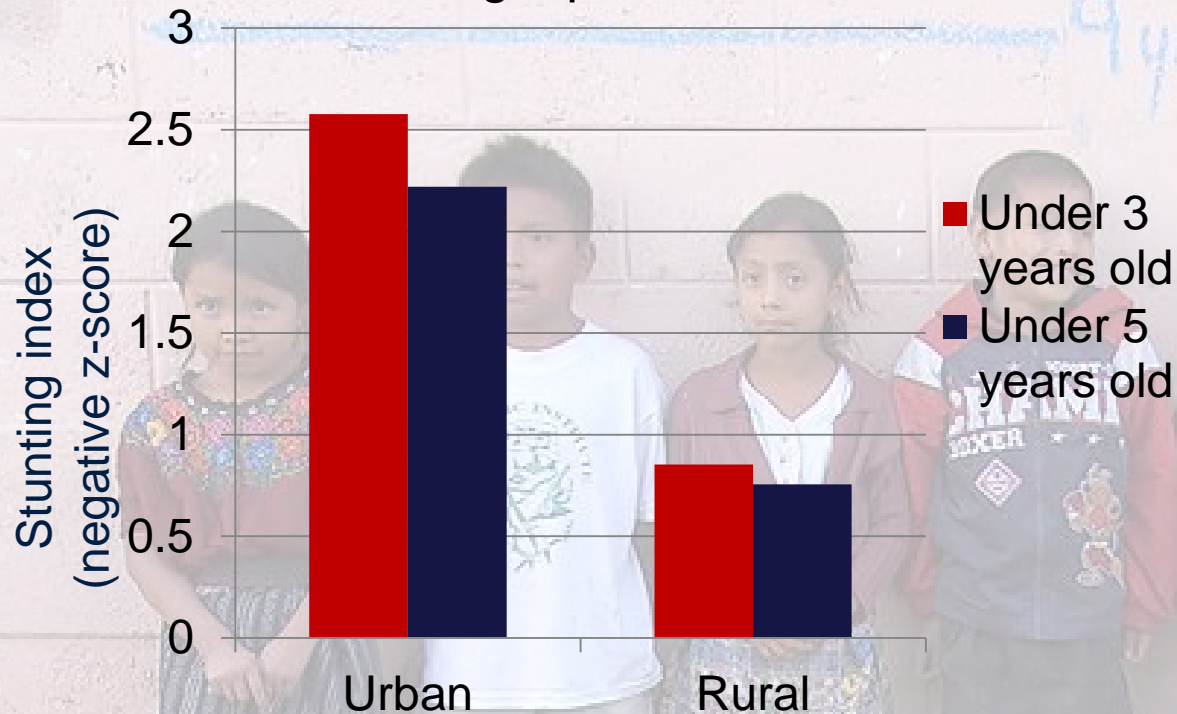
Poorest in urban areas bear most impact

Per Capita Losses
(excluding mortality impacts)



Example of costs of inadequate sanitation on stunting

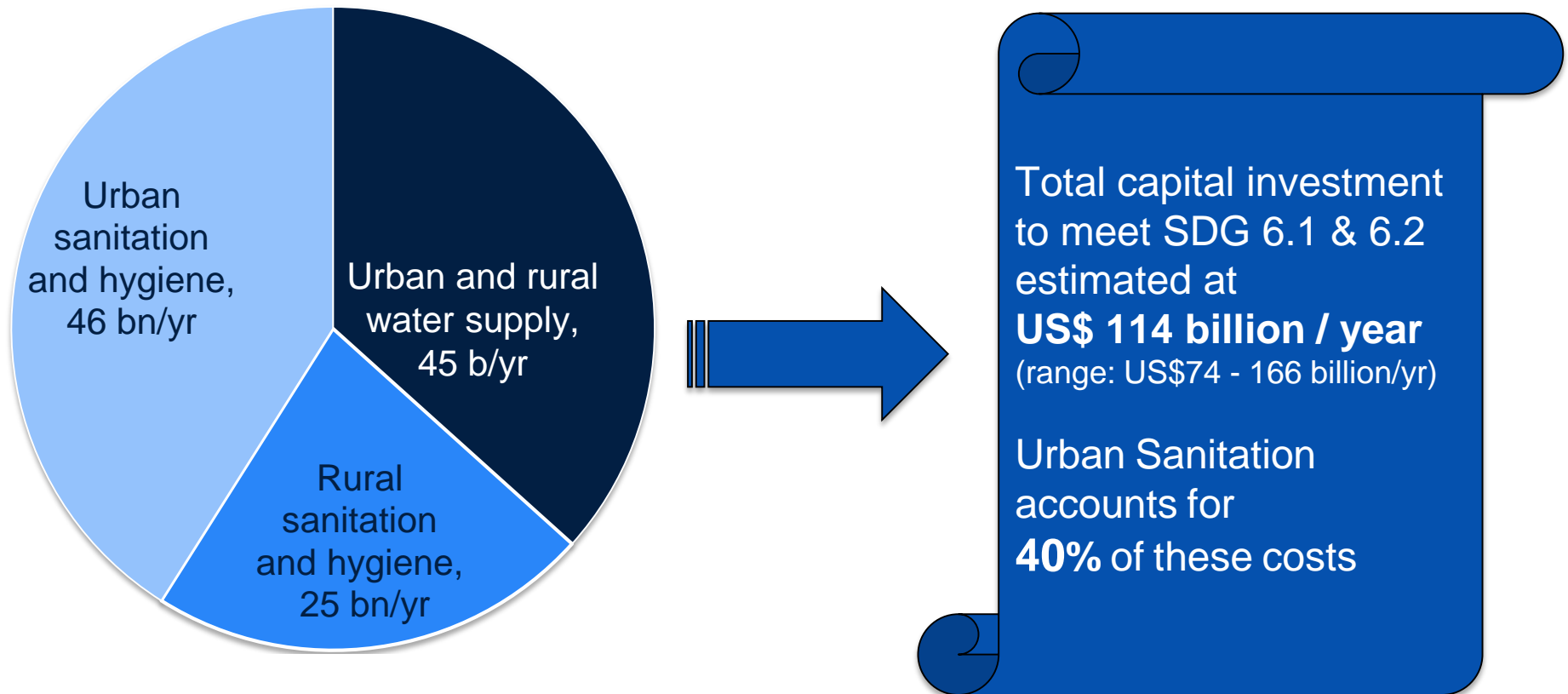
Effect on Child Height of Eliminating Open Defecation :



Stunting is an easily measurable indicator which correlates with future educational achievement, earning potential, ...and so economic growth

Poor Sanitation + High Population Density = Stunting

High estimated annual capital expenditure to meet 2030 SDG safely managed sanitation target



Source: Hutton and Varughese. 2016. The Costs of Meeting the 2030 Sustainable Development Goal Targets on Drinking Water, Sanitation, and Hygiene. Washington, DC. World Bank.

But the benefits of good sanitation are worth it

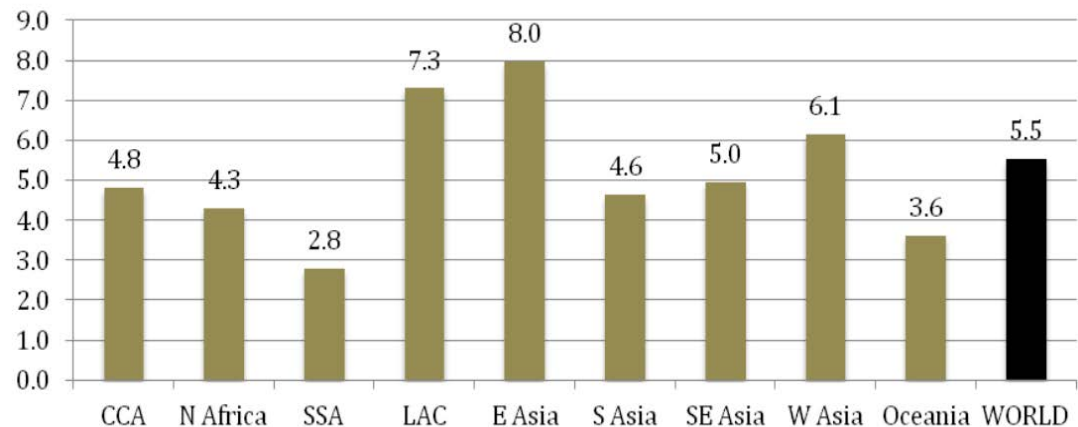
Virtual circle by reducing exposure and reducing costs:

- Public health (diarrhea and other excreta-related diseases, worms infestions, stunting)
- Environmental benefits (improved water quality)
- Quality of life for residents, recreation, etc.
- Food security (water and nutrient recovery)
- Part of a future 'low carbon economy' (energy generation; GHG emissions)
- => towards city competitiveness

Urban sanitation can be a **productive investment**

- Regional variation – reflecting differences in costs of sanitation facilities

Benefit-cost ratios of interventions to attain universal access of improved sanitation



And sanitation is now a human right...

“Physical and affordable access to sanitation, in all spheres of life, that is safe, hygienic, secure, socially and culturally acceptable and that provides privacy and ensures dignity.”

General Assembly resolution 70/169. *The human rights to safe drinking water and sanitation*, A/RES/70/169 (17 December 2015),

- Moral responsibility, especially towards the most vulnerable
- Resolution 64/292, ***The Human Right to Water and Sanitation*** adopted by the UN General Assembly in 2010

So why does urban sanitation lag so badly?

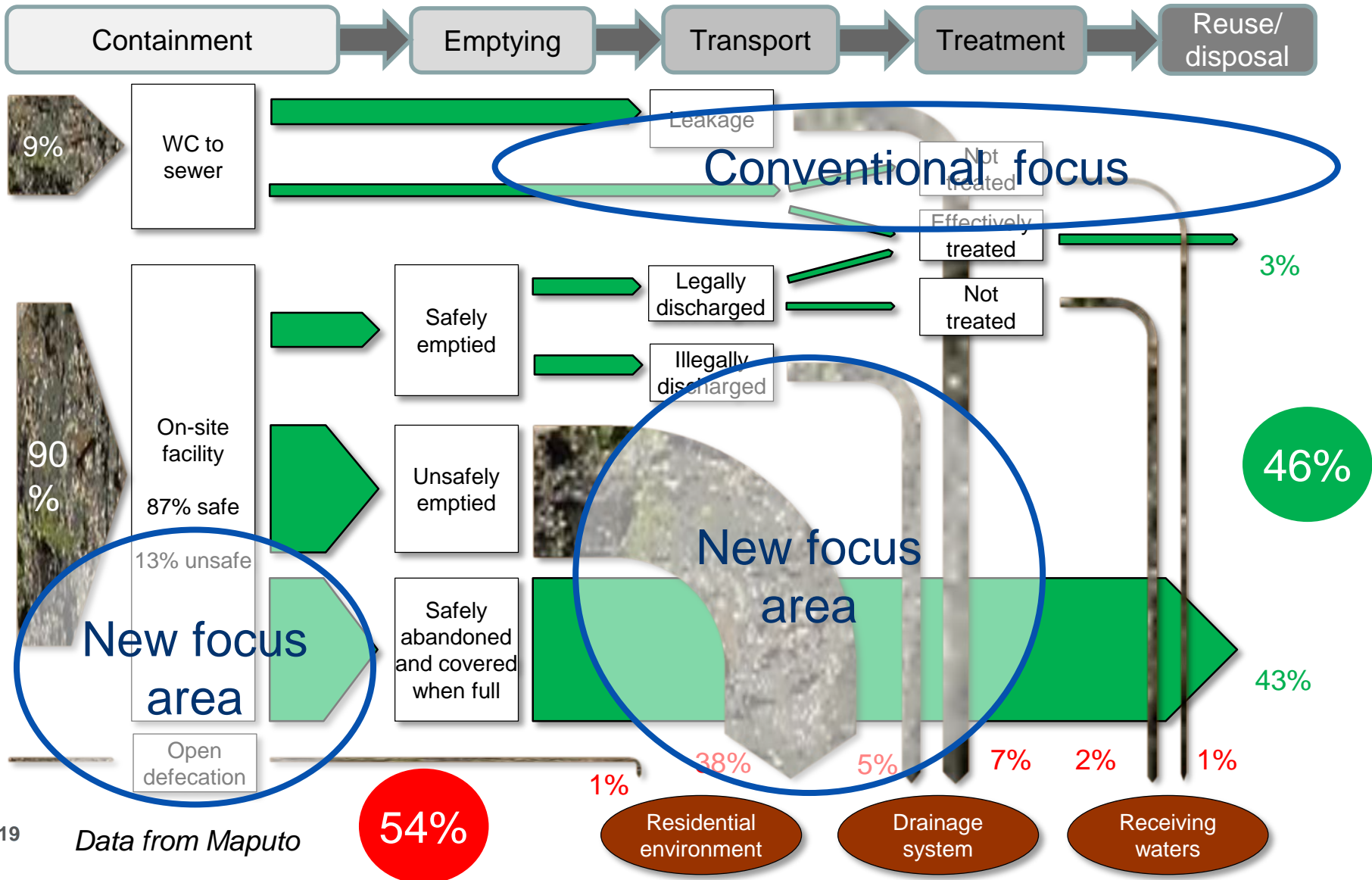
- Out of sight, out of mind? ...or turning a blind eye?
- ...politicians who only react to a crisis vs. the silent emergency
- Service providers see only one urban sanitation solution
- Engineers concerned with sophisticated engineering not service provision
- Build => *don't operate and maintain* => rebuild
- Little consideration of the full sanitation service chain
- Few robust service providers
- Tariffs not covering O&M costs
- Weak service provider leadership
- Poor relationship with politicians
- Lack of innovation, R&D
- Lack of customer focus
- Not considering interface with other urban services

Prevailing Urban Sanitation Myths...

<https://www.youtube.com/watch?v=NecZFRcLCuw&t=76s>

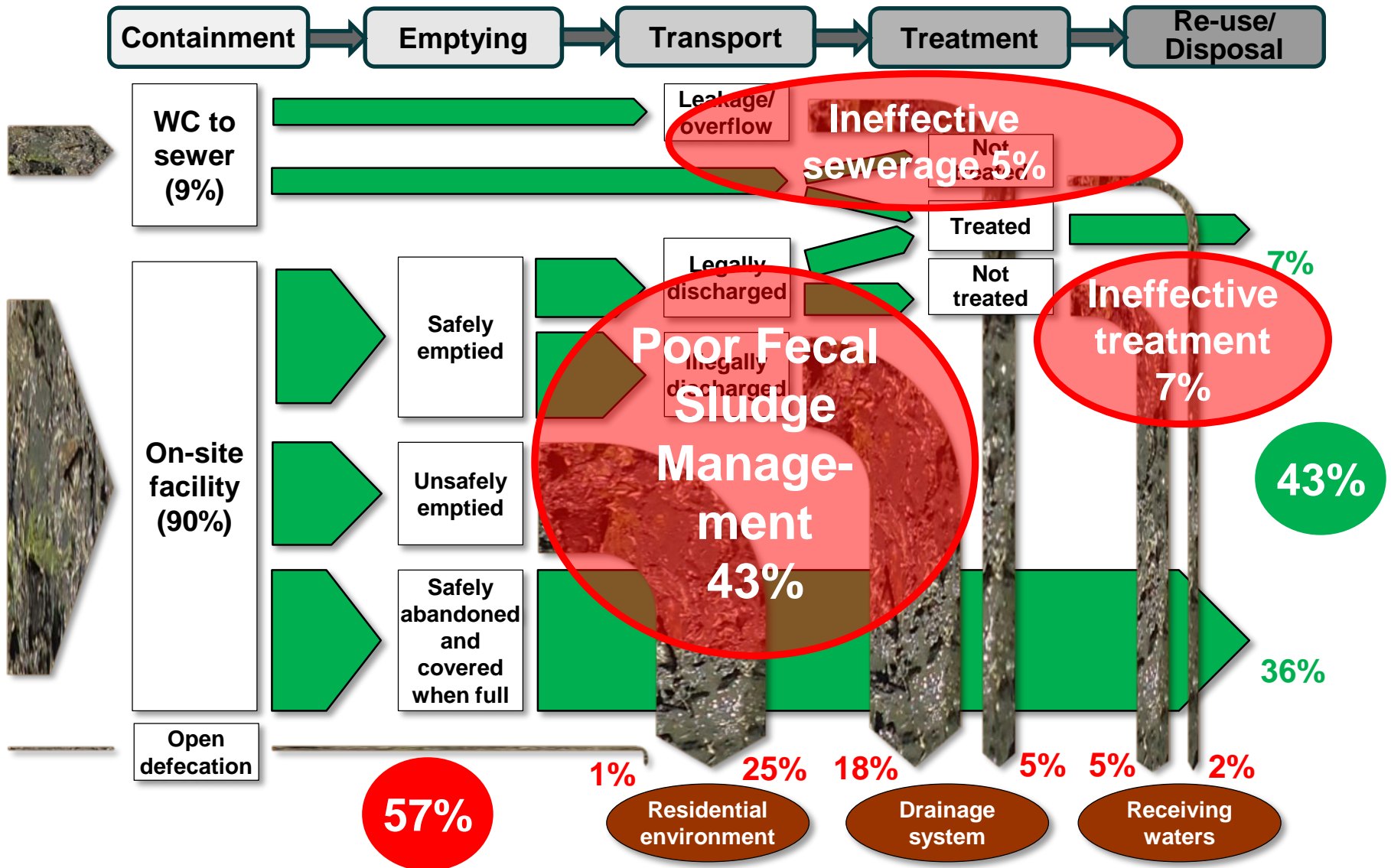
SFDs: where does a city's fecal waste go?

Getting priorities straight



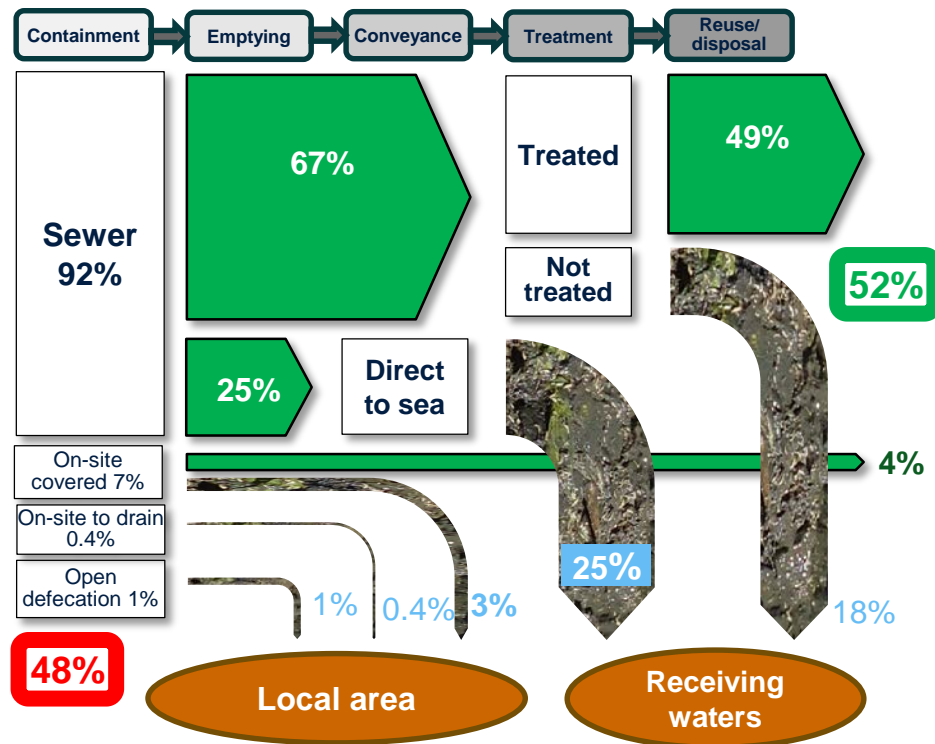
The SFD in Dar-es-Salaam

www.sfd.susana.org

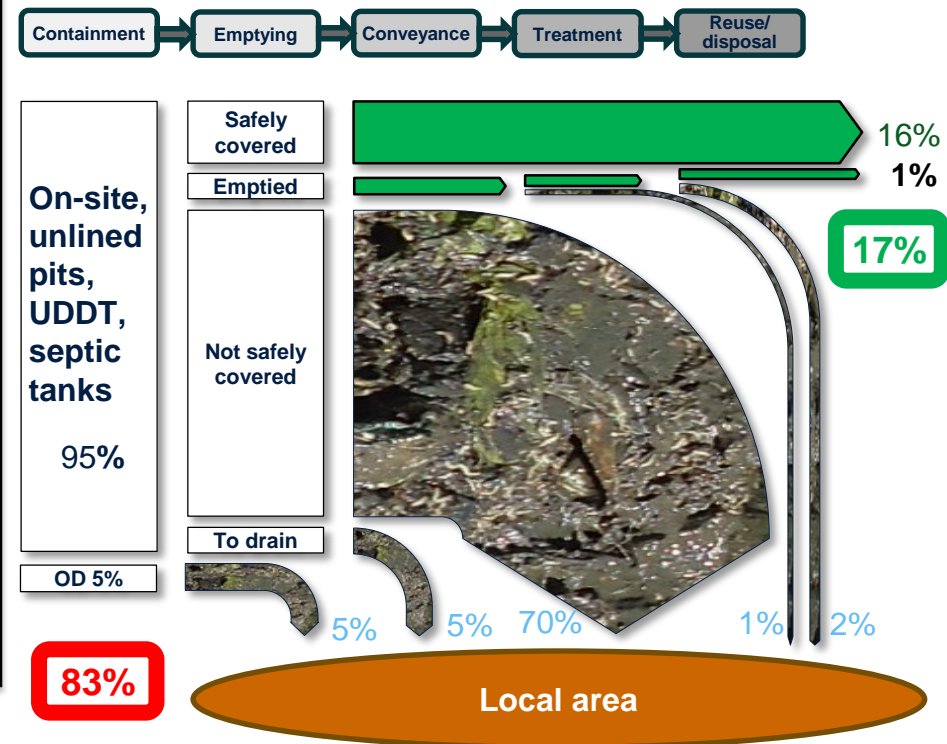


The SFD in Lima: disaggregated data for poor areas

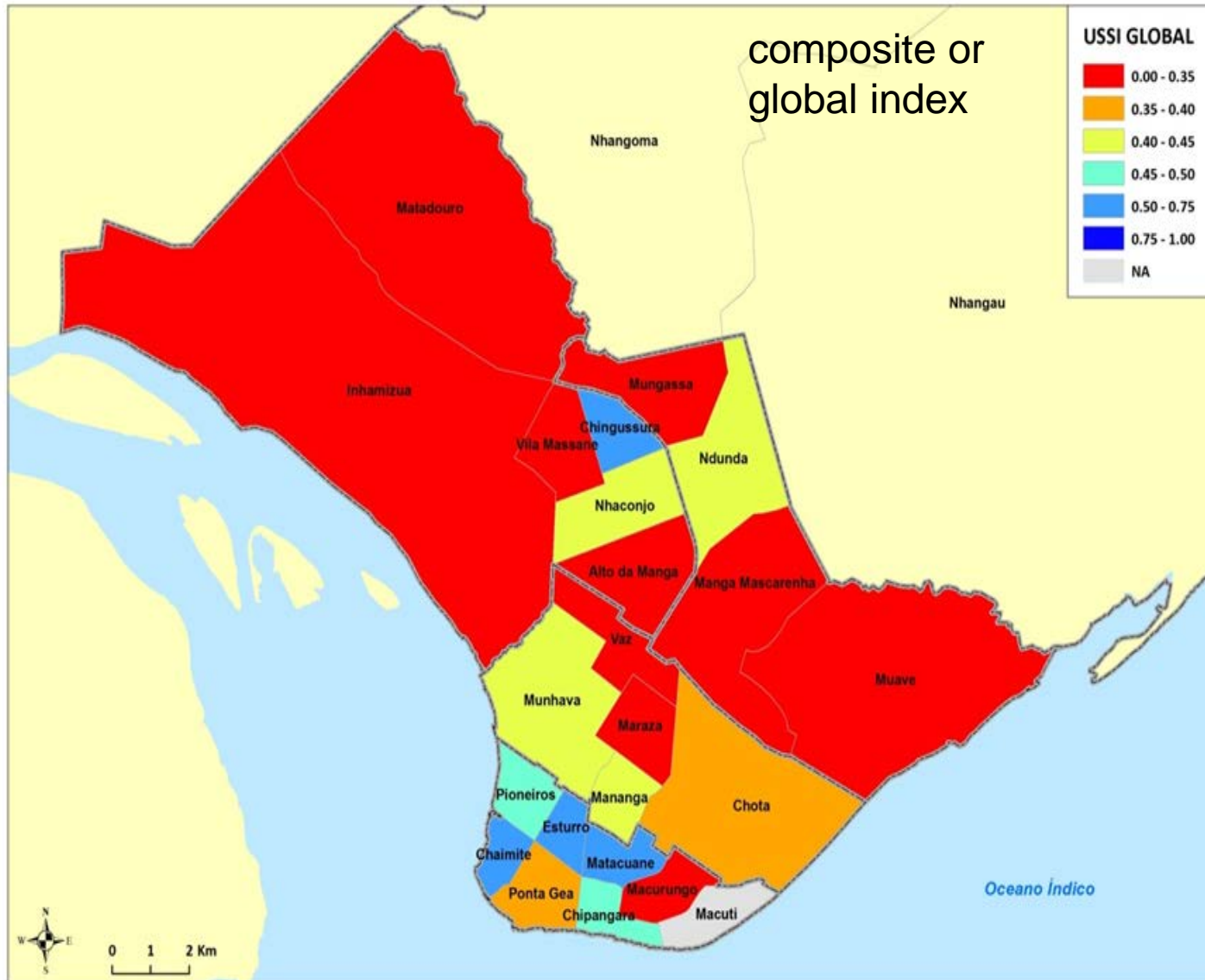
City-wide



Informal settlements

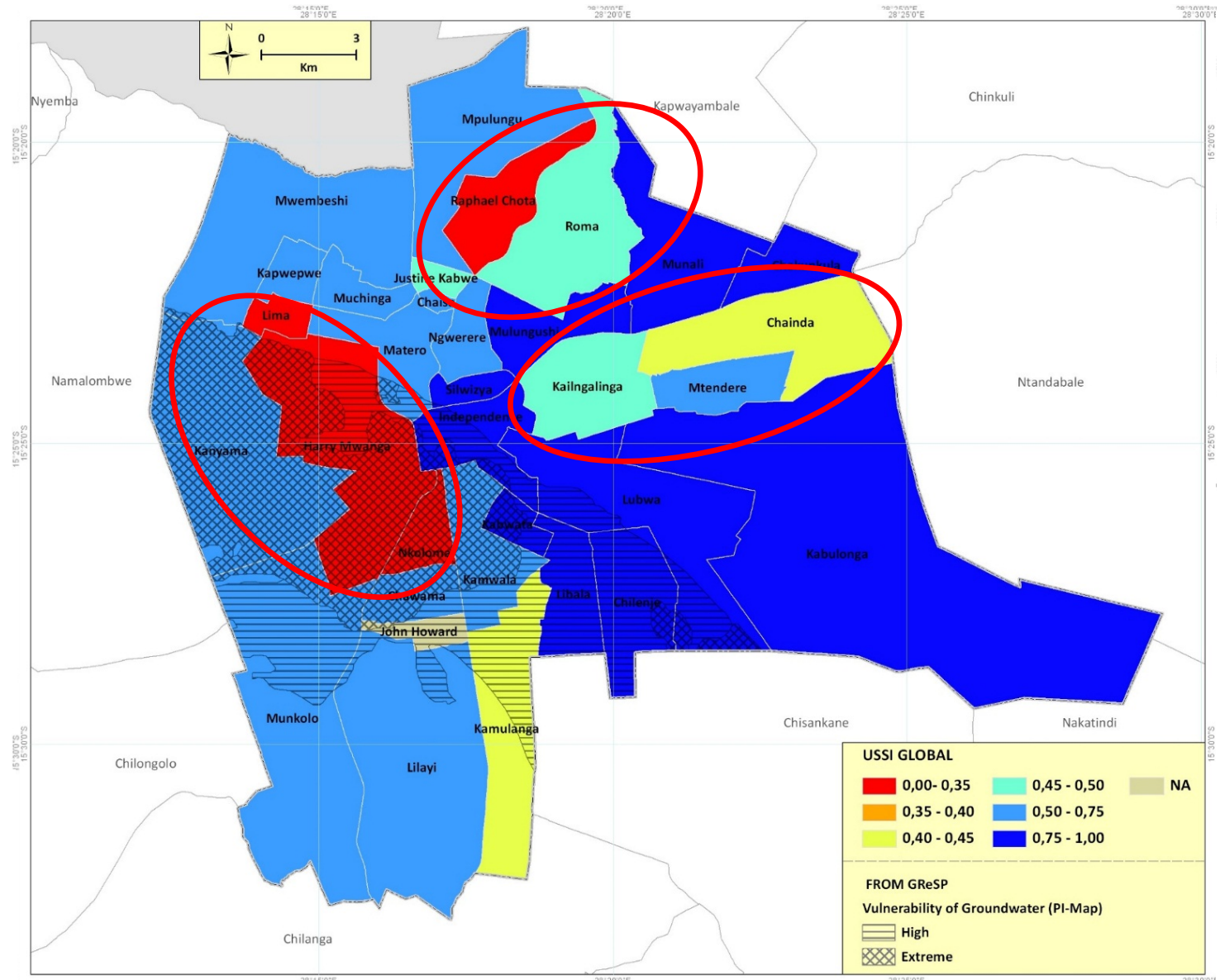


Urban Status Sanitation Index for spatial prioritization: *where is the problem?*



Data from Beira, Mozambique

The USSI in Lusaka



Data from
Lusaka

Sewerage systems are part of the solution...

Appropriate for:

- Denser residential areas
- Where capital costs are affordable and users can pay the tariffs
- Where technical and management capacity is available or can be built

Lower cost simplified sewerage options exist, but need more dissemination...

...and other safe sanitation options are needed...

Require:

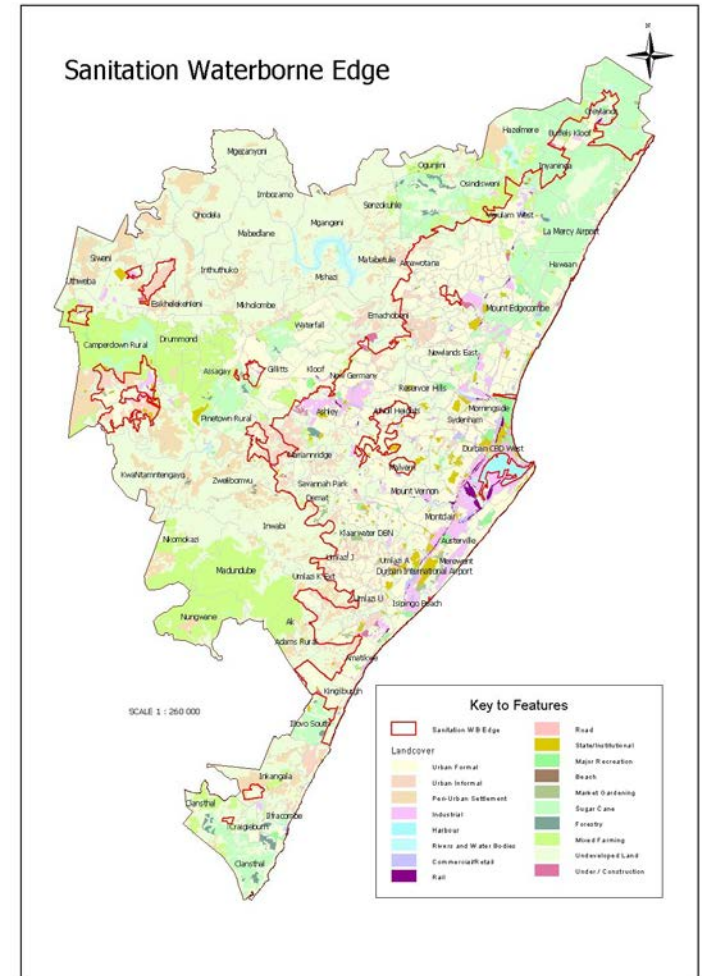
- Reliable (large) quantities of piped water
- (De)centralized treatment
 - Simpler pond systems require larger land areas
 - Compact systems: expensive, technically complex
- Costly excavation, disruption when installing sewer pipes
- High capital & recurrent costs
- House connections – often omitted in sewerage projects
- Pumping stations
- O&M

...onsite sanitation and FSM are the other part

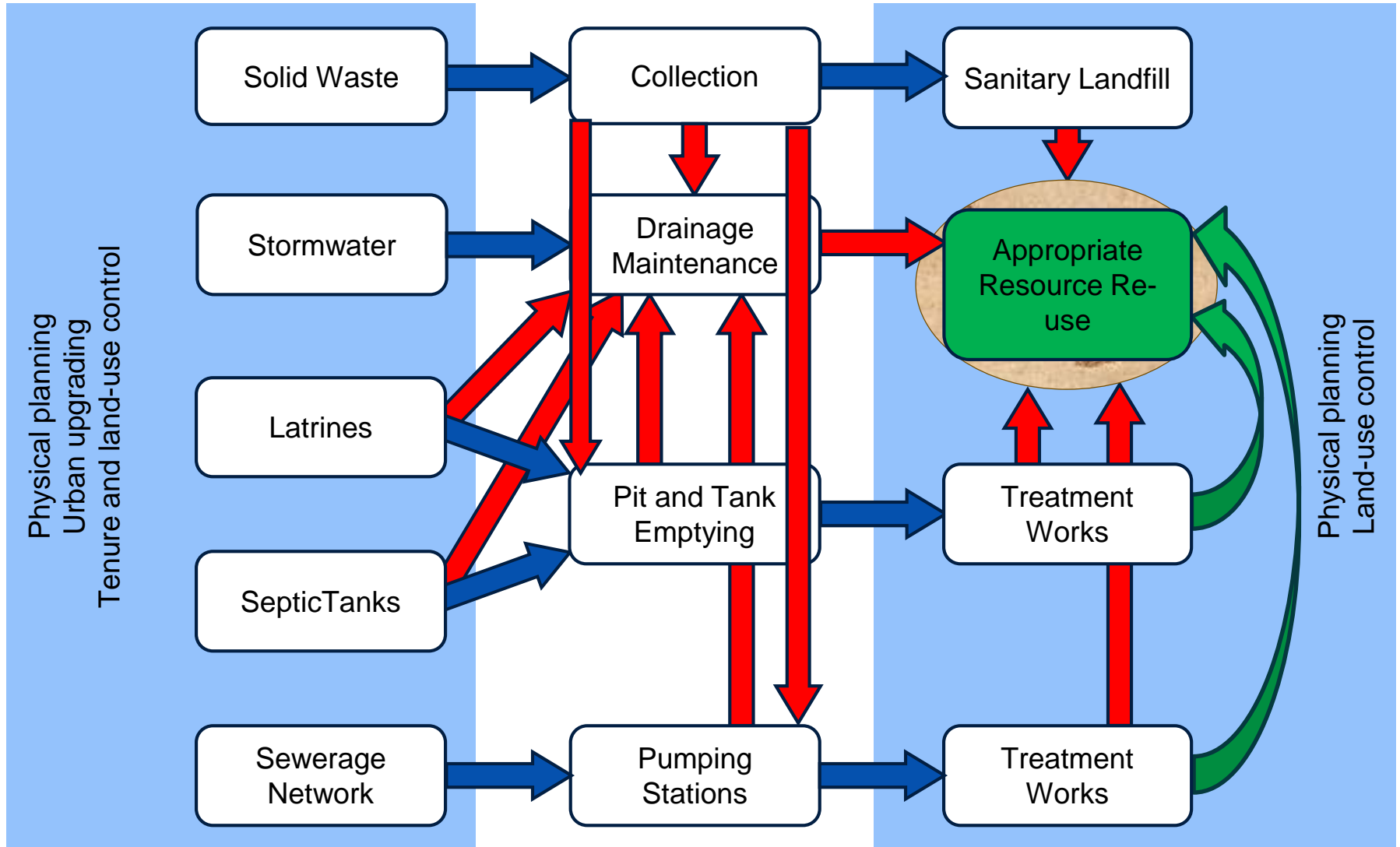
- Adequate toilet facilities:
 - Aspirational – ‘better’, ‘preferred’, households willing-to-pay
 - Hygienic and easy to clean
 - Easy to empty
 - Discourage solid waste disposal in latrine
- Effective emptying services:
 - Affordable
 - Suitable for hard-to-reach facilities
 - Hygienic sludge handling
 - Cost-effective haulage (with transfer stations?)
- Safe treatment and disposal/end-use:
 - Separate fecal sludge treatment – mix with wastewater?
 - Select end products by systematic market analysis

The 'Sanitation Edge'

- Providing sewerage to the 250,000 families not connected to piped network in Durban would cost > USD 4 billion ...and is not affordable
- The policy adopted defined a *sanitation edge* within which development densities were high enough to make affordable piped sewers connected to STPs
- Outside the urban edge, off-grid/onsite sanitation options have been provided (~ USD 65 million)



The Need for Integrated Urban Sanitary Services



Defining Citywide Inclusive Sanitation

- **Everybody benefits** from adequate sanitation service delivery outcomes
- Human waste is **safely managed along the whole sanitation service chain**
- Effective **resource recovery and re-use** is considered
- A **diversity of technical solutions** is embraced, being adaptive, mixed and incremental
- **Comprehensive approaches** to sanitation improvements, encompassing long-term planning, technical innovation, institutional reforms and financial mobilization
- Cities will need to demonstrate **political will** and technical and managerial **leadership**, and to manage **new and creative ways of funding** sanitation
- Combines **both onsite sanitation and sewerage solutions**, in either **centralized or decentralized systems**, to better respond to realities faced in Bank client cities

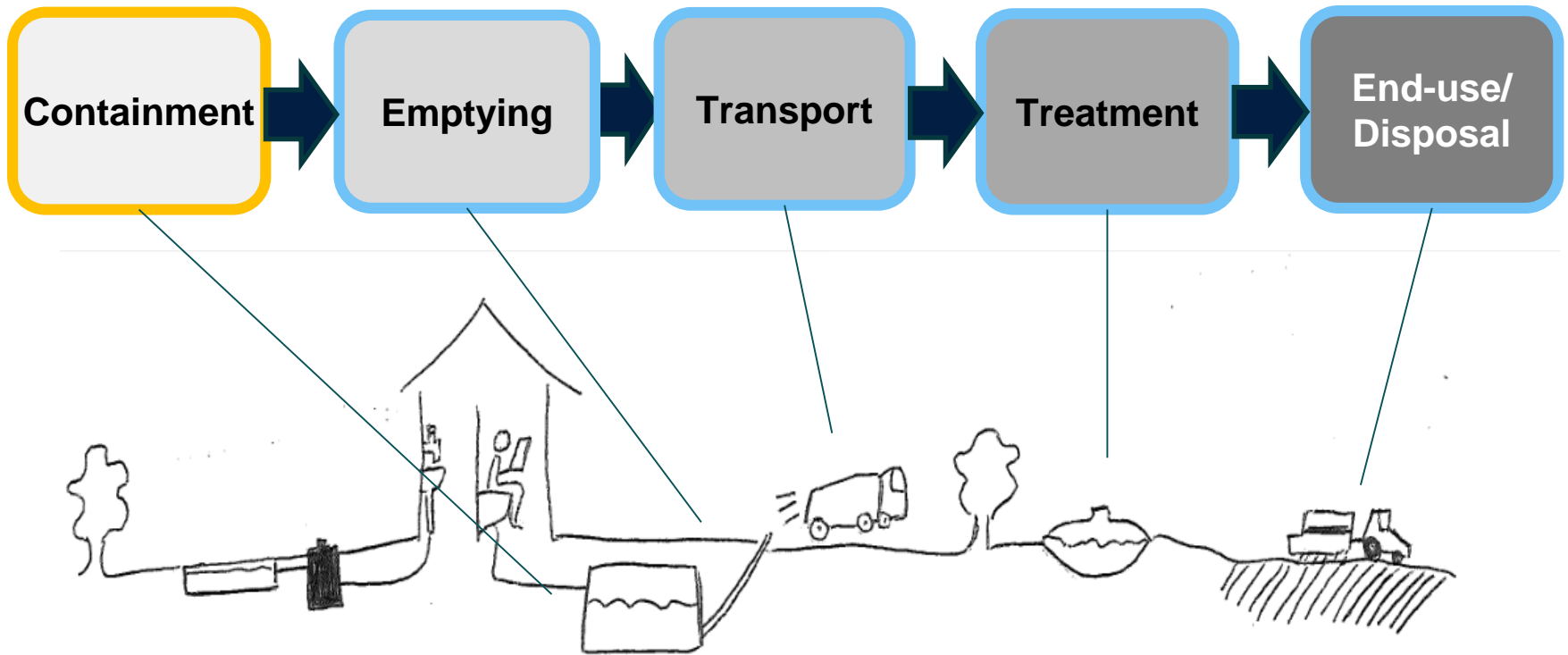
Examples of Citywide Inclusive Sanitation

<https://www.youtube.com/watch?v=z7OomhH3rOY>

Examples of Citywide Inclusive Sanitation

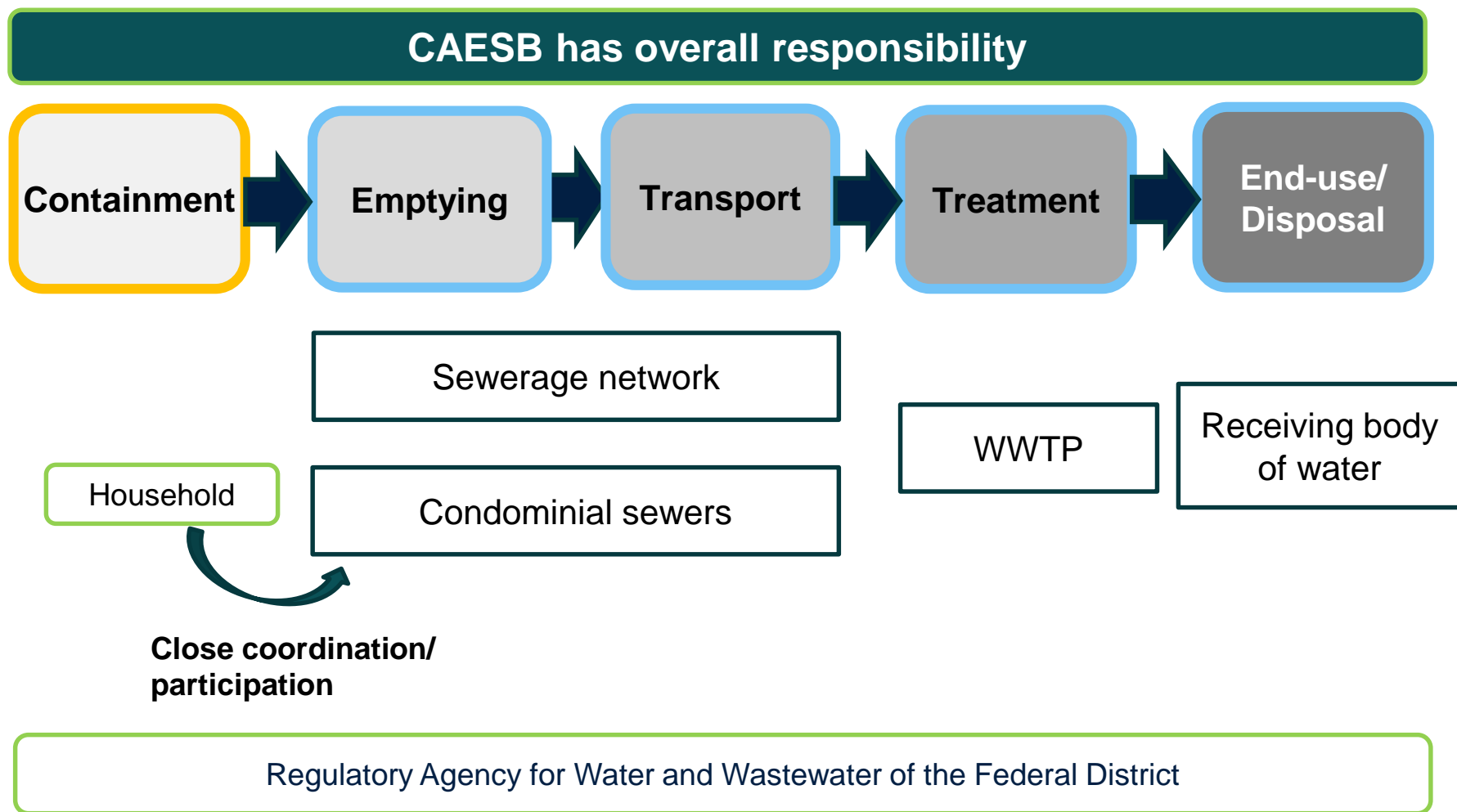
- Brasília, Brazil
- Durban, South Africa
- Manila, The Philippines
- Cochabamba, Bolivia
- Container Based Sanitation, Kenya and Haiti
- El Alto, Bolivia
- Connecting the Unconnected, Colombia and Brazil

The Sanitation Service Chain

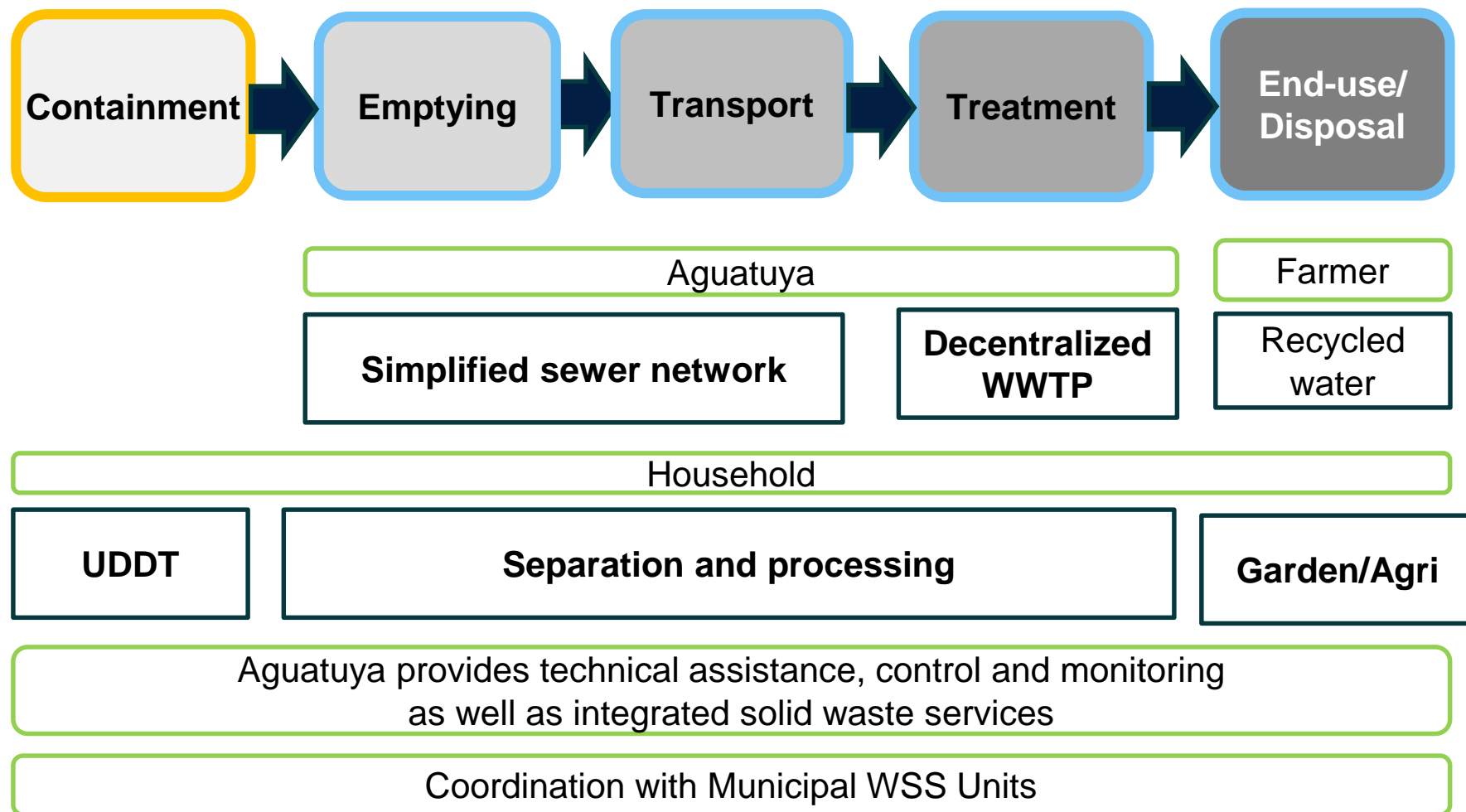


Service Delivery Institutions, Financing & Regulation

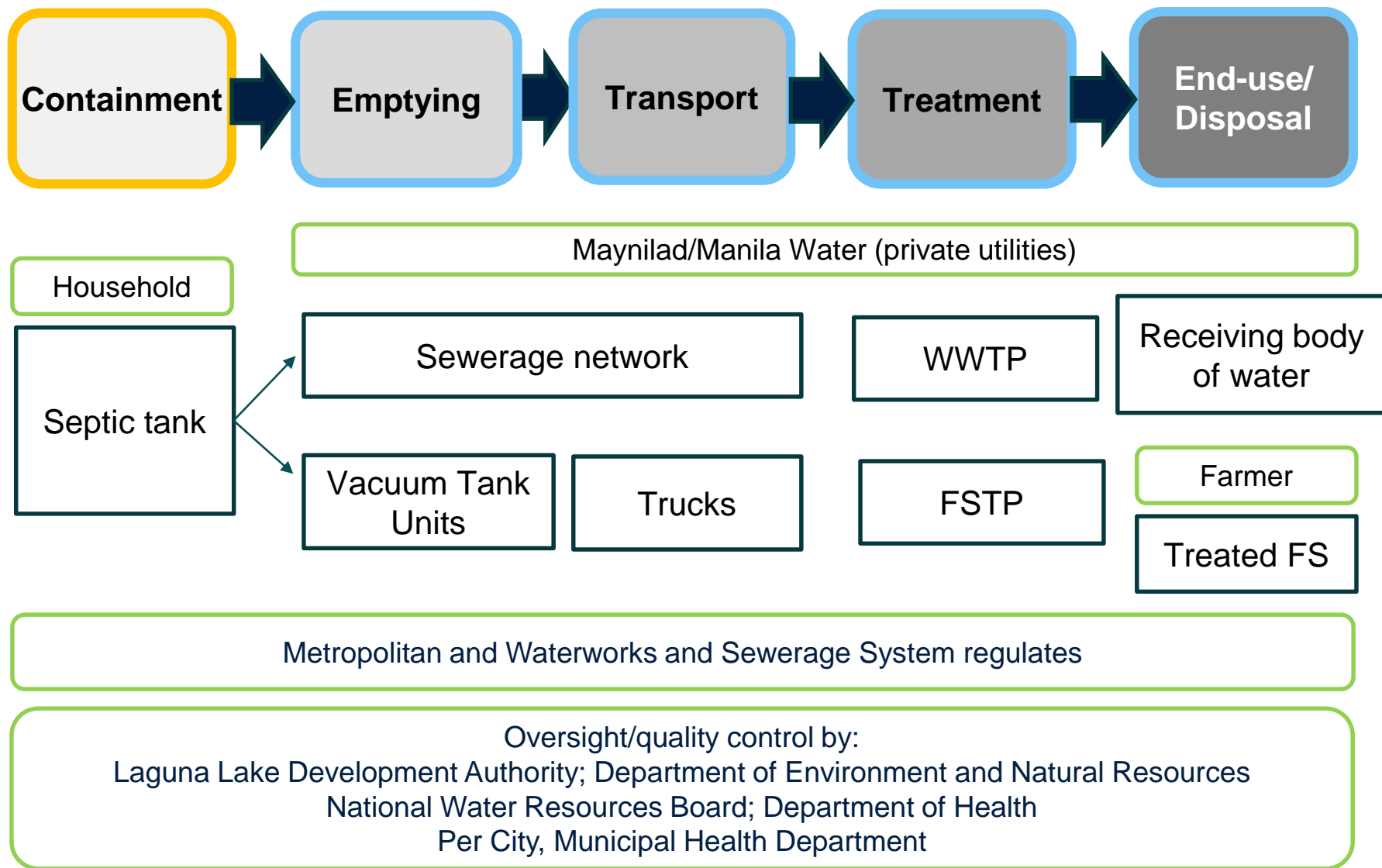
CAESB - Brasilia



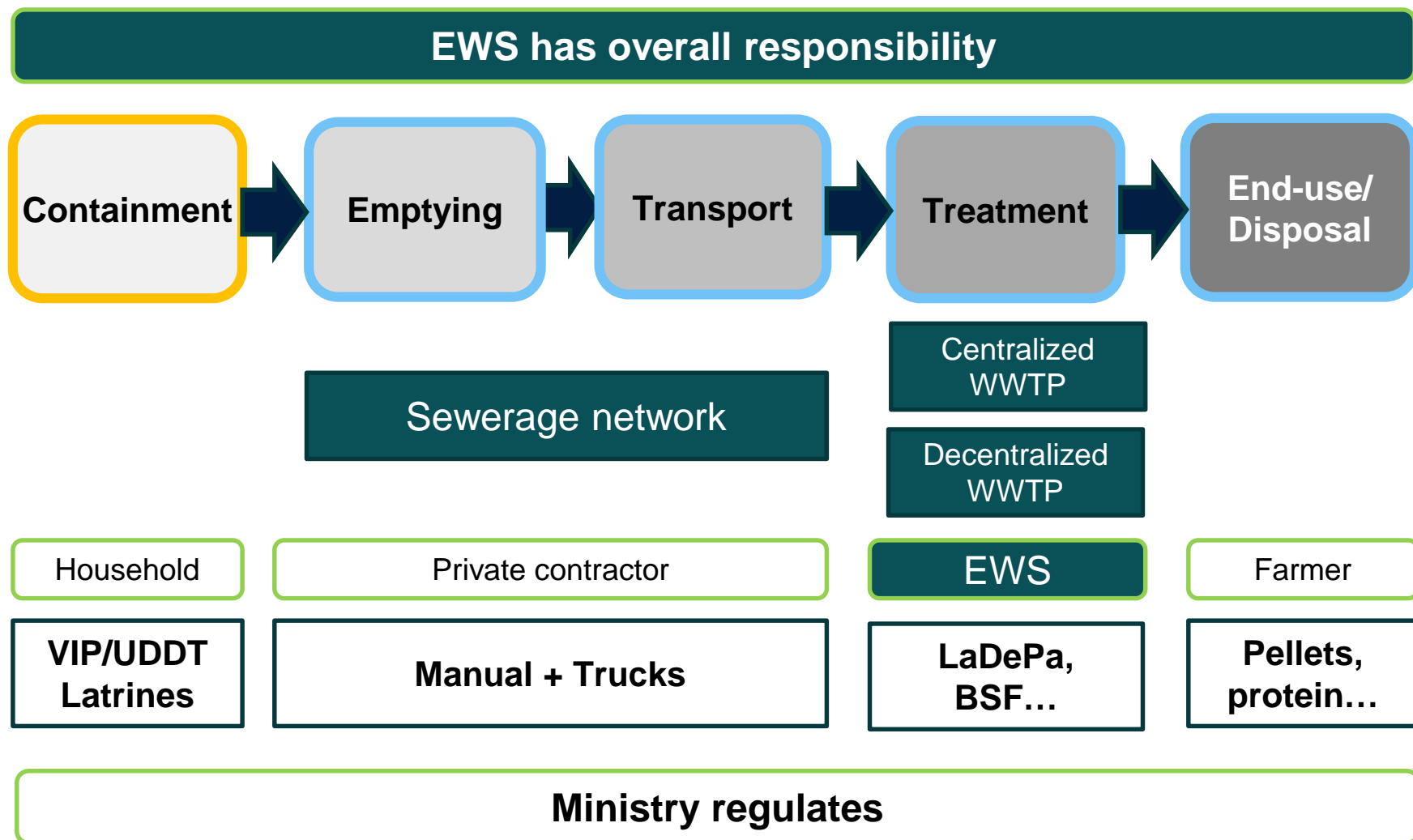
Aguatuya – Cochabamba



Maynilad/Manila Water - Manila



eThekweni Water and Sanitation - Durban



Durban CWIS K&L Event, December 2016

- Focus on *capacity building* and *business development*
 - Careful identification of the countries present and experiences presented
 - 26 countries, 100 participants
- Structured around the idea that we need to focus on *principles for success*
- *Successful experiences* shared from around the world
 - Inclusive sanitation, Durban, South Africa
 - Decentralized sanitation solutions, Cochabamba, Bolivia
 - Fecal sludge management, Dakar, Senegal
 - Sewers and onsite sanitation, Manila, Philippines
 - Condominial sewers and appropriate wastewater treatment, Brasilia, Brazil
 - Regulation of onsite sanitation and wastewater management, Malaysia

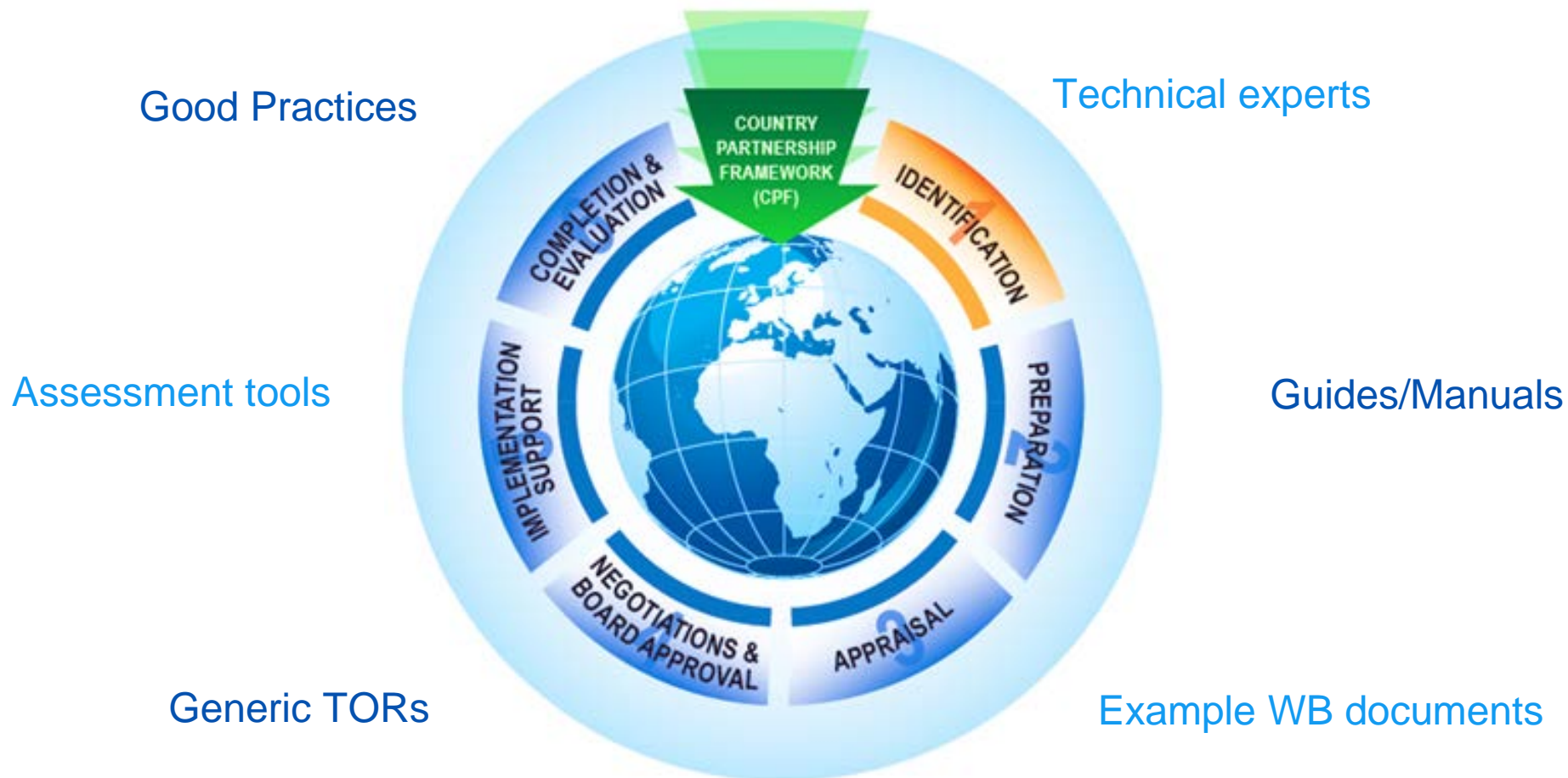
Durban CWIS K&L Event, December 2016

- Overview of *tools for diagnosis and planning*
- *Field visits* to eThekweni Water and Sanitation solutions
- *Interactive pitches* by different practitioners:
 - Sanergy, BORDA, SANDEC, WSUP, case studies presenters, WB colleagues
- Elaboration of *Action Plans* specific to each city's challenges
- *Tailored training*
 - *Inclusive Sewers and Appropriate Wastewater Management*
 - *An Introduction to Fecal Sludge Management*
 - *Financing and Regulating Citywide Inclusive Sanitation*
- *CWIS K&L II, Brasília, 2018... plus other regional events?*
- *CWIS workshops: Ethiopia, Bangladesh, Kenya...*

Durban CWIS K&L event

Coming soon...

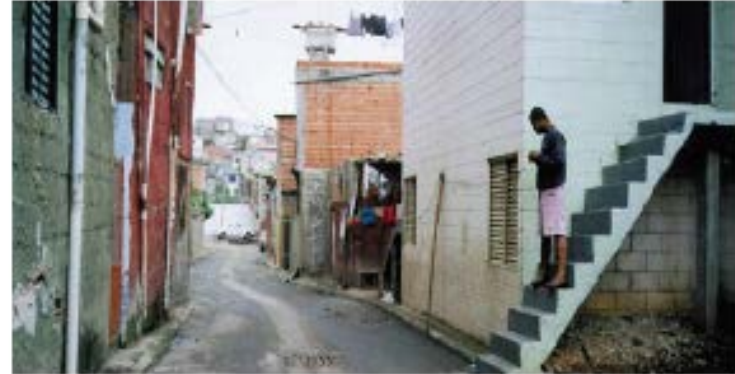
Citywide Inclusive Sanitation – *the website*



Citywide Inclusive Sanitation – *the website*

- Guidelines for undertaking Strategic Urban Sanitation Planning
- Development of a Citywide Inclusive Sanitation planning tool
- Generic TORs for the preparation of Participatory Integrated Master Planning
- Guidelines for undertaking Urban Sanitation Status Index mapping
- Generic TORs for the preparation of Fecal Sludge Management projects/components
- Guidelines and generic TORs for undertaking condominial sewerage interventions
- Translation of the Condominial Manual into English
- Global review of Container-Based Sanitation
- Guidance and good practice document on Connecting the Unconnected for conventional sewerage interventions
- Guidance document on good practice approaches to the design, implementation and management of Public/Shared/Communal Toilets
- Small Towns Wastewater Management and Reuse Manual
- Small Towns Greywater Management and Reuse Manual
- Fecal Sludge and Septage Treatment Design Manual

Citywide Inclusive Sanitation



Moving from inadequate sanitation to citywide inclusive sanitation – an example from São Paulo, Brazil



Thank you

Martin Gambrill
mgambrill@worldbank.org



WORLD BANK GROUP

Water

www.worldbank.org/water | www.blogs.worldbank.org/water |  @WorldBankWater

The Durban Water Recycling Project: The Vision Becomes Reality

DWR PROJECT PRESENTATION



Project Objective

To treat 47.5 MI/d of municipal wastewater to a near potable standard for direct reuse in industrial processes



Durban Water Recycling



Solutions & Technologies

Project Motivation

- Alternative to augmentation of the city's Southern Wastewater Treatment Works marine outfall
- Mondi Paper expressed the desire to increase its off take of reclaimed water
- Industries threatening to leave the municipality



Project History

1993: Mondi approached Durban for the provision of additional recycled water

1994: Durban implemented a technical feasibility study

1995: Pilot plant process investigation indicated the technical viability of the project



Durban Water Recycling



Solutions & Technologies

Project History

1996: Durban undertook construction of the secondary treatment plant

1997: Rand Merchant Bank indicated the financial feasibility of the project

1998: Durban invited tenders for a Public Private Partnership



Durban Water Recycling



Solutions & Technologies

Project History

1999: The concession contract was awarded to Durban Water Recycling

2000: Plant construction began

April 2001: Plant commissioning

May 2001: First water sales



Durban Water Recycling

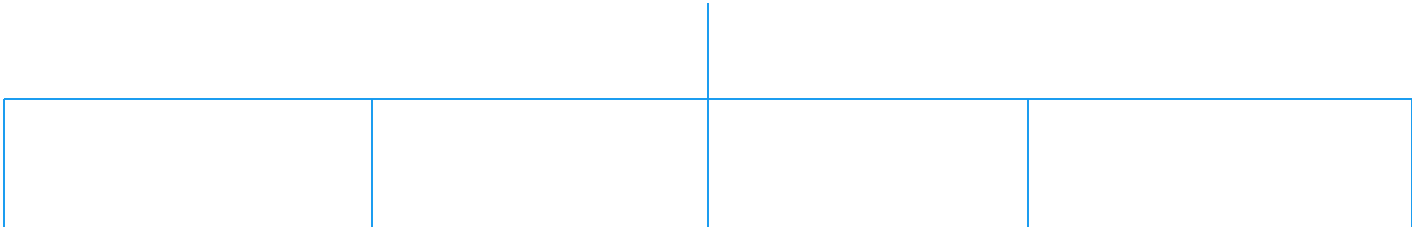


Solutions & Technologies

The Project Consortium



Durban Water Recycling



Contractual Framework



20 Year Concession



Durban Water Recycling

Operating Contract

Construction Contract



Solutions & Technologies



Solutions & Technologies

Clients



Project Achievements - Environment

Sustainable Development of Water Resources

- At capacity, plant reduces city's water consumption by 7%
- Extends the life of the city's water catchment resources
- Freed up municipal water directed to unserved communities



Project Achievements - Environment

Pollution Load Reduction and Waste Minimization

- Reduction in the sea outfall pollution load by 24%
- The process operates at 97.9% water utilization efficiency



Project Achievements - Partnerships

- The 20 year concession is the first PPP of its kind in South Africa
- Strong reliance on the relative expertise of the partners
- A model of success for PPPs in South Africa



Project Achievements - Economics

The City

- Delayed capital investment for increased marine outfall pipeline capacity
- Delayed capital investment for future bulk potable water supply infrastructure
- No capital investment for the construction of the recycling plant



Project Achievements - Economics

The City, continued

- Creation of a long term revenue stream from a levy raised on the production of recycled water
- Reduction in the city's operating costs
- Consequent reduced cost of water services to Durban's citizens



Project Achievements - Economics

Durban Water Recycling (Pty) Ltd.

- Attractive investment opportunity.
- Sustainable, long term project
- Demonstration of the company's technical capacity



Durban Water Recycling

Project Achievements - Economics

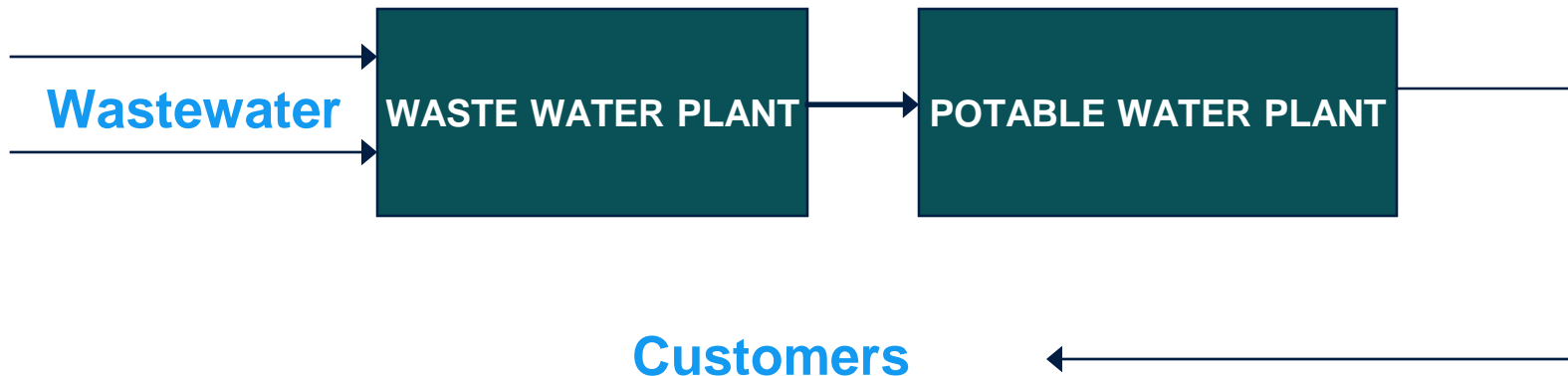
Mondi Paper and Sapref

- 52% saving in water tariff
- Probable lower escalation of recycled water than potable water
- Significantly enhanced drought supply security



The Treatment Philosophy

- A novel combination of wastewater and potable water plants to produce near potable quality water



The Treatment Process

■ Primary treatment

(SCREENING, DEGRITTING, PRIMARY SETTLING TANKS)

- SETTLEABLE SOLIDS REMOVAL

■ Activated sludge

(HIGH SLUDGE AGE)

- REMOVAL OF COD AND NITROGEN POLLUTION



The Treatment Process

- Lamella settling tanks
(COAGULATION, FLOCCULATION, SETTLEMENT)
 - REMOVAL OF COLOUR, PHOSPHATE, COLLOIDAL FRACTION
 - ✓ USAGE OF METAL SALTS, POLYMER

- Dual media filtration
(SAND, ANTHRACITE)
 - REMOVAL OF IRON, RESIDUAL SOLIDS AND REACTION PRODUCTS
 - ✓ USAGE OF POLY ALUMINIUM CHLORIDE



The Treatment Process

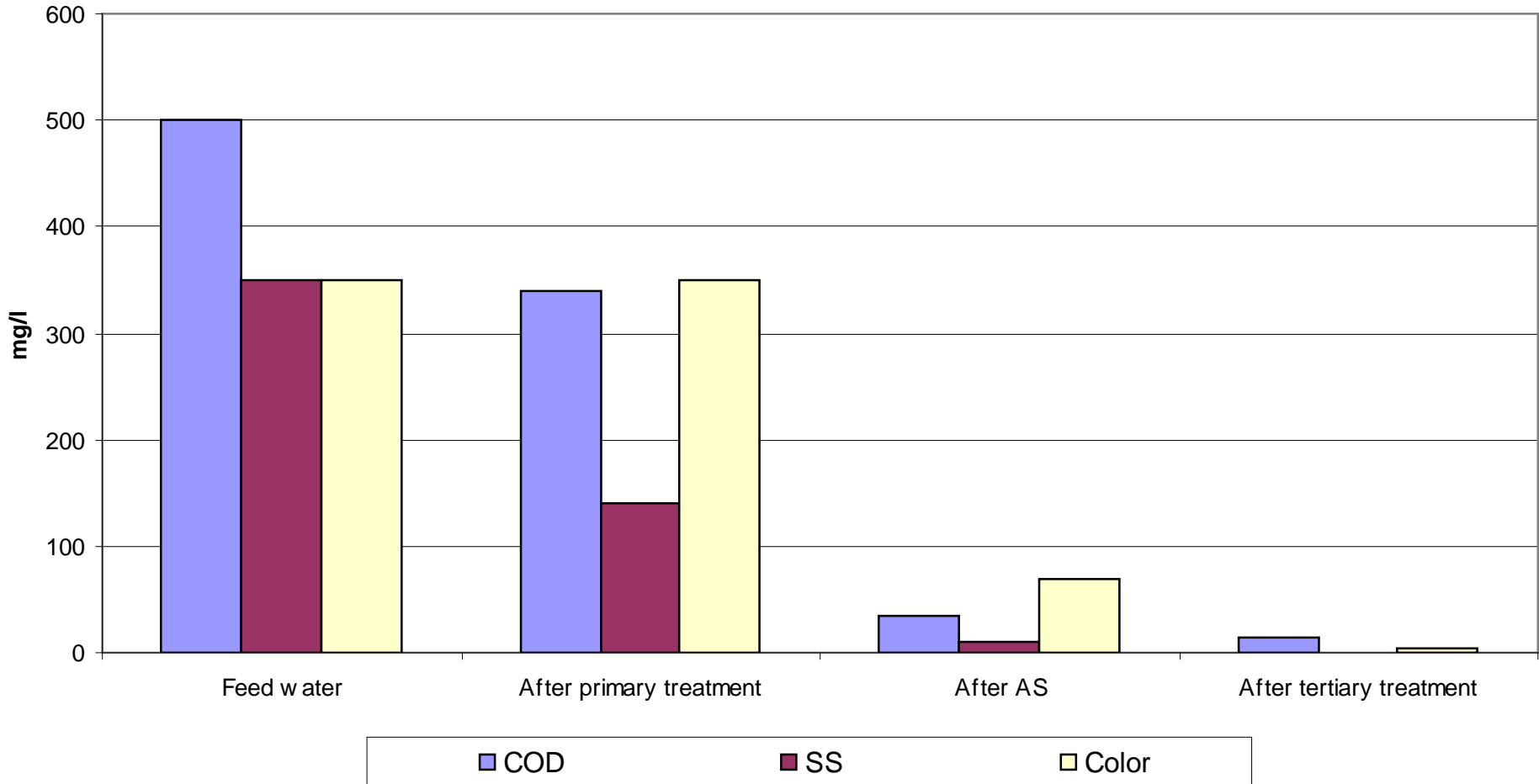
- Ozonation
 - REMOVAL OF COLOUR AND DEGRADATION OF NON BIODEGRADABLE COD
 - ✓ **USAGE OF PURE OXYGEN**

- Activated carbon filtration
 - REMOVAL OF COD BY ADSORPTION AND ASSIMILATION

- Chlorination and storage
 - STABILISATION OF TREATED WATER, STORAGE CAPACITY OF 21000 M3
 - ✓ **USAGE OF CHLORINE**



Pollution Reduction



Reclaimed Water Quality

	RECLAIMED WATER	CLASS 1 POTABLE WATER
COLOUR	2 Ptco	20 Ptco
CONDUCTIVITY	56 mS/m	150 mS/m
AMMONIA	0.2 mg/l	1 mg/l
SODIUM	90 mg/l	200 mg/l
SULPHATE	55 mg/l	400 mg/l
CADMIUM	< 0.01 mg/l	0.005 mg/l
ALUMINIUM	0.01 mg/l	0.3 mg/l
MERCURY	< 0.001 mg/l	0.002 mg/l
CHROMIUM	< 0.01 mg/l	0.1 mg/l
IRON	0.03 mg/l	0.2 mg/l
O-PHOSPHATE	0.2 mg/l	
HET. PLATE COUNT	12 per ml	100 per ml
COD	14 mg/l	



Project Achievements - Technical

- Treatment of wastewater to a very high quality standard
- Extensive re-use of existing infrastructure
- Compact design
- Fast track design and construction
- Waste minimization



Sapref Demin Project



Sapref Demin Project

- RO/mixed bed polishing unit – designed, built and commissioned by VWS in 2002
- VWS provides operational support to Sapref utilities in terms of mechanical and instrument maintenance
- VWS monitors operation of the plant and actions CIP etc

Conclusions

- A MODEL FOR SUCCESSFULL PUBLIC PRIVATE PARTNERSHIPS
- SEWAGE IS NOW A POTENTIAL RESOURCE
- A NEW VISION FOR THE FUTURE: PRODUCTION OF POTABLE WATER FROM SEWAGE...

