

SFD Promotion Initiative

Kochi India

Final Report

This SFD Report was created through desk-based research by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH as part of the SFD Promotion Initiative.

Date of production: 16/01/2016

Last update: 06/06/2016

SFD Promotion Initiative

sustainable
sanitation
alliance

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

On behalf of



Federal Ministry
for Economic Cooperation
and Development


UNIVERSITY OF LEEDS

 **WORLD BANK GROUP**
Water

 **wsp**
water and
sanitation program

WEDC

 Loughborough
University

CSE


eawag
aquatic research

Sandec
Sanitation, Water and
Solid Waste for Development

**BILL & MELINDA
GATES foundation**



SFD Report Kochi, India, 2016

Produced by:

Roeder, L.

©Copyright

All SFD Promotion Initiative materials are freely available following the open-source concept for capacity development and non-profit use, so long as proper acknowledgement of the source is made when used. Users should always give credit in citations to the original author, source and copyright holder.

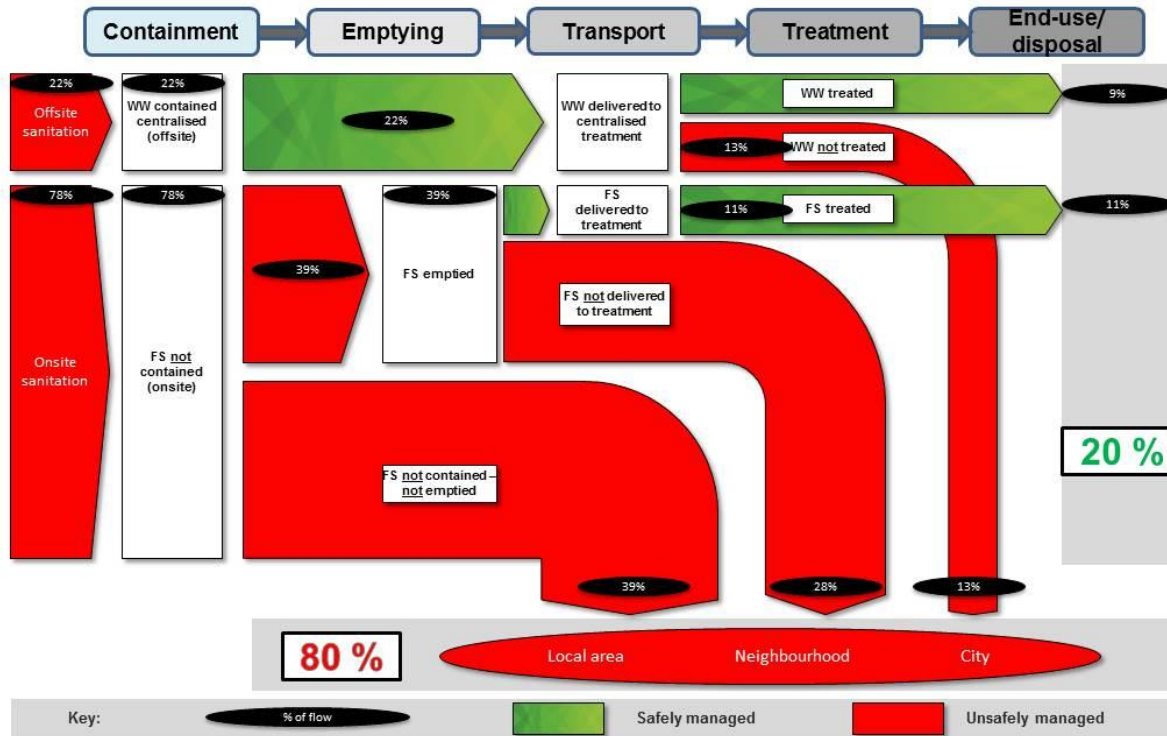
This Executive Summary and SFD Report are available from:

www.sfd.susana.org

1. The Diagram

Kochi / India (15. October 2015)
Desk based

Status: REVIEWED



2. Diagram information

Desk or field based:

This SFD followed the desk-based approach.

Produced by:

This SFD is prepared by Lasse Roeder with support from Rahul Sharma and Esakki Raj (all GIZ) in collaboration with Corporation of Cochin (CoC).

Status:

This is a final SFD.

Date of production:

16/01/2016

3. General city information

The city of Kochi (also known as ‘Cochin’) is the touristic and economic capital of the state of Kerala and is located on the south-west region of India on the Malabar Coast. Kochi is situated within the backwaters on the coastal plain with a maximum elevation of 7.5 meters above sea level.

The municipal boundary of the Corporation of Cochin (CoC) has been chosen for this SFD. CoC has a total population of just over 600,000, distributed over 95 km² (which gives a population density of over 6,300 pers./km²) and is divided in 74 wards. The annual growth rate is currently 0.75 %. The diurnal floating population is estimated to be around 25,000 (4 % of total population).

The city features a tropical monsoon climate with little temperature variations and high amounts of rainfall from May to October (annual rainfall of about 3,000 mm).

4. Service delivery context

The National Urban Sanitation Policy (NUSP) was launched 2008 by the Ministry of Urban Development (MoUD). The extensive framework supports the cities' development towards generating public awareness about sanitation, achieving open defecation free (ODF) status and an integrated, city-wide sanitation system. It concedes financial support to the states and the cities for the preparation of State Sanitation Strategies (SSSs) and City Sanitation Plans (CSPs) respectively, also including decentralized onsite sanitation solutions, to first look on faecal sludge management as of importance for public health.

The Kerala Water Authority (KWA), established by the Government of Kerala in 1984, and the Greater Cochin Development Authority (GCDA) provide water and sanitation services for the CoC. While centralized piped water supply covers the complete city, onsite sanitation facilities are the predominant form of containment, namely septic tanks which cover 71% of the domestic households. Emptying is exclusively done by private service providers. The sector is not regulated or monitored. The CoC does not have treatment facilities for faecal sludge or designated areas for dumping. Illegal dumping and the pollution of surface waters are the consequence. Illegal manual scavenging is reported. CSP outcomes show that the number of households directly connected to an existing sewer network is in the range of 5 % (according to Census 2011 data: 22 %). The total current capacity of two wastewater treatment plants (activated sludge process) operating in the city equals to about 7 % of the total sewerage generated in CoC.

A Memorandum of Understanding (MoU) signed in 2007 between CoC, KWA and the Departments of Local Self Government and of Water Resources of the Government of Kerala (GoK) seeks to produce more accountability in the sector.

The responsibilities for water and sanitation aspects on state and on city level are, however, diffuse and overlapping within the CoC and across the GoK. This applies especially to the monitoring of onsite sanitation systems.

5. Service outcomes

The Census of India from 2011 was the first census to include a section on household sanitation facilities. The questionnaire focused on the containment technologies present in the

households. However, also connections to the central sewer system were noted.

- Containment: According to the census 98.5 % of all households in the CoC have toilet facilities within their premises, with 22 % with direct connection the sewer system, 71 % septic tanks and 5.5 % with pit latrines and other systems among them. Public toilets (1 %) and open defecation (0.5 %) play only a minor role.
- Emptying: There is no central monitoring of the onsite sanitation systems (and hence no reliable data). Private companies provide the service of emptying of septic tanks and pit latrines, charging between 3,000-5,000 Rupees per mission. There is substantial demand for more affordable services. A part of the households rely on individual emptying and cleaning. It can be assumed that norms and standards of faecal sludge handling such as the Manual Scavengers and Construction of Dry Latrines (Prohibition) Act (1993) are not complied with.
- Transport: The sewerage is piped to the nearby treatment plants. As the influent of the treatment plants shows very low BOD-levels (as low as 15 mg/L) it is assumed that during the transport of the sewerage big amounts of groundwater and of water from drains infiltrate the sewer. This is due to the poor condition of the sewer network. No data is available on the transport of faecal sludge from onsite sanitation facilities.
- Treatment: Treatment of sewerage is done in two plants, run by KWA and GCDA. The total capacity of the two plants corresponds to about 9 % of the total waste water produced in CoC. However, the treatment capacity is expected to be increased to eight times the current capacity in the short term. A new Septage Treatment Plant (STP) has been built and is soon to be officially inaugurated. The capacity of the STP corresponds to about 31 % of the total faecal sludge generated in Kochi.
- End-use / disposal: According to the Service Level Status Report 2010-2011 no reuse of treated wastewater or faecal sludge is practiced in Kochi.

KWA draws the fresh water needed for the water supply of Kochi from two sources of surface water: Periyar and Muvatupuzha rivers situated around 10 and 20 km, respectively, north of the city. The flat terrain and a high water table are conditions that lead to a high risk of pollution of the groundwater by septic tanks and pit latrines. Sandy soil condition throughout the region and a monsoon season extending for more than 6 months are circumstances that additionally support fast infiltration and small retention times.



Figure 1: Water supply intake at Periyar river (CDP Kochi 2006)

6. Overview of stakeholders

The Indian constitution classifies questions concerning the water and sanitation sector as state subjects. The Kerala Municipality Act from 1994 regulates the responsibilities for these topics within the state of Kerala.

Key Stakeholders	Institutions / Organizations /
Public Institutions	Corporation of Cochin (CoC), Greater Cochin Development Authority (GCDA), Kerala Water Authority (KWA), Cochin Port Trust
Private Sector	Several private emptiers
Development Partners, Donors	ADB

Table 1: Key Stakeholders (CSP Review, 2014)

Both state-level and municipality-level (Urban Local Bodies, ULBs) agencies share responsibilities for the water and sanitation sector. This leads to overlaps in responsibilities and accountabilities. Table 2 shows the agencies responsible in CoC for the sanitation sector, divided in four service stages.

Service	Responsible agencies
Planning	KWA, CoC
Implementation	KWA, CoC, Cochin Port Trust (for Willington Island), and other local bodies

O & M	KWA, Cochin Port Trust (for Willington Island), and other local bodies
Tariff fixation	KWA

Table 2: Institutional framework and responsibilities for the sanitation sector (CSP, 2011)

7. Credibility of data

Data sources:

Data concerning the containment facilities in Kochi was drawn from the Census of India 2011. Data concerning the further steps of the sanitation chain emptying, transport, treatment and disposal / reuse were collected from official reports (like the Service Level Status Report), secondary literature review and the outcomes of Key Informant Interviews, that were already conducted during the revision of the City Sanitation Plan. This data has to be regarded as mostly qualitative. No additional Key Informant Interviews and Focus Group Discussions were conducted.

Assumptions:

- Census 2011 data was regarded as correct.
- The treatment capacity of the existing plants is fully used and treatment is done meeting the standards.
- All faecal sludge deriving from the emptying of onsite sanitation facilities is dumped on open ground or directly into water bodies.
- The proportion of faecal sludge in onsite sanitation facilities is 50 %.

Annotations:

The Census 2011 was the first census to collect data relating to the household sanitation situation (only containment-data). It is expected that, because of limited experience and technical know-how from the surveyors, the resulting data is expected to be differing from the actual situation. Cross-checking with other data sources was only possible for single numbers. A comparison of the data concerning the offsite sanitation systems supported the assessment of credibility.

Some of the issues and challenges are listed below:

Data gaps:

- The major data gap identified concerns the management of onsite sanitation systems. No regular monitoring is in place so that only vague assumptions could be made.

- There is a discrepancy between the data concerning the %age of population being connected to the sewer system and the reported treatment capacity.
- No reliable data on the amounts of waste water entering the treatment plants was available. Low BOD-levels suggest high dilution with groundwater. Leakages can only be assumed to be prevalent.
- Hydrogeological data is required for the assessment of the risk of groundwater pollution. As conditions in Kochi seem to favor contamination, possible health risks are likely to exist.
- Very limited data was available on the reuse (especially informal reuse).

Below is the list of data sources used for the production of SFD:

- Published reports:
 - Census in India 2011. HH-8 : Households by Availability of type of Latrine Facility
 - Corporation of Cochin 2011. City Sanitation Plan for Kochi
 - Ministry of Urban Development 2012. Service Levels in Urban Water and Sanitation Sector Status Report (2010-2011)
 - Administrative Staff College of India 2006. City Development Plan Kochi 2006
- Unpublished reports:
 - GIZ 2014. City Sanitation Plan Updation – Status Report Corporation of Cochin

8. Process of SFD development

This SFD is based on data derived from outcomes of the Census of India from 2011. Where ever possible, Census data was cross-checked with data from secondary sources such as the City Sanitation Plan, its review and the City Development Plan.

No additional Key Informant Interviews were conducted for this SFD.

The SFD calculation tool was then used to calculate the single mass transfers based on the data resulting from the literature review.

Limitations of SFD:

In circumstances where groundwater is a relevant environmental media that is prone to contamination detailed groundwater maps need to be used to precisely determine affected parts of town.

It should also be mentioned, that CSP data is more up-to-date (2014 for the review) than Census-data. Therefore, a comparison is difficult.

Further Key Informant Interviews and field-trips to sites of interest within the city have to be conducted in order to judge the compliance with the reality of the city.

9. List of data sources

SFD Promotion Initiative

sustainable sanitation alliance

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
On behalf of Federal Ministry for Economic Cooperation and Development

UNIVERSITY OF LEEDS

WORLD BANK GROUP

wsp water and sanitation program

WEDC Loughborough University

CSE

eawag aquatic research

BILL & MELINDA GATES FOUNDATION

SFD Kochi, India, 2016

Produced by:

Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Roeder, L.

© Copyright

All SFD Promotion Initiative materials are freely available following the open-source concept for capacity development and non-profit use, so long as proper acknowledgement of the source is made when used. Users should always give credit in citations to the original author, source and copyright holder.

This Executive Summary and the SFD Report are available from:

www.sfd.susana.org

Table of Content

1	City context	1
2	Service delivery context description	2
2.1	Policy, legislation and regulation	2
2.1.1	Policy	2
2.1.2	Institutional roles	2
2.1.3	Service provision	3
2.1.4	Service standards	5
3	Service Outcomes	7
3.1	Overview	7
3.2	SFD Matrix	8
3.2.1	Risk of groundwater contamination	10
3.2.2	Uncertainty of the data	11
4	Stakeholder Engagement	11
4.1	Key Informant Interviews	11
5	Acknowledgements	11
6	References	11
7	Appendix	12
7.1	Appendix 1: Stakeholder identification	12
7.2	Appendix 2: Tracking of Engagement	12
7.3	Appendix 3: SFD matrix	12
7.4	Appendix 4: Thematic maps	14



List of tables

Tab. 1: KMC Institutional framework sanitation sector	3
Tab. 2: Water and Sanitation services in CoC by KWA.....	4
Tab. 3: Compliance with SLBs according to service level status report 2010-2011 ('Status 2011') and CSP-review ('Status 2013').....	6
Tab. 4: Distribution of Toilet Facilities	7
Tab. 5: Sanitation types in use in households	9



List of figures

Fig. 1: Corporation of Cochin (CoC) administrative map with ward boundaries	1
Fig. 2: Septic tank serviced areas in the city of Kochi	5

Abbreviations

BMGF	Bill and Melinda Gates Foundation
BOD	Biochemical Oxygen Demand
CoC	Cooperation of Cochin
CPHEEO	Central Public Health & Environmental Engineering Organisation
CSP	City Sanitation Plan
CSTF	City Sanitation Task Force
EPA	Environmental Protection Act
FSM	Faecal Sludge Management
GCDA	Greater Cochin Development Authority
GoK	Government of Kerala
KPIs	Key Performance Indicators
IS	Indian Standard
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KMC	Kochi Municipal Corporation
KSPCB	Kerala State Pradesh Pollution Control Board
KSUDP	Kerala Sustainable Urban Development Project
KWA	Kerala Water Authority
lpcd	Liters per capita per day
masl	Meters above mean sea level
mbgl	Meters below ground level
MoUD	Ministry of Urban Development
NMC	Nashik Municipal Corporation
NRM	Non-revenue Water
Rs.	Indian Rupees (Exchange rate August 2015: 1 USD \cong 65 Rs.)
SBM	Swachh Bharat Mission



SLBs	Service Level Benchmarks
SS	Suspended Solids
SSS	State Sanitation Strategy
STCA	Septic Tank Cleaners' Association
STP	Septage Treatment Plant
TCM	Thousand cubic meters
ULBs	Urban Local Bodies
WSSB	Water Supply and Sanitation Board
WWTP	Wastewater Treatment Plant

1 City context

Kochi, also known as Cochin, is the economic, touristic and commercial capital of the state of Kerala, which is located on the south-west region of India on the Malabar Coast.

The population of the urban agglomeration of Kochi is 2.1 million. The Corporation of Cochin (CoC) was formed by the merging of three municipalities and neighboring areas in 1967. CoC has a population of just over 600,000 inhabitants, divided in 74 wards and covering 95 km² (Census 2011). The decadal growth rate of CoC is 7.8 % (annual growth of 0.75 %, GIZ 2011). As an economic and touristic center, CoC is estimated to have a diurnal floating population of 25,000 (Corporation of Cochin 2015) and an overall floatation of 30,000 people (GIZ 2014). The city features a tropical monsoon climate with little temperature variations and high amounts of rainfall from May to October (annual rainfall of about 3,000 mm).

Several physical and geographical features affect the sanitation situation in Kochi negatively.

Kochi is situated within the backwaters on the coastal plain with a maximum elevation of 7.5 meters above mean sea level (masl). The resulting high water table leads to the infiltration of groundwater into sewers. Narrow roads, predominantly sandy soil, heavy rainfalls during monsoon season and unfavorably terrain conditions further complicate the construction of new sewer lines and are major challenges for sanitation services (GIZ 2014, Devi 2016).

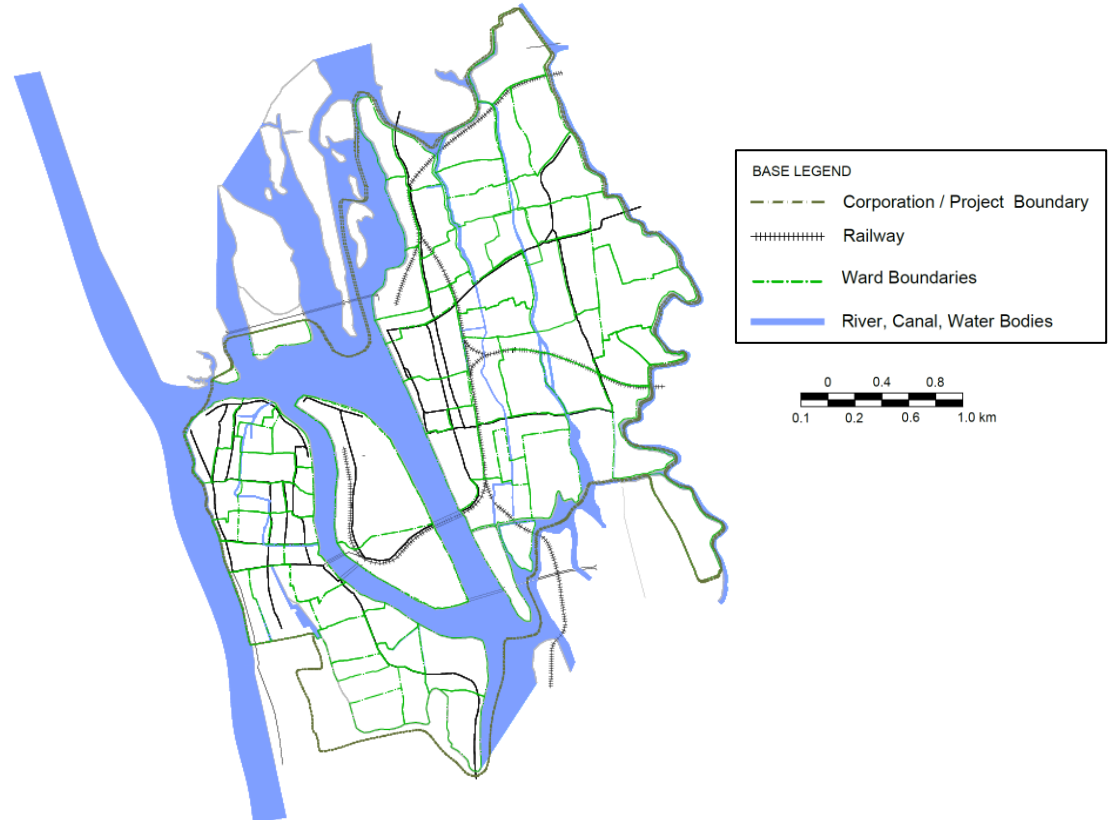


Fig. 1: Corporation of Cochin (CoC) administrative map with ward boundaries (GIZ 2014)

2 Service delivery context description

2.1 Policy, legislation and regulation

2.1.1 Policy

The recognition of the right to sanitation as part of the fundamental right to life under Article 21 of the Indian Constitution gives a strong mandate for sanitation in India.

The Water (Prevention and Control of Pollution) Act, 1974 and the Environmental (Protection) Act (EPA), 1986 together empower the government to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution (GIZ 2015). Most of the states of India (including Kerala) have, however, not used the provisions of the EPA to introduce specific rules for managing faecal sludge (GIZ 2015).

Under the Water Act and the EPA the Central Government supports programs / schemes for wastewater management in order to limit environmental pollution.

The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in 2005 focused (in terms of the sanitation sector) on investments in centralized sewerage systems. Faecal sludge management (FSM) of and onsite sanitation in general were not covered.

FSM in India is traditionally mainly regarded as a 'household / private provision' and not as concern for public health and for city-sanitation with relevance for the ULBs (GIZ 2015). The consequence is a lack of holistic planning along the sanitation chain.

It was the National Urban Sanitation Policy (NUSP), 2008 that encouraged the states and the cities for the preparation of State Sanitation Strategies (SSSs) and City Sanitation Plans (CSPs) respectively, also including decentralized onsite sanitation solutions, to first look on FSM as of importance for public health.

The Swachh Bharat Mission (SBM), launched in 2014, supports the goals expressed in the NUSP financially with a focus on the needs of the urban poor. The Atal Mission for Rejuvenation and Urban Transformation (AMRUT), launched in 2015, considers FSM management as one of its mission components & concedes financial support for the same.

2.1.2 Institutional roles

The Seventh Schedule (Article 246) of the Indian constitution classifies 'Public health and sanitation [...]' and 'Water, that is to say, water supplies, irrigation and canals, drainage and embankments [...]' as state subjects (List II, Entry 6 and List II, entry 17, respectively).

The Kerala Municipality Act, 1994 regulates the responsibilities for the topics of water and sanitation within the state of Kerala. The responsibility for the sanitation sector is entrusted to the Standing Committee for Health and Education of the Municipal Council.

The Kerala Water Authority (KWA) was established by the Government of Kerala (GoK) in 1984 with the aim to bring more commercialization to and create more accountability in the sector (Central Public Health & Environmental Engineering Organisation [CPHHEO] 2013).

Also the Kerala Sustainable Urban Development Project (KSUDP), an initiative by the GoK financially supported by the Asian Development Bank, is active in the planning and implementation sector.

Tab. 1 gives an overview over the responsibilities in the sanitation sector.

Tab. 1: KMC Institutional framework sanitation sector (GIZ 2014, GIZ 2014b)

Urban Service	Planning	Implementation	O & M	Tariff fixation	Regulation
Water Supply	KWA, KMC, KSUDP	KWA, Cochin Port Trust (for Port areas)	KWA, Cochin Port Trust (for Port areas)	KWA	KWA
Sewage Management	KMC, KWA, GCDA, KSUDP, CPT	KWA, KMC, Cochin Port Trust (for Willingdon Island), and other local bodies	KWA	KWA	KWA, KMC, Cochin Port Trust (for Willingdon Island), and other local bodies, KSPCB
On-site Sanitation	KWA, KMC	KWA, CoC, Cochin Port Trust (for Willingdon Island), and other local bodies	KWA, KMC	-	KWA, KMC, Cochin Port Trust (for Willingdon Island), and other local bodies
Faecal sludge Management	KMC, KSUDP	KSUDP, Suchitwa Mission	KMC	KMC	KMC, KSPCB

2.1.3 Service provision

KWA provides both water and sanitation services (only systems with centralized sewers) for the state of Kerala.

As a large part of the groundwater in the city of Kochi is saline and cannot be augmented as a source, water is drawn mainly from the Periyar River in close proximity to Kochi and Muvattupuzha River (GIZ 2014). Around 170-200 Thousand Cubic Meters (TCM) of drinking water are supplied daily to CoC (MoUD 2012, estimate). See Appendix 7.4 for a map of the water supply network in Kochi.

Tab. 2: Water and Sanitation services in CoC by KWA (Ministry of Urban Development, Government of India 2012, GIZ 2014 and Census 2011)

	Description	unit	value
Water Supply	Length of water network	km	1,500
	No. of total water connections	-	119,070
	No. of domestic water connections	-	110,696
Sewerage	Area covered by sewer system	km ²	4
	Area covered by sewer system / total area	%	5
	No. of total sewerage connections	-	1,052

KWA operates one Sewage Treatment Plant (capacity of 4.5 TCM daily), which is located at Elamkulam south-east of the area covered by the sewer system. Revenue from the sewerage system comes only from new connection charges. No additional user charges apply for the production of sewerage. KWA depends on the grants obtained from the State Govt. (Kerala Sustainable Urban Development Project (KSUDP) 2014). Additionally, the Greater Cochin Development Authority (GCDA) operates a small sewer network covering about 1 hectare with a treatment plant. Appendix 4 shows a map of the existing sewer networks and additionally proposed networks for future implementations (GIZ 2011).

Around 70-80 suction trucks, operated by 25-30 private service providers, are in use for the desludging of the household septic tanks. Although unregulated and non-monitored, the private operators are organized within a Septic Tank Cleaners' Association (STCA). Households have to pay Rs. 3,000-5,000 per desludging service, which is needed approximately every two to three years. The fee is regarded as very high in relation to the average local earnings (GIZ 2014b). Each truck operates around 2-3 trips per day (GIZ 2014b).

Fig. 2 shows the division of Kochi into seven sanitation zones of which six zones are almost entirely serviced by septic tanks.

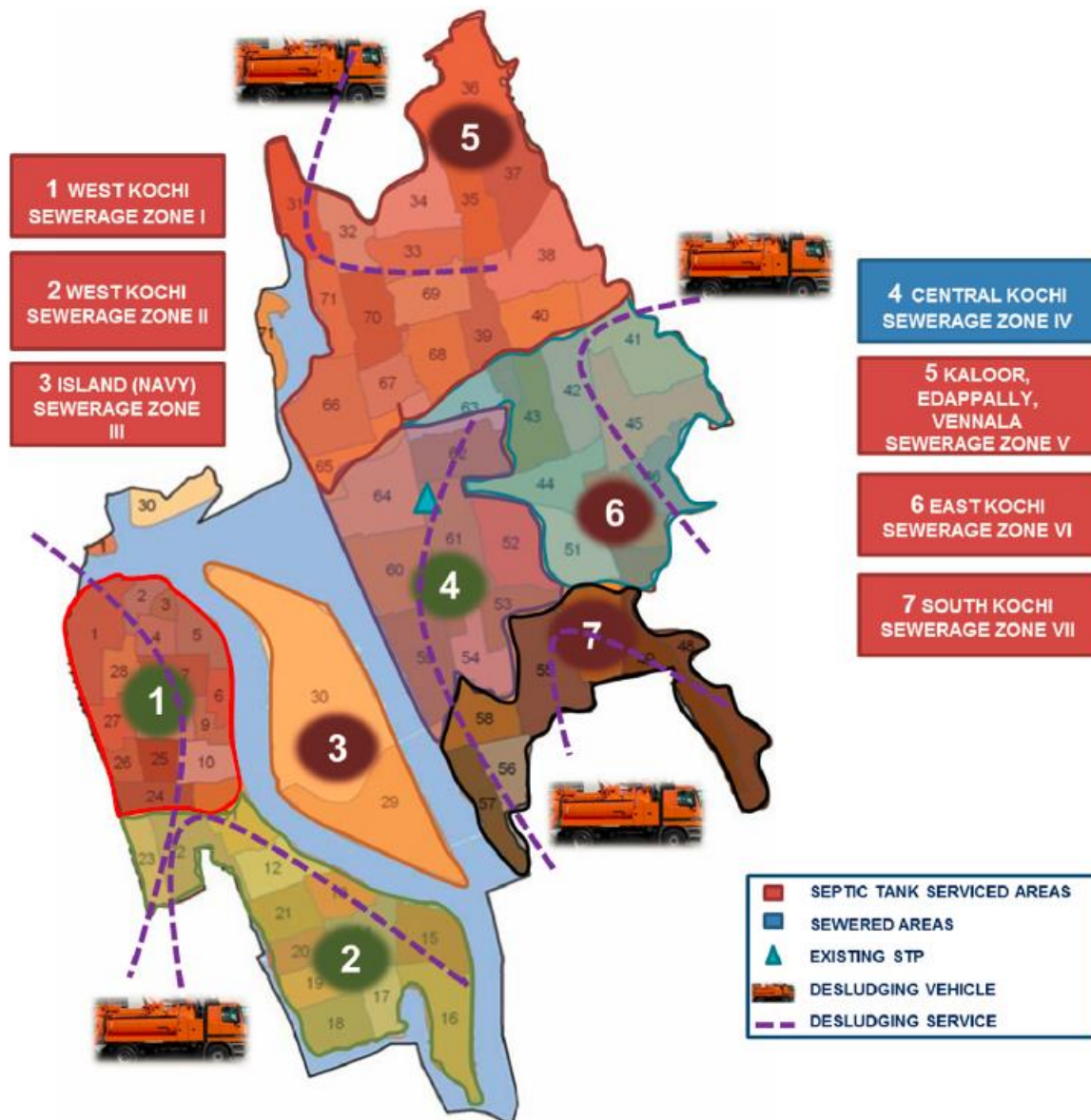


Fig. 2: Septic tank serviced areas in the city of Kochi (GIZ 2014b)

2.1.4 Service standards

The Service Level Status Report, published 2012 by the Ministry of Urban Development (MoUD), gives an overview over the compliance of the sanitation system of a city with the Service Level Benchmarks (SLBs). SLBs do not include the offsite sanitation chain, apart from the containment system.

Tab. 3 shows the service level status for sewerage benchmarks and for water supply benchmarks of importance for the sanitation sector both in 2011 (according to Service Level Status Report) and 2013 (according to the review of the CSP).

Tab. 3: Compliance with SLBs according to service level status report 2010-2011 ('Status 2011') and CSP-review ('Status 2013') (MoUD 2012, GIZ 2014). The status concerning water supply mentioned in the CSP-review relies on 2011-2012 data.

	Description	unit	SLB	Status 2011	Status 2013
Water Supply	Coverage Connections	%	100	67.7	68
	Per capita supply	<i>lpcd</i>	135	130.0	130
	Metered Connections	%	100	81.5	82
	Non-revenue Water (NRM)	%	20	40.0	39
	Continuity of supply	<i>Hrs.</i>	24	18	18
	Quality of treatment	%	100	99.3	99.5
	Cost recovery	%	100	40	40
Sewerage	Coverage of toilets	%	100	95	NA
	Coverage of sewerage network services	%	100	5	6
	Collection efficiency of the sewerage network	%	100	100	100
	Adequacy of sewerage treatment capacity	%	100	4.5	6
	Reuse and recycling	%	20	-	-
	Quality of sewerage treatment	%	100	-	100
	Cost recovery	%	100	-	-

Only 45 % of households report to rely only on municipal water supply. The rest relies on municipal supply or other sources (such as public stands posts, tanker lorries and private sources) (GIZ 2011).

Onsite sanitation systems are not operated by KWA. Information on onsite sanitation systems are not a component of the Service Level Benchmarks (SLB) The Indian Standard (IS) code 2470 (Part 1 & 2) – 1985 and the Manual on Sewerage and Sewage Treatment, 2013 published by the Central Public Health & Environmental Engineering Organization (CPHEEO) provide detailed norms and standards for the design of septic tanks and disposal of septic tank effluent.

Currently, there is no adequate monitoring of service standards for the onsite sanitation sector being executed. Also, very limited information regarding the spatial coverage of the septic tanks in the city is available (GIZ 2014b).

A baseline assessment of the faecal sludge situation carried out in 2014 showed that standards and guidelines of IS 2470 & CPHEEO regarding location, design, construction and desludging of septic tanks are in most cases not complied with. Also the 'Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993' and "The Prohibition of Employment as Manual Scavengers and their Rehabilitation' Act are not complied with (GIZ 2014b). A new act for eradicating Manual scavenging titled 'The Prohibition of Employment as Manual Scavengers and their Rehabilitation' Act came into force in December 2013.

3 Service Outcomes

3.1 Overview

This report is based on a desk-based-assessment of the sanitation situation in Kochi, Kerala, India. This SFD resorts to the City Sanitation Plan for Kochi, 2011, its Review, 2014, the concept on integrated FSM for Kochi, 2014 (all three supported by GIZ) and the Indian Census 2011 data.

The objective of the present SFD is to strictly follow the methodology of the BMGF-financed SFD promotion project.

The city of Kochi was part of a NUSP sanitation ranking exercise conducted for the years 2009-2010. Of a possible score of 100 points the score of the city of Kochi was 41.07 points, which is classified as 'need for considerable improvement'. 41.07 points equals to the 81st rank out of 423 cities.

Tab. 4 describes the summarized sanitary situation for CoC. About 19 out of 20 households have toilet facilities within the premises. Open defecation plays a minor part in the sanitation situation.

Tab. 4: Distribution of Toilet Facilities (Ministry of Urban Development 2012)

Origin category	unit	value
Households	%	95.5
Shared or communal toilets	%	4.1
Open defecation	%	0.4

KWA solely focuses on the service provision for offsite sanitation systems. Onsite sanitation systems are either abandoned or directly emptied to the open ground or water body or emptied by privately operated suction trucks. The sector is not regulated or monitored by the authorities.

Around 70-80 trucks are operating in CoC (GIZ 2014b), each with a suction capacity of 6 m³ and each with an estimated 3 transports per day. Operation times are roughly from 9pm to 5am. Desludging legal regulations such as the Manual Scavengers and Construction of Dry Latrines (Prohibition) Act are seldom compiled (GIZ 2014b). The amount paid for the desludging and transport of 6 m³ lies between Rs. 3,000-5,000 (GIZ 2014).

According to STCA, approx. 200 m³ of faecal sludge is generated per day in the city. The faecal sludge is dumped illegally to surface waters or on open ground as a matter of routine (GIZ 2011). There are no plans to treat and reuse faecal sludge by the city administration (GIZ 2014b). No designated areas for the treatment or the disposal of faecal sludge exist (GIZ 2014).

- The most common **containment** technologies in Kochi are the septic tank, followed by pit latrines, and centralized sewer and open defecation. Surveys show that many septic tanks do not comply with location, design and construction guidelines (GIZ 2014b).
- **Emptying** is not monitored by the authorities but managed by private run businesses. Desludging is done on request of the residents when a septic tank is overflowing (GIZ 2014b). Due to high groundwater tables, infiltration of onsite technologies has to be considered as unsafe disposal.
- **Transport:** The properties of the influent entering the WWTP suggest considerable dilution of the sewage by groundwater. Transport of faecal sludge is conducted via faecal sludge trucks.
- **Treatment:** The sewage is conveyed to the WWTP in Elamkulam and treated in an activated sludge process. Effluent data suggest an adequate treatment performance (GIZ 2014). A new Septage¹ Treatment Plant (STP) was constructed recently at Brahmapuram east of the city center with a capacity of 100 m³ daily. Official inauguration and starting is expected soon. There are plans for an additional STP near Mundamveli (West Kochi Sewerage Zone I in Fig. 2, Devi 2016).
- **End-use / Disposal:** As there is no designated disposal site in the city either, the faecal sludge is illegally and irregularly dumped on open ground or directly in water bodies. The treated wastewater is disposed to the nearby river.

3.2 SFD Matrix

The Census of India 2011 was the first census to include a sanitation questionnaire. The census covered only the interface and the containment steps of the sanitation chain.

Tab. 5 shows the ratios of the domestic sanitary facilities present in Kochi. Although the data does not show it is assumed that the public latrines are equipped with septic tanks (1 % of Kochi households relying on public latrines as per census data).

¹ Faecal sludge deriving from septic tanks is generally referred to as 'septage' in the Indian context

Tab. 5: Sanitation types in use in households (Census 2011, rounded values)

Interface	Containment	Unit	Value	Reference in SFD
Flush or pour flush toilets	Connected to sewer	%	22	W1
	Connected to septic tank	%	72	F1
	Connected to open drain / open ground	%	2	F1
	Total	%	96	-
Pit latrines	VIP	%	3	F1
Direct connection to open drain		%	1	F1
Open defecation		%	0	OD9

Containment

All the sewage from the households connected to the sewer system (as per Census 2011) is contained centralized (offsite, 22 %).

There is no information available on the status of the onsite sanitation systems present in the city of Kochi. All septic tanks and pit latrines are therefore assumed to be fully functional and containing the supernatant/ faecal sludge. Pits that are abandoned when they are full have to be assumed not containing the faecal sludge because of the high water tables and the possible contamination of drinking water sources (78 %, see section 3.2.2).

Emptying

Private operators provide desludging services for septic tanks. The service provision in terms of number of vehicles is adequate (GIZ 2014b). Therefore it is assumed that all septic tanks are emptied in specific intervals. There are no reports regarding the desludging services for pit latrines. It is assumed that the proportion of each septic tank which is FS is 50 % (as default).

Transport

The sewer network conveys the collected sewerage to the treatment plants. As no data concerning the capacity of the sewer network is available, it is assumed that all conveyed wastewater reaches the WWTP. Faecal sludge is transported by privately operated trucks.

Treatment

The treatment capacity of the two existing treatment plants for the sewer-conveyed waste water is about 5.5 TCM daily. With a water supply of 135 liters per capita and day and an assumed wastewater generation of 80 % of the water supply this corresponds to a treatment adequacy of 9 % (according to the sewage generation projections from 2014, GIZ 2014).

There is a discrepancy between the %age of people being connected to the offsite sanitation system (22 % according to Census 2011) and the capacity of the WWTP.

The maximum capacity of the existing treatment plants is assumed to be utilized and treatment quality is assumed to be sufficient (see Ministry of Urban Development 2012).

A newly constructed STP with a capacity of 100 m³ daily in Brahmapuram east of Kochi is about to be inaugurated. With a volume of faecal sludge generated daily in Kochi of 326 m³ (GIZ 2014b, Devi 2016) about 31 % of the faecal sludge generated can be assumed to be treated. It is further assumed that the treatment quality is adequate.

Reuse / Disposal

All data reviewed for this report stated there is no reuse of treated faecal matter in Kochi.

Results

Following the reports and the assumptions made and explained in this report, 20 % of the faecal matter in Kochi is safely managed. This corresponds to the capacities of the WWTP operated by KWA in Elamkulam, the WWTP operated by GCDA in the Marine Drive area and the new STP in Brahmapuram.

This results in 80 % of the faecal matter being managed unsafely. 67 % derive from onsite sanitation systems that are emptied by private service providers but for which no treatment facility is available.

Safely managed: 20 %

Unsafely managed: 80 %

3.2.1 Risk of groundwater contamination

Several aspects influence the risk of groundwater contamination. As a large part of the Kochi sanitation chain is not regarded as safely managed, contaminants reach the open ground and surface waters. The risk of groundwater pollution and the interrelated consequences to the urban health strongly depend on hydrogeological conditions and the question, where drinking water derives from.

As stated in Section 1 Kochi lies entirely on the coastal plain and the maximum elevation of Kochi is 7.5 masl. The soil tends to be supporting infiltration because of low organic content and coarse soil composition. The depth of the groundwater level in the Kochi area ranges between 2 and 4.5 meters below ground level (mbgl) (GIZ 2011). Contamination of groundwater resources is therefore very likely to occur.

Piped drinking water is extracted from two surface water sources north of the city (section 2.1.3). The coverage of water supply is 68 % as of 2013 (Tab. 1). According to a survey only about 45 % of the population relies solely on piped water supply (GIZ 2011). The remaining 23 % partially rely on other sources, such as private bore-holes. The 32 % of the population without household water connections either rely on shared water connections or on other sources such as wells. Therefore the risk of drinking water sources being contaminated with unsafely managed faecal matter seems very realistic.

3.2.2 *Uncertainty of the data*

This report is produced as a desk-based assessment. No field-visits were conducted. It is based on several reports from 2011 to 2014. Therefore, data deriving from different years had to be used.

There is a discrepancy between Census data concerning households connected to the sewer network and the data from the Service Level Status Report regarding the adequacy of the treatment capacity.

There is very little data available concerning the onsite sanitation chain.

4 Stakeholder Engagement

4.1 Key Informant Interviews

A Key Informant Interview (KII) was conducted in accordance with the methodology to verify the information retrieved from various reports. Aim of the interview was the validation and the actualization of data derived from the reports. The interview was conducted via e-mail with Mr. Esakki Raj (GIZ) and Mrs. Girija Devi (Executive Engineer II, Kochi Municipal Corporation).

5 Acknowledgements

This SFD is dedicated to the citizens of Kochi. It wouldn't have been possible without the support of Dirk Walther, Rahul Sharma and Esakki Raj (all GIZ India).

6 References

- 1 Census of India 2011. HH-8: Households by Availability of type of Latrine Facility
- 2 Central Public Health & Environmental Engineering Organization, 2013 - Manual on Sewerage and Sewage Treatment Systems. Third Edition – Revised and Updated
- 3 Corporation of Cochin 2015. Urban Knowledge Base – Demography. Available from: <<http://www.innovation.gov.au>>. [06 August 2015].
- 4 Devi 2016. Personal communication with Mrs. Girija Devi via mail. February 2016.
- 5 GIZ 2011. City Sanitation Plan for Kochi
- 6 GIZ 2014. City Sanitation Plan Updation – Status Report Corporation of Cochin
- 7 GIZ 2014b. Support to National advisory on integrated septage management – City level concept for Kochi
- 8 GIZ 2015. Sanitation Management – Implementation Framework
- 9 Kerala Sustainable Urban Development Project (KSUDP) 2014. City Development Plan Kochi

10 Ministry of Urban Development 2008. National Urban Sanitation Policy – Towards City Wide Sanitation

11 Ministry of Urban Development 2012. Service Levels in Urban Water and Sanitation Sector – Status Report (2010-2011). First Edition, January 2012

12 State Level Sanitation Committee (SLSC), GIZ 2015. Kerala: State Sanitation Strategy (Under National Urban Sanitation Policy, 2008)

7 Appendix

7.1 Appendix 1: Stakeholder identification

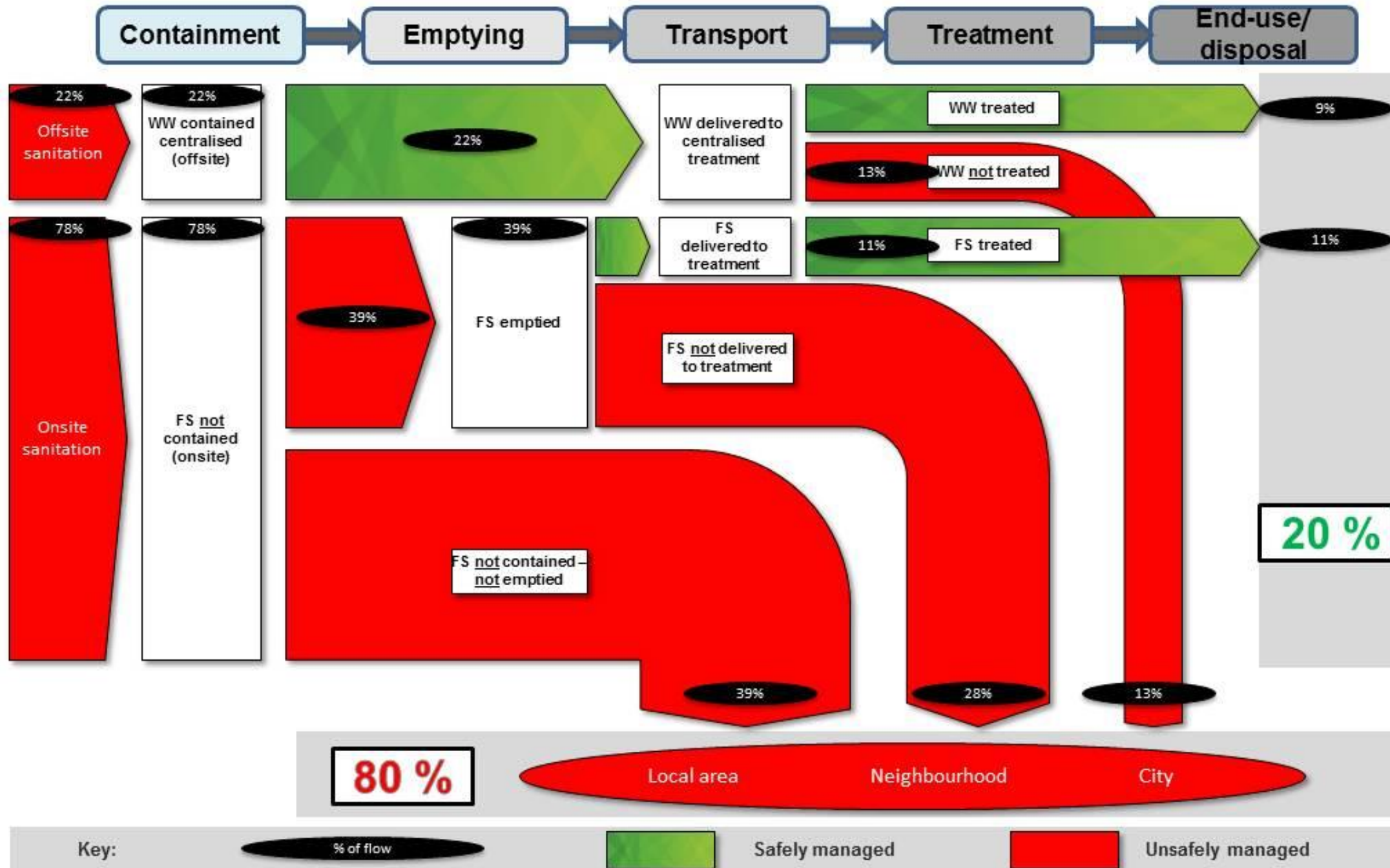
Additionally to the Key Informant Interviews that were conducted during the CSP-process, the GIZ representative in Kochi, Mr. S. Esakki Raj, working at the offices of the Corporation of Cochin, was contacted for an update of information.

Mr. S. Esakki Raj (Technical Expert, SNUSP, GIZ Environmental Cell, PIU), Corporation of Cochin.

7.2 Appendix 2: Tracking of Engagement

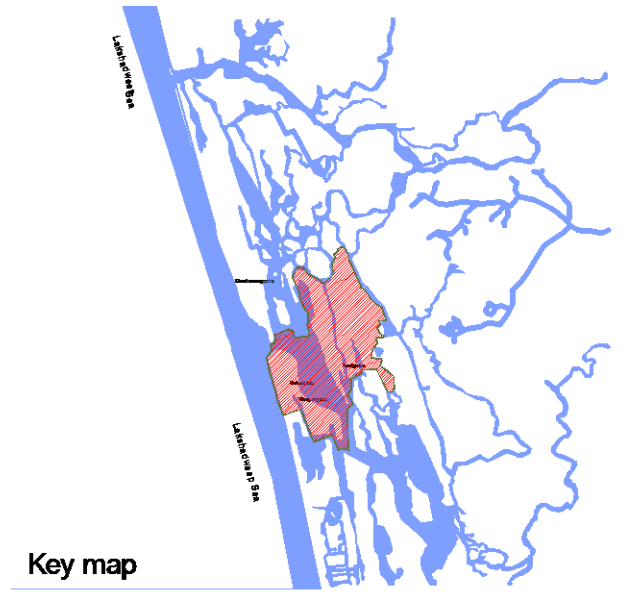
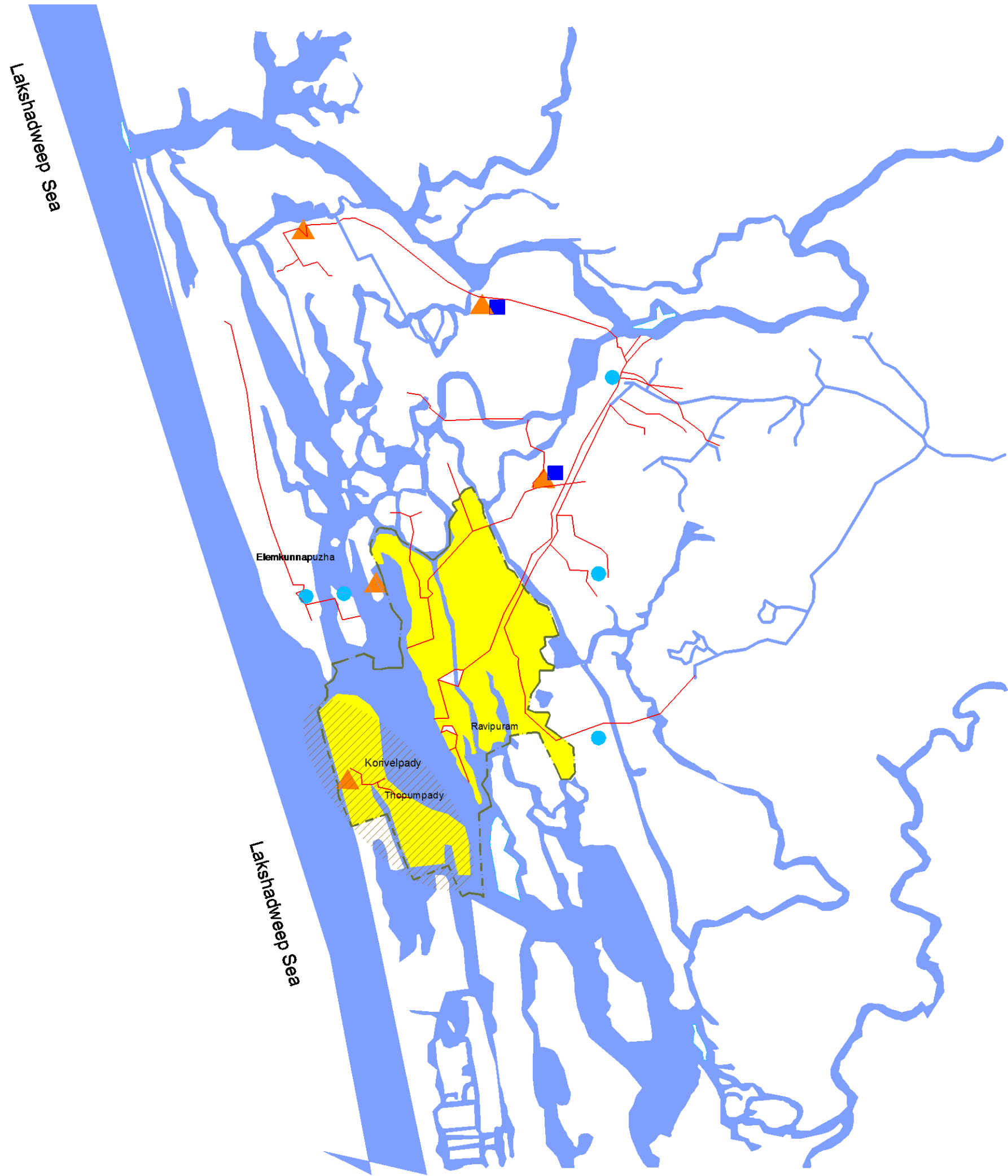
The stakeholder was contacted by mail the 23rd of August 2015. The main outcomes were a better up-to-date understanding of the institutional framework in the sanitation sector, more precise information on private agencies active in the sector and on the newly built STP in Brahmapuram.

7.3 Appendix 3: SFD matrix





7.4 Appendix 4: Thematic maps



- BASE LEGEND**
- Corporation / Project Boundary
 - River, Canal, Water Bodies
- OVERLAY LEGEND**
- Pumping Main
 - G.L. Reservoir
 - Pumping Station
 - Over Head Tank
 - Corporation Area
 - Water Supply Deficit Area

Map 6:
Water Supply Distribution System

Adapted from:
Kerala Sustainable Urban Development Project (KSUDP)

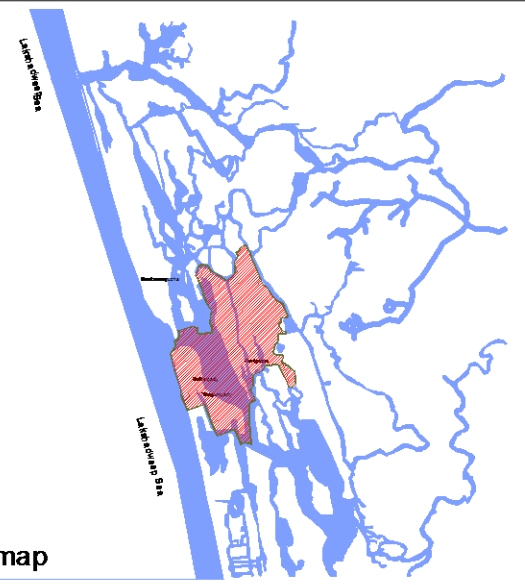
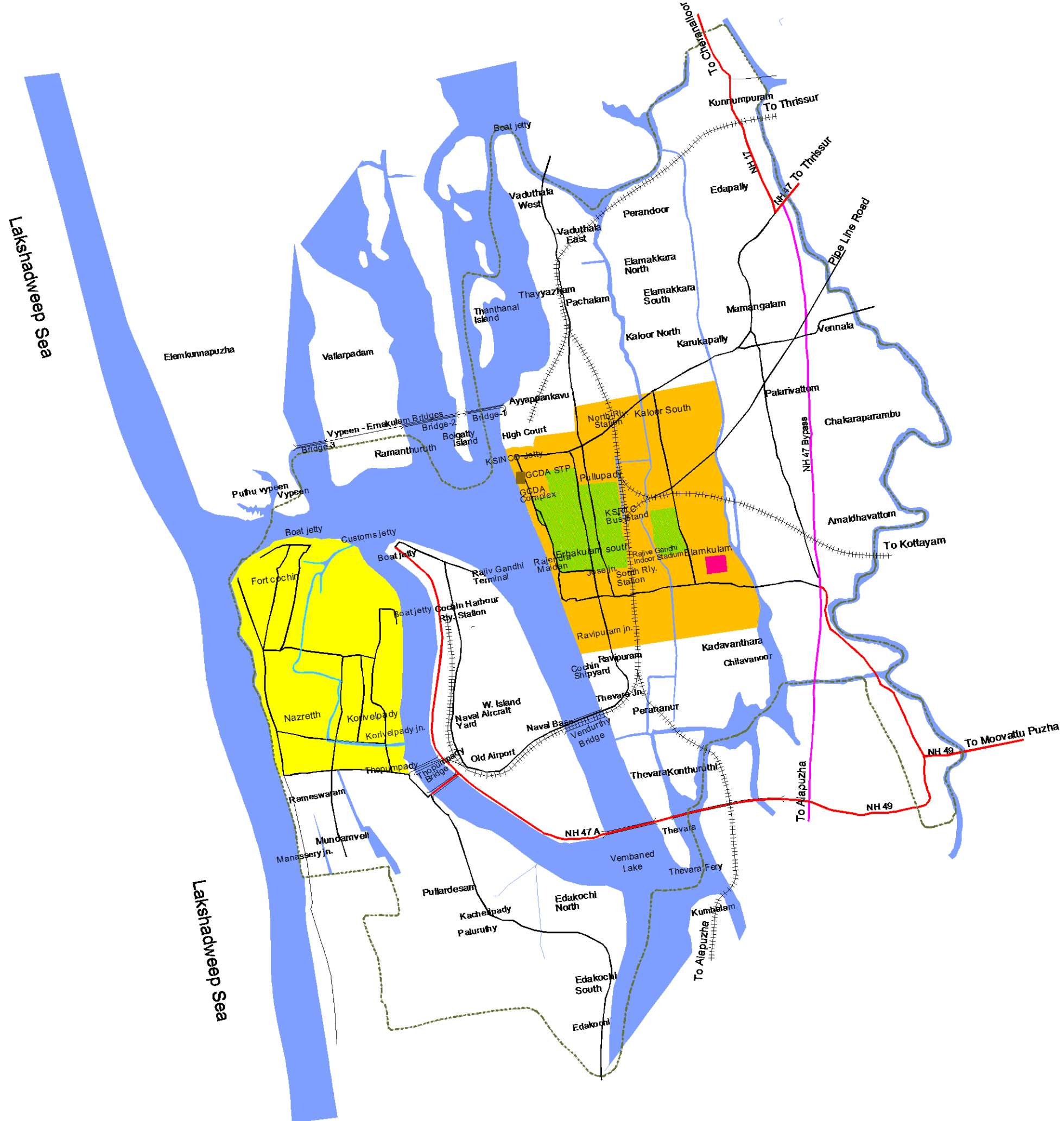
Project:
City Sanitation Plan - Kochi

Client:
Kochi Municipality & GTZ

Scale:

Consultant:

ICRA Management Consulting Services Limited



Key map

- BASE LEGEND**
- Corporation / Project Boundary
 - +++++ Railway
 - National Highway
 - Nh Bypass
 - Major Roads
 - Minor Roads
 - River, Canal, Water Bodies

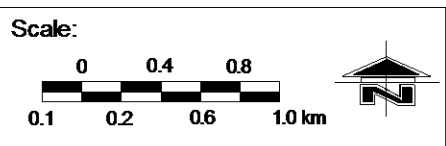
- OVERLAY LEGEND**
- Selected Sewerage Projects**
- Area Covered by existing sewerage system
 - Sewerage System - South Emakulam
Population - 60,000
 - Sewerage - North Kochi
Population - 180,000
 - 1. Additional 10 MLD STP (South Emakulam)
 - 2. 23 MLD STP of North Kochi at Mundamvelli
 - GCDA STP

Map 9:
Sewerage System/network Map - Kochi

Adapted from:
Kerala Sustainable Urban Development Project (KSUDP)

Project:
City Sanitation Plan - Kochi

Client:
Kochi Municipality & GTZ



ICRA Management Consulting Services Limited