

Wastewater Investment Master Plan Package 1: Makassar

Final Master Plan

August 2011
Indonesian Infrastructure Initiative

Australia Indonesia Partnership
Kemitraan Australia Indonesia

Mott MacDonald

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Content

Glossary and Acronyms

ABR	Anaerobic Baffle Reactor	
ADB	Asian Development Bank	*Bank Pengenbangan Asia*
Amdal	Environmental Impact Assessment	*Analisis Menganai Dampak Lingkungan*
Andal	Environmental Impact Assessment	*Analisis Dampak Lingkungan*
APBD	Regional Revenue Expenditure Budget	*Anggaran Pendapatan Belanja Daerah*
APBN	National Revenue Expenditure Budget	*Anggaran Pendapatan Belanja Nasional*
AusAid	Australian Agency for International Development	
BAPEPAM	Capital Market Regulatory Official	*Badan Pengawas Pasar Modal*
Bappeko		*Badan Perencanaan Pembangunan Kota*
Bappenas	National Development Planning Agency	*Badan Perencanaan Pembangunan Nasional*
Bappeda	Local Government Planning Agency	*Badan Perencanaan Pembangunan Daerah*
BLH	Environmental Agency	*Badan Lingkungan Hidup*
BOD	Biochemical Oxygen Demand	
BORDA	Bremen Overseas Research and Development Association	
BOT	Built Operate Transfer	
BPHTB	Land and buildings property transfer tax	*Bea Perolehan Hak atas Tanah dan Bangunan*
CARE	American NGO	
CBD	Central Business or Commercial District	
CD	Covered Drains	
CKTR	Human Settlements and Spatial Planning	*Cipta Karya dan Tata Ruang*
COD	Chemical Oxygen Demand	
CSS	City Sanitation Strategy	
CT	Communal Treatment	
DAK	Special allocation of funds (from central to regional governments)	*Dana Alokasi Khusus*
DAU	General allocation of funds	*Dana Alokasi Umum*
DED	Detailed Engineering Design	
DEWATS	Decentralized Wastewater System	
DGHS	Directorate General of Health Service	
DGT	Directorate General of Taxation	
DINAS	Municipal office	
DJCK	Directorate General of Human Settlements of the Ministry of Public Works	*Direktorat Jenderal Cipta Karya*
DKI	Special Capita District	*Daerah Khusus Ibukota*
DKP	Department of Hygiene and Gardening	*Dinas Kebersihan dan Pertamanan*
DPRD	Regional Government parliament	*Dewan Perwakilan Rakyat Daerah*
EHRA	Environmental Health Risk Assessment	
ESP	Environmental Service Program	
FAP	Facultative Anaerobic Pond	
FOPIP	Financial and Operational Performance Improvement Plan	
GAPENSI	The Indonesia Constructors Association	*Gabungan Pelaksana Konstruksi Nasional Indonesia*
GDP	Gross Domestic Product	
GoA	Government of Australia	
GoI	Government of Indonesia	

GPS	Global Positioning System	
IBRD	International Bank for Reconstruction and Development	
ICD	Interceptors (leaching pit which has been made watertight or septic tank) and discharge of the effluent in adapted covered stormwater drains	
IPAL	Sewage Treatment Plant	*Instalasi Pengolahan Air Limbah*
IPLT	Septage Treatment Plant	*Instalasi Pengolahan Lumpur Tinja*
IUIDP	Integrated Urban Infrastructure Development Program	
LIDAP	Local Institutional Development Action Plans	*Rencana Pengembangan Institusi Pelaksana Daerah*
LKPP	Government Institution on Procurement Policy	*Lembaga Kebijakan Pengadaan Pemerintah*
LP	Leaching Pit	
LP+	Improved Leaching Pit	
MCK	Community toilet and washing facility	*Mandi Cuci Kakus*
MDB	Multilateral Development Banks	
MDG	Millennium Development Goals	
Mott MacDonald	Mott MacDonald Indonesia	
MoF	Ministry of Finance	
MPW	Ministry of Public Works	
MSMHP	Metropolitan Sanitation Management and Health Project	
NGO	Non Governmental Organization	
NJOP	Property valuation	*Nilai Jual Obyek Pajak*
NMCP	NGO Management Certificate Program	
O&M	Operation & Maintenance	
OBA	Output Based Aid	
OD	Open Defecation	
ODF	Open Defecation Free	
PAMSIMAS	Community based water supply and sanitation	*Penyediaan Air Minum dan Sanitasi berbaSis Masyarakat*
PBB	Property Tax	*Pajak Bumi dan Bangunan*
PD	Government Owned Company	*Perusahaan Daerah*
PDAM	Local Drinking Water Corporation	*Perusahaan Daerah Air Minum*
PERDA	*Local decree*	*Peraturan Daerah*
Perpres	Presidential Decree	*Peraturan Presiden*
PKL	Food Stalls	*Pedagang Kaki Lima*
PLN	National Electricity Company	*Perusahaan Listrik Negara*
PLP	Directorate of Environmental Sanitation	*Penyehatan Lingkungan Permukiman*
PMK	Ministry Of Finance Regulation	*Peraturan Menteri Keuangan*
PNS	Government Employeee	*Pegawai Negeri Sipil*
POKJA	Work Group	*Kelompok Kerja*
PP	Government Regulation	*Peraturan Pemerintah*
PPN	Value added tax	*Pajak Pertambahan Nilai*
PPSP	Settlement sanitation development acceleration	*Percepatan Pembangunan Sanitasi Pemukiman*
PSO	Public Service Obligation	
PSP	Private Sector Participation	

Puskesmas		*Pusat Kesehatan Masyarakat*
RBC	Rotating Biological Contactor	
RISPK	Urban Sanitation Plan	*Rencana Induk Sanitasi Perkotaan Kota*
RO	Reverse Osmosis	
Rp.	Indonesian Rupiah	
RPJM	Regional/Local Medium-term Development Plan	*Rencana Pembangunan Jangka Menengah Daerah*
RPJMN	National Medium-term Development Plan	*Rencana Pembangunan Jangka Menengah Nasional*
RSH	Urban green planning	*Rencana Daerah Hijau*
RTRW	Regional/Local Spatial Plan	*Rencana Tata Ruang Wilayah*
Rukan	Combined house and office	*Rumah Kantor*
Ruko	Combined house and shop	*Rumah Toko*
Sanimas	Community Based Sanitation	*Sanitasi Masyarakat*
SBS	Small Bore Sewerage	
SDS	Sewer Discharge Station	
SIER	Surabaya Industrial Estate Rungkut	
SMS	Septage Management System	
SOSEC	Social-economic	*Sosial Economic*
SPAL	Domestic wastewater disposal system	*Saluran Pembuangan Air Limbah*
SS	Shallow Sewerage	
SSDP	Sewerage and Sanitation Development Program	
ST	Septic Tank	
ST/AUF	Septic Tank with Anaerobic Upflow Filter	
STei	Septic Tank effluent infiltration	
STP	Sewage Treatment Plant	
SUSENAS	National Census	*Survei Sosial Ekonomi Nasional*
TG1	Task Group 1	
TG2	Task Group 2	
TG3	Task Group 3	
TG4	Task Group 4	
TLP	Twin Leaching Pit	
TPA	Permanent disposal site/facility	*Tempat Pembuangan Akhir*
TPS	Temporary disposal site/facility	*Tempat Pembuangan Sementara*
TUPOKSI	Main Task and function	*Tugas Pokok dan Fungsi*
UASB	Upflow Anaerobic Sludge Blanket	
UASBR	Upflow Anaerobic Sludge Blanket Reactor	
Unair	Airlangga University	*Universitas Airlangga*
UPTD	Technical implementation unit office	*Unit Pelaksana Teknis Dinas*
USAID	United States Agency for International Development	
USRI	Urban Sanitation and Rural Infrastructures	
WIP	Wastewater Investment Plans	
WSI	Water and Sanitation Initiative	
WTP	Willingness to Pay	
WWTP	Waste Water Treatment Plant	

Executive Summary

The Water and Sanitation Initiative (WSI) for Indonesia is a bilateral cooperation project between Australia and Indonesia, funded by the Australian Agency for International Development (AusAID) and is delivered through the Indonesian Infrastructure Initiative (IndII). As part of this initiative, Mott MacDonald Indonesia was appointed by IndII as consultants to develop a Wastewater Investment Plan for the city of Makassar.

Makassar is the capital of South Sulawesi, the fourth largest city in Indonesia and the largest city in East Indonesia. Makassar presently has approximately 1.3 million inhabitants and it is expected that that this number will grow to around 1.8 million by the end of the planning period in 2030. By then 18% of the population will live in areas with a population density of more than 300 capita/ha[1].

The overall aim of the project is to develop a Master Plan with a 20 year planning horizon to 2030 and to develop, together with the Makassar City Government, the tools and skills to update and enhance its current City Sanitation Strategy (CSS), dated June 2007. The Master plan considers three phases of implementation : to 2015, 2020 and 2030.

Environmental problems

Increase in population will aggravate the present environmental problems related to inadequate wastewater collection, treatment and disposal. The key reasons identified are:

- 12% of inhabitants continue to defecate in the open, usually on the beach, in canals, drainage channels, vacant land or gardens ('*kebun*')
- More than 60% of inhabitants use private wastewater treatment facilities that directly discharge into surface water drainage channels
- Less than an eighth of the sludge that accumulates in the on-site systems (mainly leaching pits) is collected and transported to the sludge treatment plant IPLT at Nipa Nipa by government vacuum trucks. The remainder is either collected by private vacuum trucks and dumped haphazardly, or emptied by hand and dumped into the nearest drainage channel or watercourse. It can also accumulate in the on-site systems leading to malfunctions and overflow.
- The IPLT is not operating properly and untreated sludge overflows into adjacent watercourses.

[1] Gross population density is used, i.e. the number of people living in a Kecamatan (sub district) divided by the total area of the Kecamatan. A better figure to use would be the net population density, but unfortunately the area of the built-up area (net area) is not available.

- Even hotels and restaurants highly recommended in the tourist guidebooks of the Losari Beach area, the “icon” of Makassar, discharge their wastewater untreated or partially treated straight into the same sea that makes their location so attractive. Analysis of seawater has indicated high levels of coliform bacteria. The city authorities have started recording and monitoring wastewater effluent from these commercial properties, but legislative action to improve the situation has been limited.

Current initiatives

Makassar City Government has been planning for many years to improve the unhygienic conditions around the Losari Beach area by providing a centralised sewerage system. Current plans have been developed for a 1,357ha wastewater collection network with a 7,000m^3/day capacity sewage treatment plant (STP) at the Jl. Metro Tanjung Bunga Bridge over the Jongaya Canal. By 2015 the proposed sewerage system could provide 9,000 connections and by 2030 up to a total of 20,000 connections.

A program of intermediate wastewater treatment systems in the high density slum areas along the Panampu-Jonggaya canal is being implemented with 3,820 households currently planned to be served by 2015 and 9,740 by 2030.

Some promising community based neighbourhood wastewater collection and treatment systems have already been developed. These have been paid for from National budgets, such as the USRI and local Public Works funds.

There are currently no initiatives aimed at improving on-site systems, although approximately 89% of the current population have such wastewater facilities.

Masterplan Objectives

In order to reduce the environmental impact of wastewater and provide better living conditions for inhabitants, a multi-focus “Total Wastewater Improvement Approach” is required. This approach involves the provision of improved wastewater services for all and ensuring that all facilities in a particular area are environmentally acceptable. The Master plan therefore establishes four key objectives:

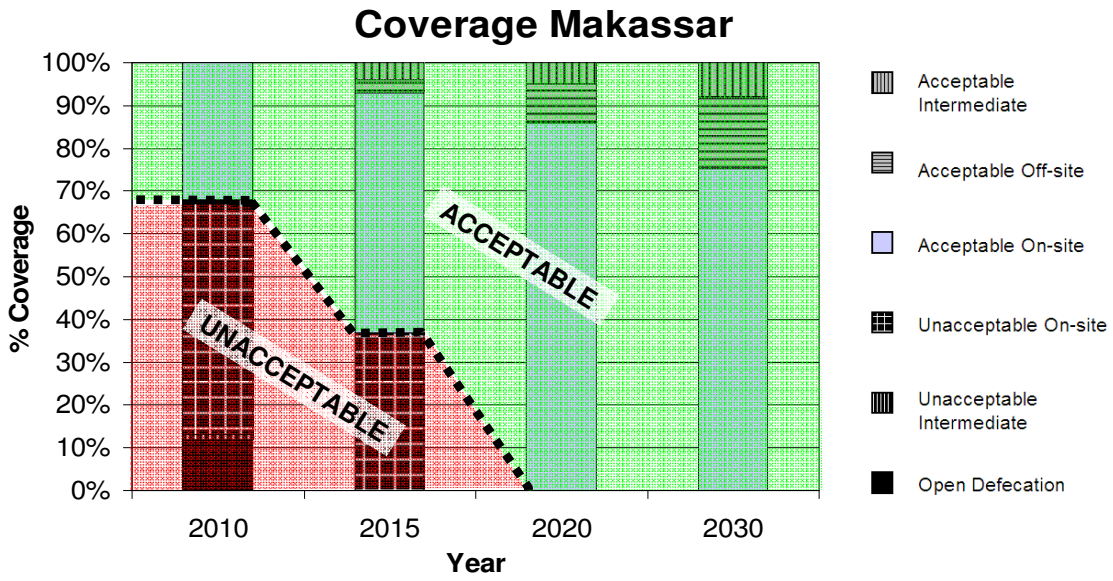
1. Reach ODF (open defecation free) status by 2015 using a mixture of on-site and intermediate facilities
2. Create a healthy and pleasant environment around the Losari Beach area by the implementation of an off-site system
3. Make improvements in all areas with relatively unhealthy living conditions using a mix of on-site, intermediate and off-site solutions by 2020

4. Reduce the environmental pollution load from wastewater in Makassar by 65% by 2030, as compared to the 2010 pollution load

A core strategy is to identify as many areas as possible in which is it practical to implement “on-site” systems. With favourable conditions, appropriate technology and competent installation, on-site systems can provide improvements to both health and the environment comparable with standard sewerage collections systems; at a fraction of the cost. In Makassar, however, such systems are constrained by adverse site and ground conditions. As such, Intermediate system are proposed to incorporate medium level technology, where appropriate (i.e. high density, low income areas), and off-site wastewater collection zones provided for businesses and properties that can afford to pay for the operation and maintenance of the system. The inclusion of an off-site system is also seen as a potential contributor to future economic development of the city.

Such interventions need to be phased so that they balance available human and financial resources in order to provide improvements that are both ‘reasonable’ and ‘challenging’. This balancing of resources has been the main driver behind the prioritisation of interventions.

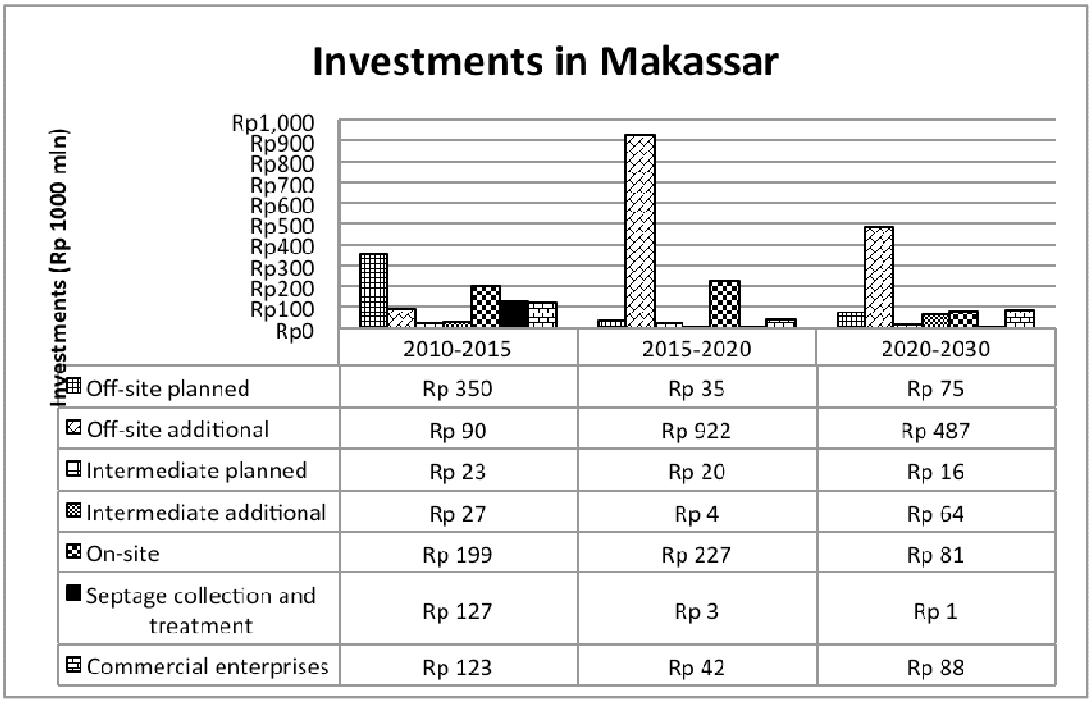
The graph below shows the planned incremental change in coverage by different “acceptable” and “unacceptable” systems over the three planning horizons.



Investment Costs

The total cost of the interventions to realise the targets and objectives included in The Master plan is approximately **Rp 3 trillion (US $ 334 m)** over 20 years. Operation and Maintenance (O&M) costs are estimated to be around 2% of total investment costs.

The anticipated split in investment costs is shown graphically below split down to individual interventions over each planning period.



	2010-2015	2015-2020	2020-2030
Off-site planned	Rp 350	Rp 35	Rp 75
Off-site additional	Rp 90	Rp 922	Rp 487
Intermediate planned	Rp 23	Rp 20	Rp 16
Intermediate additional	Rp 27	Rp 4	Rp 64
On-site	Rp 199	Rp 227	Rp 81
Septage collection and treatment	Rp 127	Rp 3	Rp 1
Commercial enterprises	Rp 123	Rp 42	Rp 88

Constraints to Improvement

Improvements to the wastewater situation are hampered by 3 recognised bottlenecks. These are:

1) Many people are unconcerned about the present insanitary conditions;

2) All stakeholders including the general public, the private sector and responsible government agencies have relatively little knowledge of good wastewater systems; and

3) There is a premise that improvement of wastewater collection, transport and treatment costs too much money.

This Master plan deals with these aspects by recommending the creation of an enabling environment by:

- Improving public perception of environmental and health issues related to wastewater. This will be dealt with in the proposals to be developed by the recently started ADB MSMH Capacity Building project, which has the intention of providing support to the proposed wastewater operator;
- Improving wastewater collection and treatment management knowledge by developing local knowledge among stakeholders and the dissemination of good practices; and
- Proposing cost effective interventions.

1. Introduction

1.1 Background

The Government of Australia (GoA) announced its Water and Sanitation Initiative (WSI) in December 2008. The WSI program for Indonesia is delivered through the Indonesian Infrastructure Initiative (IndII); a bilateral cooperation project between Australia and Indonesia, funded by the Australian Agency for International Development (AusAID). The approved allocation for the WSI in Indonesia is A$60.5 million; with bilateral funds to be expended during the period 1st July 2009 to 30th June 2011. The preparation of Wastewater Investment Plans under this initiative is one component of the WSI for Indonesia.

Mott MacDonald Indonesia was appointed by IndII as consultants for the Wastewater Investment Plan Package 1: Surabaya and Bogor with a project commencement date of 1st September 2010 and project completion date of 30th June 2011. Makassar was subsequently added to the scope of the project, with mobilization on 3rd January 2011.

1.2 Framework

The IndII Wastewater Investment Plan forms a key element of the Indonesian National Wastewater Strategy and Policy Implementation plan.

The Master Plans, and associated wastewater feasibility studies and proposals, are identified within the Indonesian national strategy for the development of domestic wastewater management systems. The implementation of the Master Plan is directed through a number of regulations and commitments. The two principal relevant regulations with regard to investment planning are:

5. Public Work Regulation No. 16/PRT/M/2008 on National Strategy and Policy on Domestic Wastewater Management;
6. Government Regulation No. 16/2005 on Water Supply Development;
7. Public Work Regulation No. 14/PRT/M/2010 on Minimum service standards on public works and spatial planning.

The above regulations provide a framework for the common vision and mission of wastewater management system development and activities. They have both been used in the development of the current Master Plan for Makassar, with adjustments made to match specific wastewater requirements and specific local characteristics.

The Government of Indonesia (GoI) has also committed to achieve the Millennium Development Goals (MDG) targets in the sector of sanitation. The MDG states that 76.8% of the national population should have access to safe and proper sanitation by 2015.

1.3 Aims and Objectives of the Master Plan

The overall aim of the project is to develop a Master Plan with a 20 year planning horizon and to develop, together with the City Government, the tools and skills to update and enhance the current City Sanitation Strategy (CSS), dated June 2007.

A requirement of the ToR for the project is to incorporate proposals for an off-site system as part of the Master Plan, along side other interventions that create a healthy living environment in Makassar through

the collection, transport, treatment and final disposal/reuse of wastewater ('wastewater management'), based on principles of sustainability, by 2030.

In addition, the Master Plan aims to identify priority interventions for the first five year period, i.e. by 2015 that will enable Multilateral Development Banks (MDB's) and bilateral development agencies to commit to further development of current wastewater proposals, in agreement with the GoI.

The output has been tailored to match the specific requirements of the MDB's or bilateral agencies that have committed to provide funding, where appropriate.

Institutional support has been limited to supporting the City Government in making decisions as to the future operator of the wastewater systems to be developed in the City. Capacity Building support is to be provided by a separate ADB funded project.

Feasibility Study

A review of the existing feasibility study for the current planned sewerage system for the central Losari area (as promoted by the 2008 MSMH project funded by the Asian Development Bank) has also been undertaken as part of the project.

Consultation

All work carried out in development of the Master Plan has been done in close consultation and collaboration with local government agencies; to enhance their capacity in the skills for sustainable future wastewater management.

Scope

The Master Plan covers physical infrastructure and the financial implications of wastewater system development. Capacity building is the subject of a separate study (refer to Chapter 10).

1.4 Constraints of the Assessment

The Master Plan has been developed over a period of 6 months. This short timescale has resulted in certain limitations and constraints on the study. In particular,

- Inability to undertake detailed topographical surveys;
- SOSEC surveys restricted to representative sample areas with not all areas of the city sampled;
- Use of secondary data without detailed review;
- Use of sub-district '*Kelurahan*' boundaries, rather than geographical/demographic areas for zoning;
- City data and statistics based on district records;
- Industrial wastewater not being included in the study as specific data was not able to be collated; generally it is assumed that waste should be treated by the industry that is producing it.
- Inability to include specific solutions for home industry wastewater (i.e. jewellery manufacture)

- Identification of sites for the sewage treatment plants (STPs) has been limited to land within the administrative area of the City.

1.5 Planning Horizon

The TOR requires that the Master Plan describes agreed interventions, both physical and non-physical, over a planning horizon of 20 years and that the interventions are implemented within four 5-year periods. The feasibility study, to be reviewed as part of the project, addresses interventions in the first 5-year period only.

In consultation with IndII, it was agreed to modify the grouping to three periods: a short period (5 years), medium-term period (10 years) and a long-term period (20 years). This is more in line with current planning practices in Indonesia: immediate improvements (5 years), paving the path for sustainable solutions (10 years) and indicating the long-term goal (20 years). In addition, Indonesia is developing so rapidly that another 'benchmark' between 10 and 20 years is not very effective.

Consequently, the target years used are: 2015 (as year 5), 2020 (as year 10) and 2030 (as year 20). The main reason is that 2015 is a very important benchmark: the year of the Millennium Development Goals (MDGs).

Table 1.1: Planning Horizons

Horizon	Year	Target Year of Master Plan
Current Status	2010	Year '0'
Phase I	2015	year '5'
Phase II	2020	year '10'
Phase III	2030	year '20'

Source: Mott MacDonald

From a foreign funding perspective, implementation of the first phase of interventions by 2015 might be very optimistic. Under normal circumstances the Master Plan would be approved in July 2011 followed by detailed feasibility studies to be approved by October 2011 and project funding from 2012/13 onwards. In practical terms therefore, construction of the projects for year 5 of the Master Plan may not be completed until 2017/18.

1.6 Definitions

Wastewater

'Wastewater' in the context of the Master Plan has been identified as that produced only from human activities, i.e. excluding stormwater. More specifically, three sources of wastewater can be distinguished:

- **Domestic wastewater** consisting of:
- 'Black' water ('kakus') made up of human waste (excreta and urine) and water used for anal cleansing and toilet flushing (usually by hand, pour-flush)
- 'Grey' water: typically water produced during bathing ('mandi') and cleaning/laundry ('cuci')

- **Non-domestic wastewater**[2]: water originating from small businesses, home industries, industrial areas
- **Septage** or faecal sludge: the residue from faeces that remains after a period of anaerobic digestion in leaching pits ('cubluk'), septic tanks ('tanki septik') or any other treatment/storage system.

In the framework of the Master Plan, therefore, the term '***wastewater***' refers to domestic wastewater and septage, but excluding non-domestic wastewater and storm water. The removal, transport and treatment of septage have been considered in the Master Plan.

Wastewater Systems

Sewerage systems, or wastewater network systems, are also often referred to as "off-site" systems or "conventional sewerage" systems. This can lead to some confusion. In the context of the Master Plan we refer to these sewerage systems as "off-site" systems, which does not include the collection of storm water (i.e. separate sewerage).

To prevent confusion we will use the following terminology in the Master Plan:

- **"On-site" systems**: referring to treatment systems at an individual household level
- **"Off-site" system**: referring to a conventional sewerage collection system with centralised treatment facilities
- **"Intermediate" systems**: referring to communal systems at a neighbourhood or cluster level. Such systems may be used as an intermediary step between "on-site" and "off-site" systems.

[2] Non-domestic wastewater from home industries such as 'tahu' production or 'industrial' type pollution from gold jewellery manufacture, etc can produce significant environmental effects on local communities. Due to the study timescale, location of these industries could not be identified and are as a result not covered in the Master Plan.

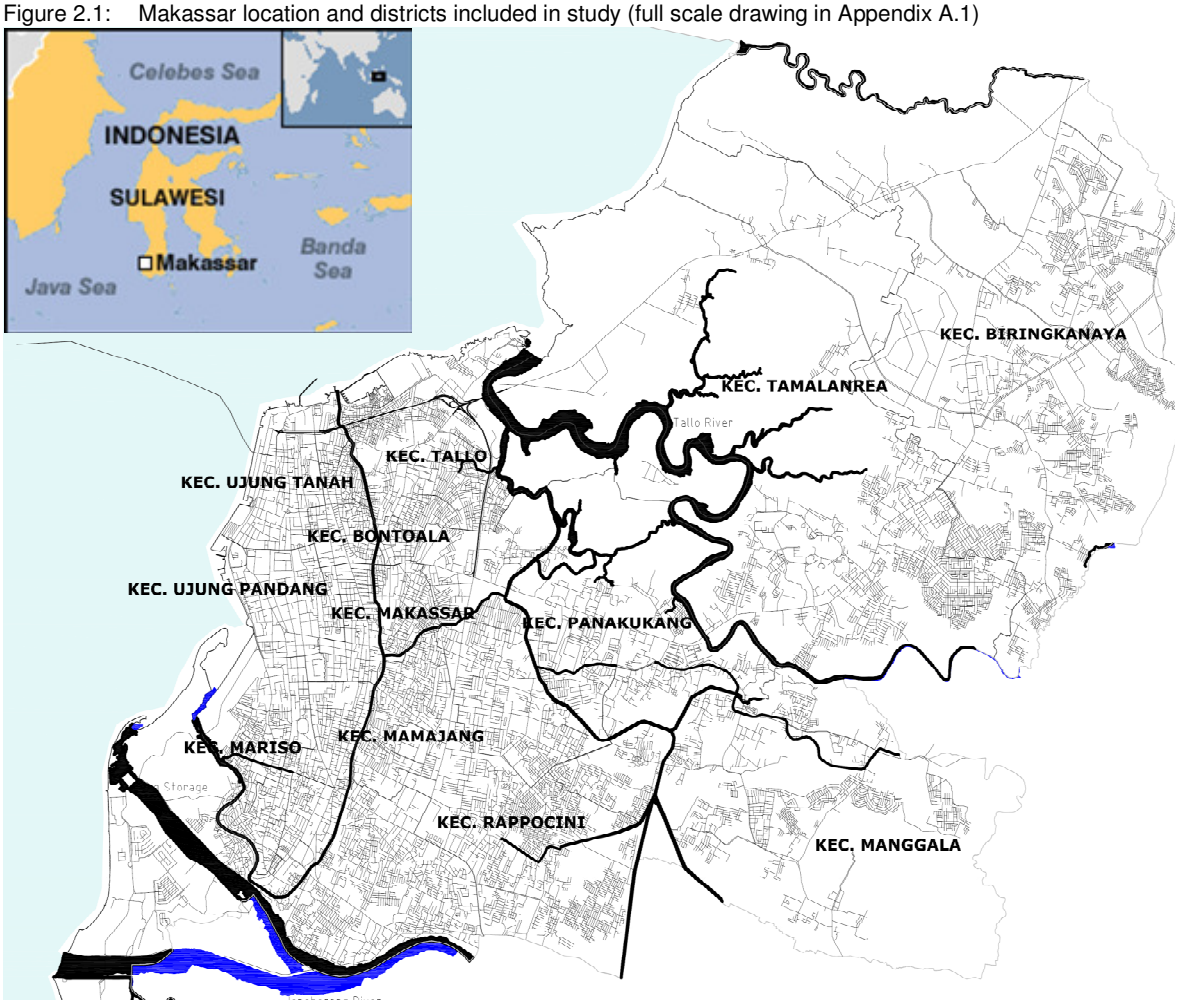
2. Description of Makassar

2.1 Location and Study Area

Makassar is situated geographically between 119O18'28"-119O32'31" East Longitude and 5O30'30"-5O14'49" South Latitude. It is located on the Western coast of South Sulawesi, as indicated in Figure 2.1 below. It is the fourth largest city in Indonesia, and the largest city in Eastern Indonesia.

The City area is divided administratively into 14 districts '*Kecamatan*' and 163 sub-districts '*Kelurahan*'. The area is bordered to the north with Pangkajene Kepaulauan, to the East with Maros District and to the South with Gowa District. The west of the city is bordered by the Makassar Strait.

Figure 2.1: Makassar location and districts included in study (full scale drawing in Appendix A.1)



The city is crossed by two rivers; the Tallo river which flows South-East to North along the Eastern edge of the city and the Jeneberang river which flows East to West along the South of city. The city is also divided by the Panampu-Jonggaya canal to the East.

2.2 Physical Conditions

2.2.1 Topography

Makassar City lies at the foot of the Bawakaraeng to the East and with the Makassar Straight to the West. The western part of city (to the West of the Tallo River) is therefore low lying with elevations in the range of 0 to 5 m. The eastern and northern parts of the City are located on the East of the Tallo River. These areas have relatively higher elevations; typically in the range of 5 to 25 m.

The area of the city covered by the study is therefore low lying and has a general gradient of between 0% and 5% from East to West. The presence of the Panampu-Jonggaya canal through the study area provides a significant disruption of this gradient. A contour map of the city is provided in Appendix A.3.

2.2.2 Climate

The study area lies in a tropical monsoon climate zone, having two distinct seasons. The wet season is from November to April and the dry season from May to October. Average annual temperature is about 28°C; temperatures vary only slightly throughout the year.

2.2.3 Hydrology

Annual average rainfall is about 2000- 2500 mm with around 75% falling during the wet season. The average humidity is about 80% in the wet season and about 75% in the dry season.

2.2.4 Groundwater

Due to its coastal location, Makassar has high groundwater levels. Table 2.1 shows an assessment of the phreatic groundwater in Makassar City. Ground water is used for private domestic supplies.

Table 2.1: Phreatic groundwater depths in Makassar

Kecamatan	Area (Ha)	Km from Sea	Water Table Depth (m)	Kind of Aquifer Layer	Porosity (%)	Spf (%)
Mariso	236	0-2.70	0.45-1.2	Fine sand Sand Clay	30-45	15
Mamajang	199	0.5-2.86	0.3-3.2	Fine sand	30-45	15
Tamalate	583	0-2.69	0.15-2.61	Sand Clay	35-55	10
Makassar	250	2.1-2.3	0.43-2.4	Fine sand	30-35	15
Ujung Pandang	263	1.75-3.9	0.25-1.6	Sand Clay	30-35	20
Wajo	252	1.7-3.8	0.2-2.1	Fine sand	35-50	15
Bontoala	125	1.6-3	0.15-1.1	Sand Clay	35-55	10
Ujung tanah	125	0-2.9	0.25-0.75	Fine sand	35-55	10
Tallo	2,944	0.8-20.9	0.17-2.5	Sand Clay	30-45	8
Panakkukang	4,119	0-4.01	0.11-0.4	Fine sand	30-35	15
Biringkanaya	8,006	0-22	0.5-15	Sand Clay	35-45	8

2.2.5 Surface Water

There are a number of important watercourses that punctuate the layout of Makassar. These are described in Table 2.2 below. All of the key rivers show signs of pollution:

Table 2.2: Main Watercourses in Makassar

Watercourse/River Reach	Description
Panampu-Jonggaya canal	The largest watercourse in Makassar City is the Panampu-Jonggaya canal. It is a major drainage channel. In addition there are many small canals and drains that criss-cross the city centre, some discharging directly to the sea and others to the Panampu-Jonggaya canal. Most of these canals in the city centre are visibly polluted. During the dry season the BOD level of most of these canals was measured to be about 120-180 mg/l.
Jeneberang River	Jeneberang river is an important river for Makassar City. It is used for irrigation, as a source of water supply, electrical power and drainage flushing.
Downstream - Jeneberang River	The river is used as a raw water supply. This depends on tidal sea water intrusion is controlled by water flows from Bili-Bili Reservoir and a rubber tidal dam. Intake Malengkeri-1 is used as the supply to Maccini Sombala Water Treatment Plant (200l/sec).
Middle - Jeneberang River	The river supplies raw water for Ratulangi Water Treatment Plant (50l/sec).
Upstream - Jeneberang River	Jeneberang Upstream River flows into Bili-Bili Reservoir, which was completed in 1999, with a total capacity of 375 million m3. The main function of the reservoir is for flood control, irrigation, raw water supply, fishery, tourism and sport.
Jenelata River	A branch of the Jeneberang River with a large catchment area of 220 Km^2.
Tallo River	This river is relatively short (approximately 30 Km). Flows fluctuate depending on the season.
Pampang River	Pampang River is allocated for fishing

2.2.6 Drainage

The main drainage channels for stormwater in Makassar are the Panampu - Jonggaya channel and the Sinrijala channel. The drainage system covers an area of about 1,675 ha. 14 *Kelurahan* depend on the canals for drainage. These are Maccini Sombala, Sambung Jawa, Jongaya, Rappocini, Bara-baraya, Maccini, Wajo Baru, Baraya, Layang, Parang Layang, Panampu, Tabaringan, Panaikang and Tello Baru.

The main drainage channels are indicated in Appendix A.4.

2.3 Land Use and Demographics

Existing land use, according to the Spatial Plan for the City of Makassar (RTRW, 2006), consists of: housing, playing fields, business areas, roads, cemeteries, rice fields, mixed plantation, fishponds, wasteland, salting production, industry, forest, meadowland, warehousing, shipping port and swamps.

In general, industrial areas are located in the north of the city, between the port area to the north west of the city and the Sultan Hasanuddin International airport to the west. The central area of the city is home to mostly commercial and domestic properties, with greater areas of wasteland, swamps and fishponds in the outlying regions. Signification amounts of land are occupied or owned by University, Military and Governmental establishments.

Details of the existing and predicted land use, as well as water supply coverage and principal road layouts are provided in Appendix A.5.

According to the Central Board of Statistics Makassar City (*Dinas Kesehatan Makassar*). Makassar had a population of 1,272,312 persons in 2010 and 296,372 households, indicating an average household size of 4.29.

The city has a total area of 175.77 km^2, which indicates a population density of 6,790persons/km^2 in 2009. The report of *Cipta Karya* Makassar City noted approximately 393 ha of slum area in Makassar City, with estimates of up to 12,900 unhealthy houses.

Further details of population and population density are provided in Section 5.2.1.

3. The Existing Wastewater Situation

3.1 Planned Initiatives

3.1.1 Medium-Term Development Plan

The City Government has already planned a number of interventions to improve wastewater management within Makassar. In particular, the RPJM 2010 proposes plans to implement a sewerage system and STP for the Losari Beach "*Pantai Losari*" area. The unhealthy and unattractive condition of the beach and seafront near the hotels and restaurants have for some time been seen as the key driver for the promotion of an off-site sewerage system.

The RPJM 2010 includes for the following interventions for completion by 2015:

- Construction of the Losari STP with a capacity of 7,000m^3/day on a 6ha site near the Jl. Metro Jangung Bunga Bridge over the Panampu-Jonggaya canal;
- Construction of a sewerage system serving the Losari wastewater collection area covering 1,357ha and having 9,000 connections by 2015 (with outline plans for around 20,000 connections by 2030); and
- Construction of intermediate systems for 3,820 households, primarily along the high density slums areas along the Panampu-Jonggaya canal (with outline plans for around 9,740 households provided with intermediate systems by 2030).

Further details of the RPJM 2010 planned interventions are provided in Section 6.1.1.

3.1.2 City Sanitation Strategy

The City Sanitation Strategy (CSS) published in June 2007 aims to ensure a 'healthy Makassar with community based sanitation by 2015' in line with the MDGs.

It provides a summary of the principles outlined in the 2006 City Spatial Plan (RTRW 2006, *Rencana Tata Ruang Wilayah*) with regard to sanitation, as well as incorporating findings from previous studies and the Medium Term Development Plan (RPJM 2010, *Rencana Pembangunan Jangka Menengah Daerah*). The document, in its current state, does not define specific and detailed strategies for the city of Makassar, but it is intended that the recommendations from the current Master Plan will feed into a revision of the CSS.

According to the CSS document, the challenges in wastewater management in Makassar City include the following:

- Meeting the basic human needs of its population by reducing the number of people with no access to toilet facilities.
- Most existing wastewater problems in Makassar are found in the high density, slum areas of the city and near the main drainage system.
- Infrastructure belonging to the government and people is not adequate.

- The City has no proper wastewater system yet and there is no responsible organization for comprehensive wastewater management. Makassar city is mainly served by "on-site" systems with a centralised Septage Treatment Plant (IPLT)
- Regulation and wastewater management are weak. The regulation that is needed by the existing management system is unclear. The role and function of Operator and Regulator is not separately clear. This indicates that there is weak coordination amongst the institutions involved in wastewater issues on establishing policy.

The CSS has, as one of its primary goals, to establish community based sanitation, as well as off-site systems. Its global key targets have been to:

- Reduce diseases caused by poor sanitation to below 5%
- Formulate District Regulations on Sanitation by the year 2008
- Increase people's awareness towards Sanitation and Health Behavior Change (SHBC)
- Increase participation in community organizations
- Create coordination between sector and program
- Make available sanitation facilities and infrastructure that meet Minimum Service Standards.

Outline targets and strategies for the City to meet these goals were included in the CSS, as indicated in Appendix B.1.

3.2 Existing Wastewater Studies

A number of key studies have previously been carried out identifying options for development of the wastewater infrastructure of Makassar. The key documents are as follows:

- Ujung Pandang Master Plan and Feasibility Study, JICA, March 1996
- Metropolitan Sanitation Management and Health Project – Sub Project Appraisal Report (MSMHP SPAR), Black & Veatch, Aug 2008
- Losari Wastewater Treatment Plant Detailed Engineering Design and Environmental Assessment, 2007 Sehati (part of the MSMHP SPAR report)
- Losari Wastewater Treatment Plant Detailed Engineering Design, Dana Consult (2008)
- Technical aid for preparation of the wastewater Institutional plan for Losari (Bantuan Teknis Penyiapan Kelembagaan Air Limbah), CV Adi Permata Konsultan (2010)

The Japan International Cooperation Agency (JICA) developed the Master Plan and Feasibility Study on wastewater and solid waste management for the City of Ujung Pandang (previous name of Makassar) in March 1996. This report forms the basis of all subsequent studies, including a number of the strategies formed by the CSS.

The JICA report recognised the need for reinforced institutional planning for implementing improvements to the wastewater systems in Makassar, including provisions for treatment of both grey water and black water in new housing developments. The JICA report considered options to enhance existing management

institutions to deal with wastewater as well as the creation of dedicated institution to be responsible for wastewater management. In the MSMHP SPAR there was limited attention for institutional development.

Both reports recognise the need for a centralised sewerage system to deal with increasing population densities, particularly in central tourist and commercial areas (in particular Losari) as well as improvements to and development of the existing on-site sewage systems (particularly in high density slum areas). Both reports also recommended improvements to, and expansion of, the existing septage treatment facility as part of an integrated solution.

A summary table comparing the findings of the studies relevant to the wastewater infrastructure of Makassar is provided below.

Table 3.1: Summary of Findings of Previous Studies

	JICA	MSMHP - SPAR		DANA Consult	
Master Plan until year	2015	2020		2028	
Feasibility Study for priority project until year	2005	Phase-1 2008-2011	Phase-2 2011-2013		
Major component projects in Feasibility Study	Sanitation Improvement Project Sanitation Improvement for Slum area Improvement of septage management Sewerage Development project Northern Sewerage System Central Sewerage System Southern sewerage System Pilot Project Losari (1 pilot) Southern (1 Pilot Project) Central (2 pilot Project Northern (2 Pilot Project)	Rehabilitation and optimization the Nipa-Nipa septage facility Technical assistance /consultant services Review Master Plan and DED priority areas Improve Public Health System Construction of communal sanitation community	Physical construction Losari-1 and Losari-2 sewerage and WWTP System. Physical construction Lembo-1 and Lembo-2 sewerage and WWTP System. Physical construction Pampang sewerage and WWTP System. Physical construction Sambung Jawa sewerage and WWTP System.	None	None
Losari WWTP System	Location Tanjung Bunga Gate Treatment Process Sedimentation, Activated Sludge Clarifier, Sedimentation Service area: Losari		Location: Tanjung Bunga Gate Treatment Process: Activated Sludge Clarifier, Service Area: Losari-1: 2 Kecamatan and 7 Kelurahan	Location: Maccini Sombala Treatment process: An-aerobic and Aerobic Stabilization pond. Service Area: Losari-1:	

	JICA	MSMHP - SPAR	DANA Consult
		24,287 people Losari-2: 3 Kecamatan, 9 Kelurahan 41,233 people Phase-1 of Capacity 1 3500 m3/day Phase-2 36500m3/day	2 Kecamatan and 9 Kelurahan 24,287 people Losari-2: 3 Kecamatan, 9 Kelurahan 41,233 people

3.3 Findings in the Field

A full description of the findings from field visits and desk studies of available data are provided in Appendix B.2 and are summarised in the following paragraphs.

3.3.1 Existing Wastewater Systems

On-site Domestic Systems

According to a 2010 survey carried out by the Public Works Department[3] , approximately 75% of households in Makassar have some form of on-site sanitation facilities (bathroom and water closet). 88% of these households use a '*cubluk*' (or septic tank and leach pit) for treatment of black water, whilst the remaining 12% discharge directly to drainage channels. Generally, grey water is discharged to the storm water channel at the front or behind the house without any treatment.

In some cases, those who have limited land, build a leach pit under the kitchen or living room, covered by tiles. This makes it difficult for maintenance and desludging. A minority of people, who have limited land and low-income, use '*Mandi-Cuci-Kakus*' (MCK), public communal sanitation and ablution facilities and/or the neighbour's toilet for washing and defecation.

Typical private apartment tenants have medium to high income. Wastewater treatment systems are normally available for each building and are the responsibility of the property management. They consist usually of a large septic tank and effluent is discharged into the nearest watercourse, as infiltration is impossible because of the high groundwater table and/or impermeable soils. It is not clear whether the septic effluent is treated in an aerobic upflow filter before discharge or not.

Commercial Housing

Municipal regulations state commercial buildings (including hotels, malls, commercial houses and offices) should install dedicated wastewater treatment facilities. It also states that treated wastewater from hotels should be less than BOD 30 mg/l (annex 26, Governor Decree 14/2003). Currently there are around 20 hotels in the central commercial and tourist area (Losari area) and only 4 hotels operate wastewater treatment systems.

[3] Based on a survey carried out by the Public Works Office of City of Makassar on wastewater sanitation infrastructure, 2010 (Survey Sanitasi Kota Makassar Dinas PU Kota Makassar, 2010)

Most types of shop houses, "*ruko*" and office-houses "*rukan*" are located in real estate or central business districts spread across the city. These are generally rented out to commercial companies, such as laundries and fast food restaurants.

Whilst some formal commercial houses use a septic tank plus leach pit, other companies that have rented houses in Kampongs discharge their wastewater into drainage (stormwater) channels, without treatment. Few restaurants use a grease trap before discharging the wastewater.

Intermediate systems

As reflected in the Community Sanitation Strategy, Makassar City has made serious efforts to develop intermediate systems from 2006 onwards. The City Government and the provincial Public Works office have installed most of the current communal systems.

Three pilot-scale small bore sewerage (SBS) schemes with Upflow Anaerobic Sludge Blanket (UASB) / Anaerobic Upflow Filters (AUF) have been undertaken since 2007, as shown in the Table 3.2 below. The aims of these programmes are generally to serve the poor community, slum and high-density housing areas and new developments that will not reach the planned off-site wastewater collection area; as well as to reduce open defecation.

Table 3.2: List of Intermediate Systems installed between 2007-2011

Type	Location	Funded	Remarks
Communal STP			
MCK With Septic Tank	High pop. density & slum area, 36 Units	Swash Care	Good
MCK with DEWATS*	1 Unit: Sambung Jawa	MPW	Coverage sanitation target 51 HH/376 persons
Bio-Filter	6 Units: Sambung Jawa, P. Barang Caddi, P. Bone Tambu, Manggala, Lette, Daya	City government Share with MPW	Small bore sewerage. Coverage sanitation target 180 HH/935 persons
SBS + UASB / AUF	3 Units: Bulurokeng, Manggala, Parang Tambu	DAK Budget to DINAS CKTR	Coverage sanitation target 300 HH (100HH per unit)
Programmed by National allocated fund to DINAS CKTR Makassar, 2011			
SBS + UASB / AUF	Kel. Buloa. Kec Tallo	DAK - DINAS CKTR	Planning
SBS + UASB / AUF	Kel. Pacerakang. Kec Biringkanaya (Permunas)	DAK - DINAS CKTR	Planning
SBS + UASB / AUF	Kel. Borong Kec. Manggala	DAK - DNAS CKTR	Planning
SBS + UASB / AUF	Kel. Wala-Walaya Kec. Tallo	DAK - DINAS CKTR	Planning
Communal STP, Programmed by CARE, 2011			
MCK + Septic Tank & Clean Water	Bunga Eja Baru, Lembo, Tompo Balang, Barabaraya selatan, Maradekaya Utara, Barabaraya Utara, Maradekaya Selatan, Bantabantaeng, Bontolebang, Mandala, Mamajang Dalam, Balang Baru, Sinri Jala, Tamamaung	CARE	Location Selection

* Decentralised Wastewater System

In addition to the above schemes, small bore sewerage systems were constructed by DGHS – Satker PLP South Sulawesi in 2009 in Rusunawa Daya, Rusunawa Mariso and RSH (Perumahan PNS) Manggala. The

system in each location consists of a communal STP to treat wastewater from the flats and housing, through a small bore sewer network.

3.3.2 Septage Removal and Treatment

There is only one centralised septage treatment facility (IPLT) in Makassar. The IPLT Nipa-Nipa is operated under "*Dinas Pertamanan dan Kebersihan*" (City Cleaning and Parks Office). It was built in 1989-1990 and has a capacity of 100 m^3/day.

On average, around 24m^3/day of sludge is taken to the IPLT. Besides four vacuum trucks owned by the City Government, there are also several private vacuum tanker companies in operation.

From a site visit undertaken as part of the current study, the IPLT was found to be in poor condition. The following was noted:

- The sludge tank and Imhoff tank have disappeared;
- The septage is put directly into the open anaerobic lagoons;
- All lagoons were full. Hence there is limited treatment and most of it flows directly into adjacent watercourses;
- The access road is long and in bad condition.

See Appendix B.3 for further details of the existing IPLT at Nipa-Nipa.

3.3.3 SOSEC Survey

A socio-economic [SOSEC] Survey of 333 households was conducted as part of the Master Plan during January/February 2011. The purpose of the survey was primarily to determine the status of domestic wastewater Management and to provide an indication of willingness to participate in wastewater programs. The survey looked in particular at public attitudes to the wastewater investment program, which is planned by Makassar City Government and shown appearing in the RPJM 2010.

Further details of the SOSEC survey are provided in Appendix B.4.

On-site Sanitation Facilities

The SOSEC survey found that 89% of respondents have their own private toilets. This is somewhat higher than the wastewater sanitation infrastructure survey carried out by the Public Works Department of Makassar, details of which are provided in Section 3.3.1.

The primary reason for respondents not having their own private toilets was because they have insufficient space/land for a toilet (approximately two thirds of respondents), with a further quarter of respondents indicating that they do not have the finances to build their own toilet. The remaining minority indicated that the reason was primarily comfort and habit. Of the sample only about 5% stated that they still use a public toilet. The main reason stated was due to private toilets being out of order.

Only around 14% of the toilets in the survey appeared to have acceptable or high quality septic tank systems that were regularly emptied. The majority (around 80%) of systems had low or very low quality

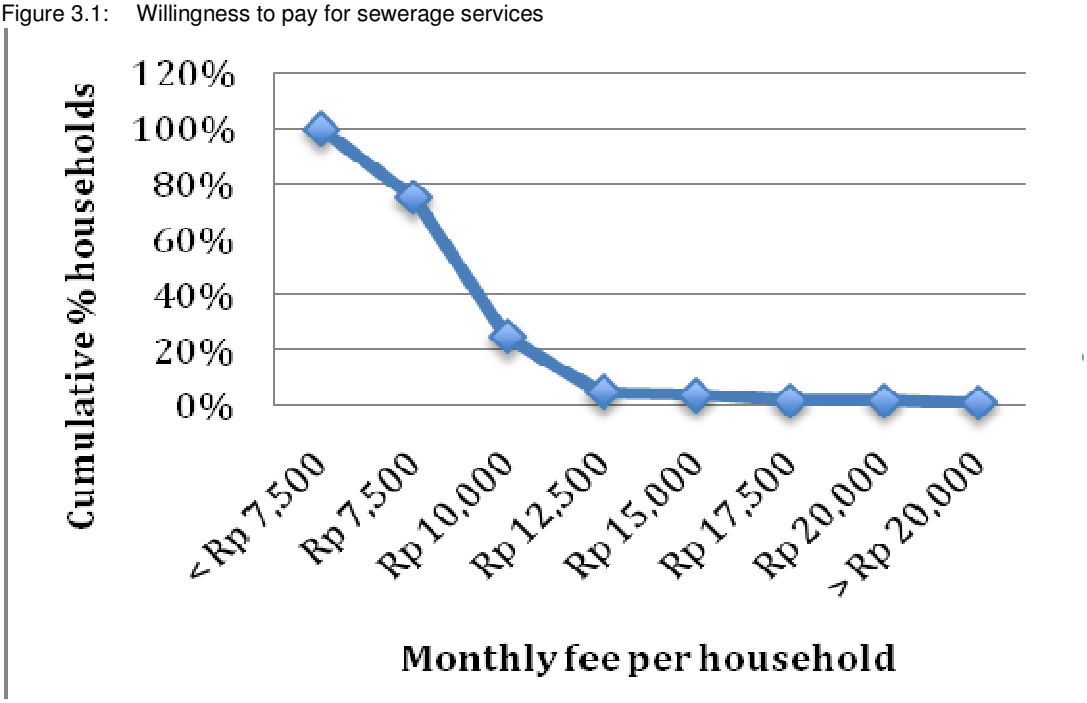
septic tanks that were emptied infrequently or never at all. The remaining 6% discharged directly to open drains or watercourses.

Off-site System Connections

Respondents were asked about their willingness to connect to an off-site sewerage system if a program was implemented in their neighbourhood. 81% of respondents indicated a willingness to connect and 19% said they would not. The reasons they were not willing to connect included non-ownership of the property, cost of the connection and satisfaction with current facilities. Of those respondents that were wiling to connect, around 79% indicated they would be prepared to pay a monthly fee and 21% indicated that they would not, either because they could not afford the monthly expense or because they did not see the added expense as providing them with a better facility than they already had. This suggests around 64% of the respondents would be willing to pay regularly for a connection to an off-site sewerage systems.

The monthly payment that respondents were willing to make are presented in Figure 3.1 below. This shows that 75% of those questioned were willing to pay up to Rp 7,500/month, 25% willing to pay up to Rp 10,000/month and only 1% of households were willing to pay up to Rp 20,000/month.

Figure 3.1: Willingness to pay for sewerage services



3.3.4 Focus Group Discussions

In addition to the SOSEC survey, Focus Group Discussions (FGD) were conducted in various Kelurahan between February 8th 2011 and March 2nd 2011. The main objectives of the discussions were to:

- Understand the community's perception of health and sanitation behaviour changes
- identify problems and understand the community's ability to respond to and solve sanitation problems

- Identify barriers for the community and/or gender issues in planning, developing, operating and maintenance of sanitation infrastructure
- Identify willingness and ability to pay for improved wastewater services.

From the FGDs it became evident that the communities generally understand the need for better sanitation to improve the region and their quality of life and recognise that current systems are not sustainable.

However, access to such systems is restricted, particularly for lower income areas, and these are also the areas with lower participation in community sanitation programmes. However, in both income groups, wastewater and solid waste are still discarded into drainage channels and awareness of good hygiene and sanitation behaviour change is poor.

There is, overall, a lack of socialization and local government action related to enforcement of sanitation regulations. The higher income groups in particular feel that the government have a responsibility towards providing sustainable sanitation systems.

Society is generally willing to participate in improving sanitation for the community, but needs more socialization particularly in areas where off-site systems are proposed to ensure that there is sufficient willingness to connect, as well as affordability, that will make the scheme worthwhile.

Gender Issues

The FGD identified that all though women, especially mothers, have responsibility for the home and well-being of the family, the decisions relating to household improvements are still dominated by men. This is particularly prevalent in lower income households. Many women have received empowerment training, through informal community institutions, but such barriers to decisions-making still remain and it is difficult for them to use the skills they learn to improve or influence the family situation. In higher income areas, however, there is a trend of women (around 5%) who have opened businesses following vocational training, who may be beginning to break free of some of these barriers.

3.3.5 Health

The number of reported cases of diarrhoea has been recorded by "*Dinas Kesehatan Makassar*" (Central Board of Statistics Makassar City) between 2008 and 2010 as indicated in Table 3.3 and Table 3.4 below.

Table 3.3: Reported cases of Diarrhoea in Makassar 2008 - 2010

	No. report cases of Diarrhoea	% of Population
2008	46,801	3.7%
2009	43,898	3.4%
2010	39,740	3.1%

Source: Dinas Kesehatan, Makassar City

Table 3.4: Number of Patients by Disease in Makassar, 2010

Disease	No. Patients	No. Fatalities
Diarrhoea	45,014	8
Typhoid	2,655	-

Disease	No. Patients	No. Fatalities
Diphtheria	9	-
Dengue Fever	255	2

Source: *Dinas Kesehatan Makassar*

There is a marginal reduction in the number of reported cases of diarrhoea reported since 2008, although this is well below the 5% of the population indicated as a threshold by the CSS. However, the SOSEC survey carried out for the project over the three-month period between December 2010 and February 2011 indicated that diseases caused by bad sanitation in the last three months had affected 65% of respondents. This suggests that many cases may go unreported.

AS indicated in Table 3.4, it is clear that diarrhoea is a significant disease risk factor to the health of the population in Makassar, although the number of reported cases remains relatively modest at 3.5% of the population and less than 1 death per 100,000 population.

3.4 Key Findings

Subsequent to the review of previous proposals and city planning documents, the following findings are considered to be the key issues to be addressed in the Master Plan for wastewater in the City:

- Open Defecation is still practised by around 12% of the present population
- Current wastewater facilities used in Makassar are mainly on-site (individual), although some communal systems exist and further development of communal systems is on-going.
- Most on-site facilities are of an inadequate standard, resulting in direct discharges to watercourses and unsanitary conditions (including contaminated well-water).
- Most citizens are aware that they should regularly empty their septic tanks but they do not. This may benefit from better regulation.
- Central septage collection and treatment facilities are limited and poorly maintained.
- The majority of residents have indicated that, assuming costs are reasonable, connection to an off-site system is both acceptable and better in the long-term for the community.
- Both kampong and real estate residents do not have a good knowledge of the various types of wastewater facilities available and the advantages that improved facilities can make. They need improved knowledge so that they are aware of the different types of sanitation facility, function and suitability of location (some people build the leach pit under the kitchen or living room)
- A minority of commercial properties have their own wastewater treatment facilities (although this is generally required by municipal regulations). Most of them outsource the operation of the facility to a third party.
- *Dinas Kesehatan* inspects community sanitation ('Intermediate') facilities once a year, to check the use of the facility and the discharge of the treated wastewater (SPAL)
- The current RPJM 2010 and CSS focus on development of an off-site sewerage system and continual implementation of communal systems, but do not consider improvement of on-site systems.

- The RPJM 2010 includes proposals for an off-site sewerage system for two areas only centred around Losari beach. The designs do not correlated well together, and do not follow a holistic approach to the city that was recommended by previous master plan reports.
- Current designs for the sewerage system appear to have low connection rates with high connection costs that are unaffordable for many households in Makassar.
- River, streams and canal, as well as some coastal areas, are heavily polluted by wastewater and It is clear that increases in population will aggravate the present environmental problems in particular due to:
    - The on-going practice of open defecation;
    - Direct discharges to surface water drainage canals and the sea; and
    - Insufficient septage removal, collection and treatment

4. Intervention Selection

4.1 Guiding principles

In line with good sanitation improvement principles[4] the wastewater of a specific area should be improved as a whole by using a "Total Wastewater Improvement Approach". This approach would involve:

- Improved wastewater services for all, ensuring all wastewater facilities in a specific area are environmentally acceptable
- Hygienic and environmentally sound management of black AND grey water
- Control of the growing backlog of wastewater infrastructure needs

Treated effluent and septage should be considered a resource and its management should be holistic and form part of integrated water resources, nutrient flow and waste management processes:

- Transport of effluent and septage should be minimized to promote efficiency and reduce the spread of pollution
- Inputs of grey water or storm water should be reduced to promote efficiency of the plant and increase retention time, as well as water and environmental security

The domain in which the environmental sanitation problems are resolved should be kept to the minimum practicable size (i.e. household, community, Kelurahan, Kecamatan, catchment and city) and waste diluted as little as possible:

- Waste should be managed as closely as possible to its source
- Water should be used minimally to transport waste
- Additional technologies should be considered for waste sanitization
- Reuse should be developed

Investments aimed at improving immediate and short-term sanitary problems should be 'non-regret' investments. That is they should be designed to form part of the sustainable longer-term infrastructure and not to be abandoned when they are no longer needed.

4.1.1 Reuse wastewater, septage and nutrients

This Master Plan concentrates on minimizing the health hazards associated with wastewater. By the introduction of improved wastewater treatment a new world of reuse opportunities opens:

4 Inspired on Bellagio principles, See for instance Household-Centred Environmental Sanitation, Implementing the Bellagio Principles in Urban Environmental Sanitation, Provisional Guideline for Decision-Makers, "Eawag: Swiss Federal Institute of Aquatic Science and Technology, June 2005"

On-site systems:

- Because grey water is kept separate from black water, treated grey water is good source to water gardens and parks. This is especially important during the dry season. There are good examples of community scale grey water treatment and reuse in Surabaya. That experience can be introduced in Makassar;
- Reuse of accumulated sludge in on-site systems as a soil conditioner: on an individual basis this is made easy in the twin leaching pit system applicable in low density areas.
- Introduction of EcoSan toilets where the urine is separated from the excreta. Diluted urine is good source of Phosphorus and can be applied without any harm. Phosphorous is required in agriculture and the world stock of Phosphorous is being depleted within the coming 20-50 years. Phosphorous can be retrieved by means of struvite from urine and/or wastewater. Composted excreta is a good soil conditioner. There are several initiatives in Indonesia, but up to now the success has been limited because of the cultural reluctance to handle fresh excreta and the direct relation between wastewater and food.
- Reuse of treated Septage at the improved Septage treatment facility.

Intermediate systems:

- The Community treatment systems as Sanimas and MCK++ are in principle good opportunities to generate biogas that can be used for cooking.

Off-site systems:

- Treated effluent of the STP can be used for watering city parks, provided it is bacteriologically safe;
- Dried sludge from the STP is a good soil conditioner. Its use is very common in Indonesia. See Section 6.7.1.2.

4.2 Standards and Design Criteria

As set out in the CSS, all interventions must meet the minimum standards for Urban Residential Wastewater Services, 2010. These are provided in Appendix C.1.

These minimum service standards provide the basis for the technical design criteria. The following standards and data sources have also been consulted:

- National Standards for Effluent Quality, Ministry of Environment Decree 112, 2003
- Comparative study Centralized wastewater treatment in Indonesia, ESP, 2004
- The “Standar Nasional Indonesia (SNI) nomor 03-2398-2002”.
- Reference Book on sanitation options: Buku Referensi Opsi Sistem dan Teknologi Sanitasi, TTPS, 2010

A summary table of the design criteria is provided in Appendix C.2 as well as in the relevant sections of the report.

4.3 Technology Selection Criteria

Where first stage sanitation improvements are required, on-site systems are often preferred because the local community or the individual householder can construct them for low capital and operational costs. It is often the case that well-constructed and well-maintained on-site sanitation systems can provide the same level of wastewater management and health benefits as an off-site system with STP.

Nonetheless off-site or communal sanitation systems are more typical in high densely populated developed cities due in part to the scarcity of space required for on-site systems at each individual dwelling. This is of increasing relevance in cities where populations are more commonly being housed in residential tower blocks, and off-site or communal sanitation systems may be seen as an indicator and possibly a contributor to a city's economic development. In Makassar, the application of on-site systems is further constrained by adverse site and ground conditions, such as:

- High building density;
- High groundwater table;
- Impermeable soils.

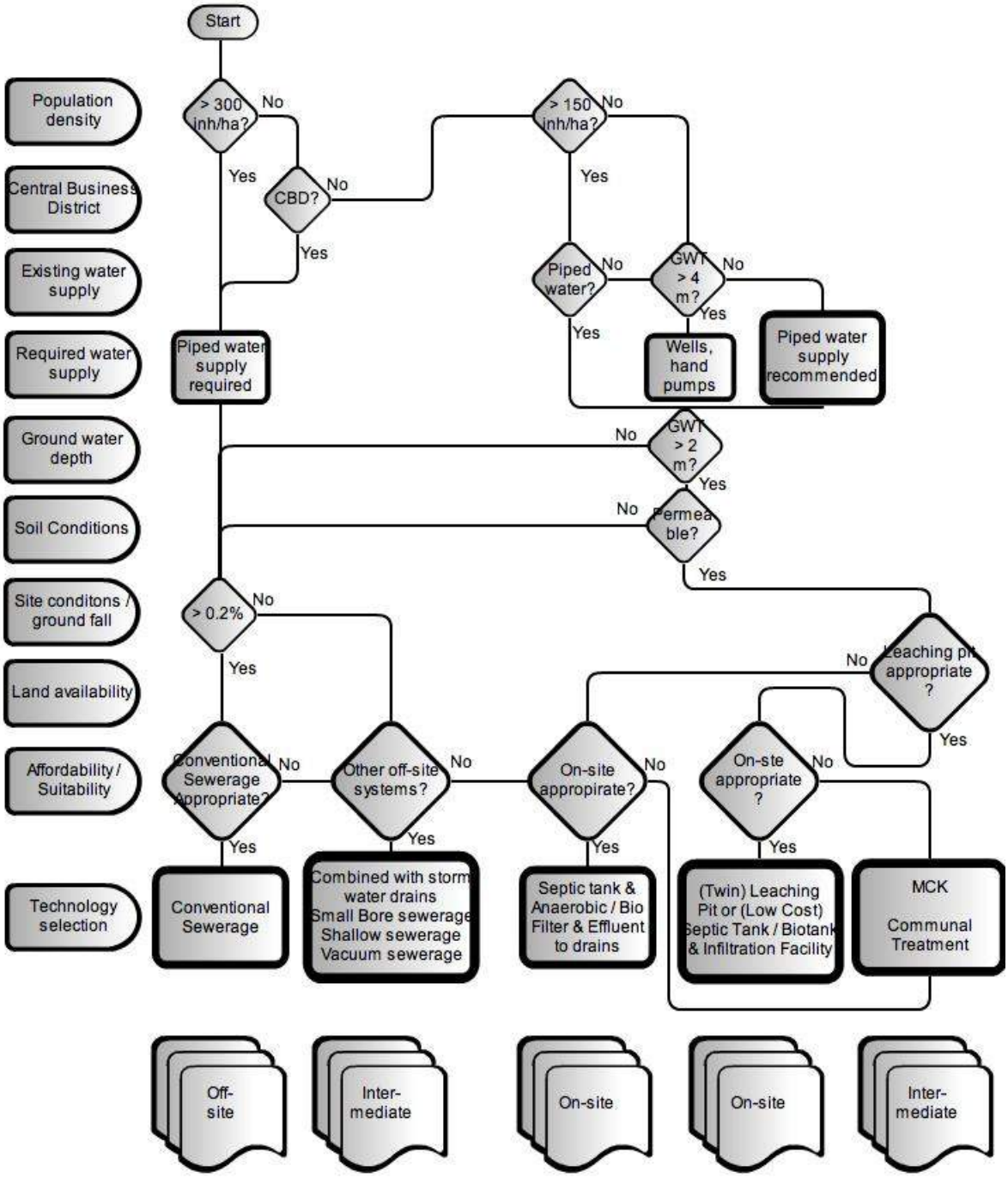
These constraints favour the selection of off-site solutions for Makassar. However, a sewerage system should only be considered if:

- Enough water is available to transport the waste and to prevent deposition in the sewers;
- The population can afford to cover the higher operation and maintenance costs or the government can afford to subsidize it;
- Site conditions are favourable for sewer gradients: the area should have enough natural slope to minimize the need for pumping.

These constraints must be carefully considered when planning wastewater systems. An indicative flow chart, see Figure 4.1, has been developed as a tool to assist in the planning process. This is the first 'rough' step of the current study to determine where on-site systems are feasible and where off-site solutions are unavoidable. The chart uses the following indicators:

- Kelurahan/Kecamatan gross population density (as the figures of the built-up or net density are not available)
- Presence of Central Business District or tourist destinations
- Existing or planned public water supply
- Groundwater depth, soil conditions and permeability
- Slope of the ground surface, availability of land
- Affordability and suitability.
- Population density

Figure 4.1: Indicate Flow Chart Technology Selection



5. Assessment of Strategic Objectives and Future Demands

5.1 Achieving the aims and objectives of the Master Plan

The RPJM 2010 plan of the City Government for the period 2010 – 2015 and key findings in Section 3.4 of this report have formed the baseline for proposed interventions. In addition, the present study has considered additional interventions to be implemented to meet the longer term planning horizon of the Master Plan to 2030.

The following four key Strategic Objectives of the Master Plan have been defined:

1. Immediate improvement of the wastewater situation for those people who defecate in the open: Open Defecation Free (ODF) status by 2015 through improvement and implementation of on-site and intermediate facilities.
2. Identification of additional wastewater collection areas and sewerage connections to optimize the use of the already planned sewerage system for the Losari beach area.
3. Target the provision of wastewater systems for housing areas where people live in relatively unhealthy living conditions. This is reflected in a combined population density/ lack of wastewater facility score of the area and will be met through the implementation of intermediate and off-site solutions.
4. Improvement in the quality and quantity of the city's wastewater infrastructure in such a way that the pollution load of Makassar is at least reduced from the present rate of BOD 30 ton to BOD 11 ton by 2030, compared to the pollution load in 2010 (i.e. a reduction of 65%).

Other specific aims of the Master plan include:

1. Persuade the population, commercial enterprises and institutes to implement, operate and maintain adequate wastewater facilities
2. Further development of the relatively new concept of intermediate systems in the areas along the Panampu-Jonggaya Canal that will later be connected to the centralized sewerage system
3. Development of proposals for an effective operator for the planned wastewater systems.
4. Development of a sustainable legal and institutional framework for management, operation and maintenance of improved wastewater facilities
5. Development of technical, financial and knowledge capacity regarding wastewater improvements, at all levels, among all stakeholders: government, institutes, private sector, neighbourhoods and community
6. Execute supporting studies for:
   a. Septage collection and treatment
   b. Monitoring the performance of UASBs and the small-bore sewer systems in existing intermediate systems that have been developed in Makassar
7. Technical demonstration of models for on-site systems, that are appropriate for Makassar conditions
8. Training/education of government staff, on sanitation and wastewater, and the need for the development of a 'Total Wastewater Improvement Approach' for a particular area
9. Develop an information centre for wastewater improvements, where people can obtain drawings, instructions, guidance and support for appropriate on-site solutions

5.2 Assessment of Future Demands

5.2.1 Population Forecasts

Current Population

The population of the City of Makassar in 2010 was around 1.3 million. The city has a total area of 175.77 km^2, which indicates an average population density of 6,790 persons/km^2 in 2010 or 68 persons/ha.

Table 5.1 below indicates the distribution of population in 2010 by district (*Kecamatan*).

Population Projections

No detailed (per Kecamatan) population projections were available from RPJM 2010 that can be used for the WWMP. The MSMH SPAR project, however, prepared projections up to 2020. These projections were reviewed and it was noted that the actual population in 2010 was less than the figure predicted in the SPAR. As a result, new population projections were prepared, based on an analysis of the census data[5] from 2000 through to 2009. Annual growth between 2000 and 2004 was 1.75%, between 2004 and 2005 it was1.22% and between 2005 and 2009 it was 1.79%. This suggests a relatively linear growth forecast.

The population projections are therefore based on a linear extrapolation of historic growth for the existing urban areas using the least square method and making additional allowances for the GMTDC development area of 15,000 inhabitants (2015), 45,000 inhabitants (2020) and 120,000 inhabitants (2030). The result is a population forecast of 1.53 million for the year 2020 and a forecast of 1.8 million for the year 2030. Table 5.1 shows the population projections for each Kecamatan based on 2004-2009 data of the Statistics Office of Makassar.

Table 5.1: Kecamatan Population Projections

No.	Kecamatan	2010	2015	2020	2030
1	Mariso	56,000	58,000	61,000	66,000
2	Mamajang	62,000	66,000	69,000	77,000
3	Tamalatte+GMTDC	157,000	184,000	225,000	322,000
4	Rapocini	147,000	156,000	165,000	182,000
5	Makassar	84,000	88,000	91,000	98,000
6	Ujung Pandang	29,000	30,000	31,000	33,000
7	Wajo	36,000	38,000	39,000	43,000
8	Bantoala	63,000	67,000	71,000	78,000
9	Ujung Tanah	50,000	55,000	60,000	69,000
10	Tallo	140,000	151,000	162,000	184,000
11	Panakkukang	139,000	148,000	158,000	177,000
12	Manggala	105,000	117,000	130,000	155,000
13	Biringkanaya	136,000	153,000	170,000	203,000
14	Tamalanresa	91,000	96,000	100,000	110,000

[5] Obtained from the statistics office (Biro Statistik Makassar)

No.	Kecamatan	2010	2015	2020	2030
	Total	1,295,000	1,407,000	1,532,000	1,797,000

It is obvious that this linear approach gives a much lower population forecast than the exponential growth rates used by Black and Veatch (B&V) in the 2008 MSMH project. The B&V forecast gives 1.6 million inhabitants by 2020 and would lead to 2.1 million by 2030, but according to previous growth levels, a linear forecast appears to be a more realistic assumption.

Population Densities

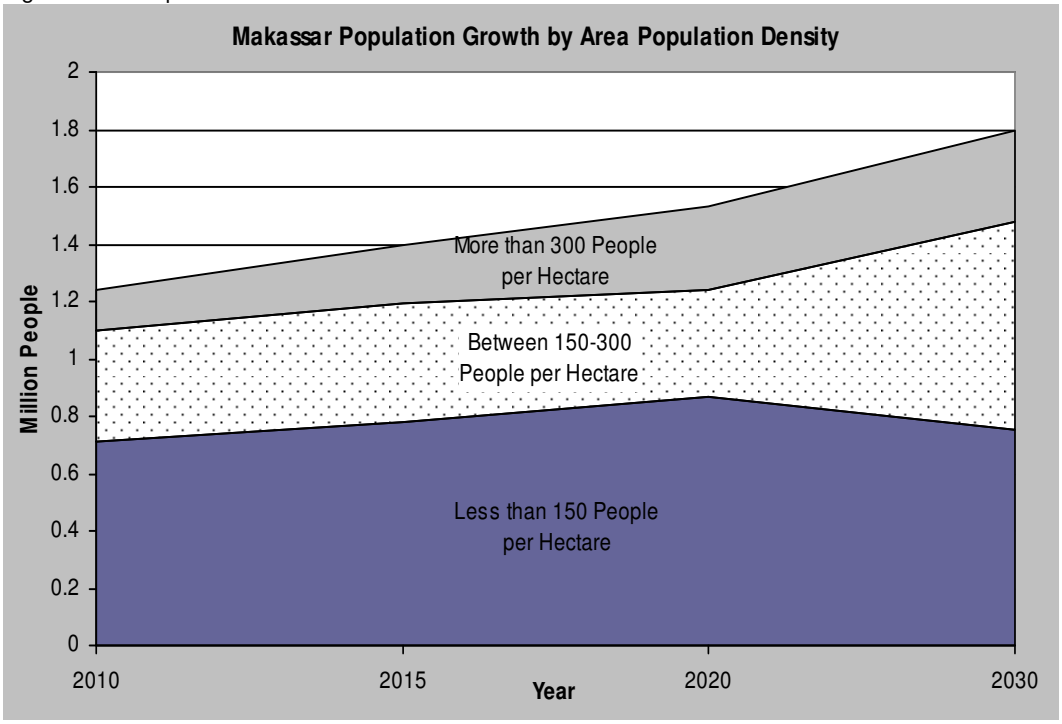
Current and future population densities have been based on the population projections indicated above. To assist with evaluation of the wastewater requirements for Makassar, population densities have been categorized into 3 levels, namely:

- High Density: population density > 300 persons/Ha
- Middle Density: population density 150 – 300 persons /Ha
- Low Density: population density < 150 persons/Ha

Figure 5.1 below shows the overall anticipated growth of the population within the design horizon and indicates the proportion of high, medium and low density areas that accompany the population growth. The figure indicates a general trend towards higher density areas.

Detailed 2010 population densities per Kecamatan are provided in Appendix D.1 and predicted population densities per Kecamatan for 2015, 2020 and 2030 are provided in Appendix D.2.

Figure 5.1: Population Forecasts



5.3 Priority Areas

In line with the aims and objectives of the Master Plan, the following areas are considered for priority interventions, i.e. to be addressed during Phase I of the Master Plan to 2015:

- Commercial areas
- Areas of open defecation
- Areas where there a combination of high density and low coverage

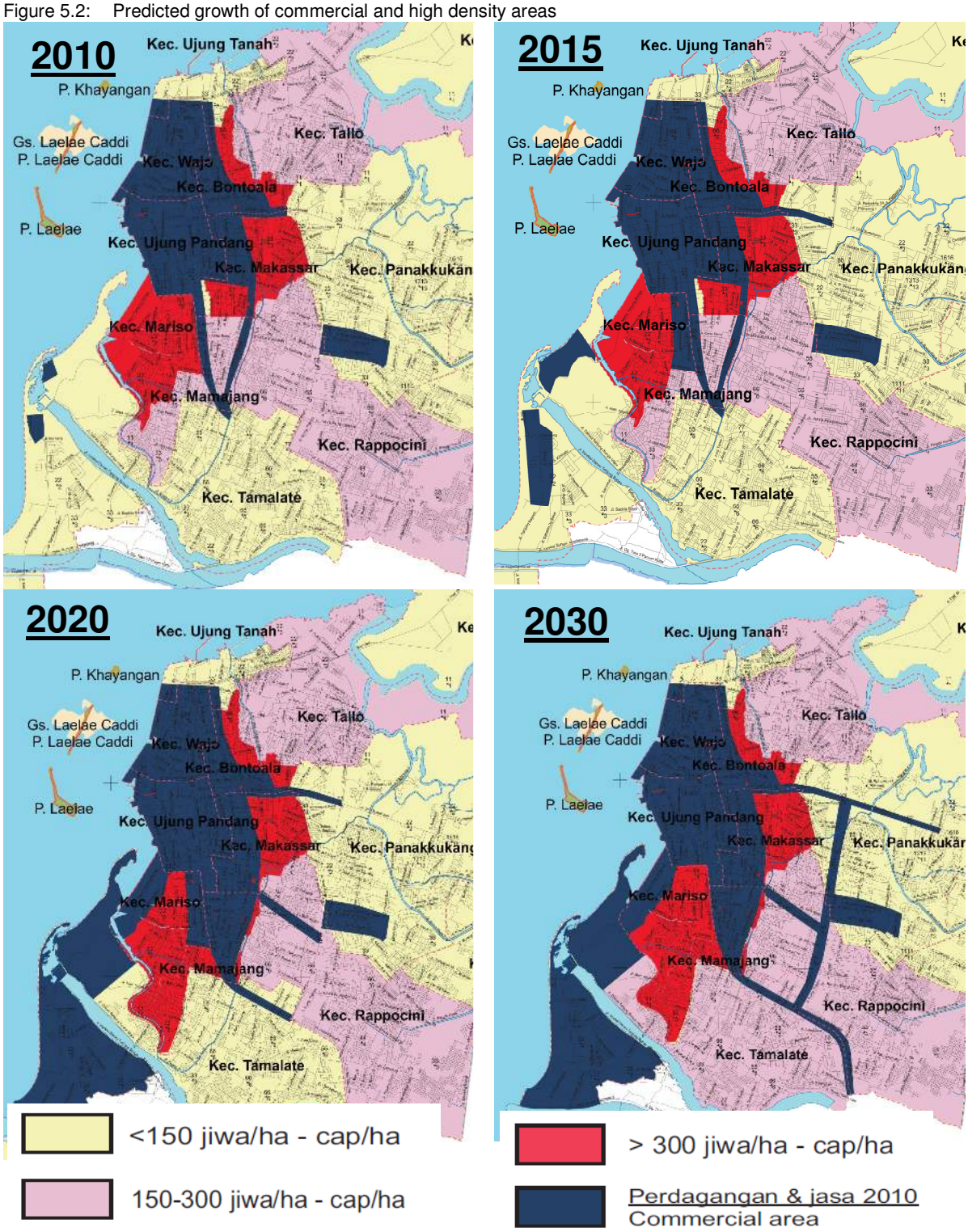
5.3.1 Commercial Areas

The Losari wastewater collection area is a central area of the city and has been included as part of the initial development of the citywide off-site sewerage system. This has been deemed a priority element for Phase 1 of the Master Plan (first 5 year planning period). The area is composed of enterprises such as malls, hotels, restaurants, etc. that can afford to contribute financially to cover the operating and maintenance costs of a formalised wastewater operator;

The Gowa Makassar Tourism Development Corporation (GMTDC) area that is currently under development is also expected to become a large commercial hub, as well as including higher income residential area and tourist areas. Although the overall population density is expected to be less than 300 cap/ha within the design horizon, there are many housing projects that have a built-up density of more than 300 cap/ha (i.e. high-density housing). Since it is much more cost effective to install sewerage connections during construction of a house, the connection of these developments early integration of this area is desirable and would provide a good income for the operator of the sewerage system and the STP.

Figure 5.2 below show the anticipated growth of commercial areas are shown in grey. Population densities are also indicated, with areas of highest density (>300person/ha) shown in red, medium density in pink and low-density areas (<150persons/ha) in yellow. These projections are based on the population density projection figures indicated in Section 5.2 above.

Figure 5.2: Predicted growth of commercial and high density areas



5.3.2 Areas of Open Defecation

12% of the population of Makassar practice open defecation (OD). These are usually the areas where, presently, coverage of wastewater facilities is relatively low;

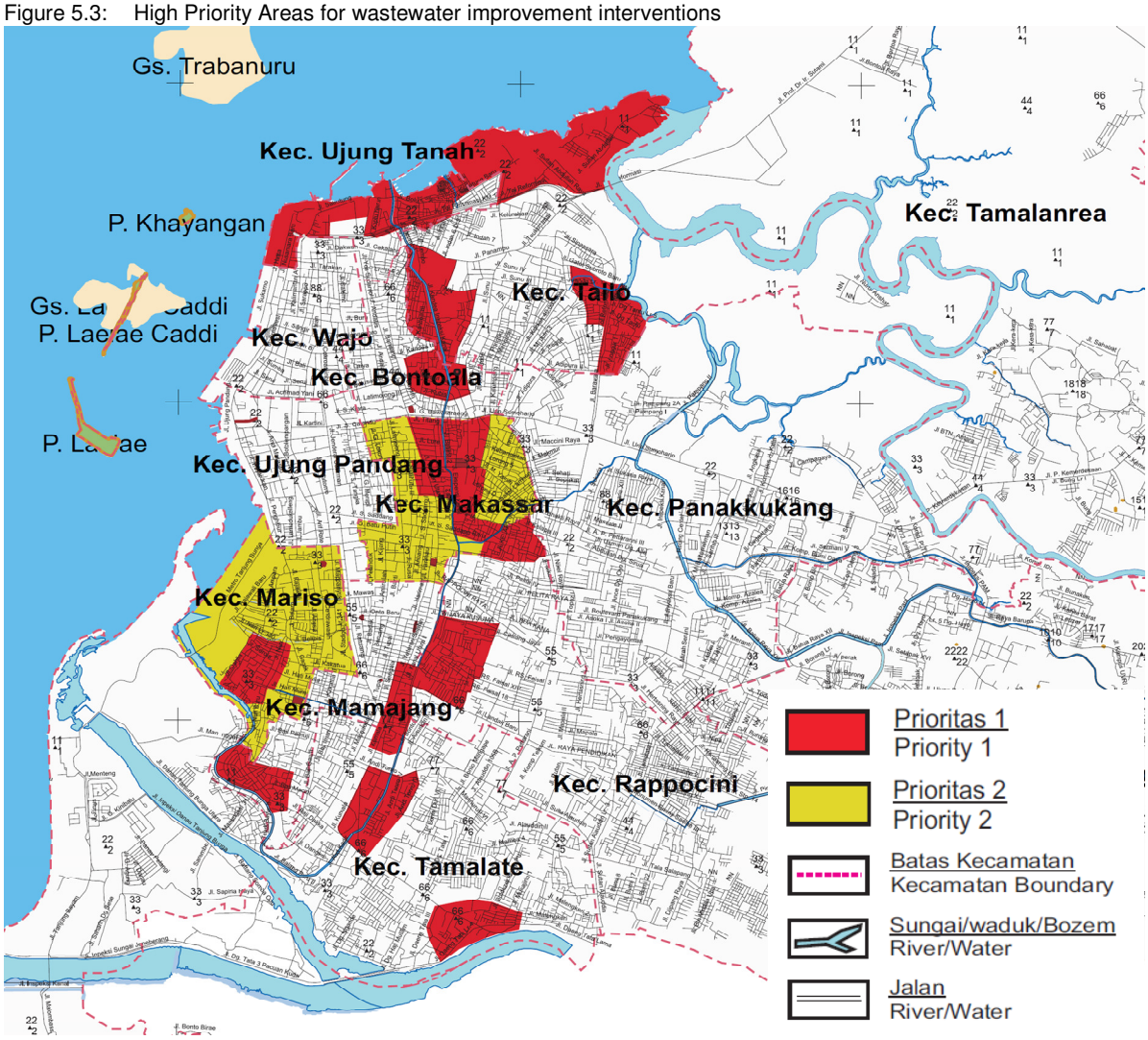
The areas with OD are mainly the urban slum areas with low coverage of wastewater facilities. These areas have been identified by the City Government as:

- Along the Panampu Canal (Kelurahan Lembo, Gusung, Baraya, Barana, Maradekaya Utara)
- Along the Panampu-Jonggaya Canal (Kelurahan Massale, Parang, Pa Baeng-Baeng, Parangtambung, Jongaya, Sambung Jawa)
- Along the Sinrijala Canal (Keluarahan Bara Baraya Selatan)
- Kampung Nelayan at Sinassara River (Kelurahan Wala Walaya, Kelurahan Rappokalling)
- Kampung Nelayan at Tallo River (Kelurahan Buloa, Kelurahan Tallo)
- Kampung Nelayan (Kelurahan Bodoa, Cambaya, Ujung Tanah, Patingan Loang).

5.3.3 Areas with a combination of high population density and low coverage

In high density areas the health hazards associated with poor wastewater facilities is relatively high compared to low-density areas. Hence, it is relatively cost-effective to improve wastewater services in areas with high density and low coverage of wastewater facilities. For the areas identified for “on-site” and “intermediate” wastewater systems, each *Kelurahan* has been assigned a priority, based on a population density and lack of wastewater facility score for the area. A summary table of this process is provided in Appendix D.3. The ‘lack of coverage’ multiplied by the gross population density provides the score used in the prioritisation for the timing of planned improvement for the area. From this data high priority areas for wastewater improvement interventions have been identified, they are shown in Figure 5.3. The sub-districts (Kecamatan) with the highest scores (priority 1) are coloured red and the sub-districts with high scores (priority 2) area coloured yellow. The summary table in Appendix D.3. also shows the specific ranking.

Figure 5.3: High Priority Areas for wastewater improvement interventions



Source: Mott MacDonald

5.4 Establishing Design Targets

Quantitative design targets have been established through a central design spreadsheet that correlates data from various sources with the objective of assessing the data to determine how the strategies and objectives outlined in Section 4.1 can be met, including coverage of on-site, intermediate and off-site systems, BOD removal scenarios and investment targets. The spreadsheet includes a series of tables that are the product of discreet design steps, as indicated below. This spreadsheet forms the basis of the recommended interventions of the current Masterplan.

1. Summary of total wastewater system coverage: existing (based on 2010 estimates) and targeted (2015, 2020, 2030);
2. Population forecasts;

3. Targeted coverage of off-site and intermediate systems for 2015, 2020, 2030;
4. Coverage of on-site systems calculated from the difference between the total coverage and coverage of off-site and intermediate systems (Steps 2 &3);
5. Grey-water system targets derived from on-site coverage;
6. Calculation of the volume of septage and consequently a calculation of the need for septage collection in terms of truck and trips are derived from the number of on-site systems;
7. Summary of the existing number of non-domestic systems and the targets for the planning period;
8. Based on the values generated in Steps 2 to 7 and using professional engineering judgement regarding the treatment efficiencies, a calculation of the pollution load in terms of BOD/day was determined for all periods;
9. Calculation of the capacities of the treatment plants and composition of wastewater;
10. Calculation of the cost of the programme implementation based on generated unit cost rates;

The tables associated with the spreadsheet are provided in Appendix D.4.

5.4.1 Phasing of Interventions

A range of interventions are required to meet the aspirations of the City of Makassar for a health living environment in which the collection, transport, treatment and final disposal of reuse is based on the guiding principles discussed in Section 4.1. Such interventions, however, need to be phased in such way that they balance the human and financial resources that are likely to be made available in order to provide incremental improvements that are both ‘reasonable’ and ‘challenging’.

This balancing of resources has been used as the primary approach to prioritise interventions for wastewater coverage across the three planning horizons, as summarised below and in Figure 5.4.

By 2015 priorities include:

- Enabling Makassar to reach the status of Open Defecation Free (ODF)
- Septage collection increased to 75% (from the present 13%) with regard to on-site sanitation systems and all collected septage is treated in an environmentally acceptable way.
- Increase in the number of acceptable wastewater facilities to 77%
- Establishment of an off-site sewerage system for the Losari wastewater collection area (as per current Government planning)

By 2020 priorities include:

- There are no unacceptable wastewater facilities
- Septage collection services cover 100% of the on-site sanitation systems and all collected septage is treated in an environmentally acceptable way
- Overall 50% of high density areas are served by off-site systems
- 50% of the operation and maintenance costs of off-site and intermediate systems are covered by the collection of user fees (maximum 50% subsidy).

By 2030 priorities include:

- Overall 70% of the high density and commercial areas are served by off-site systems

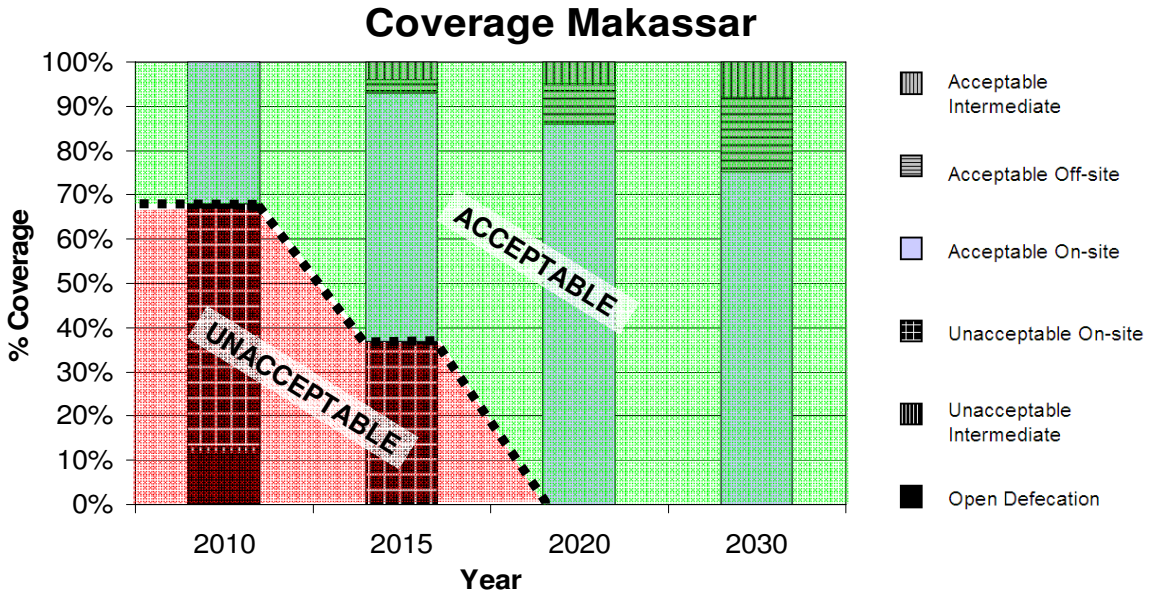
- The remainder, 30%, of the high density areas are served by intermediate systems
- All operation and maintenance costs of off-site and intermediate systems are covered by the collection of user fees, i.e. no subsidy.

5.4.2 Summary of Design Targets

Coverage

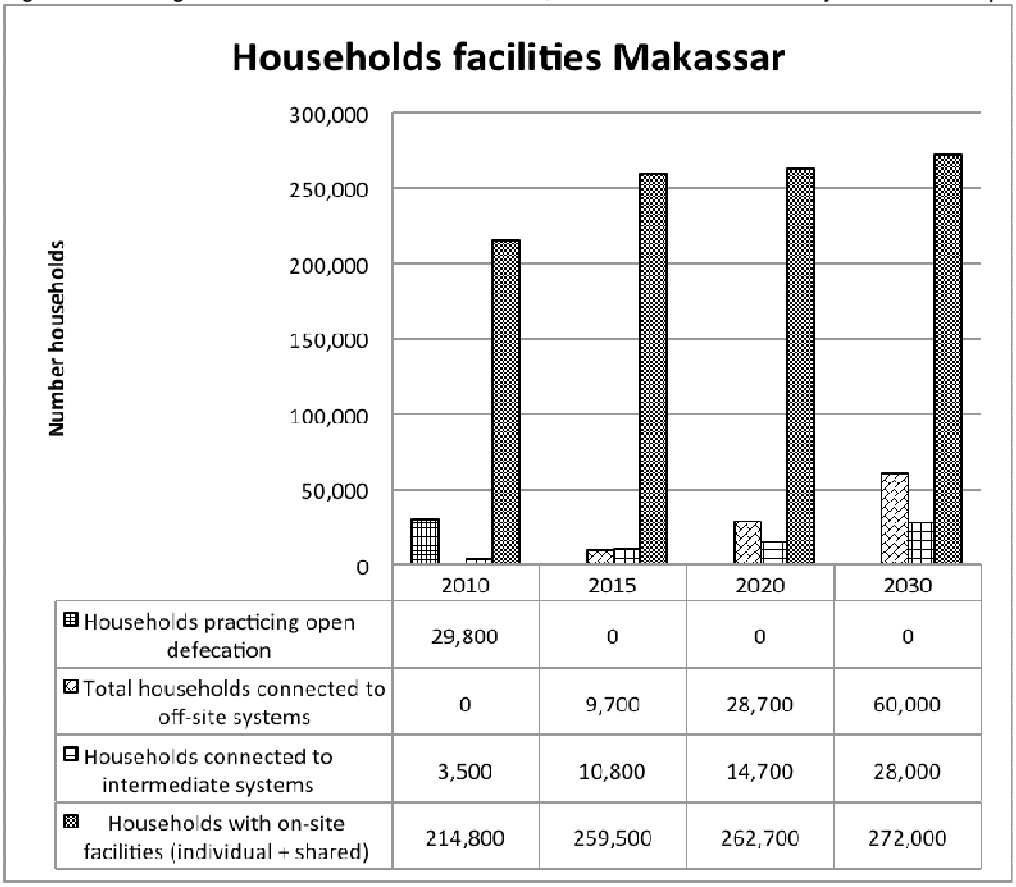
Figure 5.4 below summarises the wastewater coverage targets for each type of system (off-site, intermediate and on-site) for each of the design phase horizons.

Figure 5.4: Percentage Coverage Targets and Phasing for WWMP Makassar



Source: Mott MacDonald Indonesia

Figure 5.5: Target number of households for On-site, Intermediate and Off-site systems for each planning phase

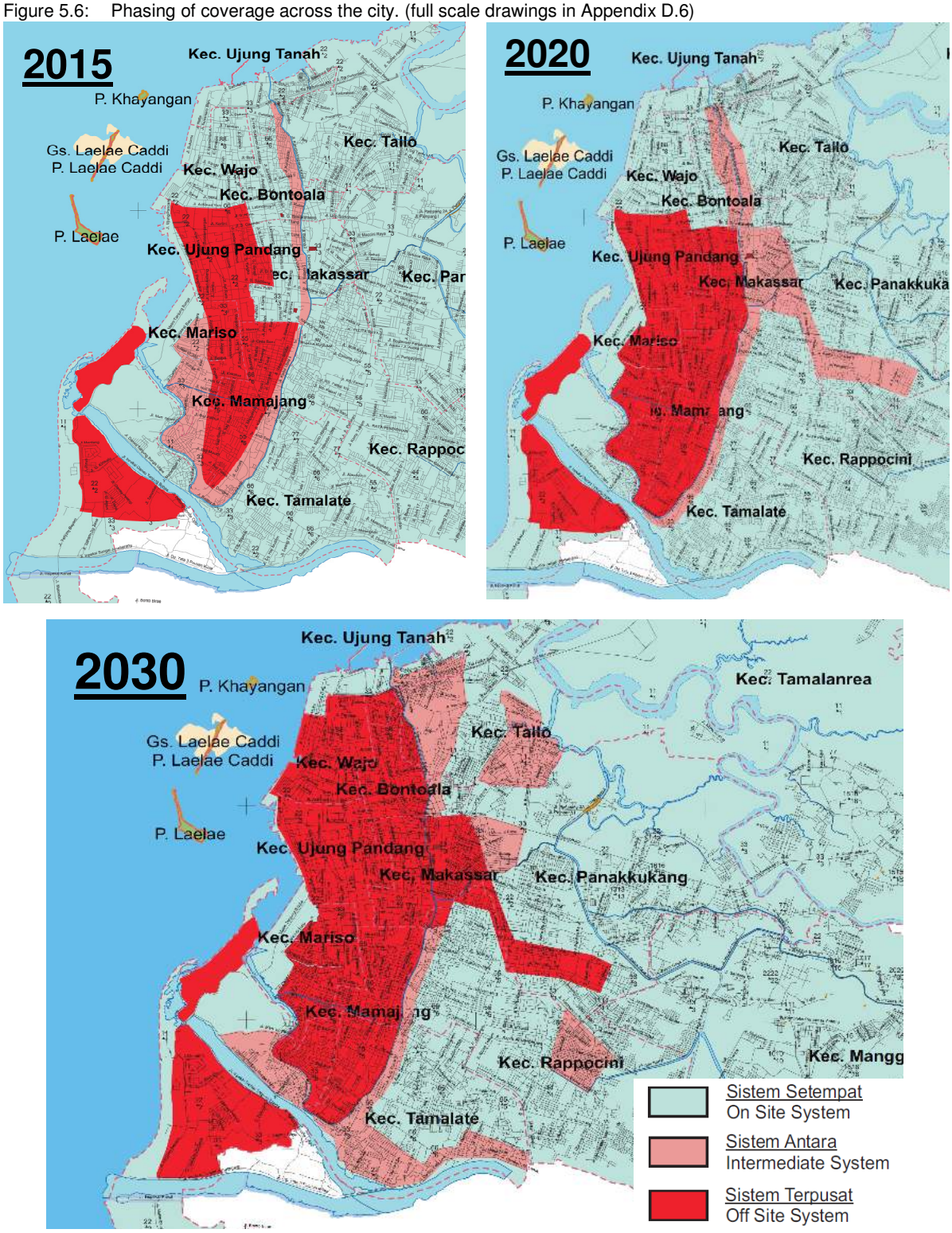


	2010	2015	2020	2030
Households practicing open defecation	29,800	0	0	0
Total households connected to off-site systems	0	9,700	28,700	60,000
Households connected to intermediate systems	3,500	10,800	14,700	28,000
Households with on-site facilities (individual + shared)	214,800	259,500	262,700	272,000

Source: Mott MacDonald

The coverage across the city for each phase of the Master Plan is shown in Figure 5.6 below. Areas marked in red indicate areas to be provided with an off-site system, pink areas are those to be provided with an intermediate system. Remaining areas will be those with on-site facilities. These figures are also provided at full scale in Appendix D.6.

Figure 5.6: Phasing of coverage across the city. (full scale drawings in Appendix D.6)



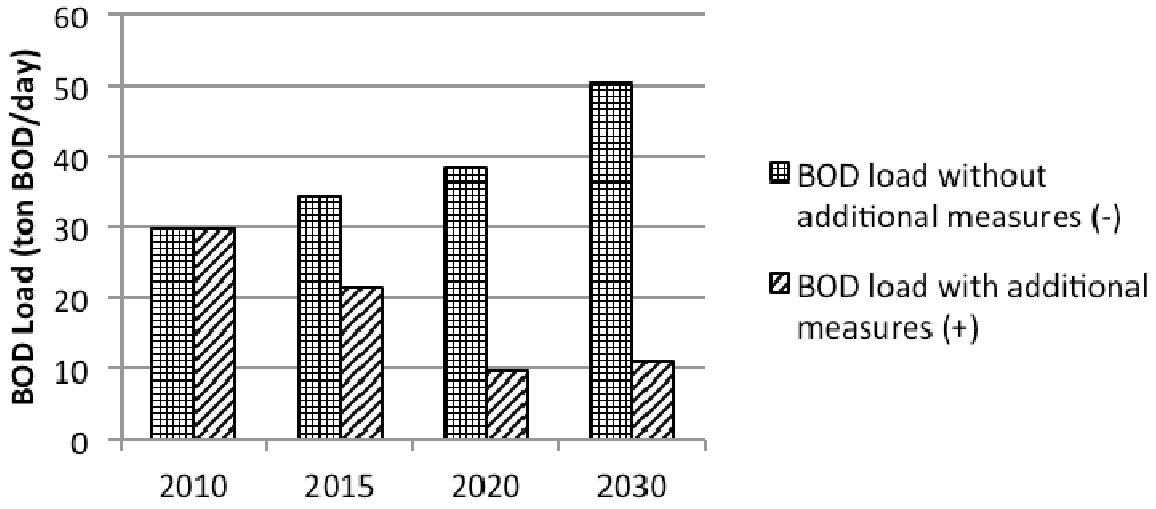
Environmental Pollution

Implementation of the interventions is translated into a reduction in pollution loads expressed in tonnes BOD ('BOD Load') into the environment.

Figure 5.7 shows the difference of pollution load between the situation where Makassar would not take any extra measures ("Business as usual") and the pollution load if the 'additional' measures proposed in the WWMP would be implemented. This illustrates achievement of Strategic Objective 4 (i.e. improvement of the quality and quantity of the city's wastewater infrastructure) in such a way that the pollution load of Makassar is reduced by 65% by 2030, compared to the pollution load in 2010.

Appendix D.7 shows how the different wastewater systems contribute to the pollution load and indicates the composition of the BOD removed.

Figure 5.7: Comparison BOD Load without (-) and with (+) additional measures



Source: Mott MacDonald Indonesia

5.4.3 Development of off-site sewerage systems

For the development of an off-site system, the Master Plan has adopted the following procedure to identify coverage areas for the City:

1. Previously planned sewerage proposals for the Losari wastewater collection areas were included, as identified in the 2008 MSMH SPAR and the expanded wastewater collection area included in the subsequent DED by Dana Consult and entered into the RPJM 2010. These are referred to as the "currently planned" proposals;
2. Areas with a projected population density in excess of 300 persons/ha in 2015, 2020 and 2030, based on population density calculations, were identified;
3. Existing and proposed business and commercial districts (CBDs) based on the existing situation and urban development plans were identified;

4. High density and CBD areas on were combined and the suitability and affordability of off-site system in these areas were assessed, based on:
   a. The outcome of Focus Group Discussions with the private sector
   b. Discussions with the POKJA;
5. The areas that 'remain' after step '4' were plotted as potential 'wastewater collection areas' on topographical maps of the City;
6. Subsequently the Master Plan 'connected' potential wastewater collection areas in a logical way and defined possible locations of future trunk sewers, considering potential land availability for sewage treatment plants. These alignments were checked in the field using GPS equipment and then discussed with the City Government Roads Department (*Bina Marga*).

6. Design and Planning of Interventions

6.1 Off-site systems and Sewage Treatment Options

6.1.1 Current Planned Interventions

There has been a long history of planning for a centralised sewerage system, in particular for the Losari beach area. According to the Public Works Office (PU-CK) of the Province of South Sulawesi, the latest proposals for Losari sewerage systems are as follows:

- Wastewater collection covering two areas known as Losari 1 and Losari 2 and part of the GMTDC area in Kecamatan Mariso. According to a presentation made on 9th June 2008 to the PU-CK Province, the planned area to be connected to the sewerage network covers an area of 1,357 ha with a current population of 88,000 and population expected to grow to 125,000 by the year 2020. The planned wastewater collection area does not extend to the slum areas along the Panampu-Jonggaya canal.
- This sewerage system assumed 9,000 connections in the period from 2011 through to 2015, representing 50% of the connection area. According to the information from the PU-CK presentation, 40% of these connections are expected to be commercial or institutional.
- The connection coverage is planned to increase from 9,000 connections by year 2015 to 12,500 connections by year 2020 (60% coverage) and 20,000 connections (80% coverage) by year 2030
- The wastewater is collected in a 500mm diameter collector trunk sewer along the sea front of Losari Beach
- The planned budget for Phase 1 of the Losari sewerage scheme was estimated to be Rp 350 billion and included 1 pumping station and a 6 ha, 7,000m^3/day capacity STP (see Appendix E.1 and Section 6.2). See Table 6.1 for details of the current budget [6].

Table 6.1: Current Planned budget - Phase 1, Losari sewerage system

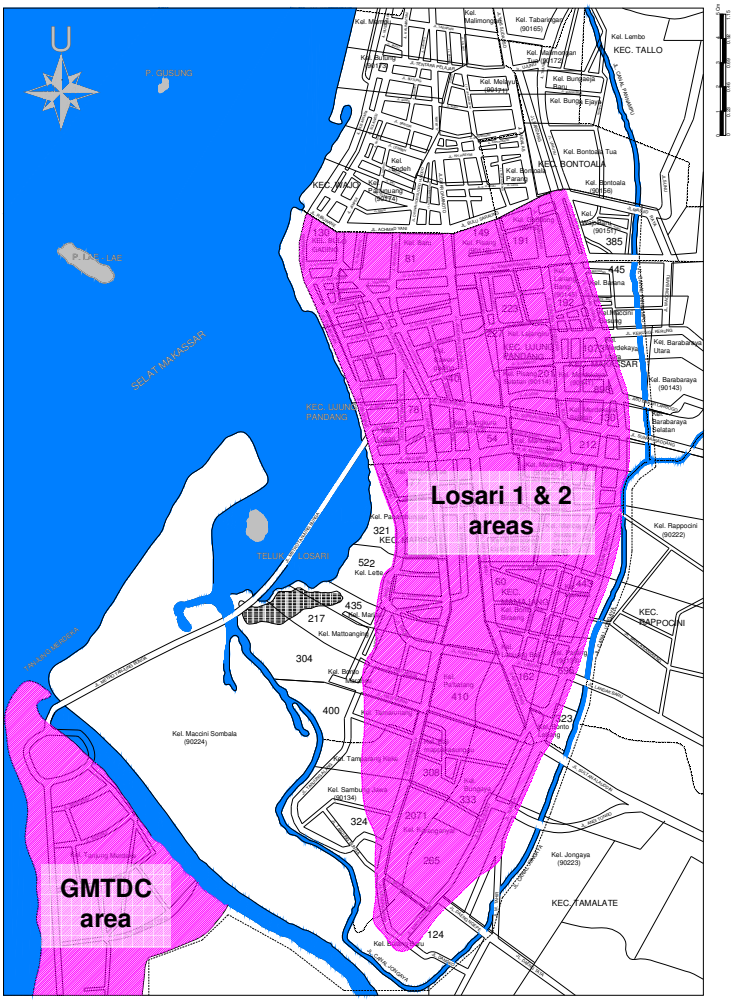
No	Description	Volume	Unit	Unit Price (Rp m.)	Cost (Rp m.)
1	**Losari 1**				
1.1	Trunk sewer (incl. Jacking)	1	lump sum	19,151.50	19,151.50
1.2	House connections and lateral sewers	4,000	connections	21.61	86,439.25
2	**Losari 2 and GMTDC**				
2.1	Trunk sewer (no Jacking)	1	lump sum	60,968.75	60,968.75
2.2	House connections and lateral sewers	5,000	connections	21.01	105,025.00
3	**STP**				
3.1	Trunk sewer	1	lump sum	12,252.00	12,252.00
3.2	Sewage Treatment Plant and Pumphouse	7,000	m^3/d	9.29	65,000.00
	Total				**348,836.50**

These proposals are incorporated in the RPJM 2010 (based on the Dana consult report of 2008). The extent of the sewerage system is indicated in Figure 6.1 and Figure 6.2 below. Figure 6.2 indicates that

[6] PU-CK has an alternative cost estimate of Rp 482 billion including an STP costed at Rp 140 billion,

according to the present design, the main trunk sewer and pumping station are located along the Losari beach sea front.

Figure 6.1: Service area of the planned Losari sewerage system



Source: Dana Consult, 2008

The environmental benefits of the planned sewerage system can only be reaped if a 'Total Wastewater Improvement Approach' is followed. That means that in the area where wastewater improvements are being implemented, 100% of the required systems in the area have to be environmentally acceptable to be operated properly and maintained properly. This is in contrast to the current planned proposals and results in a higher rate of connections within the phase 1 period to 2015.

Figure 6.2: Lay-out of the planned Losari sewerage network (based on the MSHMH project)

Source: Pekerjaan Perencanaan Teknis Pengelolaan Air Limbah Kota Makassar, Dana Consultant, 9th June 2008

As the initial off-site sewerage network for Makassar is planned to be implemented for the Losari 1 and Losari 2 wastewater collection areas, the most logical step to meet the “Total Wastewater Improvement

Approach" is to add more connections to the planned sewerage system. This system extension includes the areas referred to in the MSMH project SPAR[7] as the Lembo sewerage area.

The sewerage areas referred to as Pampang in the August 2008 MSMHP SPAR report (which has 9,000 connections in low income areas) and Maccini Sombala (which has 2,500 connections in low density area) are geographically relatively small and have characteristics more appropriate for intermediate wastewater systems rather than off-site systems. To be in line with the wastewater system selection methodology explained in Chapter 4, these areas have been included as future intermediate wastewater system areas.

Details of the planned wastewater collection areas for Lembo, Pampang and Maccini Sombala that were included in the 2008 MSMH project SPAR report are provided in Appendix E.2

6.1.2 Additional Interventions

In addition to the currently planned interventions to be implemented by 2015 the following additional interventions will lead to a more optimum planning of the Losari sewerage area up to the planning horizon of 2030:

- Restrict the wastewater collection area to 1,166ha in the first Phase; expand it to 1,376ha by 2020 and to 1,843ha by 2030. This should be achieved by connecting adjacent areas with population densities of more than 300 cap/ha
- 9,000 connections were originally planned for the Losari sewerage area by the year 2015. To this, a further 3,000 connections are added by 2015; then add 19,000 connections between 2015 and 2020 and another 25,000 connections between 2020 and 2030. The total number of planned and additional connections by 2030 will be 56,000
- Inclusion of the GMTDC development area into the Losari wastewater collection area (see Section 5.3.1). In the absence of reliable data for the GMTDC it has been assumed that the GMTDC area can provide about 24,000 connections. The following breakdown has been used:
    - 3,000 connections between 2010-2015
    - 6,000 connections between 2015 and 2020
    - 15,000 connections between 2020 and 2030

Hence the total number connections to the proposed sewerage system will be 80,000 connections by 2030. This includes the 20,000 connections already planned for 2015 and allows for a further 60,000 connections thereafter. Table 6.3 shows the total connection coverage of the proposed off-site system by district (*Kecamatan*). For details of the phased planning on a sub-district (*Kelurahan*) basis, see Appendix E.3

[7] SPAR: Sub Project Appraisal Report (SPAR) Metropolitan Sanitation Management and Health (MSMH), Black and Veatch, August 2008

Table 6.2: Total Number of sewerage connections for proposed Makassar off-site system by *Kecamatan*.

No.	District/ Kecamatan	Surface area (ha)	Population 2030 (cap)	Population Density 2030 (cap/ha)	Nr of households (nrs)	Area planned sewered area (ha) - Mott MacDonald	New systems in area off-site planned	New additional systems in area off-site	Total systems in area off-site
1	Mariso	184	66,000	359	13,200	184	4,446	6,660	11,106
2	Mamajang	226	77,000	341	15,400	226	5,085	7,627	12,712
3	Tamalatte+GMTDC	2,021	322,000	159	64,400	535	4,267	30,950	35,217
4	Rapocini	923	182,000	197	36,400	-	-	-	-
5	Makassar	252	98,000	389	19,600	172	1,836	5,874	7,711
6	Ujung Pandang	263	33,000	125	6,600	221	1,911	2,834	4,745
7	Wajo	199	43,000	216	8,600	199	693	1,617	2,310
8	Bantoala	210	78,000	371	15,600	38	384	1,226	1,610
9	Ujung Tanah	594	69,000	116	13,800	-	-	-	-
10	Tallo	871	184,000	211	36,800	136	1,157	2,701	3,858
11	Panakkukang	1,715	177,000	103	35,400	132	220	512	732
12	Manggala	2,414	155,000	64	31,000	-	-	-	-
13	Biringkanaya	4,822	203,000	42	40,600	-	-	-	-
14	Tamalanresa	3,186	110,000	35	22,000	-	-	-	-
	TOTAL	**17,880**	**1,797,000**	**101**	**359,400**	**1,843**	**20,000**	**60,000**	**80,000**

6.1.3 Off-site sewerage Design Criteria

The design criteria for off-site sewerage used in previous proposals are provided in Appendix E.4. These have been adjusted to better reflect actual field conditions, as indicated below:

- The system will, as much as possible, be **separated from storm water**. However, this will not always be possible as inflow during heavy storms through manholes cannot be avoided and some allocation of the design flow has to be made for illegal/inappropriate connections and cross connections. Hence, some overcapacity is required and emergency storm-water overflows will need to be located at strategic locations.
- As per previous design proposals, the system will **include grey water,** originating from washing, laundry and cleaning. A waste return ratio of 80% of water supplied will be used to calculate wastewater contribution. The average water supplied to domestic properties will be 132 litres/capita/day (*PDAM Makassar, 2010*) and is forecast to increase to 175 litres/capita/day by 2030 (*PDAM Makassar, 2010*).

- Due to the high groundwater levels, the design will also incorporate **infiltration from ground water**. The Medan Urban Development[8] project used 10 m^3/ha/day, which gives 30,000m^3/day. This is around 15% of the ultimate design capacity. Literature suggests 50-5,000litres/day/mm diameter[9]. It is recommended to use a figure of **10 m^3/ha/day** in the design. The reason for this recommendation is that, on the one hand it is not necessary to take the maximum value due to the silt/clay soils and on the other hand contractors, who will be hired to construct the sewers, may not necessarily familiar with the construction of sewerage and infiltration rates could be high.
- **Flushing requirements**. In Phase I not all sewers will work at full capacity. As the sewers are designed for full capacity at a relatively shallow slope, sedimentation and blockages are to be expected. Makassar already has a flushing system for its surface water drains. This flushing infrastructure can be used for the sewerage also, provided it is renovated and brought back into use.
- **Interceptor tanks**: for new property connections, the use of interceptor tanks should be discouraged, as it will unnecessarily increase the costs to the householder. For existing properties which have a watertight interceptor (septic tank) it will be useful to have the septic tank as a pre-settling tank. In that case the system can function as a small bore sewer and sewer lines can be laid at shallower gradients.
- For the sewerage design, a **Manning's coefficient** of roughness (n) of 0.013 should be used. This gives a velocity of 0.9m/s at full bore conditions for a 900mm diameter pipe.
- **Peaking factor**: for the trunk sewer a value of 2 is suggested, for the lateral sewers a value of 3-4.
- A **minimum velocity** of 0.7m/s at ultimate flow conditions and 0.6m/s at initial flow conditions is suggested to ensure self-cleansing.
- **Maximum velocity** of 1.5m/s is used to prevent damage to the pipes due to scouring.
- Due to the flat topography of Makassar, **pumping** is necessary as it is impossible to design the system to operate as a gravity system. To minimize operation and maintenance costs, the pumping need to be minimized by 'intelligent' design.
- The use of **forced pressure mains** should be avoided where possible as they may lead to operation and maintenance problems. Depressed sewer pipes are preferred for minor river and canal crossings.
- **Minimum gradients**: in order to attain a 0.7m/s minimum velocity the theoretical minimum slope for a 200mm diameter pipe is 0.0052m'/m' and for a 600mm diameter pipe 0.0012m'/m'. We suggest to keep a minimum slope of 0.001m'/m' as the installation of pipes at a lower gradient will be difficult to be constructed by inexperienced contractors.
- **Minimum invert depth** at manholes should be around 1.5 m as we have to take into account that many sewers will have to pass under storm water drainage channels.
- **Maximum depth to invert**: the maximum depth should be 6 m, as it will be very difficult to construct deeper trenches in the silt soils.
- **Grease traps** are a necessary element for domestic connections, as grey water from kitchens may contain appreciable amounts of fat and grease that can cause blockages on small diameter pipes.

[8] Second Medan Urban Development Project MUDP II, Urban Sanitation Strategy, 1992.

[9] Community Wastewater Collection and Disposal, WHO, 1975.

6.1.3.1 Key Design Considerations

The slum housing area along the Panampu-Jonggaya canal is the primary Open Defecation area in Makassar. The communities here live in extremely poor sanitary conditions and the practice of open defection in the principal drainage canal in the city results in severe degradation of the water quality. The current planned sewer system runs close to this area. By incorporating this area in the Losari sewerage area, it will not only remove the need for the planned intermediate wastewater systems in this area and avoid the construction, operation and maintenance of a large number of expensive intermediate STPs, but will also contribute significantly to improvement of the canal water quality.

By installing the main sewers to a central location of the catchment area, wastewater can be received from both sides instead of one. This will reduce the size of the sewers (as their length will be reduced) and will also avoid pumping for future extensions. This will also ensure main sewers are located away from the sea front.

There are very important medium to high-income housing and commercial developments in the GMTDC area. It is an opportunity not to be missed to include these areas in the sewerage system, both environmentally and financially.

Up to 2020 the Sambung Jawa area will have a population density less than 300per/ha. Hence it is more economical to implement the system here after 2020.

To make the expensive investment in sewerage and sewage treatment more viable, it is advised to increase the number of sewerage connections. The following sequence is recommended:

- 2015: 15,000 connections;
- 2020: 40,000 connections;
- 2030: 80,000 connections.

During the implementation, it is important to connect 100% of the properties in an area before moving on to the next area.

Makassar needs equipment for maintaining the sewers such as a vacuum truck to empty the accumulated sludge and sand in manholes and equipment to un-block the sewers such as high-pressure pumps.

6.1.4 Phasing of the Off-site sewerage intervention

Table 6.3 below indicates the anticipated phasing of total house connections to the proposed sewerage network. This totals 80,000 connections for the Losari WCS and GMTDC area by 2030. It shows that currently 9,000 connections (5,400 households, 3,600 commercial/institutional connections) are planned to be connected to the sewerage network in the period 2010-2015, while the trunk sewers are designed for 20,000 connections in 2010-2015. By adding a further 6,000 connections (4,286 house connections, 1,714 commercial connections) the trunk sewers are used in a more optimum way. The volume of 'idle infrastructure' is reduced from 11,000 (20,000 – 9,000) to 5,000 (20,000 – 15,000).

Table 6.3: "Current planned" and "new additional" off-site connections

Program		2010-2015	2015-2020	2020-2030	Total
House connections:					
- current planned off-site house connections: hc+lateral sewers	number	5,400	2,100	4,500	12,000
- current planned off-site house connections costs for main sewers	number	12,000	-	-	12,000
- new additional off-site house connections: hc+lateral sewers	number	4,286	16,868	26,846	48,000
Commercial/institutional connections:					
- current planned off-site c/i connections: hc+lateral sewers	number	3,600	1,400	3,000	8,000
- current planned off-site c/i connections costs for main sewers	number	8,000	-	-	8,000
- new additional off-site c/i connections: hc+lateral sewers	number	1,714	4,632	5,654	12,000

6.1.5 Outline Trunk Sewer design for future expansion

To guarantee operational flexibility for the pumping station, the presently planned pumping station along Jalan Metro Tanjung Bunga is to be moved to a more centrally located pumping station that receives wastewater from the complete area west of Panampu-Jonggaya canal. From this central pumping station sewage would be pumped to a STP to the south of the city (as currently proposed). This has been termed the **'All-in-one' Scenario** and it assumed that all wastewater is treated in one single STP, as indicated in Figure 6.2.

As, the currently planned site for the Losari STP only has a capacity for up to 40,000 connections (see Section 6.2.6) additional treatment capacity will need to be provided for the 2030 design horizon. The '**Switch Point Scenario**' suggests that after 2020 wastewater could also be pumped to a second STP located to the east of Losari in Pampang, as indicated in Figure 6.4.

Alternatively, a second STP could be located in the east in Pampang and a further third STP located to the north of Losari in Lembo. This has been terms the '**Three Legs Scenario**' and is indicated in Figure 6.3.

A comparison of these three scenarios has been undertaken, as indicated in Table 6.6 below.

Table 6.4: Comparison and scoring of Trunk Sewer design scenarios

Criterion \ Scenario	All-in-one	Switch point	Three legs
Availability of land for STP and environmental impact	Leads to a very large STP in an area designated as international business zone	Area available for STP Pampang is relatively large and at a distance from the built-up area. STP Losari can be kept relative small	The possible negative impact of an STP is spread. STP Pampang area is large and isolated. STP Lembo area along the toll road
Score	**(- -)**	**(+)**	**(+ +)**
Flexibility to adjust to future developments.	Rigid: all wastewater concentrated in one place	Very flexible: wastewater streams can be manipulated. It permits start-up of Losari and later turning it into a pumping station.	In this case the sewer in the part north of Losari has to run south-north. Which is difficult to change in future.
Score	**(-)**	**(+ +)**	**(0)**
Investment costs	Large diameter pipes	Medium diameter pipes	Smaller diameter pipes Three STPs
Score	**(- -)**	**(-)**	**(-)**
O&M costs	Only one 1 STP	Two STPs	Three STPs
Score	**(+)**	**(0)**	**(-)**
In line with current steps taken by City of Makassar	Land for STP Losari is being acquired	Relatively easy to acquire land in Pampang	Relatively easy to acquire land in Pampang and Lembo
Score	**(+ +)**	**(0)**	**(0)**
Total	**(-2)**	**(+2)**	**(0)**

From this analysis it can be concluded that the 'Switch Point' scenario presents the best scenario. This scenario is in line with the current steps taken by the Government and minimizes potential negative impacts. Figures 6.3 to 6.5 below graphically show the 3 scenarios considered and Figure 6.6 shows a potential layout of the main sewers to 2030 for the 'switch point' scenario, indicating centrally located pumping station and trunk mains away from the sea front.

Figure 6.3: 'All-in-one' Scenario

Figure 6.4: 'Switch point Scenario'

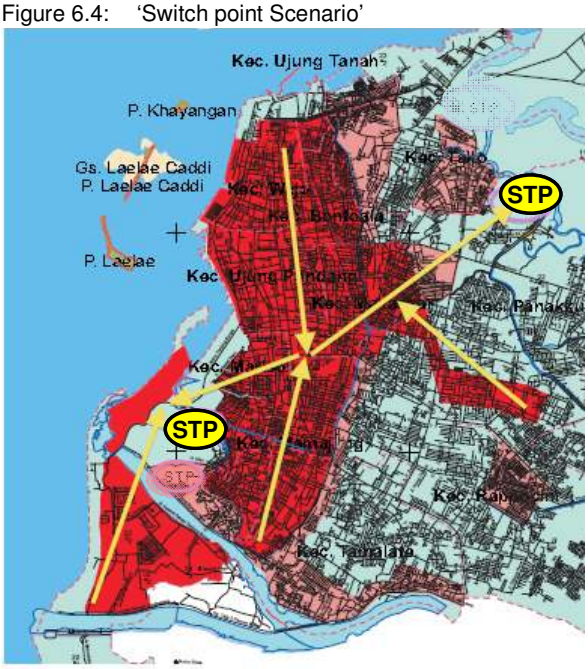


Figure 6.5: 'Three Legs' Scenario

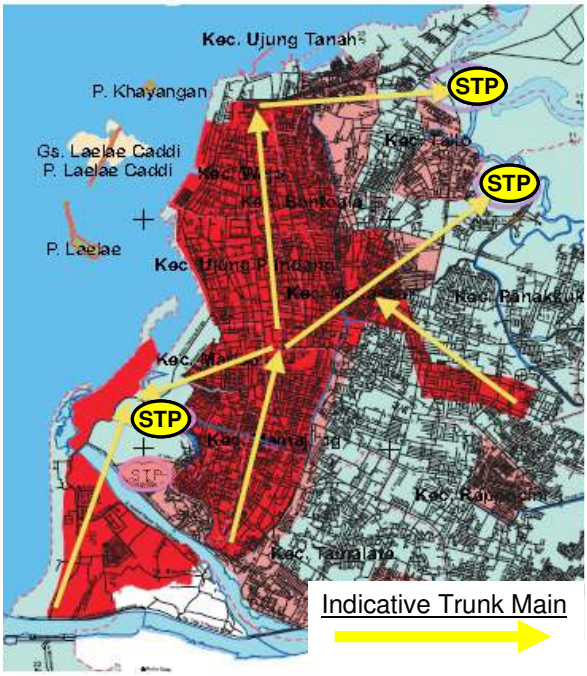


Figure 6.6: Potential Trunk Main Layout (Switch point)

Source: Mott MacDonald Indonesia

6.1.6 Sustaining program for off-site systems

Table 6.5 highlights the key risks involved in applying off-site solutions and provides remedial actions for minimize those risks. The actions have both a motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural). It is recommended that the current institutional development program incorporates, elaborates and implements these activities.

Table 6.5: Risks and motivational and capacitating activities

Risk	Motivational and capacitating activities
Most of the energy and scarce funds are being spent on providing only 9,000 to 20,000 household connections, i.e. only 3-6% of the population. This will have little effect on reducing the pollution load for the City.	- Educate the responsible wastewater agencies on the "Total Wastewater Improvement Approach" - Release of funds for off-site systems only as a part of a comprehensive wastewater improvement programme
The wastewater systems for the GMTDC are being developed in isolation and a potential revenue stream is being ignored.	- Marketing of the benefits sewerage network to GMTDC - Legislation that GMTDC has to connect to the Losari sewerage system.
Losari 1 and Losari 2 wastewater collection areas have been designed independently, leading to inadequacy and redundancy.	- Redesign the "current planned" sewerage system - Redesign the Losari sewerage system as one collection area.
Not all households and enterprises want to connect to the off-site system 1. Underperformance of the system 2. Lack of O&M funds	- Campaigning (mass media, individual approach) to explain the benefits of sewerage - Legislation that 100% of properties need to be connected - All properties pay a fee whether they are connected or not - Install property connections together with the collector sewers - Subsidize households that are not able to pay, or cross-subsidize
Risk: people discharge unwanted materials (grease, fat, chlorine, etc.) into the sewers.	- Explain how a sewerage system works and what is required from a behavioural point of view by means of mass media; - Install grease traps at all property connections
Contractors do not construct the pipes properly.	- Pay contractors only after the whole system has been inspected - Strict supervision during construction - Hire only contractors, who have experience with sewerage if possible
Not enough flow in the system.	- All properties connected should have a piped water supply connection - Install flushing devices
Too much flow in the system due to entry of storm water through manholes and illegal connections at household level, leads to 'thin' wastewater (low BOD) and treatment failures at the STP.	- Install emergency overflows and flush at intervals

6.2 Off-site centralised sewage treatment plants

6.2.1 Current planned Losari STP proposals

According to the Public Works Office (PU-CK) of the Province of South Sulawesi[10], the planned STP for the proposed Losari wastewater collection system is as follows:

- A 6ha site has been selected near the bridge of the Jl. Metro Tanjung Bunga and the Panampu-Jonggaya Canal. The site recommended by the City Government, was rejected by the ADB because it is located in the sea[11]
- An environmental impact assessment (AMDAL) has already been completed for the STP on this site. In May 2011, the Dinas Pekerjaan Umum Kota Makassar issued the Environmental Impact Assessment (AMDAL)[12]. It concluded that the STP is feasible from an environmental point of view although the site is located in an area labelled as 'international business zone';
- The Major of Makassar has issued instructions to acquire the land, as this is a prerequisite for acquiring the funds for the Losari sewerage scheme.
- The STP capacity originally identified in the MSMH project SPAR was 10,000m^3/day, but the current fund request mentions a capacity of 7,000m^3/day

6.2.2 Increased capacity of STP Losari

To serve the proposed total connections for the Losari, GMTDC and Lembo wastewater collection areas, the capacity of the planned sewage treatment needs to double by 2015 compared to current plans and increase tenfold by 2030. Table 6.6 below presents the total capacity for the Master Plan periods.

Table 6.6: Calculation of adjusted sewage treatment capacity – STP Losari

STP Losari		2015	2020	2030
Number households	number	9,686	28,654	60,000
Number institutions/commercial enterprises	number	5,314	11,346	20,000
Total number connections	number	15,000	40,000	80,000
Wastewater flow households	m3/d	5,579	17,192	42,000
Wastewater flow institutions and commercial enterprises	m3/d	7,971	17,019	30,000
Wastewater flow	m3/d	13,550	34,212	72,000
Inflow, leakage, stormwater	%	20%	20%	20%
Capacity STP	**m3/d**	**16,000**	**41,000**	**86,000**

The Pampang and Maccini Sombala wastewater collection areas, as proposed in the SPAR report, have the characteristics of intermediate area and have not been included.

[10] Ir. Husir Tjenne, Dinas PU CK on April 6th 2011

[11] Information Dana Consult on April 8th 2011

[12] Analis Dampak Lingkungan Hidup (ANDAL) Pembangunan Instalasi Pengolahan Air Limbah (IPAL) Pantai Losari Kota Makassar (May 2011).

6.2.3 Selection of technology

The currently planned treatment system for Losari STP (based on the Dana Consult report, 2008) consists of a balancing/equalisation tank, aerated lagoons, sedimentation pond, sludge thickener and sludge drying beds. Given that there are limited operation and maintenance skills available in the region, the Facultative Anaerobic Pond (FAP) system is a more appropriate option, as set out in Appendix E.5. The application of this system has the best track record in Indonesia (see Comparative Study on Centralized Wastewater Treatment Plants in Indonesia)[13].

6.2.4 Design criteria and technological aspects

The 2008 Dana Consult's design for the current planned Losari STP is based on measurement of the wastewater strength from the various stormwater drain outlets along Losari beach, as indicated in Table 6.7 below.

Table 6.7: Design criteria – STP Losari (source: Dana Consultant final report)

No	Parameter	Unit	Effluent Quality
1	BOD	mg/l	431
2	COD	mg/l	718
3	TSS	mg/l	53

Source: Laboratory analysis of Losari outflow, maximum parameter

The value of 431 mg BOD/l is usually associated with black water whereas the future wastewater will be composed of black water, grey water, some stormwater inflow and some infiltration from ground water. Hence this value needs to be adjusted. The composition and strength of wastewater varies between one area and another in Makassar and depends mainly on prosperity: the more prosperous, the richer the diet, the more water used, the stronger the wastewater (higher value BOD). The estimates for the overall composition of the wastewater in Makassar is presented in Table 6.8 below and the planned composition of the wastewater to be treated at STP Losari is presented in Table 6.9.

Table 6.8: Overall composition of Makassar wastewater

Calculation Pollution	Source		2015	2020	2030
Domestic piped water usage	PDAM Makassar	Lcd	144	150	175
Ratio drinking water/waste water	Mott MacDonald estimate based on experience Indonesia	%	80%	80%	80%
Daily wastewater production	Calculation	Lcd	115	120	140
Ratio volume black/grey water	Mott MacDonald Estimate	%	25%	25%	25%
Strength black water	Mott MacDonald	mg BOD/l	450	450	450

[13] COMPARATIVE STUDY CENTRALIZED WASTEWATER TREATMENT PLANTS IN INDONESIA, ESP, 2006

Calculation Pollution	Source		2015	2020	2030
	Estimate				
Strength grey water	Mott MacDonald Estimate	mg BOD/l	170	170	170
BOD contribution black water	Calculation	gBOD/cap/day	13	14	16
BOD contribution grey water	Calculation	gBOD/cap/day	15	15	18
Ratio black/grey BOD	Calculation	%	88%	88%	88%
Domestic waste production per capita (pe)	Calculation	gBOD/cap/day	28	29	34
Daily BOD load domestic wastewater	Population forecast	kg BOD/day	38,707	44,064	60,480
Daily BOD load wastewater commercial enterprises	Number enterprises: PDAM	kg BOD/day	13,560	14,820	17,460
Daily BOD load domestic wastewater and ww commercial enterprises	Calculation	kg BOD/day	52,267	58,884	77,940
Strength domestic wastewater	Calculation	mg BOD/l	240	240	240
Strength wastewater commercial enterprises	Calculation	mg BOD/l	400	400	400

Source: Water Consumption, PDAM Makassar, 2010

Table 6.9: STP Losari proposed wastewater influent quality

STP Losari		2015	2020	2030
Total number connections	Number	15,000	40,000	80,000
Wastewater flow households	m3/d	5,579	17,192	42,000
Wastewater flow institutions and commercial enterprises	m3/d	7,971	17,019	30,000
Inflow, leakage, stormwater	%	20%	20%	20%
Capacity STP	m3/d	16,260	41,054	86,400
BOD load households	kgBOD/day	1,339	4,126	10,080
BOD load institutions and commercial enterprises	kgBOD/day	3,189	6,808	12,000
BOD load	kgBOD/day	4,528	10,934	22,080
sewage strength influent	mgBOD/l	278	266	256

The STP Losari will also receive septage sludge emptied from the on-site systems through the septage discharge stations on the trunk sewers as detailed in Section 6.67. The retention time selected for the proposed treatment plant is initially 5 days. This will reduce to 3 days by 2030, due to increased flow from the increased number of connections to the sewerage systems.

Table 6.10 provides the design criteria for the “All-in-one scenario”. The STP will still be able to deliver an effluent quality above the standard of 50mg BOD/litre.

Table 6.10: Design criteria and design for the FAP treatment system at STP Losari

Description		2015	2020	2030
Total number connections	[nrs]	15,000	40,000	80,000
Daily Capacity sewage treatment	[m3/day]	16,260	41,054	86,400
Septage	[m3/day]	81	109	113
Avg. sewage strength	[mgBOD/l]	288	266	253
Retention time	[days]	5	4	3
Volume	[m3]	81,708	164,653	259,540
Surface area	[ha]	3.3	6.6	10.4
Total depth	[m']	2.6	2.7	2.7
BOD effluent	[mg/l]	32	35	42
Sludge drying	[ha]	0.93	2.18	4.00
Nett Land requirement	[ha]	4.20	8.76	14.39
Gross Land requirement	[ha]	5.3	11.0	18.0

6.2.5 Land requirements

The land requirement for the currently proposed Aerated Lagoon technology at Losari STP is 2,500m wide and 2,500m long or approximately 6 Hectares.

The land requirements for the recommended FAP technology for the “All-in-one scenario”, which assumes all sewerage for the three wastewater collection areas (Losari, GMTDC and Lembo) are treated at Losari STP (15,000 to 80,000 connections for the years 2015, 2020 and 2030) are presented in Table 6.11. This land area is considered to be the equivalent total area required where more than one STP is proposed (i.e. “Switch point” scenario or “Three Legs” scenario).

Table 6.11: Land requirements for the FAP system

Sewage and Sludge Treatment		2015	2020	2030
Total number connections	[nrs]	15,000	40,000	80,000
Gross Land requirement	[hectares]	5.3	11.0	18.0

6.2.6 Phasing for 2015, 2020 and 2030 and the costs

The land for the currently planned 6ha STP is being acquired this year and the treatment plant was originally planned to be built in 2011.

Table 6.12 presents the phasing of the capacity of the STP to meet the planned increase in connections to the proposed STP. The STP has to be constructed before properties can be connected, so the initial capacity will be for 20,000 connections and the final capacity for 80,000 connections and needs to be built by 2020. The analysis includes commercial/institutional properties (shown as c/i in the table).

Table 6.12: Phasing – Treatment capacity of the proposed STP Losari

Program		2010-2015	2015-2020	2020-2030	total
House connections:					
- current planned off-site house connections costs for STP	number	12,000	-	-	12,000
- new additional off-site house connections costs for STP	number	-	48,000		48,000
Commercial and institutional connections:					
- current planned off-site c/i connections costs for STP	number	8,000			8,000
- new additional off-site c/i connections costs for STP	number	-	12,000		12,000

The costs for the STP are presented in Table 6.13. They are based on the cost Estimates of the Province of South Sulawesi (Satker).

Table 6.13: Costs – STP Losari ("current planned" and "new additional") in Rp million

Investment costs off-site system (sewage treatment)		2010-2015	2015-2020	2020-2030	Total
- current planned off-site house connections costs for STP (Rp m)	Rp10	120,000	-	-	120,000
- new additional off-site house connections costs for STP (Rp m)	Rp 5	-	240,000	-	240,000
- current planned off-site inst/comm connections costs for STP (Rp m)	Rp10	80,000	-	-	80,000
- new additional off-site inst/comm connections costs for STP (Rp m)	Rp5	-	60,000	-	60,000
Total (Rp m)		**200,000**	**300,000**	**-**	**500,000**
Total (US $ m)		**$22**	**$33**	**-**	**$56**
O&M (Rp m)	2%				10,000

Note - A higher unit cost has been assumed for the "current planned" STP phase than for the "new additional" treatment phase. Hence, the treatment unit costs for the "current planned" 20,000 connections is Rp 10 m/connection and the treatment costs for the "new additional" 60,000 connections is Rp 5 m/connection (Source: Mott MacDonald). The total cost is estimated as Rp 500 billion (US$ 56 m.) and do not include land acquisition.

Operation and maintenance (O&M) costs

Based on a recent USAID-funded study[14], the operation and maintenance costs are estimated at Rp 30,000/connection/month. This is around 2% of the investment costs. Hence, the ultimate O&M costs are Rp 10,000 m./year.

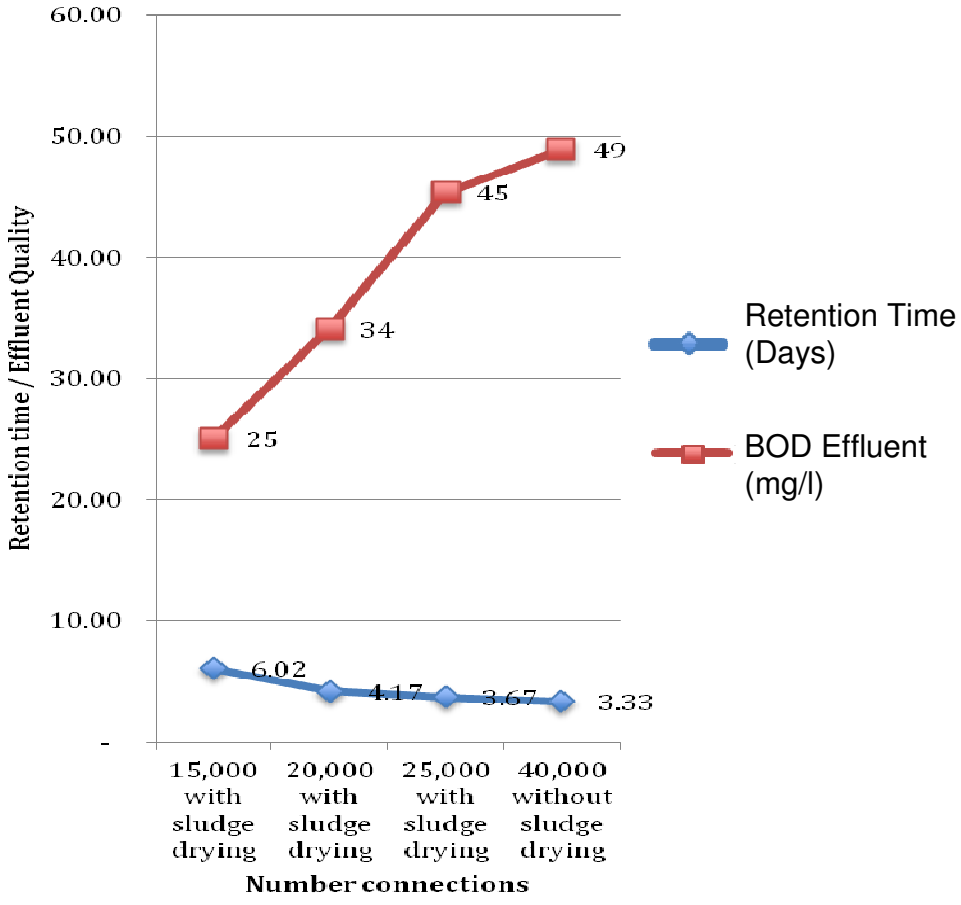
[14] Comparative study Centralized wastewater treatment in Indonesia, ESP, 2004

6.2.7 Alternative phasing "Switch-Point" and "Three-Legs" scenarios

At present 6 ha of land is being acquired for Losari STP, whereas in the future 18ha is needed (see Table 6.11). In case it is not possible to acquire more land at the same spot, it is possible to treat the wastewater of up to 25,000 connections at this site while using the FAP technology. If the sludge is removed from the site and dried at another location, the land allocated for the sludge drying beds can be used for wastewater treatment capacity and in this case the 6ha site would be large enough to treat up to 40,000 connections. The sludge can be transported by boat on the adjacent canal.

In Figure 6.7 we show the relation between the hydraulic retention time and the BOD effluent quality. For 40,000 connections, the retention time is 3.33 days and the quality of the effluent is 49 mgBOD/l.

Figure 6.7: Effluent quality and retention time for various connection rates using FAP technology



Source: Mott MacDonald

If obtaining additional land at the planned STP site is not possible, then the "Switch-point" or "Three-legs" scenario can be implemented and excess sewage flows can be diverted for treatment at additional STPs. The phasing would be as follows:

- Up to 2018 (25,000 connections) or 2020 (40,000 connections): wastewater treatment of all the wastewater at the STP Losari;

- After 2018 (25,000 connections) or 2020 (40,000 connections): additional wastewater treatment at STP Pampang ("Switch-point" scenario) or additional wastewater treatment at STPs Pampang and Lembo ("Three-Legs" scenario).

6.2.8 Sustaining the provision of the STP

As explained in Section 4.3, there are certain constraints or risks involved in developing STPs. In Table 6.14 we indicate the major risks and remedial actions to minimize the risks.

Table 6.14: Sustaining the sewage treatment plant

Risk	Remedial actions
Only 6 ha of land is being purchased and later there is no possibility to extend the system at the selected site to the 18 ha ultimately required. In that case new sites have to be found with additional trunk sewers, pumping and operation and maintenance costs.	- Purchase at least 11 ha of land and make provisions to allocate the additional 7 ha in the future, or purchase 18 ha immediately; or - Revert to the 'Switch' scenario.
The staff does not know how to operate and maintain the STP	- Appoint only educated and suitably trained staff to run the STP - Joint venture with other effluent and sewage treatment entities to facilitate peer visits and learning-on-the job
The land for the STP is not made available.	- Do not start construction of sewers until land has been purchased for sewage treatment
Contractors do not properly construct the sewage treatment works.	- Pay contractors only after the whole system has been inspected - Strict supervision during construction - Hire only contractors, who have experience with sewage treatment works.
Not enough flow in the system.	- Build the STP in relatively small parallel units - Ensure full property connection to the sewerage system
Low BOD of the incoming sewage due to too much flow in the system due to entrance of storm water through manholes and bad flushing procedures.	- Install emergency overflow.

6.3 On-site domestic systems

6.3.1 Existing plans for "on-site" domestic system improvements

According to the 2008 MSMH project SPAR report[15], on site sanitation is to be applied to medium populated areas using septic and absorption tanks. By year 2013, the use of septic and absorption tanks was targeted to reach 80% of the houses in low population density areas. Housing areas situated in high ground water table areas or in the coastal areas will use floating septic tanks according to the standards for tidally affected areas. By year 2013, the use of floating septic tanks was targeted to reach 90% of all the population in water bound settlements with low population densities. Public Bath/Wash/Toilet (MCK)

[15] TA No. 4763-INO: MSMH PPTA Final Report – Kota Makassar SPAR40

facilities designed to serve 5 families per facility were to be developed for slum areas and low-income communities.

6.3.2 The challenges to be met

None of the planned improvements mentioned above have, to date, been implemented. Hence, in order to fulfil the future design targets for on-sites systems identified in Section 5.4, a large number of on-site facilities need to be rehabilitated and new facilities need to be implemented; over an above those currently planned.

In the section below the type of technologies required for the new systems are explained.

6.3.3 Technology options

Selection of appropriate wastewater technologies depends on several physical factors and non-physical factors. The most appropriate technology is that technology which provides the most socially and environmentally acceptable level of service at the least economic cost. More precisely an appropriate technology is:

- Environmentally acceptable: the wastewater is handled in such a way that it cannot affect human beings. The wastewater is not accessible to flies, mosquitoes, rodents etc. The handling of fresh excreta is avoided. In areas where the people depend on ground water as a resource for drinking water, the groundwater should not be polluted
- Convenient: there are limited odours and unsightly conditions. The facility is a short walking distance from the house
- Simple to operate: the daily operation is minimal and only requires simple and safe routines
- Long lasting and minimal maintenance: a long technical lifetime and only occasional maintenance, i.e. every 1 or 2 years
- Upgradable: in the future “step-by-step” (incremental) improvements and extensions are possible
- Acceptable cost: this does not mean necessarily that the system is cheap. The technology selected should be within the economic and financial reach of the household and city budgets.

In Figure 6.8 we indicate the range of technology options appropriate to different categories of population density, income and soil types. Further Details of each of the technologies are provided in Appendix E.6

Figure 6.8: Appropriate on-site technologies options for Makassar (Source: Mott MacDonald).

Density / Income	*Low density [< 150 cap/ha]*		*Medium density [150-300 cap/ha]*	
Low income [< Rp 1.1 mln/month]	Favourable soil	Unfavourable soil (high gwt / impermeable)	Favourable soil	Unfavourable soil (high gwt / impermeable)
	TWIN LEACHING PITS [1.1] / reuse of septage	**MCK [3]** WITH IMPROVED (RAISED/COLLAR) TWIN LEACHING PITS / reuse of septage OR IMHOFF TANK AND ANAEROBIC FILTER / EFFLUENT TO DRAINS	(SHARED) **LEACHING PIT / LOW COST SEPTIC TANK [1]**	**LEACHING PIT OR LOW COST SEPTIC TANK / ANAEROBIC UPFLOW FILTER [1.3]** ('BIO TANK') / DRAIN
Medium income [Rp 1.1 - Rp 3 m	Favourable soil	Unfavourable soil (high gwt / impermeable)	Favourable soil	Unfavourable soil
	LEACHING PIT OR LOW COST SEPTIC TANK [1]	**IMPROVED** (RAISED/COLLAR) **LEACHING PIT OR LOW COST SEPTIC TANK [1.2]**	**LEACHING PIT OR LOW COST SEPTIC TANK [1]**	**LEACHING PIT OR LOW COST SEPTIC TANK / ANAEROBIC UPFLOW FILTER [1.3] ('BIO TANK') /**
High income [> Rp 3 mln./month]	Favourable soil	Unfavourable soil (high gwt / impermeable)	Favourable soil	Unfavourable soil (high gwt / impermeable)
	SEPTIC TANK WITH EFFLUENT INFILTRATION PIT [2] / reuse effluent	**SEPTIC TANK WITH (RAISED) EFFLUENT INFILTRATION FIELD [2.1]**/ reuse effluent	**SEPTIC TANK WITH EFFLUENT INFILTRATION PIT [2]** / reuse effluent	**SEPTIC TANK / ANAEROBIC UPFLOW FILTER [2.2] ('BIO TANK')** / DRAIN

Key:
On-site systems
Intermediate systems

We refer to:

- Population density: on-site systems are usually restricted to low (< 150 cap/ha) and medium (150-300 cap/ha) densities. In these areas there is almost always room for the construction of a wastewater facility
- Income: we differentiate between low-income (< Rp 1.1 million/month), medium income (Rp 1.1-3 million/month) and high income (> Rp 3 million/month)
- Favourable soil or unfavourable soil: in Makassar unfavourable soil means high groundwater table and/or impermeable soils (clay).

The following assumptions have been made:

- The majority of the population uses piped drinking water or bottled water as the PDAM coverage is relatively very large;
- All parts of the town can be served by septage collection services, hence there is no need to identify systems that need to be emptied by hand.

Using the matrix indicates the following range of technologies have been deemed appropriate for the conditions in Makassar:

Leaching Pits or Low Cost Septic Tanks

- 1: Leaching Pit or Low Cost Septic Tanks (LP)
- 1.1: Twin Leaching Pits (TLP)
- 1.2: Improved (raised/collar) Leaching Pit or Low Cost Septic Tank (LP+)
- 1.3: Leaching Pit or Low Cost Septic Tank with Anaerobic Upflow Filter and discharge of effluent into storm water drains

Septic tanks

- 2: Septic Tank with effluent infiltration pit (ST)
- 2.1: Septic Tank with (raised) effluent infiltration field (STei)
- 2.2: Septic Tank with Anaerobic Upflow Filter ('Biotank') and discharge of effluent into storm water drains (ST/AUF).

6.3.4 Recommended technology

Specific conditions per Kecamatan were studied for the different years and the most appropriate technologies identified. The result of the analysis are presented in Table 6.15 below.

Table 6.15: Recommended on-site technologies for new systems

	Systems		2015	2015	2020	2020	2030	2030
			Number	%	Number	%	Number	%
1	Leaching Pit / Low Cost Septic Tank	LP	4,711	11%	1,406	11%	4,034	15%
1.1	Twin Leaching Pits	TLP	-	0%	-	0%	-	0%
1.2	Improved Leaching Pit / Low Cost Septic Tank	LP+	-	0%	-	0%	-	0%
1.5	Leaching Pit / LCST / AUF / drain	LP/AUF	23,997	54%	6,439	50%	11,456	42%
2	Septic Tank / effluent infiltration	ST/ei	13,908	31%	4,764	37%	11,510	43%
2.1	Septic Tank with / Infiltration Field	ST /if	-	0%	-	0%	-	0%
2.2	Septic Tank / UAF / 'biotank' / drain	ST/AUF	2,183	5%	391	3%	-	0%
	Total		**44,800**	**100%**	**13,000**	**100%**	**27,000**	**100%**

6.3.5 Incremental improvements

Some other staged incremental improvements for on-site systems have already been referred to and include:

- Single leaching pit to twin leaching pit or LCST
- Single leaching pit to leaching pit to leaching pit with anaerobic upflow filter and discharge into stormwater drains
- Septic tanks to Septic tank with Anaerobic Upflow Filter and discharge of effluent into storm water drains.

Other incremental improvements relate to the conversion of on-site systems into intermediate systems:

- Leaching pits via pipes to communal treatment systems (Technology 3.1, see Chapter 6, Section 6.4)
- Leaching pits into covered stormwater drains (Technology 4.1, see Chapter 6, Section 6.4)
- Leaching pits or LCST or septic tanks into small- bore sewer systems (Technology 6, see Chapter 6, Section 6.4).

In the period 2020 to 2030 around 100,000 household systems will need to be improved in this way.

6.3.6 Phasing 2015, 2020, 2030 and costs

The phasing of the different systems is indicated in Table 6.15 above. The costs are indicated in Table 6.16 below. Given the rather challenging site conditions in Makassar, the use of a leaching pit will not always be possible and the installation of a septic tank will be necessary. In this case the low cost septic tank is recommended or a Biotank. Based on information of the suppliers, the figure of Rp 3 million per domestic on-site system is used. When rehabilitating/improving existing on-site systems part of the existing infrastructure can be used, so the costs are less than the costs of a new on-site system: around Rp 2 million.

Table 6.16: Cost of program of on-site systems (Rp million)

Investment costs on-site systems	Unit cost	2010-2015	2015-2020	2020-2030	Total
- new on-site facilities	3	134,400	39,000	81,000	254,400
- Rehabilitation on-site facilities	2	65,000	188,000	-	253,000
Total (Rp m)	-	**199,400**	**227,000**	**81,000**	**507,400**
Total (US $ m.)	-	$22m	$25m	$9m	$56m
O&M	5%				25,400

The operation and maintenance costs are restricted to emptying of the facility once every two years. At the moment the private and government operators charge Rp 300,000 / trip. Hence, the annualised cost is Rp 150,000 / facility or 5% of the investment cost. The private vacuum truck operators are being charged around much less to empty the tank contents at Nipa-Nipa. Hence, if emptying is better regulated and competition is improved, O&M costs can be reduced to Rp 60,000/household/year or 2%.

6.3.7 Sustaining the programme of on-site systems

As explained in Chapter 3, Section 3.4 on the existing wastewater situation in Makassar, there are many risks involved in applying on-site solutions. In Table 6.17 we indicate the major risks and the recommended remedial actions to minimize the risks. The actions have motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural).

Table 6.17: Sustaining the on-site sanitation program

Risk	Motivational and capacitating activities
Wastewater management is not regarded as an issue. The construction of on-site systems has a very low priority. Nobody is interested in upgrading their existing facility of purchasing a new system.	- Persuasion and campaigning to explain the benefits of on-site systems - Legislation that 100% of properties need to be provided with an on-site system - School sanitation - Good toilets at Puskesmas and other government institutions - Explain how an on-site system works and what is required from a behavioural point of view by means of mass media reporting - "Blame and shame" neighbourhoods with poor on-site sanitation systems - Rewards for areas with good systems, e.g.: a new mosque or kindergarten
Many households think that on-site systems are expensive so nobody wants to purchase one.	- Provide good, cheap solutions - Subsidize the purchase of on-site systems - Micro-credit schemes to assist in the purchase of an on-site system - "Arisan" schemes to purchase on-site systems
Existing systems fail because of the high groundwater level and impermeable soils. Nobody wants to pay for a new system.	- Develop a good 'Makassar' toilet and marketing programme - Mass media coverage for appropriate examples.

6.3.8 The challenges of rehabilitation of on-site systems

As a household is usually not aware that its on-site system is not functioning well, the rehabilitation of on-site systems is as challenging, if not more so, than the introduction of new appropriate on-site systems. Hence, an integral part is 'software' on on-site systems and the creating an enabling environment. The activities needed have a motivational and capacitating nature, including:

1. Study performance existing on-site systems: what parts are failing?

1. Develop 'Makassar fit' system for rehabilitation: what is the most effective way to rehabilitate?
2. Pilot projects on rehabilitation and dissemination of the results
3. Marketing rehabilitation of on-site systems
4. Organize the community through NGO's e.g. based on the experiences of the Community Led Total Sanitation (CLTS) methodology to motivate the population and at the same time capacitate the community (e.g. credits) and provide technical backstopping of the NGO's
5. Training of sanitarians and government staff on how to rehabilitate on-site systems
6. Dissemination of plans, drawings, models etc. through a (mobile) Wastewater Information Centre
7. Rehabilitation of the sanitation at schools, Puskesmas and institutes
8. Award households with the best rehabilitation and blame and shame household that are not interested in cooperating.

These activities need to be elaborated in the DED phase as part of a more holistic capacity building exercise or a campaign to eradicate poor performing on-site systems.

6.4 Intermediate domestic systems

6.4.1 Current planned programmes of intermediate domestic systems

As part of the wastewater strategies in the City, the City Government already has plans for the development of a number of intermediate domestic systems. They are located at the periphery of the planned wastewater collection area of Losari 1 and Losari 2, along the Panampu-Jonggaya Canal. These areas are where poor communities live in urban slums. They will not be able to afford the relatively high charges for a traditional sewerage scheme. See Figure 6.10 below for an impression of these areas. Table 6.18 presents the original number of planned facilities; these proposals have not been implemented to date.

The following intermediate systems are planned for 2011:

- USRI (Urban Sanitation and Rural Infrastructures, through the Province of South Sulawesi to the City of Makassar), which is 100% funded by Central Government: 16 units
- PAMSIMAS (World Bank Funded Community water and sanitation program, through the Province of South Sulawesi to the City of Makassar): 8 units
- CARE: 14 units
- SLBM (Sanitasi Lingkungan Berbasis Masyarakat, Community based sanitation from Public Works, straight from the Central Government to the City of Makassar): 3 units
- Sanitasi Perumahan (Ministry of Housing): 3 units.

Figure 6.9: Impression of the areas planned for intermediate domestic systems

Source: Mott MacDonald field survey

Figure 6.10: Impression of the borders along the Panampu-Jonggaya Canal

Source: Mott MacDonald field survey

Table 6.18: Planned intermediate systems

No.	Uraian	Satuan	Eksisting	Tahun				
			2008	2009	2013	2018	2023	2028
A.1	Jumlah Penduduk Terlayani	jiwa	-	22.342	47.877	62.628	79.647	99.225
A.2	Jumlah KK	KK	-	4.213	9.029	11.810	15.020	18.712
B	System Pelayanan Intermediate							
1	Paket Intermediate (100 KK)	unit	-	13	13	27	35	45
2	Paket Intermediate (50 KK)	unit	-	17	36	47	60	75
3	Paket Intermediate (30 KK)	unit	-	8	18	24	30	37
4	Paket Intermediate (20 KK)	unit	-	4	9	12	15	19

6.4.2 Recommended increase in the numbers of planned intermediate facilities

In order to deal with the present problems as identified in Chapter 3, Section 3.4 and to fulfil the future demands identified in Chapter 4, Section 4.3, an increased number of wastewater facilities need to be implemented, over and above those already planned.

In high-density areas (greater than 300 cap/ha) where “on-site” solutions are not possible, due to the lack of space, and where “off-site” solutions may not be operationally or financially feasible, intermediate facilities are required. Makassar has already implemented some to these intermediate systems.

6.4.3 Technology options

Figure 6.11 below indicates the range of intermediate technology options appropriate for specific conditions within Makassar. Further details of these options are provided in Appendix E.7. We refer to:

- Population density: a particular type of intermediate system, the MCK is applicable for low (< 150 cap/ha) density areas. More complicated Intermediate systems are typically solutions for higher (>300 cap/ha) density areas. In these areas there is almost never room for the construction of a wastewater treatment facility
- Income: we differentiate between low-income (< Rp 1.1 million/month), medium income (Rp 1.1-3 million/month) and high income (> Rp 3 million/month)
- Level of community involvement to be expected
- Coverage of existing on-site wastewater facilities.

Figure 6.11: Appropriate intermediate technology options for Makassar (Source: Mott MacDonald)

Density / Income	*High density [> 300 cap/ha]*		
Low income [< Rp 1.1 mln/month]	Low coverage on-site sanitation		High coverage on-site sanitation
	High level community involvement	Low level community involvement	
	COMMUNAL TREATMENT [3.1] / UASB REACTOR / biogas / ANAEROBIC UPFLOW FILTER / EFFLUENT TO DRAINS / reuse garden watering	**Directly to covered drains: COMBINED DRAINAGE [4] / PARTIAL TREATMENT**	**INTERCEPTOR / COVERED STORMWATER DRAINS [4.1] / PARTIAL TREATMENT**
Medium income [Rp 1.1 - Rp 3 mln./month]	Low coverage on-site sanitation		High coverage on-site sanitation
	SHALLOW SEWERAGE [5]		**INTERCEPTORS - SMALL BORE SEWERAGE [6]**
High income [> Rp 3 mln./month]	Ground fall < 2 o/oo		Ground fall > 2 o/oo
	Low coverage on-site sanitation	High coverage on-site sanitation	
	SHALLOW SEWERAGE [5]	**INTERCEPTORS - SMALL BORE SEWERAGE [6]**	**CONVENTIONAL SEWERAGE / STP [7]**

Hence, the following range of technologies is appropriate for Makassar conditions:

- 3: MCK
- 3.1: Communal treatment systems (CT)
- 4.1: Direct discharge into adapted covered stormwater drains (Combined Drainage CD)
- 4.2: Interceptors (leaching pit which has been made watertight or - low cost - septic tank) and discharge of the effluent into adapted covered stormwater drains (iCD)
- 5: Shallow Sewerage (SS)
- 6: Small Bore Sewerage (SBS)

6.4.4 Recommendations of intermediate technology

Based on a study of the specific conditions (secondary data on density and income) for each Kecamatan for the different years, the most appropriate technologies were identified as MCKs in areas with high

density low income and Small Bore Sewerage in other intermediate areas where most households have some kind of interceptor (usually a leaching pit from which the bottom can be sealed). This is combined with the phasing of the already planned and presented in Table 6.19. Fore details per Kecamatan see Appendix E.8. Combined drainage both direct and indirect are regarded not cost effective.

Table 6.19: Phasing of recommended intermediate systems

	Systems	2015	2015	2020	2020	2030	2030
		Number hh	%	Number hh	%	Number hh	%
3	MCK	1,006	14%	264	7%	895	7%
3.1	Communal Treatment	-	0%	-	0%	-	0%
4	Direct combined drainage	-	0%	-	0%	-	0%
4.1	Interceptor/Stormwater drainage	-	0%	-	0%	-	0%
5	Shallow sewerage	5,639	76%	868	22%	8824	66%
6	Interceptor/SBS	755	10%	2768	71%	3581	27%
	Total	**7,400**	**100%**	**3,900**	**100%**	**13,300**	**100%**

Source: Mott MacDonald Indonesia

6.4.5 Incremental improvements

Intermediate systems are by definition, systems fit for incremental improvement:

- MCKs can become communal treatment systems, provided they are situated sufficiently low to receive wastewater from neighbouring houses
- SBS neighbourhood systems can become part of the off-site system.

6.4.6 Phasing 2015, 2020, 2030 and costs

One of the aims of the first 5 years is to eradicate OD. One of the areas with a high percentage of OD is around the Panampu-Jonggaya Canal. The intermediate systems east of the Canal are 'permanent' intermediate SBS systems with UASB reactors to treat the collected wastewater and discharge the effluent into the canal. The situation west of canal differs: as explained in Section 6.1.2 connecting the intermediate small bore sewer systems to the future trunk sewers will alleviate the burden of many 'mini' STPs. That would mean that in the period 2010-2015 the direction of the SBS would be West-East and after 2015: East-West. This would be a costly affair. Hence, the intermediate systems to be implemented west of the canal during the first period are MCK facilities, along the canal. If the treatment facilities of the MCKs are constructed out of GRP, they can be reused at another place in future.

The phasing of the different systems is indicated in Table 6.19 above. The costs are indicated in Table 6.20 below. Unit rates have been taken from the Feasibility Studies for Bogor and Surabaya.

Table 6.20: Cost of the planned and additional program of intermediate systems (Rp million)

Investment costs intermediate system			2010-2015	2015-2020	2020-2030	Total
- current planned intermediate facilities	Rp6.0	m/hh	Rp23 000	Rp20 000	Rp16 000	Rp59 000
- new additional intermediate facilities	Rp6.0	m/hh	Rp21 000	Rp4 000	Rp64 000	Rp89 000
- rehabilitation intermediate	Rp2.5	m/hh	Rp6 000	Rp-	Rp-	Rp6 000

Investment costs intermediate system			2010-2015	2015-2020	2020-2030	Total
facilities						
Total			**Rp50 000**	**Rp24 000**	**Rp80 000**	**Rp154 000**
Total (US $ m.)			**$6m**	**$3m**	**$9m**	**$17m**
O&M	2%					Rp3 100

The operation and maintenance costs differ from one system to another. Besides removing septage every 2 years the sewer lines and the decentralized treatment facilities need regular operation and maintenance. Hence, O&M requirements are the same % as for off-site system, at around 2% of the investment costs per year: total Rp 3,500 m/year.

6.4.7 The challenges of up-scaling intermediate systems

Makassar has already some good experiences with the introduction of intermediate systems. However, to arrive at the targeted number of intermediate systems is very challenging. Hence, an integral part of the current institutional development program is to devote a number of 'software' activities on intermediate systems, thus creating an enabling environment, e.g.:

- Study performance existing intermediate systems
- Pilot projects (sbs, ss)
- Dissemination results
- Marketing intermediate systems
- Community organization/ NGOs
- Backstopping community initiatives

Activities on the overall creation of an Enabling Environment include:

- Wastewater Information Centre
- School Sanitation
- Puskesmas Sanitation
- Sanitation at institutes
- Training government staff on sanitation
- Blame and shame / Ombudsman / Grievance procedures

6.4.8 Sustaining the program of planned intermediate systems

As mentioned before, intermediate systems have not always been implemented at the right spots in Makassar. Hence, there are many risks involved in applying these systems. In Table 6.21 we indicate the major risks and remedial actions to minimize the risks. The actions have motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural).

Table 6.21: Sustaining the intermediate system program

Risk	Motivational and capacitating activities
The system is implemented as a 'free' top-down project. Finding the land for the communal treatment becomes the main obstacle → availability of land for the communal treatment becomes more important than the need and appropriateness of the system.	- Develop a clear set of guidelines and rules of how and where to implement the system - Always demand at least 20% in cash from the communities involved to assure sense of ownership - Cite and publish good examples - Blame and shame poor examples - Break down and remove communal systems that are not being used instead of leaving 'white elephants' around. Reuse the communal treatment systems in areas that are in need
Nobody feels responsible for operating and maintaining modular intermediate neighbourhood systems.	- Organize construction, operation and maintenance in such a way that the private sector or a neighbourhood organization can make a living → O&M fees should be more than enough to cover the O&M costs
There are relatively few skilled wastewater personnel and staff in Makassar, including government staff.	- Hire experienced consultants and contractors to design, construct and supervise the systems - Cooperation/peer visits with international enterprises who have experience with wastewater operation and maintenance - Hire only staff who have an education and training in wastewater management
People discharge unwelcome materials (grease, fat, chlorine, etc.) into the shallow/ small bore sewers.	- Explain by means of mass media programmes how an intermediate system works and what is required from a behavioural point of view - Install grease traps at all property connections
Contractors do not properly construct the pipes.	- Pay contractors only after the whole system has been inspected - Strict supervision during construction - Hire only contractors who have experience with intermediate systems
Many households think that intermediate systems are expensive, nobody wants to connect.	- Provide good, cost effective solutions - Subsidize the funding for intermediate systems - Micro-credit schemes to assist in the development of an intermediate system - Legislation that 100% of the neighbourhood has to connect - All properties pay a fee, whether they are connected or not.

6.5 Grey water disposal

The off-site systems and the sewered intermediate systems with treatment, such as SBS and SS, are to include the grey water from the connected properties as part of a 'total wastewater approach', as well as being in line with previous proposals.

Normally, grey water should not be connected to the first chamber of the septic tank. The environmental benefits of acceptable "on-site" black water systems and MCKs will be nullified if acceptable on-site grey water management does not accompany them. Grey water improvement is implemented hand-in-hand with the implementation of the improved and new "on-site" systems. Figure 6.12 shows the technological options for grey water management.

Figure 6.12: Technological options grey water management

Low-Medium density [< 300 cap/ha]				*High density [> 300 cap/ha]*	
Favourable soil		Unfavorable soil (high gwt/low permeability)			
Septic Tanks used for wastewater treatment	Leaching Pits, Low Cost Septic Tanks, Biofilters and other on-site systems receiving only black water	Demand for reuse - Strong community organization required	No demand for reuse - Good solid waste and drainage management	Favourable soil	Unfavourable soil
Large (> 4m3) Septic Tank: Septic Tank / Small (< 4m3) Septic Tank: Soakaway	**Soakaway**	**Treatment and Reuse**	**Anaerobic Upflow Filter /drain**	**Soakaway**	**Small Bore Sewers / Shallow Sewers / Sewerage**

Key:

On-site systems
Intermediate systems

The following technologies are appropriate for grey water treatment:

- Second chamber septic tank;
- Soak-away;
- Anaerobic Upflow Filter and discharge into storm water drains.

6.6 Non-domestic systems

6.6.1 Introduction

This wastewater Master Plan mainly deals with domestic wastewater, as information was not able to be collected on non-domestic wastewater. Non-domestic wastewater is wastewater from:

- Industries. Makassar has a relatively large number of industries and the impact of the lack of wastewater collection, transport, treatment and reuse/disposal can be rather significant. It is assumed that the large port area has its own wastewater collection system and treatment plant;
- Home industries, especially food related, fish cleaning, tahu and krupuk production, but also small metal industries, such as gold jewellery manufacture etc. can have a large local negative environmental impact;
- Commercial entreprises: hotels, restaurants, malls, etc..
- Institutes, Government offices etc.

As explained in Chapter 4, the unhygienic conditions and ugly appearance of the hotel and restaurant area around Losari Beach, the Icon of Makassar, has been the impetus for the planned Losari sewerage system. As shown in Chapter 3, the effluent from hotels presently discharged into the sea exceeds the effluent

discharge standards. Hence, all hotels and restaurants in the planned wastewater collection area are planned to be connected to the new sewerage system. The design criteria (Sehati and Dana Consult) for the planned sewerage areas mentions that hotels and hospitals should have to pre-treat the wastewater before it can be discharged into the sewerage system.

6.6.2 The challenges to be met

In order to fulfil the future demands identified in Chapter 4, Section 4.3, the number of commercial enterprises to be dealt with is presented in Table 6.22.

Table 6.22: Improvement of wastewater treatment at commercial enterprises

Commercial/institutional non-sewered Program		2010-2015	2015-2020	2020-2030	total
- new treatment facilities commercial and institutional enterprises	number	2,600	2,100	4,400	9,100
- rehabilitation treatment facilities commercial enterprises	number	7,100	-	-	7,100

6.6.3 Recommended technologies

If the commercial enterprises are located in the Losari wastewater collection area, i.e. Losari 1 and 2+ or the GMTDC area, that are to be sewered during the first phase of the Master Plan (by 2015), it is recommended that they should be connected to the sewerage system as it becomes available. However, if they are located in areas that are not to be sewered yet or they need to pre-treat their wastewater before discharge into the sewers, then specific technologies are recommended as appropriate to the type of business. The businesses considered are:

- Institutes;
- Hotels;
- Restaurants;
- Shopping malls.

Details of the specific technologies for these businesses are provided in Appendix E.9.

6.6.4 Phasing for 2015, 2020, 2030 and costs

The phasing of the different systems is indicated in Table 6.22 above. The costs are indicated in Table 6.23 below.

Table 6.23: Cost of the program for improvement of the wastewater facilities of commercial enterprises (Rp million)

Investment costs commercial enterprises		2010-2015	2015-2020	2020-2030	Total
- new treatment facilities commercial and institutional enterprises	Rp 20	52,000	42,000	88,000	182,000
- rehabilitation treatment facilities commercial enterprises	Rp 10	71,000	-	-	71,000
Total		**123,000**	**42,000**	**88,000**	**253,000**
Total (US $ m.)		**$ 14m**	**$ 5m**	**$ 10m**	**$ 28m**
O&M	2%				5,100

O&M requirements are the same % as for off-site system: around 2% of the investment costs per year: total Rp 28 m/year.

6.6.5 Sustaining the program of improvement of wastewater facilities of commercial enterprises

Several commercial property wastewater treatment plants were visited during April 2011. The high percentage of rather poorly constructed and maintained facilities indicates that there are many risks involved in applying wastewater treatment improvements at commercial enterprises. In Table 6.24 we indicate the major risks and remedial actions to minimize the risks. The actions have motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural).

Table 6.24: Risks and remedial actions on improvement of wastewater facilities at commercial enterprises

Risk	Motivational and capacitating activities
Treatment plants do not perform as commercial enterprises are interested in running their enterprise and have no interest in proper wastewater management.	- Explaining the importance of proper wastewater management through the Chambers of Commerce; - Awards for best performing enterprises; - Licensing of the enterprises and regular strict monitoring of the treatment plant effluents; - Naming and shaming of poorly performing enterprises; - Introduce a labelling system in the tourist areas so tourists can choose only those enterprises, which are hygienic, and aesthetic.

6.7 Septage collection and treatment

6.7.1 The challenge to be met

Field visits have been made to the existing sludge treatment facility at IPLT Nipa Nipa and private septage emptying enterprises have been contacted. The City Government office responsible for emptying septic tanks has also been contacted; at present there are 4 government vacuum trucks, which collect about 13% of the estimated septage sludge produced by the community. The government trucks discharge the septage at IPLT Nipa Nipa.

There are many challenges regarding septage collection, they include:

- The existing IPLT Nipa Nipa is located in the east of Makassar, 18 km from the town centre. Hence, the trips are relatively long;
- The IPLT Nipa Nipa is in a deplorable condition: there is hardly any difference between dumping the septage straight into the river or dumping it at the official IPLT. Any septage discharged at the IPLT overflows immediately into the adjacent watercourses. Hence, the City Government itself does not set a good example and it will be hard to explain to the private sector the benefits of using the official IPLT for discharging the septage that they regularly collect.
- At present, government tankers collect only 13% of the estimated septage generated across the city. This indicates that:
- Leaching pits and septic tanks are not emptied regularly or at all: people wait till the tanks are completely full and overflow or backflow, before calling upon a vacuum truck service; and/or
- More septage is being collected by the government trucks but the trucks dispose of the septage in the nearest watercourse or it is not recorded at the IPLT; and/or

- Private vacuum vehicles are active which dump the septage haphazardly; and/or
- Septage is removed manually and dumped straight into the nearest storm water drain.

In section 6.2 we have already explained that to overcome the long trip to the IPLT in the East the future trunk sewers could be used to allow discharge of the septage from the vacuum tankers and transfer it to the future Losari STP in the West. In Table 6.25 we have made an assessment of the number of septage collections needed and the treatment capacity required at the IPLT. The calculation assumes that 50% of the collected sludge is transferred to STP Losari.

Table 6.25: Septage collections and necessary septage treatment capacity

SEPTAGE COLLECTION (DESLUDGING)		2010	2015	2020	2030
Annual septage production	litres/cap/year	40	40	40	40
Annual septage production on-site facilities	m3/year	42,958	51,909	52,535	54,400
Monthly septage production	m3/m	3,580	4,326	4,378	4,533
Number of septage collection trucks	number	4	18	24	25
Volume septage collection truck	m3	3	3	3	3
Number of trips septage collection trucks per month	number/m	40	60	60	60
Volume septage collected monthly	m3/m	480	3,244	4,378	4,533
Coverage septage collection	%	13%	75%	100%	100%
Volume septage treated daily	m3/d	24	162	219	227
Volume septage treated daily in STP Losari	m3/d	24	81	109	113
Volume septage treated daily in IPLT Nipa2	m3/d	-	81	109	113

From this analysis, we can see that:

- There is hardly any septage sludge collected at the moment. To arrive at a figure of 75% coverage in 2015 and 100% coverage in 2020, means that the existing 4 vacuum trucks need to be increased to the equivalent of 18 trucks by 2015 and 24 trucks by 2020. This estimate assumes 60 trips per month (3 trips per working day per truck);
- IPLT Nipa Nipa with a capacity of 100 m^3/day can easily accommodate the 109 m^3/day septage that should be delivered by 2015, provided it is renovated and becomes an acceptable facility.

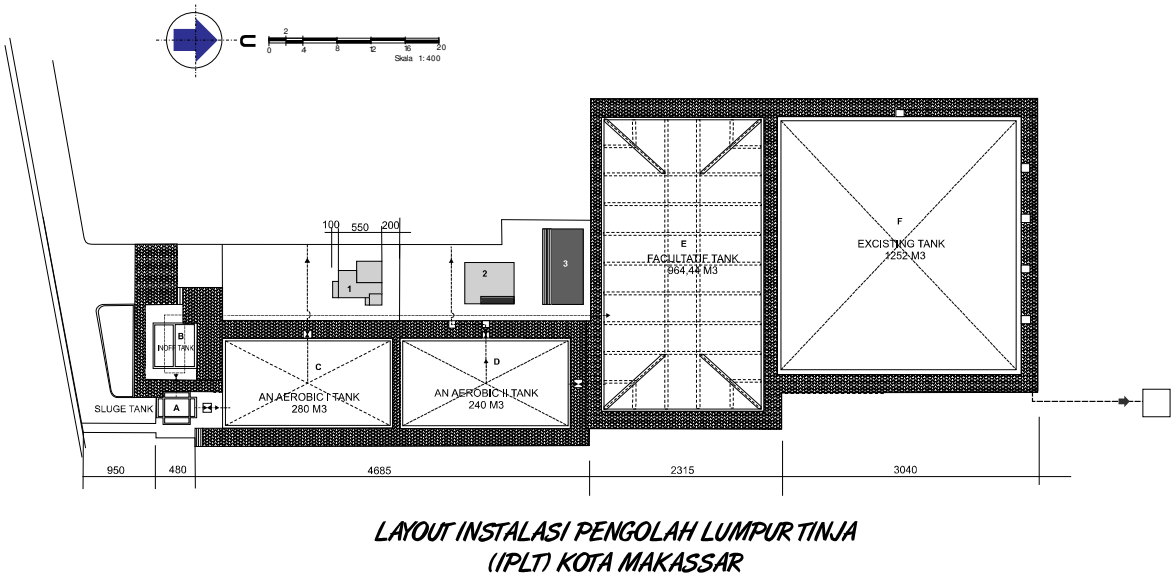
Conclusions: The situation concerning septage collection and disposal is not clear;

- There is not enough demand for septage removal by the householders: septage removal has a very low priority, people wait until their tanks are full and overflowing;
- Just adding more vacuum tankers will not be a solution: it will have to be accompanied/ preceded by intensive marketing;
- Given the low demand it is unlikely that the private sector will be interested in providing a septage emptying service;
- In principle the IPLT Nipa Nipa has enough capacity to accommodate any improved rate of septage removal and delivery up to 2015.

6.7.1.1 Planned rehabilitation of IPLT Nipa Nipa

The layout of the IPLT Nipa Nipa is presented in Figure 6.13.

Figure 6.13: Current lay out IPLT Nipa Nipa



Source: Design drawings, Makassar City

As part of the 2008 MSMH project SPAR report, a subproject was proposed for the re-development of the IPLT to clean and optimize the Nipa-Nipa sludge treatment plant since its condition at present is technically not feasible. The SPAR observed that:

"Excrement is disposed into the STP (human waste disposal installation/facility) in Nipa-Nipa village, Antang submunicipal, subdistrict of Manggala, located 18km from the city centre, which was built in the 1980s. The facilities are built on 10,000m2 of land and the building occupies 2,181m2 or 21.8% of the whole land. The Nipa-Nipa STP is currently not functioning at optimum capacity, as the facilities are not properly maintained. Studies by consultants from CV Arista Cipta Consultan in 2000 concluded that there were significant differences between observations in the field, the shop drawings and the as-built drawings. These size differences contribute towards the non-optimum operations of the STP.

Physically, the Nipa-Nipa STP facilities containment capacity has decreased due to heavy sedimentation, clogged outlets, broken outlet valves in the Imhoff tank, aerobic tanks I and II, and in the optional ponds, sludge has begun to leak out; there are no spare inlet/outlet ducts and there are no drying facilities. The sludge-drying tank is covered with caked sludge, caked sludge containment tanks are too small and the inlet pipes are corroded/damaged. The supporting facilities and infrastructure are inadequate, and are heavily damaged and unusable."

The planned optimization consists dredging out the thickened sludge and improvement of the pond walls and leakage channels. In addition, it is planned to replace valves that do not function. Based on a study previously carried out, the SPAR presents proposals for rehabilitation of Nipa- Nipa IPLT, these are replicated in Appendix E.10. The costs for the planned work were estimated at Rp 113 m (2001 prices) for cleaning and 280 m (2001 prices) for rehabilitation.

6.7.1.2 Improvements to IPLT Nipa Nipa

Since the Jica studies were carried out in the year 2000 and the MSMH project in 2008, no single improvement has taken place at the IPLT. The Imhoff tanks and sludge sedimentation tanks have now been filled with rubble and covered over, allowing the tankers to discharge their contents directly into the anaerobic tanks without any treatment. This situation shows that reviving a defunct structure will not solve anything. In mid 2011 the DED for improvements is planned to be contracted by the Province of South Sulawesi. The scope of works is not known, this is a good opportunity for 'additional' improvements. The improvements are based on the KSS, 'Keep Septage-treatment Simple' concept:

- Construct a ramp where vacuum trucks and vacuum motorbikes can discharge. Similar to the ramps at the solid waste transfer stations;
- Reintroduce the Imhoff tanks, see below;
- Lead the sludge from the Imhoff Tank into sludge drying beds;
- Lead the wastewater from the Imhoff tank into a facultative and a maturation pond.

It is anticipated that part of the existing infrastructure can be reused. The new IPLT could be operated and maintained by a private contractor. Dried sludge could be sold as a soil conditioner.

6.7.2 Phasing for 2015, 2020 and 2030, investment and O&M Costs

6.7.2.1 Phasing

The following phasing is foreseen:

- Immediate improvement: enable the safe disposal of septage by renovating the IPLT Nipa Nipa according to the KSS principle;
- Marketing (2010-2015):
    - Study the reasons for the low level of septage collection;
    - Based on the outcome of the study on septage collection rates, develop a marketing strategy. The marketing of septage collection could should be an integrated part of the marketing of on-site sanitation systems, for example: 'purchase an approved "on-site" facility and receive free septage collection services for 10years', i.e. 5 free empties;
    - Invite the private sector to provide a private septage emptying service, say, with 13 vacuum trucks ($3m^3$ each) and 6 vacuum motor cycles ($0.5m^3$ each);
    - Install Septage Discharge Station (SDS) points on the trunk sewers of the first phase of the Losari sewerage system (details of the SDS are provided in Appendix E.11);
- After 2020:

- Install SDS on the other trunk sewers as they are developed across the City;
- Invite the private sector to add 6 more vacuum trucks.

6.7.2.2 Investment and operating cost estimates

The investment costs for the improvements and vacuum trucks and vacuum motorcycles are shown in Table 6.26. It is assumed that 6 vacuum motorcycles can be purchased at the cost of 1 vacuum truck.

NOTE - As the SDS is part of the of the sewerage network, the investment costs for the SDS are included in the investment costs for the "off-site" centralized sewerage system given in Chapter 6.1. The necessary investment for accommodating the septage at the centralized STP is included in the investment costs for the STPs in Chapter 6.2.

Table 6.26: Investment and operation and maintenance costs - Septage Management (Rp million)

Septage collection and management			2010-2015	2015-2020	2020-2030	Total
- vacuum truck (Rp)	Rp 500	m/truck	7,000	3,000	500	10,500
- septage treatment facility (Rp)	Rp 1,000	m/100 m3/d	120,000	-	-	120,000
Total (Rp)			**7,000**	**3,000**	**500**	**10,500**
O&M (Rp)	20%					2,100

6.7.3 Sustaining the program of additional septage collection and treatment

As mentioned before, attempts to revive IPLT Nipa Nipa have not been implemented yet, for various reasons. Hence, there are many risks involved in investing in septage collection and management. In Table 6.27 we indicate the major risks and recommended remedial actions to minimize the risks. The actions have both a motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural).

Table 6.27: Programme of studies and activities for septage collection and treatment

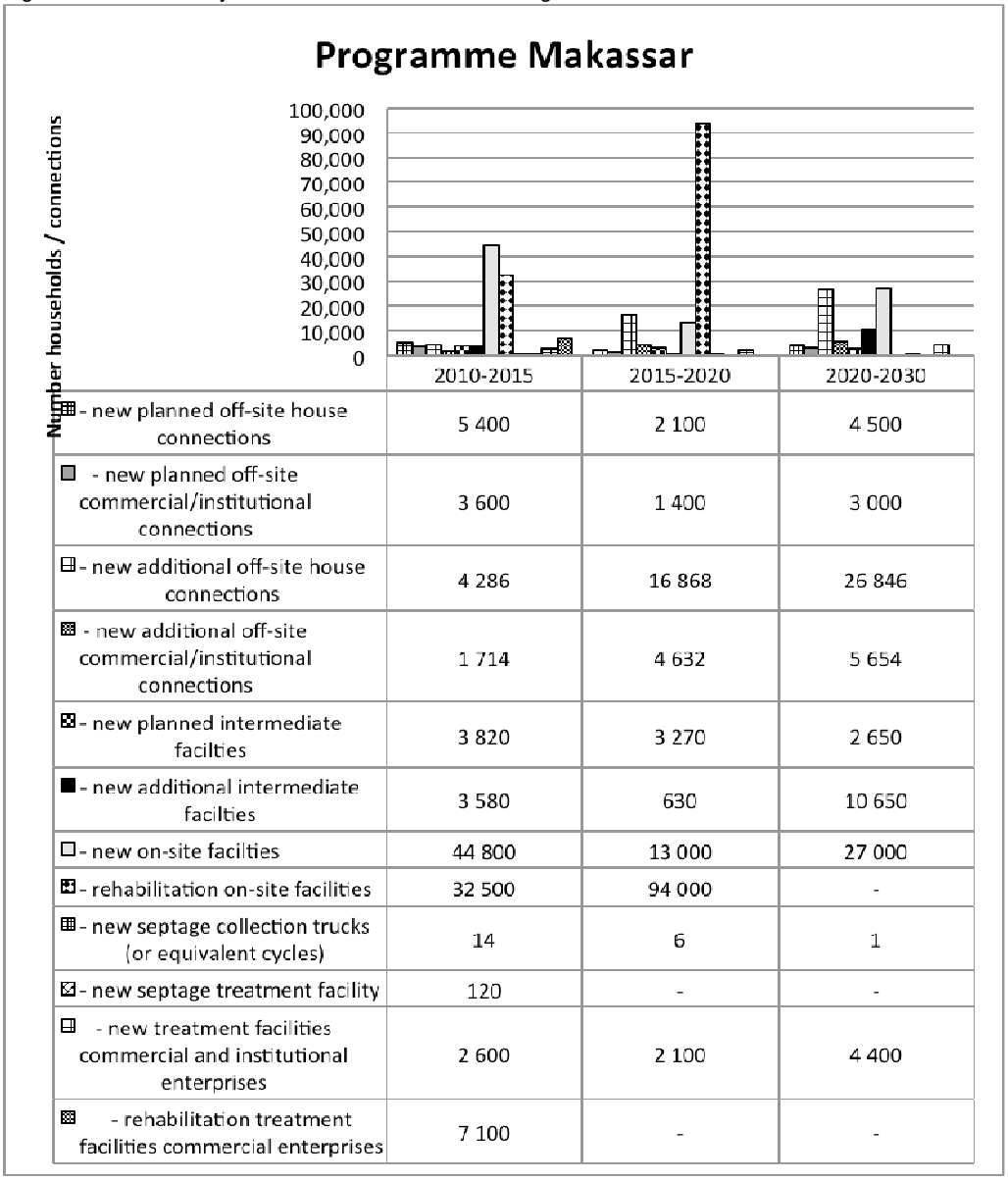
Problem	Activity
Operation and maintenance of IPLT Nipa Nipa is too complicated.	- Keep septage management simple
The reasons for the low coverage of septage collection and treatment are unknown.	- Study the reasons: no demand?, illegal practices?, transport distance too far?
Present manual septage collection practice is both unhygienic and adds to the pollution of the Makassar.	- Provide the manual septage collectors with mechanical motorcycle devices e.g. by means of Micro Credit Scheme. Credit given if septage is transported to the IPLT.
The operation and maintenance of the IPLT is below expectations: effluent quality is below standard and the sludge-drying beds are full.	- Train the staff of the IPLT e.g. by the support of a professional sludge treatment entity (i.e. water board).

7. Planning Targets

7.1 Summary of Intervention Targets

Proposed overall targets for the Master Plan interventions are shown in Table 7.1 below.

Figure 7.1: Summary of Master Plan Intervention Targets



	2010-2015	2015-2020	2020-2030
- new planned off-site house connections	5 400	2 100	4 500
- new planned off-site commercial/institutional connections	3 600	1 400	3 000
- new additional off-site house connections	4 286	16 868	26 846
- new additional off-site commercial/institutional connections	1 714	4 632	5 654
- new planned intermediate facilties	3 820	3 270	2 650
- new additional intermediate facilties	3 580	630	10 650
- new on-site facilties	44 800	13 000	27 000
- rehabilitation on-site facilities	32 500	94 000	-
- new septage collection trucks (or equivalent cycles)	14	6	1
- new septage treatment facility	120	-	-
- new treatment facilities commercial and institutional enterprises	2 600	2 100	4 400
- rehabilitation treatment facilities commercial enterprises	7 100	-	-

Source: Mott MacDonald

7.2 Key performance indicators

7.2.1 Sustaining the programme in general terms

The planned and additional programme of system interventions will be sustained only if all stakeholders involved, i.e., the City Government, private sector and community are able to continue the operation of the systems without additional special programmes and interventions.

In 5 years the initial wastewater programs will have been implemented but it will probably take another 5 years for them to become sustainable. Besides institutional development planned, Table 7.1 shows the desired results and activities necessary to achieve a sustainable situation by 2020.

Note - It is recommended that these activities are incorporated in the work of the ADB funded MSMHP Capacity Building Program (Refer to Section 10).

Table 7.1: Sustaining the program by 2020

Problem	Solution/Desired result	Activities
All attention, energy and funds are focused on the off-sit system. It will be a big disappointment if people find out that the insanitary conditions persist, even with an off-site system.	- Investments in "off-site" wastewater improvements lead to the environmental benefits expected. - Projects are effective and efficient.	- An area wide, "**Total Wastewater Improvement"** approach.
Wastewater installations installed do not work properly due to poor design/ wrong locations/ wrong operation and maintenance.	- Government agencies and staff are knowledgeable on wastewater management so they can guide designers and contractors in a good way. - Contractors and general public have good information and good examples of appropriate wastewater technologies.	- Government level: - Education of existing government staff - Only recruit knowledgeable staff (part of job descriptions) - Develop wastewater information centres where contractors and the general public can obtain information on appropriate technologies (models, construction drawings, etc.).
Wastewater management has a very low priority (is not 'sexy')	- High priority for wastewater management	- The local leaders (Mayor) to make sure wastewater becomes an important issue - Award and rewards for most clean and green area/government official - Good examples at government offices, hospitals, School sanitation, Puskesmas sanitation.
Poorly installed wastewater installations keep on polluting the environment.	- Every owner of a wastewater treatment installation is responsible for good operation and maintenance.	- Publish the effluent quality of all licensed waste treatment installations on the internet - Award and reward for the best working installation, visit by the Mayor and publicity.
The perception is that the treatment of wastewater only costs money.	- At all levels it is realized that there is also an economical benefit in living healthily.	- PR campaigns and interviews with influential people.

The conditions required to sustain the programmes outlined in Table 7.1 are listed in Table 7.2.

Table 7.2: Conditions required to make the program sustainable

Programme	Conditions
Construction of new off-site house connections	Income from wastewater fee should be equal or more than the operation and maintenance costs
Construction of new intermediate facilities	Monitoring of the appropriateness and success of the intermediate facilities Dissemination of the monitoring results
Construction of new on-site facilities	Within the building permit there should be a requirement that every house should have an adequate on-site facility Monitoring of the facilities Law enforcement
Construction of new treatment facilities for commercial enterprises	Within the business permit there should be a prescription that every commercial enterprise should have an adequate wastewater treatment facility Law enforcement

7.2.2 Key Performance indicators

Recommendations for key performance indicators have been developed to monitor the implementation of the planned wastewater programme. In this respect they are output indicators based on the indirect results of the implementation of the wastewater programme. The list of performance indicators is shown in Table 7.3.

Table 7.3: Recommended Performance Indicators

Indicator	Target 2015	Target 2020
Financial: cost recovery for public facilities (sewerage system, intermediate systems)	50%	100%
Institutional: is there an institution which: Oversees, monitors the operation of public facilities Operates public facilities (off-site, septage treatment, intermediate systems etc) Oversees and monitors private and community wastewater facilities.	Available	The “man in the street” knows who is responsible and where to complain. Complaints are followed up within 3 days.
Environmental: the proportion of BOD load Makassar town discharging into the environment compared to the BOD load produced.	35%	16%
Technical: treatment efficiency of off-site, intermediate and on-site systems	60%	80%
Social/behavioural: hand washing after toilet use and before food preparation	50%	100%

8. Institutional Plan

8.1 Overview / identification and evaluation of existing wastewater services and institutional arrangements

8.1.1 Existing wastewater services

As of 2006, 86.4% of household premises were reported by the Health Department to be equipped with individual on-site septic tanks or leaching pits ("on-site facilities"), whilst there were also 18 communal septic tank units and 27 communal MCKs (both of which are defined as "intermediate facilities"). Sludge is treated at a human waste sludge treatment facility (IPLT), with a throughput capacity of 1,000 m^3 per day and located at Nipa-Nipa some 20 kilometres from the city centre. Constructed in 1990 and located nearly 20 km from the centre of Makassar, the facility was operated and managed until recently as part of the functions of the city-owned cleansing services enterprise (PD Kebersihan Kota Makassar). However, early in 2010, this BUMD was declared bankrupt and formally closed down, and its activities taken over by Dinas Pertamanan (Parks Service). The Dinas was re-labelled Dinas Pertamanan dan Kebersihan (Parks and Cleansing Services Department –DPK). All the assets from the failed enterprise, including the IPLT and 8 vacuum trucks, were also transferred to the Dinas. Only four of these trucks are now operational, with the newest having been purchased in 1999. Even assuming that these trucks operate at maximum utilisation, it is evident that household coverage is very limited.

The service is managed within DPK through two UPTDs which are respectively responsible for sludge collection (with vacuum tucks) and its disposal (at the IPLT). Although the UPTDs have their individual TUPOKSI, operations are run on what can only be described as an informal basis and they have no budgets distinct from DPK; consequently, O&M is well below required standards. Utilisation and revenue records do not appear to be particularly reliable.

No information on private sector tankerage activities was available in the Dinas. However, a local newspaper carries advertisements for 10 operators. Two of these were interviewed and neither disposes of the sludge in an environmentally friendly manner (usually to storm drains). It is suspected that none of the sludge collected by private sectors is taken to the IPLT, with the distance to the facility, as well as any tipping fee payable, being disincentives.

Community arrangements consist of MCKs and SANIMAS installations connected to small community-managed wastewater treatment facilities. The city government appears to exercise little supervisory or institutional responsibility over MCKs, whilst recently constructed SANIMAS facilities are managed by local community heads (RW/RT). Accountability for user fees appears to be lacking. In addition, there are intermediate systems on residential housing estates, where wastewater disposal is managed by the developer and paid for by residents.

The Environmental Department (*Badan L:ingkungan Hidup*) has a sub-department which is responsible for supervising and controlling the quality (pollution levels) of water sources through its UPTD for Wastewater Management.

Responsibility for grey water rests with the Public Works Department. As far as investment is concerned, it should be noted that the central government is responsible for primary drainage, the provincial government for secondary drainage and the city government for tertiary (meaning grey water) drainage. O&M for all

three categories is the responsibility of the city. However, in practice, tertiary drainage O&M is left almost entirely to the community and therefore frequently neglected.

Other city government agencies involved in the wastewater sector are Bappeda, which is responsible for sector macro-planning, and the Health Department which carries out public education campaigns to mitigate unhygienic conditions caused by poor sanitation/wastewater practices. Responsibility for issuing building permits lies within a department for one-stop permits (*Badan Permberian Perizinan Terpadu*) under Mayoral Decree 14/2005, following approval by the Department of Spatial Planning (*Dinas Tata Ruang*).

8.1.2 Current institutional arrangements

Central Government Regulation (PP) 38/2007 concerning the division of responsibilities between the three levels of government (central, provincial and city/regency) states that government is based on two principles – obligation and choice. The procedures for implementing these two principles are stipulated in PP 41/2007 on government organization. The organization of the city government of Makassar is set out in Regional Government Decree (*Perda*) 03/2009 and the basic responsibilities and functions (TUPOKSI) for wastewater management in Mayoral Decree (*Perwali*) No 20/2009 within the Department of Public Works. Under this decree, the Department has the responsibility for infrastructure development in the city. Located within the sub-department (bidang) for planning and implementing environmental infrastructure, there is a section responsible for wastewater. Its principal duties are:

- Producing work plans in accordance with its responsibilities and functions (tupoksi)
- Planning the implementation of new wastewater facilities or the rehabilitation of existing units;
- Carrying out surveys, measurements and designs, and making site plans in housing areas designated for provision with incremental environmental health improvements by means of wastewater infrastructure;
- Collection and management of data related to wastewater infrastructure;
- Construction of new wastewater facilities and rehabilitation and maintenance of existing units, including toilets for low-income families, household and communal septic tanks, MCKs and grey water drainage channels;
- Technical supervision of implementation and maintenance of wastewater infrastructure;
- Liaison with other concerned city government agencies.

Other formal institutional arrangements for wastewater management are: Mayoral Decrees No 149/2009 on the UPTD for wastewater management in the Environmental Department, No 85/2009 for the two UPTDs in the Parks and Cleansing Department for the removal, transport and disposal of human waste sludge, and No 80/2009 for the maintenance of drains in the Public Works Department.

A review of these decrees shows that the TUPOKSI are concerned with each department in isolation. They are, in effect, parallel institutions, without any common thread which might provide a pathway towards a comprehensive sector approach to domestic wastewater management. The city government is now considering transferring the human waste sludge activities currently under the Parks and Cleansing Department to the Public Works Department. Although no formal measures have yet been initiated in this regard, it is a step in the right direction towards an all-inclusive integrated approach.

8.2 Selection of proposed operator

8.2.1 Sewered system service providers in operation in Indonesia

At present, sewered wastewater systems elsewhere in Indonesia are operated by the following regional government service providers.

Operator	Regional Government(s)
Dinas	None
UPTD	DKI Yogyakarta (UPTP), Makassar
BLU-D	Greater Denpasar
PDAM	Balikpapan, Bandung, Cirebon, Medan, Solo
PD-PAL	Banjarmasin, DKI Jakarta

It should be noted that all PDAM operators were appointed before the issue of PP 23/2005 and Ministry of Home Affairs Decree 61/2007, both of which are concerned with BLU and BLU-D.

The Consultant's task for future wastewater institutional arrangements in Kota Makassar is limited to assisting the ADB-appointed MHSMP[16] capacity building consultant in guiding the city government towards the selection of a wastewater management operator, based on experience already gained in the cities of Bogor and Surabaya.

8.2.2 Selection of proposed operator

There are several institutional options available to organize the delivery of the service. In order of ascending management and financial autonomy, these are:

- *Dinas* – a department and an integral part of all regional governments. A *dinas* has its own budget, but any revenues are passed to the regional government treasury. Most regional government technical operations, whether or not revenue-generating, are managed by a *dinas*;
- UPTD (*Unit Pelakasan Teknis Daerah*) – a UPTD is a sub-unit of a *dinas*, established to undertake technical operations in a specified functional or geographical area;
- BLU-D (*Badan Layanan Umum – Daerah*: a regional government public service agency) – these are not separate legal entities but formally part of the regional government apparatus. However, a BLU-D has more autonomy than a *Dinas* or UPTD. It is not required to make a profit, although it is allowed to. To date, few BLU-D have been established, partly because the concept is relatively new (implementing regulations were issued in 2005[17]), and most BLU-D to date have been set up to manage hospitals. Exceptionally, the Trans Jakarta Bus way is managed by a BLU-P (province).
- BUMD (Badan Usaha Milik Dearah) – unlike any of the above, a BUMD is a separate regional government-owned legal entity (perusahaan daerah – PD) with its own resources. At the end of 2008, there were more than 800 provincial, city and rural government-owned enterprises, most of which operated in the water supply sector, but also in regional banking and micro finance, with the statutory objective of profit-making. Within the wastewater sector context, selection of a BUMD operator would involve the establishment of a PD-PAL (wastewater management enterprise,

[16] Metropolitan Health and Sanitation Management Project in Medan and Yogyakarta
[17] PP 23/2005

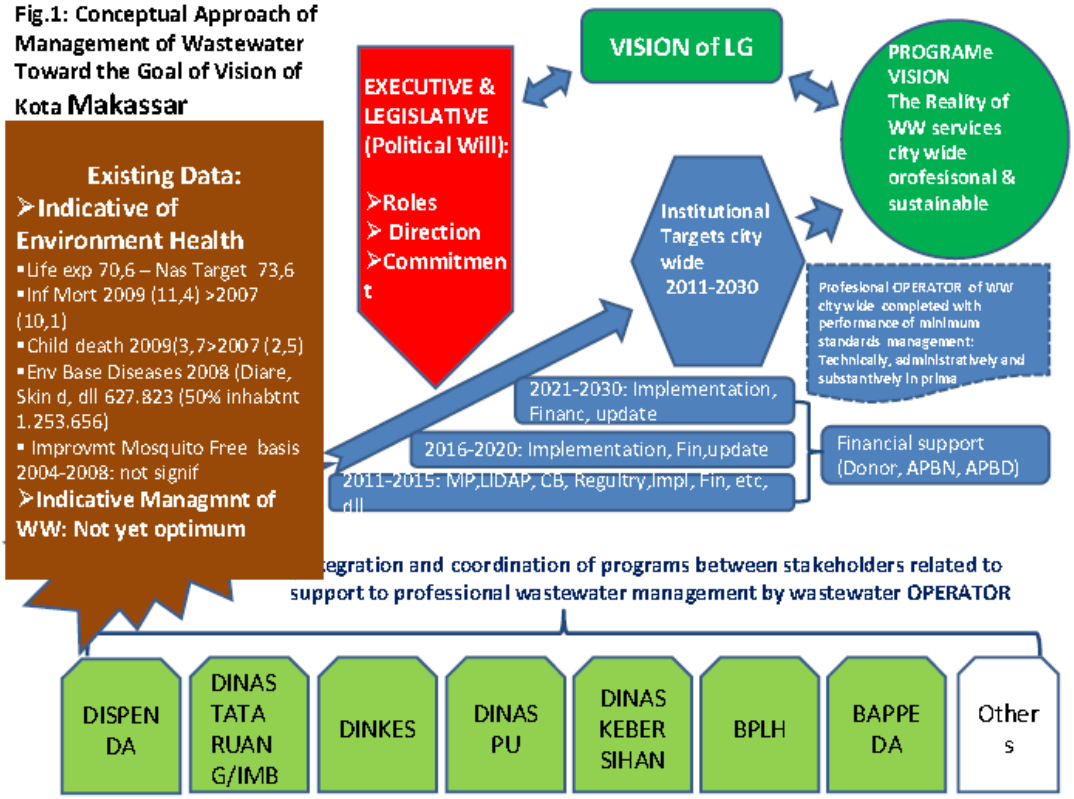
usually preceded by forming a division within the water supply enterprise (PDAM) and hiving it off later as a separate entity. The wastewater division would have a similar organization structure to that of a PDAM, but with its own accounting systems, assets and revenues.

A description of the principal characteristics of the institutional options available to organise the delivery of the wastewater service is given in Appendix F.1.

8.2.3 Conceptual approach to future wastewater institutional arrangements

As a sector which is going to be almost completely transformed, wastewater management will be involved in many environmental issues which will have to be solved by reaching out to the community through pro-environmental actions which will attract the support of large sections of the community. In an era of regional autonomy, wastewater institutional arrangements will require vision, political initiative and goodwill from the city's chief executive, its legislative body and senior government officials, since appropriate and comprehensive regulatory measures will be essential to support the programme. Interdependency between these various players is essential to ensure that appropriate synergy is created which will overcome the conventional bureaucratic approach to the attainment of conservatively-determined physical targets, a continuation of which is unlikely to guarantee sustainability of the sector. Figure 8.1 illustrates this approach.

Figure 8.1: Conceptual Approach to Wastewater Master Plan Institutional Arrangements 2011 – 2030



In order to operationalise the new tasks and responsibilities of the upgraded wastewater sector, the existing UPTD will require significant capacity improvements if it is to achieve its long-term goals as illustrated in the bullet point list below, irrespective of the choice of "full" operator. These capacity-building measures will be introduced through step-by-step approaches, including: (i) improvements oriented towards focused tasks and responsibilities (TUPOKSI) aimed at efficient management control of a city-wide wastewater service, and (ii) recruitment of personnel with capabilities to fit the task and responsibility requirements. Both of these approaches must take into account performance indicators.

Indicative Long-Term (2011-2030) Institutional Reforms for the Wastewater Sector include;

- Establishment of an operator with accountability for implementing the piped sewerage service and the environmentally friendly collection and disposal of human waste sludge;
- Introduction of building permit regulations with appropriate technical standards for wastewater disposal which reflect environmental needs as the wastewater sector is progressively developed;
- Provision of capacity building to establish a regulator for the wastewater sector in accordance with prevailing laws and regulations;
- Improvement of community awareness of the importance of wastewater management;
- Introduction of retributions and recourse to other sources of revenue (such as property taxes) to fund wastewater sector recurrent expenditure (operations, maintenance, administration, community awareness, campaigns, etc);
- Regular preparation of regular strategy and business plans;
- Promotion of a full cost-recovery tariff for non-domestic sewered premises;
- Assistance to low-income households for wastewater management;
- Establishment of stakeholder committees;
- Introduction of enforcement procedures with sanctions for transgressors;
- Development of benchmarks;
- Incentives for the private sector to invest in wastewater infrastructure management.
- Encouragement to the private sector to invest in wastewater management infrastructure

8.2.4 The selection process for the sewered system operator

In 2010, the Province of South Sulawesi commissioned a report by CV Adi Permata on the steps required for the establishment of institutional arrangements for wastewater management in the Losari area of Makassar. The study recommended the appointment of a single operator for both black and grey wastewater management, initially in the form of an UPTD to be located within the organisation structure of the Public Works Department but later to be upgraded to a BLU-D. The report has yet to be formally endorsed by the city government, although it is evident that city government departments with wastewater management responsibilities actively participated in the study assignment.

Ministry of Public Works (MPW) Decree No 16/2008 (concerning National Policy and Strategy for the Development of Domestic Wastewater Management) recommends, inter alia, the appointment of a semi-autonomous operator/manager and a separate regulator. This would preclude the selection of either a Dinas or a UPTD as the operator/manager, limiting the choice between a BLU-D, the establishment of a

separate division for waste water management within the PDAM or proceeding directly to the creation of a PD-PAL. MPW also recommends that, in the event of a decision being made to establish a separate division within the PDAM as the operator, any subidies to the operator should be provided by the city government, i.e. that there should be no cross-subsidies from the water supply division tariff revenues.

The Consultant spent several days interviewing senior officials in city government, including the Secretariat, the legal and organisation divisions in Bappeda and the Parks and Cleansing, Public Works, Environment, Health, Spatial Planning and Permits Departments. The conclusions arising from these meetings were that:

- the CV Adi Permata report and its recommendations were well received by the city government;
- senior officials were in favour in extending the scope of the wastewater management function from that of operator of an off-site system in the Losari to city-wide management of all wastewater activities (off-site, intermediate and on-site, plus grey water management);
- the PDAM is in an unsatisfactory financial condition *(kondisi tidak sehat*) and therefore an unsuitable candidate for wastewater operator;
- the establishment of a PD-PAL would be premature in view of the profit-oriented scope of regional government enterprises, and therefore
- the selection and establishmentof a BLU-D as the wastewater sector manager/operator would be most appropriate.

On 13 April, 2011, the Consultant presented these conclusions to a formal meeting attended by senior city and provincial government officials. The city government heads of the Parks and Cleansing Services, Public Works and Environment Departments, i.e the departments currently most involved in wastewater management, supported the selection of a BLU-D as the manager/operator, as well as the appointment of a regulator to be established within the Environment Department, although these endorsements require formal confirmation by the mayor.

8.3 Establishment and responsibilities of the operator

8.3.1 Regulatory process

Paragraph 7.2.3 summarises the processes through which Kota Makassar has selected a BLU-D in principal as the manager/operator for the wastewater sector. By means of this appointment, the BLU-D will also act as the supervisor of intermediate and on-site wastewater management, as well as the operator of the sewered off-site systems. Ministry of Home Affairs (MOHA) Decree 61/2007 requires a transitional process for the establishment of a BLU-D, during which the capacity of the agency is gradually built up from UPTD status so that it can progressively assume greater tasks and responsibilities to the point where it becomes the operator of the major sewered systems and wastewater treatment faciities by the end of 2017. The various functional aspects of a UPTD and BLU-D are subsequently covered in greater detail in Appendix F.2, whilst the actual regulatory process described below is expanded upon in Appendix F.3.

The establishment of the BLU-D will be effected in three stages:

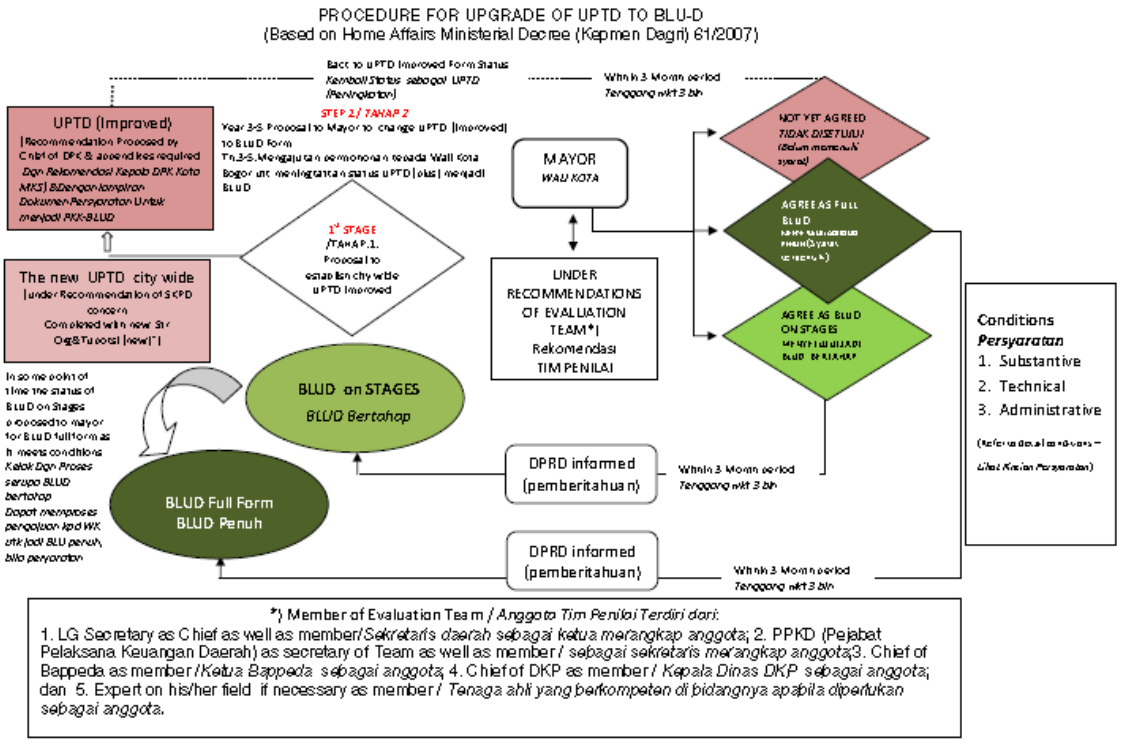
The **first stage** will be the transfer of the two UPTDs from the Parks and Cleansing Department and their consolidation into a single upgraded UPTD (hereinafter referred to as a “UPTD Plus”) within the Public Works Department. (It is possible that the city government will prefer to do this in two stages: the first being

the transfer and conversion of the two UPTDs into a single unit and then, subsequently the UPTD into a UPTD Plus). The UPTD Plus will continue to manage the IPLT at Nipa-Nipa, including its rehabilitation and will supervise the privatisation, licensing and services of vacuum truck desludging operations and conveyance of sludge to the IPLT. In addition, it will commence the registration and inspection of on-site wastewater units, provide guidance to community and private sector management of MCK Plus and SANIMAS facilities, support grey water environmental disposal activities and progressively operate small bore intermediate piped systems and localised treatment facilities. Arrangements for capacity building should take place by early 2012 by means of a mayoral decree for staff recruitment as well as for the preparation a capacity building programme. The recruitment for the UPTD consolidation and capacity improvement will be carried out in accordance with PP No 41/ 2007.

The **second stage** will be the conversion process of the UPTD Plus to an embryo BLU-D, with an organization structure which will permit a more efficient and effective discharge of responsibilities in accordance with its function of professional manager/operator for off-site, intermediate and on-site systems and grey water services. In addition, responsibilities will be extended through improvement of human resources capabilities and training to prepare for the establishment of a full service by assuming the management and operation of the full conventional sewered system and off-site wastewater treatment

Figure 8.2 illustrates the process for upgrading the UPTD Plus to a BLU-D.

Figure 8.2: Procedure for Upgrading UPTD Plus to BLU-D



The BLU-D is expected to commence its existence as an embryo in late 2014.. It will be organised in accordance with PP No 41/2007, PP 23/2005 in terms of financial management and Ministry of Home Affairs (MOHA) Decree No 61/2007.

The third stage will be the conversion of the embryo BLU-D into a full BLU-D as the fully fledged operator of the Losari area centralised sewered and small bore intermediate off-site systems and their treatment facilities, and as the supervisor of community intermediate and on-site wastewater services. At this point the Losari area wastewater treatment plant will also be used to accept human waste septage from vacuum truck operators. The range of services to be provided by the full BLU-D is described in Paragraph 7.3.3 below. This conversion is proposed to take place at the end of 2014, or one year before the Losari area sewered system and wastewater treatment facilities become operational.

Figure 8.3 shows the complete process of institutional change of management of the wastewater sector, whilst Figure 8.4 provides an overview of a proposed organizational structure of the eventual full BLU-D prior to detailed definition through the LIDAP process change of the BLU-D for Wastewater Management within the Kota Makassar organization structure.

Figure 8.3: Process of Proposed institutional Change in the Wastewater sector

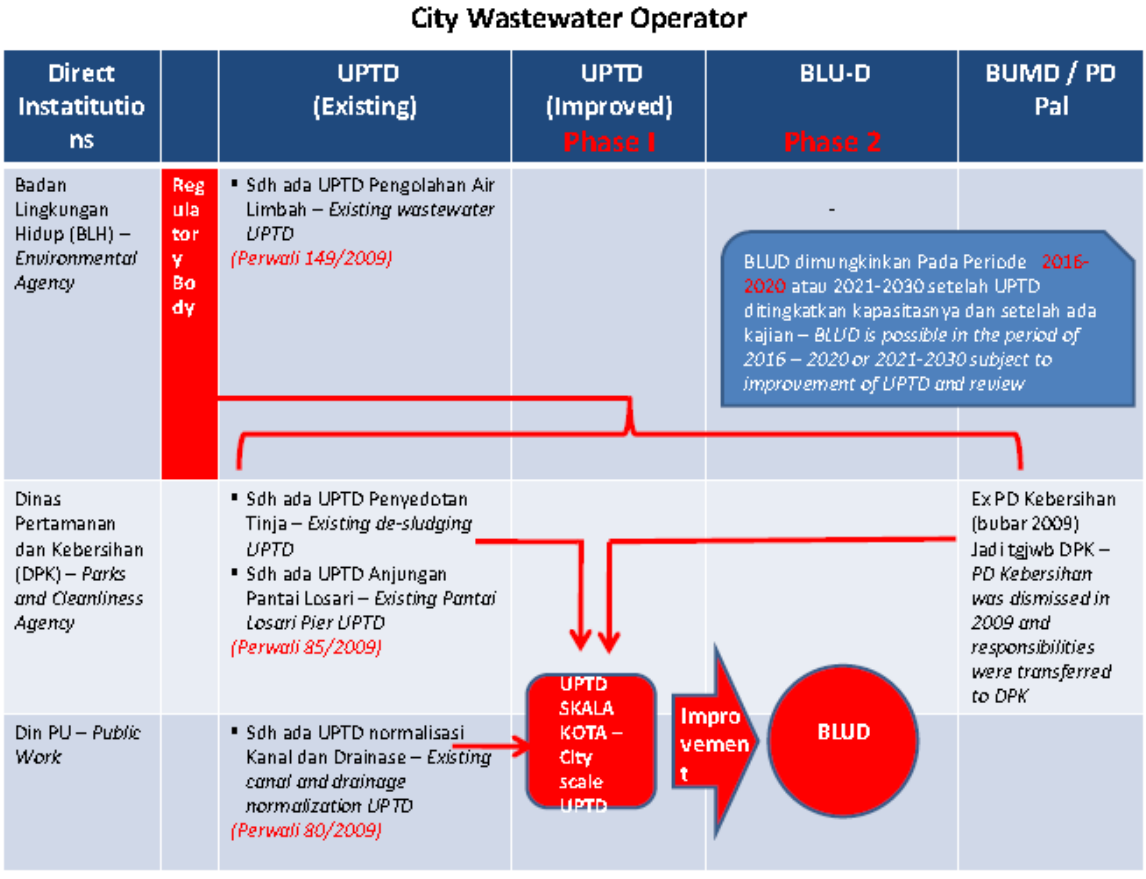
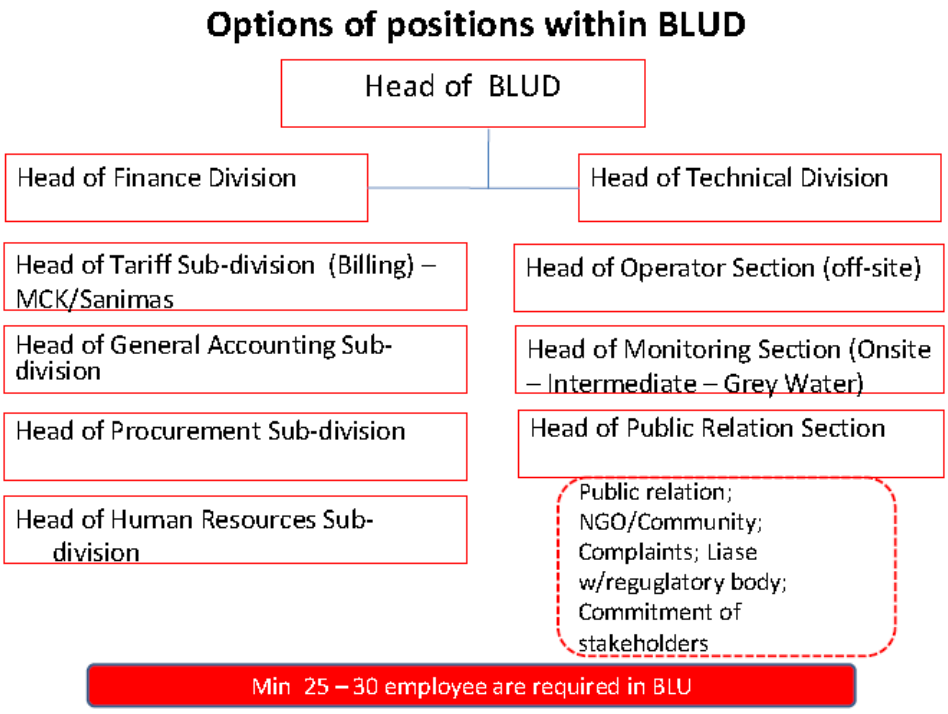


Figure 8.4: *Indicative Organisational Structure of Full BLU-D*



8.3.2 Background to the assignment of the responsibilities of the manager/operator

Selection of a BLU-D as manager/operator, when confirmed by the mayor, will mean that the services can be managed on an integrated basis. In some cases, the BLU-D operator will directly manage/operate services (on-site servicing and disposal, sewered systems and treatment), whilst for others the BLU-D will supervise activities, guide the provision of community services towards higher standards of hygienic and environmental quality, and collaborate with other deliverers of infrastructure and soft services. Summary descriptions of services to be provided by the operator are divided into on-site, intermediate, off-site and greywater disposal services.

Integrated wastewater management is defined as “a process which promotes the co-ordinated development and management of wastewater, water, land and related resources in order to maximise economic benefits and social welfare in an equitable manner without compromising the sustainability of vital ecosystems”. [18]

Off-site systems, in particular, should be accompanied by the control of designated land use and landscape design. These systems must be planned and designed to avoid potential social conflict over land and accessibility issues This will require collaboration between government, community and the private sector in order to achieve sustainable development of the sector.

[18] United Nations World Water Development, Report No 3, Water in a Changing World, UNESCO 2009

In general, there is a lack of suitable institutional arrangements for managing decentralised wastewater (i.e. intermediate systems), as well as a lack of a suitable policy framework which would encourage a decentralised approach. Failure to address these decentralisation issues could lead to fragmentation of the sub-sector, e.g. in peri-urban areas where boundaries may be loosely defined. Without a formal institutional framework which monitors and regulates these systems, efforts to introduce supervision of decentralised wastewater systems may not succeed and lead to pollution and other environmental and health issues..

On-site wastewater systems will require regulation and supervision of a mix of technologies, including:

- upgrading of existing and provision of new community ablution facilities for existing and new individual household premises, with on-site or decentralized treatment (SANIMAS"), including use of environmental enhancements such as production of biogas and recycling of treated wastewater;
- Upgrading of individual and shared toilet facilitie**s** for existing and new dwellings with individual or shared on-site treatment of waste;
- Ablution facilities for public facilities (schools, markets, transport terminals, etc) with on-site treatment;
- Septic tank sludge collection services;
- Improvement of existing and development of new facilities for septic tank sludge treatment.

Based on the above considerations, as well as administrative and substantive issues, the TUPOKSI should address the wastewater management services described in Section 8.3.3 below

8.3.3 Service responsibilities of the manager/operator

8.3.3.1 On-site wastewater services

Registration and inspections

- Identify locations of septic tanks and leaching pits; prepare and maintain a central register, divided into household, community and non-household (schools, markets, etc) categories. It is accepted that it may not be possible to locate all such facilities or to access some of them from vacuum trucks;
- Ensure that all new buildings have adequate provisions for on-site disposal (toilet construction, waste pipes and septic tanks) and that such facilities are registered and approvals sent by the operator to the Licensing Department (*Badan Pelayanan Perizinan Terpadu dan Penamanan Modal* - BPPDPM), which provides a one-step service, before building permits (IMB) are issued;
- Carry out periodic inspections of all such facilities and report on their condition; the report to be recorded on the central register, to include recommendations on requirements to empty septic tanks and provision of subsidies to low-income families in high-density areas to upgrade existing facilities;
- Advise the Health Department on areas with unsanitary conditions so that intensive focus can be provided to communities on household hygiene;
- Encourage NGOs and community organizations to assist in the above services as necessary and in accordance with capacity-building progress.

On-site servicing and disposal at IPAL

- Freeze the size of DPK's vacuum tanker fleet and re-deploy to parks service, as required. Advertise privatization of the service to a pre-determined level. License private sector operators. Issue new decree on desludging services with fees determined by volume of sludge and distance to the IPLT.
- Manage demand for desludging service on the basis of inspections of septic tanks. Private sector operators to be contracted by the Wastewater Operator.
- Authorise payments on production by vacuum truck operators of receipt certifying delivery of sludge to IPAL.

8.3.3.2 Responsibilities of the operator for intermediate wastewater services

- Carry out periodic inspections of community facilities, provide technical advice to community supervisors on operation and maintenance;
- Identify and make recommendations for installation of new and additional community facilities in areas currently unserved or inadequately served;
- Check RW/RT accounting records for disposition of revenues;
- Carry out periodic inspections of intermediate systems and disposal facilities on residential housing estates and ensure that O&M conditions are in accordance with the building permit;
- Encourage NGOs and community organizations to assist in the above services as necessary and in accordance with capacity-building progress.

8.3.3.3 Responsibilities of the operator for off-site wastewater services

- Operation and maintenance of the sewered wastewater conveyance systems, including the small bore intermediate systems, plus periodic inspections of primary and secondary mains and manholes;
- Operation and maintenance of the wastewater treatment plant facilities, both centralised and decentralised
- Observance of all technical and environmental standards;
- Formulation of technical plans for improving and extending the system;
- Commercialisation of tariffs for non-household and non-social customers;
- Responsiveness to customer attitudes and complaints in order to enhance customer satisfaction, including inspections of tertiary mains and connections;
- Provision of affordable solutions to low-income households with regard to connections and user tariffs and service charges;
- Accountable management of financial and administrative systems.

8.3.3.4 Responsibilities of the operator for grey water disposal services

- As part of periodic inspection duties, check functionality of tertiary drainage;
- Report problems to responsible Pemkot agency (e.g. solid waste blocking drainage, minor construction/repair problems);

- Advise households and community heads on need to maintain drainage in good operating condition and provide assistance on repair methods;
- Advise *Dinas Bina Marga dan SDA* of need for construction of new tertiary drainage;
- Encourage NGOs and community organizations to assist in the above services as necessary and in accordance with capacity-building progress.

8.4 Other institutional actions required

8.4.1 Office of the regulator

The need to establish a regulator who is independent of the operator but accountable to the legislative and executive city authorities is absolutely essential to avoid conflicts of interest. The city administration has, in principal, selected a BLU-D, a not necessarily for profit agency, as the manager/operator; therefore the regulator should have a different perspective to that of a supervisory board of a profit-mandated operator where commercial considerations are more important.

The recent law on the environment (UU 32/2009) places much responsibility on regional governments for sustaining the environment and makes provision for the appointment of a regulator (Section 15). However, the necessary implementing regulation (PP) has not yet been issued, although all PP required from the law were required to be complete in 2010. Nevertheless, establishment of the regulator's office within the Environment Department appears to be the logical choice from a reading of the law on the environment.

In addition, the office of the regulator should have the responsibility for ensuring that the provisions of UU 25/2009 on public services are carried out in accordance with service quality requirements laid down for the wastewater sector. It is noted that, under this law, the community has the right to establish its own supervisory institution for the oversight of public services (Section 39).

There will be a need for perda to implement and operate both these laws in Kota Surabaya. Inter alia, it is recommended that, in addition, the perda should take into consideration the following issues:

- The need to set and publish performance standards in the sector, and to disseminate to the sector the degree of compliance at periodic intervals;
- The means of enforcement and sanctions against transgressors – ideally, this should include the need for accountability of city government institutions, as well as individual transgressors.
- Capacity building programme

In order to be able to discharge these tasks, the regulator will need to have full access to information. This will require the regulator having full access to all reports that are made by or delivered to the operator, as well as reports on corrective actions taken by the responsible agencies or individuals.

8.4.2 Review of the building permit regulation (*Ijin Memberikan Bangunan* – IMB)

The current mayoral decree No 27/2009 on Buildings has been reviewed for clarity and adequacy of sections concerning specifications which have to be met in applications for the issue of building permits. Overall, the contents of the decree are satisfactory in respect of toilets, waste disposal sites and individual septic tanks. However, the Building Permits Division in the Spatial Planning Department does not seem to

have the capability to interpret the adequacy of wastewater arrangements as shown on drawings, but limits the scope of its review to spatial planning and wayleaves only.

There is a need for additional sections to be written into the existing decree to manage the transition from almost universal septic tank on-site coverage to the progressive introduction of intermediate and sewered systems. This includes a requirement for provisions and technical standards in respect of connections to intermediate systems, bearing in mind that communal MCK Plus and SANIMAS facilities and small bore sewered systems on privately managed industrial estates are already operational. Mayoral decrees No 27/2009 on Buildings and No 14/2005 on Arrangements for Issuing Permits, as well as Regional Government Decree No 03/2009 on the Organization Structure and TUPOKSI will require revision

Consideration will need to be given to authorization for the continued use of septic tanks, whether for individual households, residential housing units and light industries, and their gradual phasing-out in areas which accessed by intermediate and sewered systems. Paragraph 8.3 of the Final Master Plan recommends the passing of a decree which will make connection to a sewered system mandatory for owners of premises with access to piped sewerage alignment (with suitable arrangements to be made for low-income households).

It is recommended that the UPTD Plus be given authority to sign off on the adequacy of wastewater arrangements for all new building permits. This authority would be passed on to the BLU-D. The authority for actually issuing the permit would remain with the Licensing Department (BPPD).

8.4.3 Performance indicators

A basic set of measurable performance indicators should reflect the scope and purpose of the wastewater sector programme to be managed progressively by the UPTD, UPTD Plus and BLU-D. The measurements will vary in accordance with the direction of the plans and activities to be announced. In order to achieve good performance targets, the role of wastewater supervision must be developed and improved through training and on-the-job experience, including supervision and education of the community towards hygienic personal management towards wastewater. There will thus be need for internal performance indicators in terms of the technical, operational, financial and administrative performance of the manager/operator and external indicators in terms of the impact on the community (e.g incidence of wastewater-related illnesses, resolution of complaints, etc).

8.5 Phasing of institutional development over the Master Plan period

Table 8.1 provides a summary of the proposed regulatory action plan for institutional development and reform of the wastewater sector. Appendix F.4 gives a detailed phasing over the three phases of the Master Plan: Phase I (2011-2015), Phase II (2016-2020) and Phase III (2021-2030).

Table 8.1: Proposed Regulatory Action Plan

Proposed Actions	Target Date	Regulatory Action
Establishment of the Operator		
Transfer two UPTDs from Parks and Cleansing Services department to Public Works Department and consolidate as UPTD Plus single unit	End of 2011	Cancel PerWali 80/2009, 85/2009 and 149/2009 Revise PerWali 20/2009 Revise Perda No 03/2009 Issue new Perwali (May need two-step process)
Establish BLU-D embryo	End of 2013	Further revision to successor of PerWali 20/2009 and Perda 03/09 New Perda required
Establish full BLU-D embryo	End of 2014	Revision to Perda of 2013 establishing embryo BLU-D required
Review whether to continue BLU-D or establish PD-PAL at appropriate juncture	2020-2030	New Perda required if PD-PAL
Changes to Building Permit (IMB)		
Housing estates Individual houses Light industrial waste	2013	Amend PerWali 14/2005, 20/2009 and 27/2009
Changes to Desludging Operations		
Eliminate existing UPTDS in Parks and Cleansing Services Department	End of 2012	Cancel PerWali 80/2009
Establish privatisation of vacuum truck desludging service and regulate licensing of private sector operators		New PerWali required

9. Finance and economic Issues

9.1 Identification and evaluation of existing and potential resources available for development

9.1.1 Introduction

Kota Makassar plans to eliminate open defecation by the end of 2015, and ensure that at least 25% of the city's households have access to off-site or communal wastewater facilities by the end of 2030 (refer to Chapter 4 and 6 for details). This requires major investments in the construction (and, where appropriate, rehabilitation) of three types of wastewater services:

- Off-site wastewater systems, which collect household black and grey waters, which are pumped through a piped system to a sewage treatment plant (STP).
- Intermediate wastewater systems (such as SANIMAS and MCK *Umum*), each of which collects and treats the black water of approximately 50 households, and communal wastewater and treatment systems which collect and treat black and grey waters from communities of up to 2,000 households.
- On-site wastewater systems, which collect the black water of individual households in a septic tank (or similar storage facility); once the tank is full, it is emptied by a vacuum truck, which transports the sludge to a dedicated septage treatment facility (*Instalasi Pengolahan Lumpur Tinja* or IPLT).

In addition to these physical investment requirements, the city will need to invest in improving the capacity of the institutions and personnel involved in the wastewater sector, especially during Phase I of the Master Plan period. The total cost of the required investment is estimated at Rp 3.07 trillion for 2011-2030 (Table 9.1) expressed in 2011 engineering base constant prices, PPN tax included. An allowance of 15% for detailed engineering design (DED) and construction supervision is included in the off-site physical investment costs.

Table 9.1: Investment Cost for Wastewater Services in Kota Makassar (Rp billion, Indicative)

Wastewater Service	Phase I (2011-2015)	Phase II (2016-2020)	Phase III (2021-2030)	TOTAL (2011-2030)
Off-site wastewater	440	958	563	1,960
Intermediate wastewater	61	26	88	174
On-site wastewater	404	152	82	638
Commercial facilities	123	42	88	253
Capacity building	45	-	-	45
TOTAL	**1,073**	**1,177**	**820**	**3,070**

Source: Mott MacDonald

To identify how these investments may be financed, it is necessary to first identify the parties responsible for the financing of the various services (central government, city government, or private sector). This step is followed by the identification of funding sources available to each of these parties.

9.1.2 Allocation of responsibilities for financing wastewater services

In 2008, the Ministry of Public Works (MPW), which is responsible for regulation of the wastewater sector, issued a decree on a "national strategy and implementation of the development of a system on the treatment of human waste".[19] It stipulates that central government is responsible for financing: (i) funds to encourage mobilization of private funds for household wastewater (*dana stimulan*), (ii) the facilitation of PPPs in providing wastewater services, and (iii) the initial investment in piped sewerage, which would be further developed by regional governments. Since the issuance of the decree, MPW has been involved in the preparation of only one major urban wastewater services project (Metropolitan Sanitation Management and Health Project or MSMHP). The Directorate General of Human Settlements (DGHS) in MPW has confirmed that the financing principles used for this project will also apply to the financing of investments in the wastewater sector by Kota Makassar. These principles are the following (also shown in Table 9.2 below):

- Off-site wastewater. MPW will finance the cost of new piped sewerage systems (WWTPs, and primary and secondary sewer mains), insofar as these costs are eligible for financing from a multilateral or bilateral loan. Provincial governments are responsible for the financing of non-eligible costs (such as land acquisition and resettlement), and the *kota* government for sewer connections, tertiary sewer pipes, and the expansion of existing systems. Households and businesses will finance private toilets, including any plumbing needed to connect to the sewer system.
- Intermediate wastewater. MPW and the *kota* government will provide funds to communities to construct communal wastewater facilities.
- On-site wastewater. Households/businesses will finance private toilets and septic tanks; vacuum trucks by either the city government or the private sector. The *kota* (possibly supported by the province) is responsible for investments in septage treatment facilities.
- Capacity building. MPW wishes to use its own training centres or finance this activity from foreign grants.

Households and businesses are responsible for financing O&M of toilets, septic tanks, and communal wastewater facilities. Subject to a guideline of a 2% household income ability-to-pay factor, they are also required to finance the full O&M cost of piped sewerage systems and IPLTs through sewerage charges and tipping fees. (The *kota* government is responsible for covering any shortfalls between fee revenue and O&M expenditure from its own resources.) Sludge collection fees are required to cover the full cost of vacuum trucks and related equipment, irrespective of whether these are owned by public or private operators.

[19] PerMenPU 16/2008 is partly based on PP38/2007, a Government Regulation that allocates the responsibilities for all public services to central, provincial and *kabupaten*/*kota* governments.

Table 9.2: Financing Responsibilities by Wastewater Service

WASTEWATER SERVICE	INVESTMENT				O&M			
	DGHS	Province	Kota	Private	DGHS	Province	Kota	Private
Off-Site								
Private toilet				√				√
Sewer connections, tertiary sewers*			√				√	√ **(fees)**
Primary and secondary sewers, STP	√	√**	√***				√	√ **(fees)**
Intermediate								
Communal wastewater	√		√					√
On-Site								
Private toilet, septic tank				√				√
Vacuum truck, etc			√	√				√ **(fees)**
IPLT		√	√				√	√ **(fees)**
Capacity Building	√		√					

Source: MPW (DG Cipta Karya)

* Defined as all pipes located in alleys (*gang*)

** Costs not eligible for foreign loan financing

*** System expansion only

It is possible that financing responsibilities may change before project implementation, particularly those for off-site wastewater.

9.1.3 Identification of available funding sources

The following sources of funding will likely be available for financing wastewater sector investments in the short and medium term (shown in Table 9.3 below):

- Central, provincial and city government budgets. DGHS, South Sulawesi Province and Kota Makassar itself may allocate funds from their own budgets to co-finance investments. Because the wastewater sector competes for scarce funding with other sectors, it is not possible to forecast available funds.
- Foreign loans. DGHS plans to utilize US$400 million of ADB loan funds to finance eligible costs of off-site wastewater systems in 16 metropolitan cities, including Kota Makassar. DGHS is also currently preparing an ADB loan for Urban Sanitation and Rural Infrastructure (USRI) to finance SANIMAS facilities in South Sulawesi and other provinces (a lump sum of Rp 350 million would be made available for each facility). Until this loan becomes effective, DGHS will make funds available from its own budget (APBN) to finance SANIMAS facilities for which there is a demonstrated need.

Table 9.3: Available Funding Sources for Investment in Wastewater Services

WASTEWATER SERVICE	DGHS	Province	Kota	Private
Off-Site				
Private toilet				Own funds, micro-credit
Sewer connections, tertiary sewers			APBD-Kota, OBA	
Primary and secondary sewers, WWTP	APBN, foreign loans passed on as grant	APBD-Prov	APBD-Kota, municipal bonds	
Intermediate				
Communal wastewater	APBN, foreign loans passed on as grant		APBD-Kota, OBA	
On-Site				
Private toilet, septic tank				Own funds, micro-credit
Vacuum truck and related Equipment			APBD-Kota, bank loans	Own funds, bank loans
IPLT		APBD-Prov	APBD-Kota	
Capacity Building	APBN, foreign grants		APBD-Kota	

Source: MPW (DGHS)

- Foreign grants (including OBA). IndII is expected to have a budget available for output-based aid (OBA). Under this scheme, a *kota* government would be reimbursed for installation of sewer connections or communal wastewater facilities financed from its own resources. Foreign grants may also be available for capacity building.
- Own funds. Households and business will finance part of the investments (toilet, septic tanks, internal plumbing) from their own savings.
- Bank loans (including micro-credit). The track record of domestic banks, both state-owned and private, in providing finance for regional government long-run infrastructure services has been deeply disappointing to date. Contractors have been more successful than regional governments in obtaining this kind of finance, but at high interest rates and short loan tenors, the costs of which eventually have to work their way into tariffs. It would be optimistic to expect a change of policy on the part of domestic banks, at any rate during the first phase of the Master Plan period.

- Domestic bank loans can finance investments with a relatively short economic life cycle (5-7 years), the cost of which can be fully recovered from user charges. In the short and medium term, only vacuum trucks meet these two conditions. Low-income households may have difficulties in financing sewer connections or septic tanks from their own (often very limited) savings, and the city government may wish to encourage the use of micro-credit to enable users pay for such services in instalments.
  - Municipal Bonds. MOF regulations (PP 54/2005 - and its successor currently in draft - and PMK 147/2006) allow regional governments to issue bonds for financing revenue-generating public infrastructure delivery services. PMK 147/2006 does not require full cost recovery from the services, with payment of interest and repayment of bond principal being supported by the issuer's general cash flows. No such bonds have yet been issued in Indonesia, but DKI plans to do in 2011 or 2012. The DKI administration will shortly request the DPRD to give the required approval to proceed to asking for the required approval from MOF and thereafter to the domestic capital

markets via BAPEPAM. One of the 4 projects planned to be funded from the bond proceeds is an expansion of the sewered system in the Central Business District of Jakarta at an estimated cost of Rp 253 billion (USD 28.4 million equivalent).

- Private Sector Participation. A visit was made to the Kota Makassar office of GAPENSI (the Indonesia Constructors Association) to elicit interest in BOT activities such as wastewater treatment facilities. The discussion was not productive in terms of realistic responses. It therefore seems that no large-scale investment by the private sector can be anticipated for the time being.

- The desludging activity currently operated by DKP uses trucks which have reached or are approaching the end of their economic lives. It is recommended that the private sector, which appears to operate already on an unlicensed basis, be invited to participate on a formal basis. This means that that the city government would license and centrally manage the activity through a case-by-case standard domestic and non-domestic services contract against published tariffs, with fees to be paid by the city government against proof that the sludge has been disposed of in an environmentally appropriate manner. Paragraph 8.5 and Section 7 deal with this issue in more detail.

9.1.4 Evaluation of existing resources (Phase I)

Total required investments in wastewater services during Phase I (2011-2015) are estimated at Rp 1,073 billion in 2011 constant prices. It seems likely that sufficient ADB loan funds will be available to finance investments in off-site wastewater for households and businesses (which, in the case of Kota Makassar would absorb about US$ 60 million of US$ 400 million at current exchange rates). Similarly, it is assumed that foreign grants would be available to assist in the financing of capacity building programs, whilst commercial facilities would finance investments in on-site wastewater from their own resources. There may be constraints on the Kota Makassar APBD depending on the amount of OBA funding available for intermediate wastewater services.

Table 9.4: Investment Cost for Wastewater Services in Kota Makassar during Phase I (Rp Billion, Indicative, 2011 Constant Prices, PPN tax Included)

Wastewater Service	Cost Estimate	Potential Funding Sources	Evaluation
Off-site wastewater	440 bn	ADB loan passed on as grant (except for land acquisition)	No obvious constraint
Intermediate wastewater	61 bn	DGHS (about Rp 10 billion)*, OBA (?), APBD-Kota (?)	Potential shortage of APBD funds; depends on amount of OBA
On-site wastewater	404 bn	Private sector	No obvious constraint
Commercial facilities	123 bn	ADB Loan for off-site connections (US$ 15 million) passed on as grant, remainder by private sector	No obvious constraint
Capacity building	45 bn	Foreign grants (about US$ 1.5 million), balance between APBD-Kota, community organizations, commercial sponsors	Potential shortage of APBD funds
TOTAL	**Rp 1,073 bn**		

Source: Mott MacDonald

Assumptions: DGHS allocates 10% of its APBN for SANIMAS to Kota Makassar (Rp 10 billion, to be financed from the proceeds of an ADB loan).

9.2 Potential constraints to efficient allocation of resources

9.2.1 Assets transfer

Assuming that the MHMSP financing principles continue to be followed, DJCK will pass on the ADB loan proceeds as deconcentrated funds (*"dana dekonsentrasi"*) to South Sulawesi where the provincial Dinas Cipta Karya will tender and manage the sewered system civil works and wastewater treatment plant equipment supply and civil works contracts.

There have been problems in the past regarding transfer of assets between levels of government, a good example being the value of water supply assets having remained on provincial government books for many years due to "administrative" difficulties in transferring them to PDAM. PP 06/2006 and its legal successor PP 38/2008 appear to provide a mechanism by stipulating that assets valued at more than Rp 5 billion can be transferred from a provincial to a *kota* government subject to the approval of the provincial legislature (DPRD) and the issue by the provincial government of a letter of transfer of assets. This issue was raised by the South Sulawesi Province Public Works Department at a presentation of the draft Master Plan, and needs to be investigated to avoid delay in transferring the ADB-funded assets to Kota Makassar. Alternatively, the Government could decide to transfer the assets directly to the city government, using PMK 168/2008 as the channelling mechanism.

9.2.2 Installing household sewer connections

Table 9.3 above shows that the *kota* government is responsible for financing tertiary sewer pipes and connections. DGHS considers that current regulations prohibit installation of primary and secondary pipes together with tertiary pipes and connections at the same time and by the same contractor. The consequences of this are unnecessary expenditures because: (i) the work of two contractors needs to be carefully coordinated (which rarely happens), (ii) it is more expensive to hire two contractors than one, and (iii) roads and drains have to be dug up and repaired twice.

DGHS recognizes the problem. The Consultant has suggested that a single contractor installs all the works, and that city government reimburses central government for the value of the works by investing an equivalent amount through the APBD on SANIMAS facilities. DGHS does not accept this as being feasible under current regulations.

An opinion has been requested from the Government Institution on Procurement Policy (*Lembaga Kebijakan Pengadaan Pemerintah* – LKPP) for an interpretation of joint procurement in accordance with the latest Presidential Decree (Perpres 54/2010) on Procurement. It is likely that LKPP would be prepared to issue a written opinion to INDII.

Even if this opinion is negative, it will still be highly desirable that a solution to this issue is found before project preparation is complete, either through an amendment to existing regulations or the issue of a new decree by MOF to establish an appropriate funding mechanism. External donors are likely to query this unnecessary expenditure of funds.

9.3 Sewered system tariffs

9.3.1 MSMHP Covenants

The MSMHP project documents recommend that participating *kota* governments set tariff levels for customers connected to the sewered system at levels which will recover all recurrent O&M costs within 3 years of loan agreement signing. Financial analyses are based on connection charges being recovered within 12 months. Similar undertakings are likely to be required for any new external donor loans for investment in sewered systems.

9.3.2 Tariff-setting principles

Commercial and industrial customers should be required to pay full O&M cost recovery tariffs. However, it is not possible to apply the same principles of wastewater tariff system administered by the DKI Jakarta-owned PD-PAL to households in view of the DGHS policy that monthly household wastewater charges may not exceed 2% of monthly household income. This limitation may result in total revenues being insufficient to fully cover O&M expenditures; in which case, a subsidy in the form of a public service obligation (PSO) on the APBD would be needed to cover the shortfall.

9.3.3 Capital levy

Kota Makassar may also wish to consider the introduction of a capital levy on all households and other establishments with premises which have access to the sewered pipeline alignment. The first-phase sewered main and, probably, most subsequent sewered installations during the master plan period, will be along city protocol streets, which are usually lined with commercial establishments and high-income households with strong ability-to-pay. Payment of the levy should be obligatory, irrespective of whether or not the owner of the premises connects to the system. The levy should comprise a connection charge, plus a monthly retribution based on a fixed wastewater discharge volume (say, $10m^3$) and service charges.

9.4 Other revenue sources to fund wastewater sector services

A sustainable wastewater sector is going to require significant financial inputs from PemKot Makassar, in addition to the PSO for the sewered system, in order to provide for other essential wastewater services, especially to low-income communities. The following suggestions for sources of funding are made below.

9.4.1 Wastewater retribution

The rationale for introducing a universal wastewater retribution (except for those already paying the sewered system tariff or capital levy) is known as the “polluter pay” principle, i.e. that all households and establishments discharge wastewaters which, to varying degrees, contribute to environmental degradation, and therefore they should make a financial contribution towards the proper disposal of such wastes. The fee could be graduated, depending on the typology and area of the building, or calculated as a factor against its property tax assessment.

The introduction of such a retribution would require the consent of the DPRD. A key factor to the successful outcome of such a fee would be the method of billing and collection. Separate collections of universal regional government retributions have rarely, if ever, been successful in Indonesia. A suitable mechanism would be a surcharge on the electricity bill, as is already in place for the street lighting tax. This would have

to be acceptable to the provincial PLN office which, on past experience, may not be amenable to such an arrangement. Alternatively, the city government could mandate PDAM to surcharge the water supply bill, although piped water supply has a lower service coverage (about 80%) than that for electricity (almost 100%). Both have sanctions which can be applied if the consumer fails to pay. Kota Makassar has indicated its intention of surcharging the water bill.

9.4.2 Property taxes.

These consist of the land and buildings annual property tax (PBB) and the land and buildings property transfer tax (BPHTB). Until recently, both were administered by the Directorate General of Taxation (DGT) at the Ministry of Finance (MOF), with receipts allocated to the various levels of government as follows:

Tax	% MOF (for admin)	% Province	% Kab/Kot (specific)	% Kab/Kot (general)	Incentives
PBB	9.0%	16.2%	64.8%	6.5%	3.5%
BPHTB	-	16.0%	64.0%	20.0%	-

In the latest revision to the law on regional government taxes (Law 28/2009), both taxes were devolved in their entirety to *kota/kabupaten* governments. All regional governments are required to start administering these taxes by January 2014 at the latest. Kota Makassar has begun administering the BPHTB as of this budget year, and it is understood that the city government will have completed the necessary readiness criteria for the PBB to begin administering this tax in 2012.

Although the PBB revenue yield and its contribution to GDP are low when compared internationally, it is highly efficient in terms of tax object identification and revenue collection. Kota Makassar's income from this source will rise by more than 40%, assuming the 9% allocation for administration, considered by most to have been excessive, is unchanged. The increase from the BPHTB is 56%. Availability from the city government of FY 2010 and 2011 ADB actual and budget data would enable the Consultant to make an estimate of the value of the incremental revenues involved, but it is probably in the region of Rp 80-100 billion per annum in 2011 prices..

Both taxes have considerable scope for growth in the urban context, especially the PBB whose revenues are skewed towards assessments and future growth in the mining sector. Furthermore, as the urban property market develops and matures, truer property values and transactions will be registered to increase the BPHTB yields significantly. Furthermore, these property-related taxes are efficient and almost universally levied and would therefore be more equitable than a retribution surcharged on the water bill.

The practice in Indonesia for funding specific activities is to nominate a generic source, e.g. APBD and APBN revenues. However, in many countries, property tax legislation contains provisions for allocating stipulated percentages of annual property tax receipts for investments in and O&M of specific urban service deliveries such as street lighting and wastewater and solid waste collection and disposal. It appears that putting such allocations into the annual APBD would need only the overall budgetary approval of the DPRD.

In addition, incremental services in the wastewater sector could be funded by absorption into the next round of property valuations (*nilai jual obyek pajak – NJOP*). For example, in the case of desludging services being paid for by the city government, the extra cost to be added to the PBB, assuming an all-in

fee of Rp 100,000 and provision of the service once every four years, the average annual increase on the PBB per household would be only Rp 25,000.

9.5 Proposed applications of funds in the wastewater sector

Revenues from the above sources could be utilized towards funding the following wastewater services:

- provision of a regular service to households equipped with on-site septic tanks. All septic tanks (at least those which can be located and accessed) would be registered with the *kota* government. Desludging would be privatized and vacuum truck operators would licensed and contracted by the *kota* government to empty tanks at specific periods and paid against proof that the sludge has been delivered for treatment at the IPLT;
- setting of standards and periodic inspections of intermediate communal septic tanks and MCKs, as well as small bore sewer systems and disposal facilities on private residential estates:
- provision of family toilets (*jamban*) and septic tanks for poor households;
- a PSO for any shortfall in the ability of tariffs to cover recurrent O&M of the sewered system due to ability-to-pay issues;
- a subsidy for low-income households connecting to the sewered system;
- coordination with the city's health department in terms of providing public health education the revenue department in respect of vetting technical standards of wastewater disposal for the issue of building permits.

9.6 Proposed phasing of wastewater sector financial reforms

Target dates for reforms assume the sewered system and associated facilities will be come operational in early 2015.

Proposed Reform	Target Date	Regulatory Action
Using single contractor to install sewered systems and connections	December 2013	Perpres 54/2010 is being investigated. Reform could require amendment to PP 38/2007 and/or KepMen PU 16/2008, and may require MOF PMK.
Transfer of assets from provincial to kota government in a timely manner	December 2012	Assess adequacy of current PP 06/2006 and 38/2008
Introduction of capital levy on all premises with access to sewered systems	December 2014	New perda required
Tariff for sewered system, with full O&M cost recovery for commercial /industrial premises	December 2014	New perda required
Provide PSO for shortfall in full O&M recovery due to household ability-to-pay issues	December 2014	APBD perda
Introduce new wastewater retribution OR Support wastewater services by specific allocation from PBB or general revenues	December 2013	New perda required
Provide PSO for shortfall in full O&M recovery from off-site systems due to household ability-to-pay issues	December 2014	APBD perda

10. Capacity building plan

The capacity building support for the selected operator of the wastewater systems to be provided in Makassar will be given by the ADB MSMH project Capacity Building consultants, Royal Haskoning Indonesia, appointed in March 2011. The MSMH capacity building consultants team for Makassar have been present during meetings between the project Institutional experts and the City Government regarding the support that has been provided by this project during City Governments selection of the operator.

11. Conclusion

11.1 Identification of the 20 year investment requirements for wastewater infrastructure

The following table includes the investment requirements, at current prices, for wastewater infrastructure. Those projects identified in previous wastewater studies are referred to as **"current planned"** while new projects identified in this Master Plan are referred to as **"new additional"**.

Table 11.1: Investment program Makassar 2010-2030

COST ESTIMATE (m)	Unit Rate	2010-2015	2015-2020	2020-2030	Total
- current planned off-site house connections: hc+lateral sewers	Rp10	Rp54 000	Rp21 000	Rp45 000	Rp120 000
- current planned off-site house connections for trunk sewers	Rp5	Rp60 000	Rp-	Rp-	Rp60 000
- current planned off-site house connections for STP	Rp10	Rp120 000	Rp-	Rp-	Rp120 000
- new additional off-site house connections: hc+lateral sewers	Rp10	Rp43 000	Rp169 000	Rp268 000	Rp480 000
- new additional off-site house connections for trunk sewers	Rp5	Rp21 000	Rp84 000	Rp134 000	Rp239 000
- new additional off-site house connections for STP	Rp10	Rp-	Rp480 000	Rp-	Rp480 000
- current planned off-site comm/inst connections: hc+lateral sewers	Rp10	Rp36 000	Rp14 000	Rp30 000	Rp80 000
- current planned off-site comm/inst connections for trunk sewers	Rp5	Rp40 000	Rp-	Rp-	Rp40 000
- current planned off-site inst/comm connections STP	Rp5	Rp40 000	Rp-	Rp-	Rp40 000
- new additional off-site comm/inst connections: hc+lateral sewers	Rp10	Rp17 000	Rp46 000	Rp57 000	Rp120 000
- new additional off-site comm/inst connections for trunk sewers	Rp5	Rp9 000	Rp23 000	Rp28 000	Rp60 000
- new additional off-site inst/comm. connections for STP	Rp10	Rp-	Rp120 000	Rp-	Rp120 000
- current planned intermediate facilities	Rp6	Rp23 000	Rp20 000	Rp16 000	Rp59 000
- new additional intermediate facilities	Rp6	Rp21 000	Rp4 000	Rp64 000	Rp89 000
- rehabilitation intermediate facilities	Rp2.5	Rp6 000	Rp-	Rp-	Rp6 000
- new on-site facilities	Rp3	Rp134 000	Rp39 000	Rp81 000	Rp254 000
- rehabilitation on-site facilities	Rp2	Rp65 000	Rp188 000	Rp-	Rp253 000
- vacuum truck	Rp500	Rp7 000	Rp3 000	Rp500	Rp10 500
- septage treatment facility	Rp1000	Rp120 000	Rp-	Rp-	Rp120 000
- new treatment facilities commercial and institutional enterprises	Rp20	Rp52 000	Rp42 000	Rp88 000	Rp182 000
- rehabilitation treatment facilities commercial enterprises	Rp10	Rp71 000	Rp-	Rp-	Rp71 000
Total investment cost Rp (m)		**939 000**	**1 253 000**	**811 500**	**3 003 500**
Cumulative investment cost Rp (m)		**939 000**	**2 192 000**	**3 003 500**	
Cumulative investment cost US$ (m)		**$104**	**$244**	**$334**	
Total investment cost per kg BOD removed (m)	**Rp/kg BOD**	**31**	**44**	**45**	

Table 11.1 above includes the following major interventions over the 20 year Master Plan period

11.1.1 The "current planned" interventions

- Construction of a 7,000m^3/day STP (for 12,500 connections) near the Jl. Metro Jangung Bunga Bridge over the Jangaya Canal, covering 6ha
- Construction of the Losari wastewater collection area covering 1,357ha with a wastewater collection area for 20,000 connections
- Construction of intermediate systems for 9,740 households
- Renovation of Nipa Nipa IPLT.

11.1.2 The "new additional" interventions

The new additional interventions for off-site systems will include:

- Extension of the Losari wastewater collection area to 1,700 ha
- Connection of the GMTDC area into the Losari wastewater collection area with 24,000 connections by 2030
- Inclusion of an additional 36,000 connections in the original planned Losari wastewater collection area and additional sewerage areas to give an overall total wastewater collection area with 80,000 connections
- STP capacity expansion for the planned STP to a 18ha, 86,000m^3/day capacity STP, which can also treat 50% of the planned increase in septage collection (three-in-one scenario) or alternatively:
- **Option1** an STP for 25,000-40,000 sewerage connections at the planned 6ha site and an STP for 55,000-40,000 sewerage connections at a new STP site in the east (switch point scenario);
- **Option 2** an STP for 25,000-40,000 sewerage connections at the planned 6ha site and two STPs for 55,000-40,000 sewerage connections at a new STP site in the east and a new STP in the north-east (three-legs scenario);

11.1.3 Improvements to private on-site domestic systems

Even by 2030, planned and additional off-site systems will only serve 17% of the population of Makassar. On-site sanitation will remain the prime wastewater management system, covering 76% of the population. However, more than 60% of present septic tanks are not watertight and leach their hazardous contents straight into surface and groundwater. 'Normal' septic tanks are very expensive and beyond the reach of most of the urban poor. This Master Plan introduces the concept of a Low Cost Septic Tank with a soakaway. The black water settles and digests anaerobically in this tank. For good performance it is very important that bathing water (mandi) is led straight into the soakaway and not into the watertight receptacle.

11.1.4 Improvements to septage removal

Septage collection is a big challenge in Makassar. At present only 13% of the septage produced by the community is collected officially and very little is actually received for treatment at the septage treatment plant. Unfortunately the 'official' septage facility at Nipa Nipa is not operating properly, septage taken there immediately overflows to the adjacent watercourses and so has the same negative environmental impact as the 'unofficial' dumping to drains and watercourses.

As stated above, very little septage is collected across Makassar. To make it easier for the vacuum trucks to discharge their contents, septage discharge points can be installed on the Losari sewerage system when it is built. This type of septage emptying facility can be introduced to other parts of Makassar, as the sewerage system is extended. To make septage removal easier in high-density areas, with narrow gangways between the properties, vacuum motorcycles could be introduced. They can enter the gangways and remove the septage in an environmentally sound way.

The existing relatively low demand for septage services illustrates that there is little knowledge of the need for good operation and maintenance of on-site facilities. For good performance of on-site wastewater systems, regular septage removal is crucial and this message has to be conveyed to the population through intensive marketing efforts.

11.1.5 Development of intermediate systems

In high-density areas “on-site” solutions are not possible, due to lack of space. Plus off-site solutions may not always be technically or financially feasible. For these areas this Master Plan plans to add more ‘intermediate systems’ to those communal systems already planned by Pemkot for completion over the next few years. By 2030, 8% of the population of Makassar is planned to be served by intermediate wastewater systems. All intermediate systems will have a communal wastewater treatment plant, probably the Upflow Anaerobic Sludge Blanket (UASB) reactor type. The UASB system is already being used in Makassar. There are three types of intermediate systems proposed for Makassar. They are:

- MCK
- Shallow Sewerage (SS)
- Small Bore Sewerage (SBS).

For high density areas where “off-site” solutions are practical, but their location is too far from trunk sewers to be connected, then SS or SBS systems are planned.

11.2 Identification of the operator for the improved wastewater systems

"Public Works Decree 16/2008” recommends the choice of a semi-independent Operator and a separate Regulator. Given the current unsatisfactory operating condition of the PDAM, the Consultant has recommended the appointment of a BLU-D as the eventual Operator of the off-site wastewater systems and as the manager of the entire wastewater sector. The City Government [Environment Department] would operate as the nominated Regulator. These proposals were presented at a meeting held on the 13th April 2011. The City Government departments currently most involved with the wastewater sector, i.e. the Parks and Cleansing Department, the Public Works Department and the Environment Department, supported this recommendation. However, representatives from South Sulawesi Provincial Government [Public Works Department], which will supervise the tendering, contract award and construction of the projects for the off-site systems, queried whether their responsibilities, which would also vest ownership of the assets in the Provincial Government and the subsequent operation by the City Government, were compatible with each other. This issue of assets transfer is discussed in Chapter 8, Section 8.2.

11.3 Identification of proposals for financing the improved wastewater systems

It is recommended that financial support, in the form of a public service obligation, be made available by the City for domestic wastewater services. Proposals are made that the funding source could be from the property taxes that the city now manages in its own right, or from targeted retribution, or from both sources.

11.4 Recommended alternative STP technology for Losari STP

Given that there are limited operation and maintenance skills available in the region, the Facultative Anaerobic Pond (FAP) system has been recommended as an alternative technology for the planned STP at Losari. The application of the FAP system has the best track record in Indonesia (see Comparative Study on Centralized Wastewater Treatment Plants in Indonesia). The FAP is a waste stabilization pond, using mechanical aerators to get higher oxygen transfer into the wastewater. With higher oxygen transfer the ponds can be designed with smaller hydraulic retention time and therefore have smaller volumes and so need smaller areas of land for the STP. Thus the 6 ha land that is currently being purchased by the City Government can accommodate a higher level of property connections with FAP treatment than the treatment process that is currently being planned by the Pemkot.

12. Priority projects and follow-up actions

12.1 Priority projects

Wastewater projects which have been identified for inclusion during the first five years (period 1) of the Master Plan are shown below in Table 12.1.

Table 12.1: Program 2010-2015 (Rp million)

Program for 2010-1015	Volume	Unit price	unit	Costs Rp M	%
- current planned off-site house connections: hc+lateral sewers	5 400	Rp10	m/hh	Rp54 000	6%
- current planned off-site house connections costs for trunk sewers	12 000	Rp5	m/hh	Rp60 000	6%
- current planned off-site house connections costs for STP	12 000	Rp10	m/hh	Rp120 000	13%
- new additional off-site house connections: hc+lateral sewers	4 286	Rp10	m/hh	Rp43 000	5%
- new additional off-site house connections costs for trunk sewers	4 286	Rp5	m/hh	Rp21 000	2%
- new additional off-site house connections costs for STP	nil	Rp10	m/hh	nil	0%
- current planned off-site comm/inst connections: hc+lateral sewers	3 600	Rp10	m/e	Rp36 000	4%
- current planned off-site comm/inst connections costs for trunk sewers	8 000	Rp5	m/e	Rp40 000	4%
- current planned off-site inst/comm connections costs for STP	8 000	Rp5	m/e	Rp40 000	4%
- new additional off-site comm/inst connections: hc+lateral sewers	1 714	Rp10	m/e	Rp17 000	2%
- new additional off-site comm/inst connections costs for trunk sewers	1 714	Rp5	m/e	Rp9 000	1%
- new additional off-site inst/comm connections costs for STP	nil	Rp10	m/e	nil	0%
- current planned intermediate facilities	3 820	Rp6	m/hh	Rp23 000	2%
- new additional intermediate facilities	3 580	Rp6	m/hh	Rp21 000	2%
- rehabilitation intermediate facilities	2 400	Rp2.5	m/hh	Rp6 000	1%
- new on-site facilities	44 800	Rp3	m/hh	Rp134 000	14%
- rehabilitation on-site facilities	32 500	Rp2	m/hh	Rp65 000	7%
- new septage collection trucks (or equivalent cycles)	14	Rp500	m/truck	Rp7 000	1%
- new septage treatment facility	120	Rp1 000	m/100 m3/d	Rp120 000	13%
- new treatment facilities commercial and institutional enterprises	2 600	Rp20	m/unit	Rp52 000	6%
- rehabilitation treatment facilities commercial enterprises	7 100	Rp10	m/unit	Rp71 000	8%
Total Rp M	-	-	-	**Rp939 000**	**100%**
Total (US $ m.)	-	-	-	**$104 m**	-

The following individual projects are included in Table 12.1 for implementation by 2015:

12.1.1 The "current planned" Losari interventions

The following interventions were included in the recommendations of the August 2008 MSMHP report and the subsequent DEDs for the Losari project by Sehati (Losari 1) and Dana Consult (Losari 2 extended):

- Construction of the planned 7,000m^3/day Losari STP, covering 6ha
- Construction of the Losari wastewater collection system, covering 1,357ha, with 9,000 connections
- Construction of intermediate systems for 3,820 households
- DED for the renovation of Nipa Nipa IPLT.

12.1.2 The "new additional" Losari interventions

Additional interventions for off-site systems will include:

- Connection of the GMTDC area into the Losari STP wastewater collection area, with 3,000 connections by 2015
- Extension of the planned Losari STP to provide additional treatment capacity for 8,000 connections
- Inclusion of an additional 3,000 connections to the Losari wastewater collection system

12.1.3 Other additional interventions will include.

- Construction of intermediate systems for 3,580 households
- Rehabilitation of existing intermediate facilities for 2,400 households
- Onsite domestic systems, rehabilitation and new for 89,600 households
- Non-domestic systems, rehabilitation and new for 9,690 properties
- 14 septage emptying vehicles
- New Nipa Nipa IPLT capable of treating 130M3 septage per day

12.2 Follow up actions

To overcome the present shortcomings of the wastewater systems in Makassar, to sustain the interventions and to arrive at healthy living conditions in Makassar, we recommend that the following actions are needed:

- Seek management support for the operation of the planned Losari STP and the renovated IPLT Nipa Nipa
- Motivate and capacitate the population in areas with poor sanitation to improve their wastewater facilities and hygiene behaviour
- Motivate and capacitate the population, commercial enterprises, institutes and government to implement, operate and maintain adequate wastewater facilities
- Develop simultaneously: physical, financial, institutional and technical capabilities regarding wastewater improvements
- Work at all levels simultaneously: government, institutes, commercial enterprises, neighbourhood and community to promote all wastewater initiatives

- Implement motivational and capacitating activities identified in Chapter 6 and focus on:
- The education of responsible government staff
- The implementation of a Wastewater Improvement Kantor Informasi [WIKI] or Wastewater Resource Centre [WRC] where contractors and the general public can obtain information on appropriate technologies (models, construction drawings, etc.) especially information on the Low Cost Septic Tank
- Elaborate the concept of the Low Cost Septic Tank and production of models of other on-site and intermediate systems suited to Makassar conditions, with displays at government offices, hospitals, schools, Puskesmas
- Execute a number of studies to back-up and refine planned interventions by:
    - Monitoring and evaluating the performance of communal treatment systems, such as the UASB
    - Looking into the reasons and causes of the present extremely low coverage of formal septage collection services. Is there really no demand for services, or is present demand served by illegal/informal practices?
- Developing a good marketing strategy to persuade the owners of on-site systems to have septage removed at regular intervals
- Publish the effluent quality statistics of all licensed wastewater treatment facilities in Makassar on the internet (Wiki-leaks Makassar)
- Develop proposals for “Award and Reward” for the best working wastewater treatment facility. Visit by the mayor and generate publicity
- Subsidize the purchase of on-site systems for the urban poor
- Develop micro-credit schemes to assist in the purchase of on-site systems for the medium-level income groups and/or develop “Arisan” schemes to purchase on-site systems
- Consider and implement legislation to ensure that 100% of the community connects to off-site systems, or neighbourhood intermediate systems where they are available for connection
- Consider and implement legislation to ensure that all properties pay a wastewater fee, whether they are connected to off-site and intermediate systems or they are not connected.
- The estimated cost of these initiatives is in the region of Rp 45 Bn which would be funded by DGHS and the City. Grants are likely to be available from foreign grants. World Bank have already indicated their interest in supporting this type of initiative in other Cities.