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PATHWAYS TO INTEGRATED URBAN WATER MANAGEMENT FOR GREATER JAKARTA

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RIGHTS AND PERMISSIONS

All photos by Irma Setiono

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ABBREVIATIONS

APEKSI	*Asosiasi Pemerintah Kota Seluruh Indonesia* (Association of Indonesian Municipalities)
Bappenas	*Badan Perencanaan Pembangunan Nasional* (Ministry of National Development Planning)
Bappeda	*Badan Perencanaan Pembangunan Daerah* (Regional Planning Agency)
BKAT	*Balai Konservasi Air Tanah* (Groundwater Conservation Agency)
BKSP	*Badan Kerja Sama Pembangunan* (Local Government Development Cooperation Agency)
BNPB	*Badan Nasional Penanggulangan Bencana* (National Disaster Management Agency)
BOD	Biological oxygen demand
BOT	Build-Operate-Transfer
BPBD	*Badan Penanggulangan Bencana Daerah* (Regional disaster management authority)
BPS	*Badan Pusat Statistik* (Central Bureau of Statistics)
CFR	Case fatality rate
CGE	Computational General Equilibrium
CMMI	Coordinating Ministry for Maritime Affairs and Investment
COVID-19	Coronavirus disease
CWIS	Citywide Inclusive Sanitation
DAS	*Daerah Aliran Sungai* (Unit of Watershed)
DKI Jakarta	*Daerah Khusus Ibukota* Jakarta (Jakarta Special Capital Region)
DLHD	*Dinas Lingkungan Hidup Daerah* (Regional Environment Agency)
ENSO	El Niño / La Niña Southern Oscillation
EWS	Early warning system
FFD	Fecal flow diagram
FSM	Fecal sludge management
GCB	*Gerakan Ciliwung Bersih* (Clean Ciliwung Initiative)
GDP	Gross domestic product
GPS	Global positioning system
IPAL	*Instalasi Pengolahan Air Limbah* (Wastewater treatment plant)
IPLT	*Instalasi Pengolahan Lumpur Tinja* (Sludge treatment plant)
IUWASH PLUS	Indonesia Urban Water Sanitation and Hygiene *Penyehatan Lingkungan Untuk Semua* (a USAID project)
IUWM	Integrated Urban Water Management
JICA	Japan International Cooperation Agency

KLHK	*Kementerian Lingkungan Hidup dan Kehutanan* (Ministry of Environment and Forestry)
KOTAKU	*Kota Tanpa Kumuh* (National Slum Upgrading Program)
KPPIP	*Komite Percepatan Penyediaan Infrastruktur Prioritas* (The Committee for Acceleration of Priority Infrastructure Delivery)
KSN	*Kawasan Strategis Nasional* (National Strategic Region)
MAASP	Ministry of Agrarian Affairs and Spatial Planning
MOEF	Ministry of Environment and Forestry
MOEM	Ministry of Energy and Mining Resources
MOF	Ministry of Finance
MOH	Ministry of Health
MOHA	Ministry of Home Affairs
MPWH	Ministry of Public Works and Housing
MSS	Minimum service standard
NCICD	National Capital Integrated Coastal Development
NRW	Non-revenue water
NUWAS	National Urban Water Supply Framework
PDAM	*Perusahaan Daerah Air Minum* (Local government–owned water utility)
PD PAL	*Perusahaan Daerah Pengelola Air Limbah* (Local government–owned wastewater management utility)
RBO	River Basin Organization
RISPAM	*Rencana Induk Sistem Penyediaan Air Minum* (Drinking Water Supply Master Plan)
RPJMD	*Rencana Pembangunan Jangka Menengah Daerah* (Regional Medium-Term Development Plan)
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional* (National Medium-Term Development Plan)
RTRW	*Rencana Tata Ruang Wilayah* (Regional Spatial Plan)
SANIMAS	*Sanitasi Berbasis Masyarakat* (Community-based sanitation system)
TPA	*Tempat Pembuangan Akhir* (Final disposal site / landfill)
UNFPA	United Nations Population Fund
USAID	United States Agency for International Development
WICER	Water in Circular Economy and Resilience
WTP	Water treatment plant

EXECUTIVE SUMMARY

Water insecurity challenges in Indonesia are of significant concern, particularly in regions that are critical for economic growth. A third of Indonesia's river basins (36 percent) are under stress year round, and almost half (46 percent) are under stress during the dry season. Water stress is particularly worrisome in regions driving development on the island of Java, where, if left unaddressed, it is projected to undermine Indonesia's development success. On the other hand, projections show that addressing water insecurity in a concerted and integrated manner could help to drive economic growth and result in positive development outcomes.

Nowhere is addressing water insecurity more critical than in the Greater Jakarta region, which produces 22 percent of Indonesian total GDP output and is home to 12 percent of the country's total population. Greater Jakarta, comprising 14 district and municipal governments under three provincial jurisdictions, is already experiencing extreme deficits in water balance, which are compounded by regular and widespread flood events and deteriorated water quality from poor sanitation. Climate projections also point to heightened vulnerability from increasing hydrometeorological anomalies and coastal processes, which are expected to cause more drought and increased rainfall, as well as greater exposure to sea level rise phenomena that result in damaging storm surge and could render high-density areas unlivable.

With one of the fastest-growing populations of metropolitan urban regions in East Asia, Greater Jakarta has increased in population density, with development encroaching further into the critical regions of the watershed. Greater Jakarta's population grew by 7 million people between 2000 and 2010 and doubled in absolute numbers between 2000 and 2020, reaching 33.5 million people in 2018. Throughout that time, the metropolitan region also increased in density and population distribution. Between 1992 and 2018, built-up areas grew by over 28 percent, with noticeable land conversion in upstream areas, posing significant new challenges to water supply, flood management, and environmental quality. Considering the scale of growth of the metropolitan region, the governance structures in place have been inadequate to provide citizens with acceptable public water services and environmental quality, and insufficient to protect an increasing population at risk from flooding.

Flooding is frequent and severe in Greater Jakarta, and flood data monitoring is inadequate for tracking the scale of the problem, identifying solutions, and showcasing the success of existing initiatives. Data collected by BPBD (the regional disaster management authority) on the number of flood events and affected residents are drawn from existing government databases and media reports that have many shortcomings. As a result, BPBD figures likely far underestimate existing flood conditions. In part, this is due to mainstreaming issues across newly established agencies

and the lack of data reporting and recording mechanisms, particularly across jurisdictions. This report helped to identify the spatial dynamics and widespread extent of flooding in ways that can help government agencies make better sense of the problem and more effectively target solutions. This will be crucial, as even the current data indicates the severity of flooding in Greater Jakarta. BPBD figures for the period 2013–2020 included 1,741 flood events affecting anywhere from 28,000 to 377,000 people each year. Furthermore, flood data collected for the year 2020, which only covered January and February, already shows a significant increase in flood events and impacts over previous years. This could reflect an unusually high year of rainfall in the region, but more likely represents the heightened risks from widespread urbanization and exposure to climate effects. In the future, Greater Jakarta is likely to experience increased flood magnitude and intensity from more severe local and upstream rainfall conditions, accompanied by a higher likelihood of coastal storm surges. For context, the 2007 flood event in DKI Jakarta alone was estimated to have incurred US$900 million in financial losses, and with an estimated return period of two years, serves to highlight the chronic and compounding impacts of flooding. As the incidence of flooding across Greater Jakarta rises, expanded exposure and more damaging inundations will exact a substantial economic toll on the region.

Additionally, Greater Jakarta faces severe constraints on water resources, and during stakeholder discussions for this study, local governments expressed concern over meeting targets listed in development plans, particularly in light of likely future growth projections. This study noted the technical and administrative service rates for the water utilities of Greater Jakarta, and spatially overlaid water distribution networks to highlight the potential for improved coordination. Findings suggest inefficient investment practices relative to population densities and distribution. Some water treatment infrastructure is underutilized, and while piped supplies are available only to a limited proportion of Greater Jakarta, there are also locations that overlap in water utilities' service areas. Utilities have initiated plans to increase surface water allocations and treatment capacity, but leakage and non-revenue water continue to hamper operations. In addition, incentives and other water demand management measures are not in place, nor are there ongoing efforts to promote water conservation. Unfortunately, data on water abstraction points and volumes for private property developments and commercial and industrial sites remain unavailable. While some spatial data on deep groundwater wells were obtained (for Kota Tangerang Selatan), concerns remain over regulations for and enforcement of abstraction licenses in vulnerable groundwater zones, both in terms of the oversight of permits as well as the volumes abstracted.

Sanitation coverage throughout Greater Jakarta remains extremely low, implying significant contamination and deterioration of ground- and surface water quality. While sanitation access remains low throughout Greater Jakarta, encouraging signs of a growing commitment to delivering services provide a template for replication and scaling up of successful initiatives. However, off-site sanitation infrastructure services are minimal, and the existing conditions of on-site management systems also point to a sector mostly overlooked and inadequately maintained, regulated, and

coordinated. Responsibility for sanitation provision is decentralized and spatially fragmented; each local government manages its own sanitation services, with minimal coordination. This general disregard for sanitation has resulted in degraded ecosystems, public health crises, and overall decreased livability, especially in dense urban areas.

In combination with existing governance challenges, Greater Jakarta's growth trends, recurrent flooding, and water constraints further strain institutional capacity to provide adequate water supply and sanitation services. Agencies are most visibly overwhelmed during the perennial and widespread flooding events that regularly bring the region to a standstill. In 2020, the rapid and continuing growth of Greater Jakarta ushered in a landmark decision to relocate Indonesia's capital to East Kalimantan. Regardless, water insecurity will still present a major challenge for the Greater Jakarta region, which will continue to serve as Indonesia's prime economic center. Without the ability to provide consistent water supply, businesses large and small and communities rich and poor throughout the region are forced to seek out their own water sources. In some cases, this places extreme pressure on groundwater, which has led to irreversible land subsidence, and places particular burdens on the region's most vulnerable residents. Land subsidence also undermines the overall functionality of the flood management system, leading to more widespread and longer lasting flood events. To address these complex and interlinked water concerns, Greater Jakarta will need to build upon existing initiatives to coordinate across aspects of the water cycle, an approach that can be maximized and scaled up through an Integrated Urban Water Management (IUWM) framework.

As an overarching framework, IUWM combines a cohesive set of principles with urban spatial plans and river basin management, and has strategic potential for application in Greater Jakarta. The framework's key principles encompass the various elements of the urban water cycle – water supply, sanitation, stormwater, and wastewater – to create a coordinated approach to water issues. Initiatives in both Latin America and East Asia, which have long been supported by the World Bank, illustrate the distinct benefits of the IUWM approach. For example, IUWM can help identify added value for water efficiency, complement large infrastructure projects, integrate flood risk with various urban design considerations, and innovate for water quality improvements at different scales. Case studies drawing from cities around the world also highlight how solutions implemented to address a pressing water issue can be scaled up to catalyze IUWM, positioning institutions to better integrate development plans throughout the water cycle rather than responding reactively at moments of crisis. In Greater Jakarta, IUWM also provides a strategic opportunity to model these principles for other regions in Indonesia facing water insecurity.

To examine Greater Jakarta's water challenges and the opportunities for IUWM, this study combined data analysis with stakeholder discussions. Using government data, the report team established a set of key indicators to visualize three water sectors – flood management, water supply, and sanitation – and convened key institutions from central and local government agencies, establishing a process that iteratively raised a set of prompts for catalyzing IUWM. Official data

across the three water sectors were visualized in a series of maps to facilitate discussions around common concerns, bridging national priorities with regional jurisdictional interests articulated in development plans. Central government partners at the National Development Planning Agency (Bappenas), the Ministry of Home Affairs (MOHA), and the Ministry of Public Works and Housing (MOPWH), among others, participated in a series of workshops with each of the districts and municipalities from the Greater Jakarta region, involving their planning departments, line agencies, utilities, and other stakeholders. Initial workshops discussed broad conceptual barriers and opportunities for IUWM, while smaller regional cluster workshops used data visualizations to prompt participants to discuss existing coordination challenges and propose solutions.

The findings of this report are based on a collaborative research process involving local stakeholders in the collection, analysis, and interpretation of data, and in the identification of actions. Inputs from stakeholders were gathered in a series of physical and online workshops, cluster-based consultations, and in-depth interviews with 71 government officials, utility managers, and private sector and development partners conducted in 2019–2021. This report is accompanied by the National IUWM Framework Report, which presents findings and recommendations for IUWM implementation at the national level. Such efforts require a supportive enabling environment for inter- and intra-jurisdictional collaboration, improved data and information management, and a paradigm shift towards nature-based solutions and ecosystem services, buttressed by adequate financing and authority. Recommendations point to a pathway toward engaging national ministries and local governments from across Greater Jakarta to begin implementing immediate interventions that will help transition the knowledge base and capabilities for longer-term planning around IUWM.

The report offers a list of recommendations to support the adoption of IUWM in Greater Jakarta. The recommendations acknowledge the need for coordination at three governing scales: i) interjurisdictional cooperation; ii) vertical coordination between local governments, regional authorities, and the central government; and iii) horizontal coordination across sectors and agencies within local governments and bridging with other stakeholder groups. The study reveals gaps and opportunities that require action in the immediate, short, and medium terms. These should be addressed through an implementing framework and through direct IUWM interventions, both of which work toward establishing longer-term institutional reforms. The roadmap recommendations pertain to water threats facing Greater Jakarta across five IUWM framework categories (law and regulation, governance, planning and implementation, information management, and financing). Recommended actions focus on measures for immediate implementation by local governments through independent resource allocations that do not require large investments. The roadmap of recommendations also tracks actions that will require larger investments, such as situating ongoing large-scale infrastructure development programs. These include the Jatiluhur and Karian Dam for water supply, the various Jakarta Sewerage initiatives to scale up and improve sanitation service coverage, the National Capital Integrated Coastal Development (NCICD) plans, and upstream dams under preparation for flood control and protection.

The report concludes with immediate priority actions for IUWM to address water insecurity in Greater Jakarta. These include interventions to accelerate expanding access to sanitation and water supply – key to halting or reducing groundwater over-abstraction – and recommendations regarding the implementing framework to improve water management and planning. The specific implementing framework priority actions include both ongoing activities and key initiatives, such as improving interjurisdictional coordination, developing guidelines and protocols for planning and data sharing across sectors, enforcing existing regulations on discharge permits and water supply and sanitation standards, and addressing groundwater management. Priority interventions include accelerating water resource initiatives at scale, improving the efficiency of water supply systems, implementing demand management and water reuse, and improving drainage, as well as expanding water supply and sanitation services through blended sources of financing and tariff regulations.

1. Introduction

1 INTRODUCTION

1.1. Water and development in Greater Jakarta

1. **Water risks in Indonesia are acute, particularly in the Greater Jakarta region, which constitutes the economic and political center of Indonesia.** Failing to address threats to water security in this region will significantly undermine progress towards national development targets in the medium and long term. The Indonesia Water Security Diagnostic (World Bank, "Indonesia Vision," forthcoming) projects that water insecurity in Indonesia is increasing due to rising water demand, inadequate planning and management, and climate variability. Employing a Computational General Equilibrium (CGE) model, the Diagnostic projected losses of up to 4.9 percent of GDP by 2030 and up to 7.3 percent by 2045 if water security is not addressed.[1] Conversely, the study found that taking action to address water security could significantly accelerate GDP growth. The social and economic impacts of water insecurity will be felt strongly in Greater Jakarta,[2] which continues to experience rapid population growth and is home to 33.5 million people, or about 12 percent of Indonesia's total population. As this study will show, Greater Jakarta's water insecurity is most prominently expressed in the form of severe and recurring flooding, heightened scarcity of clean water, and dangerously deteriorated surface and groundwater quality.

2. **Figure 1 highlights the two adjacent river basins that traverse and are connected to Greater Jakarta, and which are experiencing some of the most acute water stress in Indonesia.** Greater Jakarta is largely dependent on water supply from the Citarum basin, which was declared the most polluted river basin in Indonesia, prompting a presidential decree in 2018 to establish an emergency clean up taskforce under the *Citarum Harum* program.[3] The neighboring Ciliwung-Cisadane basin, which experiences severe water stress, also spatially overlaps with Greater Jakarta, and accounts for an area that generates 22 percent of national GDP. The economic development risks of inaction on water issues could therefore undermine significant areas of potential growth, both for the region and nationally.

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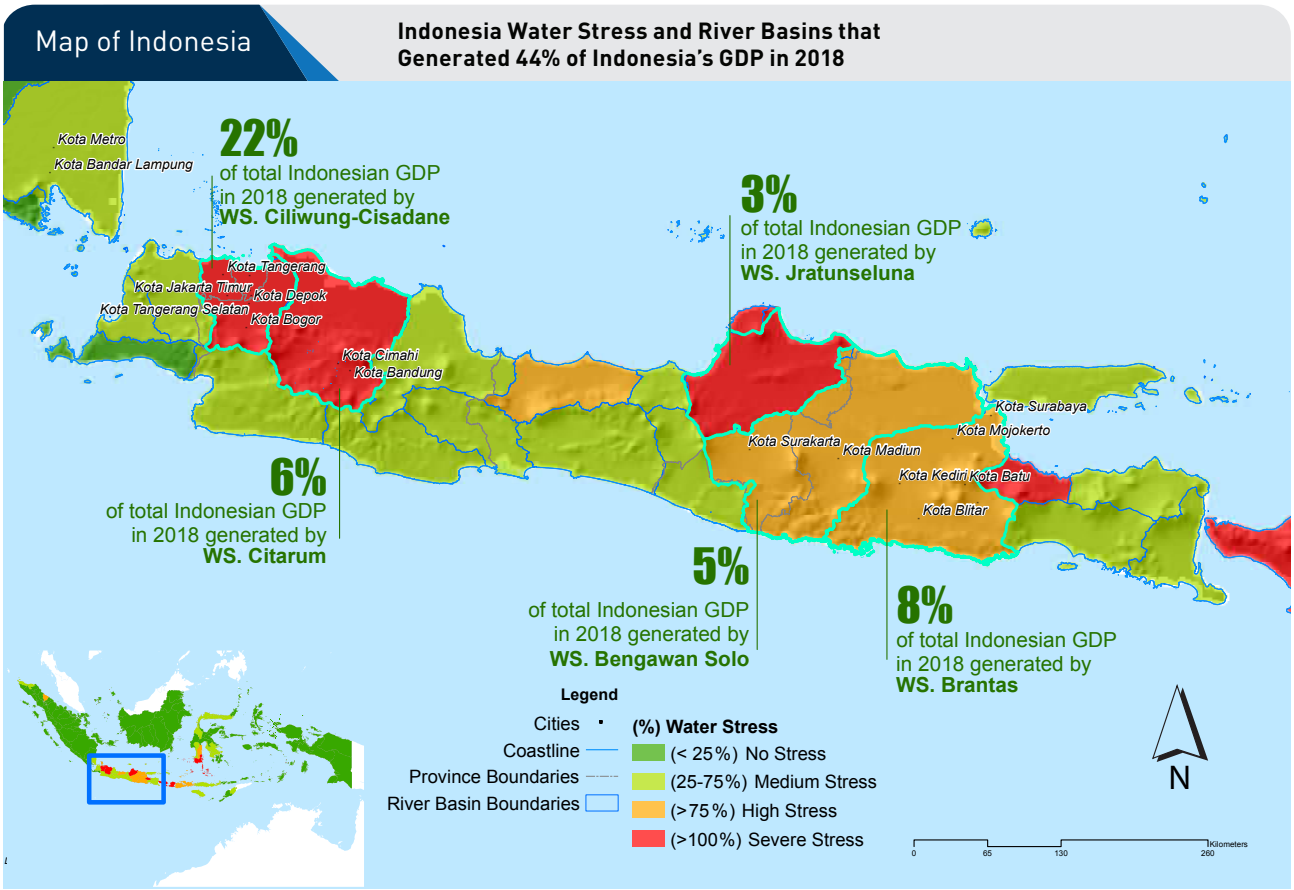
[1] Figures generated using pre-COVID-19 estimates.

[2] The Greater Jakarta region covers 14 local (kota and kabupaten) governments (see figure 2), which are spread across three provinces: Banten, West Java, and the Special Capital Region of Jakarta (Daerah Khusus Istimewa, DKI Jakarta).

[3] The *Citarum Harum* program is overseen by Presidential Decree Number 15 of 2018 on the Acceleration of Pollution Management and Deterioration of the Citarum River Basin.

Figure 1: GDP Relative to Water Stress of River Basins in Java



3. **Greater Jakarta is one of the fastest-growing metro regions in East Asia.** The East Asia Changing Urban Landscape Study found that, between 2000 and 2010, Greater Jakarta's population grew at an annual rate of 3.7 percent, adding a total of 7 million people during that period (World Bank 2015; World Bank 2016a). DKI Jakarta's population density also continues to rise, reaching 16,260 persons per square kilometer in 2018 (up from 12,200 persons per square kilometer in 2000, and second in East Asia only to Hong Kong), and rapid growth is taking place in the neighboring jurisdictions of Bekasi and Tangerang (see table 1). Greater Jakarta's primacy in Indonesia is evident from its size and scale compared to other metro areas. Greater Jakarta covers almost 6,500 square kilometers, which is more than twice the land area of the second largest conurbation in Indonesia (Surabaya). Greater Jakarta is also growing faster uniformly across the landscape, at a rate of 1.8 percent per year, compared to 1.5 percent in other Indonesian cities.

Table 1: Urban Growth in East Asia

CITY	COUNTRY	POPULATION 2020 (THOUSANDS)	RATE OF CHANGE, 2015 - 2020 (%)
Jakarta (DKI)	Indonesia	10,770	1.14
Bekasi	Indonesia	3,394	3.66
Tangerang	Indonesia	2,339	2.58
Surabaya	Indonesia	2,944	0.64
Bandung	Indonesia	2,580	2.10
Hong Kong	PRC	7,548	0.82
Manila	Philippines	13,923	1.59
Bangkok	Thailand	10,539	2.28
Kuala Lumpur	Malaysia	7,997	3.09
HCMC	Vietnam	8,602	3.15

Source: UN-Habitat 2020.

4. **Urban growth has been especially prominent in the upper part of the watershed, transforming catchment and agricultural regions into built-up areas.** Figure 2 shows this dramatic change, highlighting how built-up areas increased more than 28 percent between 1992 and 2018. Table 2 indicates the corresponding changes in land use, which have led to an expansion of impermeable surfaces and a decline in the number and size of water bodies. While the loss of agricultural areas is correlated to the expansion of settlements, the area of rivers, lakes, and ponds also decreased, from 180 square kilometers in 1992 to 150 square kilometers in 2018.

Figure 2: Land Cover Change in Greater Jakarta, 1992–2018

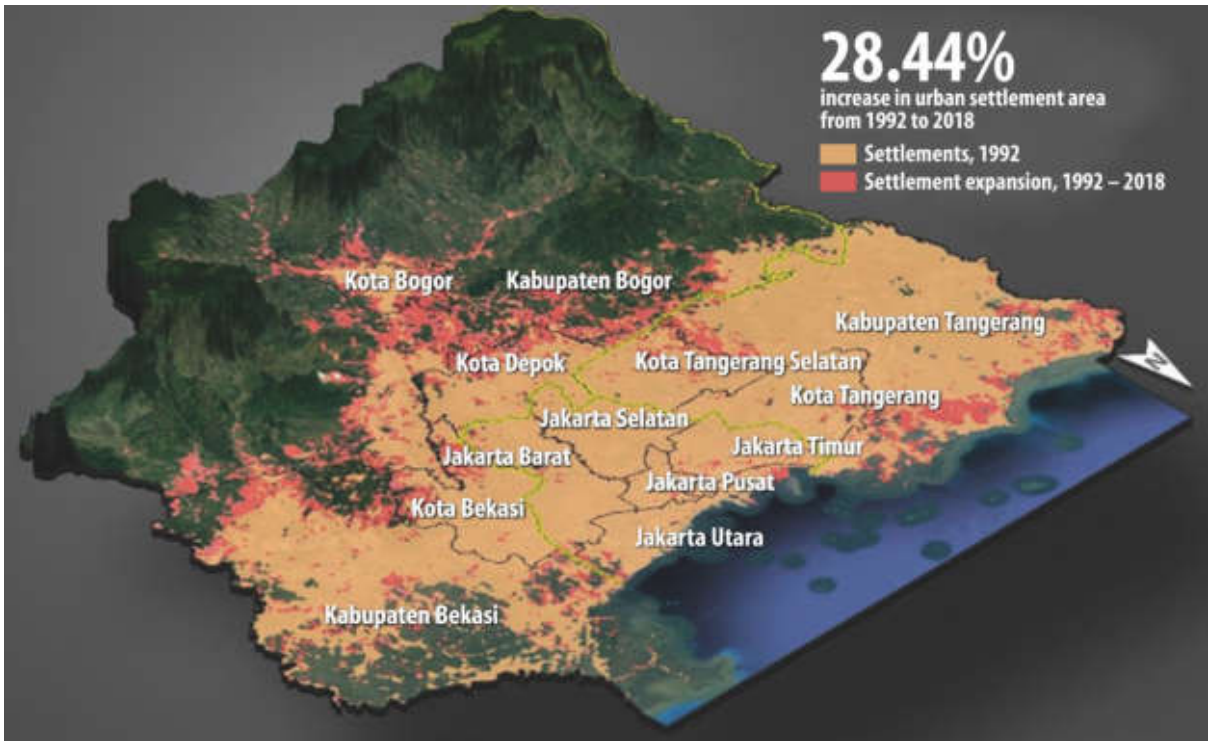


Table 2: Nominal Land Cover Values in Greater Jakarta, 1992–2018

LAND COVER	1992 (KM^2)	2000 (KM^2)	2010 (KM^2)	2018 (KM^2)
Settlement	2,739.96	2,906.10	3,383.19	3,519.18
Agriculture	2,824.47	2,612.70	2,196.63	2,056.59
Forest	730.89	782.55	757.98	764.82
Other	22.77	18.90	7.11	6.75
Water	179.91	177.75	153.09	150.66
Total area: 6,498 km^2				

5. **As the increase in built-up areas in Greater Jakarta has transformed the region, the corresponding demand for resources and basic services has created immense development challenges, and solutions are poorly coordinated between jurisdictions.** Water security and development planning are closely interlinked across many sectors. For example, chronic, interrelated issues include poor spatial planning and uncontrolled development without the corresponding planning, regulation, and delivery of basic services that support livability and growth. With respect to water, policy approaches remain inherently sectoral and siloed within the confines of local government development efforts, and most initiatives tend to overwhelmingly focus attention within the borders of DKI Jakarta. This habit persists even though policymakers and planners have long promoted the establishment of a broader metropolitan region under a coordinated authority (Firman 2004; Silver 2008).[4] Given the scale of densification and urban expansion, solutions to complex development challenges will require greater synergies between different levels of governments.

6. **One major recent decision is expected to change the character of Jakarta.** In 2020, the Indonesian government announced plans to move the political and administrative capital to East Kalimantan due to compounding risks and resource constraints in and around Greater Jakarta. This shift will require long-term planning, and even with the national capital relocated, Jakarta will remain the country's major population center and serve as its commercial and financial hub. The capacity to manage water risks in Greater Jakarta will thus be critical to the Indonesian economy for a long time to come.

7. **The impact of water risk is felt disproportionately by the most vulnerable communities in Greater Jakarta.** Low-income communities have more limited access to piped water supply systems and are more likely to rely on poor quality groundwater for drinking and household use. They also face higher health risks due to extremely low rates of safe sanitation, wastewater collection, and wastewater treatment, and the high contamination levels of urban rivers, Jakarta Bay, and other water bodies. They are also at greater risk from flooding. Impacts on vulnerable communities are discussed in more detail throughout the design, analysis, and recommendations sections.

[4] See section 4 for more details about institutional context.

8. **An Integrated Urban Water Management (IUWM) approach can be employed to address interrelated water risks in Greater Jakarta while overcoming barriers to adoption and encouraging cooperation between government actors and other stakeholders.** Box 1 provides a brief introduction to IUWM. To address water risks in Greater Jakarta, large-scale investments in water resource development, storage, treatment, and flood protection infrastructure are likely to be necessary. IUWM provides a bridging set of actions that complement the development of large infrastructure projects, emphasizing integrated planning, efficient design and utilization, demand management, and conservation.

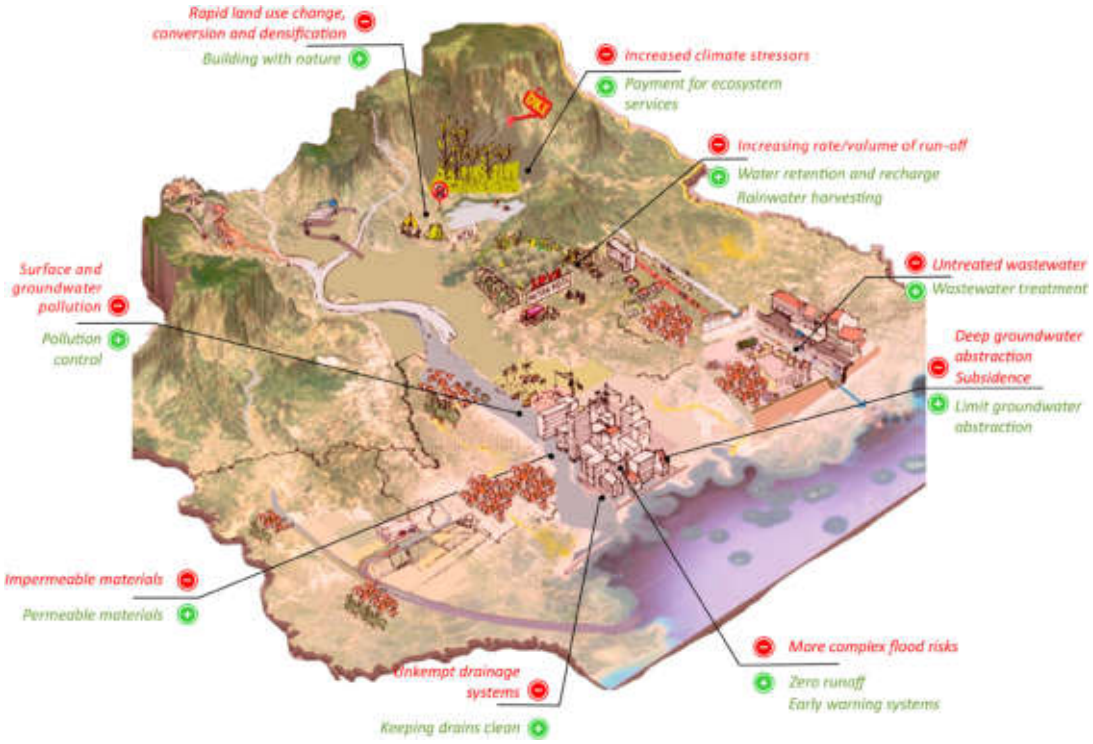
Box 1: Integrated Urban Water Management

IUWM is an approach in which the development and management of all water sources (ground, surface, storm water, recycled water, desalination, etc.), all stages of the water cycle (resource management, treatment, and distribution, and wastewater collection, treatment, and disposal), all uses of water and sources of demand, and the protection of the urban water environment and ecology are coordinated, taking into account specific local characteristics. It implies horizontal coordination with other urban infrastructure sectors and policy areas – including spatial development, solid waste management, and disaster management, among others – to ensure that policies and plans in these areas take full account of their impacts on urban water. Figure 3 illustrates the interlocking elements of the urban water system and the problem-solution context for Greater Jakarta that IUWM seeks to address.

Over the past two decades, IUWM has evolved to incorporate contemporary urban challenges and concepts. These include climate change adaptation and mitigation, resource and energy efficiency, circular economy and closed loop systems for water, and building resilience for current and future risks. These concepts are embedded in conceptualizing IUWM for Greater Jakarta.

> *“ IUWM implies horizontal coordination with other urban infrastructure sectors and policy areas to ensure that policies and plans in these areas take full account of their impacts on urban water. ”*

Figure 3: Problem-Solution Elements of the Greater Jakarta Urban Water System



Source: Adapted from the Water Partnership Program 2016.

9. **The objective of this report is to build on existing initiatives in the water sector, identifying policies, planning, and practices that can lead to more integrated approaches, complementary actions, and long-lasting institutional frameworks.** The study is not designed to comprehensively cover each of the water-related sectors, as studies at the regional and municipal levels across Greater Jakarta are numerous and detailed in their engagement. Rather, this study makes use of the IUWM framework to utilize on-going sectoral engagement as a catalyzing point. From this perspective, this study links water risks to overall planning and development initiatives across the metropolitan region, identifying areas for integration to achieve optimal results.

10. **This study thus focuses on the institutional context, examining complementarity, contingencies, and synergies towards IUWM.** The report bridges national- and subnational-level perspectives on the complexities of IUWM by applying a framework (see IUWM National Framework report), and positions the roles of key national ministries – such as the Ministry for National Development Planning (Bappenas), the Ministry of Public Works and Housing (MOPWH), and the Ministry of Home Affairs (MOHA) – alongside the planning and development processes and perspectives of district and municipal governments across Greater Jakarta. The report's recommendations are intended to provide immediate actionable interventions in the short term while building up the knowledge base and expertise for more strategic institutional planning and development approaches in the longer term. This will require sustained and iterative engagement.

11. **This report is structured as follows.** Section 1.2 sketches out the major water risks in Greater Jakarta. Section 1.3 describes the complex governance structure that shapes the urban water system in the region. Section 2 explains the collaborative methodology used for this study. Section 3 presents analysis and visualizations of the quantitative data, while section 4 presents findings on current IUWM efforts under implementation in Greater Jakarta, as garnered from the iterative collection of complementary qualitative data. Finally, section 5 presents recommendations. The report should be used as an entry point for understanding the most pressing water risks in Greater Jakarta relative to broader development planning approaches. The study also functions as a foundation for a set of initial guidelines to establish institutional reforms and actionable steps for addressing cross-sectoral issues related to water security.

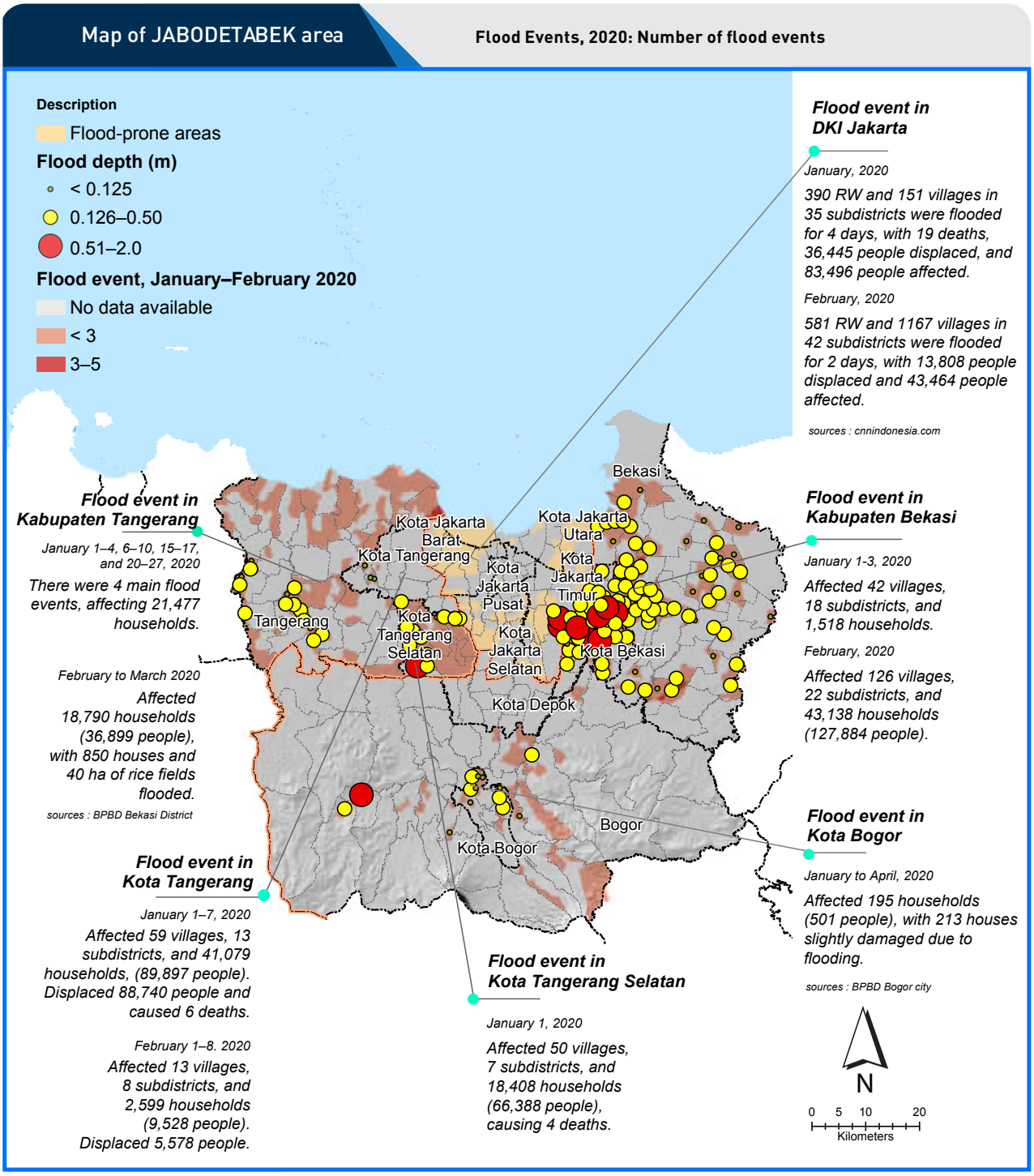
1.2. Overview of water risks and urban development in Greater Jakarta

12. **Greater Jakarta faces severe challenges across the elements of the urban water system.** Throughout the region, access to water is low and water demand is growing, which forces people to seek out alternative water sources, resulting in over-abstraction of groundwater and in severe, irreversible land subsidence. Subsidence undermines the flood management system, which is already unable to cope with perennial damaging floods. Meanwhile, low levels of safe wastewater treatment and waste management deteriorates water quality, affecting public and environmental health. This section provides an overview of each of these interrelated water subsectors and the issues they face.

1.2.1. Flooding and stormwater management

13. **Greater Jakarta contends with recurring inundations due to three types of flood hazards – upstream rainfall, localized rainfall events, and tidal fluctuations – which have major impacts on lives and property.** The most severe event in the last two decades occurred in February 2007, when floods resulted in 57 deaths, affected over 400,000 people, and caused approximately US$900 million in financial losses (World Bank 2019b). In early 2020, floods in Greater Jakarta caused 66 fatalities and cost an estimated Rp 5.2 trillion, or US$370 million (Bappenas 2020). Figure 4 shows the extent of flooding, which the National Disaster Management Agency (BNPB) described as the worst flooding since the 2007 disaster. Although the data in figure 4 are incomplete for all of Greater Jakarta, the breadth of the effects is clear. The red shading in the figure represents areas where villages (*kelurahans*) were repeatedly inundated, and the dots measure the depth of flooding, giving a picture of the magnitude and extent of the floods. Peak flood conditions tend to occur at the beginning of each year, but are not uncommon throughout seasonal monsoonal changes. Early 2021 has been similarly devastating.

Figure 4: Flood Inundations in Early 2020



14. **Greater Jakarta is prone to floods from localized rainfall events due to poor drainage systems and management, and downstream areas are also exposed to floods from high rainfall events in which large volumes of water are conveyed from the upper watershed.** The most densely populated part of the metropolitan area is located on a flat alluvial plain bordered to the south by hills. Orographic rainfall conditions – the increasing amount of rainfall induced with elevation – result in significant flood risk. High-intensity rainfall

events in upstream areas, particularly at the peak of the rainy season, transfer large volumes of water toward densely populated downstream plains. Over the past three decades, seasonal flood risk has been exacerbated by upstream development and land-use changes, which have reduced the retention capacity of the upper watershed and accelerated the rate and volume of delivery downstream. Flood risk management in Greater Jakarta is inadequate and largely uncoordinated across jurisdictions, and rainfall events throughout the system can trigger flooding (Hahm and Fisher 2011; World Bank 2019b). Inadequate and ineffective solid waste management and sedimentation control and maintenance also create additional blockages in drainage systems.

15. **Floods are expected to become more frequent and severe due to land subsidence, land-use change, urban growth, densification, and climate change.** Several studies have modelled future flood inundations for Jakarta through 2050. Takagi et al. 2016 projects a rise of 86 percent in the extent of the flood risk zone, mostly attributable to land subsidence factors, which are expected to intensify markedly after 2025. Coastal and riverine flood risks are also increasing due to land subsidence. Subsidence compromises the fundamental hydrogeologic structure of Greater Jakarta along its northern coastline, undermining existing flood management strategies, which aim to release floodwaters to the sea (Budiyono et al. 2015). Observed land subsidence is associated with groundwater over-abstraction, natural settling processes, and loading factors that, when combined with tidal fluctuations and rising sea levels, pose significant threats to the flood management system that were unanticipated at its creation (Abidin et al. 2011).

16. **Flood management plans in Greater Jakarta have historically been spearheaded and implemented by MOPWH.** The rivers, canals, drains, and waterways are controlled and maintained under complex coordination relationships between the MOPWH's River Basin Organizations (RBOs) and the local governments (World Bank 2011). In many instances, budgets to maintain canals cannot be disbursed because corresponding preparation responsibilities have not been carried out by other government agencies.

17. **The flood master plan for Greater Jakarta relies on a polder system introduced in the seventeenth century and last updated in 1975, which remains inadequate to the scale of the region's growth.** The city's spatial orientation and public service development are very much linked to its colonial past: the flood system is based on Dutch principles, redirecting water to the region's lowest point and pumping it into a system of canals that drains to the sea (Silver 2008; Kooy and Bakker 2008). A large-scale ring drainage system promoted in the 1975 master plan finally connected the East and West Flood Canals to protect low-lying areas. However, the unanticipated scale of development in Greater Jakarta is not yet reflected in an updated flood master plan. Furthermore, extreme land subsidence along coastal areas undermines the fundamentals of the polder network, slowing delivery and producing

path dependencies that require increased pumping capacity. The World Bank–supported Jakarta Urgent Flood Management Project assisted in an effort to rehabilitate the existing flood management system of DKI Jakarta and restore it to its original design capacity through dredging and embankment repairs, while also supporting the establishment of a maintenance program to keep the system working at intended capacity. Meanwhile, larger-scale master planning has been underway to address unanticipated urbanization and re-evaluate conditions emerging from the destabilization of flood management fundamentals due to land subsidence. The result is a national commission, formalized as the National Capital Integrated Coastal Development (NCICD) program, which, given its cross-sectoral dimensions, is overseen by a coordinating ministry (Bappenas 2016). The NCICD aims to construct a 33-kilometer dike enclosing Jakarta Bay in 12 distinct locations, adding seven new pump stations and upgrading four existing pumping stations (see KPPIP, n.d.).

18. **Many low-income settlements are located in high-flood-risk areas.** MOPWH estimates that 71,000 low-income households (figures cited in Rukmana and Indraprahasta 2020) live in informal settlements along DKI Jakarta's rivers and embankments and are consequently exposed to the most severe flooding. This study will also show the widespread geographic impacts of flooding throughout Greater Jakarta, highlighting how lower-income communities face additional adaptation barriers to coping with floods across the region. These conditions pose risks to lives and property, and exacerbate water-borne diseases linked to the degraded condition of the water environment. For DKI Jakarta, a Governor's Regulation (No.90/2018) mandates the improvement of settlement quality, focusing on improving drainage and expanding wastewater services. The MOPWH-implemented KOTAKU program works to address water-sensitive elements in its slum upgrading and housing program (see KOTAKU 2017). Nevertheless, site-specific and regional initiatives such as these need to be more closely integrated into planning and development initiatives at scale to address broader risks around flooding, drainage, and water quality.

1.2.2. Water resources

19. **Greater Jakarta relies on water sources located outside of the metropolitan region, and some areas already face resource constraints.** Key water infrastructure for supplying Greater Jakarta includes the Jatiluhur Dam, which supplies 345,600 cubic meters per day, divided between DKI Jakarta, Kabupaten and Kota Bekasi, and Karawang. The Karian Dam currently under construction (with a capacity of 315 million cubic meters and expected supply of 276,500 cubic meters per day) is expected to be completed in 2021. Additional water supply from the dam will be distributed to Kabupaten Lebak, Kabupaten and Kota Tangerang, Tangerang Selatan, and DKI Jakarta through the Karian-Serpong SPAM (water supply system), which is expected to be completed by 2023. Resource constraints are already experienced in some locations in the region. This is most apparent in DKI Jakarta,

which relies on sources outside its jurisdiction for 94 percent of its bulk water supply. Other districts and municipal water utilities across Greater Jakarta rely on surface water and water treatment plants through publicly run utilities that are sometimes supported by private operators, complemented by smaller water supply support projects to rural communities, and through other community-based initiatives.

20. **Bulk water supply is insufficient to reach 100 percent piped water coverage in Greater Jakarta by 52 cubic meters per second (or 51,940 liters per second),** based on 2019 water supply and demand data estimates. For piped water among populations within the service area of water utilities (*Perusahaan Daerah Air Minum* or PDAMs), current infrastructure operates at an estimated deficit of 18.5 cubic meters per second in Greater Jakarta. In 2020, Bappenas estimated a deficit of 22 cubic meters per second in bulk water supply in Greater Jakarta due to institutional capacity constraints. The estimates differ due to variations in assumptions and projections, but it is evident that bulk water supply is unable to meet even the current demand for piped water in Greater Jakarta. As demand continues to grow, estimates show that even additional supply from the Karian Dam would be insufficient to meet future piped water demand in a business-as-usual scenario. Plans for improved service provision and getting customers online will invariably result in an increase in bulk water demand. Transitioning away from over-reliance on groundwater is critical, but doing so will require investments in piped water infrastructure, demand management, and systems for alternative water sources to meet the piped water supply deficit.

21. **There is a pressing need to increase available water resources through efficiency improvements, demand management, and the promotion of water reuse and recycling, particularly for non-potable uses.** Current water losses in water transfer and distribution systems are high (see section 3.2). However, until now, local governments have prioritized new water resource infrastructure over efficiency measures. On average, household water consumption in Greater Jakarta is at around 150 liters per capita per day (lpcd), while the minimum service standards are 100 lpcd. Although some commercial buildings and private developers implement water reuse or recycling within their properties, overall incentives and other measures to support water conservation are still limited. Meanwhile, the number of people served by water infrastructure in Greater Jakarta as of 2019 was 12.1 million, and projections point to an anticipated 22.5 million served by 2025. With such ambitious expansion plans, efforts to improve efficiency, demand management, and water reuse and recycling must play a critical role in future water resources management planning.

1.2.3. Water supply

22. **Piped water supply in Greater Jakarta suffers from low coverage and uneven reliability, leading many consumers to rely on alternative access modes that exacerbate land subsidence.** Middle- and high-income areas and commercial and industrial users often rely on groundwater abstraction using deep wells, and low-income areas on shallow wells. The widespread over-abstraction of deep aquifers is a particular cause for concern because it intensifies land subsidence. Combined geodetic- and GPS-based studies indicated subsidence of 15 to 25 centimeters per year along the northern coast of Greater Jakarta, and remote sensing analysis shows subsidence levels between 9.5 and 21.5 centimeters per year, confirming that the rapid rates of land subsidence are attributable to groundwater abstraction in both industrial and mixed-use areas (Chaussard et al. 2013). There is therefore an urgent need to provide adequate water supply through piped water services to stop groundwater use. Given the existing extent of groundwater use, expanding piped water supply sufficiently may imply the need to secure additional water resources. Doing so must be complemented by increasing efficiency through demand management and introducing alternative sources for non-potable water.

23. **Most piped water supply connections in Greater Jakarta are served by public water utilities owned by the municipality or districts (PDAMs), except in DKI Jakarta.** There, the water utility is owned by the provincial government and services are provided by two private concession companies. The private sector is also involved in building and operating water treatment plants in Tangerang and Bekasi. Because responsibility for water supply is allocated to local governments under Indonesia's decentralized governance system, coordination of and collaboration in service provision across the metropolitan area is a challenge, especially for communities located along the boundaries. These coordination challenges and the overall hesitancy of local governments to collaborate has resulted in large tranches of underserved households, or in some cases, neighborhoods served by multiple providers (e.g., Kota and Kabupaten Tangerang, Kota and Kabupaten Bekasi).

24. **All PDAMs in Greater Jakarta are classified as "healthy" according to standards set by MPWH, but these utilities still sustain service inadequacies.** PDAM performance is evaluated based on a range of indicators for financial performance, service delivery, operational performance, and human resources (see IUWM National Framework report). Generally, PDAMs in Greater Jakarta achieve poor profitability, have low overall network coverage, provide intermittent, non-potable supply at low pressure, and exhibit high levels of non-revenue water and other operational inefficiencies.

25. **Bottled drinking water is ubiquitous across all households.** As of 2010, when the last census was taken, of all the jurisdictions across Greater Jakarta, only 12 percent of the population used piped water as their primary drinking water source. In 2020, this same level of access would imply that more than 29 million people rely on non-piped water sources. Households at all income levels almost exclusively purchase drinking water from water bottling companies or water refill stations, a phenomenon that has growing implications across Indonesia (World Bank 2020). Lack of access to clean and affordable water disproportionately heightens vulnerability among the poorest. This is discussed further in section 3 of the report.

26. **In addition to PDAMs, private property developers also construct and operate water distribution networks in their larger developments.** These developers include Pantai Indah Kapuk, Lippo Karawaci, Summarecon (in Bekasi and Serpong), BSD City, Bintaro Jaya, and Alam Sutera, among others. Industrial zones also seek out their own water access. Some of these private sector operations obtain resources directly from surface water and/or groundwater, and others purchase bulk water supply from the local PDAM.

1.2.4. Sanitation and wastewater management

27. **The Greater Jakarta region suffers from some of the lowest levels of sewerage coverage in the world.** Approximately 90 percent of DKI Jakarta uses onsite wastewater treatment systems (pit latrines or septic tanks). Some private developers operate small-scale collection and treatment facilities in high-end real estate developments, but all other wastewater in Greater Jakarta is managed at the household level through such on-site systems. These systems vary in quality and maintenance; they are often substandard and not regularly serviced, resulting in high levels of groundwater pollution in their immediate surroundings (DLH DKI Jakarta 2020).

28. **Septage management is under-regulated and some septage is dumped illegally in water bodies rather than delivered to the treatment plant.** Private and public truck operators collect septage on demand, although scheduled desludging approaches are being developed in several cities. Septage treatment plants, which are managed by the local governments, are usually constructed at the outskirts of their jurisdictions. Access is difficult and cost-prohibitive, and the facilities suffer from a lack of capacity, untrained personnel, and irregular maintenance.

29. **Plans to expand sanitation coverage in DKI Jakarta are underway.** Fifteen service zones have been designated, one of which is currently served by the Setiabudi wastewater treatment plant (WWTP). In four additional zones, construction of sewerage networks and improvement of on-site services is ongoing; by 2022, 26 percent coverage is expected

for both on-site and off-site services in DKI Jakarta. Kota Bogor, Kota Tangerang, and Tangerang Selatan have already introduced small-scale sewerage networks with off-site treatment systems, although these systems operate at a very limited scale relative to the total population.

1.2.5. Water environmental quality

30. **The environmental quality of raw water resources is poor in Greater Jakarta.** In 2016, all the major rivers in Greater Jakarta (Cidurian, Cisadane, Ciliwung, Citarum, and Bekasi Rivers) were moderately to heavily polluted according to the Indonesian pollution index, which considers physical, chemical, and biological indicators (MOEF 2016). Nitrate, phosphate, and ammonia levels all exceed thresholds, pointing to the high levels of organic, agricultural, and domestic effluent and waste that flow untreated into Greater Jakarta's waters. Heavy metals (lead, mercury, and others) that originate from industrial and urban waste also exceeded standard thresholds, mirroring the accumulated levels observed in the green mussels and fish of Jakarta Bay (Riani et al. 2018). Studies on water quality repeatedly show the poor quality of water emptying into Jakarta Bay, with municipal sewage making up 70–80 percent of pollutants (Dsikowitsky et al. 2018). Poor raw water quality has negative implications for the environment, health, and drinking water supply.

31. **In the Medium-Term National Development Plan (RPJMN 2015–2019), the national government identified 15 priority watersheds (*Daerah Aliran Sungai*) for rehabilitation, three of which are located in Greater Jakarta:** the Cisadane, Ciliwung, and Citarum watersheds. However, initiatives to act on this priority are limited. Aside from the *Citarum Harum* program noted earlier, there is also the *Gerakan Ciliwung Bersih* (GCB) initiative. GCB was formed in 1989 by the Ministry of Environment and Forestry (MOEF), together with MOPWH and local government agencies of DKI Jakarta – the Governor of DKI, the environment agency (DLHD), Bappeda, and PAM Jaya. A multi-stakeholder framework was convened that included Universitas Indonesia, local community groups, and private stakeholders. The GCB organizes events, seminars, capacity-building, and community outreach activities, aiming to establish unity and facilitate coordination among stakeholders for the protection and conservation of the Ciliwung watershed, especially along the riparian zones of the Ciliwung River. Nevertheless, across the watershed and river basins, local governments have not sufficiently dedicated plans to improve raw water quality.

32. **In 2019, 50 percent of groundwater aquifers within DKI Jakarta were found to be slightly polluted and 20 percent moderately to highly polluted.** Significant amounts of fecal coliform and total coliform were found in heavily polluted aquifers, a result of poor maintenance of sanitation facilities and septic tanks (DLH DKI Jakarta 2020). In addition, aquifers in North, West, and East Jakarta were found to contain particularly high

concentrations of salt (sodium chloride), which has been attributed to saltwater intrusion (BKAT 2016).

1.2.6. Climate change and resilience

33. **Climate change exacerbates flood risks in Greater Jakarta by generating higher-intensity rainfall regimes in upstream areas and causing sea level rise.** Although the effects of land subsidence pose more immediate and faster-accelerating threats to Greater Jakarta's coastlines and flood management system, increased flood exposure due to climate change suggests intensifying flood risks (Fuchs 2010; Firman et al. 2011). Pacific equatorial regions are expected to experience sea levels 30 percent higher than the global average, representing an increase in average sea level rise (SLR) of up to 1 meter by 2100 under an intermediate emissions scenario, and potentially of several meters under a business-as-usual emissions scenario. Meanwhile, greater-intensity rainfall in upper elevations, occasioned by shifting climatic processes, poses flooding risks due to greater water volumes and more rapid conveyance to already-saturated downstream areas.

34. **These climate change threats make it imperative that Great Jakarta implement adaptation measures to build resilience.** The NCICD comprises major flood control adaptation measures, the most prominent being the sea wall off North Jakarta. Also underway are several mitigation measures, such as urban forests and waste-to-energy systems designed to improve energy and resource efficiency. These mitigation measures have yet to generate significant impact in reducing DKI Jakarta's carbon footprint, especially as uncontrolled urban growth persists throughout the region.

1.2.7. Solid waste management

35. **Solid waste management is closely interlinked with wastewater and sanitation.** Conditions in Greater Jakarta present additional challenges to public health and affect overall livability, as well as posing a significant barrier to flood management efforts. Table 3 shows the amount of solid waste produced by each Kabupaten or Kota, and the amount that ended up in landfills in 2019 and in rivers in 2015. Although these figures are from different years, they are illustrative of the amount of solid waste in rivers in Greater Jakarta. In 2020, solid waste is reported to be higher than in the previous year due to COVID-19; as people worked from their homes, more plastic waste was produced in most jurisdictions (Fauzan 2020).

36. **Challenges abound across the solid waste service chain.** The chain begins with truck collection and transport to transfer stations. Depending on its type, waste is then transferred to various processing stations, and finally ends up at one of the 11 landfills

of various sizes located throughout Greater Jakarta. Challenges throughout the process include the inadequacies of localized collection systems, shortages of dump trucks, management issues at transfer stations, and significant issues at landfills. All the landfills have exceeded their capacity, resulting in massive pileups of solid waste at these sites. Such conditions also result in significant incidences of open dumping and contamination of water bodies, particularly in and around the landfill sites. The high incidence of solid waste, particularly plastics in waterways, also significantly impedes the efficacy of flood control systems.

Table 3: Solid Waste that was Produced, Sent to Landfills, and Ended Up in Rivers in Greater Jakarta

Kabupaten/Kota	Landfill (TPA)	Solid waste produced in 2019 (tons/day)	Solid waste produced in 2020 (tons/day)	Amount sent to landfills (tons/day)	Amount that ended up in rivers in 2015 [5] (tons/day)
DKI Jakarta	Bantargebang	7,700 [6]	7,600 [7]	6,000–7,500	365
Kabupaten Bekasi	Burangkeng	2,100 [8]	2,000 [9]	700–800	No data
Kota Bekasi [10]	Bantargebang and Sumur Batu	1,800	1,900	850–900	775
Kabupaten	Galuga and Lulut-Nambo (regional)	2,800 [11]	2,900 [12]	500–550	707
Kota Bogor [13]	Galuga	700	600	600	136
Kota Depok	Cipayung	1,300 [14]	1,300 [15]	700–800	273
Kabupaten Tangerang	Jatiwaringin [16]	1,500 [17]	1,000	700–800	No data
Kota Tangerang [18]	Rawa Kuching	1,200	1,500	1,400 [19]	265
Kota Tangerang Selatan [20]	Cipeucang	900	900	900	No data

[5] Mantalean 2019.
[6] Nursastri 2019.
[7] Faisol 2020.
[8] "Setiap Hari" 2021.
[9] Ikbal and Ismail 2020.
[10] Mantalean 2019.
[11] Fatubun 2019.
[12] Ikhsan and Assifa 2020.
[13] Saudale 2020.
[14] Rajaguguk 2019.
[15] Nurdiansyah and Yolandha 2020.
[16] Mantalean and Parnistik 2019.
[17] Panduwinata 2020.
[18] Fauzan 2020.
[19] Septalisma 2019.
[20] Masqudi and Jarkasih 2020.

37. **Poor management at landfills are known to produce methane explosions and dangerous "avalanches" that expose the overburdened and degraded conditions of these sites.** Such conditions particularly affect the large numbers of scavengers that seek out livelihood opportunities at these locations. New landfills are slated to come online in the near future – for example, the Lulut-Nambo regional landfill at Kabupaten Bogor slated to begin operation in 2022, which will serve several local governments as well as waste-to-energy incineration plants to be constructed in DKI Jakarta. Additional information about solid waste management is provided in Annex 4.

1.2.8. Health

38. **Water-borne health risks are prevalent in Greater Jakarta.** Across the region, in 2019, more than 900,000 cases of diarrhea were reported (table 4). In DKI Jakarta, 10 percent of post-neonatal (1–11 months old) and 10.4 percent of toddler (1–4 years old) deaths in 2019 were due to diarrhea, which is the second leading cause of death for these age groups after pneumonia (MOH 2020). These figures strongly justify more concerted efforts to improve environmental water quality, access to sanitation infrastructure, and community outreach on better hygiene practices.

39. **Dengue fever is another significant water-related health risk in Greater Jakarta.** Particularly during the rainy season, flooding and water retention leads to increased populations of the *Aedes* mosquito, a vector for the dengue virus (MOH 2020). In 2019, in DKI Jakarta, the incidence rate per 100,000 people for dengue fever was 82.5, well above the national incidence rate of 51.5 (MOH 2020). The incidence and Case Fatality Rates (CFR) of dengue fever in 2019 across Greater Jakarta are shown in table 4. As stagnant water during floods provides the grounds for breeding of *Aedes* mosquitoes, improved flood management may potentially reduce the risk of dengue fever in Greater Jakarta.

> *"High incidents of water-borne diseases strongly justify more concerted efforts to improve environmental water quality, access to sanitation infrastructure, and community outreach on better hygiene practices."*

Table 4: Diarrhea and Dengue Fever in 2019 in Greater Jakarta

Kabupaten/Kota	Population 2019	Diarrhea		Dengue		
		No. of cases	*Incidence rate (%)*	*No. of cases*	*Incidence rate (%)*	*Case fatality rate (%)*
DKI Jakarta	10,557,810	298,293	2.83	8,705	0.08	0
Kota Tangerang	1,742,604	47,050	2.70	133	0.01	0
Kota Tangerang Selatan	1,696,308	45,800	2.70	484	0.03	0.40
Kabupaten Tangerang	3,584,770	96,789	2.70	139	0.00	1.40
Kota Bekasi	3,003,923	81,106	2.70	2,373	0.08	0.20
Kabupaten Bekasi	3,763,886	10,1625	2.70	511	0.01	1.00
Kota Bogor	1,112,081	30,026	2.70	611	0.05	1.60
Kabupaten Bogor	5,965,410	161,066	2.70	1,210	0.02	6.90

40. **This section has shown the interrelated, multi-faceted water risks faced by Greater Jakarta. While these risks are of critical importance to the region's future, the rest of this study focuses on flood risk management, water supply, and sanitation services.** This focus is motivated by three considerations. Firstly, these three water subsectors are ones in which local governments can and do play a leading role in policy design and action, enabling innovation and flexibility to suit local conditions in line with an IUWM approach. In contrast, large-scale cross-jurisdictional water resource development and coastal protection efforts are led by the central government, and local governments do not have the authority or capacity to contribute significantly to policy design in these areas. Secondly, the institutional and regulatory structure for our selected subsectors is well established and provides a strong foundation for adopting IUWM. In other subsectors, notably groundwater management and subsidence, greater clarity in the institutional framework is needed before IUWM can be usefully adopted. Thirdly, clear and demanding policy targets have been set for access to water supply and sanitation and for flood management, and responsibility for meeting these targets lies with local governments. This provides a strong driver for local governments to look for and engage in new approaches like IUWM.

1.3. Governance

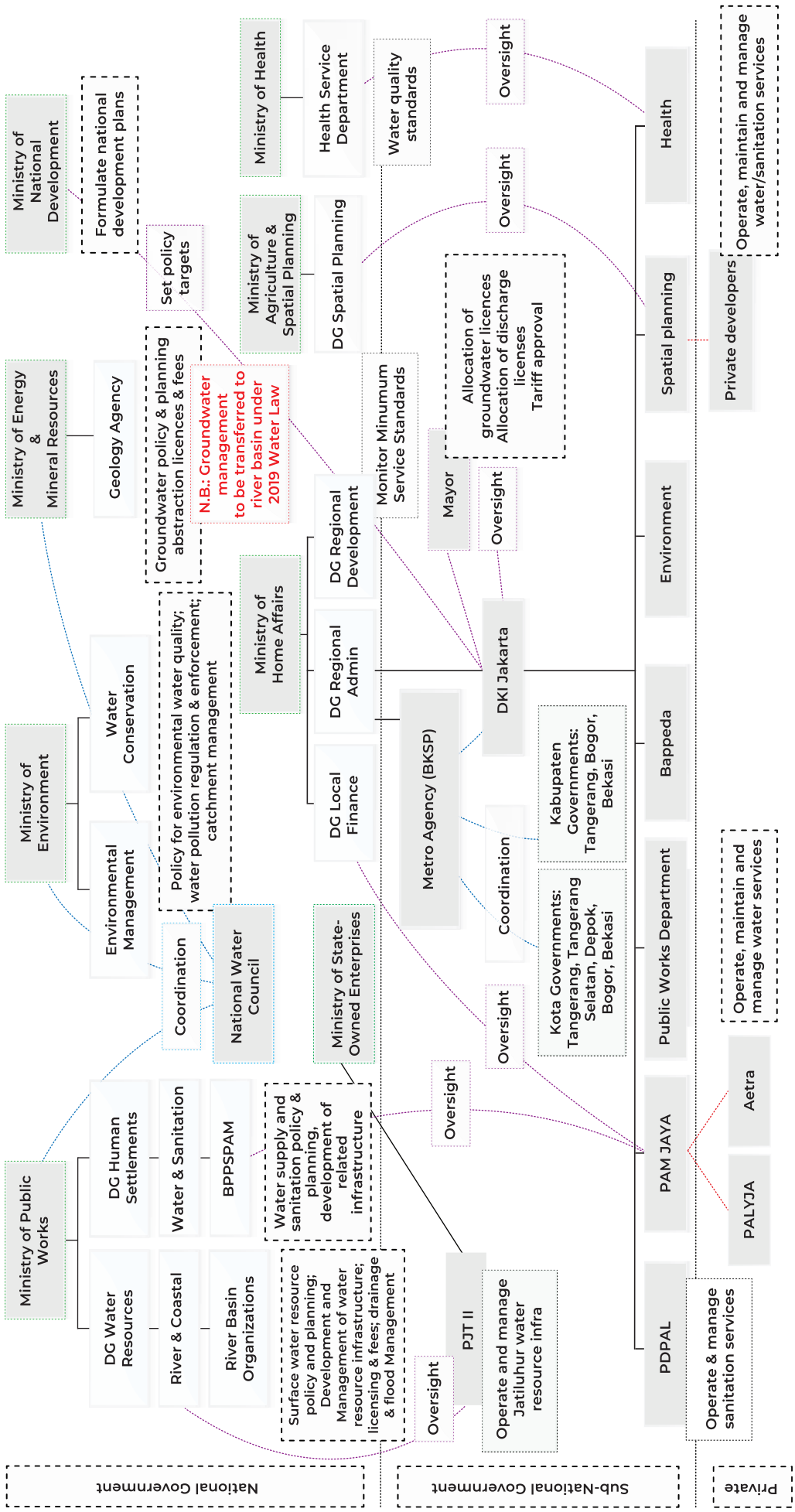
41. **Despite the positive reforms instituted by the 2019 Water Law, the institutions governing the water cycle in Greater Jakarta are numerous and fragmented.** One of the key changes enshrined in the Water Law addressed the issue of competing demands, and in particular addresses the previously contentious question of managing water as a public resource (Maskur 2019). Nevertheless, provisions stop short of regulating water services and the structure of utilities (World Bank 2021). The Water Law specifically stipulates the prioritization of surface water over groundwater and provides additional provisions for improved zoning around water bodies, especially on priority lakes. The Law also provides key improvements to data management, data collection, and transparency, integrated within the national One Map[21] and One Data policies.

42. **The institutional structure that will implement the legal provisions are listed in figure 5.** The institutional mapping presents the overall structures of water governance in Greater Jakarta, describing the different scales and mandates of agencies, as well as their lines of cooperation. It highlights both horizontal, vertical, and administrative fragmentation, particularly in terms of the roles and responsibilities regarding regulation and management of water resources. Several ministries play a key role in establishing norms and standards; however, local governments have the core mandate to plan, budget, implement, and coordinate the various elements of their application. By highlighting the water governance institution of DKI Jakarta relative to neighboring local governments, the institutional mapping in figure 5 illustrates a particular disconnect between jurisdictions over water governance, as well as issues with intra-agency coordination within local governments over water (discussed further in section 4).

43. **Water management in Greater Jakarta is further complicated by overlapping spatial designations.** MOPWH employs the terminology of river basins (*Wilayah Sungai*), which are divided into *water districts* (see figure 6, image A1 and A2, respectively), to plan and finance infrastructure development for water resources. MOPWH works through provincial authorities and in partnership with local governments on arrangements to build, construct, and coordinate maintenance. In parallel, the MOEF has authority to manage lands within the Forest Estate (*Kawasan Hutan*), usually located in upstream areas. MOEF largely works to plan forest management for production, rehabilitation, protection, or conservation, but also holds authority over water quality monitoring, which it conducts at the level of the watershed (*Daerah Aliran Sungai* or DAS, figure 6, image A3, in green).

[21] The regulation for One Map is specified in Presidential Regulation Number 9 Year 2016 (Peraturan Presiden Nomor 9 Tahun 2016).

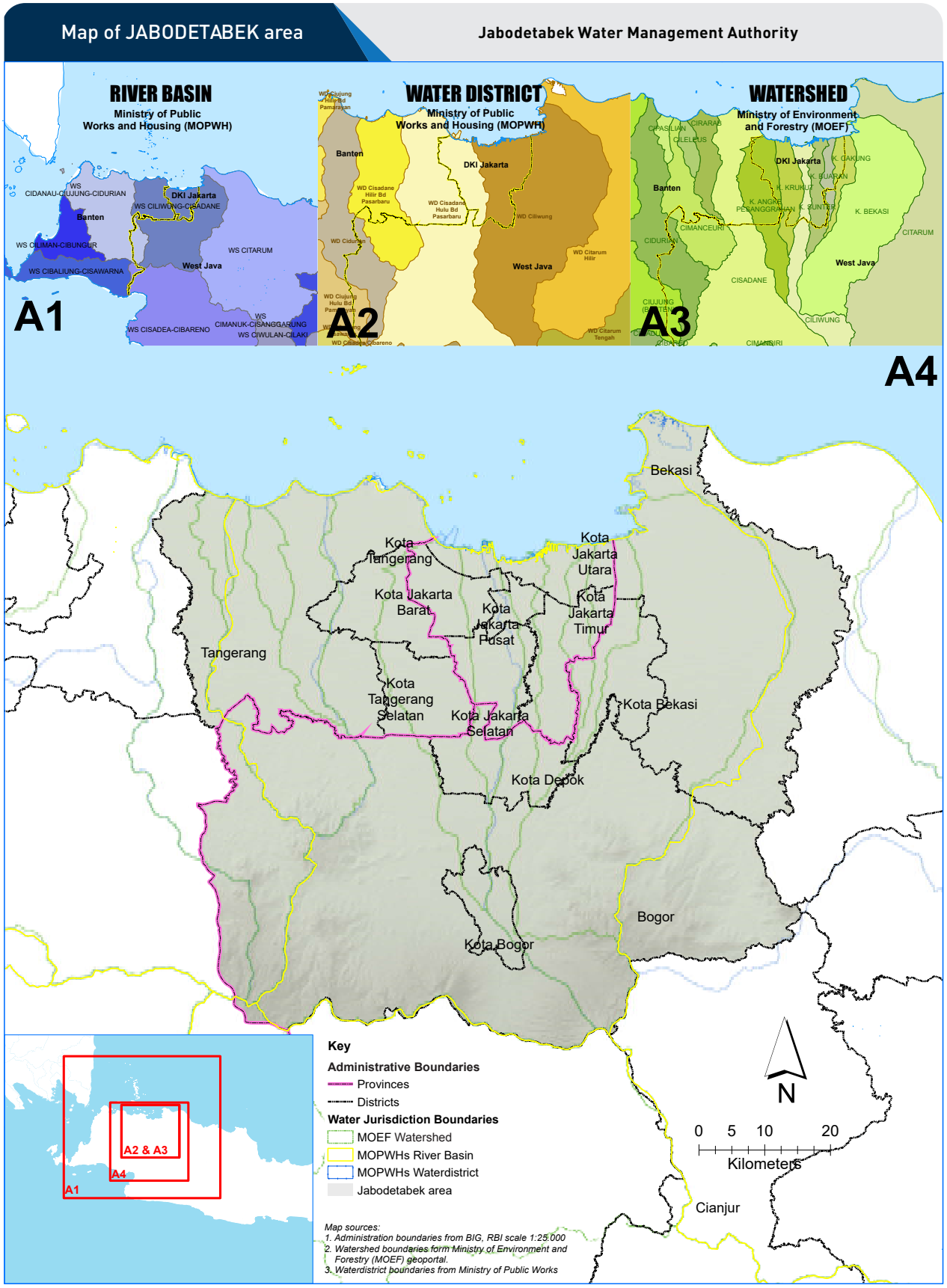
Figure 5: Institutional Map of Water Governance in Greater Jakarta



44. **Law 23/2014 has initiated some key changes in decentralization, particularly in terms of governing natural resources.** Local governments are vested with the authority through elected leadership to perform some water management functions within their administrative boundaries (figure 6, image A4). Figure 6 shows how these boundaries spatially intersect with the overlapping MOPWH RBO authorities, MOEF watershed mandates, and jurisdictional areas of provincial and district or municipal governments. Any engagement by these ministries requires close coordination and involvement of local government agencies, suggesting not only the importance of capacity building but also the key strategic function of incentivizing cross-jurisdictional coordination, particularly around upstream-downstream water security issues.

45. **Local governments in Greater Jakarta must meet minimum service standards (MSS) in basic services provision, including water supply and sanitation,** in accordance with Government Regulation 2/2018. As laid out explicitly in Law 23/2014, water supply and sanitation is under the jurisdiction of local government authority. The Law establishes opportunities for developing partnerships to meet targets through joint secretariats that cross local government jurisdictions. As of today, the BKSP (*Badan Kerja Sama Pembangunan*, or Local Government Development Cooperation Agency), which was established prior to the passage of Law 23/2014, is the only coordinating body for cross-jurisdictional collaboration in Greater Jakarta. This study is thus also explicitly engaged on examining the various mechanisms for updating cooperation agreements under dynamic regulatory and legal changes.

Figure 6: Water and Spatial Jurisdiction in Greater Jakarta

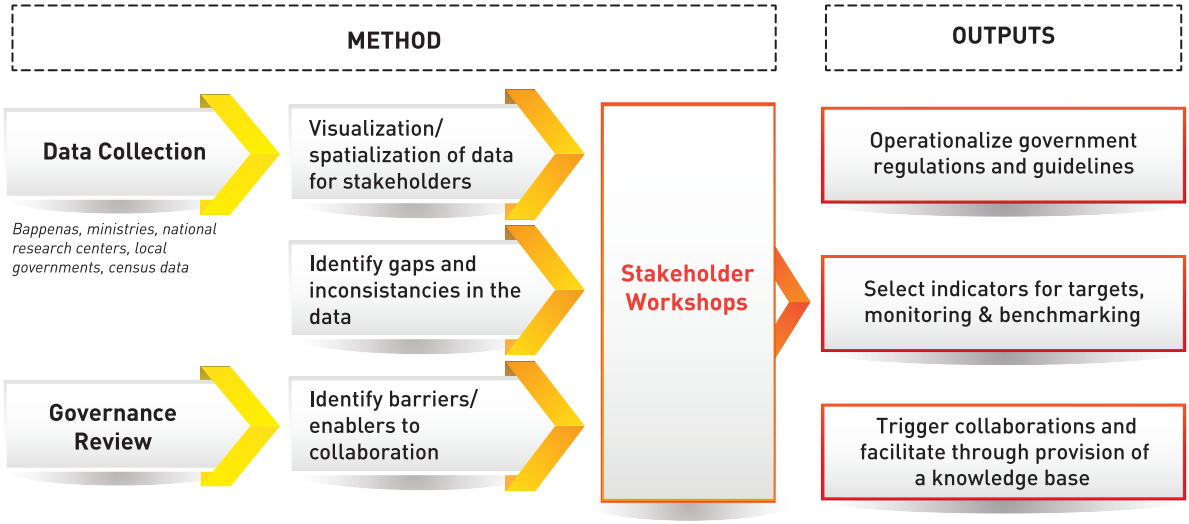


2. Methodological approach

2 METHODOLOGICAL APPROACH

46. **The study's approach involves working with central and local government partners to identify IUWM-consonant priority actions that can be applied in Greater Jakarta to address water security.** The approach began with the building of an evidence base for the selection and coordination of actions by stakeholders, followed by the identification of barriers to adoption of IUWM at local, regional, and national levels. Thereafter, the effort strategically set out to trigger stakeholders' interest in innovative policy actions and approaches to tackling water security. In keeping with IUWM best practices, the study adopted a collaborative approach by involving policymakers from the outset in the data collection and analysis process and in the development of the recommendations. Figure 7 presents the overall methodology. The study involved three stages, which are addressed in turn in the following sections: i) data collection; ii) data analysis and visualization; and iii) development of recommendations.

Figure 7: Study Design: Method and Outputs



2.1. Collaborative data collection: Sources, validation, and approach to missing data

47. **Data were gathered on key indicators pertaining to flooding, water supply, and sanitation, with a strong emphasis on geo-localized data; this evidence base was supplemented by information on governance and planning frameworks.** Data were collected from government databases, reports, and plans at national and subnational levels; articles published in academic journals; and datasets and reports prepared by development partners. Key sources of official data (listed in Annex 1) included Spatial and Development Plans (*Rencana Tata Ruang Wilayah*, or RTRW, and *Rencana Pembangunan Jangka Menengah Daerah*, or RPJMD) and the Drinking Water System Master Plans (*Rencana Induk Sistem*

Penyediaan Air Minum, or RISPAM), as well as various other databases managed by departmental counterparts. Initially, the study team contacted each of the relevant units at national and subnational levels with a formal, detailed data request. This was followed by direct communications with agency staff. From the outset of data collection, core engagement focused on working with the subnational governments across Greater Jakarta. This approach intentionally had a capacity-building dimension and the study team sought to identify ways in which data collection, storage, and management in these agencies could be improved.

48. **As expected, the study team encountered considerable challenges in finding up-to-date, valid, reliable, and comparable data on key indicators.** These challenges related in part to the decentralized governance structure of Indonesia, which leads to variations in data collection between subnational actors, despite national guidelines intended to ensure that reporting is uniform across jurisdictions. Furthermore, there are weak incentives and little precedent among local officials with regard to sharing data in formats suitable for comparative analysis and coordinated planning in line with the IUWM approach. In addition, the onset of the COVID-19 pandemic coincided with the middle of the data collection period, preventing direct interaction with local officials and precluding site visits.

49. **The data collection process revealed numerous gaps and inconsistencies in the data across jurisdictions.** For example, regional disaster management authorities (*Badan Penanggulangan Bencana Daerah*, or BPBDs) are required to collect data on flood incidents on an annual basis. However, the data are poorly managed and it proved impossible to gather complete data on flooding for the period 2013–2020 for all nine jurisdictions. Donor programs were very generous with their data, particularly UNFPA, and the long-standing close cooperation of local governments and civil society through the USAID IUWASH-PLUS project also proved helpful.

2.2. Data analysis and visualization

50. **To trigger change, data must be conveyed to decision-makers in ways that are easily understood.** This study primarily uses maps to translate data into messages. Maps are suitable for conveying the interjurisdictional nature of many water security issues and the potential for coordinated action across administrative boundaries to address these risks. The maps help to contextualize and make sense of the issues in a way that can catalyze and sustain IUWM initiatives. They also highlight where data collection is inadequate. The broader political premise is that policy and planning decisions would be made to address areas of common concern.

51. **Data was collected on specific subsectors: i) flood and stormwater management; ii) water supply; and iii) sanitation and wastewater.** For flooding, the team sought out data on a few simple questions: how often does flooding occur, what are the causes of flooding, and what are its direct impacts (i.e., how many households are affected by flooding)? For water supply, the approach was to identify the broader ways that access to water is secured, supplemented by explanations about who gets access to water. Finally, wastewater and sanitation questions revolved around the types of sanitation infrastructure, the different service providers and treatment facilities, and considerations about overall water quality. The expectation of the study team was that developing a complete dataset would not be possible, but rather that the goal should be to present a data collection and management method that can build ownership in local institutions and serve as a basis for coordination, planning, and interventions going forward.

52. **Data were visualized in a series of thematic maps, which were used to engage cross-jurisdictional and cross-sectoral stakeholders in identifying potential areas for collaboration.** Key issues could be highlighted by using the most up-to-date data available to local governments, presented in clear visualizations to government counterparts and other stakeholders. This provided a foundation to enable collaboration and to effectively, succinctly, and accurately facilitate discussions among targeted stakeholders.

2.3. Stakeholder workshops: Verification and engagement

53. **The study was conducted with close engagement of the central government (Bappenas, MOPWH, MOHA) and local governments, including the provincial government of DKI Jakarta and the eight surrounding district and municipal governments.** Given the important role of Bappenas and MOPWH in planning and implementing IUWM-related policy and infrastructure, these institutions constituted the main counterparts in the central government. Bappenas, through the Directorate for Spatial Planning and Disaster Management, articulated regulatory and strategic approaches for water-driven spatial planning across jurisdictions. Meanwhile, the Directorate for Housing and Settlements highlighted the ambitious, nationally mandated targets for increasing and improving access to water and sanitation coverage, and showcased to local governments in Greater Jakarta the national programmatic support being offered to help meet these targets. MOHA, through the Directorate General of Regional Administration, plays a crucial role in providing policy direction and establishing coordination mechanisms at the subnational level – a critical component, as this study aims to support cross-jurisdictional coordination and intersectoral engagement. MOHA provided inputs into the overall regulatory standing

of a regional authority that could support IUWM across Greater Jakarta and clarified mechanisms for establishing relationships that maximize mutual benefits between local governments. Data were also gathered from official sources, e.g., the national census data from the Central Bureau of Statistics (*Badan Pusat Statistik* or BPS) and central government agencies (see Annex 1). Coordination involved the Association of Indonesian Municipalities (*Asosiasi Pemerintah Kota Seluruh Indonesia* or APEKSI) to facilitate governance workshops, and regular coordination took place with other donor agencies.

54. **Three sets of stakeholder workshops helped to guide the overall study.** The workshop process began with a broad identification of issues, moved on to convening around specific policy concerns, and finally scaled down to cluster workshops among sub-regions. An initial workshop (in 2019) helped to establish a common framing of IUWM, introduced the study approach, and engaged central and local governments on the broader issues associated with jurisdictional and cross-jurisdictional coordination. Several months later, in November 2019, a second workshop convened around issues of data collection while deepening questions about opportunities within the system of regional authority, exploring possible national policy support options, and taking stock of sectoral initiatives. Due to COVID-19 pandemic concerns, a third planned workshop was moved to an online format. In August and September 2020, four cluster group discussions were held.[22] In this final workshop, overall findings from the data collection and visualization phases were presented by the study team, followed by question prompts to facilitate areas of IUWM collaboration. MOHA and Bappenas actively participated in providing feedback on potential regulations that could help overcome potential barriers to collaboration, while local governments listed opportunities for IUWM in Greater Jakarta going forward. The draft report was also distributed to all partners, and all input was meaningfully incorporated into the report, including input gathered through additional direct consultations.

55. **Development of recommendations.** Over a series of governance-related workshops, stakeholders from central government and relevant local government agencies were brought together to discuss common sectoral issues. As the data and maps became more specific to key issues, key stakeholders were convened into cluster groups through the identification of potential areas to cultivate longer-term collaboration by establishing potential working groups to address the problem. This approach provided pathways for the study team and stakeholders to identify initial measures to foster IUWM and to identify the elements of a national framework to support IUWM. The recommendations for the national framework are presented in an accompanying report. The two reports were written in parallel so that the overall findings on regulatory dimensions, policy, and governance informed the Greater Jakarta study, and vice versa.

[22] The first cluster involved the Greater Bogor Region and included Kota Bogor, Kabupaten Bogor, and Kota Depok; a second cluster comprised the Greater Bekasi Region, constituted by Kota Bekasi and Kabupaten Bekasi; a third cluster convened DKI Jakarta; and a final cluster represented the Greater Tangerang Region, including Kota Tangerang, Kota Tangerang Selatan, and Kabupaten Tangerang.

56. **Consultation.** The recommendations in this report were developed iteratively with national and local policymakers during the course of the study. Case studies of initiatives taken by local governments in Greater Jakarta helped inform efforts to develop the national IUWM framework. The consultations are anticipated to continue among working groups pursuing the thematic issues identified in the study.

3. Visualizing water security in Greater Jakarta

3 VISUALIZING WATER SECURITY IN GREATER JAKARTA

3.1. Flooding

57. **Data were collected to address three overarching questions: Where does it flood and how often? What causes flooding? How many households are affected by flooding?** The data was collected from BPBDs, but less than half of the datasets were available for the period 2013–2020 (see Annex 2). The data were not always available at the village level (*kelurahan*) and some datasets only included descriptions of an incident without further explanation of the causes of flooding or the number of households affected. Although the spatial representations of existing data divulge unique findings, the study also undertook to develop conservative estimates to try to present a more accurate visualization of flood dynamics for the 2013–2020 period.

3.1.1. Frequency of flooding in Greater Jakarta

58. **Figure 8 shows the frequency of flooding in Greater Jakarta from 2013 to 2020 using raw data collected from BPBDs.** It shows flood events over an eight-year period, collected from monitoring data recorded by BPBDs. This method generates an estimated total of 1,741 village/*kelurahan*-level flood events for Greater Jakarta (table 5). The highest incidence of flooding occurred in Kabupaten Tangerang – a total of 460 flood events for the eight years – but those high numbers are also a reflection of the local government keeping the most complete records. Nevertheless, cross-checking Kabupaten Tangerang BPBD data with numerous media sources on flooding suggests that the official figures likely under-represent the actual flooding incidences during the period. This highlights the need for more robust data collection approaches.

Figure 8: Flooding Events in Greater Jakarta, 2013–2020

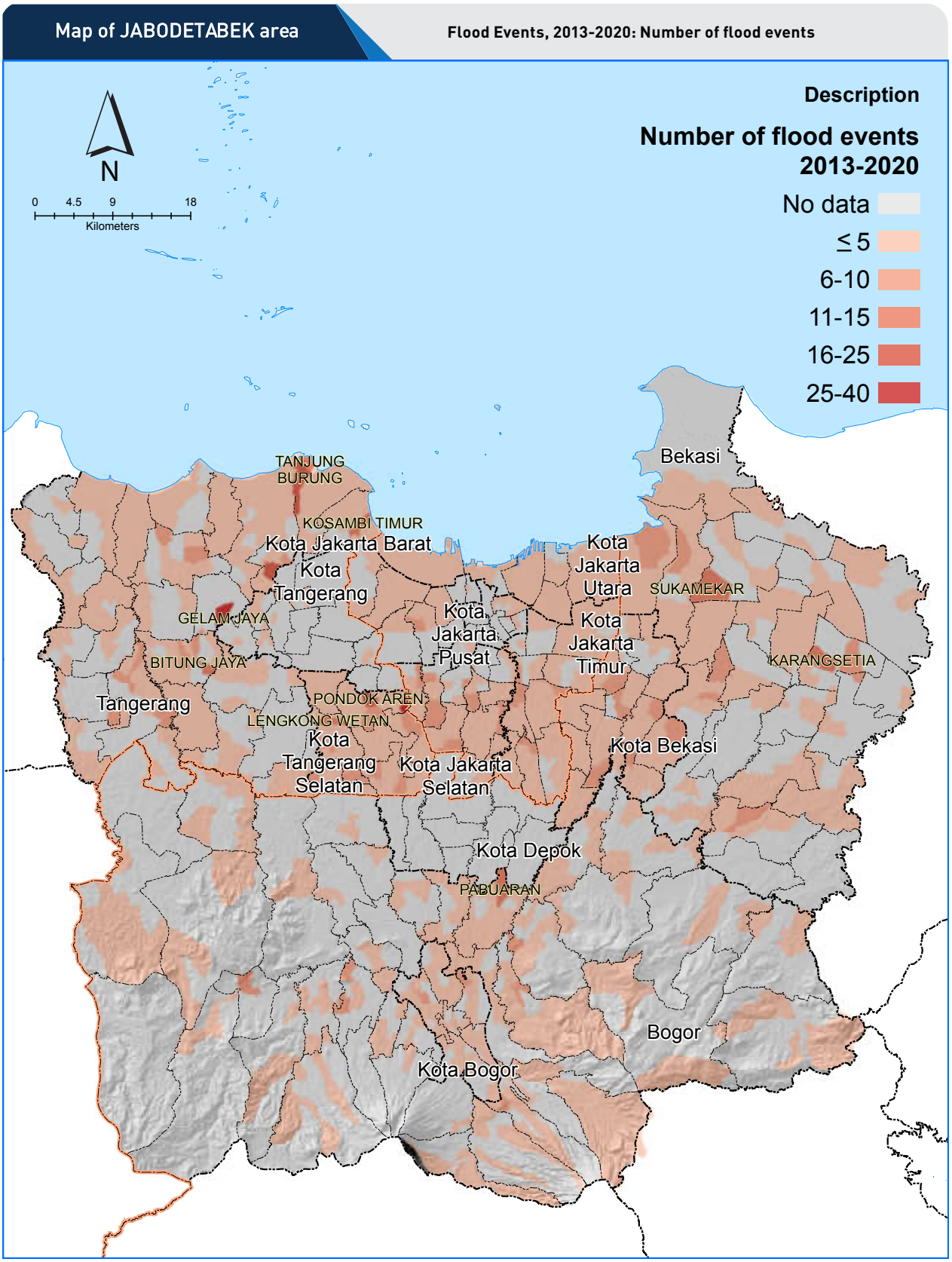


Table 5: Number of Flood Events per Year in Greater Jakarta

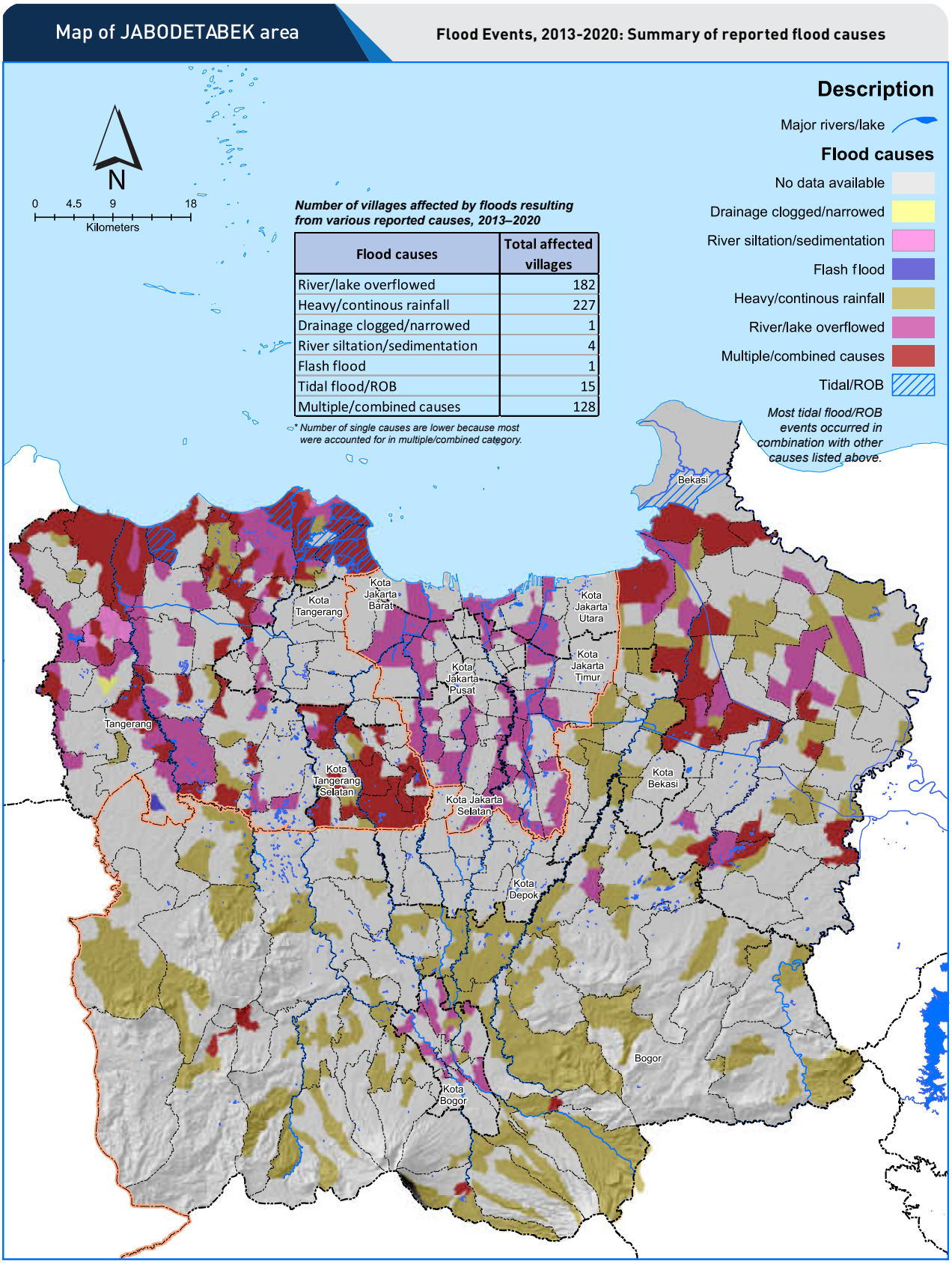
Kabupaten/Kota	Number of flood events per year								
	2013	2014	2015	2016	2017	2018	2019	2020**	2013–2020
Kab. Tangerang	52	64	57	30	59	31	17	150	460
Kota Tangerang								4	4
Kota Tangerang Selatan	39	33	11	13	36	18	10	55	215
Jakarta Barat		12		15	17				44
Jakarta Pusat		9			3				12
Jakarta Selatan		33		56	40				129
Jakarta Timur		34		49	44				127
Jakarta Utara		25		5	8				38
Kab. Bekasi						26	14	112	152
Kab. Bogor	25	37	14	46	57	58	24	35	296
Kab. Depok									
Kota Bekasi	3	5	4	12	6	13	12	110	165
Kota Bogor		1	1	13	18	31	22	13	99
Total	**119**	**253**	**87**	**239**	**288**	**177**	**99**	**479**	**1,741**

**For cells shaded in gray, no data was available.*
***The dataset for 2020 includes only the months of January – March.*

3.1.2. The causes of flooding

59. **Figure 9 complements the data on flooding frequency by mapping the causes of inundations in Greater Jakarta as recorded by BPBDs.** The map categorizes the causes of flooding in every village/*kelurahan* that reported flood events. Flood events were grouped into categories of overflow, heavy localized rainfall, clogged drainage, sedimentation, flash flooding, tidal flooding, and combined causes. Flood events most commonly occurred due to heavy rainfall events in areas with inadequate localized drainage, a cause that accounted for 227 village/*kelurahan* reports. Although some causes of floods can be addressed locally (e.g., broken or blocked drainage or infrastructure), some require more upstream-downstream collaboration. During the consultations with local governments, visualizations such as figure 9 helped to facilitate discussions on potential interventions over a specific flooding problem, whereby different agencies and cross-jurisdictional entities could work together to address them together.

Figure 9: Causes of Floods in Greater Jakarta by Village/*Kelurahan*, 2013–2020



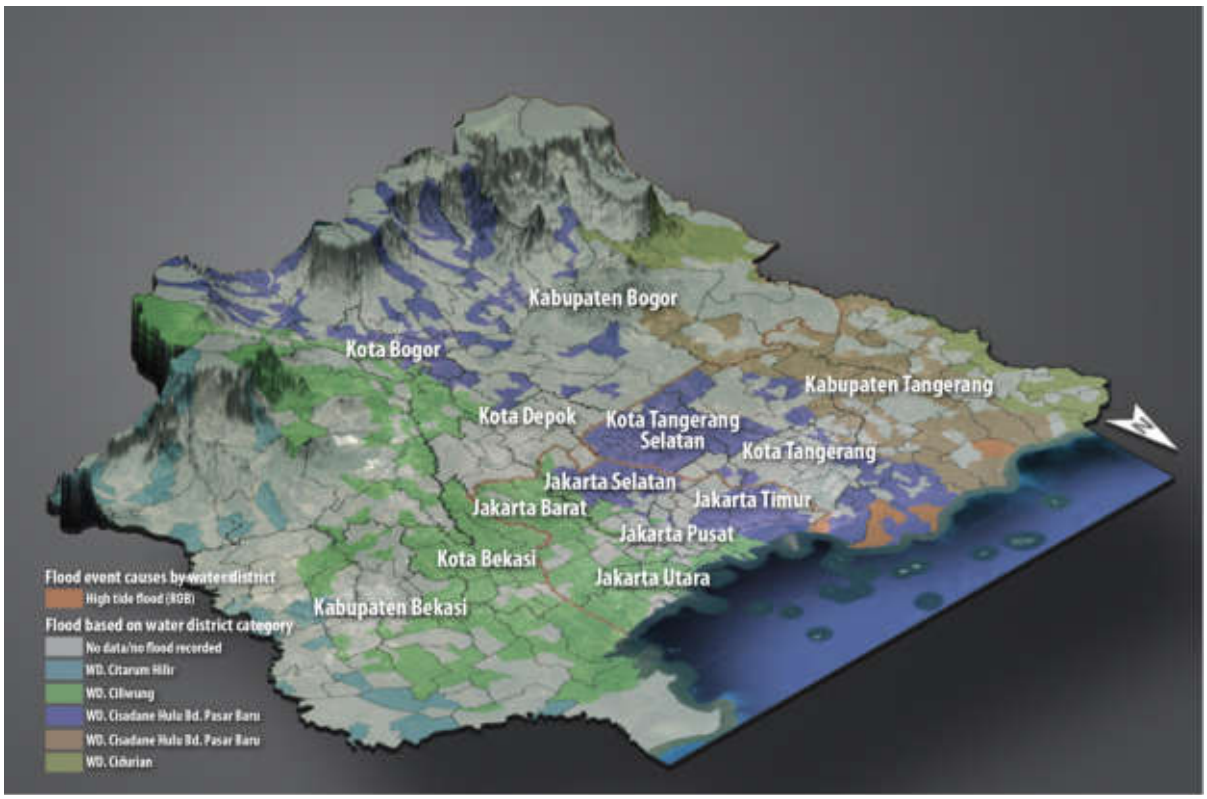
Number of villages affected by floods resulting from various reported causes, 2013–2020

Flood causes	Total affected villages
River/lake overflowed	182
Heavy/continous rainfall	227
Drainage clogged/narrowed	1
River siltation/sedimentation	4
Flash flood	1
Tidal flood/ROB	15
Multiple/combined causes	128

** Number of single causes are lower because most were accounted for in multiple/combined category.*

60. **Floods are not merely a downstream phenomenon, as inundations affect jurisdictions in all parts of the watershed.** The relief map presented in figure 10 shows the geographic extent of villages/*kelurahans* affected by flooding. Even given the incomplete datasets from all Greater Jakarta BPBDs, the available data show that over half (768 of 1,504) of all villages/*kelurahans* across Greater Jakarta experienced flooding in the past eight years. The map distinguishes flood events by water district (indicated by color) as a way to provide more continuity around topographical dimensions of basin boundaries. Discussions in the workshops noted that viewing water connectivity in this way can help to initiate discussions between upstream and downstream jurisdictions and encourage involvement by central government agencies mandated to manage watersheds (MOEF) and river basins (MOPWH).

Figure 10: Flood Distribution by Water District of Village/*Kelurahan* Events, 2013–2020



3.1.3. Flood impacts on households

61. **Figure 11 and table 6 highlight the scale of flood impacts on households in Greater Jakarta.** The data do not specify whether some households experience multiple impacts year on year. The definition and interpretation of flood impact among BPBDs also remains very broad. Based on the BPBDs' data and definitions, table 6 shows the number of households affected by floods from 2013 to 2020. There is a wide variation in the number of households affected each year, from 5,627 households (over 28,000 people) in 2018 to 75,565 households (377,000 people) in 2020; the latter figure excludes flood impacts in DKI Jakarta in 2020, which had not been made public at the time of writing.

Figure 11: Flood Impact by Household, Greater Jakarta, 2013–2020

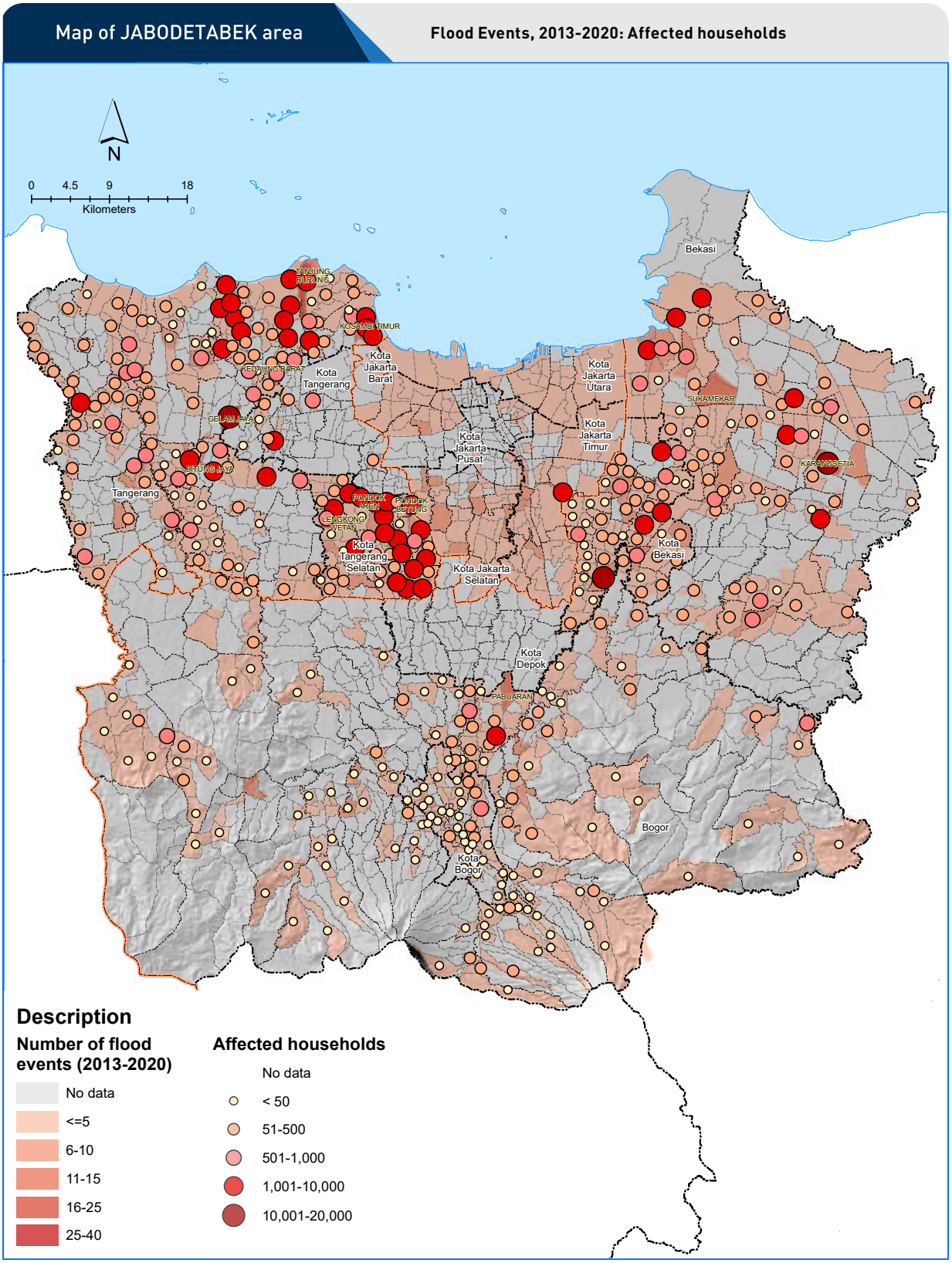


Table 6: Number of Households Affected by Floods in Greater Jakarta, 2013–2020

Kabupaten/Kota	Number of flood events per year							
	2013	2014	2015	2016	2017	2018	2019	2020
Kab. Tangerang	8,150	18,245	6,763	2,382	8,889	1,351	249	38,806
Kota Tangerang								32
Kota Tangerang Selatan	10,116	6,161	939	405	2,661	942	29	18,205
Jakarta Barat	165,893	32,189	16,296	10,740	225,118			
Jakarta Pusat	4,627	5,449	3,832	0	13,907			
Jakarta Selatan	28,657	16,717	3,621	14,755	63,749			
Jakarta Timur	64,445	48,164	13,795	15,137	141,541			
Jakarta Utara	17,024	2,752	18,579	0	35,624			
Kab. Bekasi						1,824	1,409	15,123
Kab. Bogor	2,852	2,270	661	1,609	1,540	913	195	3,204
Kab. Depok								
Kota Bekasi	548	3,525	55	6,496	207	269	5,941	
Kota Bogor	0	556	1,000	150	0	328	186	195
Total	**21,666**	**30,757**	**9,418**	**11,042**	**13,297**	**5,627**	**8,009**	**75,565**

**For cells shaded in gray, no data was available.*

62. Floods have a significant impact on households in terms of life, livelihood, and property. Most of the direct impacts are related to health. Floods regularly cause outbreaks of diarrhea, skin disease, eye infections, gastritis, pneumonia, and acute respiratory illnesses, and correlate with spikes in dengue fever and leptospirosis (Bappenas 2016, 81). Children and infants are especially at risk during flood conditions. The regularity with which agencies need to prepare for disaster management and response also takes a significant toll, requiring coordination and allocation of resources, including for evacuation, shelter, lifelines, health, and emergency services. Loss of property and damages to public facilities also place additional investment burdens on households and public agencies, and other impacts can be measured in terms of disruptions to transportation systems and the economy more broadly (World Bank 2018; World Bank 2019a).

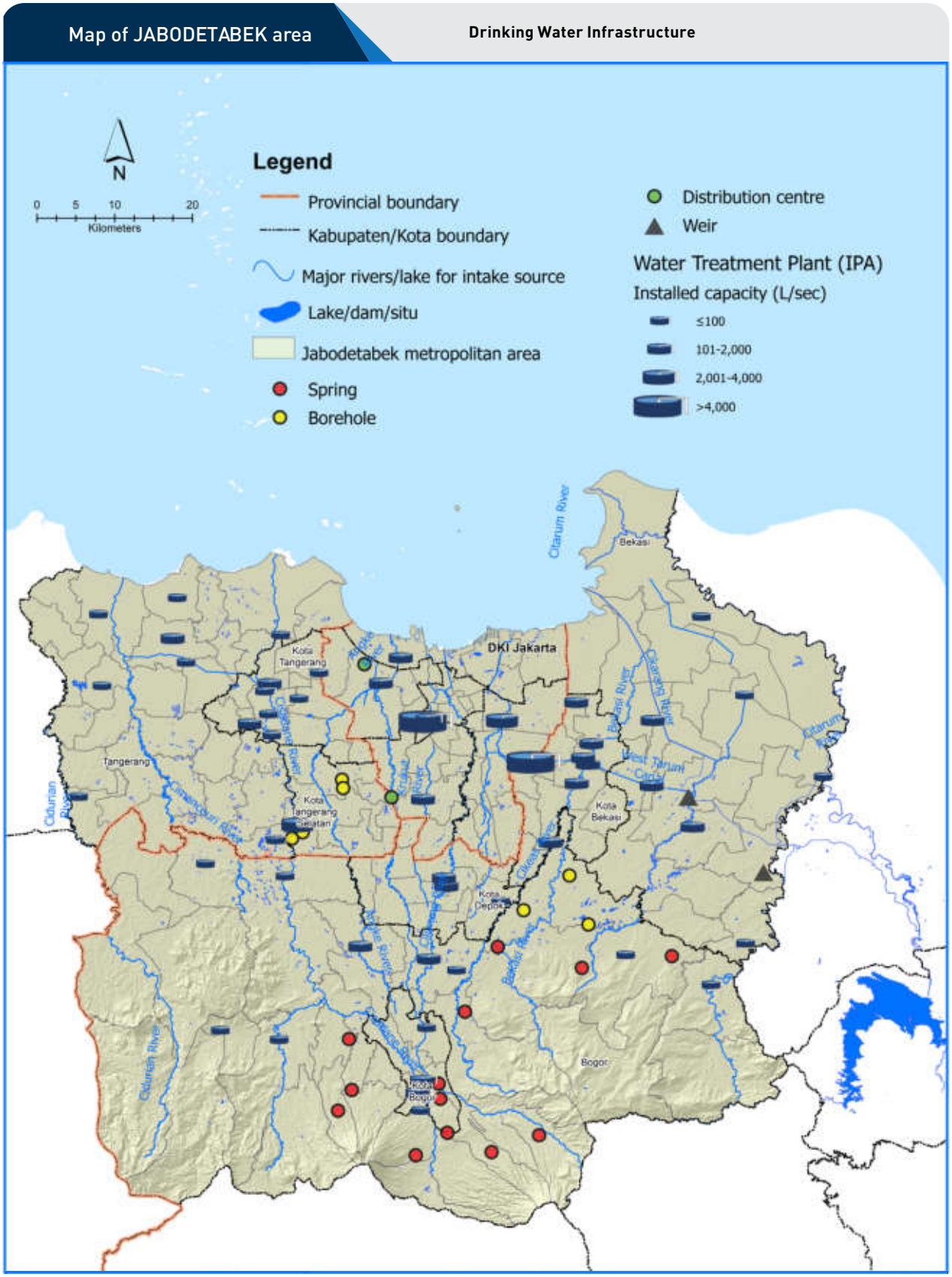
63. **One of the striking trends in the flood data points to the severity of flooding in 2020 compared to previous years.** The data for 2020 only accounts for flood events through the month of March, but the impacts had already affected 75,565 households. According to the BNPB, an estimated 397,000 people across Greater Jakarta were reported to have had to seek temporary shelter in schools and government buildings, with inundations of up to 6 meters in certain areas (Karmini 2020). This is double the average flood impacts of previous years at the household level. The severity of these impacts could be related to climate variability patterns and anomalies associated with the El Niño / La Niña Southern Oscillation (ENSO), or it could be a reflection of more reliable and robust data collection on the part of the BPBDs. Nevertheless, the return of monsoon rains in the second half of 2020 are likely to result in even higher numbers.

64. **The economic impacts of flooding in Greater Jakarta point to significant impediments to development.** The disastrous floods of 2007 incurred a toll of US$900 million in financial losses, compounded by approximately US$140 million in flood-related insurance claims (World Bank 2019b). Bappenas has already estimated losses of US$370 million from flooding in 2020 (IDN Financials 2020). Any interventions to improve flood management will significantly contribute to reducing economic impacts and protecting life and property. For example, the World Bank–funded Jakarta Urgent Flood Mitigation Project, completed in 2019, posted an economic internal rate of return on investment of 413 percent, with a net present value of US$2.79 billion (World Bank 2019b).

3.2. Water supply

65. **Data were collected on two aspects of water supply: i) bulk water sources, transmission, and treatment infrastructure, and ii) access to services.** In terms of bulk supply, data were gathered on raw water sources and intake points, and the report team identified the location, capacity, and utilization of water treatment facilities. Figure 12 shows the major water treatment plants (WTPs), spring water intakes, and boreholes throughout Greater Jakarta. The raw water source for WTPs is surface river water. Detailed information on raw water abstraction points and volumes was not available, and no data were available on water abstraction points and volumes for private property developments or for commercial and industrial sites. This is a critical gap because many of these facilities source water directly from deep groundwater aquifers, over-abstraction of which is directly linked to high rates of land subsidence. In DKI Jakarta, commercial and industrial users must secure a groundwater abstraction license and install meters to enable monitoring and charging. In theory, no new licenses for groundwater abstraction are provided in vulnerable zones. Nevertheless, some commercial and industrial sites may abstract groundwater without a license or exceed licensed abstraction volumes.

Figure 12: Drinking Water Infrastructure in Greater Jakarta



66. **At the regional and municipal levels, there is inadequate bulk water supply to meet piped water demand.** As discussed in section 1, there is an estimated water supply deficit of 18.5 cubic meters per second in fulfilling piped water demand for populations within PDAM service areas; and for the entire administrative population of Greater Jakarta, the piped water supply deficit is 51.9 cubic meters per second. Further detail on water demand projections is found in Annex 3. Deficits in bulk water supply force households to rely on other sources of water, including groundwater. Additionally, water utilities compete for these water resources and allocations between suppliers are rarely adjusted, leaving some piped water utilities in the region with inadequate raw water supply. For example, the allocation of water to PAM Jaya (the PDAM for DKI Jakarta) has not increased in the last 10 years. Furthermore, water transfer infrastructure is inadequate – a canal rather than a covered pipeline – and poorly maintained, leading to severe contamination from domestic and industrial pollutants, water losses, and periodic supply interruptions.

67. **Piped water service coverage is low.** There are nine separate piped networks operated by public utilities in Greater Jakarta, which together cover 1.7 million household connections, implying a coverage rate of 43 percent (see table 7). However, it is important to note that this figure includes connections with low pressure, intermittent supply, and even some areas with no supply at all, as well as households that have a piped connection but use other sources of water for some or all of their daily needs. On the other hand, this figure excludes households in private developments that are served by privately developed and managed networks. These private networks are not regulated, and no official data are collected on their coverage or service quality. Water supply demand for industrial and commercial entities also poses a challenge, as unfulfilled demand is connected to drivers of land subsidence. To reduce the reliance of large-scale industrial and commercial operations on groundwater, one option is to ensure an adequate, consistent, and affordable supply of piped water from PDAMs; another IUWM-consonant alternative would be to mandate these operations to manage their own water recycling or reuse.

68. **Demand is expected to increase, and several PDAMs have plans to extend networks.** Public utility planning documents indicate that they intend to expand surface water intake and treatment capacity to meet demand. However, water sector and business plans did not contain interventions to increase capital for operating efficiency, engage in demand management and water conservation, or develop alternative sources of supply. In workshop discussions, local governments indicated that they were concerned about future availability of bulk water and expected to face constraints in expanding water service coverage.

Table 7: PDAM Service Coverage Rates across Greater Jakarta

PDAM	Population served	Number of household connections	Coverage (population served as a percentage of population in service area)
DKI Jakarta – PAM Jaya	6,249,792	863,166	62%
Kota Tangerang – PDAM Tirta Benteng	180,314	55,362	13%
Kabupaten Tangerang – PDAM Tirta Kerta Raharja	1,552,509	145,738	48%
Kota Depok – PDAM Tirta Asasta	293,544	60,361	16%
Kota Bogor – PDAM Tirta Pakuan	990,230	161,658	90%
Kabupaten Bogor – PDAM Tirta Kahuripan	1,051,138	163,272	48%
Kota Bekasi – PDAM Tirta Patriot	153,296	32,501	29%
Kabupaten Bekasi – PDAM Tirta Bhagasasi	1,814,716	231,716	37%
Total	**12,098,674**	**1,713,774**	**Percentage of population served in administrative area: 43%**

Source: BPPSPAM 2019.

69. **Some municipalities in Greater Jakarta engage in transboundary cooperation in water supply infrastructure to meet water supply demands.** For example, the Serpong water treatment plant (WTP) supplies water to both Kabupaten Tangerang and Kota Tangerang Selatan, and Legong WTP and Citayam WTP, located between Kota Depok and Kabupaten Bogor, supply water to both jurisdictions. Nevertheless, there are some areas that tend to be left out or underserved because they are located close to administrative boundaries or in existing settlements within estates owned by private developers. In other areas, lack of transboundary cooperation and collaboration results in overlapping of services and inefficient investments. These issues require greater attention and improved collaboration both among PDAMs and local governments, and with the private sector. Such cooperation would allow for optimization of infrastructure and resources to fulfill demand for piped water.

70. **Capacity utilization rates indicate a significant potential to increase supply.** Table 8 shows that three of eight PDAMs in the region have capacity utilization rates below 80 percent. Optimizing the installed capacity of existing water supply infrastructure may create opportunities to expand service coverage and recover costs. In addition, reducing idle capacity would be faster and more affordable than building new infrastructure or intake points. Increasing operating efficiency is especially vital considering the limited sources and high reliance of Greater Jakarta on water sources drawn from outside of the region.

71. **Non-revenue water (NRW) rates are high.** The reported NRW rates of PDAMs in Greater Jakarta in 2018 are shown in table 8. In six of the eight PDAMs in the region, NRW rates are well above the national guideline of 20 percent. As is the case for many PDAMs in Indonesia, it is very likely that real NRW rates are much higher than the reported figures, as the lack of adequate maintenance of water meters within the distribution network and at customer locations leads to inaccurate measurements. This implies considerable scope to improve efficiency, although it is important to recognize that reducing NRW requires significant investments and strong backing from policymakers.

Table 8: PDAM Capacity, Utilization, and Non-Revenue Water across Greater Jakarta

PDAM	Installed capacity (L/sec)	Utilization rate	NRW (reported)
DKI Jakarta	20,238	98%	43.4%
Kota Tangerang – PDAM Tirta Benteng	955	76%	28.8%
Kabupaten Tangerang – PDAM Tirta Kerta Raharja	5,143	99%	13.9%
Kota Depok – PDAM Tirta Asasta	940	71%	29.3%
Kota Bogor – PDAM Tirta Pakuan	2,186	99%	30.7%
Kabupaten Bogor – PDAM Tirta Kahuripan	2,100	80%	28.4%
Kota Bekasi – PDAM Tirta Patriot	550	87%	10.7%
Kabupaten Bekasi – PDAM Tirta Bhagasasi	3,245	77%	27.1%

72. **NRW reduction and demand management have the potential to reduce the deficit in water supply.** Table 9 shows the projected water supply balance in 2030 for each jurisdiction, under two scenarios: business-as-usual and a combined NRW-and-demand-reduction scenario. Although there are plans for additional water intake capacity – namely from the Karian, Jatiluhur, and Juanda water supply systems – the timeline for operation of these

plants is not certain. As such, for the projection estimates, installed water intake capacity is assumed to be constant through 2030. With projected population increases, reducing NRW by 2 percent per year until it reaches a rate of 5 percent or lower and reducing demand to 100 liters per capita per day (lpcd)[23] could cut the water supply deficit almost in half by 2030.

Table 9: Water Supply-Demand Balance Projections for 2030 in Greater Jakarta

PDAM	Coverage within PDAM service area		Coverage for entire administrative area of jurisdiction	
	Business-as-usual (L/sec)	*NRW reduction and demand management (L/sec)*	*Business-as-usual (L/sec)*	*NRW reduction and demand management (L/sec)*
DKI Jakarta – PAM Jaya	(12,836)	(2,283)	(12,836)	(2,283)
Kota Tangerang– PDAM Tirta Benteng	(2,060)	(1,537)	(5,913)	(4,105)
Kabupaten Tangerang and Kota Tangerang Selatan – PDAM Tirta Kerta Raharja	(4,718)	(2,521)	(12,436)	(7,666)
Kota Depok – PDAM Tirta Asasta	(2,915)	(2,271)	(6,764)	(4,837)
Kota Bogor – PDAM Tirta Pakuan	(1,184)	(21)	(1,184)	(21)
Kabupaten Bogor – PDAM Tirta Kahuripan	(5,544)	(4,133)	(14,513)	(10,112)
Kota Bekasi – PDAM Tirta Patriot	(2,017)	(1,798)	(7,684)	(5,576)
Kabupaten Bekasi – PDAM Tirta Bhagasasi (includes customers from Kota Bekasi in its service coverage)	(7,567)	(5,713)	(11,215)	(8,144)
Greater Jakarta	(53,738)	(32,618)	(67,947)	(42,091)

Note: Figures in brackets indicate a deficit in water supply.

[23] 100 lpcd is the minimum service standard for PDAMs.

73. **Even with NRW reduction and demand management, Greater Jakarta needs additional water sources, especially to achieve the target of 100 percent piped water service coverage.** The Karian, Jatiluhur 1, and Juanda water supply systems will bring additional production capacity (4,600 liters per second from Karian Dam, 4,750 liters per sec from Jatiluhur 1, and 8,500 liters per sec from Juanda Dam). However, this may not be enough to meet future demand, and timelines to begin operation are still fluid. Mechanisms for alternative water sources, such as wastewater reuse, should be explored and implemented to address the water supply deficit. Private estate and building developers, as well as industries, should be engaged to implement water reuse for non-potable water purposes.

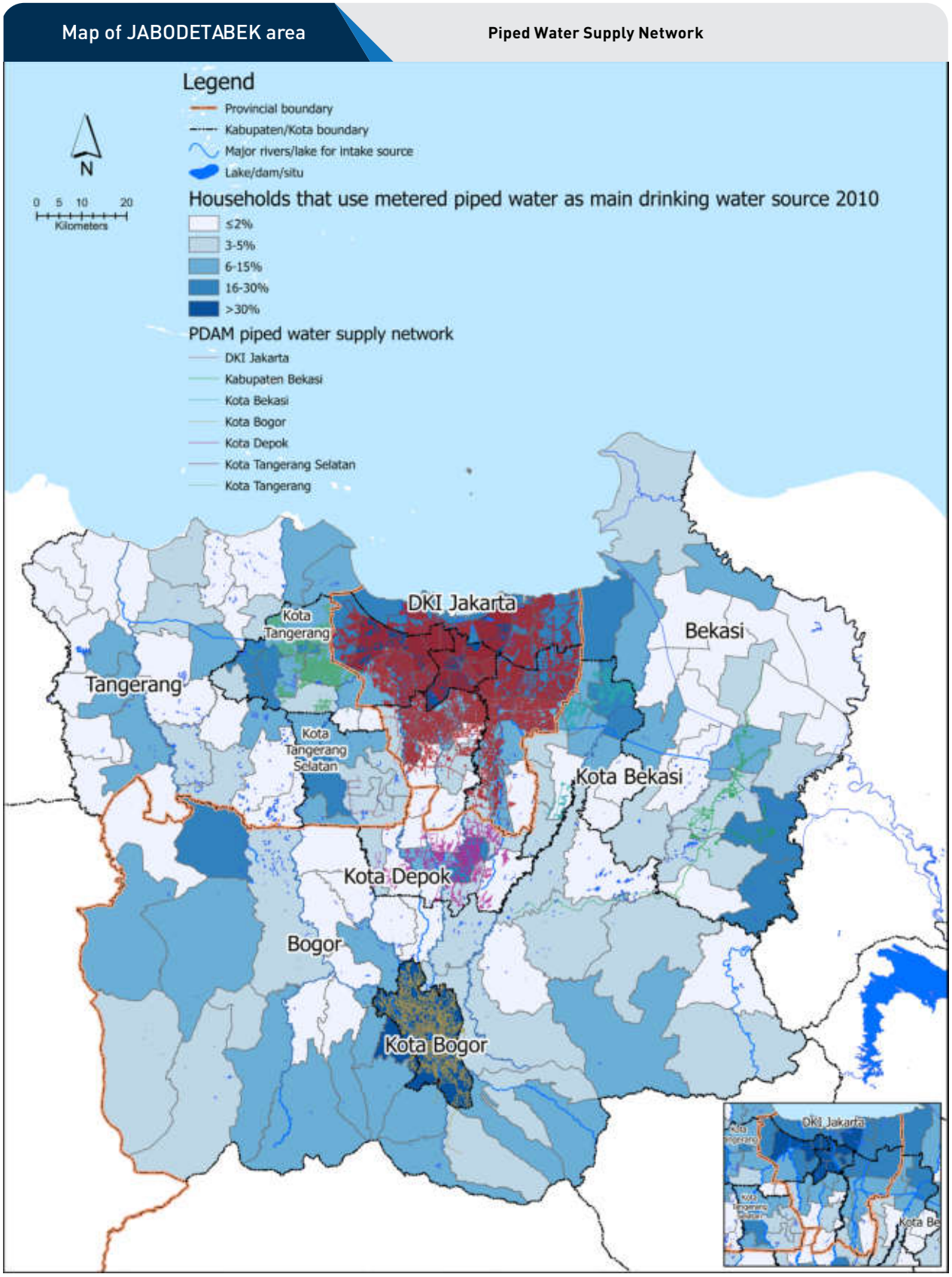
74. **The water supply deficit also underscores the importance of protecting and rehabilitating catchment areas and water resources to maintain and restore natural water storage capacity and water quality.** There is a need to scale up river and catchment rehabilitation efforts such as *Citarum Harum* and *Gerakan Ciliwung Bersih*. The scarcity of water supply also helps justify key elements of the central government–led NCICD project. These efforts increase raw water supply to help meet rising demand.

75. **Increasing raw water supply also paves the way for piped water network expansion, which is currently still limited.** Table 7 above showed that coverage rates within utility service areas are below 50 percent for six out of the eight PDAMs in the region. It is important to note that these coverage rates would be even lower if calculated on the basis of the population in the administrative area rather than the service area. PDAMs may report on either of two coverage indicators: technical service (*pelayanan teknis*) or administrative service (*pelayanan administratif*) rates. Technical service coverage is based on the population within the areas served by a PDAM's distribution network. Administrative service coverage is based on the total population within the administrative boundaries, including areas not served by the PDAM. Many densely populated areas are not served by piped networks, while some areas are served by two PDAM networks. The latter implies that other densely populated areas close to existing networks are not served, and suggests inefficient investment; it also highlights opportunities to increase coverage through better coordination between PDAMs.

76. **Some PDAMs do not have geodata for their water distribution networks.**[24] Those available are shown in figure 13. Pipe networks for Kabupaten Bogor and Kabupaten Tangerang are not available, and the distinction between primary, secondary, and tertiary pipes for other jurisdictions are not apparent on the map. Having a coordinated database with this information, overseen by a regional institutional authority, could help to facilitate IUWM opportunities (see recommendations in section 5).

[24] Geodata were gathered on PDAMs and small-scale piped network coverage, and census data was used to characterize sources of water used by households for drinking and bathing.

Figure 13: PDAM Piped Water Networks and Households Using Metered Piped Water as their Main Drinking Water Source, by *Kecamatan*



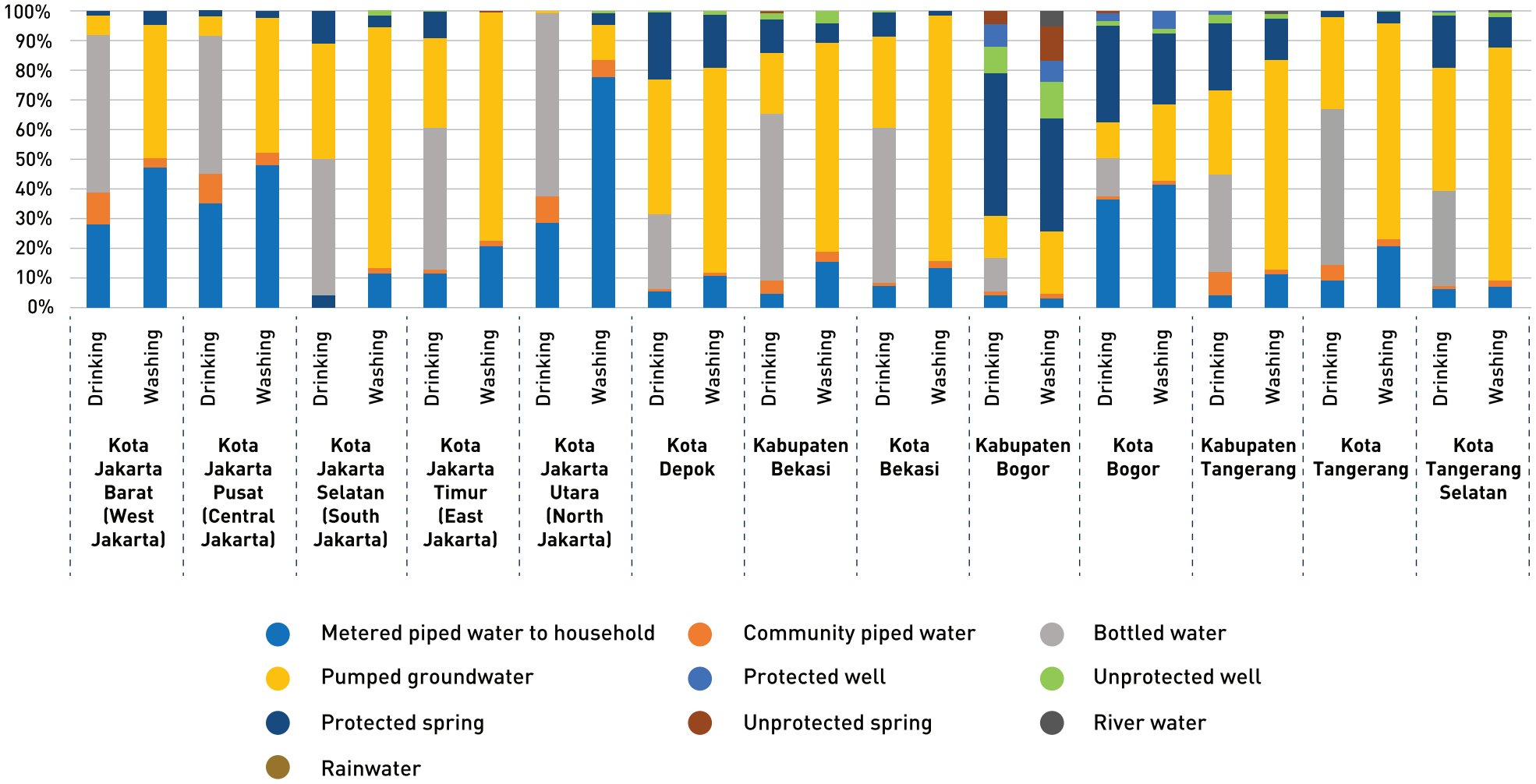
77. **Households with a piped connection may still rely on alternative sources of water supply due to poor service quality and cost factors.** This explains the low usage of piped water even in areas serviced by the piped network, as shown in figure 13 above. Piped water supplies in the region are not potable, so households must either invest in end-of-tap water treatment equipment or use bottled water or deep well water for drinking. Table 10 and figure 14 show that reliance on bottled water is very high and, based on the 2010 national census data, characterizes more than 50 percent of the four municipalities in Greater Jakarta. A higher proportion of households uses piped water for bathing, but a large majority rely on pumped groundwater (RISKESDAS 2013). This includes households that do not have a connection as well as those that do have a connection but choose to use pumped water because of poor piped service quality (low pressure, intermittent supply) or because the cost of using piped water is higher. This implies that service quality, as well as access, will need to improve in order to incentivize households to move away from groundwater use. In upstream areas, namely Kabupaten Bogor, 68 percent of households rely on water from wells and springs, which motivated efforts to increase and improve vertical drainage via infiltration wells.

Table 10: Greater Jakarta Household Water Supply Sources

Jurisdiction	Main drinking water source				Main bathing water source		
	Metered piped water (to household)	Retail piped water	Pumped water	Bottled water	Metered piped water (to household)	Retail piped water	Pumped water
DKI Jakarta	19.6%	5.3%	18.5%	50.7%	36.3%	2.8%	57.1%
Kota Tangerang	10.0%	4.5%	30.4%	52.8%	21.4%	1.9%	72.5%
Kota Tangerang Selatan	7.3%	0.3%	40.6%	32.2%	7.7%	2.1%	77.6%
Kabupaten Tangerang	4.6%	8.1%	27.3%	33.0%	12.4%	1.1%	69.5%
Kota Depok	6.3%	0.1%	44.5%	25.8%	11.3%	1.1%	68.0%
Kota Bogor	37.0%	0.6%	11.4%	13.3%	42.0%	1.1%	25.3%
Kabupaten Bogor	5.22%	0.47%	13.70%	12.01%	4.10%	1.00%	21.10%
Kota Bekasi	7.8%	1.0%	30.6%	51.7%	13.9%	2.5%	82.1%
Kabupaten Bekasi	5.3%	4.1%	20.4%	56.0%	16.0%	3.4%	70.0%

Source: Main drinking water source from the 2010 Indonesia Census (BPS 2010). Main bathing water source from Julianti et al. 2013; MOH 2013a; MOH 2013b.

Figure 14: Greater Jakarta Water Sources for Drinking and Washing

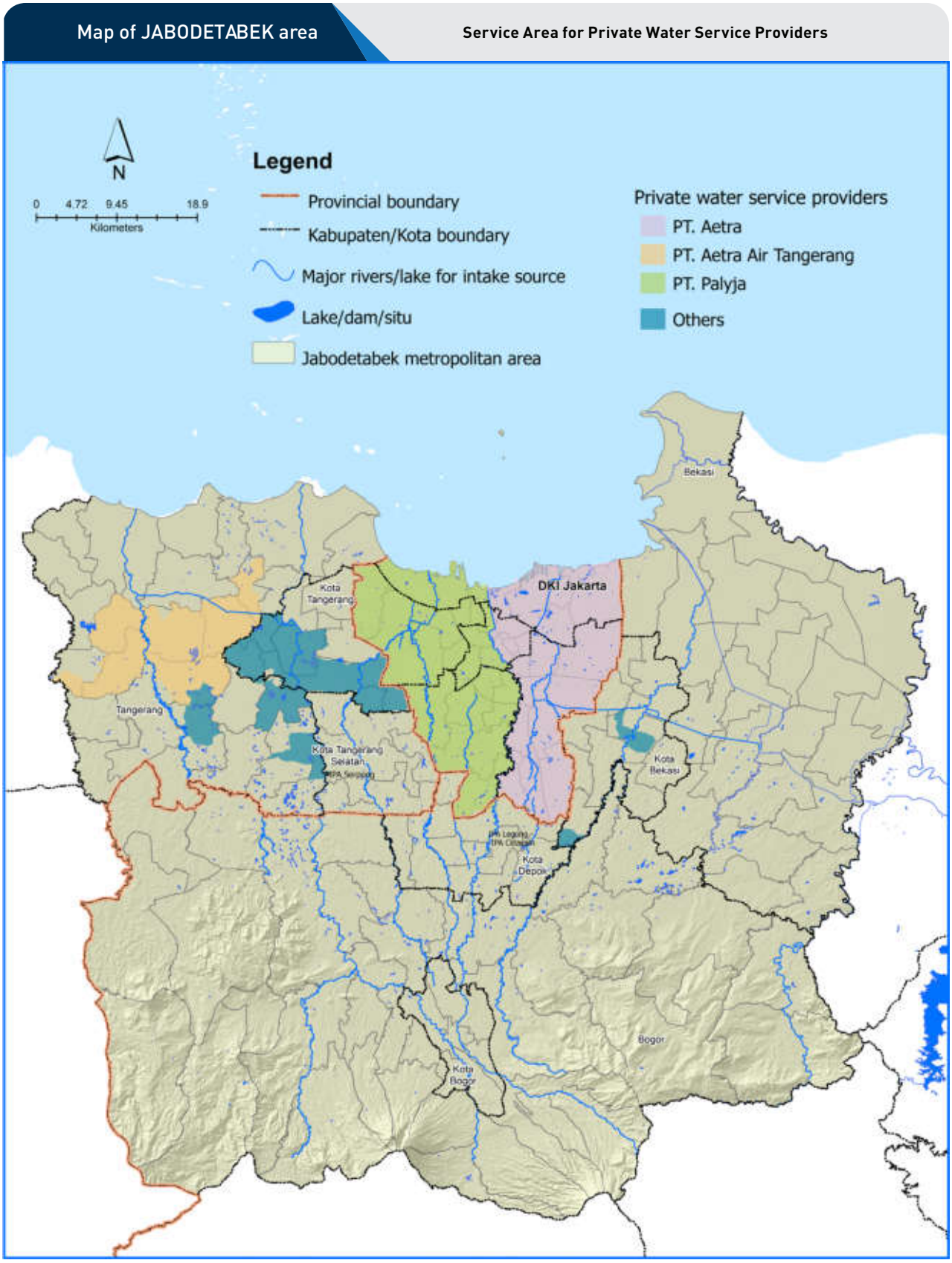


78. **Private sector companies play an important role in drinking water supply in Greater Jakarta.** For DKI Jakarta, private concessionaires provide water services under 25-year contracts. These contracts will come to an end in 2023 and it is unclear what future role the private sector will play, given the current government regulations. In Kota Tangerang, private operators provide bulk treatment and network development under a BOT+ model. In other parts of the metro region, private real estate developers construct and operate networks within their development zones – some by buying bulk water from PDAMs, some by obtaining permits to build their own WTPs from surface water (rivers) and/or groundwater sources. For example, Lippo Karawaci and Bogor Nirvana purchase water supply directly from the PDAM; those dependent on groundwater sources include Jaya Property (Bintaro Jaya and Graha Raya); and developers building WTPs that use the river as their source include Pantai Indah Kapuk and Summarecon (Gading Serpong and Bekasi). Figure 15 illustrates the extensive involvement of private actors and the spatial extent of their coverage.

79. **For poor households, the economic impacts of poor access to adequate piped water services and coverage is significant.** Studies have repeatedly shown that poor households without piped water connections spend more on water than mid- to high-income households with connections (World Bank 2006). This is especially true in informal settlement areas in North Jakarta, and among other locations dispersed throughout DKI, where households purchase water from vendors and trucks. In nominal terms, the prices of these water sources are much more expensive than the PDAM tariffs that wealthier residents pay (approximately Rp 5,000 per cubic meter). One study showed that poor residents accessing water from vendors pay on average Rp 5,000–7,500 per 25-liter container, amounting to Rp 20,000–30,000 per cubic meter; from water trucks, customers can pay up to Rp 75,000 for three tanks with a capacity of 1 cubic meter each, which is four to six times more than the PDAM tariffs.

80. **While central government–led investment may be needed for future large water resource projects, this section has revealed the wide scope for actions that can be taken by local governments within the existing governance framework.** Such actions would include building out networks, coordinating investment programs to efficiently serve communities along municipal boundaries, improving operating efficiency to increase treated water supply without additional resources, and managing demand.

Figure 15: Service Areas of Private Water Supply Providers in Greater Jakarta



3.3. Sanitation

81. **Data collection on sanitation focused on the extent of access, including on-site and off-site infrastructure, identifying community-based sanitation (*Sanitasi Berbasis Masyarakat* or SANIMAS) facilities, and locations with greywater collection and treatment infrastructure.** This section begins with the overall indicators of sanitation in terms of access to facilities, followed by the implications of and processes governing on-site sanitation systems, considerations for off-site sanitation development plans, and the potential for introducing a Citywide Inclusive Sanitation (CWIS) framework.

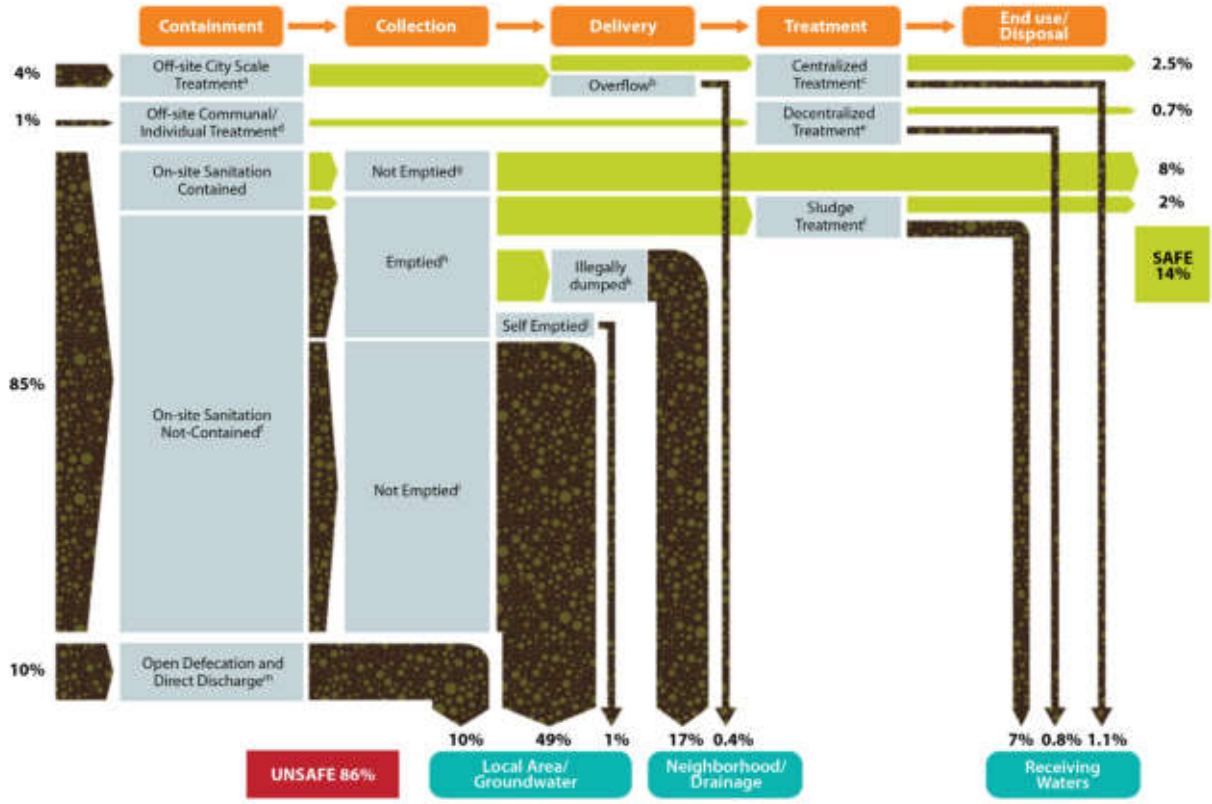
82. **Sanitation services in Greater Jakarta are almost entirely in the form of on-site facilities owned by individual households.** Poor-quality infrastructure and inadequate maintenance of onsite facilities leads to extensive contamination of ground and surface waters. DKI Jakarta's fecal flow diagram (FFD) highlights the extent of the problem (Rodriguez et al. 2016; figure 16 below). Cumulatively, 86 percent of wastewater is released to the environment without adequate treatment. Similar analysis has not been carried out for other jurisdictions within the Greater Jakarta region, but is likely to yield similar trends (though lower concentrations due to density factors) and indicate the production of unsafe water across the sanitation service chain. Applying FFDs, along with complementary analysis that showcases the extent of the problem and its implications, could help identify opportunities for building IUWM partnerships. Findings could encourage targeted, staged solutions under a CWIS approach that steadily reduce contamination and foster innovation to improve services. However, FFDs only present an evaluation of blackwater contamination. Contamination from household waste (or greywater), is an even larger source of pollution in waterways. Greywater is mostly untreated and usually empties directly into local drainage systems. Deteriorated water quality throughout Greater Jakarta's waterways significantly affects local ecosystems, is particularly detrimental to public health, and diminishes overall livability standards.

Box 2: Citywide Inclusive Sanitation

CWIS is a paradigm shift in urban sanitation. It brings together concepts of sustainable environmental health and equity for the provision of sanitation services and wastewater management, conducted through combined on-site and off-site system in ways that are integrated and complementary. The four overarching principles of CWIS are that: i) sanitation is a human right and everyone should have access to it; ii) safely managed sanitation has to be planned across the complete sanitation service chain (from containment to disposal); iii) sanitation is important for economic prosperity; and iv) coordination is needed with other sectors and stakeholders to achieve positive benefits to society (see figure below). The CWIS framework complements and supports IUWM to ensure that water and sanitation are coordinated with no negative externalities and that universal coverage of services is achieved.

Source: Bill & Melinda Gates Foundation et al. 2016.

Figure 16: Fecal Flow Diagram for DKI Jakarta Province, 2016



Source: Rodriguez et al. 2016.

83. **For a metropolitan area on the scale of Greater Jakarta, the region has some of the lowest levels of sewerage coverage in the world** (table 11). There are only two existing sewerage networks: one in the center of DKI Jakarta, and a smaller system in Bogor (figure 17). There are some private operations, like Summarecon in Bekasi, that manage private sewer networks for real estate developments. DKI Jakarta's main sewerage network serves approximately 2 percent of the total population, but plans are underway to significantly expand services in the near and medium term. DKI Jakarta is divided into 15 sanitation zones, two of which are anticipated to begin sewerage construction in the near future, supported by the Japan International Cooperation Agency (JICA). Although the data for Greater Jakarta in table 11 is dated, based on the current literature and conversations with stakeholders, sewerage network coverage expansion in Greater Jakarta has not significantly increased since 2010, spotlighting the severe inadequacies of sewerage network coverage in the metro region.

Table 11: Percentage of Urban Population with Access to Sewerage Network

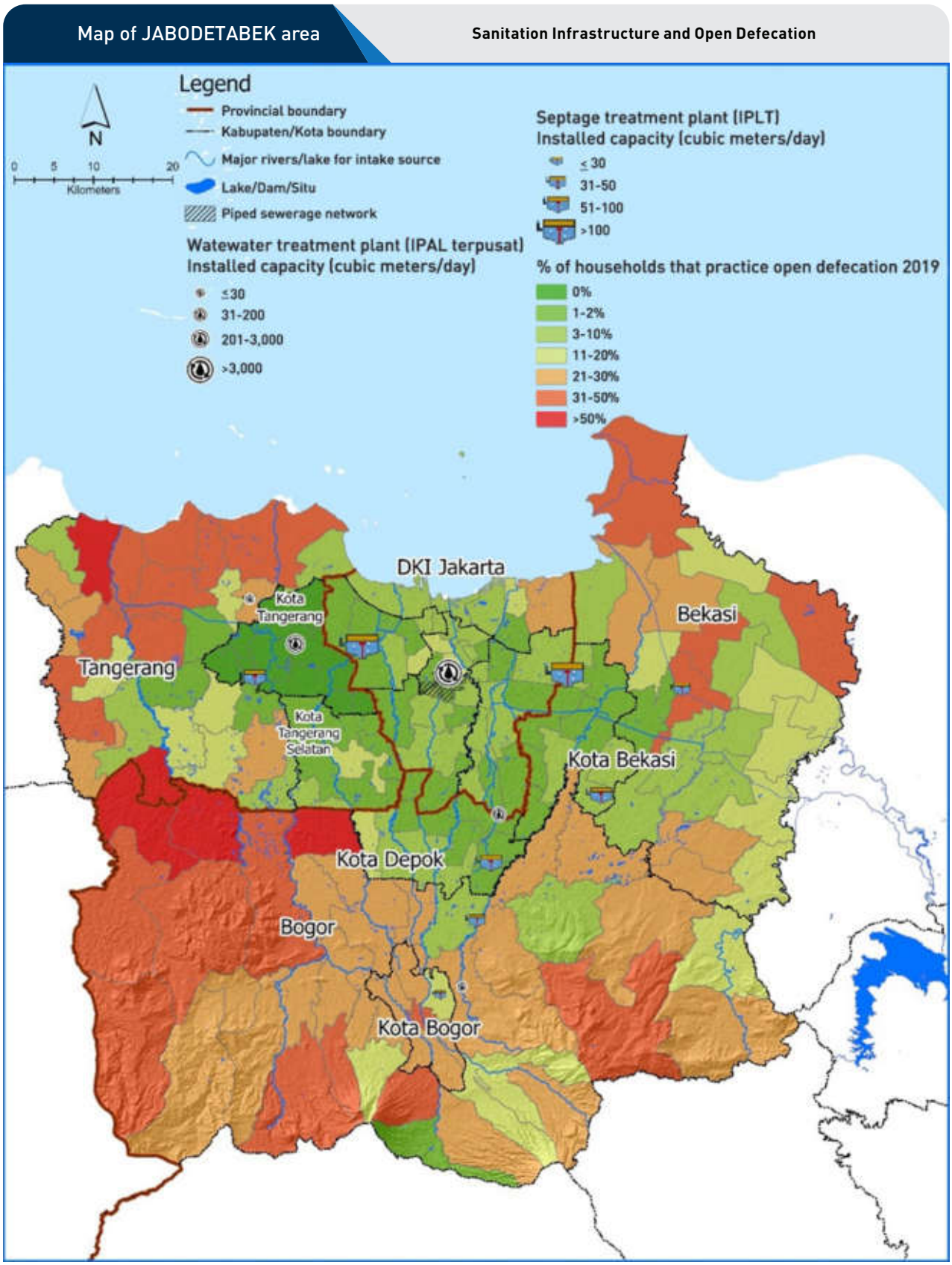
Urban area	Sewerage network coverage
Greater Jakarta	~2% (2010)
Metropolitan Manila	15% (2019)
Bangkok	40% (2016)
Greater Vitoria Metropolitan Region (GVMR), Brazil	54% (2016)
Beijing	95% (2016)
Chennai	100% (2016)

Sources: Data for Greater Jakarta from the 2010 Indonesia Census (BPS 2010); for Metropolitan Manila, UNESCO 2019; for GVMR, Kennedy-Walker et al. 2020 (GVMR); for Bangkok, Beijing, and Chennai, IWA 2018.

84. **Because of the decentralized approach to sanitation services, each district or municipal government develops its own plans to provide sanitation services.** While DKI Jakarta is unique for its existing and planned expansion of sewerage infrastructure, all other local governments depend on their single septage treatment plant (*Instalasi Pengolahan Lumpur Tinja*, or IPLT) for that jurisdiction (figure 17). Each of these local governments place their IPLTs in the boundary areas. Their geographic location and the transportation services required to deliver septage to IPLTs could provide opportunities for cross-jurisdictional coordination. Nevertheless, existing capacities of local government agencies, septage transportation services, and the IPLTs themselves fall far short of what would be required to process sufficient volume and ensure safe sanitation throughout the system. Most households have their own septic tanks that need to be periodically emptied by septic trucks, requiring transportation of septage to IPLTs. Septic tanks are typically not emptied and maintained often enough, leading to leakages and contamination of land and water resources.

85. **In DKI Jakarta, there are efforts underway to improve sanitation services.** In addition to the planned expansion of sewerage infrastructure, PD PAL is upgrading on-site systems through a septic tank support program and is piloting regular desludging to enhance fecal sludge management. One program, SANIMAS, has had some success and is popular in Kota Bogor and Kota Bekasi. SANIMAS provides support for community-based institutions, ranging from approximately 20 to 100 households, to connect their toilets to a single system.

Figure 17: Wastewater Infrastructure and Open Defecation in Greater Jakarta



86. **Access to a toilet and open defecation indicators provide a broader stock-take of sanitation across Greater Jakarta and point to a low baseline of coverage, which affects water quality across water systems.** Figure 17 shows the spatial pattern of open defecation in Greater Jakarta; table 12 extends the analysis by presenting data on the percentage of households in each Kabupaten and Kota that practice open defecation. Overall, 89.2 percent of Greater Jakarta's population has access to some form of toilet and does not practice open defecation, but there are variations among Kabupatens and Kotas, as well as stark differences within each jurisdiction. While there are areas – particularly on the fringes of Kabupaten Tangerang, Kabupaten Bogor, and Kabupaten Bekasi – where more than 30 percent of households practice open defecation, some municipalities (e.g., Kota Tangerang) have taken pains to fully eradicate open defecation, which should be a priority target for local governments. Data on toilet access and open defecation help to highlight public health concerns, particularly at the household level. Such data can be connected to corresponding public health indicators from subdistrict-level health facilities (*puskesmas*). Studies are also increasingly connecting sanitation to the incidence of stunting, which has become an important area of public concern in Indonesia (Rah et al. 2020; Cameron et al. 2021).[25] The data also reinforces water quality concerns: when viewed from a systems level, studies repeatedly show that Greater Jakarta's rivers are severely polluted, particularly as a function of domestic wastewater flowing directly into rivers (Riani et al. 2018; Dsikowitsky et al. 2018).

Table 12: Percentage of Households with Access to a Toilet, 2019

Kabupaten/Kota	Open Defecation	Permanent toilet	Semi-permanent toilet	Shared toilet
DKI Jakarta	3.9%	82.7%	8.2%	5.2%
Kabupaten Bekasi	8.9%	68.1%	16.5%	6.5%
Kabupaten Bogor	25.9%	38.8%	31.4%	3.9%
Kabupaten Tangerang	20.3%	41.0%	30.3%	8.4%
Kepulauan Seribu	32.8%	0.7%	0.2%	66.3%
Kota Bekasi	1.0%	92.5%	3.4%	3.1%
Kota Bogor	26.3%	69.0%	2.8%	1.9%
Kota Depok	2.5%	88.1%	8.9%	0.5%
Kota Tangerang	0.0%	92.2%	0.5%	7.3%
Kota Tangerang Selatan	0.4%	78.0%	16.4%	5.1%
TOTAL	**10.8%**	**68.4%**	**15.8%**	**5.0%**

Source: MOH 2021.

[25] RPJMN 2020–2024 sets a target for reducing stunting to 14% from 27.7% in 2019.

87. **The economic impacts of sanitation present a particularly stark development barrier, especially for low-income communities and informal settlements.** A study by the Water and Sanitation Program (WSP) for DKI Jakarta indicated that poor sanitation costs US$1.4 billion per year, 1 billion (or 80 percent) of which is associated with health-related losses from unsafely managed sanitation (Rodriguez et al. 2016). These losses are three times higher in Greater Jakarta than in the rest of the country, with estimated per-capita losses amounting to US$139 per person per year. Impacts to the poor are significantly higher due to their existing vulnerabilities and greater likelihood of contact with unclean water, as well as the heightened relative costs for them to seek treatment for illnesses.

88. **The three sectors discussed in this section – flooding, water supply, and sanitation – are interrelated.** Flooding is exacerbated by subsidence, which is partly attributed to deep groundwater abstraction. Groundwater is still being widely used for water supply in the absence of more reliable services and sources. Water resources for drinking and domestic consumption are limited by the poor quality of surface and groundwater, which is substantially contaminated by fecal matter and other pollutants, exacerbated by poor sanitation services and practices. Closely related are issues pertaining to solid waste: large volumes of solid waste are exceeding management systems and capacity, causing significant levels of waste to end up in rivers and canals, which reduces the functionality of drainage systems, intensifying flooding and deteriorating overall water quality (see Annex 3). These interrelated issues across the three connected sectors highlight the need for an integrated approach to solving urban water problems. The next section further analyzes the interlinkages across sectors.

3.4. Intersectoral analysis

This section presents data and visualizations of some of the most important cross-cutting water issues.

3.4.1. Subsidence, groundwater abstraction, and saltwater intrusion

89. **Figure 18 plots groundwater usage against subsidence and saltwater intrusion,** the phenomenon of saltwater flowing inland into freshwater aquifers. The figure shows high rates of subsidence in coastal areas across the northern part of Greater Jakarta, where many low-income communities are located, and where subsidence substantially raises coastal flood risk in the northern part of the city. The map also shows high rates of subsidence in densely populated and commercial areas of central Jakarta and in the high-end residential areas to the southwest and southeast of DKI Jakarta.

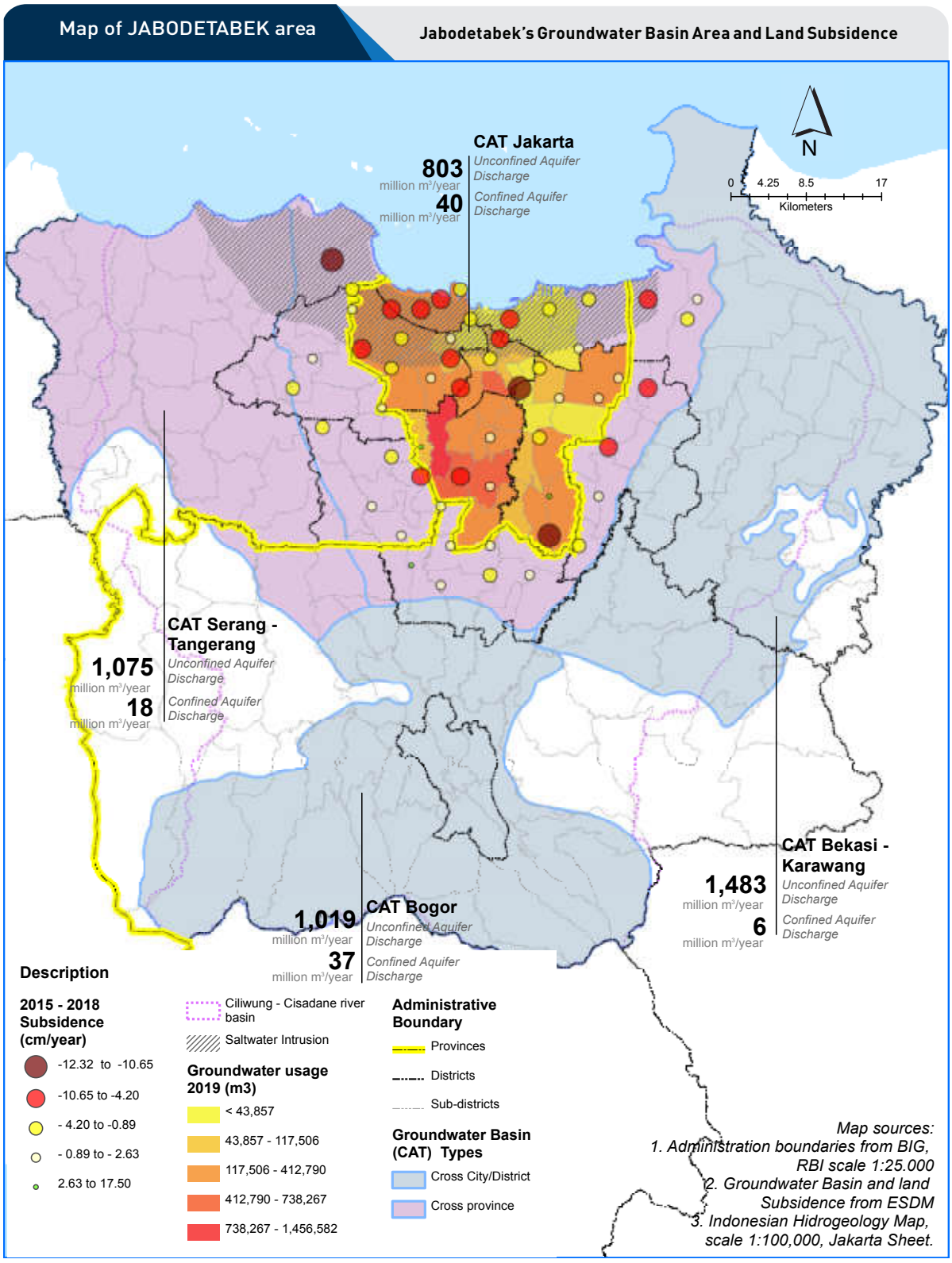
90. **High subsidence correlates with areas where access to piped water supply is limited:** either no piped network has been constructed (as in the southwest) or the existing piped network provides intermittent, low-pressure supply. In the absence of network services, high-income households use water pumped from the confined aquifer while poorer households depend on shallow groundwater. Thus, low-income households face compounded risks from limited access to piped water; contaminated, saline groundwater supply; and coastal flood risks. Excessive groundwater abstraction is both a consequence of poor piped supply and a cause of subsidence and saltwater intrusion, and managing it thus requires an integrated set of solutions: stronger groundwater governance and effective monitoring and enforcement of abstraction licenses, in parallel with the extension of piped water services to reduce the demand for groundwater.

3.4.2. Flood management and aquifer recharge

91. **Effective flood management requires coordinated action at the national, regional, and local levels, implying an urgent need for collaboration between government levels and agencies.** The high frequency of flood events across Greater Jakarta creates a host of negative impacts. Flooding is clearly not just a downstream problem. While the northern part of the metro area is more exposed to coastal surges and detention basin overflows, upstream areas face risks from poor localized drainage systems and flash flooding, and potentially face dangerous landslides. There are few protective actions that individual residents or local communities can take to protect themselves against coastal flood risk. Some downstream jurisdictions, like Kota Tangerang Selatan, have instituted a zero-run-off policy for new properties, which has yielded significant flood mitigation results. However, upstream action should also aim to better protect riverbanks from encroachment, prevent against land-use change in critical parts of the catchment, and slow river flows through retention features (e.g., infiltration wells, vertical drainage), which together would provide significant benefits to surrounding communities in the upper catchment as well as those downstream.

92. **For upstream jurisdictions, a further benefit of constructing infiltration wells is the additional water resource that such interventions can provide.** This has been demonstrated in Kabupaten Bogor, where an initiative involved retaining flood waters and using them to restore spring water sources that had been depleting over time.

Figure 18: Greater Jakarta Groundwater Basin Area and Land Subsidence



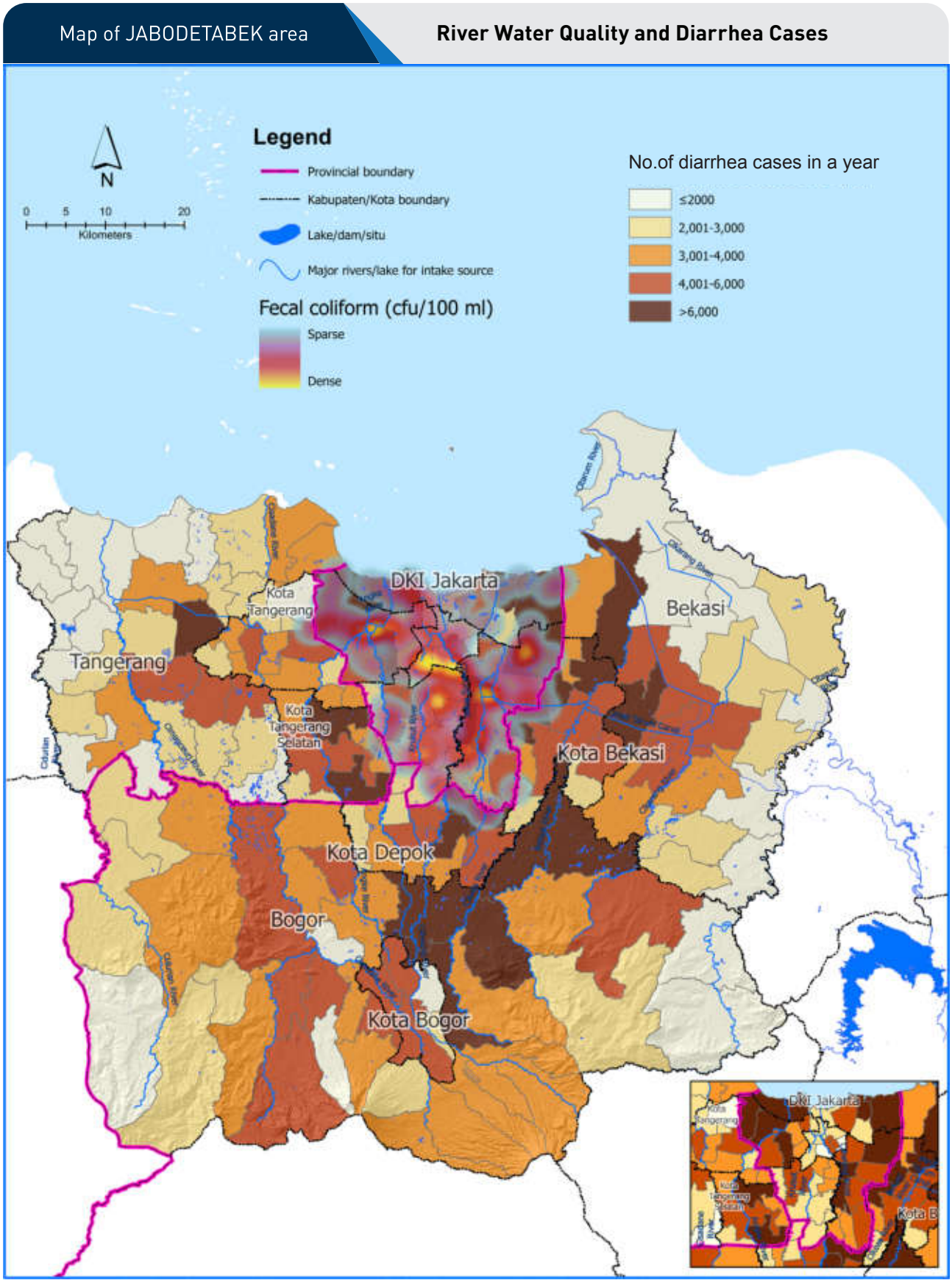
3.4.3. Water resources quality, sanitation, and health

93. **Figure 19 shows surface water quality alongside health outcomes, focusing on the pervasive health risk of diarrhea.** Although the analysis showed no clear relationship between open defecation and surface water quality, this is likely due to the lower population densities in the outer areas of Greater Jakarta, leading to comparatively less loading of contaminants in water bodies. However, the high levels of coliform contamination found throughout the densely populated urban areas provides evidence that current standards for on-site septic tank equipment, installation, and maintenance are not adequate to prevent environmental contamination and related health risks. Solid waste similarly acts as a vector for disease, creating unseemly environmental health conditions.

94. **All major rivers in Greater Jakarta are moderately to heavily polluted** (MOEF 2016). Poor river water quality leads to higher water treatment costs for downstream jurisdictions. If WTPs are not equipped to treat influent water adequately, poor river water quality also reduces raw water supply, leading to interruptions at intakes. This poses a challenge in providing piped water to households. Inadequate raw water is cited by local governments as justification for an inability to expand pipe networks, but there may be potential to increase water supply if raw water quality is improved. This suggests that it would be helpful to establish a payment mechanism through which downstream users could finance costs of reducing contamination in jurisdictions upstream.

95. **Cleanup efforts such as *Ciliwung Bersih* and *Citarum Harum* have not generated significant positive impacts yet, but they offer a promising opportunity for initiating IUWM activities that simultaneously address multiple water-related concerns.** Success could present potential pathways for scaling up to other waterways that cross jurisdictions, including the Cisadane, Cidurian, and other major rivers.

Figure 19: River Water Quality and Diarrhea Cases



4. IUWM barriers and opportunities in Greater Jakarta

4 IUWM BARRIERS AND OPPORTUNITIES IN GREATER JAKARTA

96. **Stakeholders in Greater Jakarta expressed a high degree of buy-in regarding IUWM implementation initiatives for the region.** This eagerness is driven by a growing understanding of the acute risks posed by water security issues. National-level stakeholders in Bappenas, MOHA, and MOPWH are familiar with IUWM concepts and support their adoption by local governments. Local government officials were often unfamiliar with the term IUWM, but in many jurisdictions they were able to identify ongoing actions consistent with IUWM.

97. **In certain respects, the existing governance and regulatory framework is consistent with IUWM principles, but stakeholders identified challenges to adopting IUWM throughout the policy process for water-related issues.** In particular, disjointed governance across administrative boundaries in Greater Jakarta and uncoordinated planning processes across sectors need to be addressed to support the adoption of IUWM (see Box 3). This section of the report summarizes key issues specific to Greater Jakarta that were raised by stakeholders during the project workshops and cluster discussions held in 2019–20. A parallel report, "National Framework for Integrated Urban Water Management in Indonesia," presents the national-level findings raised in these discussions.

Box 3: Institutional Coordination in Greater Jakarta: History and Issues

Ali Sadikin (Governor of DKI Jakarta from 1966 to 1977) was among the most prominent of Jakarta's leaders and has left an indelible legacy in shaping th convened several public events on establishing a coordinating ministry focused solely on Jakarta and surrounding areas. Nearly half a century later, Greater Jakarta stands as one of the largest metropolitan areas in East Asia, and still does not have an authoritative coordination body.

Greater Jakarta's development has fused together urban areas across jurisdictional boundaries. The 1998 post-*reformasi* democratic decentralization policies initiated a splintering of Indonesia's administrative units, adding further complexity to governing Greater Jakarta. Moreover, early regional autonomy laws vested authority in local governments (*kabupaten/kota*) that had neither the capacity nor the resources to undertake such responsibilities. With the exception of DKI Jakarta, which maintained provincial authority, local government development planning devolved to municipal and district mayors/*bupatis* and parliaments, further entrenching coordination challenges.

The central government, through the Ministry of Home Affairs (MOHA), stepped in to facilitate coordination, issuing ministerial regulation number 6 of 2006 on the establishment of the Local Government Development Cooperation Agency (BKSP) for Jabodetabekjur, a portmanteau of the representative local governments. MOHA directs BKSP to focus on issues such as flooding, traffic congestion, sanitation, water supply, and food security. MOHA's regulation also provides the basis for structuring the agency, whereby the chairmanship rotates once every three years between governors. Jakarta hosts the secretariat office for BKSP, while all provinces provide budget support for its operations, with Jakarta shouldering the largest responsibility.

Though it largely serves a coordinating role, BKSP has facilitated some key agreements on cross-boundary issues between provinces. These include agreements on infrastructure, such as transportation and solid waste. Though they are significant in their own right, success on these agreements also required untangling the following governance challenges:

1. There is asymmetric autonomy among the local governments within Greater Jakarta, and between DKI Jakarta, Banten, and West Java, further complicated by the local governments in each province. This exacerbates coordination challenges, as each jurisdiction follows different governing timelines, shaped by political parties that contest power among local parliaments and the executive.

2. There is no mechanism to enforce compliance on BKSP agreements. Initiatives are only legally binding to the extent local government plans internalize them. Budget approval is also contingent upon local government parliaments and no monitoring system is in place to ensure their compliance with agreements.

3. BKSP remains unable to establish a long-term planning vision for the metropolitan area. Most agreements and activities are ad hoc and short term. Local governments view BKSP meetings as transactional negotiations between Jakarta and surrounding local governments.

Keenly aware of these issues, MOHA is reviewing the mode of BKSP coordination, and seeking to apply similar measures to other rapidly growing metro areas. The Law on Regional Governance number 23 of 2014 has been expanded upon by Government Regulation number 28 of 2018 on Local Government Cooperation and MOHA Ministerial Regulation number 20 of 2020 on Mechanisms of Local Government Cooperation, providing more robust options for cooperation. Those regulations do not specifically mention BKSP. MOHA is still looking for an appropriate mode of cooperation and explicitly proposed the water sector as an ideal pilot.

4.1. Law and regulation

98. **The Water Law and its implementing regulations provide a strategic basis for addressing groundwater concerns and improving pollution control.** The Water Law, passed in 2019, mandates stronger limits and restrictions on the use of groundwater, which can help address the alarming trends of land subsidence in Greater Jakarta. In addition, draft regulations on drinking water acknowledge the importance of integrating provisions on wastewater and solid waste management, and require service providers to develop water safety plans to address pollution.

99. **Building regulations and codes can be and are already being used to incentivize private sector actors to adopt and scale up on-site water recycling and water retention.** A leading example is the zero-run-off policy in Tangerang Selatan, which is rigorously monitored with detailed sentinel satellite imagery and ground truthing. This policy consists of a coordinated partnership between the planning department, public works agency, and permitting office to require offsets as a prerequisite to issuing permit recommendations. The local government believes this system has profoundly reduced flooding. However, in other jurisdictions, building codes sometimes include stringent requirements that are not accompanied by measures to incentivize implementation or the necessary monitoring and enforcement.

100. **Local governments are aware of the benefits of open permeable space and natural water bodies in managing flooding, and regulatory authority to protect and expand permeable, open, and green spaces is supported by existing spatial planning laws.** In particular, Law 26/2007 on Spatial Planning mandates that each local government designate a minimum of 30 percent of total land area as open green space by 2030, 20 percent of which should be on public land. DKI Jakarta has struggled to move toward this goal and, in consultations, officials suggested that it would be difficult to achieve by 2030. Plans to expand green open spaces are expected to lead to only modest gains at high cost because of elevated land values in the dense metropolitan core. Under current interpretation of the regulations, each jurisdiction within the Greater Jakarta region must meet the 30 percent requirement within its own land area. However, if the requirement were applied at the regional level, there would be strong incentives for more densely built municipalities to cooperate with jurisdictions in the outer part of the metropolitan area to support and finance conversion and protection of land for open green space. Doing so would also incentivize longer-term protection measures in key areas that might be facing pressures related to urbanization.

101. **Some private sector developers in Greater Jakarta are at the forefront of green design.** They have been incorporating water reuse, and controlling water quality control through green open space and the use of permeable materials. For example, PT Lippo

Karawaci and PT Summarecon, among others, have adopted innovative approaches to green design, incorporating IUWM in their private integrated real estate and commercial developments. They provide continuous piped water services, wastewater collection and off-site treatment, demand management, and water retention and recycling for non-potable uses, as well as in some cases offering water-based recreation. Lippo Karawaci, in particular, has been recognized as a pioneer in Edge Cities in Indonesia. Stakeholders recognized opportunities for replication and scale-up of these initiatives, and noted that there was scope to incentivize existing developments to raise water management standards to meet these best practices. In addition, incentives can be employed to require future developments to incorporate flood water retention, water demand management, wastewater treatment, and on-site recycling.

4.2. Governance

102. **Stakeholders in Greater Jakarta recognize the importance of cross-jurisdictional and cross-sectoral coordination, but efforts have been constrained by limited authority and weak incentives.** However, regulations relating to regional governance are currently under review, providing a window for reform. Additionally, Government Regulation 28/2018 supports cross-jurisdictional cooperation and highlights partnership mechanisms between central and local governments and across local governments, which strengthens the basis for local government–led initiatives in Greater Jakarta and other regions. MOHA Regulation 22/2020 provides further details on cross-jurisdictional partnerships. Under this new regulatory framework, teams dedicated to cross-jurisdictional partnerships can coordinate development planning initiatives between regions through plenary and technical meetings; the initiatives are then approved by leadership of each region.

103. **The existing regional development authority for Greater Jakarta, BKSP (*Badan Kerja Sama Pembangunan*), has a mandate to coordinate across jurisdictions.** BKSP was created in 1976 to coordinate the jurisdictions of Jakarta, Bogor, Tangerang and Bekasi (see Box 3). Its scope was broadened in 2010 to include Depok and Cianjur. BKSP was given a coordinating mandate under Presidential Decree 54/2008 and Greater Jakarta was listed as a national strategic region (*Kawasan Strategis Nasional* or KSN) under Government Regulation 28/2008.[26] Its structure and responsibilities were set out in MOHA Regulation 6/2006, which specifies its authority to establish development partnerships around the themes of spatial planning, infrastructure, water resources, the environment, and transportation. However, changes to the decentralized governance framework in 2014 (Law 23/2014) rendered key elements of MOHA regulation 6/2006 obsolete and brought BKSP's status and role under review.

[26] Given the water-related focus of this study, Cianjur, though part of the formal BKSP, is not included in the analysis as it is located outside of the main river basin that covers Greater Jakarta.

104. **MOHA is envisioning new institutional mechanisms in the form of sector-specific secretariats vested with the authority to enforce collaboration between local governments.** MOHA's Director of Deconcentration, Coadministration, and Cooperation – a participant in all four Greater Jakarta cluster workshops for this study – described plans to establish a new structure for local government–led cooperation under thematic secretariats. At the time of this report, the regulations are still under discussion between MOHA and the Ministry of Agrarian Affairs and Spatial Planning (MAASP). Local and central government stakeholders see the water sector as a suitable focus area for an initial Secretariat for Greater Jakarta. The Secretariat would serve as a strategic umbrella, addressing water risks through IUWM to prepare for the future while achieving concrete results in the near term. IUWM in Greater Jakarta could then be extended through several key clusters formed as working groups for the Greater Jakarta Development Authority, specifically around the common interest of addressing flooding, the mutual dependency on water supply, and the overall imperative to improve water quality. A Water Secretariat could potentially also demonstrate to other policy sectors the new institutional arrangement for Greater Jakarta.

105. **Existing cooperation between jurisdictions has been limited, but there have been successful efforts to coordinate flood early warning systems.** Collaborations on flood management between jurisdictions commonly call into the category of early warning systems (EWS). Some EWS aspects are coordinated downstream within neighborhoods, but the systems can also link upstream flood sluices and downstream wards. There are numerous examples of collaboration on the EWS from Bogor to Jakarta, but there are also ways to expand coordination beyond early warning into more comprehensive engagements.

4.3. Planning and implementation

106. **National ministries overseeing spatial planning, notably Bappenas and MAASP, expressed approval for a transition from administrative and land-use planning to a framework that focuses on rivers, water, and watersheds.** Nevertheless, applying functional mechanisms in Greater Jakarta will be challenging due to the lack of mandates or incentives. Currently, as per Law 26/2007, spatial planning takes place with either a functional or administrative approach, but the latter has clearer mandates and procedures. Bappenas has worked to support functional planning focused on strategic water resource issues by proposing new frameworks that mandate and incentivize regional governments to improve targets on water supply, sanitation, flooding, drainage, and solid waste management. For example, the One Map Policy works across central government ministries to down-scale mapping products and develop thematic maps as a way to support water resources planning. Law 23/2014 lays out mandates for natural resource management – including water resources – specifying responsibilities for each

level of government (central, provincial, and district or municipality) based on the scale of the activity. The law also mandates that it is the role of the provincial government to improve coordination between and among each level of government.

107. **The decentralized planning process leads to tensions between local governments seeking to protect local autonomy and meet economic development and fiscal objectives.** Elected mayors and district heads (or governor in the case DKI Jakarta) and local elected parliaments influence development planning. Local governments note that, as a result, there is little incentive to take into account policy impacts that fall outside their jurisdictions. In terms of water resources specifically, local governments in Greater Jakarta's upstream regions expressed the view that they were not compensated adequately for the value of their water resources to downstream areas; conversely, downstream jurisdictions described burdens from pollutants and flood waters as a result of development decisions upstream. In Greater Jakarta, a specific planning hurdle relates to the hierarchical placement of government of DKI Jakarta, which has provincial status, in contrast to the surrounding regional governments, which are all at the level of the district or municipality. This exacerbates coordination issues, because the respective local governments report to their provincial capitals in Bandung (West Java) and Serang (Banten), which are geographically distant from DKI Jakarta.

108. **Across this complex governance landscape, the mid-term development plan (RPJMD) is the most significant document in guiding budgeting and implementation processes.** RPJMDs are guided by district heads or mayors (or governor in the case of DKI Jakarta) and shape the overall framework for delivering on their campaign promises. It is therefore unsurprising when such development planning processes contradict one another. Though the regional spatial plans (RTRW) may call for coordination and cooperation, incoming leaders are certain to make revisions to their plans through the RPJMD process, and the timing of elections also means that the planning processes are taking place at different periods, posing additional difficulties in synchronizing initiatives.

109. **Within local governments, fragmented planning processes for the different elements of the urban water cycle also poses a challenge for the adoption of IUWM.** Although the workshops highlighted broad-based support for IUWM, challenges to coordinating spatial planning with sectoral plans are hampered by issues with data collection and sharing, disincentives from budget allocation processes, and other institutional barriers. For example, RISPAM, PDAM business plans, and city sanitation strategies only provide cursory reference to spatial plans. The lack of intersectoral planning also poses challenges for developing proposals to benefit from the additional support programs offered by the central government.

110. **Several local governments in the region have begun to adopt pilots for water reuse and integrated flood management, which could be replicated or scaled up.** For example, a Bed Biofilm Reactor, which will treat wastewater for reuse, is planned for inception in 2021. The plant, sited along the Krukut River, anticipates capacity to treat and recycle water at 100 liters per second and will be utilized by neighboring buildings to flush toilets, by the forestry agency to water plants, and by the fire department to extinguish fires. Along similar lines, Kota Bekasi has implemented a promising pilot project called the Biocord Galaxi wastewater facility, which treats greywater from several thousand surrounding households. Kota Bekasi is now planning to expand the scheme in several stages, with replication slated for nine other locations throughout the city. Meanwhile, initiatives for water retention are included in the spatial and development plans and highlighted in RISPAMs. The RISPAMs list infiltration wells in DKI Jakarta, Depok, and Bogor; infiltration ponds in Tangerang Selatan and Kota Bekasi; retention and detention ponds in Kota Bogor; vegetated banks and green belts along rivers in Kota Tangerang Selatan and Kota Tangerang; and river development controls in Kota Bekasi and Kota Tangerang. Kabupaten Bogor is also planning to strategically place infiltration wells to replenish the subsurface springwater sources of the Cisadane and Ciliwung rivers. Kota Bogor has plans to reforest and restrict development at key infiltration sites to reduce groundwater pollution. Kota Tangerang is planning eco-tech gardens by integrating ornamental plants to treat domestic wastewater discharged into water bodies.

4.4. Information management

111. **Data is not collected transparently, reliably, or in a targeted, coordinated way, posing a significant barrier to IUWM in Greater Jakarta.** During Workshop 2, Bappenas representatives pointed out that the lack of data would make it difficult to establish benchmarking, monitor targets, or identify the basis for providing additional support, even if there were more incentives in place to support IUWM. Indeed, simple data collection of basic water sector indicators represented a significant undertaking throughout this study, as discussed above for flooding. Since the region is so frequently affected by floods, a public database of historical flood events – including the causes of flooding, impacted populations, and economic impacts – could easily be made available, continuously updated, and used to track progress toward policy goals and establish joint benchmarks. Furthermore, basic data indicators on water and sanitation also do not provide a clear picture of the sectoral challenges, as they are usually presented as data overseen by specific agency mandates. In the past, the BKSP played a role in centralizing data across jurisdictions, but local governments expressed the view that although they would openly share data when requested, there was rarely any follow up.

112. **For the data available, values are not stored in formats easy to analyze or compare.** The study had to rely on repeated coordination with agency personnel from across Greater Jakarta to ensure data comparability. In addition to the absence of flood data mentioned above, datasets on deep groundwater abstraction points were either not collected or unavailable for sharing. Kota Tangerang Selatan was the only local government to share this data. Clear data on abstraction points could help to convene policy solutions that address this fundamental issue. Where data were collected, they tended to be inaccessible due to different storage formats. Flood data were collected in different types of software, not in spreadsheets, resulting in significant time lags to conduct basic comparative analysis. The study team tried to engage with several national and local government agency offices to obtain data and faced multiple limitations.

113. **Differing institutional mandates for data collection and varying indicators, definitions, and calculation formulas make it difficult to measure and compare performance.** For example, MOEF and MOPWH employ different spatial boundaries for planning and monitoring (watersheds and river basins, respectively). The national census, meanwhile, collects different indicators on drinking water supply from those collected by local government agencies and PDAMs. This poses challenges in forming a metro-level picture of access to services, which could be used to prioritize action and funding. These discrepancies erect analytical barriers to translating knowledge into action, which is fundamental to successful spatial planning.

114. **Addressing data reliability, improving accuracy, and promoting transparency and accessibility provides an opportunity to catalyze IUWM.** Although the data were difficult to access, their ultimate collection and presentation in simplified and visual formats led central and local government partners to express enthusiasm and agreement over the potential benefits of more targeted and coordinated data collection and visualization. Data helped to catalog the challenges, causes, magnitudes, intensity, geography, and impact of water issues in ways that can help improve understanding of a problem and better craft and track solutions. Clear data and visualization also offer opportunities to build trust, establish public campaigns around water challenges, and highlight intervention success.

4.5. Financing

115. **There are no existing financing mechanisms that specifically incentivize IUWM approaches.** Financing mechanisms currently in place mostly target the separate sectoral elements of the water cycle. They generally take the form of transfers or loans from the national government to local governments for infrastructure investment or direct financing, or comprise the procurement of large infrastructure projects by the central government. Funds for maintenance and operation of these projects are drawn from local government operating budgets and in most cases are inadequate. Increasingly, central

government funds are linked to specific outputs. In relation to water supply, for example, financing is linked to PDAMs' level of operational performance, measured through a broad set of indicators including coverage, NRW, and financial sustainability. These output-based funding approaches could provide the basis for funding schemes for IUWM.

116. **While quantifying the economic impact of IUWM in Greater Jakarta will require a more detailed study, the existing pilots and studies in other cities around the world show the potential economic benefits of IUWM implementation.** Upstream catchment management and better sanitation will improve surface water quality and reduce treatment costs. Investments in improving operation efficiency and managing water demand will reduce the need for large expenditures to build new water sources and production facilities. Managed groundwater recharge can restore spring capacity, stop or slow land subsidence, and prevent saltwater intrusion. IUWM implementation in Greater Jakarta can also produce additional quantifiable benefits over time, such as reduced flooding, improved health and environment, improved tourism, and reduction in greenhouse gas emissions. For example, global estimates show that upstream pollution, as measured by increased Biological Oxygen Demand (BOD) concentrations, reduce GDP growth in downstream areas by a third (Damania et al. 2019). At Kota Malang and Batam, when the PDAM and private concessionaires invested in NRW reduction and energy efficiency measures respectively, they managed to generate cost savings of more than US$5 million each from fewer leakage repairs and postponed investments of additional water supply infrastructure (World Bank, "WICER," forthcoming).

4.6. Existing initiatives aligned with IUWM

4.6.1. Flood management: Complementing infrastructure development

117. **While planning is underway to transform much of DKI Jakarta's flood infrastructure through large-scale investments (in the form of seawalls and upgraded transference and pumping capacity), there are also numerous opportunities for complementary IUWM initiatives and potential areas for collaboration.** Many of these have already been listed above: incentivizing expansion of green open spaces, water recharge, and zoning policies for zero runoff, all of which can improve water retention capacity across the watershed. Through coordinated action between and within jurisdictions, such initiatives are already being implemented in the retrofitting of neighborhoods and individual properties to support retention and infiltration.

118. **Examples and best practices from around the world offer examples of IUWM flood management initiatives.** For instance, decades ago, the Tokyo-Yokohama metropolitan area undertook concerted measures to address significant land subsidence and flooding.

Although it represents a very different political and institutional context, this experience could be one model for immediate action for Greater Jakarta. Through an integrated approach involving law enactments, urban planning measures, the institution of a fit-for-purpose water use system, and engagement with private developers, the regional authority in Japan addressed the drastic effects of land subsidence. Laws limited groundwater abstraction, particularly for industries, while wastewater reuse was scaled up to meet industrial water demand. Flood-prone areas were marked as urban no-development zones, and private developers were mandated to construct retention basins for stormwater management. The efforts profoundly reoriented the region's spatial development trajectory and assured greater livability for future generations.

4.6.2. Water supply: Overlooked zones and opportunities for expansion

119. **Lack of access to water is especially pronounced for certain types of communities that tend to be overlooked in service provision.** Vulnerability is heightened among these communities due to their geographical location or their distance from service areas – for instance, locations at the margins of jurisdictions. Although populations may be dense in border zones, service networks may not extend there due to the geographic profile of the particular local government and its planning processes. Lack of water access is also pronounced for low-income communities located in coastal areas that have experienced subsidence or saltwater intrusion and are located outside of PDAM coverage. In addition, PDAMs de-prioritize servicing large geographical areas managed by private entities. As a result, pocket communities adjacent or enclaved within private developer areas receive less attention in terms of network coverage development. In combination, these conditions apply to a substantial number of households, which do not have water supply service.

120. **During the cluster workshops of this study, government representatives explored ways to coordinate opportunities for increased water access, such as through improving the efficiency of service delivery and working with the private sector.** For example, the placement of networks in neighboring jurisdictions may afford opportunities to more readily service communities in border zones, even if they fall under a neighboring service coverage area. Small acts of cooperation can also help to serve other communities that lack alternatives. Another example of increased water access is in the Kepulauan Seribu district of DKI Jakarta, in which the local government made targeted efforts to reach remote island communities in Jakarta Bay by constructing several seawater reverse osmosis (SWRO) plants.

4.6.3. Sanitation: Citywide Inclusive Sanitation (CWIS)

121. **With such low levels of reliable sanitation service coverage throughout Greater Jakarta, surface and groundwater quality is severely degraded, and any effort to improve treatment at all levels will have profound benefits.** Greater Jakarta suffers from widespread systemic neglect of sanitation infrastructure. Central and local governments often express the view that sanitation is costly and a lower priority than water supply. However, agencies overseeing higher density urban areas are aware of increased water treatment costs as a result of sewage contaminating water sources. PD PAL Jaya's efforts to extend sewerage coverage to new zones in DKI Jakarta show the high costs and complex implementation arrangements required in terms of land acquisition, connections, piping, pumping, and transfer. With slow expansion of centralized sewerage systems in Greater Jakarta, local governments are instead relying on household-level septic tanks combined with scaled-up Fecal Sludge Management (FSM) services. Such initiatives are promising but are not adequate to address the broader challenges of urban wastewater.

122. **Citywide Inclusive Sanitation (CWIS) offers an approach to build upon and maximize existing strengths, as well as identify opportunities to collaborate and recycle water.** CWIS is an approach that is gaining currency in Indonesia among national institutions, and several local governments in Greater Jakarta, particularly Kota Bekasi and Kota Bogor, are eager to begin applying its principles. CWIS involves building on existing on-site and off-site systems to improve overall capacity, increase efficiency, and, in a staged process, begin to expand coverage. The approach also encourages collaboration and reuse of water for added value or revenue generation. One clear example of potential intergovernmental collaboration is enlarging and upgrading septage treatment plants to maximize efficiency. Agencies highlight land acquisition as the most significant barrier to constructing wastewater or septage treatment plants. Existing plants are already sited at jurisdictional boundaries; by formalizing working arrangements to upgrade these facilities to cover a wider service area, local governments can avoid the high costs of further land acquisition or duplicating management arrangements. In addition, not only are government agencies and their technical units beginning to experiment with wastewater reuse and recycling, there are also opportunities to work with industrial areas to do the same, helping to offset treatment costs.

123. **In Manila, a combined sewer-drainage system is used to treat effluent from drains before it is discharged into rivers – an interim measure that would have significant benefits for water quality in Greater Jakarta.** Drains are often contaminated with fecal matter and urban pollutants from direct discharge into drains and canals, leakages from septic tanks and runoff. They therefore act as vectors for disease during periods of flooding.

In Manila, interceptor boxes have been installed along the main canals to direct water to flow through a wastewater treatment plant (WTP) before it is discharged into rivers. Treatment is done at the Olandes Sewage Treatment Plant by Manila Water, which has an underground WTP surmounted by a green recreational space to maximize to maximize land use (World Bank Water 2017). Such initiatives not only enhance water quality but also afford complementary opportunities to introduce urban design features that improve livability along waterways.

5. Recommendations and concluding remarks

5 RECOMMENDATIONS AND CONCLUDING REMARKS

124. **IUWM can supplement the many sectoral studies, initiatives, plans, and projects on various water-related sectors that are already in place.** While these efforts will continue to be crucial for addressing the multi-dimensional issues related to water in Indonesia, IUWM can offer complementarity while also helping to catalyze systematic shifts that will lead to more robust institutions that are better positioned to address water insecurity.

125. **Much of the engagement in this study has focused on examining IUWM at three different scales.** The first includes the many opportunities for interjurisdictional cooperation, which can be pursued by re-establishing and re-invigorating the Greater Jakarta Regional Authority. With adequate mandates, resources, and legitimacy, a Greater Jakarta Regional Authority could help to facilitate vertical and horizontal coordination, establish indicators and benchmarking systems, collect and analyze data, raise and maximize financing, and bring diverse stakeholders together to develop and mainstream innovation. The second scale involves vertical coordination between local governments, regional authorities, and the central government. MOHA and other central government agencies are looking into ways to catalyze, formalize, and ease potential coordination mechanisms around IUWM themes listed in this report. The third scale of engagement addresses horizontal coordination *within* local governments, and seeks out opportunities to introduce IUWM collaborations across sectors, agencies, and stakeholder groups. The recommendations that follow acknowledge the need for coordination across these three scales.

126. **The analysis and findings above reveal opportunities for IUWM that can be classified into two categories: implementing framework and interventions.** Actions relating to the implementing framework enable effective IUWM implementation, such as developing regulations, and are primarily led by higher levels of local governments. Interventions, on the other hand, are direct IUWM projects. These efforts, especially those that do not require large capital investments, can be undertaken by local government agencies. The recommendations below are separated into these two categories, with the leading agency specified for each action.

127. **The recommendations are also phased into different timeframes, which reflect the degree of readiness needed to undertake the action, and conditionality or complementarity among different actions.** Immediate and short-term interventions – such as improving operational efficiency, demand management, and stormwater management, and some expansion of water supply and sanitation services – will not require large investments. Local governments can begin implementing them with their own resources, or use blended financing in collaboration with the private sector. These actions can be implemented

within the existing mandates and authorities of local governments, setting the ground for future action. On the other hand, major infrastructure requiring high capital expenditure – such as the development of new water sources or bulk water supply, city-scale sewerage systems and wastewater treatment plants, and construction of seawalls and other flood control infrastructure – may require investment support from the central and provincial governments. These short- to long-term actions may also be conditional upon preliminary actions in the preceding phases, underscoring the urgency of actions in all phases. For example, halting groundwater abstraction requires the provision of alternative sources of water supply. Also, some recommended actions, such as the Water Information Management System (WIMS), require efforts that are continuously sustained and developed. The suggested timeline of actions and phasing for implementation is as follows:

- Immediate: Within one year
- Short-term: one to five years
- Medium-term: five to 10 years
- Long-term: 10 years and beyond

128. Boxes 4 and 5 highlight the immediate priority actions for the Greater Jakarta IUWM implementing framework and interventions respectively.

Box 4: Implementing Framework: Immediate Priority Actions	Box 5: Interventions: Immediate Priority Actions
Implementing framework recommendations aim to improve water management and planning: 1. Strengthen and clarify existing regulations on: a. Groundwater management b. Interjurisdictional coordination 2. Develop guidelines or protocols for: a. Integrated planning across sectors to reduce flood risk b. Sharing of data across sectors 3. Enforce existing regulations: a. Discharge permits b. Minimum service standards for water supply and sanitation	Priority actions focus on expanding access to sanitation and water supply, especially to halt or reduce over-abstraction of groundwater: 1. Accelerate water resources development initiatives at scale (e.g., Karian Dam and Jatiluhur) 2. Optimize existing infrastructure: a. Manage water demand b. Increase water efficiency (e.g., reduce NRW) 3. Use blended sources of financing and tariff regulations Additionally, recommendations include accelerating implementation of ongoing major projects in: 4. The rehabilitation of rivers and maintenance of drainage infrastructure 5. Wastewater treatment plants and opportunities for recycled water and reuse of by-products

129. **The comprehensive recommendations are presented in the IUWM roadmap for Greater Jakarta that follows.** Implementing framework recommendations are listed in table 13; intervention recommendations, in table 14. The recommendations are classified into the five IUWM framework categories specified in section 4 (law and regulation, governance, planning and implementation, information management and financing), and the roadmap of recommendations is also sub-categorized according to six topics based on water threats faced in Greater Jakarta:

- **Improving and expanding water supply and sanitation services.** Currently, Greater Jakarta faces low and unreliable water supply and sanitation services (see sections 3.2 and 3.3).
- **Improving flood risk management and community preparedness.** Floods currently affect high numbers of people, causing numerous deaths and severe damages (section 3.1).
- **Securing water sources and improving water conservation.** The region is confronting high levels of pollution in water resources and increasing demand for water (section 3.4.3).
- **Improving groundwater management.** Jakarta's high rates of subsidence are exacerbated by deep groundwater abstraction (section 3.4.1).
- **"Planning with water" by incorporating the water cycle as part of improving urban and regional governance and development.** In a "planning with water" approach, water-related drivers, interventions, and impacts are systematically included in urban development plans, disaster risk plans, climate change and resilience plans, solid waste management, and transport plans. This will take advantage of opportunities for collaboration and coordination to improve sustainable development and water security (section 3.4).
- **Stakeholder and private sector engagement.** There are key opportunities to develop trust and knowledge-sharing with locals, and to leverage investment opportunities from the private sector.

Legend for Tables 13 and 14:					
Improve and expand water supply and sanitation services	Improve flood risk management and community preparedness	Securing water sources and improve water conservation	Improve groundwater management	Incorporate the water cycle as part of the improvement of urban governance and urban development	Stakeholder and private sector engagement

Table 13: Roadmap for Development of Enabling Framework for IUWM in Greater Jakarta

Timeline	Law & Regulation	Governance & Institutions	Planning & Implementation	Information Management	Financing
Immediate action (within 1 year)	Adopt implementing regulations that clarify authority for groundwater protection. Adopt timebound policy targets to reduce groundwater abstraction. Leading agency: MOPWH and Ministry of Energy	Reform BKSP to become a Greater Jakarta Joint Secretariat to ensure consistency with Law 23/2014 on regional governance. Equip the Joint Secretariat with adequate capacity, resources, and authority to develop and implement a strategic plan for water and other urban policy areas. Leading agency: MOHA and Ministry of Agrarian Affairs and Spatial Planning (MAASP)	Develop guidelines for integrated planning between water and sanitation utilities and operators across administrative jurisdictions. Include private developer systems, community-based systems,and other off-grid systems. Leading agency: MOPWH and Bappenas	Develop protocols for open data and one-map system for water and sanitation development (water sources and intake facilities, transmission pipelines, treatment facilities, distribution systems and networks, and sewerage and septage collection systems). Leading agency: MOPWH	Strengthen and build on existing performance- and results-based financing to incentivize local governments and PDAMs to incorporate IUWM related indicators and mainstream Citywide Inclusive Sanitation. Leading agency: MOPWH, Bappenas, and MOF
	Prepare regulatory guidelines on interjurisdictional cooperation agreements for water supply and sanitation, flood management, and water quality management, incorporating nature-based solutions and incentives for ecosystem services. Leading agency: MOHA and MOPWH		Track local governments' records of enforcing discharge permits and develop additional incentives for enforcement where necessary. Leading agency: MOHA and MOEF	Establish protocols for local governments to share data in a complete, consistent, and timely manner. Address gaps in the data and populate and validate historical data in WIMS. Leading agency: MOHA and MOPWH	

Timeline	Law & Regulation	Governance & Institutions	Planning & Implementation	Information Management	Financing
			Develop guidelines to systematically assess and incorporate blue-green infrastructure developments, including infiltration wells and vertical drainage, to replace or complement investments in grey infrastructure for flood risk management. Leading agency: Bappenas and MOPWH		
			Develop a set of urban water security indicators in consultation with local governments. Carry out a water security assessment for Greater Jakarta as a basis for objective-setting and project prioritization and to build engagement in IUWM among stakeholders. Leading agency: Bappenas and Coordinating Ministry for Maritime Affairs and Investment (CMMI)		

Timeline	Law & Regulation	Governance & Institutions	Planning & Implementation	Information Management	Financing
Short term (1-5 years)	Develop guidelines and establish incentive mechanisms for local governments to adopt water conservation and demand management through tariffs and/or other mechanisms. Leading agency: MOHA	Develop guidelines for water utilities and operators in Greater Jakarta area to expand and prioritize inclusive water supply and sanitation services for domestic use and encourage private developers (especially commercial and industrial) to reduce their water footprint. Leading agency: MOHA and MOPWH	In local government planning processes, improve coordination between water subsectors under a "planning with water" approach. Systematically include water-related drivers, interventions, and impacts in urban development plans, disaster risk plans, climate change and resilience plans, solid waste management, and transport plans. Assess potential for projects with co-benefits in two or more subsectors. Leading agency: Bappenas and MOHA	Share maps, data, studies, and strategic documents on urban spatial planning and infrastructure development across local government departments and entities to support the "planning with water" approach. Leading agency: Bappeda and all relevant units at local government levels	Build on existing fiscal-transfer mechanisms to incentivize local governments to invest in projects addressing two or more aspects of the urban water cycle. Leading agency: MOF and CMMI
	Strengthen efforts and collaboration to protect water sources and improve catchment management in upstream areas. Leading agency: MOPWH and MOEF	Integrate groundwater management with overall management of water sources and basins. Leading agency: MOPWH	Conduct a detailed review of economic and regulatory instruments to make IUWM actions a requirement in the design and management of buildings and real estate. Leading agency: MOHA and MAASP		
	Develop guidelines at the local government level that will enable and incentivize community and private sector developers to apply zero-run-off and nature-based solutions within their property or neighborhood. Leading agency: Bappeda				

Timeline	Law & Regulation	Governance & Institutions	Planning & Implementation	Information Management	Financing
Medium term (5-10 years)				Establish protocols for private developers to share data and maps, to be integrated with local governments' data and mapping systems. Leading agency: Bappeda and Spatial Planning Department	Harmonize tariffs and fees for water abstraction (ground and surface) and water supply and sanitation services to ensure aligned incentives. Incorporate user-pays and polluter-pays principles to incentivize efficiency and recover costs. Leading agency: Bappeda, PDAM and departments in charge of groundwater management, sanitation, and stormwater management
				Develop behaviour-change communication campaign program and strategy to increase community awareness and participation in implementing IUWM at all levels. Leading agency: Bappeda	Identify models for co-financing and cost allocation of small-scale partnership projects between governments and private sector for flood management, groundwater recharge, and water quality improvement. Leading agency: Bappeda

Table 14: Roadmap for IUWM Interventions in Greater Jakarta

Timeline	Law & Regulation	Governance & Institutions	Planning & Implementation	Information Management	Financing
Immediate and short-term actions (0-5 years)	Enforce implementation of minimum service standard on water supply and sanitation. Identify options for providing services to vulnerable and overlooked populations located in hard-to-access zones. Leading agency: MOHA	Improve water use efficiency by public agencies at the local level. Track local government consumption by department or agency; replace potable water with fit-for-purpose water where appropriate (urban irrigation, street cleaning, bus washing, etc.). Leading agency: Bappeda, PDAM, and water and public works departments	Improve efficiency of existing water supply infrastructure (upgrading water treatment plants, reducing non-revenue water). Prioritize increasing efficiency of extant piped water network in Central Jakarta to facilitate increased consumption of piped water over groundwater. Leading agency: PDAMs	Improve and strengthen groundwater control and monitoring by installing meters and monitoring groundwater consumption. Leading agency: Local governments, Department of Mining and Energy, and PDAM	Encourage local governments and water utilities to continue using non-public financing to accelerate expansion and improvement of water supply services. Non-public financing can be in the form of domestic borrowing, PPP, utilizing Corporate Social Responsibility, vendor/contractor financing, etc. Leading agency: MOPWH and MOF
	Urban green space: explore broader interpretation of Law 26/2007 on spatial planning mandating 20% + 10% open green space to allow for cooperation between jurisdictions to achieve targets jointly. Leading agency: MOHA and Joint Secretariat (BKSP)	Integrate groundwater management with other urban water services. Leading agency: Bappeda, PDAMs, and water and public works departments	Support uptake of Citywide Inclusive Sanitation: i) household-level containment and septage collection, treat-ment, and safe disposal; ii) wastewater (black and grey) collection, treatment, and safe disposal; and iii) reuse and recycling of treated septage and wastewater. Leading agency: MOPWH and Bappedas	Coordinate the collection and management of flood incidence data between local governments and BNPB. Under the Joint Secretariat for Greater Jakarta, establish a clear protocol for data reporting and unified flood dataset for reference, monitoring, evaluation, and planning. Leading agency: Joint Secretariat, BNPB, BPBD	Enforce adoption of MOHA regulation on water supply tariff and subsidy to support utilities in improving performance, sustainable operation, and creditworthiness. Leading agency: MOHA and MOPWH

Timeline	Law & Regulation	Governance & Institutions	Planning & Implementation	Information Management	Financing
	Strengthen and expand existing cooperation between DKI Jakarta and surrounding local governments on ecosystem services. Establish a contract or memorandum of understanding to provide incentives for ecosystem services between DKI Jakarta and Kota/Kabupaten Bogor to conserve and rehabilitate the Upper Ciliwung Basin. Leading agency: MOHA and Joint Secretariat (BKSP)		Accelerate construction and completion of the regional bulk water supply systems (Jatiluhur, Karian, and Juanda) and ensure alignment and integration with the planning processes of PDAMs and local governments (as off-takers) regarding the distribution network. Leading agency: MOPWH and PDAMs	Improve and strengthen the existing Flood Management Information and Early Warning System, and assess the potential to expand it into a Water Information Management System (WIMS) as an open and accessible online platform. Explore innovative information and communication technologies to share and visualize data and connect with a broad audience. Leading agency: MOPWH and MOHA	
			Continue and accelerate completion of projects to rehabilitate and increase capacity of rivers, canals, retention ponds, and drainage systems. Ensure adequate maintenance of river embankments, canals, and drainage systems. Leading agency: MOPWH at the central level Water and public works departments at the local level	Catalog IUWM initiatives by local governments and identify ways to scale up existing innitiatives, design pilot projects, and establish new benchmarks accordingly. Leading agency: Bappenas, MOHA and MOPWH	

Timeline	Law & Regulation	Governance & Institutions	Planning & Implementation	Information Management	Financing
			Improve community preparedness and adaptation in flood-prone areas by incorporating flood adaptation measures in urban slum upgrading and housing projects, and developing or improving community-based early flood risk management and early warning systems. Leading agency: BNPB and MOPWH at the central level BPBD and public works and housing & settlements departments at the local level		
			Scale up and replicate existing successful IUWM pilots and initiatives in other locations. Leading agency: Bappenas and MOPWH at the central level Bappeda and public works department at the local level		
			Further develop the IUWM Practical Guide for Cities into a manual for local governments on the design and implementation of IUWM projects. Leading agency: Bappenas and MOPWH at the central level Bappeda at the local level		

Timeline	Law & Regulation	Governance & Institutions	Planning & Implementation	Information Management	Financing
Medium- to long-term (5-10 years)	Enforce regulations to halt issuance of new groundwater abstraction licenses for water supply services. Phase out existing groundwater licenses in Greater Jakarta area. Leading agency: Bappedas and Department of Mining and Energy		In water supply plans (RISPAM), systematically assess off-grid or small-scale distribution systems and alternatives to new water intakes and treatment infrastructure. Include NRW reduction, demand management, provision of fit-for-purpose water for non-potable uses, and optimization of existing infrastructure. Only invest in new intake and treatment facilities if other options are not viable. Leading agency: MOPWH	Map water bodies and water retention areas (green open spaces, permeable areas) to identify interventions and surface and groundwater abstraction points. This information can be collated in the WIMS. Leading agency: MOPWH	Coordinate water infrastructure development and financing plan with neighboring jurisdictions; explore interjurisdictional network interconnections where feasible to avoid overlapping and inefficient investments. Leading agency: Joint Secretariat, Bappedas and PDAMs
	Incorporate requirements for on-site water management in private developments (water management plans, zero run-off) in building and development permits and licenses. Leading agency: Bappeda and Spatial Planning Department		Implement blue-green infrastructure (infiltration wells and vertical drainage, use of permeable surfaces for transport and pedestrian infrastructure and city parks, and capture and use of stormwater for water reuse and to replenish subsurface water). Leading agency: Bappeda and relevant departments	Develop a public communication strategy to inform and engage the public on urban water risks (including poor practices related to groundwater abstraction, subsidence, solid waste management, and sanitation) and appropriate household-level actions to reduce the risks. Leading agency: Bappeda and Department of Communication	Establish tariff and fee structure to disincentivize groundwater consumption. Leading agency: Bappeda and Department of Mining and Energy

Timeline	Law & Regulation	Governance & Institutions	Planning & Implementation	Information Management	Financing
			Collaborate with private developers to share information and best practices on pilot-level IUWM, including on-site recycling of grey water and stormwater for non-potable uses, and develop a regional competition to showcase best practices. Leading agency: Bappeda and Real Estate Developers Association		Clarify the plan for the water supply system in DKI Jakarta following the end of concession period. Leading agency: DKI Jakarta Governor and PAM Jaya

130. **Although most of the lead actors for the implementing framework actions are central government ministries, there is immense scope for engagement and direct involvement from local governments.** For example, reforming BKSP is of particular interest to local governments in DKI Jakarta. Data collection and management requires involvement from local government agencies, especially PDAMs and BPBDs. Bappeda plays an active role in establishing the implementing framework, particularly as the enabling agency to facilitate horizontal coordination within local government agencies and between local governments, and to perform vertical coordination functions with provincial and central governments.

131. **These recommendations complement existing and ongoing large-scale investments by improving the IUWM enabling framework of targeted interventions that support institutional development at the local government level.** The existing large-scale initiatives include bulk water supply enhancements at Jatiluhur, construction of the Karian Dam, a series of sewerage service expansion zones in DKI Jakarta, a network of seawall strengthening efforts, and upstream flood control dams in Ciawi, Bogor. Other planned large infrastructure programs include bulk water supply from Juanda system, the various parts of the NCICD, and sewerage development in Kota Bekasi and Kota Bogor. The recommendations show how IUWM builds complementarity for longer-term development of institutions that can better coordinate, improve services, and build resilience.

132. **Complementary initiatives that target improvements across the water cycle are cost-effective and do not require large investments; they can also be launched at the local government level.** Inspiration and lessons can be drawn from other municipalities in Indonesia, and knowledge and technologies can be shared. These actions can be funded by APBD local government budgets (or *Anggaran Pendapatan dan Belanja Daerah*), through performance-based funding under the NUWAS framework, or potentially by contracts with private contractors. These interventions include:

- Water supply:
  - Reduce NRW
  - Improve demand management
- Sanitation:
  - Improve fecal sludge management by implementing regular or scheduled septic tank desludging services
  - Enforce compliance on septic tank standards
  - Improve monitoring and regulation of sludge collection
  - Optimize operation of sewerage and wastewater and sludge treatment plants
  - Utilize and promote more recycling and reuse of effluent and treated sludge

- Flooding:
  - Improve maintenance and rehabilitation of drainage
  - Incorporate more permeable materials into roads, pavements, and parks
  - Implement and enforce zero-runoff and zero-water-footprint policies that improve permitting processes and monitoring implementation

133. **The principles of climate change mitigation and adaptation, circular economy in water, resource efficiency, and resilience against uncertainties are key for moving toward improved water security in Greater Jakarta.** These have been strategically embedded throughout the IUWM recommendations. While they are not explicitly mentioned as actions in the roadmap, they should be considered cross-cutting planning and design concepts in the implementing framework and associated interventions.

134. **This report has presented the web of challenges that threaten not only water security in Greater Jakarta, but the overall economic, social, and environmental sustainability of the region.** IUWM is an appropriate adaptive framework for organizing actions in challenging governing settings when seeking to address complex cross-sectoral interlinked challenges. With ongoing developments in the national regulatory framework, particularly the 2019 Water Law and Law 23/2014 on regional governance, there is momentum at the national-government level to implement cooperative and integrative mechanisms to achieve greater efficiency and resilience in the water sector. Within Greater Jakarta, engagement with local government agencies for this study indicates interest in and commitment to addressing water challenges. It also suggests opportunities for cooperation between agencies at horizontal and vertical levels. As an ongoing process, IUWM principles can be adapted to specific contexts while incorporating relevant concepts to build resilience for current and future urban challenges.

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7. Annexes

ANNEX 1: LIST OF COUNTERPARTS FOR IUWM STUDY JABODETABEK

Central Government

Organization	Unit	Role
Ministry of Home Affairs	Directorate of Deconcentration, Co-administration, and Cooperation; Directorate General of Regional Administration	• Manage cooperation among local governments, including metropolitan area mode of governance • Oversee implementation of Jabodetabek development cooperation through establishment of BKSP • Formulate concepts and methods of local government cooperation • Carry out administrative process of local government cooperation according to government regulations
Ministry of Public Works and Housing	Directorate of Drinking Water; Directorate General of Human Settlement	• Provide technical support for PDAMs • Provide infrastructure facilities and utility for local government
	Directorate of Water Resource and Irrigation; Deputy of Infrastructure	• Formulate national policies and programs on water resource management and irrigation
Ministry of National Development Planning (Bappenas)	Directorate of Urban, Housing, and Settlement; Deputy of Regional Affairs	• Formulate national policies and programs on urban development, housing provision, drinking water, and sanitation
APEKSI (Association of Indonesian Municipalities)	–	• Share knowledge and experience in development aspects among municipalities through regular events
Local government	Local Planning Agency (Bappeda)	• Formulate overall development policies and programs of the local government

Organization	Unit	Role
	Local enterprises	• Provide communities with basic commercial services, such as water and sanitation. A local enterprise is fully owned by the local government, or the local government possesses the largest share. In this study, we engaged with PDAMs (local water utility company) and PALs (local wastewater utility company). Names vary across local governments – for example, PAM Jaya is the water utility company in DKI Jakarta.
	Local Disaster Management Agency	• Implement programs on disaster management, including disaster risk reduction and prevention activities • Provide first response in the event of outbreaks and determine emergency status
	Departments	• Carry out specific tasks and responsibilities according to their domains. Based on the complexity of its work and need of each locality, each department may bring together several fields of responsibility in single organization unit.

Local Government

Locality	Unit
Province of DKI Jakarta (Jakarta Special Capital Territory)	Local Planning Agency
	PAM Jaya
	PAL Jaya
	Department of Public Housing and Settlement Area
	Department of Human Settlement, Spatial Planning, and Land Affairs
	Department of Health
	Department of Environment

Greater Tangerang Region	
Municipality of Tangerang (Kota Tangerang)	Local Planning Agency
	PDAM
	Department of Public Works and Spatial Planning
	Department of Health
	Department of Environment
Regency of Tangerang (Kabupaten Tangerang)	Local Planning Agency
	PDAM
	Local Disaster Management Agency
	Department of Spatial Planning and Structures
	Department of Environment and Cleanliness
Municipality of South Tangerang (Kota Tangerang Selatan)	Local Planning Agency
	Department of Housing, Settlement Area, and Land Affairs
	Department of Building and Spatial Planning
	Department of Health
	Department of Environment

Greater Tangerang Region	
Municipality of South Tangerang (Kota Tangerang Selatan)	Local Planning Agency
	PDAM
	Department of Public Works and Spatial Planning
	Department of Environment and Cleanliness
	Department of Health
Regency of Bogor (Kabupaten Bogor)	Local Planning Agency
	PDAM
	Department of Housing, Settlement Area, and Land Affairs

	Department of Environment
	Department of Health
	Local Disaster Management Agency
Municipality of Bogor (Kota Bogor)	Local Planning Agency
	PDAM
	Department of Public Works and Spatial Planning
	Department of Health
Greater Bekasi Region	
Municipality of Bekasi (Kota Bekasi)	Local Planning Agency
	PDAM
	Department of Spatial Planning
	Department of Environment
Regency of Bekasi (Kabupaten Bekasi)	Local Planning Agency
	PDAM
	Department of Public Works and Spatial Planning
	Department of Environment
	Department of Health

ANNEX 2: DATA COLLECTION FOR FLOODING

The following figure characterizes the data available from local government BPBDs with respect to flooding. Cells in gray refer to complete data, while data labelled "event only" describes the flood event but does not provide information on the number of households impacted or the cause of flooding. Finally, the areas in orange indicate data availability only to the subdistrict level, without data provided at the *kelurahan* or village level.

Flood Data List

PROVINCE	CITY/DISTRICT	2013	2014	2015	2016	2017	2018	2019	2020
BANTEN	Kab. Tangerang								
	Kota Tangerang								
	Kota Tangerang Selatan								
DKI JAKARTA	Jakarta Pusat		Event only		Event only	Event only			
	Jakarta Selatan		Event only		Event only	Event only			
	Jakarta Timur		Event only		Event only	Event only			
	Jakarta Utara		Event only		Event only	Event only			
	Kepulauan Seribu		Event only		Event only	Event only			
JAWA BARAT	Kab. Bekasi								
	Kab. Bogor								
	Kota Depok								
	Kota Bekasi								
	Kota Bogor								

Color Code

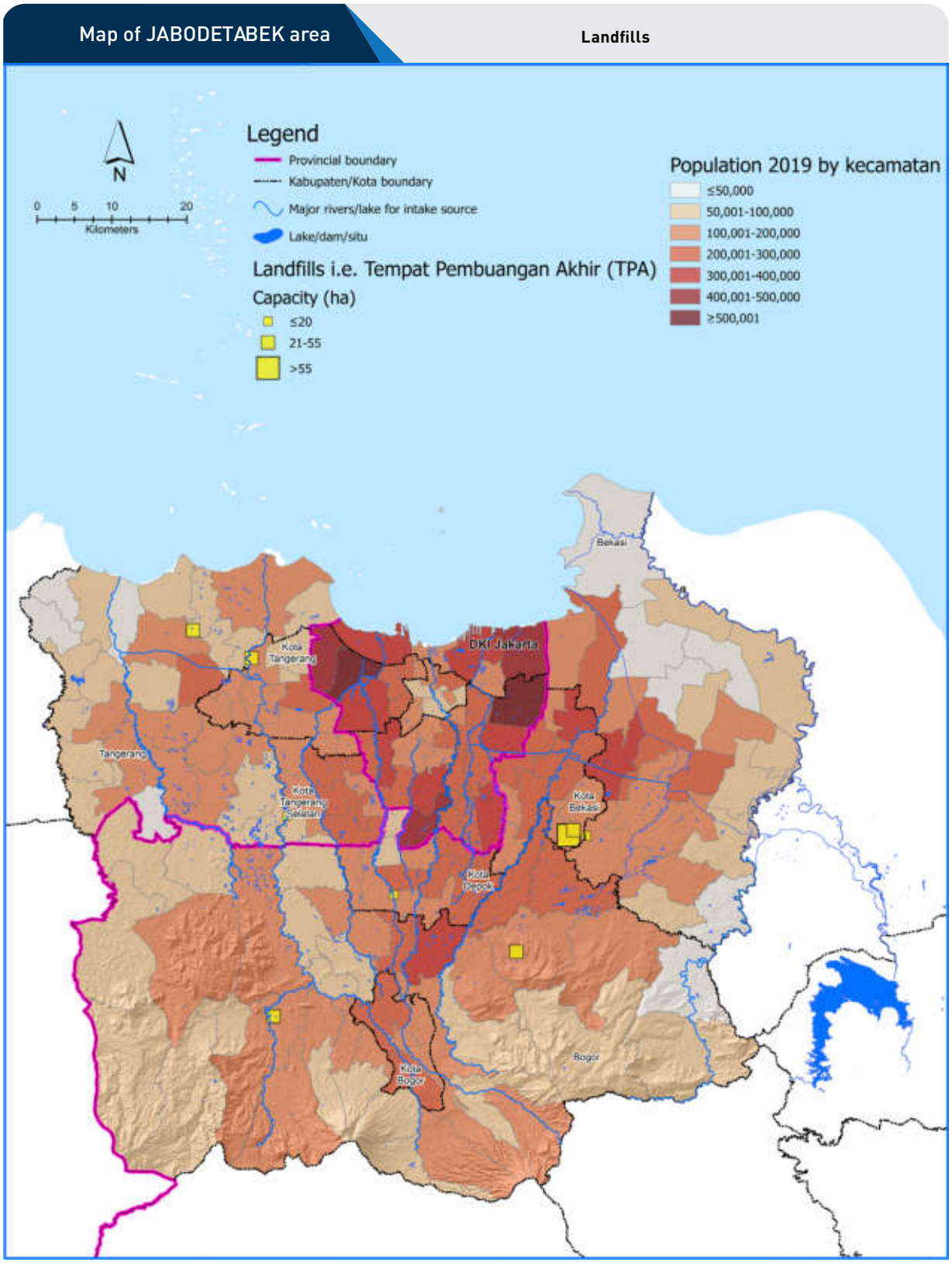
- All data available at village level
- Partially available at village level
- No data available
- Event only — means that no data on household impact was collected

ANNEX 3: SOLID WASTE MANAGEMENT ISSUES IN GREATER JAKARTA

The solid waste management system in Greater Jakarta sends waste through several levels of processing at different locations before it is disposed of in landfills. Dump trucks collect and transport solid waste from its sources to several community-level processing sites before it is disposed of at landfill sites, or *Tempat Pembuangan Akhir* (TPA). The first processing site is a temporary shelter, or *Tempat Penampungan Sementara* (TPS). Waste is sorted into four bins: organic, non-organic (plastics and glass), paper, and hazardous. The next processing site is the TPS 3R (Reduce, Reuse, Recycle), where recyclables are sorted and treated to reduce the quantity of waste in landfills. TPS 3R contains further sorting systems, organic waste composting, and/or biogas production technology. The next level of waste processing occurs at the Integrated Waste Management Site, or *Tempat Pengolahan Sampah Terpadu* (TPST), which further sorts any recyclables and treats the residual waste to reduce its volume is reduced and ensure can be safely buried in landfills (TPA). TPS and TPS 3R are typically small-scale communal facilities, while the TPST may be communal or integrated with the TPA, such as in Bantargebang. Figure A below shows the locations of landfill sites (TPA) in Greater Jakarta.

However, large volumes and improper disposal means that untreated waste remains largely unsorted and piles up in landfills, with leachates contaminating water systems. All landfills in Greater Jakarta have exceeded their capacity, leading to mountains of unsorted and untreated waste and leachate contaminating land and water resources. Although there is still available land within the landfill sites, the amount of waste produced daily exceeds the amount of solid waste that can be treated daily by the waste treatment plants. This leads to open dumping and piles of rubbish more than 10 meters high in landfills in Greater Jakarta. There is also a threat of solid waste spilling into water bodies, as some landfill sites are located close to rivers. Bantargebang landfill, located in Kota Bekasi, which serves as dumpsite for solid wastes from DKI Jakarta and Kota Bekasi, is the largest landfill in Indonesia at 110 hectares, and is particularly infamous for solid waste piling up to 40 meters high, with its smell reaching as far as several kilometers away (Wiratama 2019).

Figure A: Location of Landfills (TPA) in Greater Jakarta



Poor solid waste management poses risks at the landfill sites and to surrounding communities. For instance, contamination of groundwater is a key issue faced by households located close to Bantargebang landfill, who avoid consuming groundwater as a drinking water source ("Yang Mengintai di Bantargebang" 2017). Hot weather and cigarettes that are not properly extinguished can also turn the mountains of rubbish into a fire hazard. The smoke from fires causes respiratory problems in nearby communities and is likely to contain harmful chemicals. Landfill "avalanches" are a threat – particularly for *pemulungs*, who scavenge for their livelihoods at the sites, as several kilograms of solid waste can pile over and engulf them, causing injuries and death.

One of the limitations of solid waste management in Greater Jakarta is the insufficient number of dump trucks ("Separuh Lebih" 2019). As such, not all solid waste ends up in landfills. In some households, solid wastes are burnt and buried in the vicinity. Some are processed by private companies (for example, in Tangerang Seltan), taken up by *Bank Sampah* (a system for households to trade dry, recyclable waste for cash), or recycled. A significant amount is believed to end up in the environment.

To address some of these issues, both local and transboundary efforts are being pursued. A regional landfill at Kabupaten Bogor, Lulut-Nambo, is under construction and slated to begin operations in 2022. With a capacity to treat up to 1,800 tons of solid waste per day, it is planned to serve Kabupaten Bogor, Kota Bogor, Kota Depok, and Kota Tangerang Selatan (Jabar 2018). In DKI Jakarta, plans are underway to construct an Intermediate Treatment Facility (ITF), a waste-to-energy incineration plant located at Sunter in DKI Jakarta. ITF Sunter is set to operate in 2022 with a capacity to treat 2,200 tons of waste per day ("5 Kecanggihan ITF Sunter" 2019). At the *Kabupaten/Kota* level, local governments are planning to increase the number of dump trucks, increase recycling, and educate the community on reducing waste and consumption.