The ROCKEFELLER FOUNDATION

THE RESILIENCE SHIFT

SIWI

ARUP

THE CITY WATER RESILIENCE APPROACH

CITY CHARACTERISATION REPORT

AMMAN

ACKNOWLEDGEMENTS

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MARK FLETCHER
Arup Global Water Leader

The CWRA project team includes: Pilar Avello (SIWI), George Beane (Arup), Kieran Birtill (Arup), James Bristow (Arup), Alexa Bruce (Arup), Louise Ellis (Arup), Sophie Fisher (Arup), Mark Fletcher (Arup), Richard Gine (SIWI), Alejandro Jiménez (SIWI), James Leten (SIWI), Kathryn Pharr (Venturi Innovation), Oriana Romano (OECD), Iñigo Ruiz-Apilánez (Arup), Panchali Saikia (SIWI), Martin Shouler and Paul Simkins (Arup).

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EXECUTIVE SUMMARY

The City Water Resilience Approach (CWRA) helps cities plan and implement actions to build resilient urban water systems. A critical first step in this process is understanding the local water system, and the factors that contribute to or detract from resilience.

This report details research undertaken in Amman with the goals to:

1. Define the city water basin including natural basin(s), the urban water system and its governance structure, and the interdependencies with other systems; and
2. Identify the factors contributing to the resilience of the city water system and those increasing its vulnerability.

In developing this characterisation report, the Arup team collected desktop data on the biophysical characteristics of the basin and key actors in the water system. Arup then undertook a field mission in Amman 22 April - 3 May 2018 to build on the desktop work by engaging in-person with stakeholders.

AMMAN'S WATER SYSTEM

Situated on the East Bank of the Jordan River, the country of Jordan is almost entirely landlocked, except for a small stretch of coastline along the Red Sea. Amman, is located 800 metres above sea level situated on hilly area of north western Jordan, creating a unique catchment for the ~350mm average yearly precipitation it receives. Home to 4.4 million people, in a region of turmoil and conflict, Jordan has remained relatively stable, receiving influxes of refugees since the 1950's.

Approximately 40% of Jordan's water resources is transboundary (MWI, 2015). Amman itself is heavily reliant on water imported from its northern border with Syria, the Jordan River shared with Israel, and the Disi aquifer, a shared groundwater resource with Saudi Arabia managed under an international treaty (Eckstein, 2015). The city is supplied by twelve groundwater basins and fourteen surface water basins. Most of the population (93%) has access to improved sanitation—63% through network and the rest through other means (MWI, 2016). Surface water run-off either infiltrates sand flats and recharges the aquifers, or it drains via ponds, rivers and channels.

KEY STAKEHOLDERS

The Ministry of Water and Irrigation is the head body responsible for water and wastewater supply, planning and formulation of policy and strategy. At a regulatory level, the Water Authority of Jordan (WAJ) monitors and regulates water and wastewater utilities and promoting private sector participation in the water sector. Miyahuna Water Company under WAJ looks after the water services in Amman. The Minister for Health is responsible for water quality standards along with WAJ, while the Jordan Valley.

SHOCKS AND STRESSES

Shocks and stresses raised were highlighted by three primary themes, water scarcity, cost

recovery of water/wastewater and flooding. The major issues cited by stakeholders with the Amman water system were:

- Water stress due to extremely scarce water resources in the region.
- Water quality due to high turbidity levels can render critical water sources temporarily unavailable following rainfall events.
- Large influx of refugee migration puts excessive stress on existing infrastructure and resources.
- Cost recovery of water and wastewater services.
- Poor governance. Including urban planning, water and wastewater management.
- Poor investment from both domestic and international markets.

BUILDING RESILIENCE

Through engagement with Amman stakeholders, it was identified that there are a series of factors that would positively contribute to the resilience of the city's urban water system. Some of the most frequently mentioned were:

- "Governance, Strategy and Leadership" to generate common visions across agencies and capacity build a wider number of workers within institutions to minimise the current dependence on individuals;
- "Data, Monitoring and Forecasting". Currently SCADA systems have demonstrated to be a key enabler to planning for and responding to key shocks and stresses.
- "Infrastructure Design and Management". Redundancy, both in terms of design and operation of assets, emerged as a key theme as is critical to managing water scarcity.

To achieve this, one of the main focuses of the CWRA is to understand who the city engages not just within the basin it belongs to but also the other sectors that rely on water and that influence the use of water. The key interdependencies between the water system and city systems identified within Amman are Energy and Transport.

1

BACKGROUND

Situated on the East Bank of the Jordan River, the country of Jordan is almost entirely landlocked, except for a small stretch of coastline along the Red Sea. Jordan is one of the most water scarce countries in the world in terms of available and renewable water resources (Ray P. A., 2010). Its capital, Amman, is located 800 metres above sea level situated on hilly area of north western Jordan, creating a unique catchment for the ~350mm average yearly precipitation it receives, the city does not usually receive rainfall for its three hottest months of the year(ref). Amman serves as the cultural and economic centre of Jordan, believed to be one of the oldest cities in the world. (Climate Data, 2012)

POPULATION

Amman is home to approximately 4.4 million people—42% of the population of Jordan. In a region of turmoil and conflict, Jordan has remained relatively stable over recent decades. Since the late 1940's, Jordan has accepted several major influxes of refugees because of regional conflict. Thus, Amman's rapid population growth in recent years—doubling from 2 million to 4 million between 2004 and 2015—is the result of regional immigration (Greater Amman Municipality, 2015).

ECONOMY

Amman has a strong banking industry and also relies on tourism, which has revenues totalling one billion USD (Greater Amman Municipality, 2015). As the fourth most visited city in the Middle East, Amman has more than a million tourists a year. However, unemployment was at about 15% in 2016—largely women and youth (Greater Amman Municipality, 2015). With 40% of national employment in the informal sector, competition for such jobs includes Syrian and other refugees (Greater Amman Municipality, 2015). Inflation in Amman has increased by roughly 50% between 2006 and 2017 with average incomes not increasing at a proportionate pace, an influx of refugees has put pressure on the existing resources (IMF, 2016) making Amman was subsequently dubbed the most expensive city in the Arab World for 2018 by The Economist (The Economist, 2018).

GOVERNANCE

Jordan is a constitutional monarchy in which the king holds major executive and legislative power. Water is a national issue with much of its policy and regulatory functions under central government control. Both the Royal Water Commission and the National Water Advisory Council are consulted on water matters. More details about the ministries and organisations supporting Jordanian water governance are highlighted in Figure 1.

Established in 2007, Miyahuna Water Utility is responsible for water supply in Amman and is a private entity of the Water Authority of Jordan—the regulatory and operational arm of the Ministry of Water and Irrigation (MWI), which was established in 1992 (MWI, 2015).
At the regulatory and executive level, the Water Authority of Jordan (WAJ) looks after monitoring and managing construction and operational activities. WAJ was established as an autonomous corporate body which took over the responsibilities of previous agencies like Drinking Water Cooperation, Water Divisions of the Municipalities of the Kingdom, Amman Water and Sewerage Authority, etc. Within WAJ, the Project Management Unit (PMU) has the mandate to monitor and regulate water and wastewater utilities, execute projects, and promote private sector participation in the water sector. PMU monitors the performance of the three water companies (Miyahuna, Aqaba, Yarmouk) owned by WAJ.

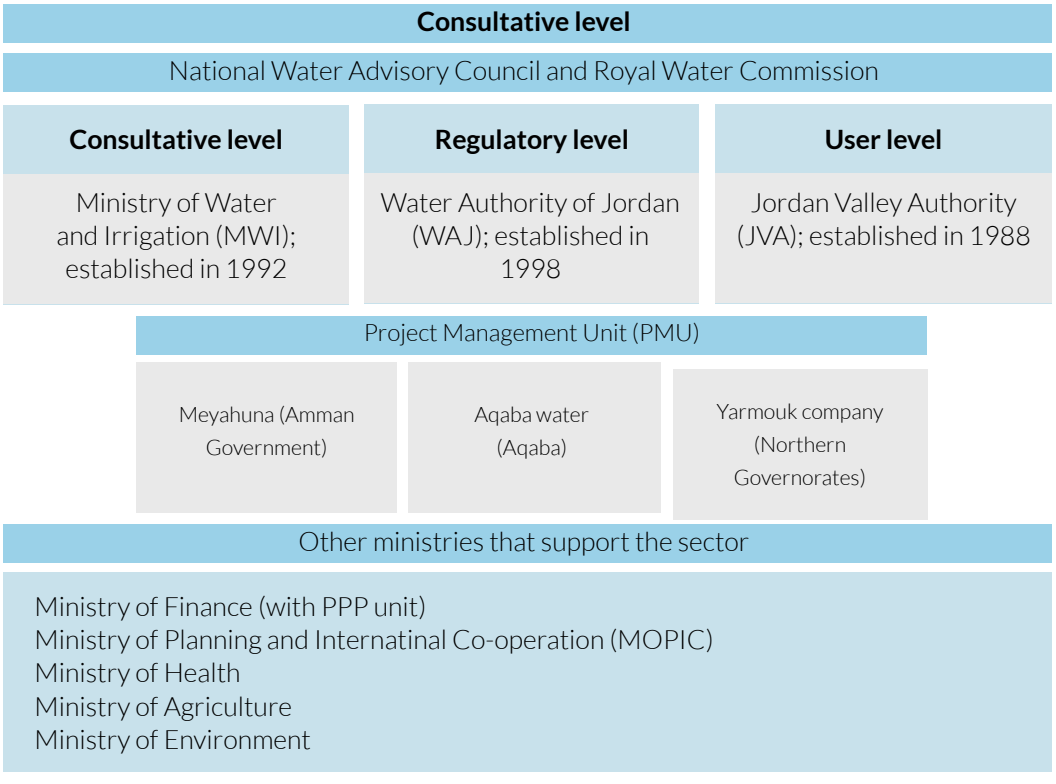


Figure 1. Main Institutions in Jordan's Water Sector (MWI, 2015)

2

RESEARCH METHODOLOGY

Engagement with Amman occurred over three stages:

STAGE 1	The first step was desktop data collection on the biophysical characteristics of the basin and identification of key water governance actors.
STAGE 2	Arup's fieldwork in Amman 22 April–3 May 2018 provided important additional insights from 112 people through : - Six 'one-on-one' interviews (private sector; government – water policy, water operations); - Six focus group discussions ranging from two to ten participants (private sector, utility; civil society; vulnerable communities; government – environment, emergency response); - One large workshop with a broad set of diverse stakeholders (government, private sector, civil society, bilateral and multilateral organisations), and; - One small workshop focused on governance (government, bilateral and multilateral organisations). Fieldwork also included five site visits to: - The largest Palestinian Refugee Camp (est. 1940's) now a formal part of the city receiving services (population increased from 30,000 to 80,000 on the same land footprint); - A wastewater treatment plant that treats 70% of the wastewater in Jordan and that is operated under Build, Operate, Transfer financing scheme, - The operation room of the King Abdallah Canal; - The National Centre for Security and Crisis Management that acts as command and control in response to 'strategic' level crisis, and; - A small water treatment plant.
STAGE 3	This report was created by combining the desktop study and the fieldwork results to provide a clear picture of the city's basin, its key stakeholders, its shocks and stresses, and its factors of resilience.

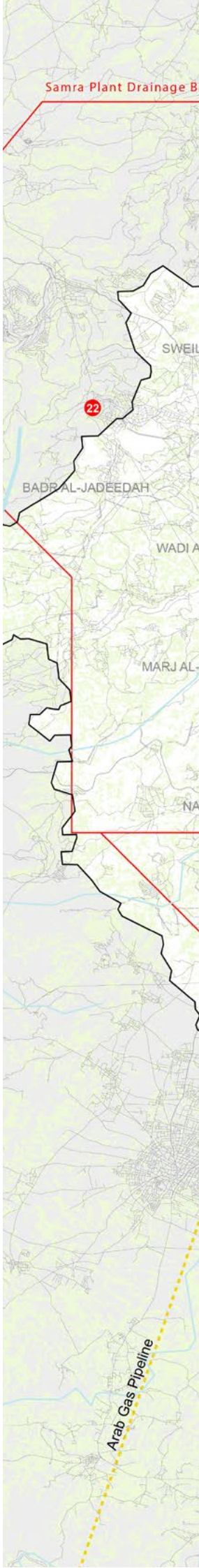
3

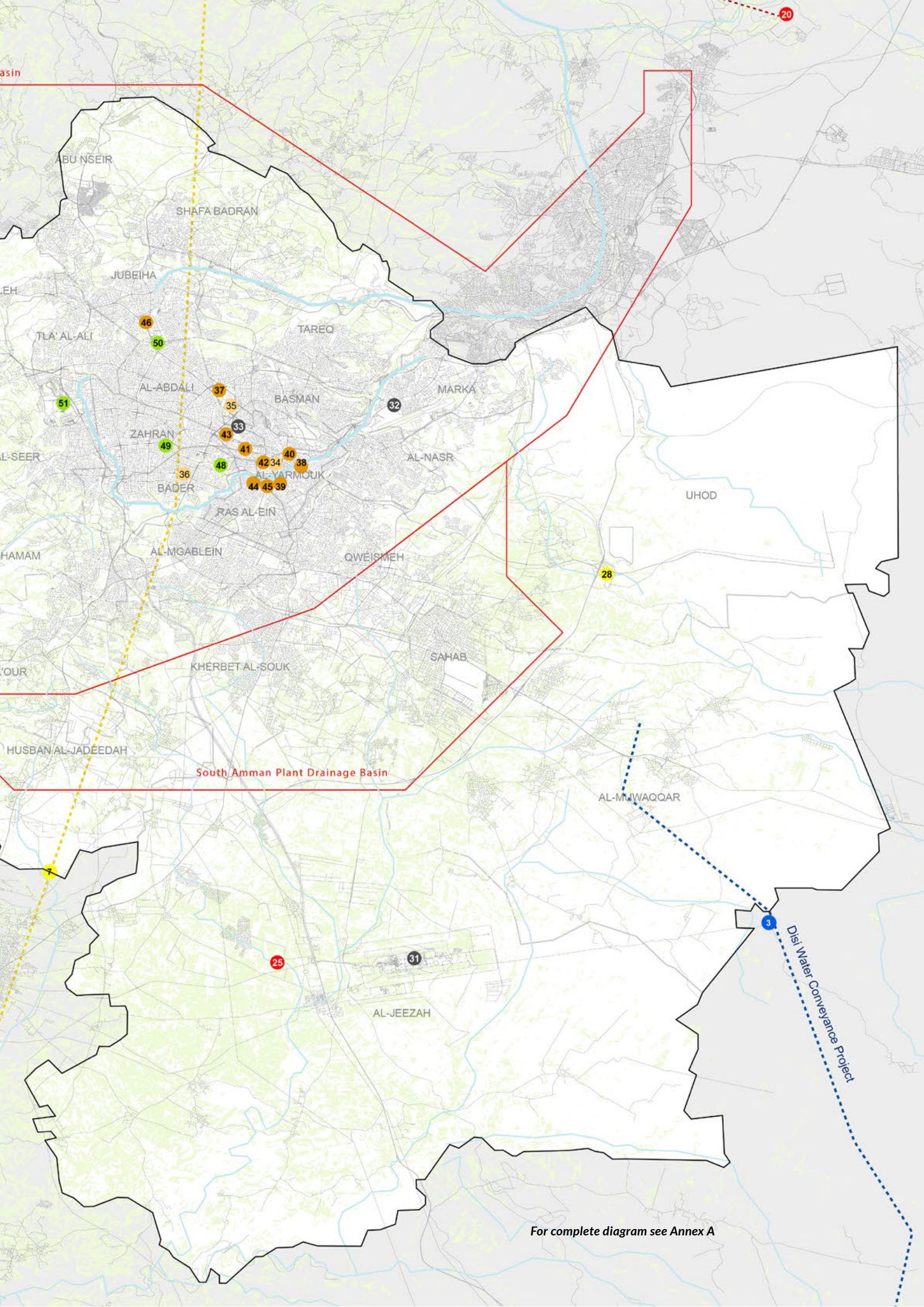
UNDERSTANDING AMMAN'S WATER SYSTEM

Approximately 40% of Jordan's water resources is transboundary (MWI, 2015). Amman itself is heavily reliant on water imported from its northern border with Syria, the Jordan River shared with Israel, and the Disi aquifer, a shared groundwater resource with Saudi Arabia managed under an international treaty (Eckstein, 2015). Therefore, the direct control that Jordan has on these water resources stops at its borders and creating challenges for water resource management.

For the purposes of this analysis, Amman's water system boundary is the entirety of Jordan, excluding the eastern desert that stretches to the Iraqi border and has no surface or groundwater resources.

The country is dependent on water sources controlled and influenced by Israel, Syria, and Saudi Arabia—with major transboundary agreements in place regarding water allocation. Annex A provides a representation of Amman's water system map and Annex B gives Amman's water governance diagram.





For complete diagram see Annex A

WATER SUPPLY

Jordan has twelve groundwater basins and fourteen surface water basins. The quantity of renewable water resources for different purposes is approximately 780 million cubic meters (MCM) per annum, which does not cover annual consumption of 1,010 MCM (MWI, 2015).

Amman sits on an undulating plateau, creating massive pumping requirements to transport water from sources outside the city to its citizens (Potter, Darmame, Barham, & Nortcliff, 2007). All five primary arteries supplying Amman must pump water more than 1000 m in elevation to reach the city. This makes the water system is an extremely energy intensive one.

Amman has 42 districts for water supply, with five main pipelines connecting the community to two main reservoirs. Service coverage rates are high—around 99% of the population has access to an improved water supply through connection to the network (MWI, 2016). However, water supply for citizens of Amman is intermittent, with households receiving water once a week on average. The system relies heavily on water tanks installed on building rooftops. At approximately 94 litres per day, per capita consumption is low when compared to neighbouring states and those with similar economic standing. Water scarcity defines a way of life for citizens of Amman.

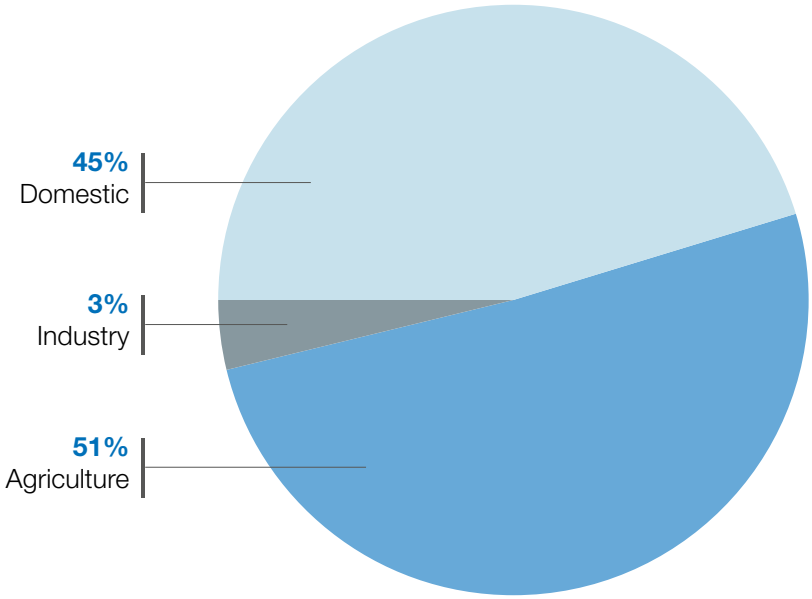
The King Abdullah Canal is the backbone of Jordan's water supply system, stretching 110 km in two main sections—from the border with Syria to Amman and from Amman to the Dead Sea.

Completed in 2013, a controversial project, the Disi Water Conveyance to abstract and convey water from the Disi fossil aquifer on the border with Saudi Arabia into Amman and other Jordanian cities, increased the available water supply by 100 MCM per year (MWI, 2016) (Wikipedia, n.d.). It was expected this project would provide enough water until at least 2025, but demand has already outpaced capacity in 2018.

Interestingly, although water quality in Jordan is of potable drinking standard, most people indicated that they only consume bottled water for drinking purposes. Therefore, bottled water is likely to be a major supplement to centralised water supply.

Amman, Jordan

Water Consumption per annum by Sector in Jordan (MWI, 2015)



WASTEWATER

Most of the population (93%) has access to improved sanitation—63% through network and the rest through other means (MWI, 2016). Al-Samra Wastewater Treatment Plant, operated by Suez, treats all of Amman's collected wastewater and 71% of wastewater collected in Jordan (MWI, 2015). Treated wastewater discharges into irrigation canals, 90% of which is recycled for agricultural purposes (MWI, 2016).

SURFACE DISCHARGE

Within the city, surface run-off either infiltrates sand flats and recharges the aquifers, or it drains via ponds, rivers and channels –naturally flowing with a majority of the Zarqa River catchment towards King Talal Dam, a manmade dam construction downstream of the river during the 1970s. The Zarqa River ultimately leads to the Jordan River and onto the dead sea. (Al-Qaisi, 2010).

Amman, Jordan

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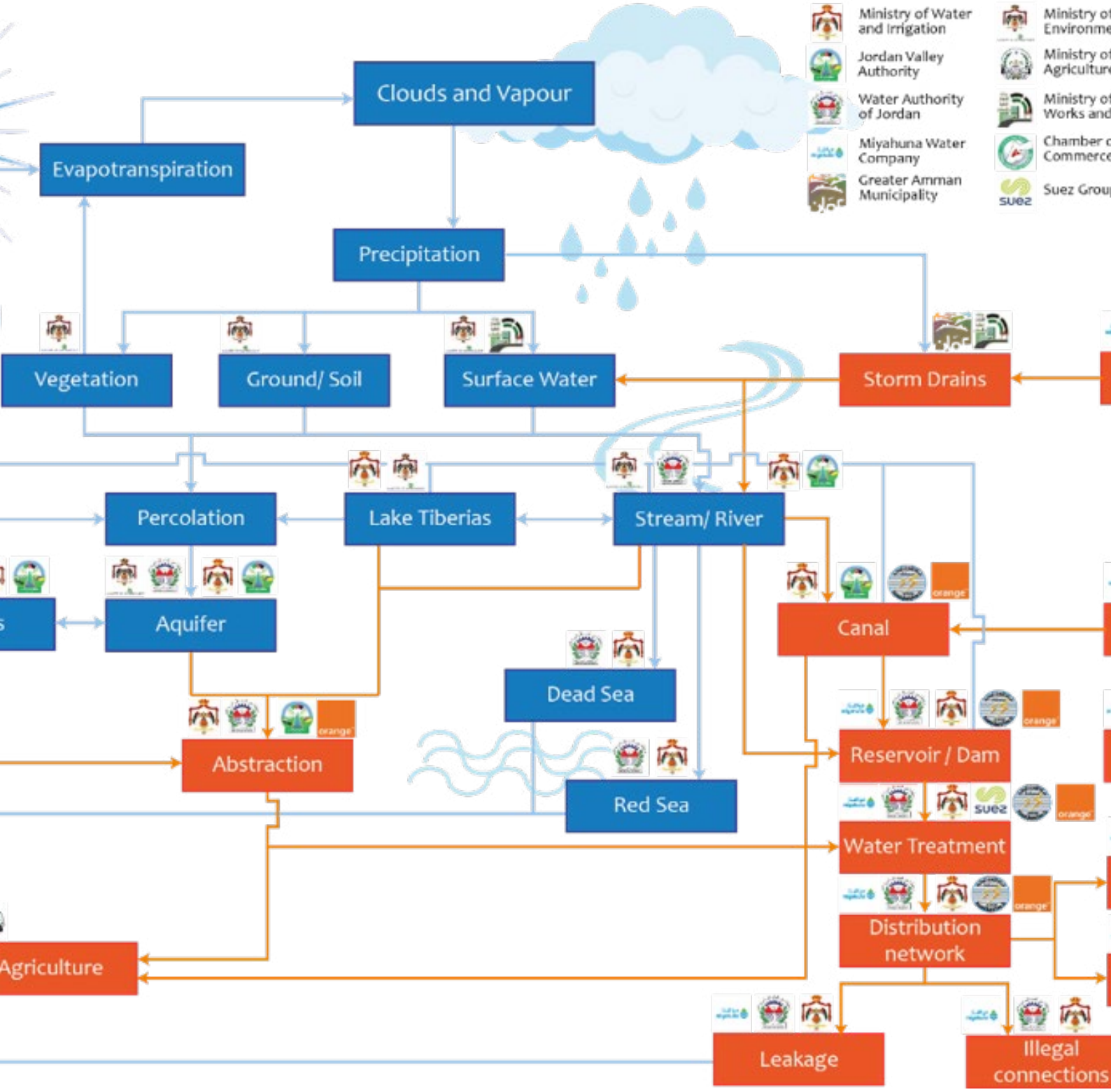
ENGAGEMENT WITH KEY STAKEHOLDERS

Water administration is structured around three key public agencies, the Ministry of Water and Irrigation (MWI), the Water Authority of Jordan (WAJ), and the Jordan Valley Authority (JVA). The stakeholder organogram (Figure 4) helps visualise which stakeholder are engaged in which parts of Amman's water cycle.



For complete diagram see Annex B

Case study

Samra Wastewater Treatment Plant)

Al-Samra Wastewater Treatment Plant, operated by Suez, treats all of Amman's collected wastewater and 71% of all wastewater collected in Jordan (MWI, 2015). Treated wastewater discharges into irrigation canals, 90% of which is recycled for agricultural purposes (MWI, 2016). The treatment plant is world class, operating at 80% self-sufficiency in terms of energy consumption.

Phase One of the plant was completed in 2008 under a build operate transfer (BOT) finance mechanism backed by the Jordanian government through USAID funding. Only two years after opening, the plant reached capacity, initiating Phase Two of the project, which was completed in 2015 backed by Millennium Challenge Corporation (MCC) funding.

The project continues to be hailed as a regional and global exemplar of successful PPP financing. The deal aligned the interests of all the parties involved, transferring much of the risk to the private sector. The project sponsors, Suez International and Morganti, raised $175 million USD in debt and equity within the context of extreme political and social turmoil in the region. A lender syndicate led by the Arab Bank offered a 20-year tenure on the commercial loan, the longest a Jordanian bank has ever offered for a limited recourse dinar loan. Financing of the project under local financing offered reassurance to the Ministry of Water and Irrigation, which did not have to take on foreign exchange risk.

The project earned the World Finance Infrastructure award and the WEX Global Award for Innovation in 2013.

Al-Samara Build Operate Transfer (BOT) Stakeholder Structure

BASIC SERVICE PROVISIONS

The Ministry of Water and Irrigation (MWI) is the apex body with overall responsibilities for water and wastewater supply planning and formulation of policy and strategy. At the regulatory and executive level, the Water Authority of Jordan (WAJ) looks after monitoring and managing construction and operational activities. Within WAJ, the Project Management Unit (PMU) has the mandate to monitor and regulate water and wastewater utilities, execute projects, and promote private sector participation in the water sector. Miyahuna Water Company under WAJ looks after the water services in Amman. The Ministry of Health takes care of the water quality standards and in monitoring for drinking water supply along with WAJ and enforcement aspect. The Jordan Valley Authority (JVA) manages water resources and provides bulk water in the Jordan Valley, primarily an agricultural region.

RISK MANAGEMENT

The Ministry of Municipal Affairs (MoMA) looks after land use planning and wastewater infrastructures within Jordan. The MoMA duties include assisting in financing matters for vital projects, providing technical advice and monitoring the municipalities actions (Jordan Government, n.d.)
The Ministry of the Environment (MoE) focuses on environmental standards. Such as protecting and conserving ecosystems, addressing issues revolving around climate change and pollution. The MoE is tasked with public awareness and behavioural change for environmental related matters at a national level including improving partnership with the private sector (Jordan Government, n.d.).

ENVIRONMENT

ECONOMIC AND SOCIO-CULTURAL

JVA is linked to the MWI and it looks after the socio-economic development of the valley. There are other agencies which support this sector, such as the Ministry of Planning and International Co-operation (MOPIC) facilitating donor engagement to the sector. The Ministry of Agriculture is involved in irrigation water management. Ministry of Finance is responsible for the budgetary management of Public-private partnership (PPPs) (OECD, 2014).

KEY PROGRAMMES

Some key existing projects and programmes related to water and resilience have been identified:

The MWI has outlined multiple water strategies over the past decade, the initial strategy was released in 2008 with goals and initiatives such as near doubling water resources and reducing the supply demand defect by 50% to be achieved for 2022 (MWI, 2009) A secondary national water strategy was released in 2016 providing positive commentary on its previous goals, noting four national policy and strategy documents along with six sector policies were in place to provide guidance for Jordan's water sector (MWI, 2016). The national water strategy 2016-2025 highlights priorities for Jordan such as climate change adaption plans, utilising innovative and efficient technologies including infrastructure and partnerships.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5

CHARACTERISING RESILIENCE

Photo by Edgardo W. Olivera

CRITICAL INTERDEPENDENCIES

The fieldwork carried out in Amman identified a series of interdependencies between the water system and other critical systems.

ENERGY

The water system accounts for more than 20% of total energy demand in the country whilst the Water Authority of Jordan (WAJ) is the largest single electricity consumer in the country (15% of total electricity demand) (MWI, GWP, 2017). This is even more astounding when one considers that al-Samra Wastewater Treatment Plant (responsible for treating 70% of Jordan's wastewater) is 80% self-sufficient in terms of energy demand. The hilly elevation and the energy required to pump water up to residents is the reason for most of the energy used.

TRANSPORT

During rainfall events, Amman's drainage system often becomes inundated and overflows onto the road network, causing major disruption. The research team experienced one such event during fieldwork.

KEY SHOCKS AND STRESSES

Shocks and stresses cited by stakeholders in Amman can be characterised into three primary themes: water scarcity; cost recovery of water and wastewater services; and flooding. Additional, but less frequently cited shocks and stresses are also listed here;

Water Stress

Water resources in Jordan are extremely scarce. Reduction in resource availability has reduced radically over time – falling from 3,600 m3 per person in 1946 to 125 m3 per person in 2013 (IMWI, 2016). Projections estimate that demand will outstrip supply by 26% by 2025 (MWI, 2016).

Jordan is the final downstream country for both the Yarmouk and Jordan Rivers. 1.2 MCM used to flow into the Jordan River, today flow does not exceed 150 MCM (MWI, 2016). Jordan only receives a third of its proposed share under transboundary agreements (MWI, 2016). Multiple stakeholders raised the outdated nature of existing transboundary agreements as a major contribution to the issue of extreme water scarcity.

Water Quality

The most common water quality issues cited was high turbidity levels that render critical water resources temporarily unavailable following rainfall events. High turbidity levels caused several of Amman's critical sources to not work for seven days during the fieldwork. Cases of contamination and water borne diseases were also reported.

Large Scale Involuntary Migration

Population growth due to refugee migration was the most commonly cited pressure on the water system in desktop research and in the field. Jordan has suffered from several influxes of refugees over the past 70 years, most notably following the establishment of Israel 1948, the Iraqi War 2003, and most recently, the Syrian Civil War 2011. Jordan has accepted an estimated 1.4 million Syrian refugees, costing the water sector ~620 USD/refugee/year (MWI, 2015).

Cost Recovery of Waste and Wastewater Services

The Jordanian water sector only recovers 60-70% of its total costs. Water and wastewater bills account for less than 1% of total household expenditure (MWI, 2016). Major capital investment and little change in tariffs since 2005 has created a continual decline in cost recovery rates. Service provision is heavily dependent on national budget subsidies and is therefore very vulnerable to fiscal crises. In addition, with limited fiscal resources, the government relies heavily on involvement from donor organisations and the private sector, which is not certain in the long-term. The cost of energy and non-revenue water were cited as the primary drivers of poor cost recovery in Amman. The cost of energy was the single most cited stress in the shocks and stresses exercise of the large, multi-stakeholder workshop exercise. Non-revenue water amounts to financial losses of more 352 million USD annually (OECD, 2014). At a rate of more than 38%, Amman's non-revenue water rates undermine the economic efficiency of the sector.

Flooding

Although characterised by water scarcity and

drought, Amman also suffers from flash floods due to the high intensity, short duration rainfall events that are typical of the region. Amman has contrasting seasons, with a wet season between November and April. The topography of Amman consists of steep hills and narrow valleys which exacerbate the quick run off dry landscape in flash floods.

In 2015 several people in low lying areas of Amman died during a particularly bad flooding event. Outside of Amman, flash flooding was a major impact on the operation of critical water resources infrastructure. The King Abdallah Canal is vulnerable to debris carried by flood waters that block the canal. Road accidents/ congestion due to flooding were mentioned several times during the shocks and stresses exercise of the main workshop as a low frequency, high impact shock.

Poor Urban Planning

Environmental stakeholders felt that poor planning has led to poor zoning of the greater Amman area, increasing the risk of flooding to those locations. In addition, development has taken place within the flood plain, increasing the number of people exposed to flooding, usually the most vulnerable.

Lack of Investment

In terms of revenue, some stakeholders expressed frustration about affordability requirements that make current water tariffs unaffordable. The battle against non-revenue water is a self-perpetuating cycle. Miyahuna, the water company, suffers from a lack of resources to deal with leakage and theft that in turn undermines the company's revenue stream. Stakeholders also felt that the low cost of water undermines the finance-ability of projects.

Donor funding has been a critical part of the fiscal budget for water projects, providing financing where government budgets are unable to. Most stakeholders saw this as a welcomed safety blanket although several highlighted concerns about the vulnerable to potential shifts in donor priorities.

Poor Governance

The single most common factor cited was a lack of coordination and collaboration amongst water sector stakeholders. Related to this, there was a sense that stakeholder groups within the sector work in silos, causing overlaps in programmes of work. Some felt this issue is exacerbated by the priorities and requirements of different donor organisations working in the same space.

Although environmental water laws and regulations are in place, the Ministry of Environment has neither the power nor the resources to enforce these regulations effectively. The environmental impact requirements of financiers were felt to be a welcome protection for the environment.

Despite this success of Public Private Partnership (PPP) projects filling in gaps regarding national funding for the water sector, there remains a lack of laws and regulations to govern PPP's in Jordan.

Poor Waste Management

Poor waste management in some parts of the city, largely home to the most vulnerable communities, causes drains to block, exacerbating issues of flooding.

Photo by Cat Collector

KEY FACTORS OF RESILIENCE

When asked what things helped or hindered city stakeholders in dealing with shocks and stresses several key themes emerged outlined in following sub-sections.

GOVERNANCE, STRATEGY AND LEADERSHIP

The fieldwork in Amman underscored the tremendous capability of those working there within the water sector. The sector's leadership and management at all levels is heavily dependent on individuals rather than on institutions or processes, which is both a strength and a vulnerability.

FINANCE

The Syrian refugee crisis has put a major strain on Jordan's economy. Within the national fiscal budget, the water sector must compete amongst a growing and diverse set of priorities to tackle the strain on the country's services.

Public private partnerships play a critical role in financing, delivering and operating major water infrastructure projects in Jordan. Most major infrastructure in Jordan have been delivered under PPP's—many of which are designed and operated to world leading standards.

EFFECTIVELY MANAGING INTERDEPENDENT SYSTEMS

Recognizing that the water system's heavy reliance on energy is a critical risk, the water sector aims to reduce reliance on centralised energy supply by developing decentralised, renewable sources—up to 25% of demand by 2025. Additionally, several initiatives seeking to improve the water assets' energy efficiency have utilised public-private partnership (PPP) mechanisms to great effect.

DATA, MONITORING AND FORECASTING

Supervisory Control and Data Acquisition (SCADA) systems enable remote monitoring and control of much of Jordan's water infrastructure assets. Thus, operators can effectively respond to shocks that hit the water system. Stakeholders raised remote monitoring and automation as a key enabler to planning for and responding to key shocks and stresses. For example, remote monitoring of water quality upstream allows operators of the King Abdallah Canal to shut off inflow until turbidity levels return to manageable levels.

Additional methods to strengthen this system were also discussed. Several stakeholders—who are responsible for and are impacted by flooding—indicated that weather forecasting would enable a more effective response. Intelligence agencies and those responsible for managing emergency situations receive daily weather forecasts, but not those who operate key assets. Other concepts were GIS mapping, specifically vulnerability mapping and smart metering.

INFRASTRUCTURE DESIGN AND MANAGEMENT

Redundancy, both in terms of design and operation of assets, emerged as a key theme. For example, the over design of the Disi water transfer scheme and of al-Samra Wastewater Treatment Plant allowed the country to absorb, and largely cope with, the major influx of Syrian refugees since 2011. On the operational side, redundancy storage is critical to managing water scarcity.

The innovative design of energy from waster and turbines at the inlet and outlet pipes of al-Samra Wastewater Treatment Plant has allowed itself to almost completely decouple from the energy grid being 80% self-sufficient. The plant treats water to non-potable standards, supplying ~20% of total agricultural demand through recycled water.

CITIZENS' ROLE IN RESILIENCE MEASUREST

Water demand in Jordan is very low, at 80 litres per person per day. Citizens of Amman receive water once a week on average and must store water in rooftop tanks to ensure continuity of supply. Media messaging informs citizens of when they will receive their weekly ration and any notices about likely droughts. Those stakeholders who shared information through the fieldwork portion of this project gave mixed messages about their personal experiences dealing with these supply limitations. Most expressed acceptance and cooperation, recognising the policy of limited delivery as a necessary measure to deal with the reality of extreme water scarcity. However, some felt not enough is being done to increase water resources capacity and therefore increase water delivery.

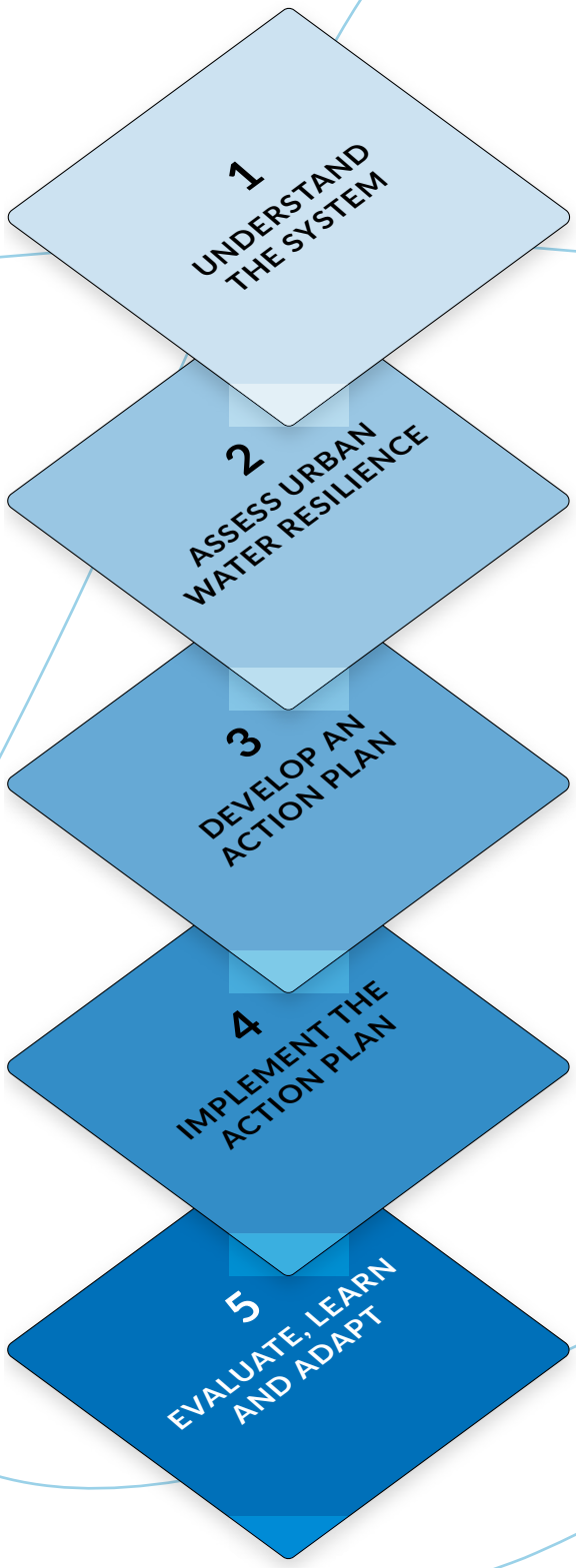
EMERGENCY PREPAREDNESS AND RESPONSE

The research team visited the emergency control centres of both Amman and Jordan writ large. These centres operate as command and control under emergency events and are critical to ensuring coordination and collaboration in response to flooding. One note for improvement is the need—not currently realised—for a backup energy supply in the water supply and flood management systems.

6

REFLECTIONS OF THE CITY WATER RESILIENCE THE APPROACH

Generally, stakeholders appreciated the concept of the City Water Resilience Approach (CWRA). The key value cited was the opportunity to facilitate better coordination and collaboration amongst water sector stakeholders towards a common goal.


1
UNDERSTAND THE SYSTEM
2
ASSESS URBAN WATER RESILIENCE
3
DEVELOP AN ACTION PLAN
4
IMPLEMENT THE ACTION PLAN
5
EVALUATE, LEARN AND ADAPT

PERSPECTIVES ON CWRF ASSESSMENT TOOL

Questions were raised about the implementation process of the CWRA action plan, specifically whether it would be feasible to implement such a framework in cities like Amman with a resource deficit. Other key questions were who would or should lead the process, how the action plan would fit with existing policies and programmes, and the implementation timeline of such a strategy.

Some suggestions were given regarding the process of stakeholder mapping and understanding the water cycle system (both human and natural);

- Have a clear approach of the institutional mapping by defining the roles and responsibilities of each actor, along with mapping the flow of the functioning and governance processes.

This approach would help in the design and implementation of the framework, providing stakeholders with a better understanding of the system and helping identify both the right actors and lead institutions to collaborate.

- Map the existing policies and programmes in the water sector, assess mandates, and regulations of the water sector.

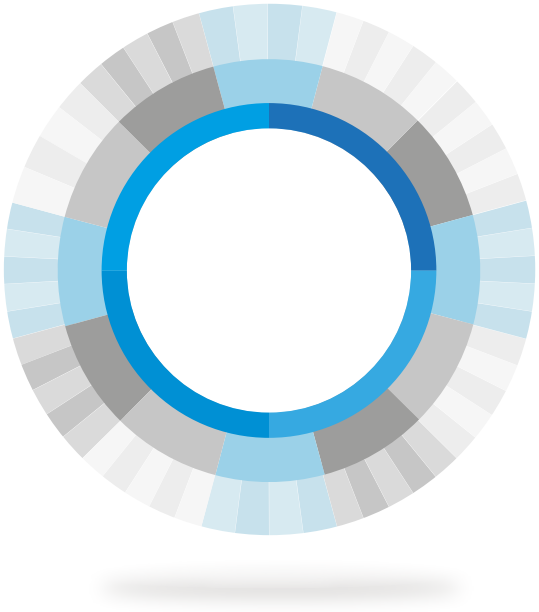
- Approach the city water system from a wider basin perspective and across sectors and levels.

For example, the water system of Amman cannot be defined at the municipal level. While the municipality is responsible for watershed management, it does not manage Amman's water resources. Since most of Amman's water supply comes from outside the city, it is crucial to study the system from hydrological and administrative perspectives beyond the city limits. Other sectors, like tourism and land development, should be identified and engaged in the process as well as other external stakeholders like NGOs, private companies, and international organizations. Their roles are equally important to build resilience in water sector.

- Map the geographical location—such as the shock areas, shock points—to better understand the water system and challenges of water resource use and demands.

For example, vulnerable population located in Jordan Valley or refugee camps may not have been thought of as the mapping exercise now stands.

For the CWRF to be useful in Amman, the water sector must own and lead the process. Representatives from all levels of government, including the municipality, would need to be brought together in committee. It was suggested the implementation methodology needed an additional step in the understanding the system that would map existing actions in the city to minimise duplication and maximise value.



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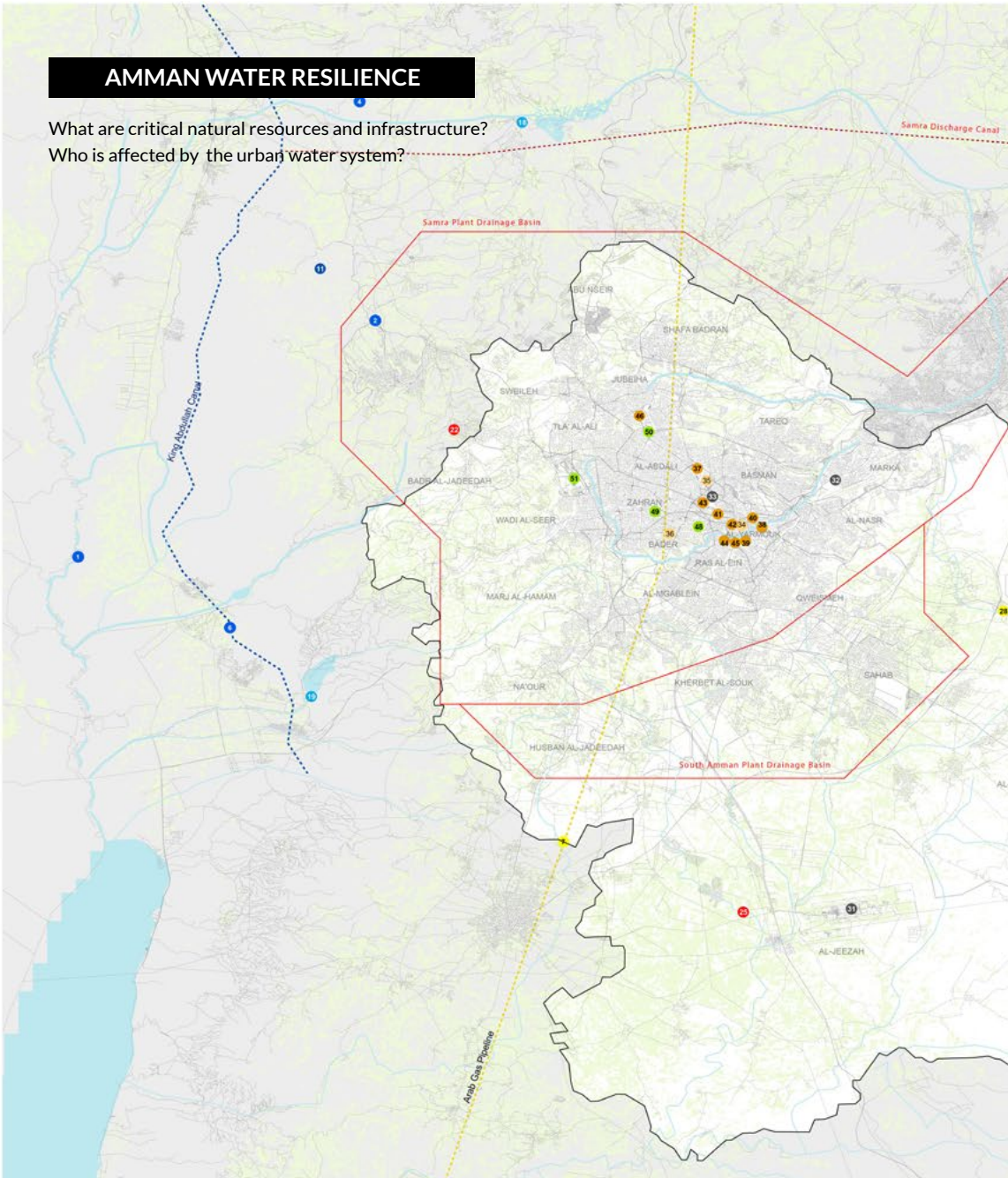
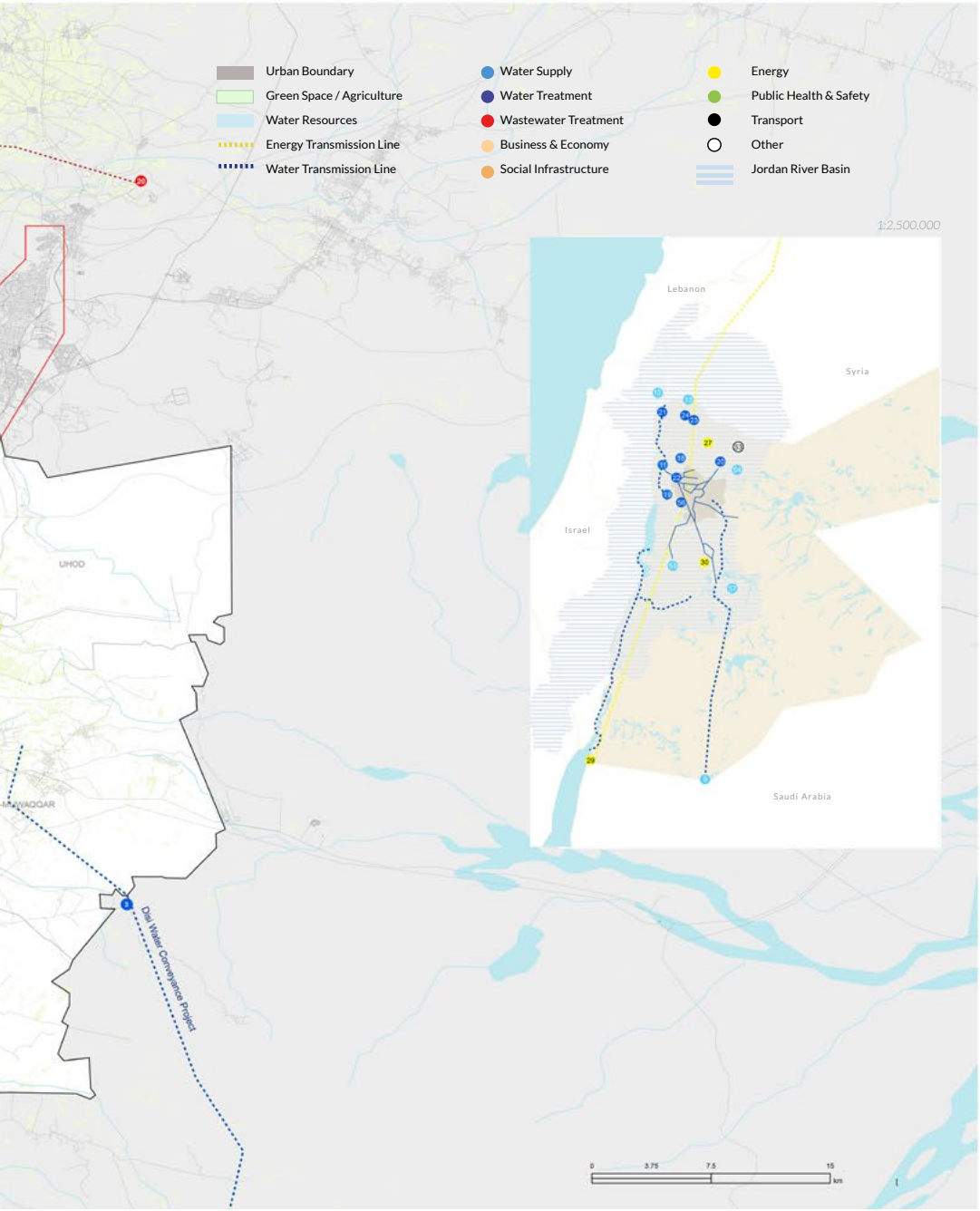
- Municipality of Greater Amman, Resilience Team
- Water Authority of Jordan
- Ministry of Water and Irrigation
- Jordan Valley Authority
- Ministry of Environment
- Miyahuna Water Utility
- Jordan's National Centre for Security and Crisis Management (NCSCM)
- UNICEF
- UNDP
- USAID Water Management Initiative
- GIZ Water Cluster

ANNEX A

AMMAN WATER SYSTEM MAP



01	Jordan River	11	Zai Water Treatment Plant	21	Wadi Al Arab (Doughara)	32	Marka International Airport
02	Zarqa River	12	Sea of Galillee	22	Al Baqa	33	JETT Bus Station
03	Disi Water Conveyance Project	13	Al-Wehda Dam	23	Wadi Shalala	34	Al Balad
04	Yarmouk River	14	Ma'in-Mujib Desalination Plant	24	Central Irbid	35	Amman Stock Exchange
05	Red Sea-Dead Sea Canal	15	Mujib Reservoir	25	South Amman Treatment Plant	36	Zahran District
06	King Abdullah Canal	16	Private suppliers (Various retailers)	27	Rihab Power Plant	37	Amman International Stadium
07	Arab Gas Pipeline	17	Wells (Various)	28	Amman East Power Plant	38	Roman Theater
08	Azraq wells	18	King Talal Dam & Reservoir	29	Aqaba Thermal Power Plant	39	Jordan Museum
09	Disi Aquifer	19	Al Kafrien Dam	30	Al Quatrana Power Plant	41	National Art Gallery
10	Deir Alla-Amman	20	As Samra Wastewater Treatment Plant	31	Queen Alia International Airport	42	Rainbow Street

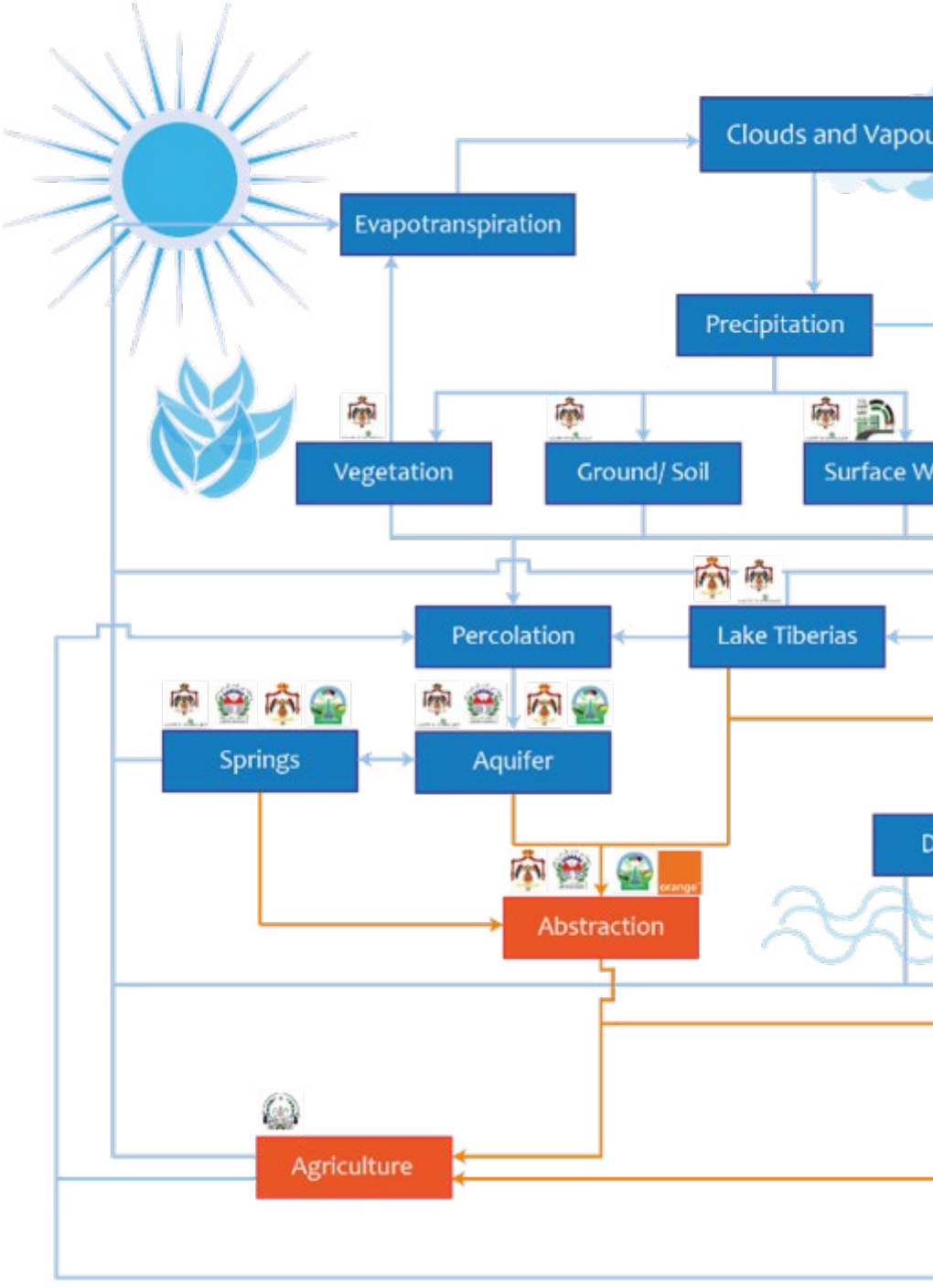


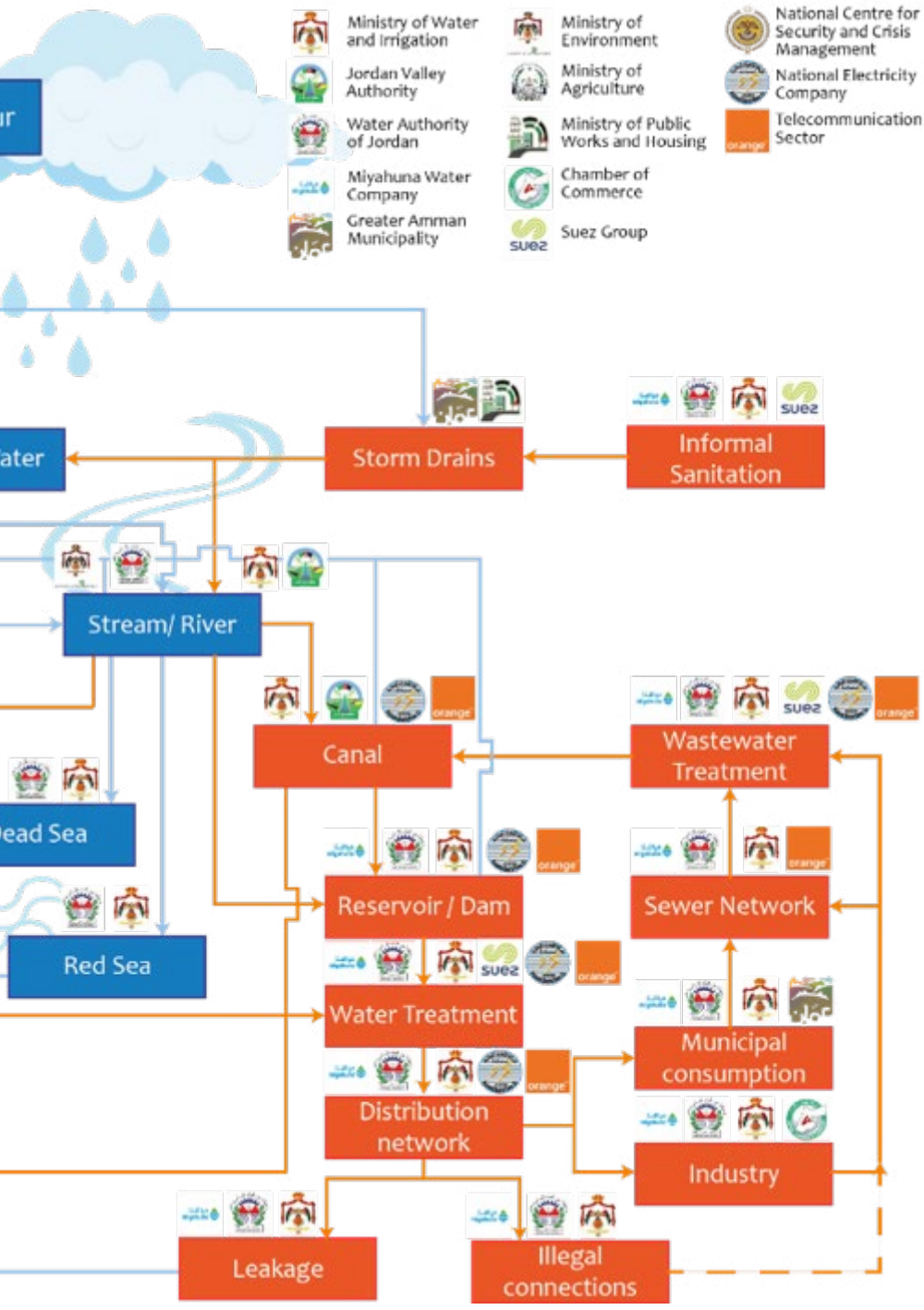
43 Abdali Boulevard
44 Al Hussein Cultural Center
45 Greater Amman Municipality
46 University of Jordan
48 Khalidi Hospital
49 Arab Medical Center
50 Jordan University Hospital
49 Arab Medical Center
51 King Hussein Medical Center
53 Zatari Refugee Camp I
54 Khaw Reservoir (supply)
55 Wala (supply)
56 Zara-Maeen (treatment)
57 Lajjoun Wells (supply)

Amman Water Source	Quantity (Approximate)	Percentage
Disi	100 MCM	32%
Zai / KAC	90 MCM	28%
Zara - Ma'een (from various)	47 MCM	15%
Internal Sources	36 MCM	11%
Khaw	18 MCM	6%
Lajjoun	15 MCM	5%
Walla	10 MCM	3%
Total	*32.5 m^3/s*	*100%*

ANNEX B

AMMAN WATER GOVERNANCE DIAGRAM




Ministry of Water and Irrigation
Jordan Valley Authority
Water Authority of Jordan
Miyahuna Water Company
Greater Amman Municipality
Ministry of Environment
Ministry of Agriculture
Ministry of Public Works and Housing
Chamber of Commerce
Suez Group
National Centre for Security and Crisis Management
National Electricity Company
Telecommunication Sector
Storm Drains
Informal Sanitation
Stream/ River
Canal
Wastewater Treatment
Reservoir / Dam
Sewer Network
Water Treatment
Municipal consumption
Distribution network
Industry
Leakage
Illegal connections
Red Sea

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