



THE CITY WATER
RESILIENCE APPROACH

CITY CHARACTERISATION REPORT
THESSALONIKI

ACKNOWLEDGEMENTS

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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 Thessaloniki 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**
2. **Identify the factors contributing to the resilience of the city water system and those increasing its vulnerability**

In developing this characterisation report, the team collected desktop data on the biophysical characteristics of the basin and key actors in the water system.

THESSALONIKI'S WATER SYSTEM

Located along the Thermaikos Gulf in the northwest corner of the Aegean Sea, Thessaloniki is Greece's second largest city and home to 1.12 million people. Due to austerity measures, tourism (2 million annually, 75% international) and the university scene (with its 150,000 students annually) has become increasingly important to sustain the city's economy. The port is also critical and brings in 293 million USD annually. Greece has a national government with a strong central focus. At the national level, the Ministry of Environment and Energy works to achieve the protection of the natural environment and resources, the improvement

of quality of life, the mitigation and adjustment to the implications of climate change and the enhancement of mechanisms and institutions for environmental governance.

KEY STAKEHOLDERS

The Ministry of Environment and Energy is responsible for regulating water quality and resources at a national level. The General Organisation of Land Reclamation is responsible for improvements to dams, irrigation canals, drainage ditches and pumping stations managing the distribution of the water needed for agricultural irrigation purposes. EYATH SA is the main utility company in Thessaloniki providing water supply and sewage services. There are various other stakeholders that manage risks, environment and economic and social-cultural aspects of the water system.

SHOCKS AND STRESSES

The key interdependencies between the water system and city systems in Thessaloniki is the water-food-energy Nexus, particularly agriculture and energy where the city is struggling to meet demand. Damage to housing and critical infrastructure caused by recent flooding to houses and critical infrastructure was also identified as a key interdependency with systems.

Thessaloniki's key shocks and stresses include water scarcity due to water demand from increasing populations. Extensive pluvial flooding in 2009 and 2014 demonstrated that flood mitigation infrastructure needs to improve. These coupled with a shortfall of

critical infrastructure, inadequate governance, pollution, aging infrastructure, limited funding and investment, and illegal connections all hinder the resilience of a city.

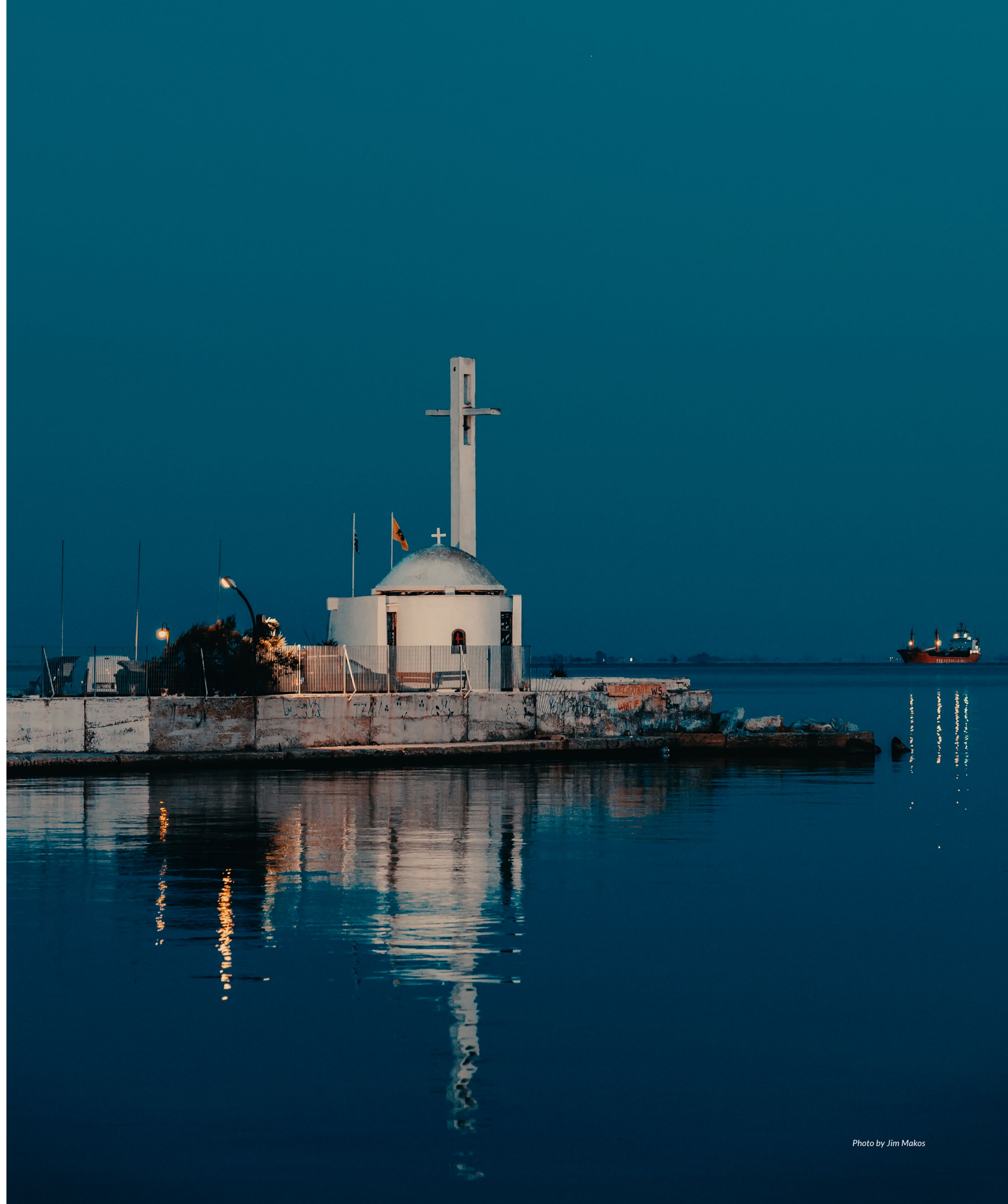
BUILDING RESILIENCE

Through engagement with Thessaloniki's stakeholders, it was identified that strong human resources, effective engagement of communities, decreases of pollution, and an upgraded sewer system would all positively contribute to the resilience of the Thessaloniki's urban water system.

1

BACKGROUND

Located along the Thermaikos Gulf in the northwest corner of the Aegean Sea, Thessaloniki is Greece's second largest city with its second largest port that provides Europe easy access to the Balkans and the Black Sea. Part of the Hellenic, Roman, Byzantine and Ottoman empires, this area has been home to human communities since 315 BCE (Wikipedia, n.d.). Its long history has led to a diversity of architectural styles and historic sites though much of the area was destroyed and then rebuilt after the Great Fire of 1917. With close cultural and economic ties to its neighbours and a strong Jewish history, Thessaloniki is a multicultural city (100RC, n.d.).



POPULATION

Of the 1.9 million residents in the Central Macedonia region of Greece, 1.12 million live within the Greater Thessaloniki area (Wikipedia, n.d.). The city's largest demographic is its ageing population (18.4%) while Greater Thessaloniki is home to 15% of Greece's total refugee population (Wikipedia, n.d.) (100RC, n.d.). In 2017, 22.1% of Thessaloniki's 20-64 year old population was unemployed, gradually decreasing since 2013 when it peaked at 32.1% (eurostat, 2017).

ECONOMY

Due to recent austerity measures, tourism (2 million annually, 75% international) and the university scene (with its 150,000 students annually) has become increasingly important (Wikipedia, n.d.). The port is also a critical component of the local economy, bringing in 293 million USD annually (Wikipedia, n.d.). The gross municipal product in 2011 was € 18.29 billion (Wikipedia, n.d.).

National (elected)	<ul style="list-style-type: none"> Ministry of Environment and Energy (Special Water Secretariat) General Organisation of Land Reclamation Ministry of Rural Development and Food Ministry of Finance and Development
Sub-National/Decentralized (appointed by national government)	<ul style="list-style-type: none"> Decentralized Administration of Macedonia and Thrace
Peripheries or Provinces (elected)	<ul style="list-style-type: none"> Central Macedonia Region
Regional Unit (indirectly elected within the regional elections)	<ul style="list-style-type: none"> Regional Unit of Thessaloniki (a.k.a. Metropolitan Unit of Thessaloniki)
Municipalities of Greater Thessaloniki (elected)	<ul style="list-style-type: none"> Municipality of Thessaloniki 9 other municipalities

GOVERNANCE

The different levels of the Greek government are outlined in Table 1. Greece has a national government with a strong central focus. At the national level, the Ministry of Environment and Energy works to achieve the protection of the natural environment and resources, the improvement of quality of life, the mitigation and adjustment to the implications of climate change and the enhancement of mechanisms and institutions for environmental governance (GME, n.d.). Within this ministry, the Special Water Secretariat develops and implements all water resource management and protection programmes throughout the country. The General Organisation of Land Reclamation is responsible for human-made water infrastructure while the Ministry of Rural Development and Food and the Ministry of Finance and Development work on agriculture and industry, respectively.

Within the national government, there is a sub-national level termed 'decentralized' government, which manage groups of smaller units called peripheries or provinces, which total thirteen and are further divided into regional units (totalling seventy-four) and then municipalities (Wikipedia, n.d.).

The province (or periphery) of Central Macedonia Region contains seven regional units, one of which is the Regional Unit of Thessaloniki. The Central Macedonia Region relies on the national government for risk management funding. The provinces of Central Macedonia, Eastern Macedonia, and Thrace constitute the Decentralized Administration of Macedonia and Thrace, which supervises the peripheries, regional units, and municipalities. With its financial and administrative autonomy, it has devolved powers that include urban planning and environmental and energy policies.

The periphery level is the lowest level of government to control European funds, so municipalities are quite dependent on funding from national and regional levels. This often leads to difficulties regarding risk management of floods and other hindrances to resilience. Municipalities' limited control results in to low municipal taxes (<0.2%), low levels of local independence, and ability to innovation. Half of the funding for the Municipality of Thessaloniki comes from central funding. (Wikipedia, n.d.)

2

RESEARCH
METHODOLOGY

Engagement with Thessaloniki occurred over three stages:

STAGE 1 A desktop study aimed at understanding the city's water basin, identifying shocks and stresses that impact the city's water system, and understanding the system vulnerabilities.

STAGE 2 Survey and Key Informant Interviews – Wave 2 cities used a stakeholder organogram created during the desk study to identify key stakeholders within their cities. These stakeholders completed a survey or interview to share their insights about the urban water system.

While the number of surveys completed for Thessaloniki was small (12), those who filled it out have unique insights and perspectives into the water system in Thessaloniki and do represent eleven of the organisations who are decision-makers in the Thessaloniki Stakeholder Organogram. Insights from the survey have been backed up by the desktop study with references listed here as relevant.

STAGE 3 This characterisation report was created by combining the desktop study and survey/interview results to provide a clear picture of the city's basin, its key stakeholders, its shocks and stresses, and its factors of resilience.

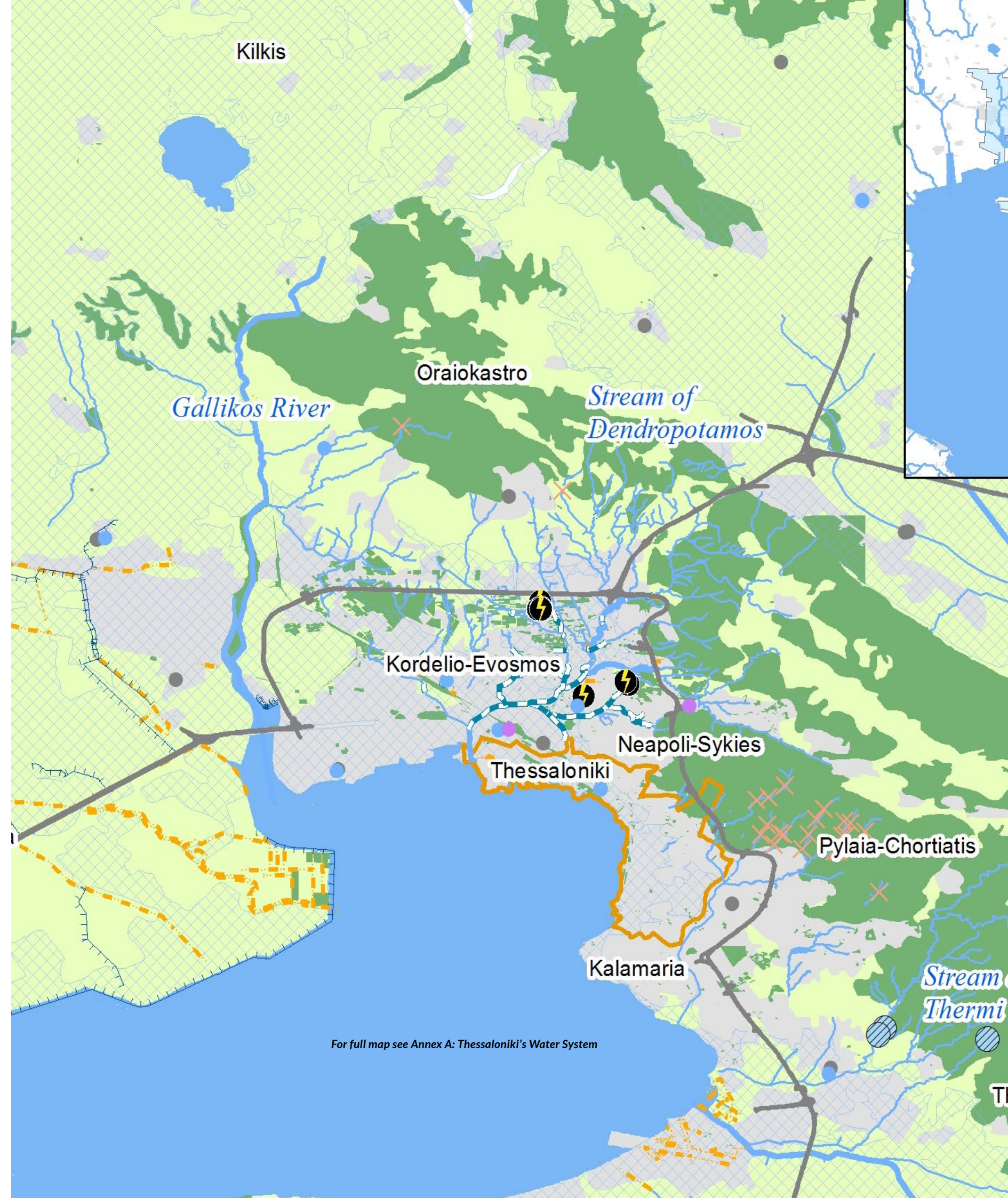
Engagement with 'Wave 1' cities included a two week field mission, where workshops, focus groups and interviews were conducted.

Engagement with 'Wave 2' cities included remote support to city partners where surveys and interviews were conducted.

3

UNDERSTANDING THESSALONIKI'S WATER SYSTEM

The water supply for Greater Thessaloniki comes largely from the Aravissos Springs (not visible on Figure 1, west of the Axios River) and the Aliakmonas River where the water is diverted via a 50 km long free-flowing channel to beneath the Axios River and then to the Thessaloniki Water Treatment Plant. This does create a lot of infrastructure (pipes) that must be maintained for the water supply to Greater Thessaloniki. Smaller amounts of the water supply derive from underground resources via boreholes at the wider city's basin area (Axios-Gallikos River Basins) (EYATH, 2017).



WATER SUPPLY

The Axios River is transboundary, with 83% in the Former Yugoslavia Republic of Macedonia (FYROM), which has built eleven hydropower dams along the river within its borders, upstream of Greece (Aristomenis P., et al., 2006).

Thessaloniki includes 40 km of coastal front from Kalochori to Aggelochori that is being developed under the Thessaloniki Resilience Strategy to encourage community to come together in work and play (GTP, 2018). On the other side of Thessaloniki are the Chortiatis mountain with the Kedrinof Lofos (Seych Sou) suburban forest.

The Axios River Basin, the Aliakmon River Basin, the Loudias River Basin, the Gallikos River Basin, the Thessaloniki streams, and the Katerini Streams feed the Thermaikos Gulf. The southern part of the Axios-Loudias-Aliakmonas Delta is now protected within the Axios Delta National Park (Axios Delta, n.d.).

Figure 2 from the Thessaloniki Resilience Strategy helps identify how the land in this area is used. (100RC, n.d.) The industrial zone of the area (pink) separates the agricultural zone (yellow) from the City of Thessaloniki (orange). What is very clear is how the wider area of the Axios-Loudias-Aliakmonas Delta and the area north of the delta is mostly an area for agriculture. While the Axios-Loudias-Aliakmonas Delta is outside the basin catchment for Greater Thessaloniki (and its jurisdiction), the choices made for agriculture in that area significantly affect the Thermaikos Gulf and thus Thessaloniki (GME, 2012).

Figure 3 from the Ministry of Environment and Energy details historical flood locations where

pink areas are high-risk flooding zones with green dots denoting historical flooding and red dots denoting significant historical flooding (GME, 2012). Another key takeaway is how much of the Axios-Loudias-Aliakmonas Delta is prone to flooding, a fact that was reflected in comments and concerns from the surveys and interviews. The industrial zone of Greater Thessaloniki is in a high-risk flood zone (more easily denoted from the insert of the map). Many areas within the City of Thessaloniki (criss-cross lines) have experienced historic flooding.

Figure 2: Axios Delta and Thessaloniki Land Use²

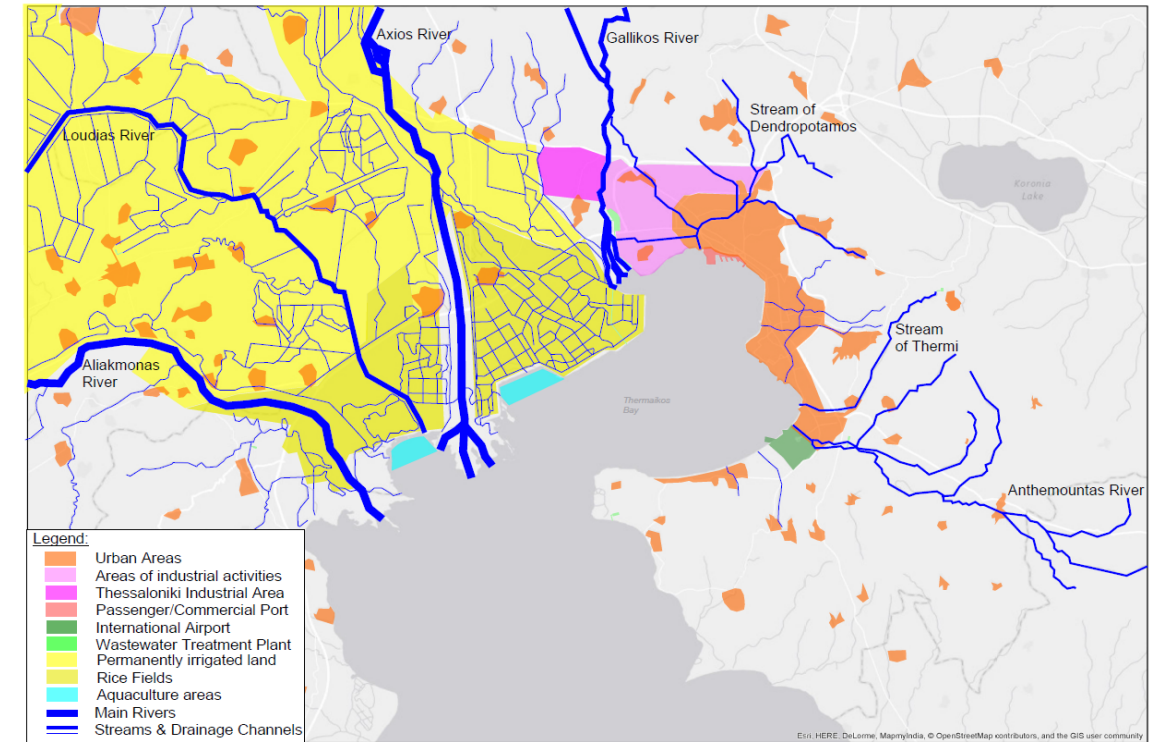
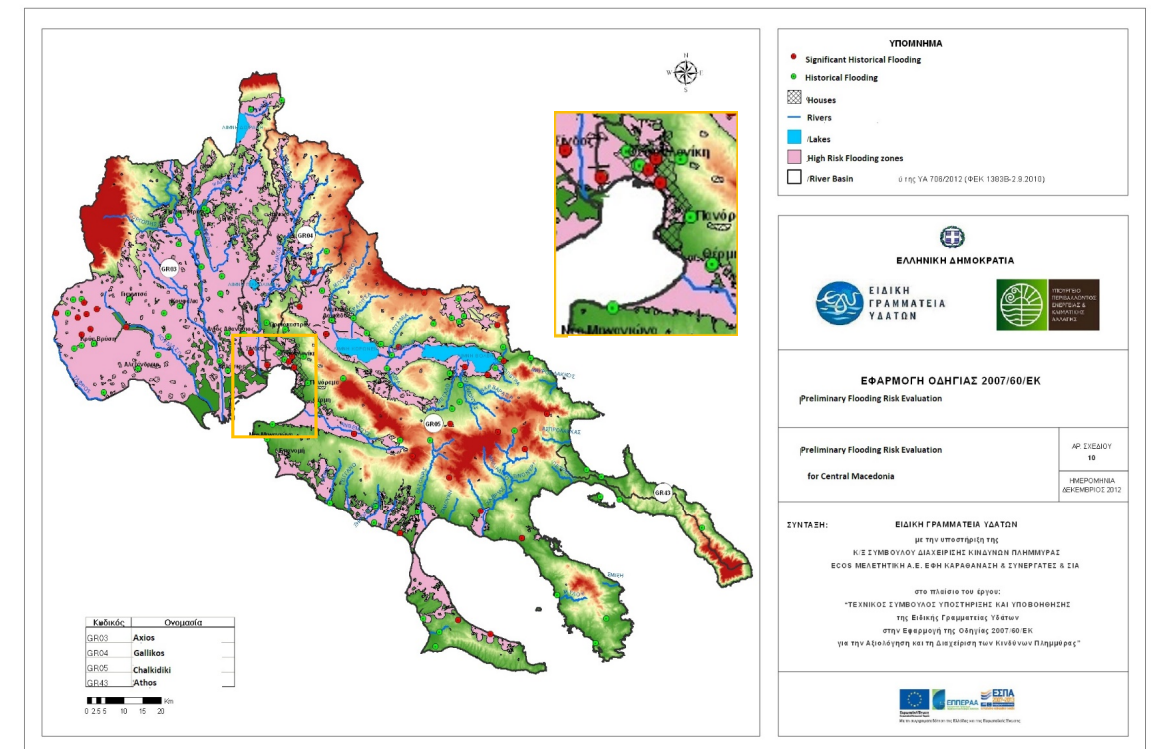


Figure 3: 2012 Regional Flood Predictions near Thessaloniki (GME, 2012)



4

ENGAGEMENT WITH KEY STAKEHOLDERS

Figure 4 is an organogram describing how the Thessaloniki water system interacts with the regional water cycle. The logos of stakeholders are indicated where they have management responsibilities within the water cycle. A legend identifies the organisations associated with the logos.

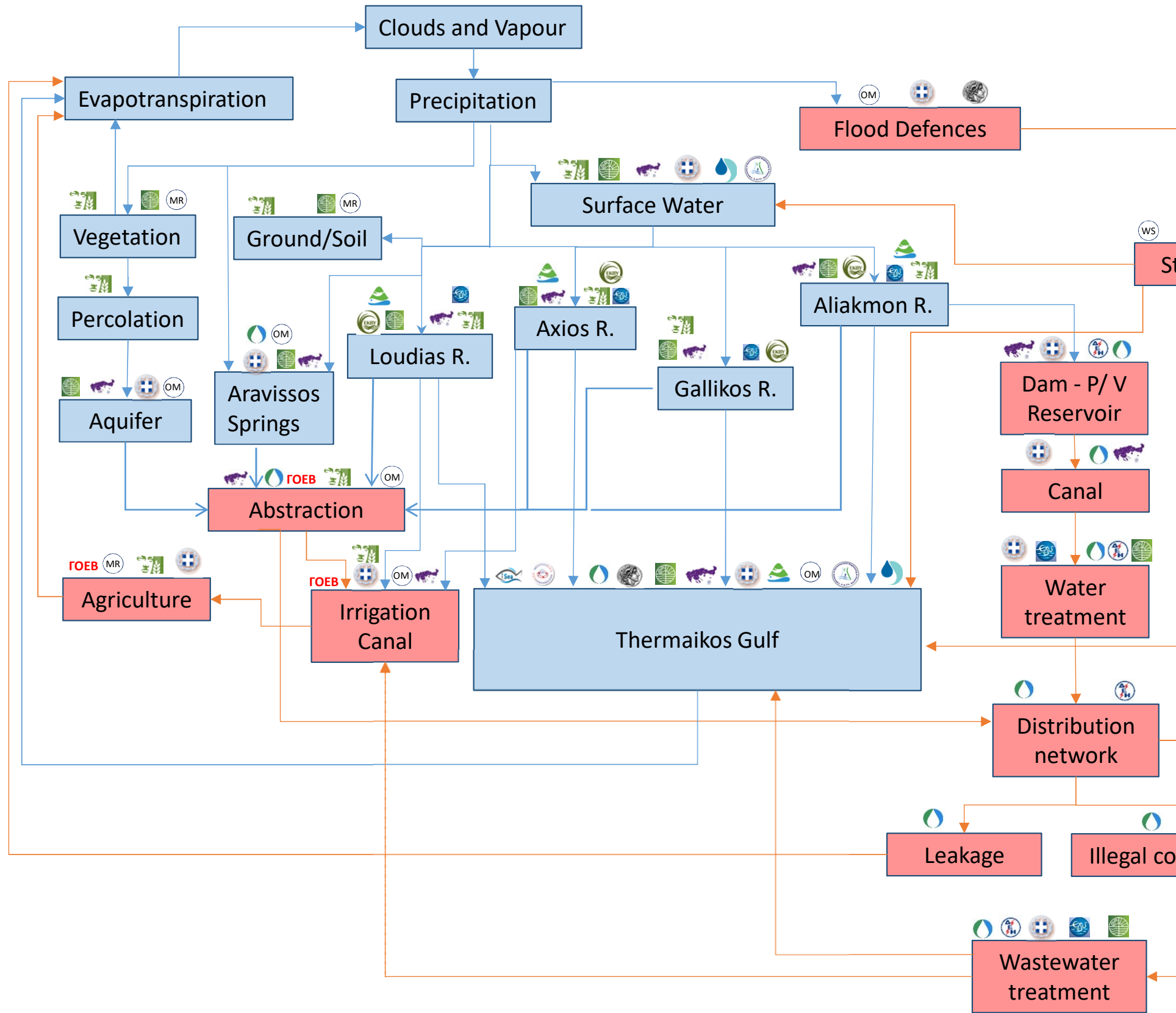




Photo by Jim Makos

BASIC SERVICE PROVISIONS

The Ministry of Environment and Energy is responsible for regulating water quality and resources. The General Organisation of Land Reclamation is responsible for improvements to dams, irrigation canals, drainage ditches and pumping stations managing the distribution of the water needed for agricultural irrigation purposes. Furthermore, by developing quality and quantity monitoring networks of the water bodies, the Land Reclamation Institute contributes to the sustainable management of surface and groundwater. EYATH SA is the main utility company in Thessaloniki providing water supply and sewage services. Other Municipalities within the Greater Thessaloniki area have Other Municipal Water and Sewage Companies that play a role in providing basic and complementary services. ETVA Industrial and Business Park, Co. manages common facilities of the Park (such as rainwater drainage) and the Wastewater Treatment Plant of the Tanneries located in a separate block of the Park, which serves as a pre-treatment stage of the tannery wastewater prior to its discharge to the general wastewater system of the Park. The Public Power Corporation (PPC), which is the biggest (publicly traded) electricity company, generates electricity in the hydroelectric factories of Aliakmonas River dams. Different departments and laboratories of the Aristotle University of Thessaloniki (AUTH) (e.g. the Centre for Integrated Water Resources Management and the Lab for Environmental Engineering and Planning) research integrated water resource management, marine water, surface water and wastewater quality.

RISK MANAGEMENT

The Decentralized Administration of Thrace and Macedonia coordinates the Central Macedonia Region and municipalities of Greater Thessaloniki on most aspects of the urban water system, including human-made water

infrastructure. The Civil Protection section of the Decentralized Administration of Thrace and Macedonia constructs prevention and avoidance risk plans and manages the confronting emergency danger and restoration actions. In the city, the Department of Civil Protection of the Municipality of Thessaloniki coordinate actions for the prevention, treatment and remediation of water related disasters. EYATH SA is responsible for the Thessaloniki sewer network and therefore the prevention of sewer flooding in cases of heavy rain.

ENVIRONMENT

The Ministry of Environment and Energy, through the Special Water Secretariat, is responsible for ensuring sustainable development principles, protection of aquatic ecosystems and wetlands, and long-term protection of available water resources. Thessaloniki follows the European Union's Urban Wastewater Treatment Directive of 1991. The Protected Areas of Thermaikos Gulf Management Authority manages the Axios Delta National Park, which is a third agricultural, outside the Greater Thessaloniki area, and significant for the health of Thermaikos Gulf. Environmental non-governmental organisations include iSea, EKBY, and MedSOS.

ECONOMIC AND SOCIO-CULTURAL

The Federation of North Greece Industries promotes not only industrial development but also economic and social progress in Northern Greece. The Ministry of Rural Development and Food is active in the agricultural space while the Land Reclamation Institute performs research for it. The Ministry of Finance and Development is more connected to industry.

KEY PROGRAMMES

There are some great programmes that Thessaloniki stakeholders are working on that should be highlighted:

1. Thermaikos Gulf Quality Monitoring Programme

EYATH SA (Thessaloniki Water Supply and Sewerage company) created and funded the Thermaikos Gulf Quality Monitoring Programme with the Aristotle University of Thessaloniki for the study of the Thermaikos Gulf marine environment at the specific areas where the underwater effluent diffusion pipes of the wastewater treatment plants are situated (EYATH, 2017).

2. EUREAU

EYATH SA (the Thessaloniki Water Supply and Sewerage company) is a member of the EUREAU Committees (European Federation of National Associations of Water and Wastewater Services). Through these working groups EYATH stay up-to-date with the current European water and wastewater policy and the relevant developments in environmental guidelines (EYATH, 2017).

3. ICME

The European Union and the Black Sea Cross-Border Cooperation funded the Integrated Coastal Monitoring of Environment (ICME), which is examining the major problems several ports, including Thessaloniki, are facing while developing tools to correct them (IMCE, n.d.).

4. 100 Resilient Cities

Thessaloniki is part the 100 Resilient Cities network and has produced the Thessaloniki Resilience Strategy which is currently being implemented (100RC, n.d.).



Photo by Jim Makos

5

CHARACTERISING RESILIENCE

One of the important aspects of this characterisation report was reaching out to key stakeholders identified in the water cycle governance diagram through interviews and surveys. The participants of the surveys and interviews provided insights into what they think the shocks and stresses for Greater Thessaloniki and about what was happening with resilience.

Figure 6 indicates the stakeholder type of those participating in the survey. Most represent some portion of the local, sub-national, or national government. There is close to equal representation from academia, civil society, and the utilities.



INTERDEPENDENCIES OF THE WATER SYSTEM

The urban water system does not exist in a vacuum. In fact, one of the main focuses of the City Water Resilience Framework is how the water system within the city engages not just with the full basin it belongs to but also the other sectors that rely on water and that influence the use of water.

WATER-FOOD-ENERGY NEXUS

There is a strain of water scarcity when considering the needs of the various sectors that depend upon it.

AGRICULTURE

There is tension around trying to meet all the needs of agriculture (and the necessary economic value it provides the region) and of urban populations—business, industrial and domestic.

ENERGY

A key theme was also about how much the water system relies on electricity to function and how loss of electric power would mean a loss of water services.

HOUSING

Concern for personal property came out as a theme given the damage caused by recent flooding to houses and critical infrastructure.

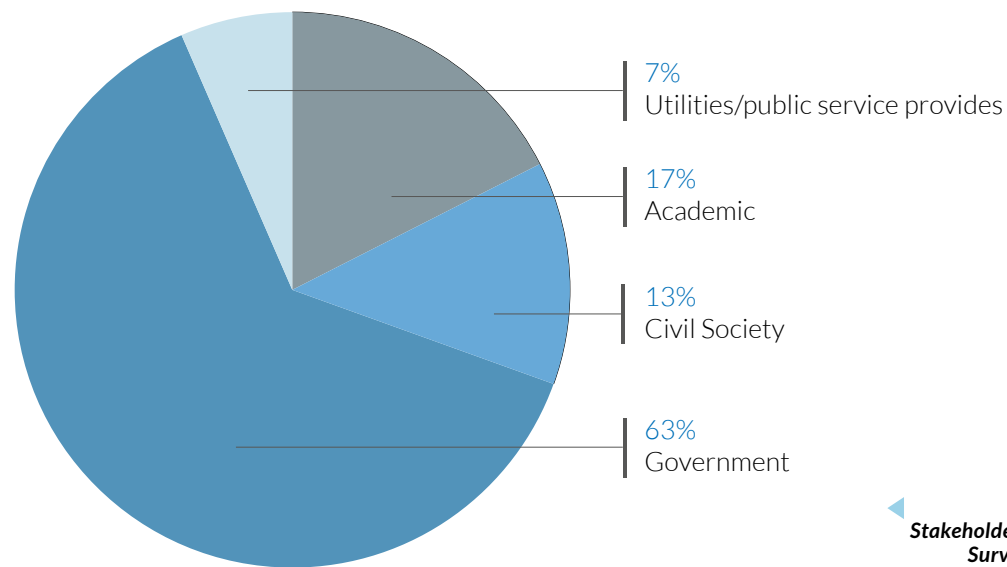


Figure 6. Types of Stakeholders for Thessaloniki Surveys and Interviews

KEY SHOCKS AND STRESSES

Figure 7 examines how the different types of stakeholders identified the top shocks and stresses. It helps demonstrate which shocks and stresses were highlighted across each stakeholder type as well as listing the top 'ten' shocks and stresses. Notice that Ageing Infrastructure and Lack of Investment were mentioned the same number of times as were Loss of Ecosystem Services and Increasing Crop Water Footprint.

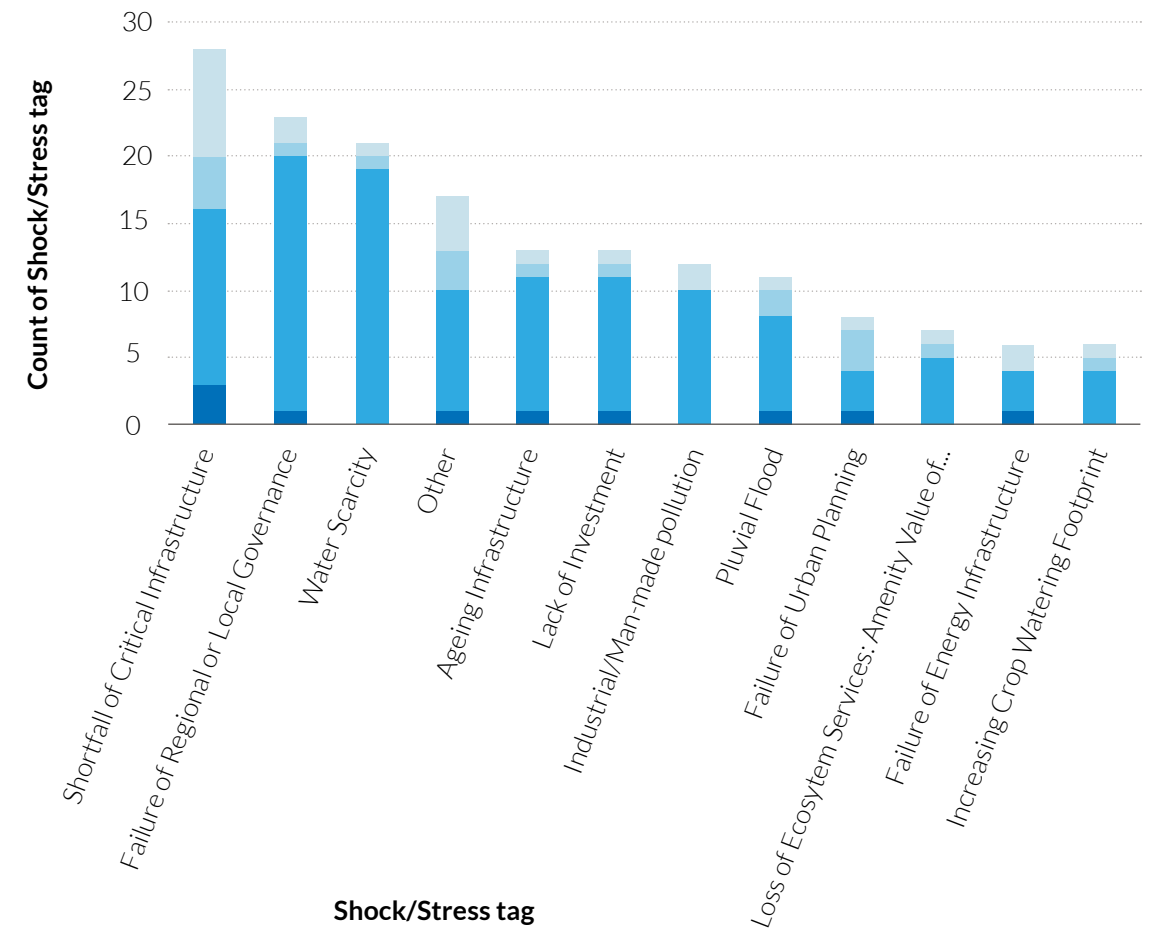


Figure 7. Types of Shocks and Stresses with Stakeholder Type

> Shortfall of critical infrastructure

Poor regulations of historic urban development have resulted in a combined sewer system that cannot handle peak flows during flooding. This was most recently demonstrated during the massive surface flooding earlier in 2018 that flooded the metro lines. Critical infrastructure includes operating and monitoring that infrastructure, so comments mentioning lack of appropriate numbers of staff also fell into this tag.

Inadequate regional or local governance

Survey responses pointed to several issues around Governance and Strategy. Concerns ranged from difficult bureaucracy, budget issues, challenges around coordinating and fostering agreement among so many stakeholders with overlapping authority, and the little power the municipality has despite perceived power by citizens. Some mentioned a lack of community engagement in decision-making. One point that came up several times was that the issues with the nearby agriculture are outside the jurisdiction of the municipalities and therefore nothing can be done.

Water scarcity

This links back to the previous Water-Food-Energy Nexus concern regarding water demand for all the allotted purposes, including increasing populations in the area.

Other

Participants had several points that did not fit into the current version of shock/stress tags. One major point, which links to the tag above, was concern about either the level of collaboration needed to move forward on anything (too many stakeholders) or the lack of collaboration among certain groups of stakeholders. Others mentioned the strain on leadership created by current shocks and stresses. Another concern that was revealed in the surveys was damage to private property due to flooding.

Industrial / man-made pollution

Concerns about pollution reaching Thermaikos Gulf were prevalent in the surveys and desktop research. Pollution comes from the industrial sector of Thessaloniki, from agriculture in the catchments, and from the port. Throughout January 2018 there were oil spills on the Aliakmon River. Fortunately, the Water Treatment Plant nearby was able to maintain a normal water supply for the city. The concern is that the location of the pollution source has yet to be identified despite initial work on pollution source detection to prevent future repetitions.

Ageing infrastructure

Ageing infrastructure was a recurring theme in the survey and interview responses. One example is the cracked pipeline in March 2018, which resulted in five days of diminished water supply (undisturbed amounts for critical users like hospitals and industry thanks to a precaution strategy) before the issue was fully resolved. This portion of the pipeline leading to the Aravissos Springs had been determined to be in a 'high-risk zone prone to cracking.'

> Lack of investment / Limited funding

The governance structure of Greece keeps most of the funding central or at the Central Macedonia Region level with little reaching the municipality level. This reality, coupled with the recent austerity measures nationally, has meant a lack of investment in the critical infrastructure that everyone agrees needs to be updated or replaced.

Flooding

Extensive pluvial (surface) flooding in 2009 and 2014 demonstrated that flood mitigation infrastructure needs to improve. Seven streams in the metropolitan area of Thessaloniki are prone to fluvial flooding. In addition to this, development in the coastal area of the Thermaikos Gulf, part of the Thessaloniki Resilience Strategy, could be in danger of coastal flooding due to rising sea levels.

Lack of permeable and semi-permeable surfaces in the dense urban environment prevents significant retention and storage of stormwater. The European average for green space per person is between 8-10 m² but in Thessaloniki it is 2.6 m² per person. These factors have contributed to infrastructure failures and localized flooding.

Failure of urban planning

There was tension around how to plan for an increasing population in a way that would ensure the safe and reliable provision of critical services to new communities and that would use the opportunity to create flood defences.

Increasing crop water footprint

In the Central Macedonian Region, irrigation water-use accounts for 85% of all water uses. Water-intensive crops, such as rice, account for high volumes of irrigation water in the area around Thermaikos Gulf (Axios-Loudias-

Aliakmonas Delta). Groundwater Depletion from irrigation has increased flood danger in that area. Other concerns include the challenges of subsidence, saline intrusion, and the quality of the remaining groundwater and how it can be replenished.

Loss of ecosystem services

Tied in 10th place with 'increasing crop water footprint' is 'loss of ecosystem services, which is fitting given how these two stresses are linked. This stress was raised as a concern due to environmental degradation from government, academic, and civil society stakeholders.

Agricultural nutrient pollution

Eutrophication from the use of fertilizers throughout the Axios-Loudias-Aliakmonas Delta has caused issues for the quality of the water in the Thermaikos Gulf, the health of the aquaculture systems places at the end of the delta, and for the port. This point came up in surveys and desktop research (Aristomenis P., et al., 2006).

Illegal connections

One issue that was discovered outside the surveys was illegal connections to the water supply system. These connections are unregulated and unpaid for while causing stress on water availability for other uses. There are no clear numbers regarding this issue in the area.



KEY FACTORS OF RESILIENCE

Figure 10 shows a breakdown of where the resilience factors mentioned in the surveys and interviews fit within the City Water Resilience Framework (CWRf) and its dimensions and goals. One of the major takeaways is the focus on Governance & Strategy as well as Infrastructure & Ecosystems, specifically Goal 8: Effective Provision of Critical Services.

STRONG HUMAN RESOURCES

While there were comments that some of the critical stakeholder organisations were short-staffed, all comments about the staff also included how competent and effective they were as individuals.

EU WATER FRAMEWORK DIRECTIVE 2000/60/EC

Many respondents were excited about this directive, which is focused on preserving water quality and on protecting coastal and inland surface waters, estuaries, and groundwater. The directive has resulted in management plans for the Central Macedonia Region (Water District GR10) focusing on drought, water scarcity, and river basin management. Participants saw this directive as a roadmap for how to adapt to climate change concerns such as flooding.

EFFECTIVE ENGAGEMENT OF COMMUNITIES

There are opportunities for effectively engaging with communities to meet resilience goals. One opportunity might be engaging with the National Water Council, which represents the Greek NGOs, as one participant suggested.

DECREASES OF POLLUTION

Work on major wastewater and stormwater infrastructure has helped clean up the water in the Thermaikos Gulf. Now the major concern is agricultural pollution from the Axios-Loudias-Aliakmonas Delta and its feeding into the Thermaikos Gulf, which is mentioned in survey responses (EYATH, 2017).

PLANNED UPGRADE FOR SEWER SYSTEM

One of the major comments throughout the surveys and interviews was about the ineffectiveness of the combined stormwater/wastewater sewer. Once the plans to upgrade the combined sewer overflows occurs, this new infrastructure will be a key part of a more resilient Thessaloniki because less combined overflows will end up in the Gulf during rain flooding.

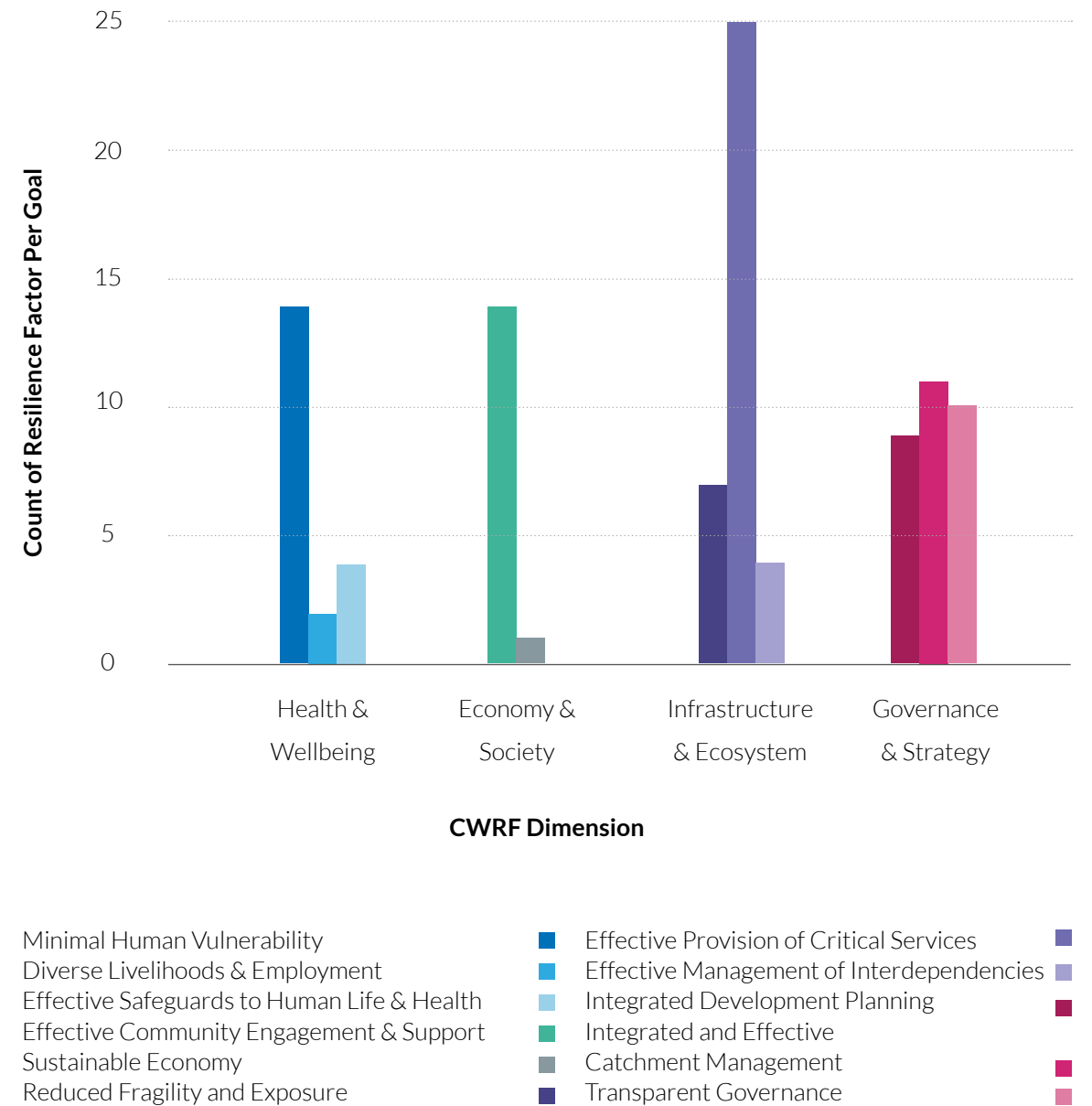


Figure 10. Number of Resilience Factors Identified Within Each CWRf Goal

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The following organisations for completing the surveys for Thessaloniki:

- Mediterranean SOS Network
- Lab of Environmental Engineering & Planning, Aristotle University of Thessaloniki
- Greek Biotype Wetland Centre
- Thermaikos Gulf Protected Areas Management Authorities
- iSea, Environmental Organisation for the Preservations of the Aquatic Ecosystems
- Municipality of Thessaloniki
- Civil Protections of the Decentralized Administration of Macedonia-Thrace
- Independent Civil Protection Directorate of Central Macedonia Region
- General Organisation of Land
- Reclamation of Thessaloniki-Lagadas
- Land Reclamation Institute (LRI) of the Hellenic Agricultural Organisation
- PPC
- EYATH

ANNEX A: THESSALONIKI WATER SYSTEM



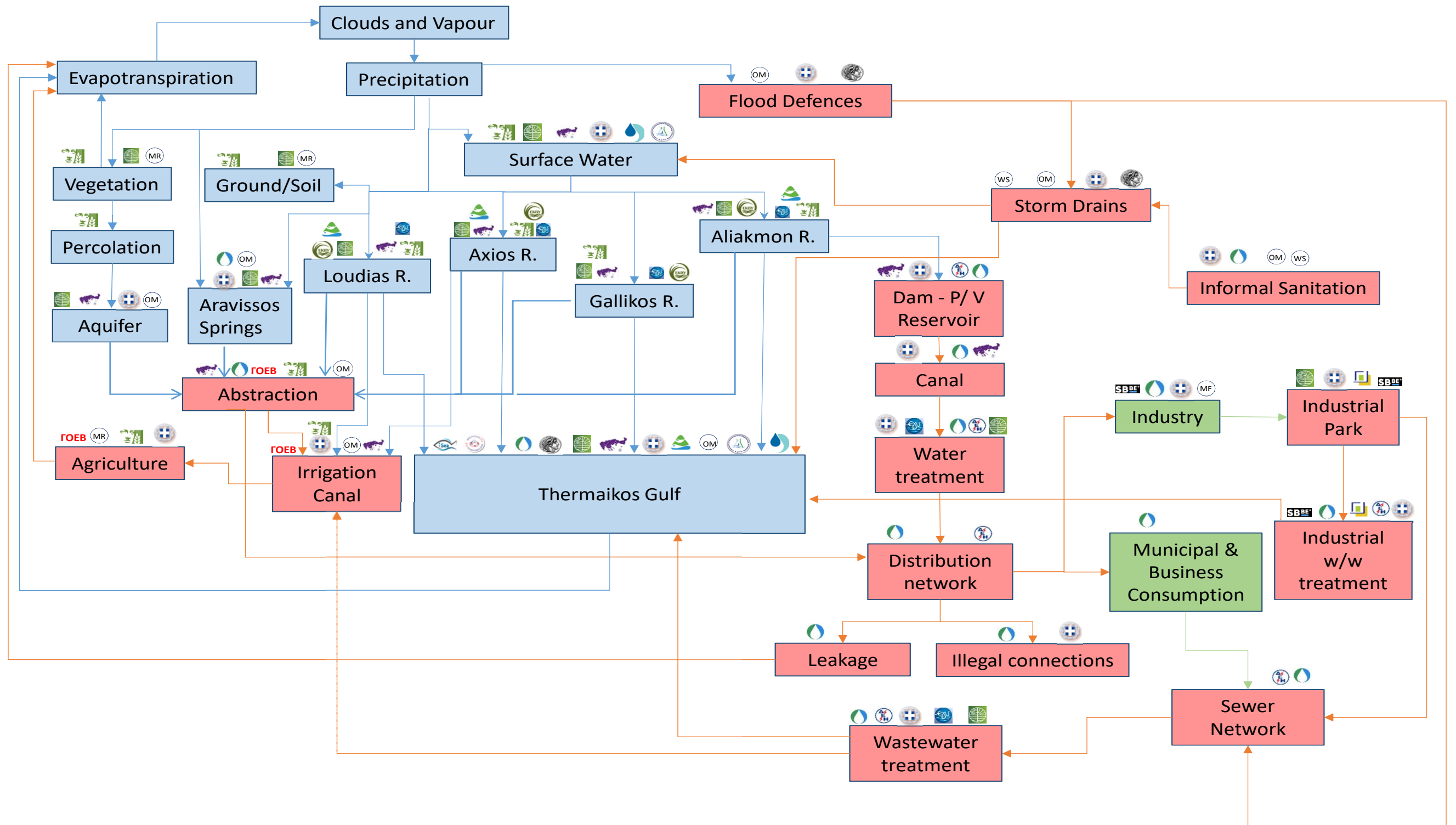
Main Legend

- | | | | |
|--|----------|------------------|------------------------------------|
| Reservoir | Power | Drains | Green Space |
| Historic Flood - from Water Infrastructure | Culverts | Motorway | Agriculture |
| Historic Flood - Fluvial | Canal | Flood Risk Areas | Thessaloniki Municipality Boundary |
| Historic Flood - No Data | River | Water | |
| Weir | Stream | Urban | |

Inset Map Legend

- | |
|------------------------------------|
| Rivers |
| Thessaloniki Municipality Boundary |
| River Basin |





















ANNEX B: THESSALONIKI WATER GOVERNANCE DIAGRAM



ANNEX C: THESSALONIKI WATER GOVERNANCE MATRIX

Basic Service Provisions				ΓΟΕΒ		WS				
Flood Risk					OM		WS			
Environment				ΓΟΕΒ						
Economic		MF		SBBE ^o						
Socio-Cultural				MR						

ANNEX D: THESSALONIKI WATER GOVERNANCE STAKEHOLDERS

1. Ministry of Energy & Environment		12. Industrial and Business Park, Co	
2. Special Water Secretariat		13. Federation of North Greece Industries	
3. Decentralised Governance of Macedonia & Thrace		14. Ministry of Rural Development	
4. Central Macedonia Region		15. Ministry of Finance & Development	
5. Thessaloniki Municipality		16. General Organisation of Land Reclamation	
6. Other Municipalities		17. Land Reclamation Institute	
7. Other Municipal Water & Sew. Co		18. NGO- Mediterranean SOS Network (MedSOS)	
8. Thessaloniki Water & Sewage Co		19. Protected Areas of Thermaikos Gulf Management Authority	
9. AUTH- Care for Integrated Water Resources Management		20. NGO- izea	
10. AUTH-Lab of Engineering & Environment Planning		21. EKBY Greek Biotape/ Wetland Centre	
11. National Electric Company			

REFERENCES

100RC. (n.d.). Resilient Thessaloniki: A strategy for 2030.

Aristomenis P., K., Kapsimalis, V., Kontogianni, A., Skourtos, M., Turner, K., & Salomons, W. (2006). Impact of 100-Year Human Interventions on the Deltaic Coastal Zone of the Inner Thermaikos Gulf (Greece): A DPSIR Framework Analysis. Environmental Management.

Axios Delta . (n.d.). National Park Protected Areas. Retrieved from <http://axiosdelta.gr/en/national-park/protected-area/>

Comision Nacional del Agua. (n.d.). CONAGUA. Retrieved from Tunel Emisor Oriente: <http://201.116.60.81/sustentabilidadhidricadelValledeMexico/TunelEmisorOriente.aspx>

eurostat. (2017). Unemployment rates by sex, age and metropolitan regions. Retrieved from eurostat: <http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>

EYATH . (2017). Eyath SA 2017 Annual Report .

GMEE. (n.d.). Retrieved from Greek Ministry of Environment and Energy : <http://www.ypeka.gr/Default.aspx?tabid=37&locale=en-US>

GMEE. (2012). Implementation of Directive 2007/06/EC Preliminary Flood Risk Assessment. Greek Ministry of Environment and Energy .


GTP . (2018). Region Takes First Step Towards Development of Thessaloniki's Coastal Front. Retrieved from <https://news.gtp.gr/2018/06/12/region-takes-first-step-towards-development-thessalonikis-coastal-front/>

IMCE. (n.d.). Integrated Coastal Monitoring of Environment. Retrieved from <http://draxis-gis.com/icme/index.php?lang=EN>

Wikipedia. (n.d.). Politics of Greece, Administrative divisions & Regional units of Greece. Retrieved from https://en.wikipedia.org/wiki/Politics_of_Greece#Administrative_divisions

Wikipedia. (n.d.). Port of Thessaloniki. Retrieved from https://en.wikipedia.org/wiki/Port_of_Thessaloniki

Wikipedia. (n.d.). Thessaloniki. Retrieved from <https://en.wikipedia.org/wiki/Thessaloniki>

A high-angle, aerial photograph of the White Tower of Thessaloniki, a prominent cylindrical stone tower with crenellated top. The tower is situated on a paved promenade overlooking the city's harbor. In the background, a dense urban landscape of multi-story buildings stretches along the waterfront. The sky is clear and bright, suggesting a sunny day. The tower's stone facade is light-colored, and it features several small, arched windows. The surrounding area includes some greenery and a few people walking on the promenade.

White Tower of Thessaloniki

