GOVERNMENT OF MALTA
MINISTRY FOR THE ENVIRONMENT, ENERGY AND ENTERPRISE
MINISTRY FOR THE ECONOMY, EUROPEAN FUNDS AND LANDS
PARLIAMENTARY SECRETARIAT FOR EUROPEAN FUNDS

WATER BE THE CHANGE

EU funds for Malta 2014-2020

Rainwater Management – An Untapped Resource

Friday 19th May 2023

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1. Executive Summary

The Conference on Rainwater Management: An Untapped Resource took place on Friday 19th May 2023. This conference highlighted the issue of water conservation, outlining measures already implemented in order to conserve water as well as suggesting methods that could be implemented.

The conference was held at 5-Star superior Corinthia Palace Hotel in Attard.

Attendees were able to sign up and register for the conference through https://water.org.mt/join-the-drops/rain-water-management-conference/, where they could fill in a form, or by calling +356 2777 2777, or by sending an email to info@emcs.com.mt to register.

The ample parking spaces and Corinthia Palace's perfect location facilitated the attendance of several participants. A standing lunch was organised for all attendees as well as a coffee break, which provided attendees with a short break and an opportunity to network.

In total, 64 people attended this conference. The attendees were made up of private and public individuals, NGOs, and different ministerial representatives. All attendees registered their attendance at the registration desk. The conference was open to all, and walk-ins were also accepted on the day.

The conference lasted till late in the afternoon and was hosted by Elaine Saliba, a Process Engineer at the Water Service Corporation and moderator. The conference consisted of an introductory speech, a pre-recorded message, nine presentations delivered by different experts in the sector along with two panel discussions. Throughout the report, one can find the presentations that were used by the various speakers, as well as the key points of each presentation.

One stand was set up inside the conference hall. Various Water Be the Change campaign related merchandise items including pencils, pens, notebooks and sticky notes were displayed at the registration desk and exhibition stand and handed out to participants. The agenda, a small note pad and a pencil were also placed on the seat of each individual.

2. Conference Agenda

Date: May 19th, 2023

Venue: Corinthia Palace, Attard, Malta

Time	
08:30	**Registration & Welcome Coffee**
08:45	**Introduction** Chief Executive Officer, Water Services Corporation | Mr Karl Cilia
09:00	**Session 1** Water Policy in Malta | Hon. Minister Miriam Dalli Conservation of Water in Buildings in Malta | Mr Matthew Degiorgio Keynote Speech 1 – Rainwater Harvesting for Groundwater Recharge | Mr Lior Netzer Panel discussion on the regulatory aspect of rainwater management.
10:30	**Coffee Break**
11:15	**Session 2** Sustaining our Groundwater Resources: Rainwater Harvesting Through Managed Aquifer Recharge | Dr Julian Mamo The Power of Suds: Examples of Successful Rainwater Management in Malta | Ms Adiel Cuschieri Community-Centric Rainwater Management: Helping to Prevent Rainwater from Entering the Sewer Network | Dr Sarah Bunney Keynote Speech 2: Rainwater Management Perspectives from UK Case Studies | Dr Peter Melville-Shreeve Panel discussion on the environmental challenges and impacts in applying rainwater management.
12:45	**Lunch**
13:45	**Session 3** The Effect of Rainwater on the WSC Sewage Network | Ing. Greta Zammit Muma & Ing. Joseph Abela Keynote Speech 3: Hydraulic Modelling for Rainwater Management | Dr Albert Chen Keynote Speech 4: RAINWIIN- Rainwater Integrated Infrastructure Network | Ms Kirsty Vella
14:45	**Final Discussion & Closing**

3. Detailed report of conference proceedings

3.1 Introduction

MR KARL CILIA, CHIEF EXECUTIVE OFFICER, WATER SERVICES CORPORATION

Mr Cilia started off by informing the attendees that this event was organised by the Water Services Corporation (WSC) and the Energy & Water Agency (EWA). He mentioned sewage overflow as one of the main issues that is still of concern. The cause of this overflow, as stated by Mr Cilia, is that the drainage network in Malta was not designed to cater for rainwater runoff. Sewage overflow is causing major issues to both private and public areas, with high costs to fix the damages caused. According to Mr Cilia, Malta is facing a preliminary infringement; this is a national problem, and not just for those who work in water services. The speaker stated that there is a need to come together and solve this issue of sewage overflow, along with making sure the infrastructure caters for the people. On a positive note, the speaker noted that more wastewater is now being produced and treated, however, this is being done while trying to use the least amount of energy possible. Mr Cilia assured that not all is lost, as lately, the WSC has been performing inspections and monitoring new permits. Although, he acknowledged that this process was not easy in the beginning, as nine out of every ten private residencies were found to be illegally connected to the sewage system. However, now positive feedback can be seen.

3.2 Session 1

HON MIRIAM DALLI, MINISTER FOR THE ENVIRONMENT, ENERGY AND ENTERPRISE (RECORDED MESSAGE)

Hon Dalli informed those in attendance that water management is essential in order to obtain carbon neutrality. She maintained that this challenge of managing water is even more pressing due to the threat of climate change, rising food and energy costs, and a global energy crisis. According to Hon Dalli, there is a lack of water resources in Malta due to its Mediterranean climate and thus, the Maltese islands strongly feel the pressure of this. The speaker highlighted that the level of water security obtained in Malta is due to the measures taken over the years, such as:

1. Preservation of rainwater
2. Investing in distillation technologies for wastewater treatment plant to enable high-efficiency recovery of water and valuables from wastewater and waste volume reduction.
3. Investing in a number of desalination plants around the islands

Hon Dalli emphasised that water is not just important for drinking and sanitary needs but is also a crucial component for agriculture and industrial sectors. A substantial amount of rainwater in Malta is lost at sea. If sufficient rainwater is collected during the rainy months of the year, Hon Dalli posited that it would help fulfil the demands throughout the year, particularly as a source of irrigation and water reuse. Hon Dalli concluded that it is very easy to take water security for granted. However, she reiterated that with efforts from the Government and the attendees, Malta's natural resources can be maximised.

MR MATTHEW DEGIORGIO, SENIOR HEAD, BUILDING AND CONSTRUCTION AUTHORITY

TITLE: CONSERVATION OF WATER IN BUILDINGS IN MALTA

In his presentation, Mr Degiorgio indicated that more than 50% of water in Malta comes from desalination, a process which takes away mineral components from saline water. The speaker stated that domestic water use is a strain on both water and energy resources, with every added unit of water production requiring energy use. Thus, according to Mr Degiorgio, a decrease in water consumption leads to a decrease in energy use.

Mr. Degiorgio directed his focus towards national strategic considerations, suggesting that instead of expending energy on pumping water back, the primary objective should be the removal of impurities. To address this issue, he delineated two pillars for action:

- Recharging of the aquifer which ensures the replenishment of natural underground water reservoirs.

- Conservation of water at the building and communal levels.

The latter point emphasises the importance of water conservation as a vital element for energy efficiency and as an end goal in itself. Notably, the significance of water conservation has been acknowledged by law for the first time since the early modern period, specifically in Document F (2007). Mr. Degiorgio proceeded to describe the contents of Document F, which encompasses building regulations categorised into different sections:

- Requirements for reservoirs in all buildings to conserve water at the building level.
- Exemption of spaces, other than roofs, from the obligation to direct water to reservoirs if they do not exceed an area of 300 square meters and are not paved.
- Mandate for the installation of interception traps.
- Mandatory provision of at least one flushing draw-off point for watering plants in every building.

There exists an updated version of Document F, known as Technical Document F (2016), which comprises of two versions. Mr Degiorgio stated that some provisions have been retained, such as requirements for wells or cisterns (in the second version) and the requirement for draw-off points for flushing toilets and watering plants. However, the latter requirement has been tightened to areas not exceeding 200 square meters.

In Malta, a calculation methodology has been established to determine the energy requirements for each building. Mr Degiorgio affirmed that compliance with these requirements is mandatory, as it promotes the tightening of minimum energy performance standards, optimises cost efficiency, and incentivises water conservation.

Another significant concern highlighted by the speaker is the efficacy of cistern requirements for water conservation, which are based on the principle of collecting rainwater for use during dry periods. However, this principle is not always feasible. As an alternative, Mr Degiorgio proposed the continuous use of water, whereby the same amount of water can be conserved in a smaller cistern. The success of this method depends on various factors, including rainfall patterns and the rate of second-class water usage relative to the size of the roof. Mr Degiorgio acknowledged that the discussion and proposal to address this point are still ongoing.

Mr Degiorgio mentioned a proposal to collect rainwater at the building level, which is the adoption of Sustainable Drainage Systems (SuDS). He maintained that this method has been successfully implemented in numerous local case studies, primarily in large-scale buildings. However, challenges arise when applying SuDS to small buildings, including the potential for abuse, such as waste dumping, and difficulties in enforcing compliance effectively.

Mr. Degiorgio concluded by outlining the future prospects of water conservation, stressing the need for its integration from the very inception of building projects. He underscored the necessity for an effective compliance regime and the design and implementation of second-class water systems, including reservoir designs. Collaboration between

professionals involved in building and construction is crucial to achieving tangible results in water conservation efforts.

MR LIOR NETZER, HEAD OF HYDROGEOLOGY OF COASTAL AQUIFER BRANCH, ISRAEL WATER AUTHORITY

KEYNOTE SPEECH 1: RAINWATER HARVESTING FOR GROUNDWATER RECHARGE

Mr Netzer informed the attendees that aquifers, which are underground water sources, have a high risk of contamination. He stated that in Israel, urbanisation has grown by 50%, resulting in more water being directed into drainage systems which can lead to flooding in cities. To prevent this, the speaker acknowledged that the planning ministry in Israel implemented a policy three years ago, which requires calculations to determine the amount of water that needs to be treated for each building construction.

The speaker presented a document called the "Guidance of Rain Water Harvesting by Infiltration", which provides instructions on how the filtration system should collect rainwater from roofs.

Mr Netzer mentioned that Tel Aviv, a densely populated city in Israel, only retains five percent of its rainwater, with the rest going into the drainage system. He went on to state that in order to test the effectiveness of infiltration systems, two infiltration wells were built near Tel Aviv. Before installation, the soil was checked to ensure it was suitable for infiltration. Mr Netzer assured that the soil was determined to be suitable, so the wells were drilled. One well is a dry well, which houses lift stations, pumps, and valves in an easily accessible pump room, while the other well is a wet well, which is a separate chamber connected to or located near the dry well structure. The speaker elaborated that the infiltration system is connected to the roof, and a filtration chamber with a filtration mesh is used to clean the water from the roof.

In his presentation, Mr Netzer demonstrated that the water level rise in the wet well was minimal and within the system's maximum discharge capacity, indicating that it can handle large volumes of water. In contrast to this, the water level rise in the dry well was higher. Mr Netzer concluded that both wells have their advantages and disadvantages, but the wet well has a higher infiltration capacity. Mr Netzer acknowledged that the filtration meshes in the system catch a lot of particles, so regular cleaning is necessary. If not cleaned, the meshes can become clogged and lead to water leakage. Thus, Mr Netzer reiterated that maintenance of the system is an important issue that needs to be addressed.

At a city-wide scale, Mr Netzer posited that reservoirs are a preferred solution to prevent flooding. He asserted that in Israel, efforts are being made to promote the construction of reservoirs by providing financial incentives to cities based on the volume of water infiltrated into groundwater. Barcelona was used as an example of this by the speaker as it also has large reservoirs to catch water and prevent flooding. Mr Netzer reiterated that wherever water can be pumped, it can also be infiltrated into the ground and that this approach can

be seen as a win-win situation, as it helps prevent flooding and contributes to recharging the groundwater.

PANEL DISCUSSION 1: RAINWATER MANAGEMENT REGULATIONS

This panel consisted of four speakers:

- Mr Trevor Chircop Bray, Managing Professional Discharge Permitting at Water Services Corporation
- Mr Matthew Degiorgio, Senior Head of Building and Construction Authority
- Ing. Matthew Cauchi, Technical Director at Chi Consultants
- Dr Jeanette Muñoz Abela, Kamra Tal-Periti

The speakers were initially questioned by the moderator, Ms Elaine Saliba, then there was time allotted for questions to be asked and statements to be made from the audience.

Moderator: What are the problems that the WSC is facing with regards to rainwater management regulations and what feedback do you get from your customers?

Mr Chircop Bray asserted that every time a small storm passes by in Malta, the same issues occur; flooding of residences, manholes, problems caused to sewage treatment system, and so on. He mentioned that WSC frequently ends up in legal cases due to flooding in residences. According to the speaker, customer objections received are mostly due to rainwater flooding into the system. Hence, WSC is at the mercy of the elements as there is no back up system. He concluded that Malta's sewer network is not a combined sewer for rainwater.

Moderator: What are the changes and plans you would be implementing so that these issues are resolved, both for the sake of WSC and also for the sake of the residents?

Mr Degiorgio stated that, with regard to buildings, the main aspect is trying to keep water in reservoirs. In Malta, according to Mr Degiorgio, the sewer for water runoff has been the street, however, there is some investment now to mitigate this. He reiterated the need to invest in harvesting rainwater at a communal level. Additionally, the speaker maintained that buildings need to keep water within it for common use. He posited that the challenges are not coming from regulation sites, but rather the problem is stemming from enforcement; and that having compliance from the very beginning would make things easier.

Moderator: Do you think the different stakeholders are aware of the correct practices of harvesting water? From your profession, do you think this is an issue?

Dr Muñoz Abela asserted that most people know of the benefits of having a well. The challenge, according to Dr Muñoz Abela, is not for the single use home, but rather for apartments. She put forth the question of how the use of a well is going to be distributed equally among all the residents as most of them would like to have wells. The speaker asserted that there will be a cost implication on the capital cost.

Ing. Cauchi reiterated the importance of efficiency and water conservation. He maintained that the challenges that are being faced on a day-to-day basis apart from the legislative side are challenges that are not easy to explain. The speaker affirmed that water leakage is a big issue, and the general Maltese population is not aware of how much damage water can do to the whole island. Water conservation is not just about using water for irrigation or flushing; Ing. Cauchi asserted that it is also about understanding where it will bring the Maltese population in the future. He added that the first rain is the one that is doing damages to the property and thus, only one event is needed to cause major capital loss.

Moderator: From your profession, what can be done to ensure that these issues are resolved in the construction sector?

Ing. Cauchi assured that there is a lot to be done and there is no one size fits all solution.

Moderator: In heavy urbanised areas, what can be done from an architect point of view?

Dr Muñoz Abela posited that green roofs are a very good way of managing rainwater. However, green roofs cannot just be put without doing the necessary checks which, Dr Muñoz Abela affirmed sometimes happens.

Ing. Cauchi stated that one of the main challenges that Malta needs to face is increasing the number of trees and plants in cities and towns, and at the same time harvest water.

Dr Muñoz Abela added that, in Malta, there is a tendency of working in silos. Buildings cannot be looked at in isolation; the infrastructure needs to be seen as a whole.

Mr Chircop Bray confirmed that what Dr Muñoz Abela mentioned, could be seen in the inspections performed by WSC on new buildings. He reiterated that it is a fragmented industry and infrastructure should be done in one concerted effort.

Mr Degiorgio brought up the issue of older buildings, elaborating that the problem is with renovations. He explained that during a renovation, reservoirs should be built but there is no reinforcement of this as it might deter people from renovating.

Moderator: What are your suggestions as possible solutions to this issue?

Dr Muñoz Abela maintained that one of the challenges would be to have a system in which the full set of people involved in the design are there from the beginning to the end of the project. She elaborated that this idea is more in relation to smaller projects such as residential buildings. The speaker concluded that all parties should be involved, starting from the consultation and then throughout, as it is vital that everyone involved understand one another.

Ing. Cauchi noted that one of the most important things is calculating how much people save and use water. According to Ing. Cauchi, making people aware of how much they are using, makes them accountable. The challenge of the buildings, as asserted by the speaker, is a design issue and thus, in the future rebuilding and redesigning will need to take place in order to increase greenery. For Ing. Cauchi, there is not enough education and knowledge on the goals of water conservation, stating that people need to not think in a short-sighted manner.

Mr Chircop Bray mentioned that during the compliance vetting that WSC conducts, they see an issue with all the entities involved in this as each entity makes its point regardless of the other entities. The speaker reinforced the need to work more together and develop in a more environmentally conscious way.

Mr Degiorgio agreed with Mr Chircop Bray, stating that there is room for improvement in terms of coordination, which includes coordination between the Government and the private sector.

Mr Chircop Bray emphasised the need to make something more concrete and suggested forming a committee, for both the private and the public sector.

Mr Michael Stivala: We have various regulations, and nothing is coordinated. If you do a well in a building of apartments, no one wants to take responsibility of it. Enforcement is not the solution. The solution is very simple: we need a holistic approach. Water should not be taken care of by one department as it would not work. Regulations cannot be changed from one day to another. It cannot just be from the Government; it needs to also be from the private sector. The solution is easy but there has to be real effort by all of us.

Dr Muñoz Abela affirmed that all the issues discussed in this panel come together with the building regulations.

Mr Michael Stivala: If there are no proper regulations then who is responsible for what? We need to have a proper plan. We have to do it all together. Water is a scare resource, and we cannot wait anymore.

Mr Chircop Bray reiterated that WSC started doing inspections last year and have faced several complaints after cases of flash floods and new problems emerged. The speaker asserted that often, the complaints stated that these problems rose after new buildings were built on the same road or nearby. He concluded that although every entity can make its point, he agrees with Mr Stivala' standpoint.

In Mr Degiorgio's opinion, the problem is that it is not always clear which regulations will eventually be enforced and which to a certain extent only. Thus, there is a need for clarity, continuity and improvements.

Ms Jessica Rossitto: We need to inform the people how water is going to be used. How is this problem going to be solved with just 200 pages of text? No, we need to inform the people with publicity.

Dr Muñoz Abela assured that there has been some discussion on how the awareness is going to be given out to the public. Properties go from people who build it to people who will use it. Dr Muñoz Abela informed the attendees that there is going to be a document on solving this issue, however, it will take a long time to finish. In the meantime, the speaker noted that there is no better thing than questions; when in doubt ask the people who have the information. She acknowledged that there is a lack of information transfer, and it is a task that needs to be tackled.

Ms Jessica Rossitto (final statement): If you talk with an old person who might not be able to read, why should we not inform them how to use something?

Ms Anthea Fenech: I agree with Mr Stivala and think that along with authorities we should also include banks. Now we are constructing towers, but no one is evaluating what the water is being used for. We should be more aware and teach people.

Mr Chircop Bray assured that WSC ask for the residents' water plan so when inspections are performed, it is used as a guide. He stated that this water plan is a requirement for larger complex buildings, but it is still asked for simple developments.

Mr Michael Stivala: The ESG report, a report that is an environmental, social and good governance report. From this year, the European Central Bank is enforcing the big banks in Malta to do this report. This is going to be a major change and is happening now.

Mr Mario Agius: I am speaking as a citizen, not a professional. I think on the whole there is not enough appreciation of the rainwater. We are letting it go away. We have a lot of valleys which are very dirty and not organised to collect water. We have two reservoirs in Msida that are very dirty. We build water reservoirs in the roundabout, and we fill them with water from reservoirs. This is the direction which I would like to

hear. I live in Attard, in front of my house there is a block of flats which leaked water for four years. The water is coming from the tanks. No action has been taken. Portable water going on the main road.

3.3 SESSION 2

DR JULIAN MAMO, ENVIRONMENTAL MANAGEMENT & PLANNING DIVISION, INSTITUTE OF EARTH SYSTEMS

TITLE: SUSTAINING OUR GROUNDWATER RESOURCES: RAINWATER HARVESTING THROUGH MANAGED AQUIFER RECHARGE

Dr Mamo's presentation focused on the importance of sustaining groundwater resources. He highlighted the significant contribution of groundwater to the nation's water supply and emphasised the recharge processes that maintain its availability. The efficient utilisation of water was discussed, including measures to optimise usage and the implementation of flow rate regulations.

The historical context of rainwater collection systems in Malta was noted in Dr Mamo's presentation, underscoring the demand for groundwater and the need for control measures. Two potential solutions, municipal and private supply systems, were outlined by the speaker, highlighting the importance of recognising the value of groundwater resources.

Dr Mamo assured that the impact of urbanisation on buildings and impermeable surfaces was analysed, noting the consequences of reduced infiltration, stormwater quality degradation, increased flooding risk, and diminished soil moisture. The issue of mixed waters, resulting from the combination of sewage and groundwater, was also addressed.

Managed Aquifer Recharge (MAR) was introduced as a method to replenish aquifers intentionally for various benefits. Dr Mamo listed the advantages of MAR as such: aquifer replenishment, increased storage capacity, enhanced water supply security, and emphasised natural treatment capabilities. The need to manage recharge systems and store water underground was also highlighted. According to Dr Mamo, there are also risks associated with Rainwater Harvesting (RWH) and MAR, including groundwater pollution and clogging. He went on to emphasise the importance of considering catchment types and their implications for water quality.

Dr Mamo concluded by reiterating the importance of protecting recharge areas, providing safe aquifer recharge strategies as well as considerations for catchment areas and water quality, and the design of sustainable schemes based on local hydrological contexts. Overall, his presentation provided valuable insights into sustaining groundwater resources and promoting responsible water management practices.

MS ADIEL CUSCHIERI, PROJECT OFFICER (HYDROLOGY), MINISTRY FOR PUBLIC WORKS AND PLANNING

TITLE: THE POWER OF SUDS: EXAMPLES OF SUCCESSFUL RAINWATER MANAGEMENT IN MALTA

Ms Cuschieri stated that the phenomenon of flash floods occurring in Malta during rainfall has become a matter of concern, despite its historical absence as an issue. She posited that the reason for this is that in the past, the inhabitants of Malta employed effective rainwater harvesting practices. An example given in the presentation of such practices is the Ta' Misqa Tanks which had been meticulously carved into the stone, served to collect and preserve water, preventing evaporation during the arid summer months. Remarkably, these ancient tanks continue to function and hold water even after thousands of years, attesting to the ingenuity of their engineering.

Ms Cuschieri informed the attendees that over time, as water sewage systems were established, water cisterns gained significance, particularly during the era of the Knights of St John. The cisterns were employed to capture rainwater during the wet season, providing a vital freshwater source within the fortified cities during the dry summer months. The speaker also mentioned valley dams which represent a prevalent method of water harvesting in Malta. She explained that these are designed to allow controlled leakages into the earth; these dams slow down the flow of water towards the sea, enabling its utilisation by farmers or absorption into the soil.

In an effort to revive these traditional water harvesting systems, Ms Cuschieri acknowledged that initiatives such as the one pursued by Alter Aqua seek to refurbish both private and public cisterns. She also noted that the water collected from these cisterns occasionally serve public spaces. The successful restoration of the Santa Katarina Channel was presented as an example due to its notable achievement by the public department of the project wing. Emphasising the gradual drainage of water into the ground, Ms Cuschieri reiterated that the project aims to maintain a manageable volume in the immediate aftermath of rainfall.

In her presentation, Ms Cuschieri mentioned The Green Stormwater Infrastructure Guidance Manual (GSI Manual), which serves as a valuable resource for planners, policymakers, and other stakeholders involved in decision-making processes. She elaborated that through focusing on the promotion of green stormwater infrastructure (GSI) in Malta, the manual identifies rainwater harvesting techniques as promising strategies; It highlights innovative approaches, such as the utilisation of green roofs, bio-retention systems, and other similar practices.

According to Ms Cuschieri, it is imperative to recognise that addressing water management challenges requires a multifaceted approach. She posited that by considering successful historical practices and developing new solutions based on this knowledge, a sustainable and efficient water management system can be established.

DR SARAH BUNNEY, CHIEF OPERATING OFFICER, OURRAINWATER

TITLE: COMMUNITY-CENTRIC RAINWATER MANAGEMENT: HELPING TO PREVENT RAINWATER FROM ENTERING THE SEWER NETWORK

In her speech, Dr Bunney discussed the significance of the innovation fund established by Ofwat. Dr Bunney stated that with an allocated budget of £200 million, the fund aims to enhance the capacity of the water sector to innovate and address the evolving needs of customers, society, and the environment. The primary objectives of this project, as outlined by Dr Bunney, are as follows:

- Collaboration for Rainwater Capture and Storage
- Community-Centric Rainwater Management

The first objective of this project, according to Dr Bunney, seeks to foster collaboration among communities and stakeholders to encourage the capture and storage of rainwater. This approach aims to reduce the inflow of water into drainage systems, thereby mitigating sewer spills caused by storm overflows. Additionally, local rainwater storage can help meet water demand during periods of scarcity. Dr Bunney stated that the second objective emphasises the development and sharing of an engagement strategy focused on community-centric rainwater management. This strategy aims to empower communities and align rainwater management practices with their specific needs and contexts.

Dr Bunney posited that the urgency of these initiatives is underscored by the projections of the World Meteorological Organisation, indicating that the next five years are expected to be the warmest on record. The speaker maintained that this global warming trend contributes to an increase in extreme weather events such as flooding, droughts, and heatwaves. The combined effects of climate change and population growth exacerbate the limited availability of water resources. Without proactive measures, Dr Bunney asserted that future water supplies may fall short of meeting demand. She indicated that by 2030, water demand will surpass availability; in the East and Southeast regions of England, more than half of the water resources are projected to experience deficits within the next five years, and these are already classified as "serious." The speaker maintained that addressing these challenges is critical to avoid a significant water supply shortfall by 2050.

Dr Bunney stated that the Ofwat innovation fund project aims to assess the global value of downpipe disconnection within target communities as it would provide insights into the benefits and impact of disconnecting downpipes as part of rainwater management strategies. Moreover, Dr Bunney emphasised the need to recognise the significance of rainwater management for both individual homeowners and larger community settings, as understanding the motivations and factors driving rainwater management adoption is crucial for effective implementation. Another aim of the Ofwat project, as elaborated on by Dr Bunney, is to develop and share a comprehensive stormwater management project that prioritises community involvement, thus ensuring that solutions are tailored to specific community needs and preferences.

Dr Bunney concluded her presentation by stressing the importance of understanding the diverse needs and motivations within communities. Recognising that there is no one-size-fits-all solution, she highlighted the necessity of finding alternative approaches that are context-specific to effectively manage rainwater and address the challenges posed by climate change, population growth, and urbanisation.

DR PETER MELVILLE-SHREEVE, LECTURER IN ENGINEERING & ENTREPRENEURSHIP, UNIVERSITY OF EXETER

KEYNOTE SPEECH 2: RAINWATER MANAGEMENT PERSPECTIVES FROM UK CASE STUDIES

Dr Melville-Shreeve started off his presentation by proposing that rainwater harvesting systems should be referred to as rainwater management systems, emphasising the importance of using consistent terminology in addressing this subject matter. He also advocated for a shift from single-purpose rainwater harvesting to a multifaceted approach, considering the broader spectrum of benefits these systems could offer.

The speaker highlighted the significant energy investment associated with water resource management, suggesting that current design practices often focus on mitigating water resource issues in specific settings. However, he asserted the need to transition towards designing drainage systems that offer multiple purposes, such as sustainable urban drainage systems (SUDS), which contribute to overall water resource management.

Dr Melville-Shreeve informed the attendees that in the United Kingdom, a robust design guide is in place, mandating the capture of rainwater from new developments through large plastic storage tanks. Nonetheless, the speaker emphasised an overlooked opportunity to design reusable tanks instead of solely focusing on stormwater control. Due to regulatory requirements, developers often prioritise meeting specific volume storage criteria, neglecting aesthetic and functional considerations, resulting in visually unappealing and ineffective storage ponds.

The speaker mentioned the implementation of real-time control systems such as Internet of Things (IoT), to remotely monitor and regulate water levels in both drinking water and rainwater tanks. This facilitates remote intervention and real-time management of these assets. He also underscored the potential of analytics platforms and emerging artificial intelligence in enhancing decision-making processes concerning the operation of these assets within urban settings.

A case study from a small island in the United Kingdom was presented by the speaker, where rainwater systems were installed to address water scarcity during the summer months, characterised by an influx of tourists. He elaborated that the incorporation of IoT technologies in these systems enables the monitoring of various parameters, including air and water temperature, inflow, outflow, and the option to supplement rainwater with the drinking water network during periods of insufficient rainfall. Through remote control, these systems optimise water usage, manage stormwater discharges, and ensure that tank top-ups occur during low-demand periods.

Dr Melville-Shreeve suggested actively involving communities, stakeholders, and water resource managers in the utilisation of these tools to design appropriate solutions. He further discussed the increasing accessibility and cost-effectiveness of monitoring approaches, citing the example of a water company deploying a large number of sewer level monitors to proactively predict blockages and prevent wastewater network issues.

PANEL DISCUSSION 2: ENVIRONMENTAL CHALLENGES AND IMPACTS IN APPLYING RAINWATER MANAGEMENT

This panel consisted of six speakers:

- Dr Julian Mamo, Lecturer, Environmental Management & Planning Division at the Institute of Earth Systems
- Ms Adiel Cuschieri, Project Officer (Hydrology), Ministry for Public Works and Planning
- Dr Sarah Bunney, COO at OurRainwater
- Dr Peter Melville-Shreeve, Lecturer in Engineering & Entrepreneurship at University of Exeter
- Mr Lior Netzer, Head of Hydrogeology of Coastal Aquifer Branch at Israel Water Authority
- Dr Angela Bartolo, Senior Officer at Biodiversity and Water Unit at ERA

The speakers answered the questions posited by the moderator Ms Elaine Saliba as well as one question from an audience member.

Question: Could you point out the potential drawbacks to rainwater harvesting and management in your area of expertise?

Dr Mamo stated that there is a lot to learn from one another. There are many different ideas, however, the challenge for Dr Mamo is coming up with the best solution.

Ms Cuschieri noted that nowadays there has been an effort in increasing collaborations, but these things take time. Another big issue mentioned by this speaker is that it took Malta a long time to start taking rainwater management seriously, and thus, there is a lot to catch up with.

According to Mr Netzer, there is no one solution, but the answer is rather a combined solution. He reinforced the need to take a system's-based approach.

Dr Bunney acknowledged that once the drawbacks of rainwater harvesting can be understood better, then the focus can be on how to move forward. She agreed with Mr Netzer that a system's-based approach is the answer.

Dr Melville-Shreeve mentioned that in the UK there is a lot of funding for innovation, so everyone is now incentivised to come up with a solution. He wondered if there are opportunities to bring some of the Maltese partners into these innovation projects in the future.

Dr Bartolo highlighted the importance of staying updated. Science keeps on changing and thus, Dr Bartolo maintained that it is crucial to keep up. She also informed the panel that ERA is currently monitoring emerging concerns. The speaker elaborated on how this is being done: first there was a preparatory action which explored what was currently on the market. Then since last March, monitoring of water commenced and results will be obtained in June. Dr Bartolo informed the attendees that this project is two years long.

Question: How difficult is it to ensure quality in the water being recharged?

Dr Mamo acknowledged that there is not a lot of data available on this, thus a lot of work still needs to be done.

Question: How can we measure the impact of effective water recharge?

According to Dr Mamo, this is done through looking at it from a quantity point of view. For quality, he asserted that samples are taken.

Mr Netzer posited that water is in very good quality and that the problem is with the first flush.

Question: How do you get the public involved?

Mr Netzer suggested that involvement should come through regulations. However, he acknowledged that it is problematic to enforce this for private homes, opting instead to do this at the city scale.

Ms Cuschieri stated that she is in favour of engaging stakeholders and the public. According to Ms Cuschieri there has been a recent initiative for this, however, reiterating that these things take time. The speaker noted that even though there are initiatives, they are still not reaching the general public.

Dr Bunney observed that people do not know what to do or who to go to for information. She has come into contact with homeowners who have experienced surface water flooding but do not know which organisation they need to speak to or even where the water is

coming from. The speaker concluded that surface water flooding is very challenging as there is no real ownership of it.

Mr Paul Vassallo: In Mater Dei hospital we do not use rainwater, but we could not throw it into the streets. Thus, we now have what is called a soak away. That is how water management has to be done.

Dr Melville-Shreeve mentioned that in the UK they have an infiltration first policy for new development and examples like the one Mr Vassallo gave should be constructed as a standard.

Ms Cuschieri stated that one of the things that make this soak away work is that it is managed by Mater Dei, reiterating that though these ideas work, they are not applicable to everywhere. There are always other aspects that need to be considered.

3.4 Session 3

ING. GRETA ZAMMIT MUMA & ING. JOSEPH ABELA

TITLE: THE EFFECT OF RAIN WATER ON THE WSC SEWAGE NETWORK

Ing. Zammit Muma delivered an extensive presentation on the Water Service Corporation's (WSC) sewage network, offering a detailed examination of its various components, including tunnels, trunk sewers, gravity surface sewers, pumping stations, and rising mains. She also provided a visual representation of these elements on a map.

During her presentation, Ing. Zammit Muma delved into the impact of rainwater on the sewage network, specifically focusing on heavy floods and their consequences. When streets experience overflow, it signifies that the sewage gallery is at maximum capacity and unable to handle the influx. According to Ing. Zammit Muma, this overflow poses several negative implications, such as inconvenience for pedestrians, hazards for drivers, and the wastage of potentially reusable water.

Ing. Zammit Muma asserted that the primary cause of the overflow is the direct connection between rainwater from exposed areas and the sewage pipe. She went on to state that the sewage infrastructure is ill-suited for handling rainwater, thus leading to a significant strain on the WSC sewage infrastructure during wet weather conditions. She added that consequently, pumping stations become overloaded, resulting in continuous pump operation, thereby wasting electricity that could otherwise be preserved. Moreover, this scenario necessitates increased maintenance efforts. Ing. Zammit Muma reiterated that it could take several hours or up to two days for the WSC Sewage Network to restore proper functionality following an influx of rainwater. Furthermore, the speaker elaborated on the various repercussions of rainwater, which include overflowing manholes, damage to road infrastructure, water spills onto adjacent fields, and infiltration into private properties.

In addition to the challenges faced by the sewage network, Ing. Zammit Muma stated that there is a crucial issue concerning stormwater infiltration at the Waste Water Treatment Plants in Malta and Gozo. This infiltration significantly increases the volume of water requiring treatment, leading to escalated costs and reduced effectiveness in treating the actual wastewater. She explained that since sewage treatment is a biological process, the bacteria responsible for the treatment process are highly sensitive to changes in influent water. Therefore, Ing. Zammit Muma concluded that maintaining process stability is vital to ensure the quality of the generated effluent.

In response to the issue of duplicated costs incurred in pumping sewage, Ing. Abela introduced several improvements. One notable measure involves the establishment of a dedicated pipework system designed to redirect road rainwater runoff away from the existing sewage infrastructure and channel it towards road surface runoff. This action, according to the speaker, aims to segregate rainwater from sewage flow, thereby creating a more efficient system. He stated that through recognizing the need to resolve the problem of road rainwater runoff, which has adverse effects on both the WSC Sewage Network and third-party entities, a coordinated effort has been undertaken to tackle this

issue. Ing. Abela assured that the implementation of the dedicated pipework system ensures the diversion of road rainwater runoff, leading to improved operational efficiency and the elimination of duplicated costs associated with pumping sewage. Moreover, the collected rainwater has the potential for reuse, as the current sewage infrastructure is not equipped to handle the substantial volumes of rainwater.

Additionally, Ing. Abela noted that the Building and Construction Authority (BCA) has issued a technical guidance document known as Document F, which provides a legal framework to be adhered to. The WSC, as reiterated by the speaker, has consistently emphasised that rainwater must not be connected to the sewer system. This condition has been imposed as a standard requirement by the WSC on all Planning Authority permit applications. Ing. Abela informed the attendees that since May 2019, the WSC has been requesting a declaration from a warranted architect or engineer to certify compliance with the Legal Notice LN 47 of 2018 and Technical Guidance Document F. Furthermore, Ing. Abela stated that since late 2021, sample inspections on buildings, encompassing both residential and industrial structures, have been conducted by the WSC prior to issuing a "no objections" compliance certificate with regards to WSC requirements.

Ing. Abela concluded by stating that in order to effectively communicate and educate the public on proper practices, the WSC has actively employed social media platforms. He gave the example of the "PPP" Campaign, which was used to emphasise what should and should not be disposed of into the sewage network. Ing. Abela added that improper disposal of waste can lead to similar negative effects as rainwater discharges into the sewers.

DR ALBERT CHEN, PERSONAL CHAIR, WATER AND THE HUMAN ENVIRONMENT

KEYNOTE SPEECH 3: HYDRAULIC MODELLING FOR RAINWATER MANAGEMENT

In his presentation, Dr Chen started off by explaining the rationale behind using the hydraulic approach to analyse rainwater management and water systems. He stated that this approach enables a comprehensive understanding of system performance under different conditions, including potential failures, and facilitates the identification of adaptation and improvement strategies. Structural solutions for rainwater management are explored as part of the hydraulic modelling analysis to mitigate these issues. The speaker mentioned that in the United Kingdom, organisations like the Construction Industry Research and Information Association provide comprehensive guidelines and procedures for rainwater management system design, focusing on hydrological analysis, infiltration rates, and sizing requirements.

The interconnectedness of different elements and conditions cannot be overlooked in rainwater management. Dr Chen emphasised the need to analyse different scales, integrate various implementation strategies, and consider factors like climate, land use, and infrastructure. To analyse the performance of rainwater management systems, Dr Chen reiterated the need to employ different modelling approaches. Hydrological models are utilised to understand runoff and catchment-scale processes, while two-dimensional surface models simulate water movement and incorporate detailed information about

properties and infrastructure. Dr Chen proceeded to list off some of the most widely used modelling tools in the field, such as Flood Modeller, InfoWorks ICM, and Mike11. These enable the simulation and analysis of water behaviour on the surface, estimate potential property damage, and assess the impact on infrastructure and transportation.

Dr Chen noted that rainwater management encompasses not only hydraulic aspects but also considerations of pollution and waste. In some countries, water quality and its environmental impact are analysed in the assessments conducted by his research team. According to Dr Chen, the integration of machine learning and artificial intelligence is expected to enhance modelling capabilities, enabling faster simulations and improved control of rainwater management systems. He asserted that this advancement opens doors for more efficient planning and operation in the future.

KIRSTY VELLA, PROJECT GREEN

KEYNOTE SPEECH 4: RAINWIIN- RAINWATER INTEGRATED INFRASTRUCTURE NETWORK

One of the many projects Ms Vella is currently overseeing is the RAINWIIN project, which stands for Rainwater Integrated Infrastructure Network. In her presentation, Ms Vella explained that this initiative entails the development of a comprehensive planning framework and actionable plans for the establishment of an integrated infrastructure network focused on rainwater management within five catchments in Malta. She further elaborated that RAINWIIN comprises of two essential components:

- Element 1, which involves the project planning framework encompassing action plans and research.
- Element 2, which pertains to the pilot project encompassing pilot site selection and its associated objectives.

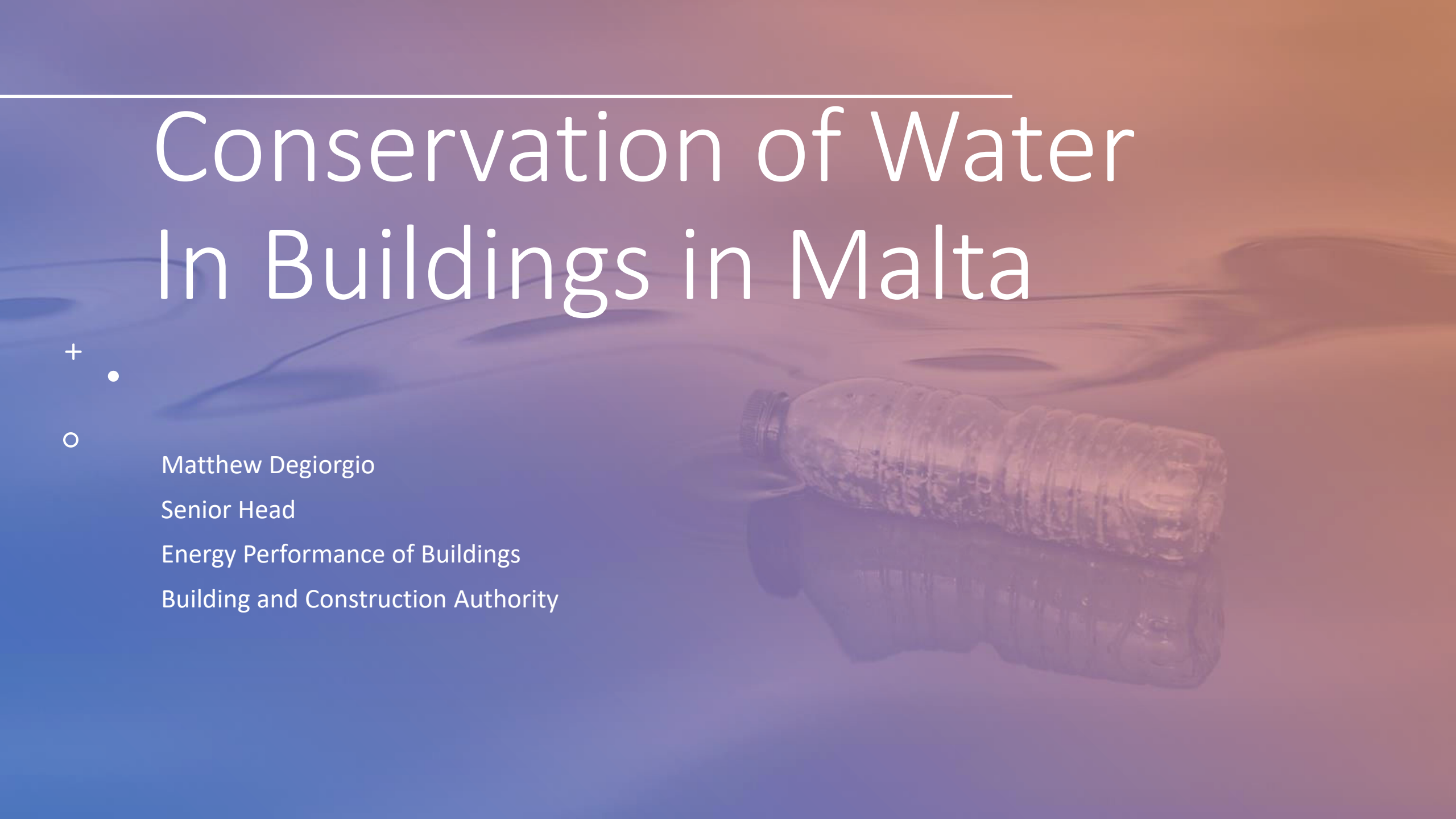
According to Ms Vella, within Element 1 a series of strategic actions have been undertaken. These include a sediment qualification study, extensive desktop studies and surveys, meticulous data collation, and a prioritisation exercise. Additionally, a thorough cost-benefit analysis has been conducted, resulting in the development of comprehensive design plans.

Under Element 2, notable achievements have been realised by Ms Vella's team. She mentioned that she and her team have successfully excavated approximately ten bases within the valley basin and restored six water retention dams. Furthermore, the team has embarked on an extensive tree and shrub planting initiative, involving the careful selection and maintenance of 30 distinct species, totalling an impressive count of 200 trees. Ms Vella revealed an additional accomplishment which entailed the restoration of a previously non-existent dam, alongside the construction of nine new dams. Lastly, the installation of hydrological monitoring equipment, including a weather station and water level sensors, has significantly enhanced data collection capabilities.

During the presentation, Ms Vella proceeded to outline the objectives of Phase 2, which delineate the necessary actions to advance the project. These actions comprise of the identification and assessment of the value of services rendered by local groundwater and rainwater infrastructure, aimed at optimising both green and grey infrastructure. Additionally, she stated that a feasibility assessment is being sought to determine the viability of achieving tangible improvements in rainwater harvesting. Ms Vella's collaborative efforts extend to working closely with various public departments to ensure the successful realisation of these objectives.

5. Presentations

Conservation of Water In Buildings in Malta



Matthew Degiorgio

Senior Head

Energy Performance of Buildings

Building and Construction Authority

Water as an energy consumer

Domestic water use is not only a strain on water as a natural resource but also as a major energy user.

With more than half of water coming from desalination plants, every added unit of water will necessarily require energy to produce.

4.6kWh required for every cubic metre produced (WSC, 2013)

Therefore Reduction of water use and waste lead directly to reduction in energy use.

National Strategy Considerations

2 main pillars

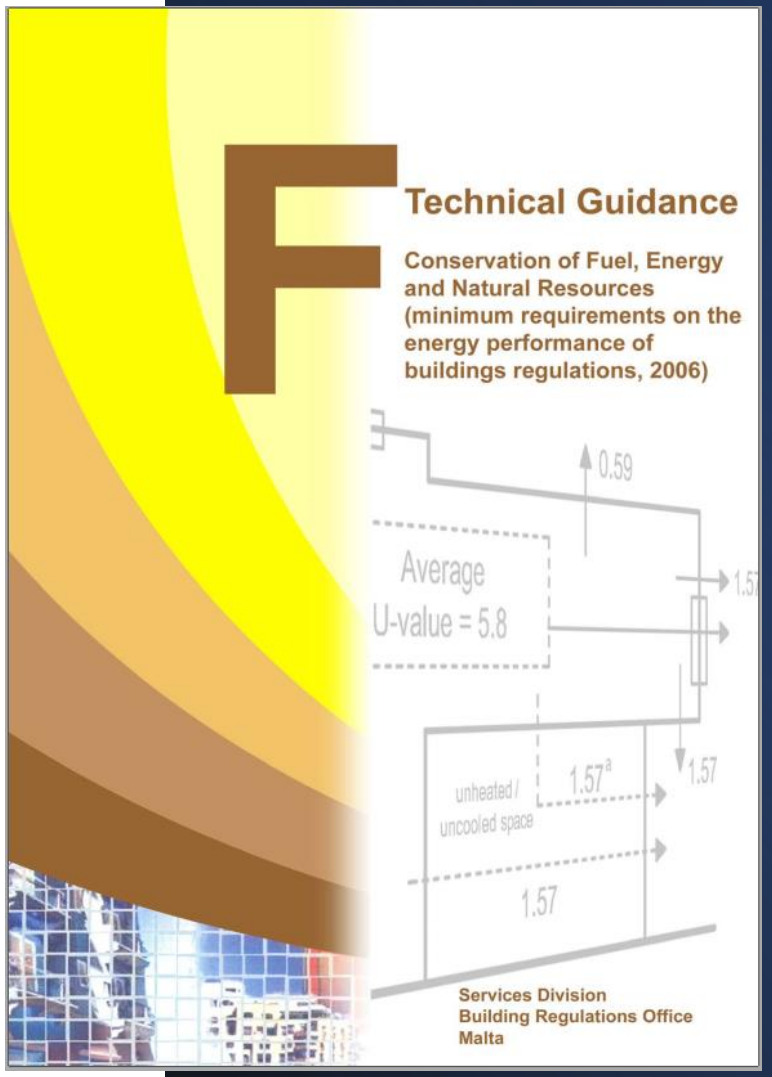
- Recharging of the Aquifer
- Conservation of Water at Building level and communal level.

Rainwater Conservation in Building Regulations

The conservation of rainwater has been entrenched in national law since early modern period.

Conservation of water was deemed to be an essential element in both energy performance and as an end to itself from the very beginning of minimum energy performance requirements.

Conservation of water was included in Building Regulations under the Document F for the first time in 2007



Document F (coming into Force 2007)

- Requirements for Reservoirs in all buildings to conserverVE water at building level
- Spaces on areas other than roofs are exempted from directing water to reservoir if these are no open paved areas greater than 300sq.m
- Requirement to have interception trap
- Requirement to have draw off points for Watering of Plants and flushing of toilets

Size of well or cistern **Table F.10**

Building Type	Size of cistern (m^3)
1. Domestic dwellings (inc. Apartment blocks)	Total roof area (m^2) x 0.6m
2. Hotels, Schools, Offices, Factories, Industrial buildings and Hospitals	Total roof area (m^2) x 0.6m
3. Shops and showrooms, and places of public gathering and entertainment not integrated in 2 above	Total roof area (m^2) x 0.45m
4. External paved areas (inc. open terraces and balconies) *	Total paved area (m^2) x 0.6m
***Note:** This requirement applies only if the total open paved area is greater than 300sq.m	

Technical document F coming into force 2016

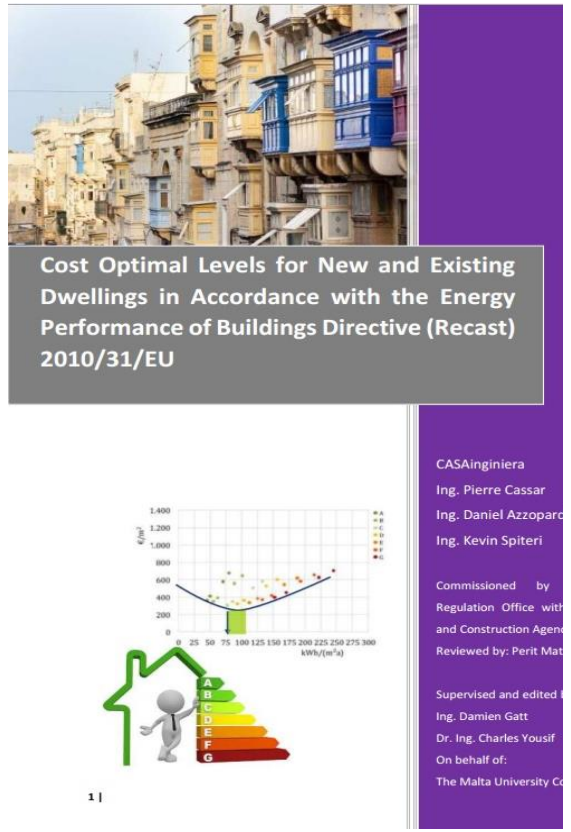
Requirement for Wells or Cisterns were retained in the second version of Technical document F with the same volumes

The requirement for draw off points for Flushing of toilets and watering of plants retained.

The requirement for water on open spaces to be conserved tightened to 200 sq.m – Areas covered by soil were exempted from this requirements

Water Conservation and Energy performance calculations

- The Conservation of Rainwater at Building level is considered as an energy efficiency measure.
- The current Energy Performance Rating for Buildings in Malta calculates the amount of energy required for desalination and pumping of water to each building
- Buildings may be able to achieve compliance to energy performance levels by the introduction of a second class system
- This Calculation methodology is expected to be retained and with increasing tightening of minimum energy performance requirements to cost-optimal levels there is increased incentive to conserve water



Continuous use of water

- The requirements for cistern are based on the principle that rainwater is conserved during rainy season to be used during dry period.
- With Continuous use of water the same amount of water can be conserved with a smaller cistern.
- The ability to reduce the size cistern depends on external factors (rainwater pattern) as well as building specific factors (rate of use of second class water compared to size of roof)

Sustainable drainage systems (SuDS)

The use of SuDS has been proposed as a possible solution at building level in lieu of collection of rainwater

The successful use of SuDS has been experienced in a number of case studies locally mostly on large scale buildings.

Main issues with SuDS in small buildings include:

- Abuse such as possible dumping of waste
- Inability to carry out enforcement effectively (e.g. no access)

Looking forward

- The Conservation of Water is expected to remain a pillar as a means in itself and in view of energy performance implications
- With increased requirements for buildings (higher buildings, works adjacent to third parties), the design of reservoir is required to be included in design from concept stage.
- Enforcement is lacking. The lack of an effective compliance regime is hindering the proper implementation of water conservation.
- The way forward necessarily requires the design and implementation of second class water systems from the very beginning of projects to execution.

Rainwater Harvesting for Groundwater Recharge

Lior Netzer
Head of Hydrogeology of Coastal Aquifer Branch
Israel Water Authority
19/05/2023

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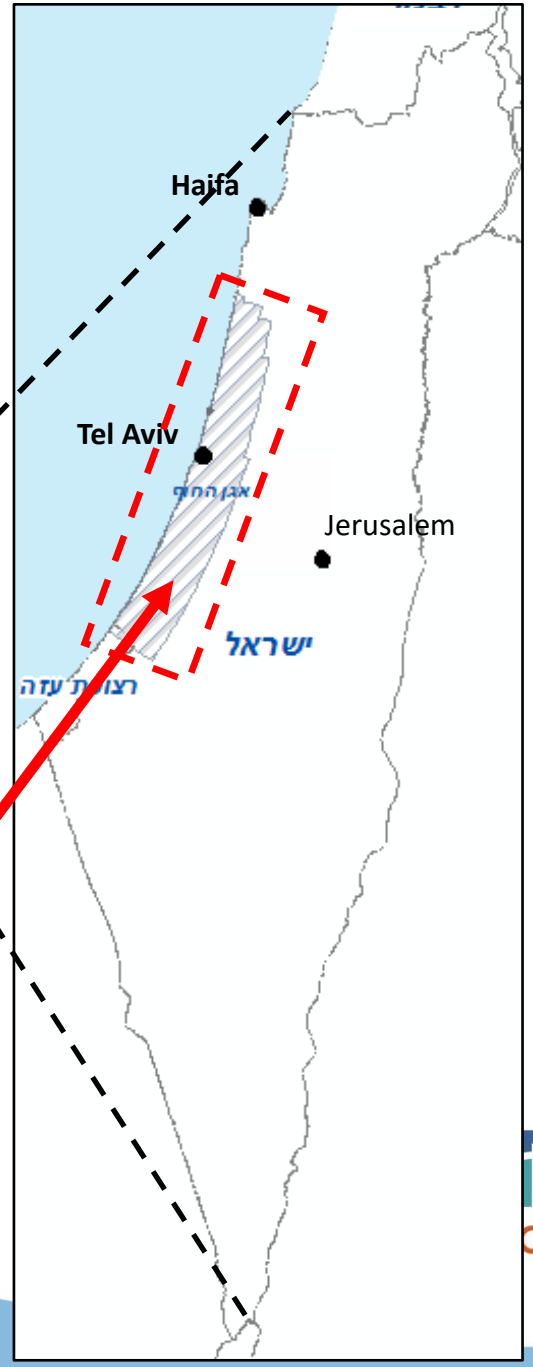
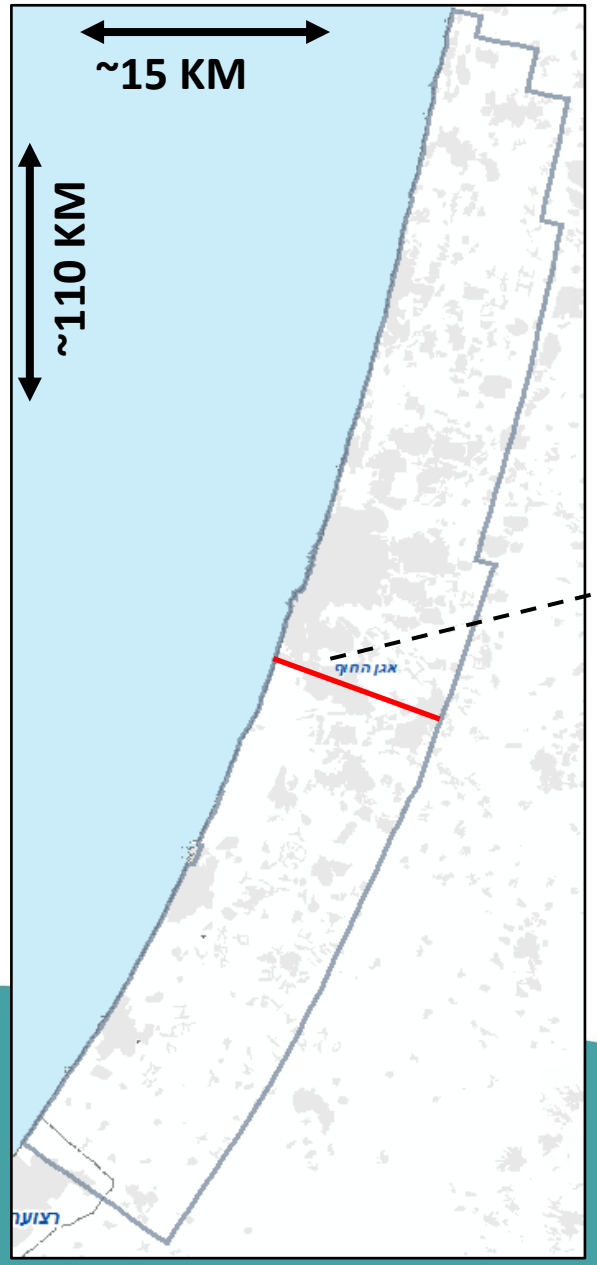
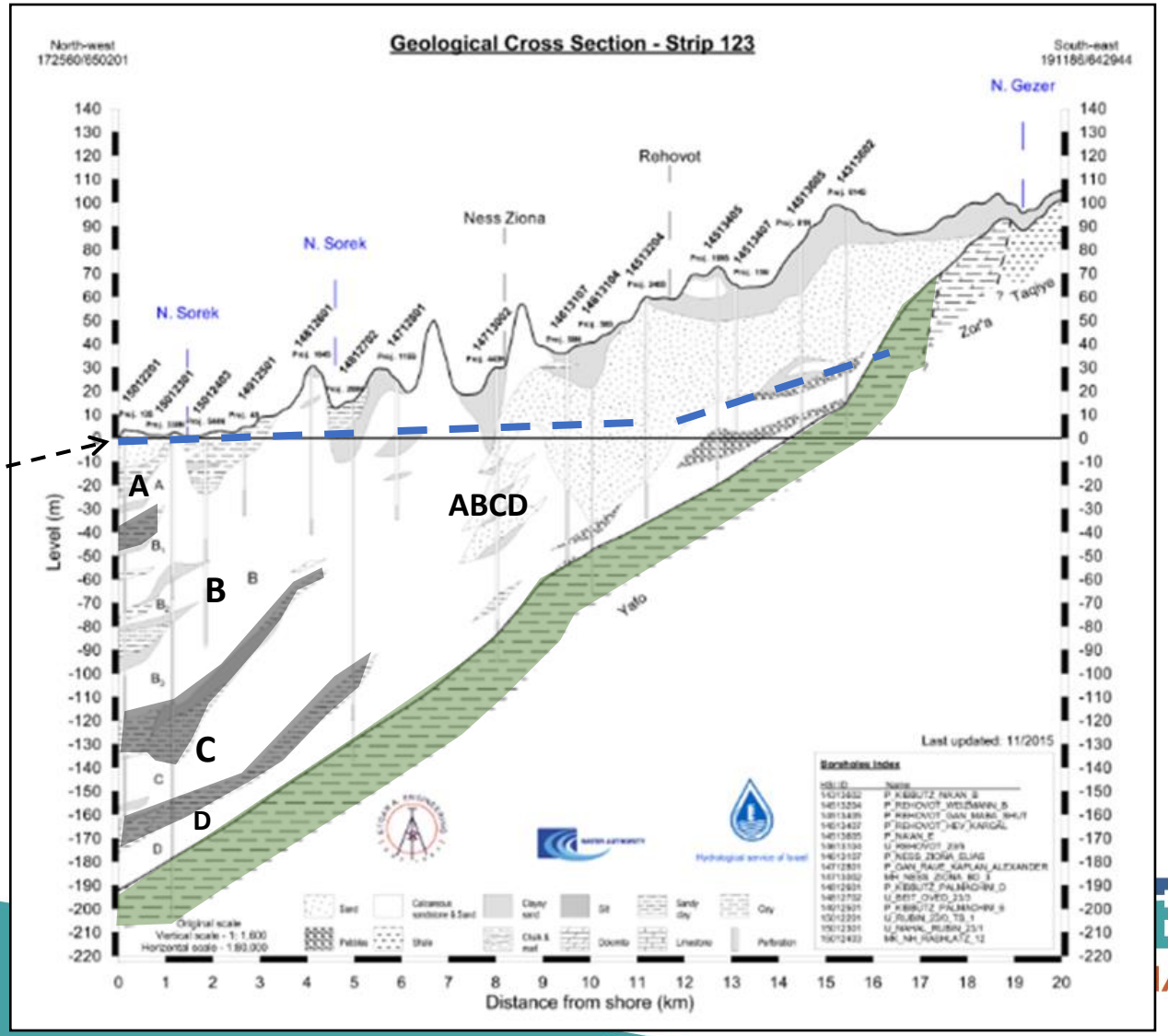
רשות המים



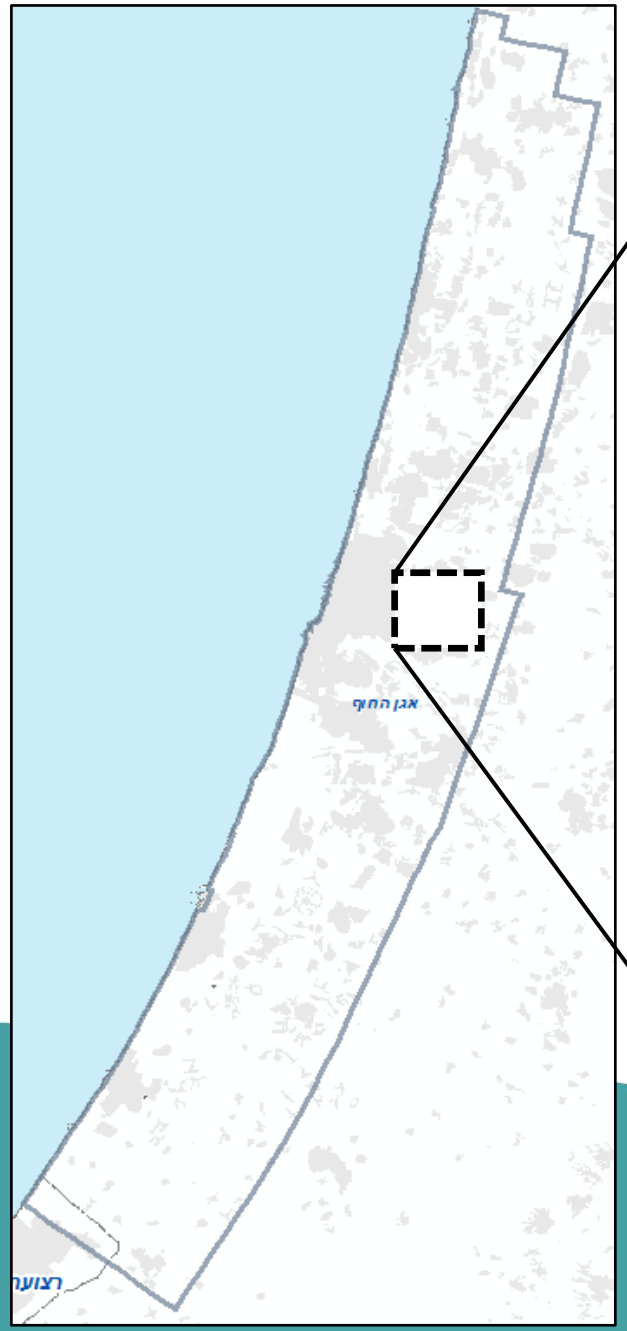
The Coastal plain aquifer

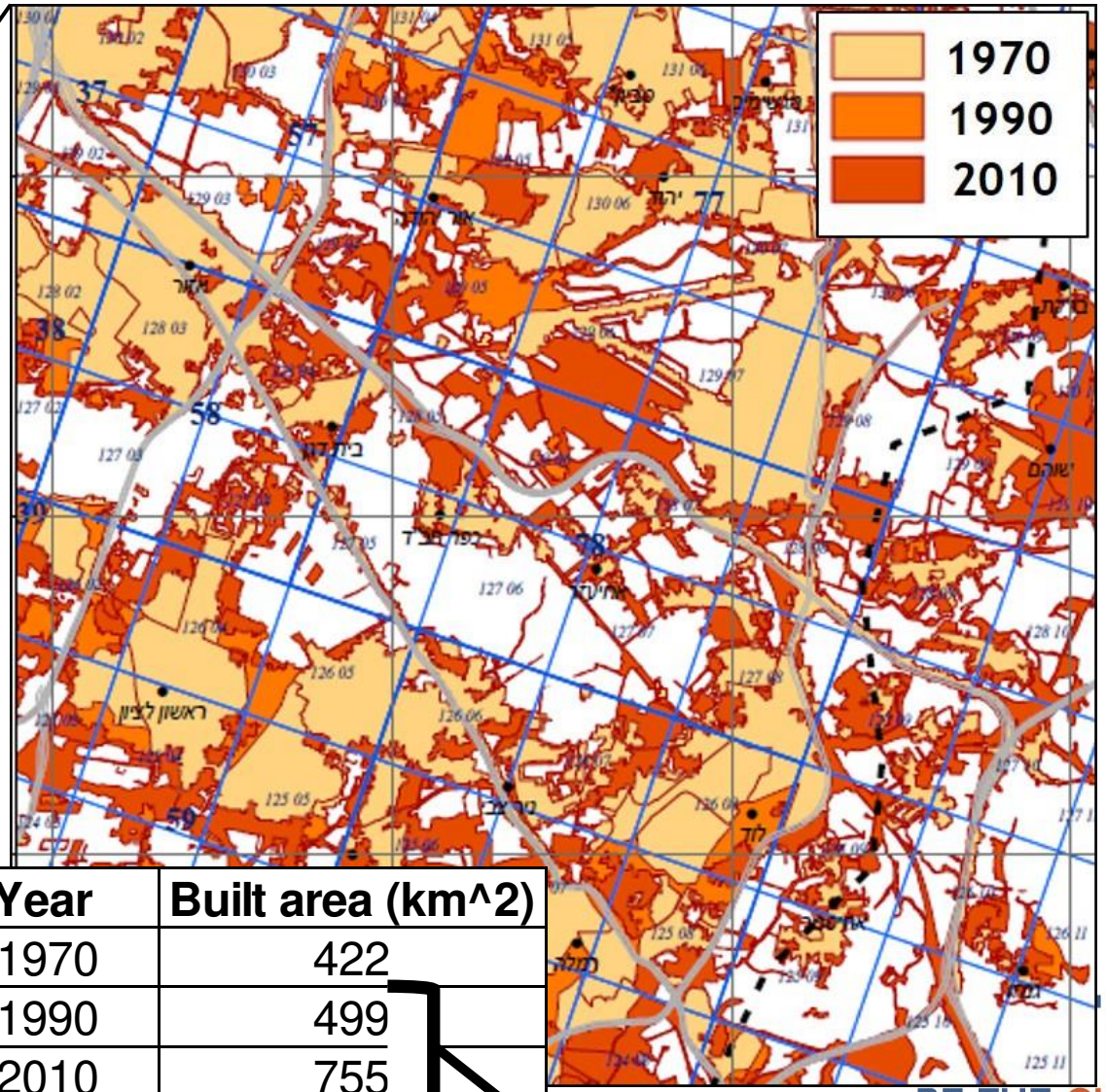
The Coastal plain aquifer





Urbanization





Year	Built area (km^2)
1970	422
1990	499
2010	755

Increase by 50%

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Municipal Flooding

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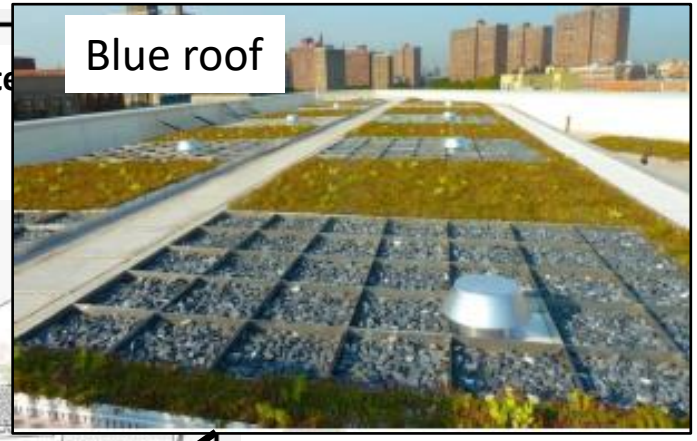

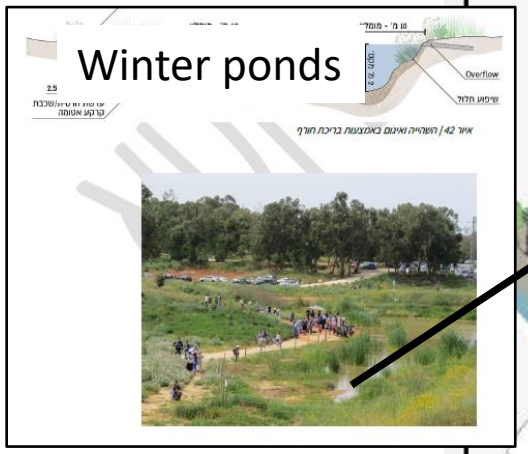

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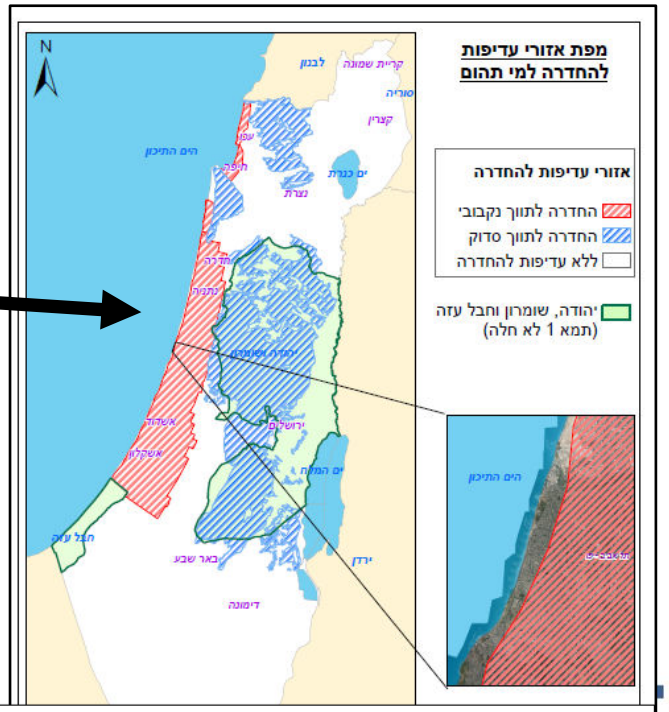
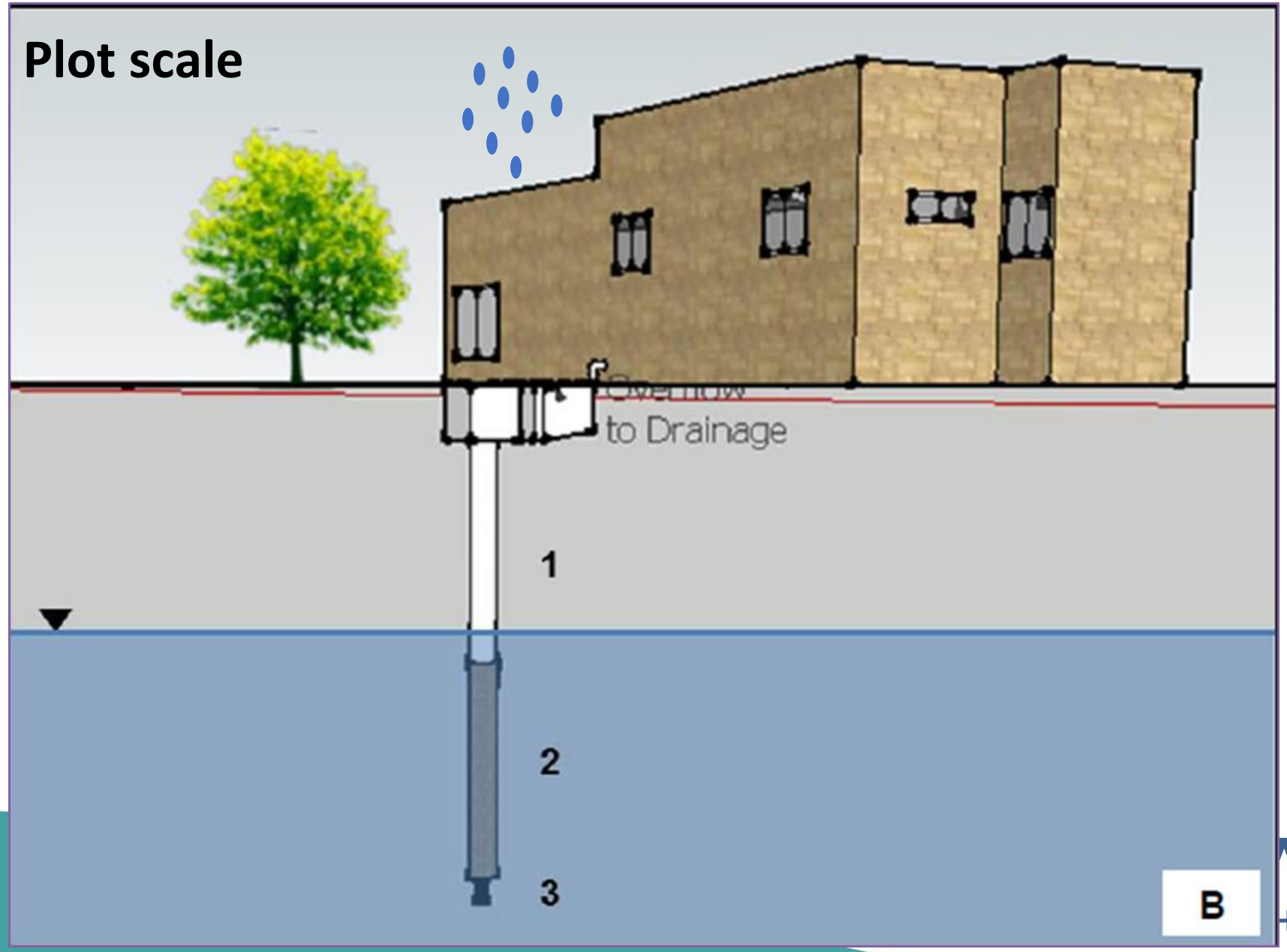
Guidance of Rain Water Harvesting by infiltration

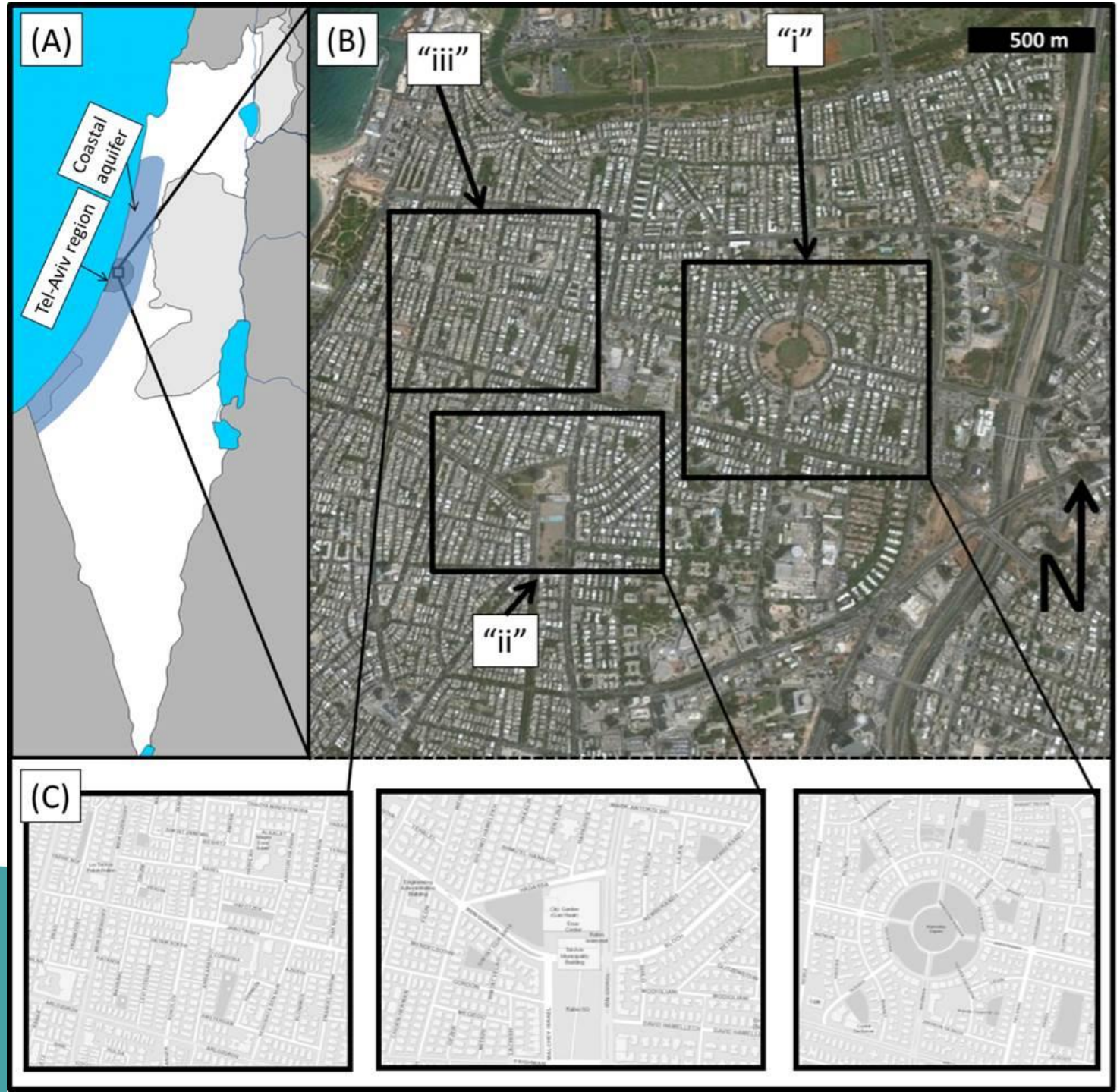


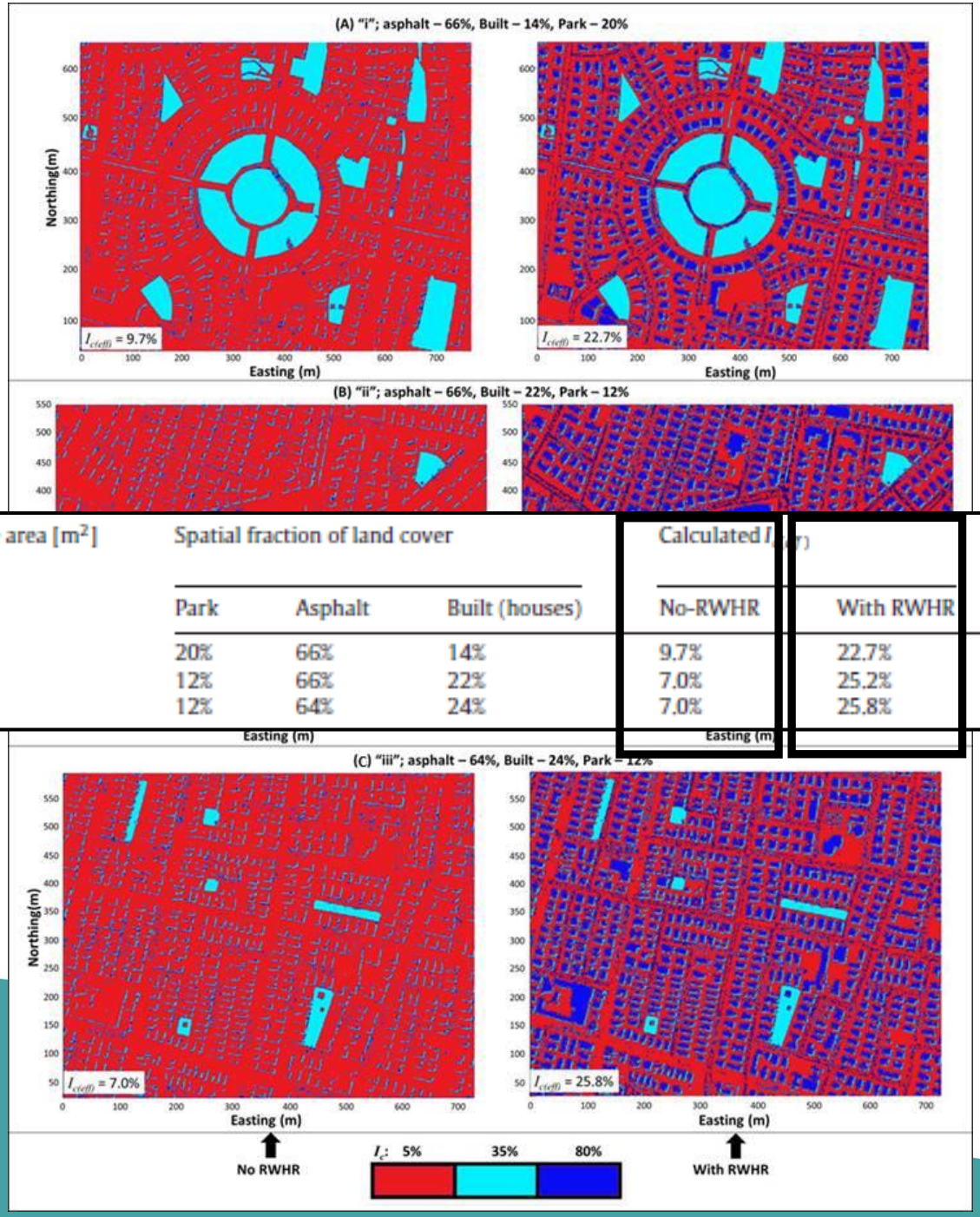
The Infiltration System:

1. **Will collect** the volume of water received from the roof at a 10 min rain storm with time returning of 5 years.
2. **Will infiltrate** in 1 hour the volume of water from the roof at a 1 hour rain storm with time returning of 50 years.

Plot scale




(A)
Coastal aquifer
Tel-Aviv region
(B)
"iii"
"i"
500 m
"ii"
N
(C)



	Total surface area [m^2]	Spatial fraction of land cover			Calculated $I_{c(eff)}$		Calculated groundwater recharge [m^3]	
		Park	Asphalt	Built (houses)	No-RWHR	With RWHR	No-RWHR	With RWHR
Region i	456,511	20%	66%	14%	9.7%	22.7%	24,355	56,995
Region ii	406,406	12%	66%	22%	7.0%	25.2%	15,647	56,328
Region iii	546,511	12%	64%	24%	7.0%	25.8%	21,041	77,550

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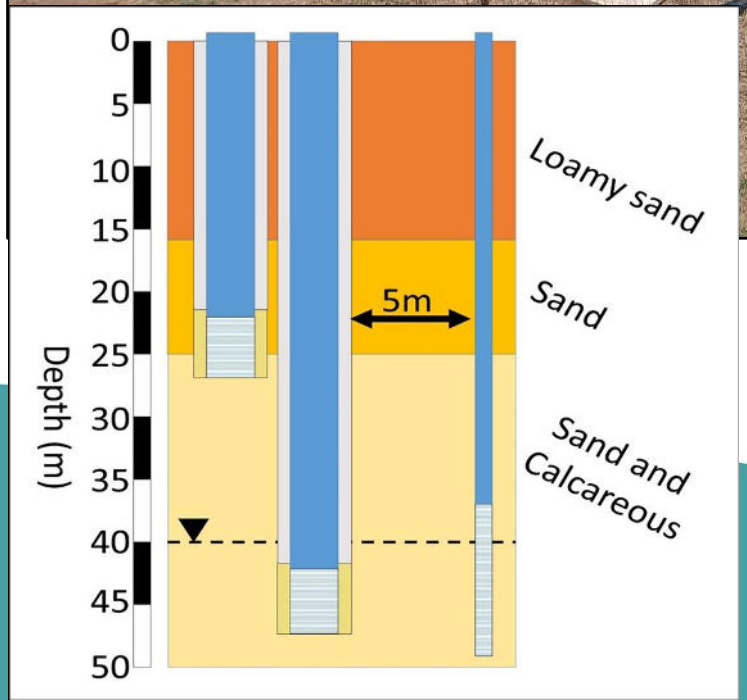
Research site

Infiltration Wells



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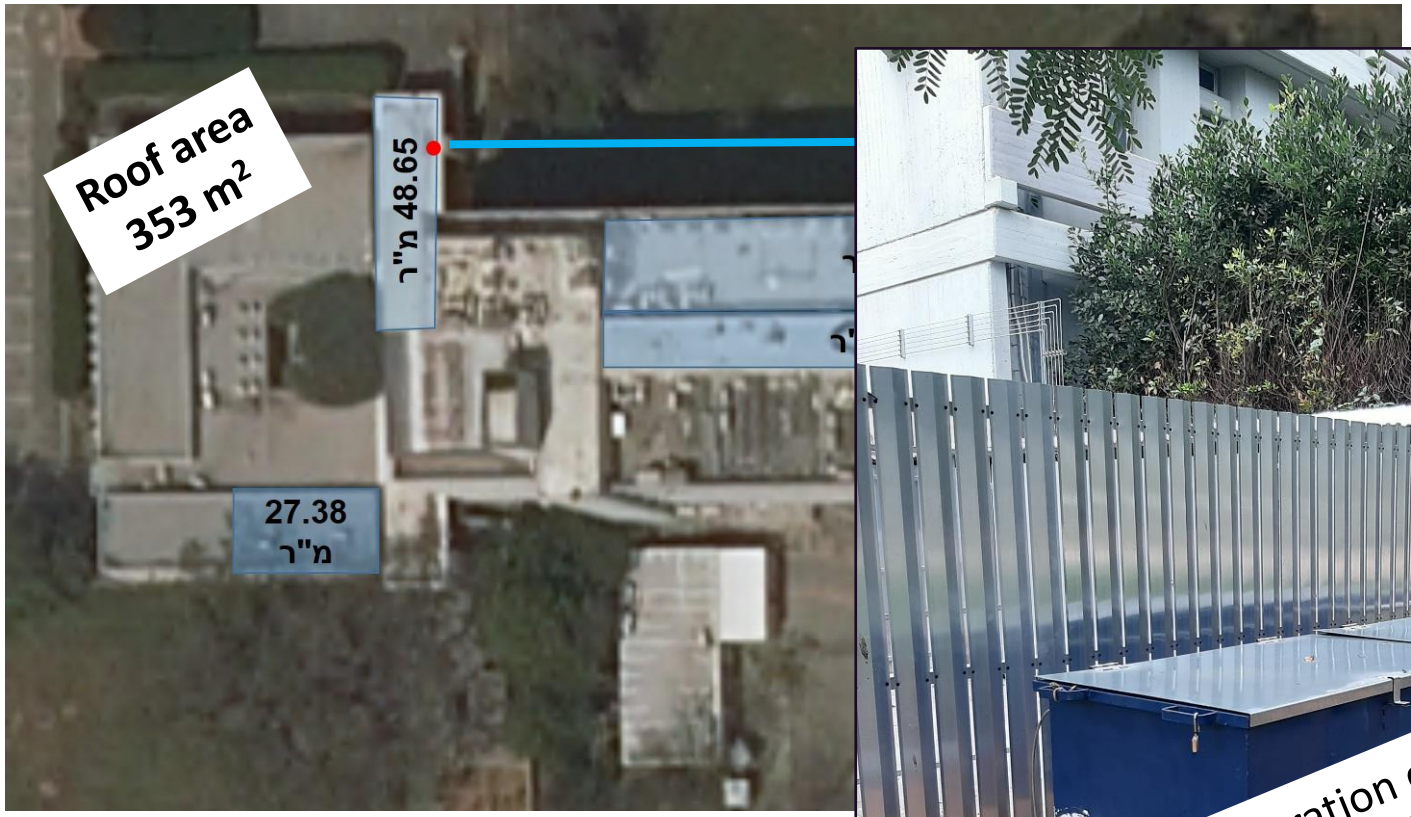
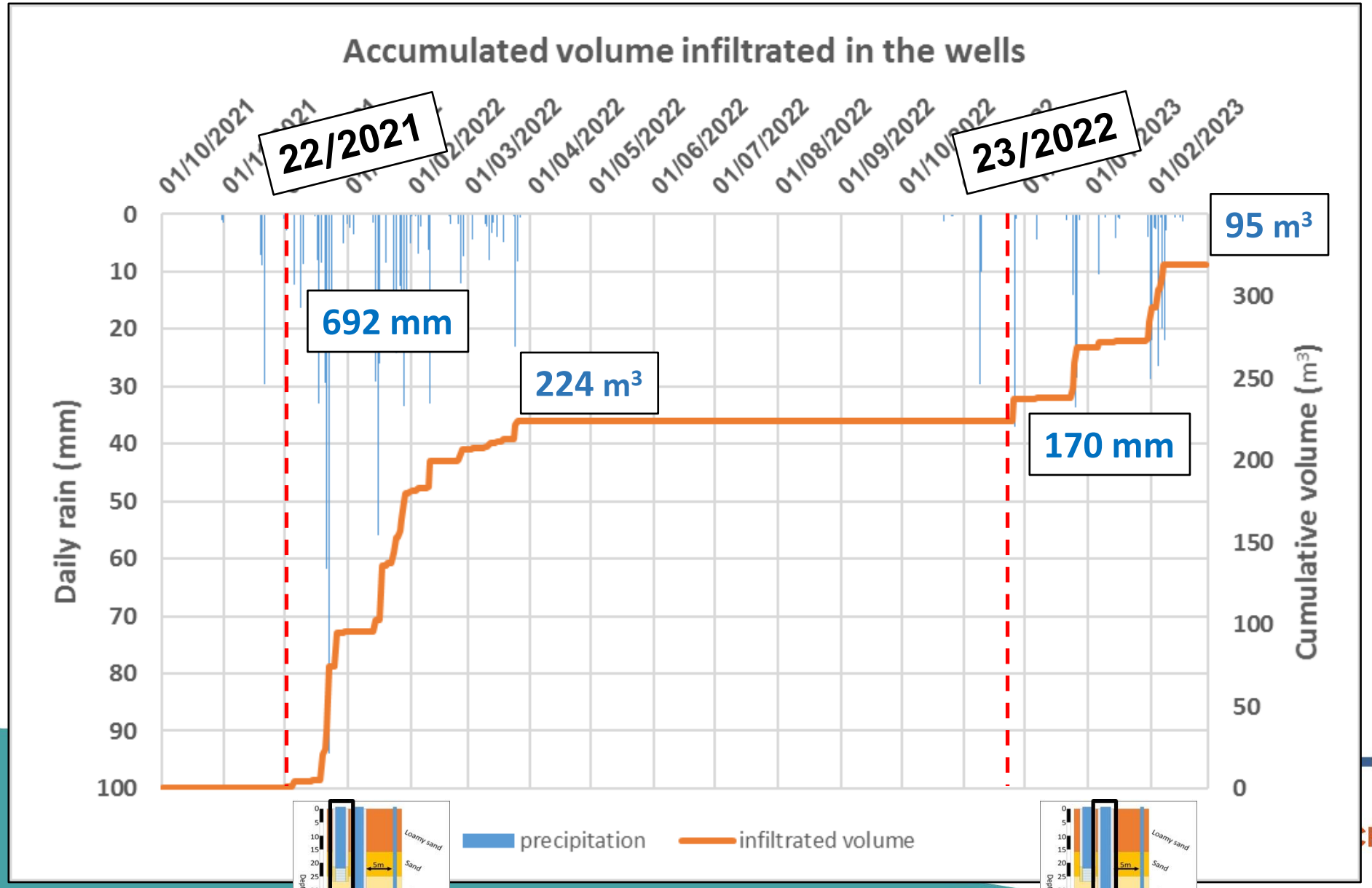
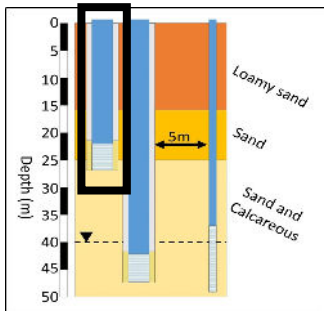

Roof area
353 m2
48.65 מ"ר
27.38
מ"ר


Filtration chamber

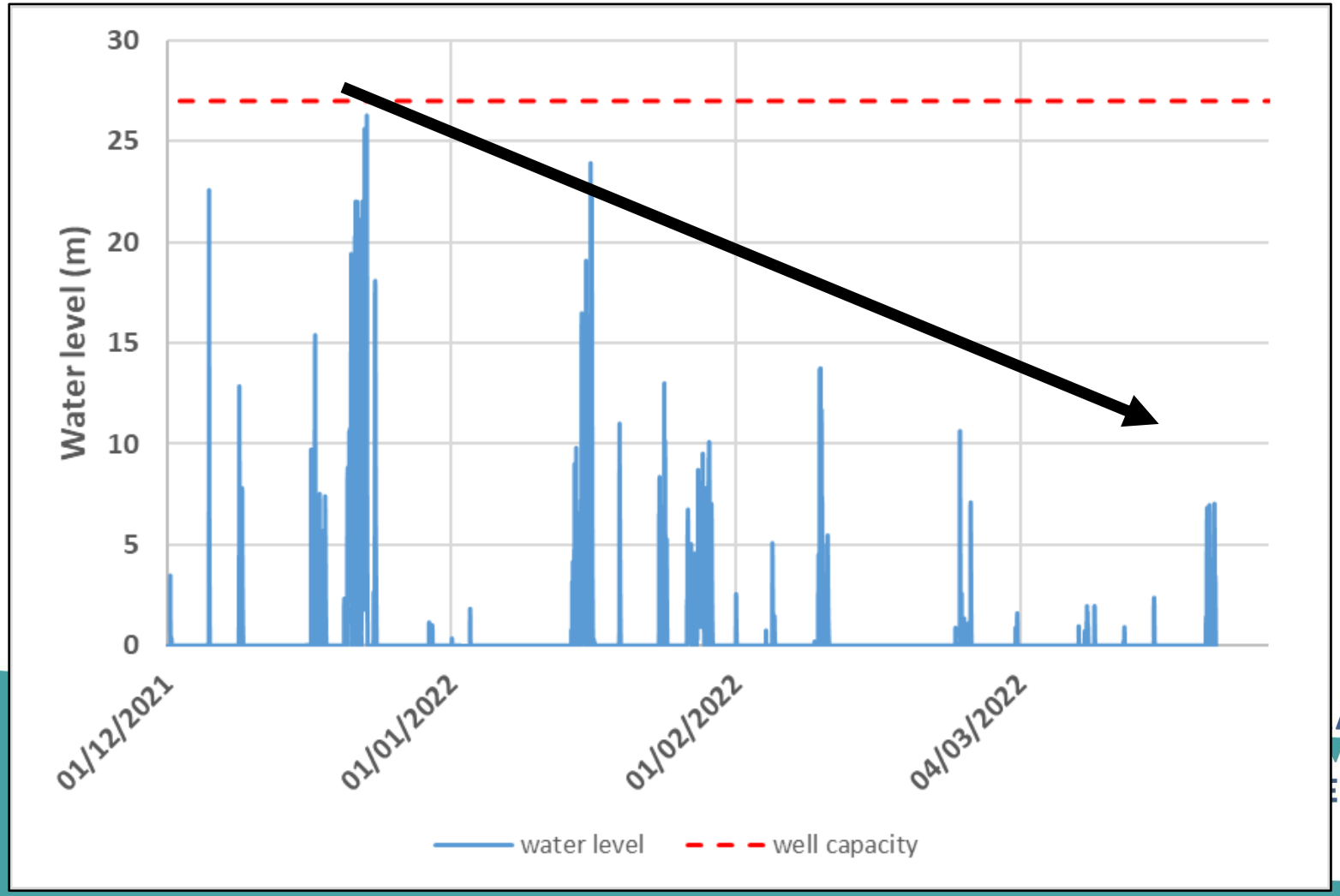
Filtration chamber


Accumulated volume infiltrated in the wells
22/2021
23/2022
692 mm
224 m³
170 mm
95 m³
Daily rain (mm)
Cumulative volume (m³)
precipitation
infiltrated volume
Loamy sand
Sand
Sand and Calcareous
5m
Depth (m)



Winter 2021/22

Dry well infiltration



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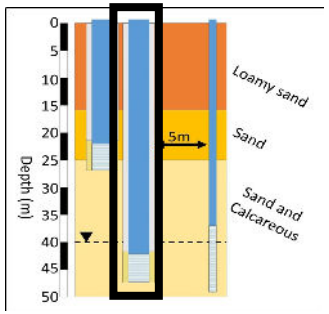
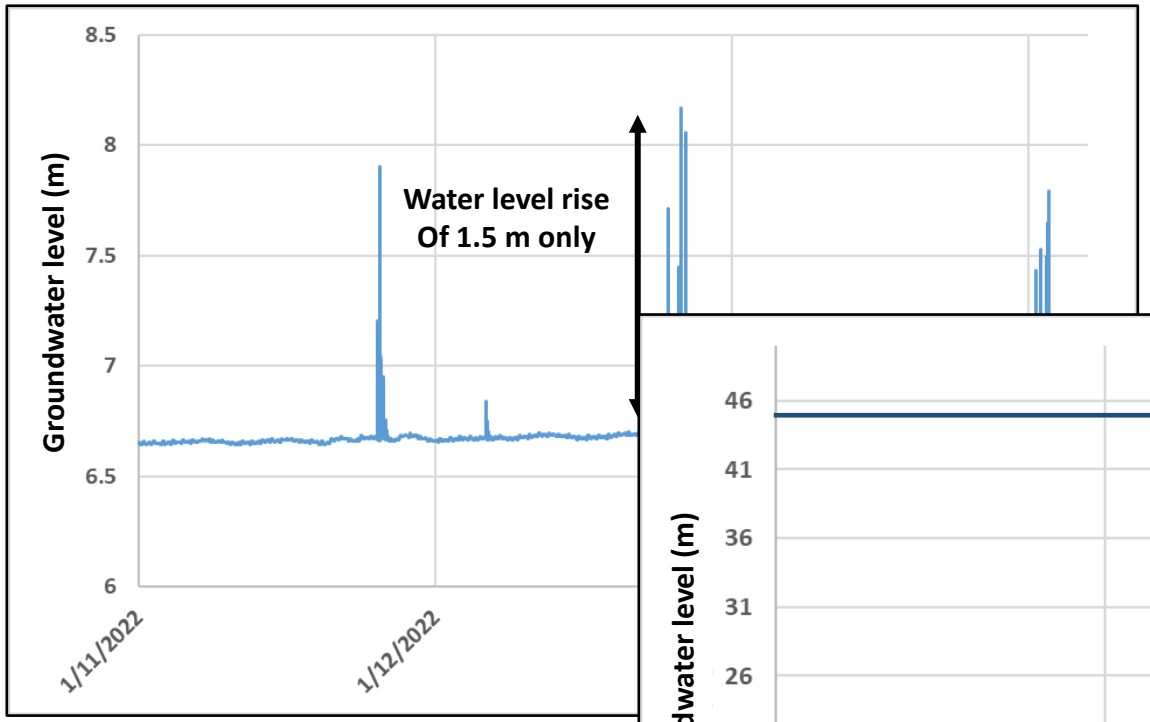
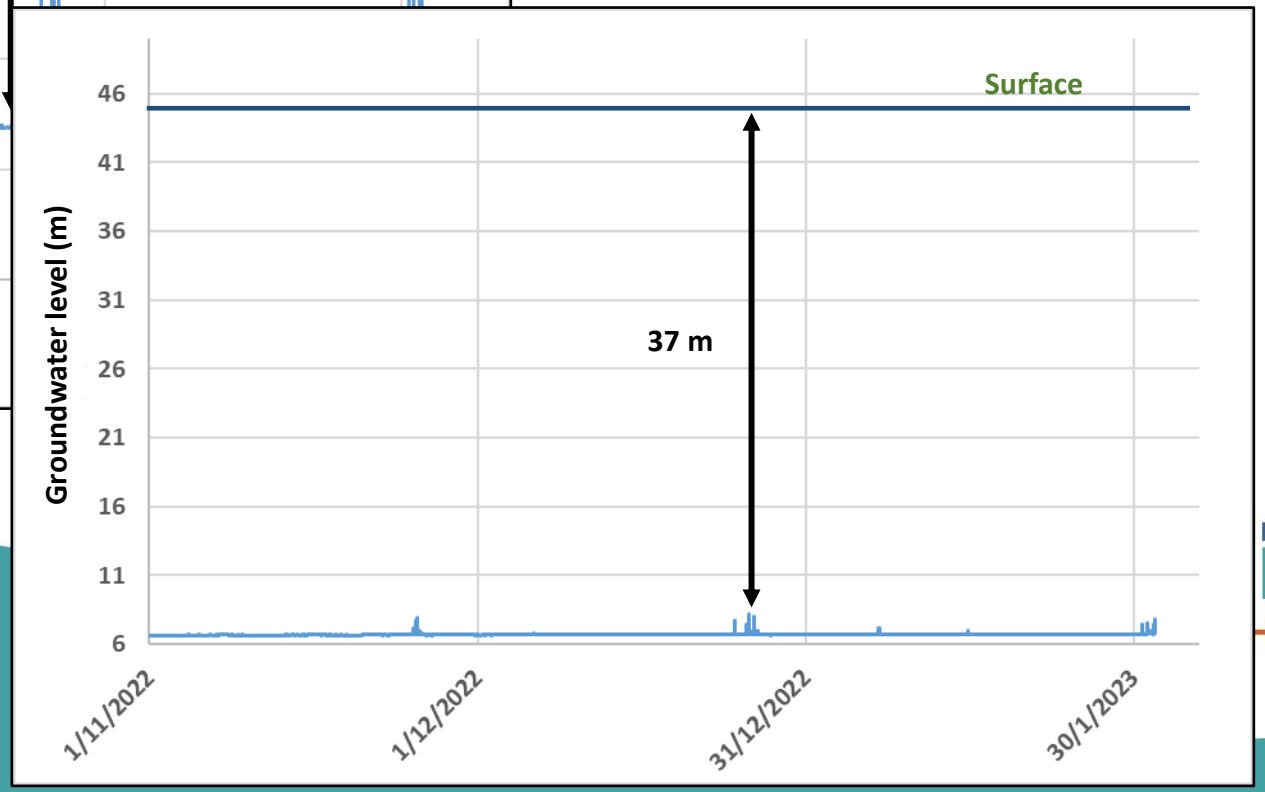
Winter 2022/23

Wet well infiltration

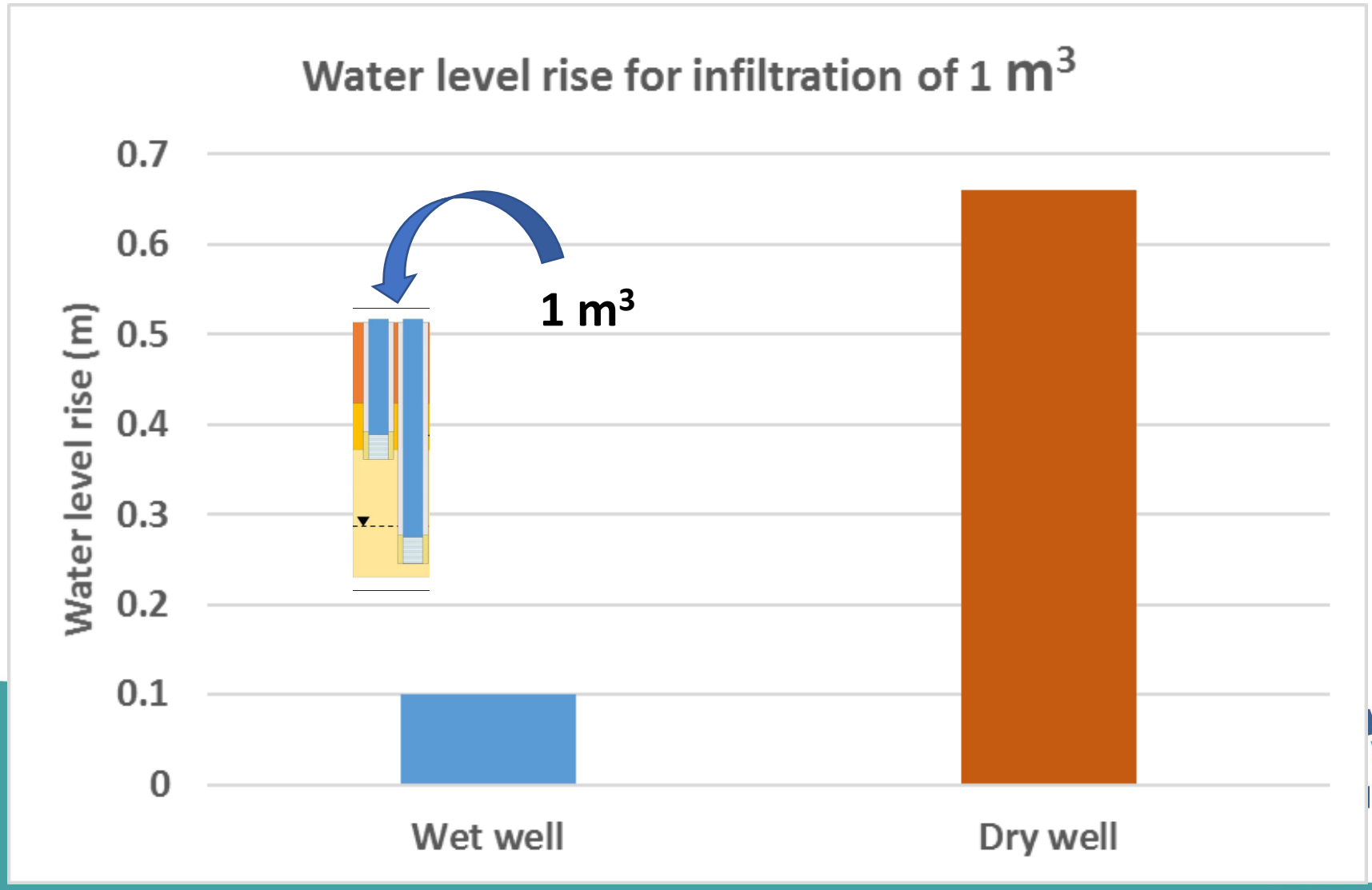






Infiltration Capacity (Controlled infiltration experiments)

For well with 0.35m drilling diameter, and 5 m perforation



Empty rapidly

High infiltration capacity

Need small area

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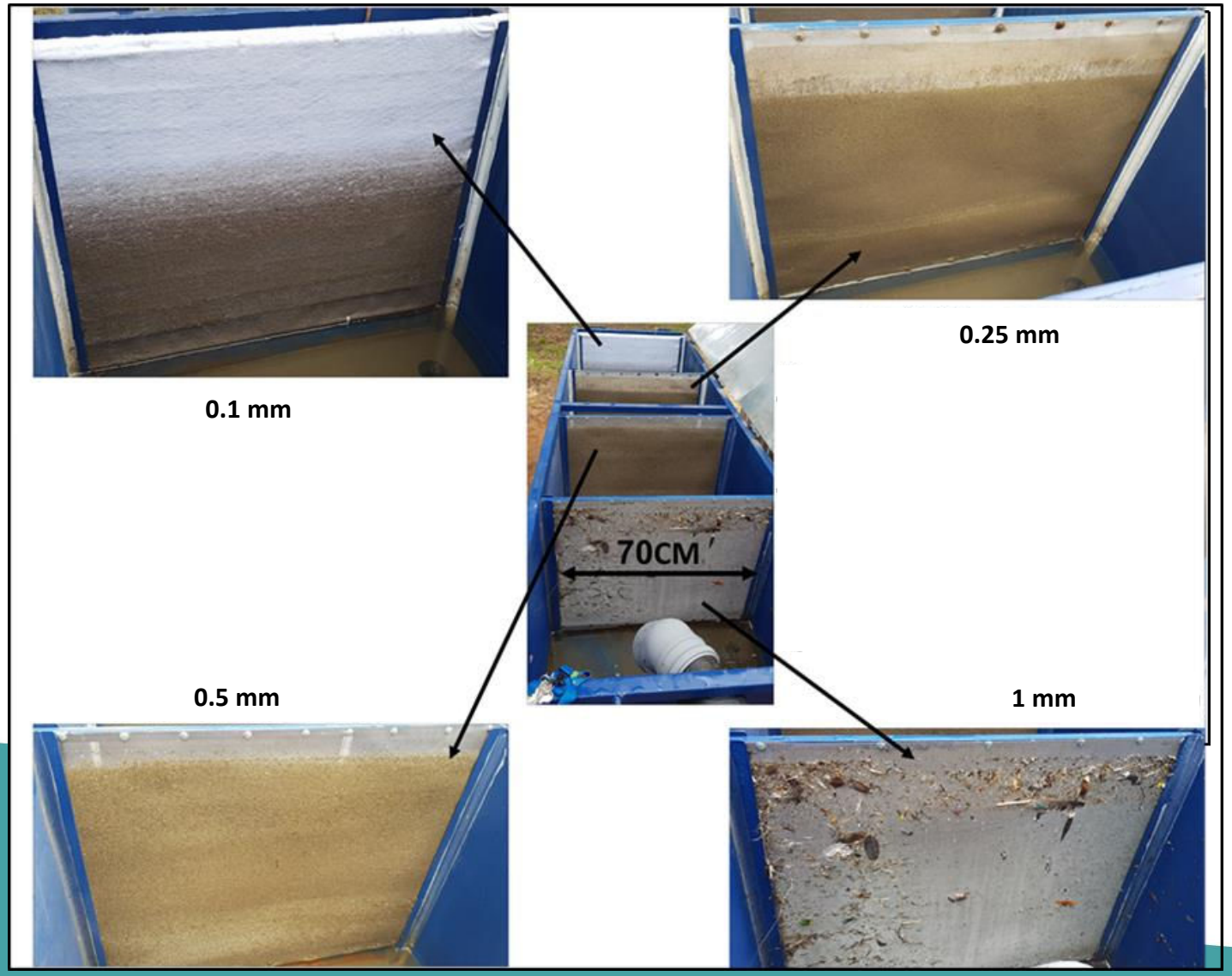
The infiltration system

Maintenance is needed!!!!!!



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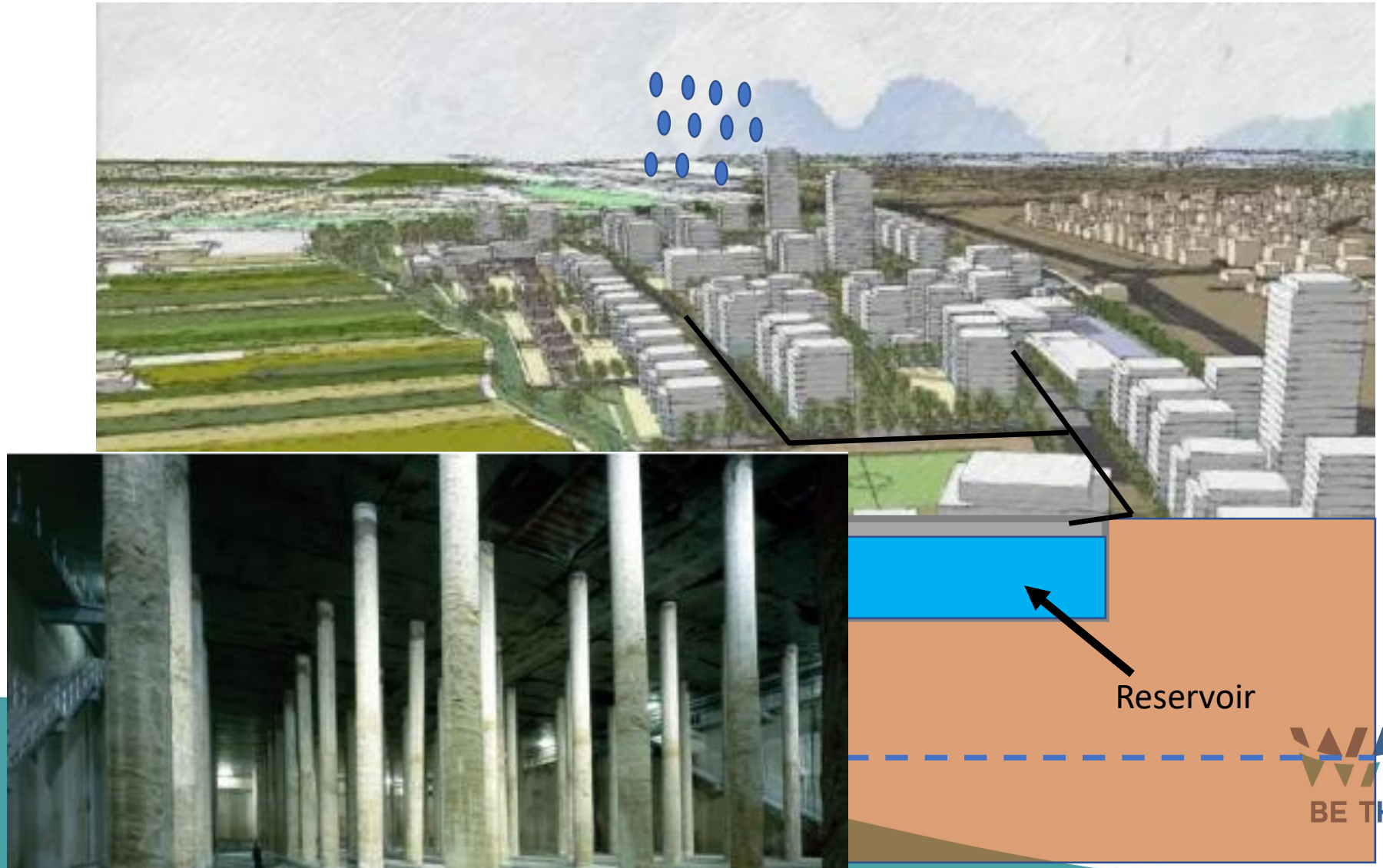
Preferred solution at the city scale



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Summary:

Infiltration of Roof Rainwater by wells in the Coastal Aquifer of Israel is working!!!

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Lime stone- Mountain Aquifer

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CONFERENCE ON

RAINWATER MANAGEMENT – AN UNTAPPED RESOURCE

MAY 19, 2023

WATER.ORG.MT

Sustaining our Groundwater Resources: Rainwater Harvesting through Managed Aquifer Recharge

Julian Mamo
Environmental Management & Planning Division
Institute of Earth Systems

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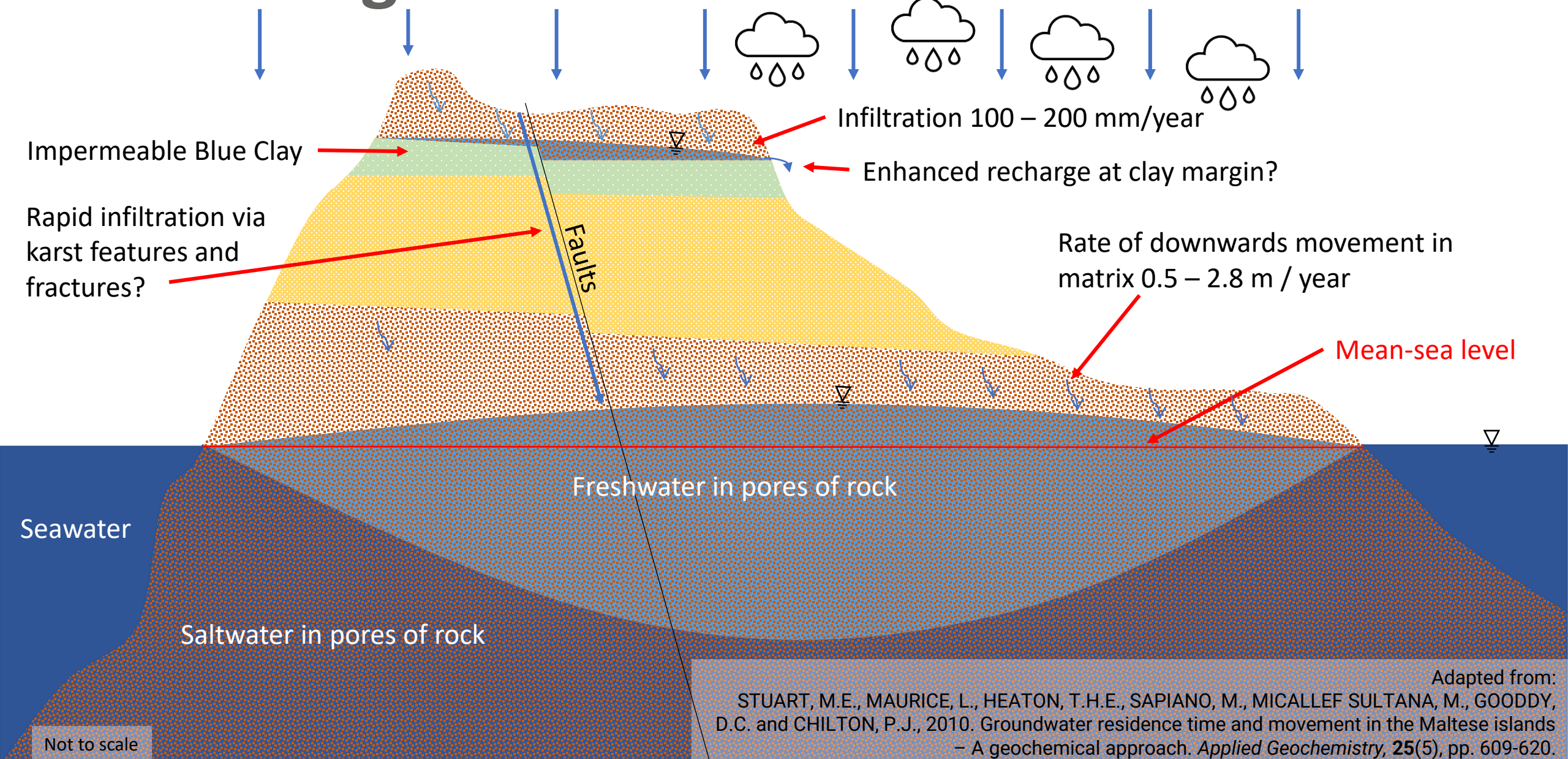
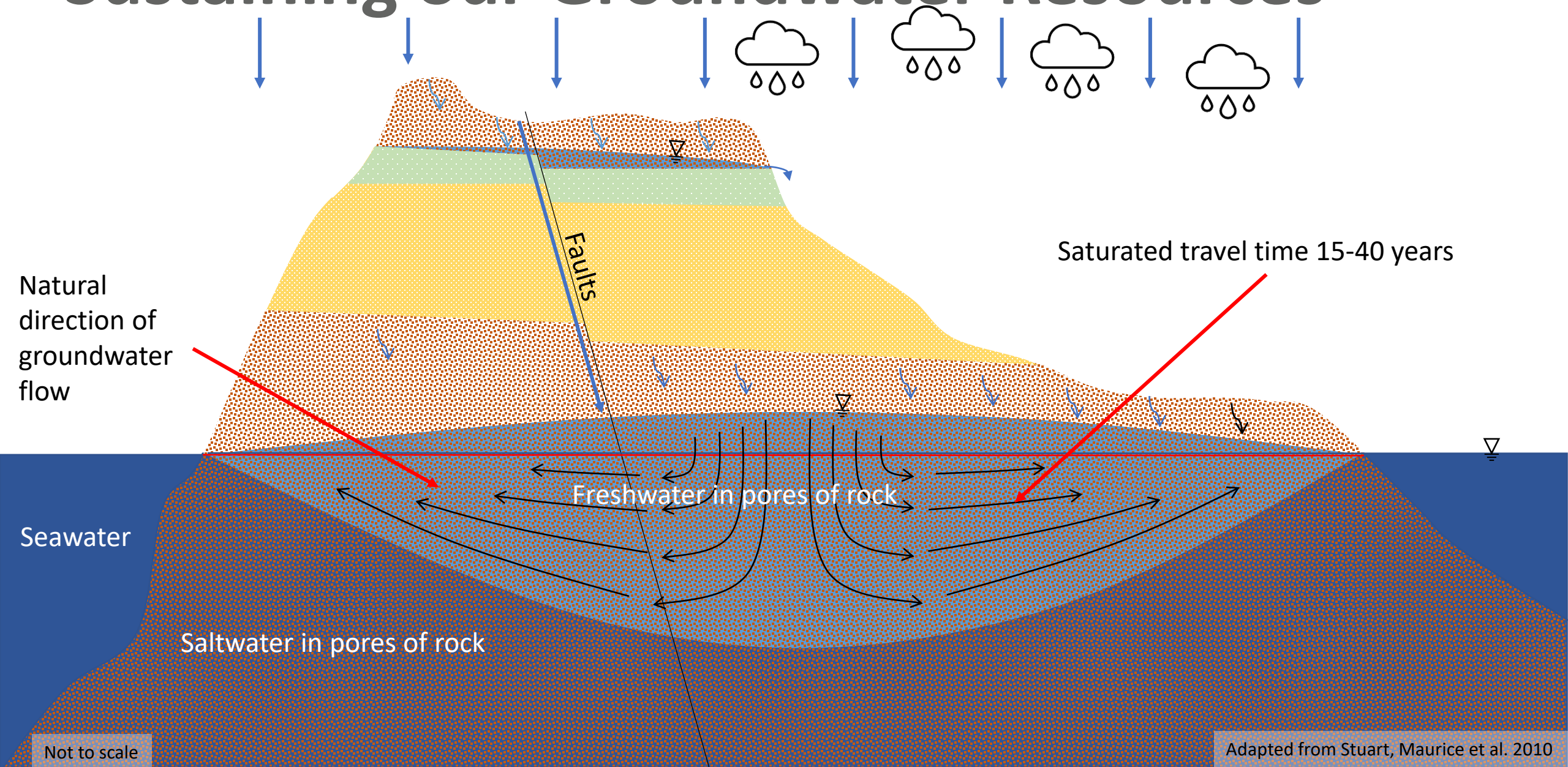
L-Università ta' Malta
Institute of Earth Systems

Sustaining our Groundwater Resources

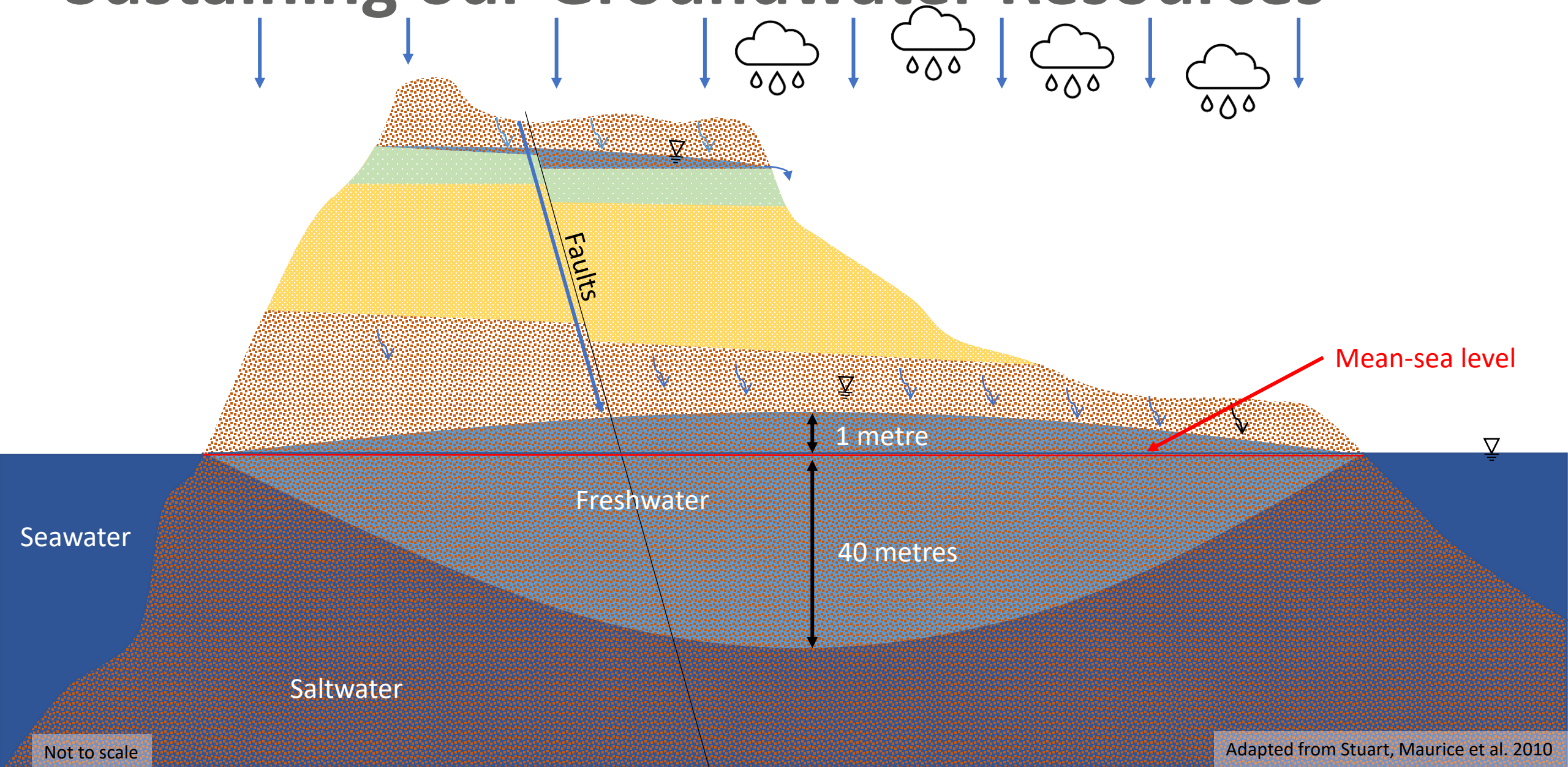


Adapted from:
STUART, M.E., MAURICE, L., HEATON, T.H.E., SAPIANO, M., MICALLEF SULTANA, M., GOODDY, D.C. and CHILTON, P.J., 2010. Groundwater residence time and movement in the Maltese islands – A geochemical approach. *Applied Geochemistry,* **25**(5), pp. 609-620.

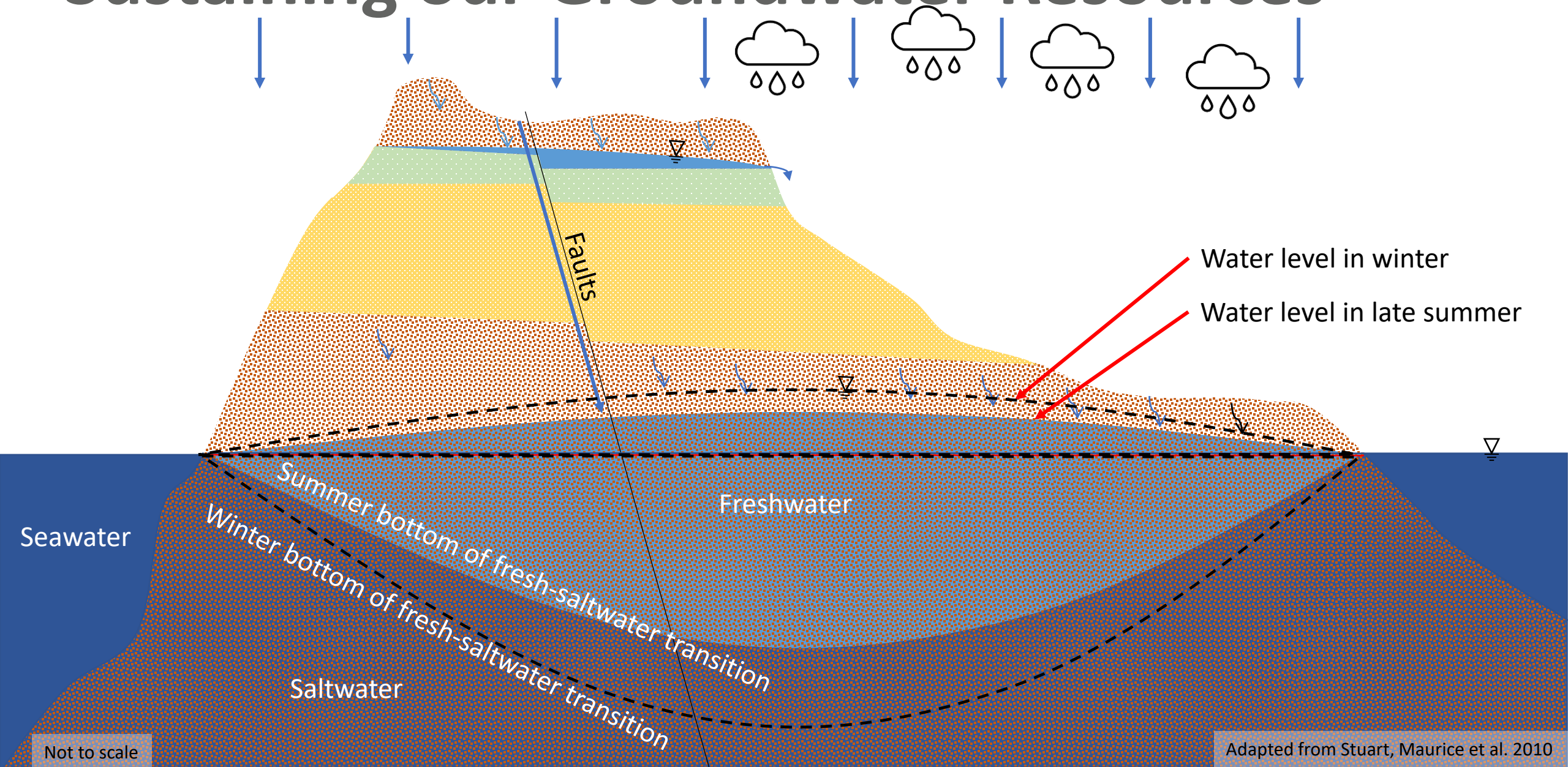
Sustaining our Groundwater Resources



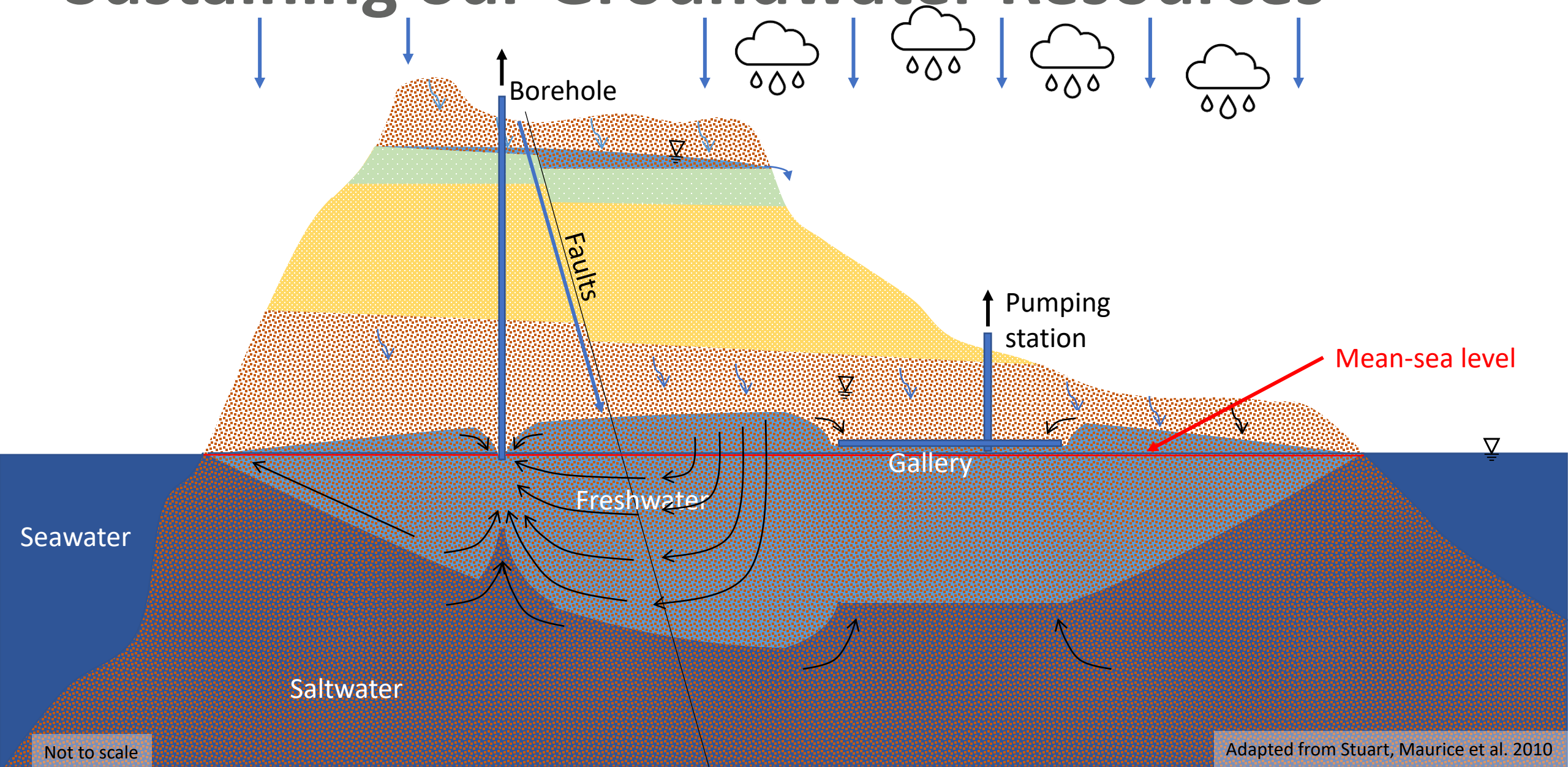
Sustaining our Groundwater Resources



Sustaining our Groundwater Resources



Sustaining our Groundwater Resources



Before speaking about Rainwater Harvesting…

1) Water Use Efficiency

Setting the flushing cistern water level

Fixing leaking flushing mechanisms

Measuring and regulating flow rates

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The 5-6-7 rule, flow no more than -

Bathroom faucet 5 LPM

Toilet flushing 6 L (Full flush)

Shower Head 7 LPM

Or about Managed Aquifer Recharge …

2) Rainwater Harvesting and Use

Detail from a watercolor depicting the construction of the new city of Valletta.

Commission appointed by the Grand Master Jean de La Vallette to draw up regulations for the building of the new city houses stated:

> *"… every house should have an underground tank for the collection of rainwater, under penalty of fifty scudi for failure to comply …"*

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Source:
SAPIANO, M., MICALLEF, P., ATTARD, G. and ZAMMIT, M., 2008. The evolution of water culture in Malta: An analysis of the changing perceptions towards water throughout the ages. Options Méditerranéennes, A no 83 - Water Culture and Water Conflict in the Mediterranean Area.

Linking Water Use Efficiency and Onsite Rainwater Harvesting and Use to Groundwater Protection – Reducing Demand

Municipal Supply

Portable Water Production Source / m^3

Ground Water, 14,193,251, 41%

Desalination / RO, 20,082,401, 59%

Source: WSC 2021 Annual Report

Private Supply

Trucking groundwater remains an important source of 'second-class' water for the commercial/ industrial sector (as well as the agricultural sector)

Urbanisation – Buildings and Sealed Surfaces

Impacts

Reduced infiltration

Impact on stormwater quality

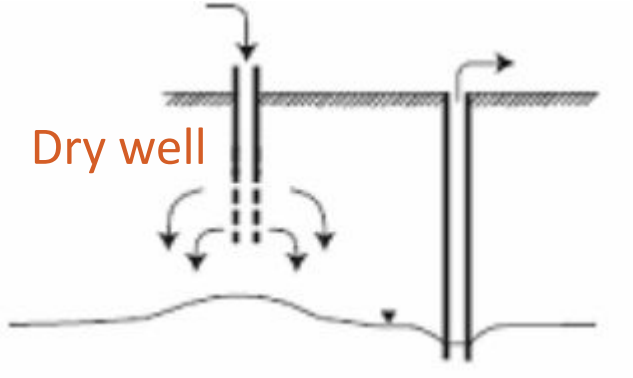
Flooding,

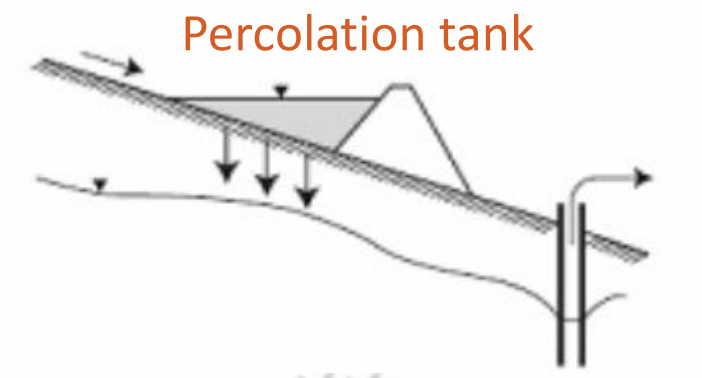
collection and flow over sealed surface

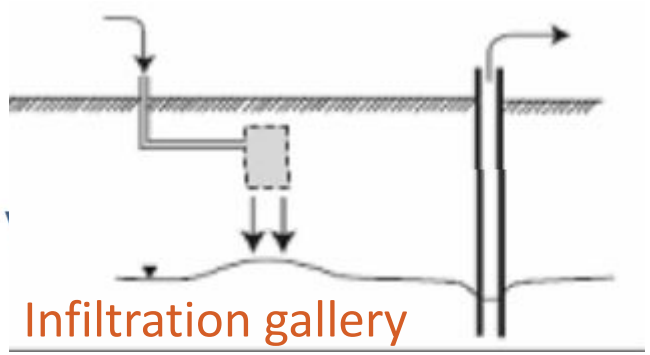
Reduced soil moisture

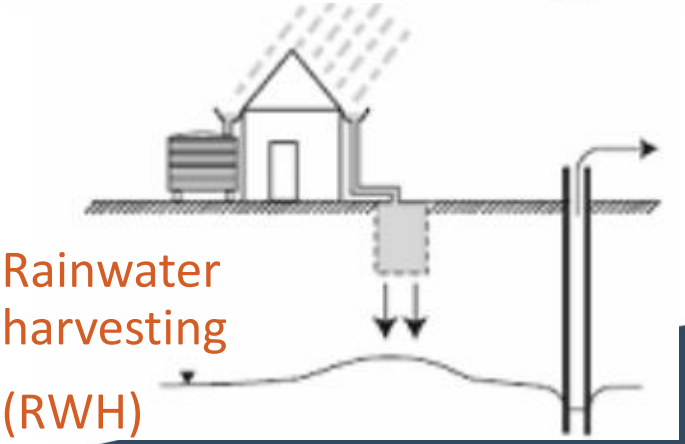
Managed Aquifer Recharge (MAR)

*the **intentional** recharge of water to aquifers for subsequent use or environmental benefit*









- *Aquifer replenishment*
- *Increase storage for drought supply – security of supply*
- *No evaporation losses*
- *Natural buffering and treatment capacity*

Source:
AUSTRALIAN COUNCILS OF NAT. RESOURCE MANAGEMENT, 2009. Australian Guidelines 23 for Water Recycling: Managing health and environmental risks (Phase 2) Managed Aquifer Recharge.

Considerations - RWH through MAR

1. Risk of groundwater pollution
2. Risk of clogging – an inevitable problem

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Risk of groundwater pollution

Linking risk to catchment type

Roof Stormwater Quality

Road Stormwater Quality

Agricultural / Rural Stormwater Quality

Risk of groundwater pollution

Linking risk to catchment type

Road Stormwater Quality

Traffic activities
motor vehicle exhaust emissions,
fuel dripping,
brake and tire wear,
road degradation,
road debris
Sewer overflows
Other urban activities

Agricultural / Rural Stormwater Quality

Nutrients
Organic matter
Suspended matter

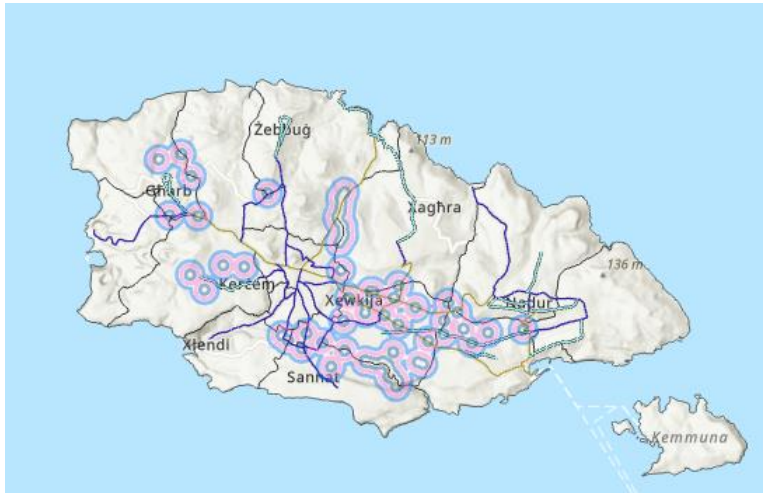
Roof Stormwater Quality

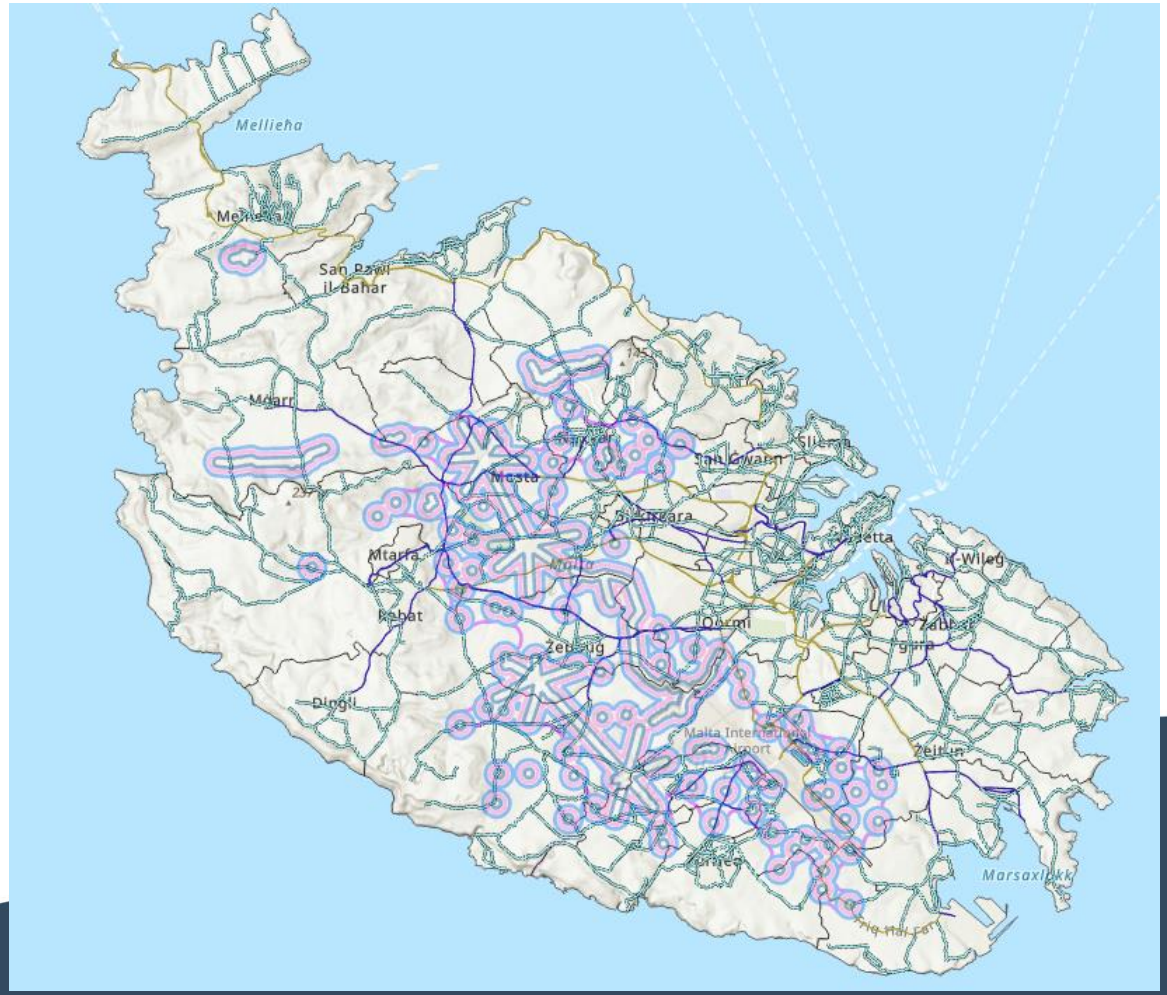
Direct atmospheric deposition,
Overhanging foliage,
Bird, rodent, pet droppings,
Roof material degradation

Compilation of Stormwater quality data in Malta
Green Stormwater Infrastructure Guidance Manual
Ministry for Public Works and Planning , June 2022

Risk of groundwater pollution

Groundwater Safeguard Buffer Zones





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Source: Planning Authority Mapserver

Risk of groundwater pollution

Linking risk to hydrogeological setting

Groundwater in the mean sea-level aquifer is characterized by the mixing of waters with two different infiltration processes:

- a very slow infiltration, through the matrix porosity, which is the dominant recharge process of the aquifers and
- a fast infiltration, through cracks and fractures.

Source:
Sapiano, M. 2015. Characterisation of the sea-level aquifer system in the Malta South. MARSOL Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought Region.

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Risk of groundwater pollution

Linking risk to hydrogeological setting

"… a large part of the replenishment of the Main Sea Level Table takes place through the small inliers of Lower Coralline Limestone which outcrop in the central region of the island… It follows, therefore, that every effort should be made to conserve these outcrops, and all the channels which drain into them, in as clean and effective a condition as possible. Their importance in the Island's water supply regime is completely out of proportion to the relatively small superficial area which they occupy. It should be arranged that any planned redistribution of the congested village populations of the interior shall take place in directions away from these inliers…"

MORRIS, T.O., 1952. The Water Supply Resources of Malta. The Government of Malta.

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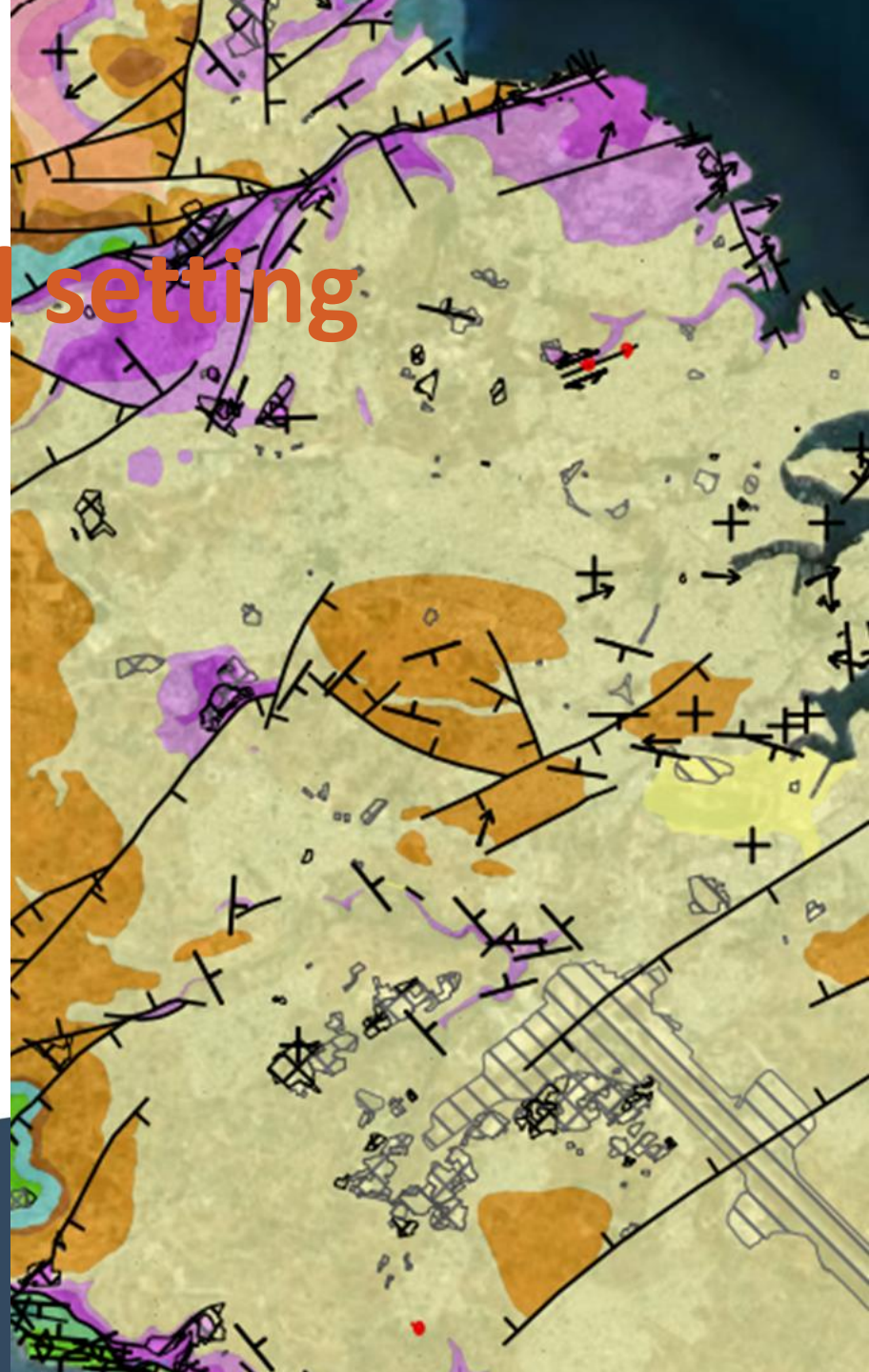
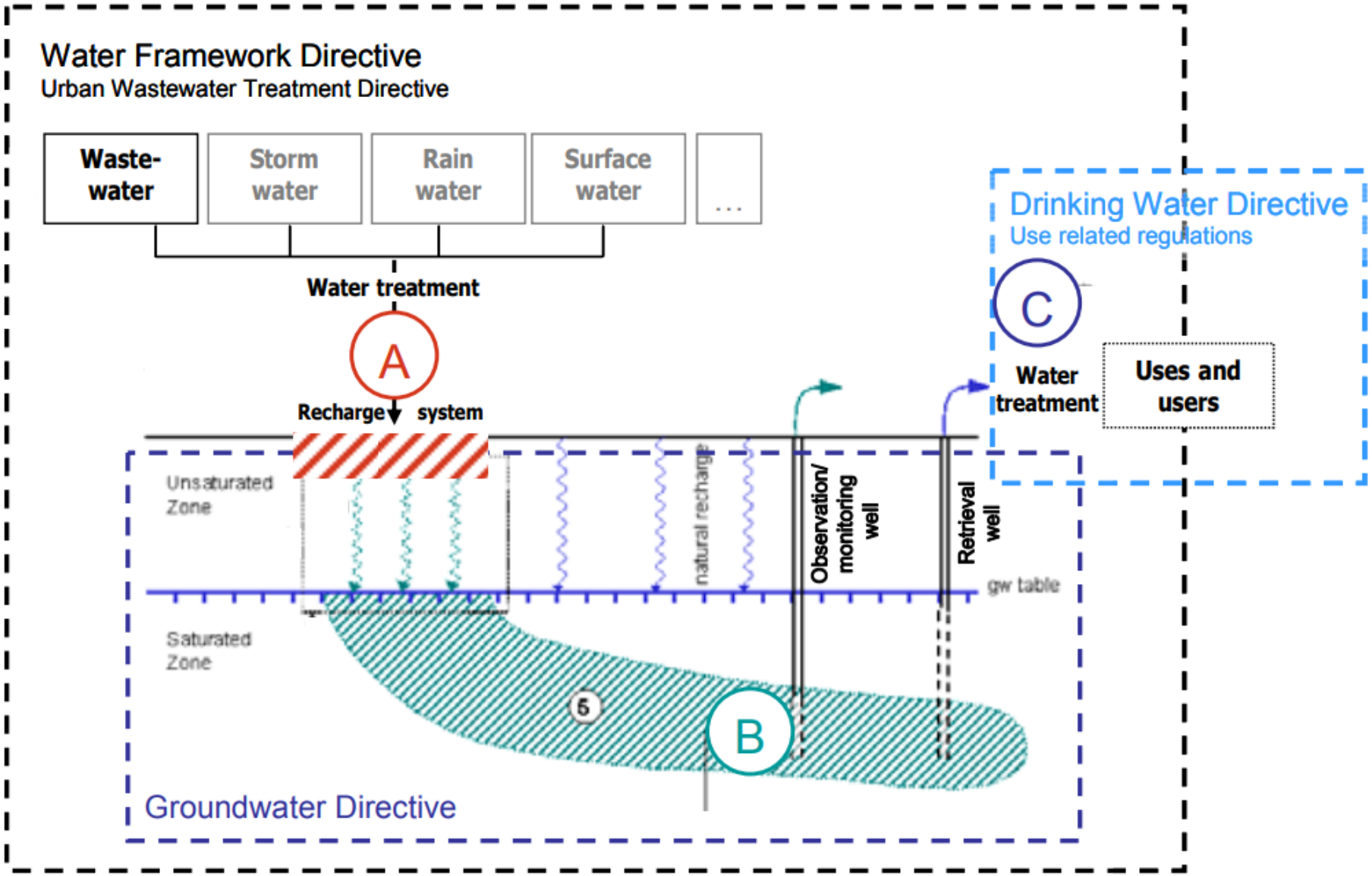


Source: Continental Shelf Department

Legislative framework

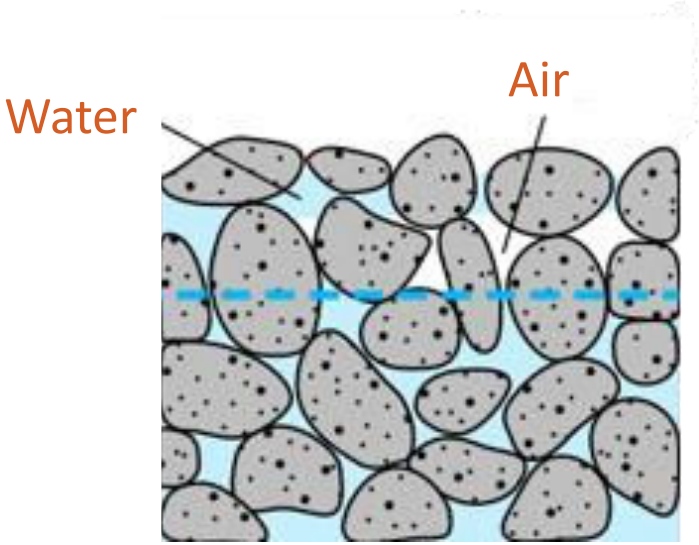


Source:
WINTGENS, T., HOCHSTRAT, R., KAZNER, C., JEFFREY, P., JEFFERSON, B. and THOMAS, M., 2012. Managed Aquifer Recharge as a component of sustainable water strategies–a brief guidance for EU policies.

Risk of clogging

Clogging as a significant challenge in MAR operations

- Physical - the accumulation or injection of organic and inorganic suspended solids blocking the pores of the infiltration
- Chemical - chemical reactions, such as precipitation and/or dissolution of minerals, which result from the mixing of different compositions from resource water and groundwater
- Biological - Biological growth and the accumulation of by-products resulting from the decomposition of biological products



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Source:
Song Y, Du X, Ye X. Analysis of Potential Risks Associated with Urban Stormwater Quality for Managed Aquifer Recharge. Int J Environ Res Public Health. 2019 Aug 27;16(17):3121.

Key messages

1. Our groundwater system - a delicate balance between abstraction and recharge
2. The protection of recharge areas as a critical component in sustaining our groundwater resources
3. Managed Aquifer Recharge – considerations to safely recharge our aquifers with stormwater considering the risk of utilising different catchment areas on water quality
4. Designing sustainable schemes fitting within the local hydrogeological context

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MINISTRY FOR THE ECONOMY, EUROPEAN FUNDS AND LANDS

PARLIAMENTARY SECRETARIAT FOR EUROPEAN FUNDS

water services corporation

EU funds for Malta 2014-2020

L-Università ta' Malta
Institute of Earth Systems

julian.a.mamo@um.edu.mt

Operational Programme I – European Structural and Investment Funds 2014-2020
"Fostering a competitive and sustainable economy to meet our challenges"
Project part-financed by the Cohesion Fund
Co-financing rate: 85% European Union Funds; 15% National Funds

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RAINWATER MANAGEMENT – AN UNTAPPED RESOURCE

MAY 19, 2023

WATER.ORG.MT

LIFE IP Programme 2014-2020
LIFE 16 IPE/MT/000008 - *"Optimising the implementation of the 2nd RBMP in the Maltese River Basin District"*
Co-financing rate: 60% European Union, 40% National Funds

The Power of SuDS

Public Works Department

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MINISTRY FOR PUBLIC WORKS AND PLANNING

Examples of Successful Rainwater Management in Malta

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A presentation by Adiel Cuschieri

The relation between flooding and water harvesting

Storm Helios: Worst is yet to come, Civil Protection on full alert as Met Office issues Orange warning

Civil Protection chief Peter Paul Coleiro says no major incidents have been reported so far as storm Helios batters Malta but reiterated calls for people to exercise caution

9 February 2023, 2:14pm
by Marianna Calleja
2 min read

TIMES of MALTA

Latest National World Opinion Fact-check X2 Sport Motoring Business Communi

Malta is becoming too dry to support its habitat, experts warn

Another devastating year for farmers amid low rainfall

National Weather Climate change

May 3, 2021 | Kristina Abela | 86

3 min read

malta independent 17 May 2023, Wednesday RSS View E-Paper Search

Home > Local > News > Updated (4): Widespread flooding as heavy storm hits Malta;...

Updated (4): Widespread flooding as heavy storm hits Malta; cleanup operations underway

Thursday, 25 November 2021, 10:45 Last update: about 2 years ago

Latest

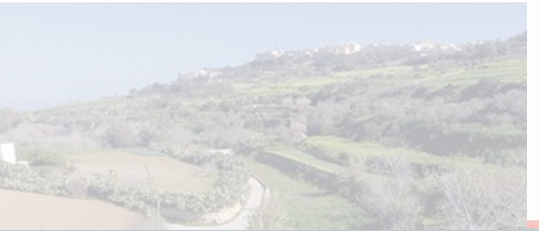
Third season of dry weather fu desertification

A month into winter, Chadwick Lakes reduced to puddles

National

January 18, 2018 | Times of Malta | 16

2 min read



Weather warning as torrential rain descends on Malta

Some households saw hail fall as streets continue to flood

National Weather

November 26, 2022 | Times of Malta | 38

2 min read

maltatoday HOME NEWS BUSINESS SPORTS ARTS COMMENT VIDEO ARCHIVES Gourmet DIGITAL PAPER

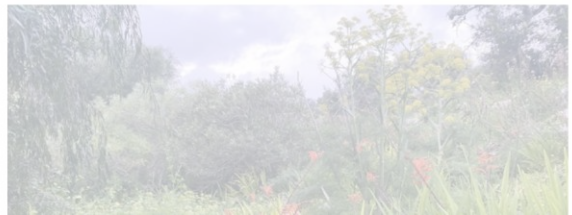
Editorial Letters Cartoons

Blogs

How much of Malta has to burn to ashes, before we start taking climate change seriously?

instead of 'doing their bit', by trying to be as hydrologically 'self-sufficient' as possible... these new developments only place further strain on the water-table

Raphael Vassallo
July 2022, 7:00am
8 min read



History of SuDS Practices

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Ta’ Misqa Tanks

Images by The Megalithic Portal

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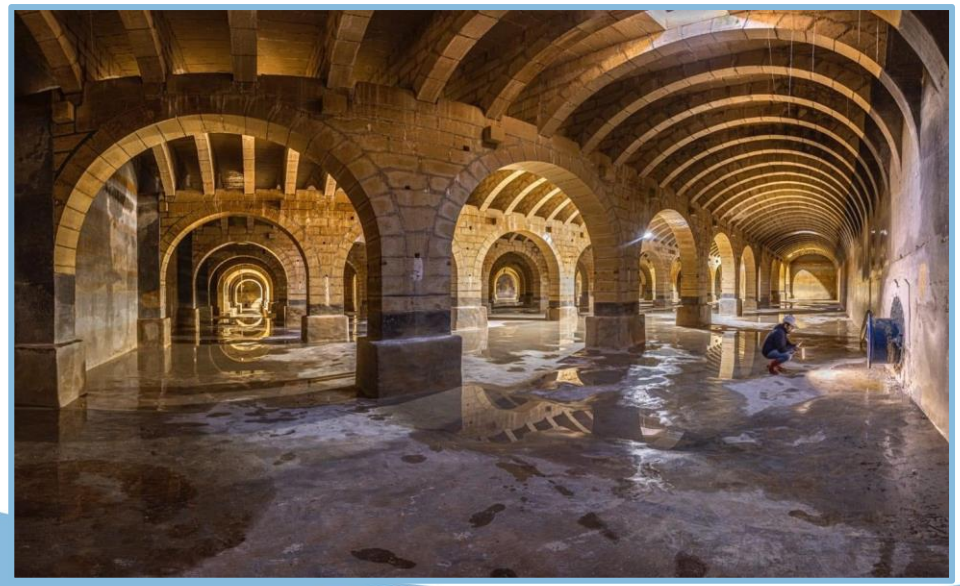
Water cisterns

These water harvesting structures became a necessity during the time of the Knights of St John. This is especially so since their cities needed to have a source of freshwater within their fortifications.

Image by Alfred Baldacchino



Images by il-Gibjun

Valley Dams

Typical dam

Image by National Geographic

Maltese dam

Image by TVMnews

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Current SuDS Practices

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Alter Aqua Project

"The Alter Aqua Programme was initiated in November 2011 to help the Maltese Islands combat water scarcity and raise awareness on sustainable methods to protect freshwater resources"

PER YEAR OVER...

1930000000

Liters of water conserved

OVER 10 YEARS...

17650

Students

1380

Teachers attended various workshops & visits

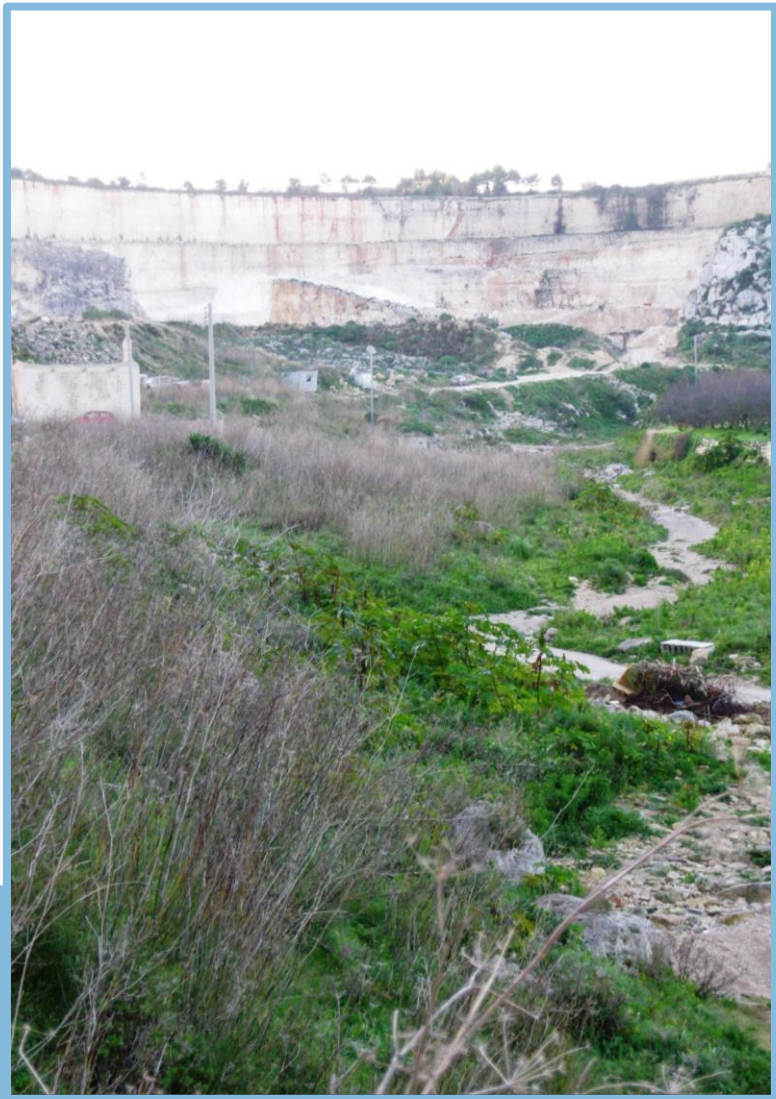
56

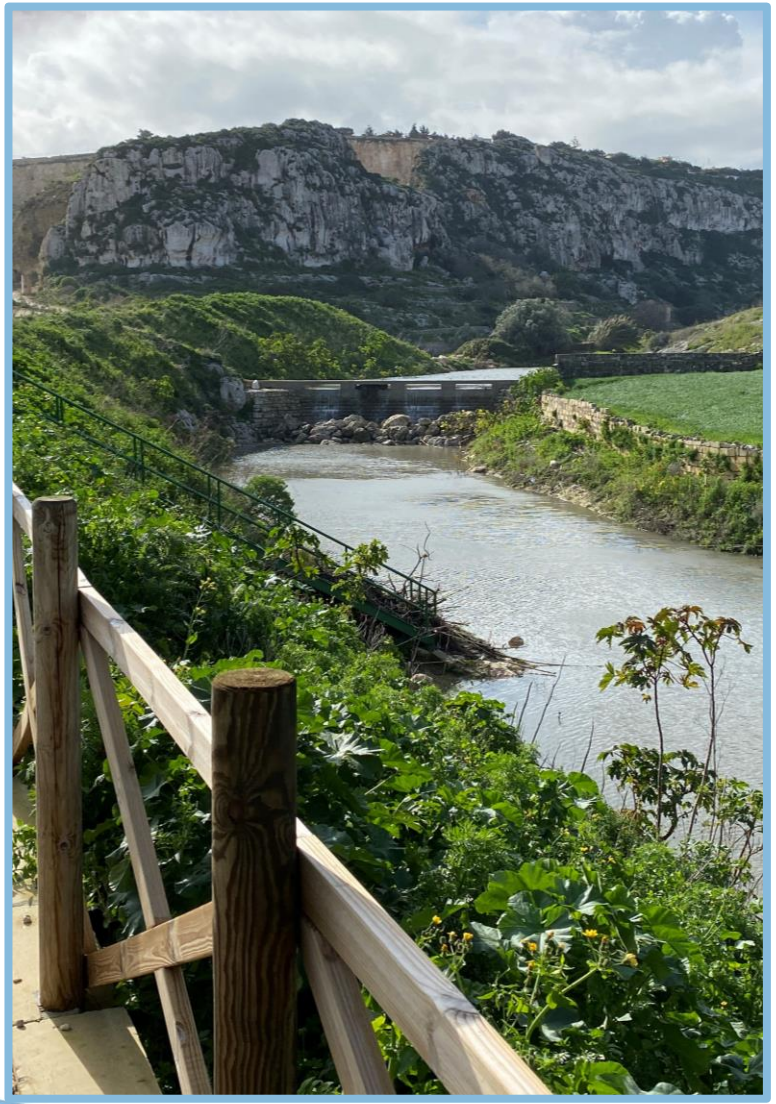
Technicians worked on Alter Aqua related projects

Other reservoir restorations

Restoration of Santa Katarina Channel

Public Works
Department





What’s next?

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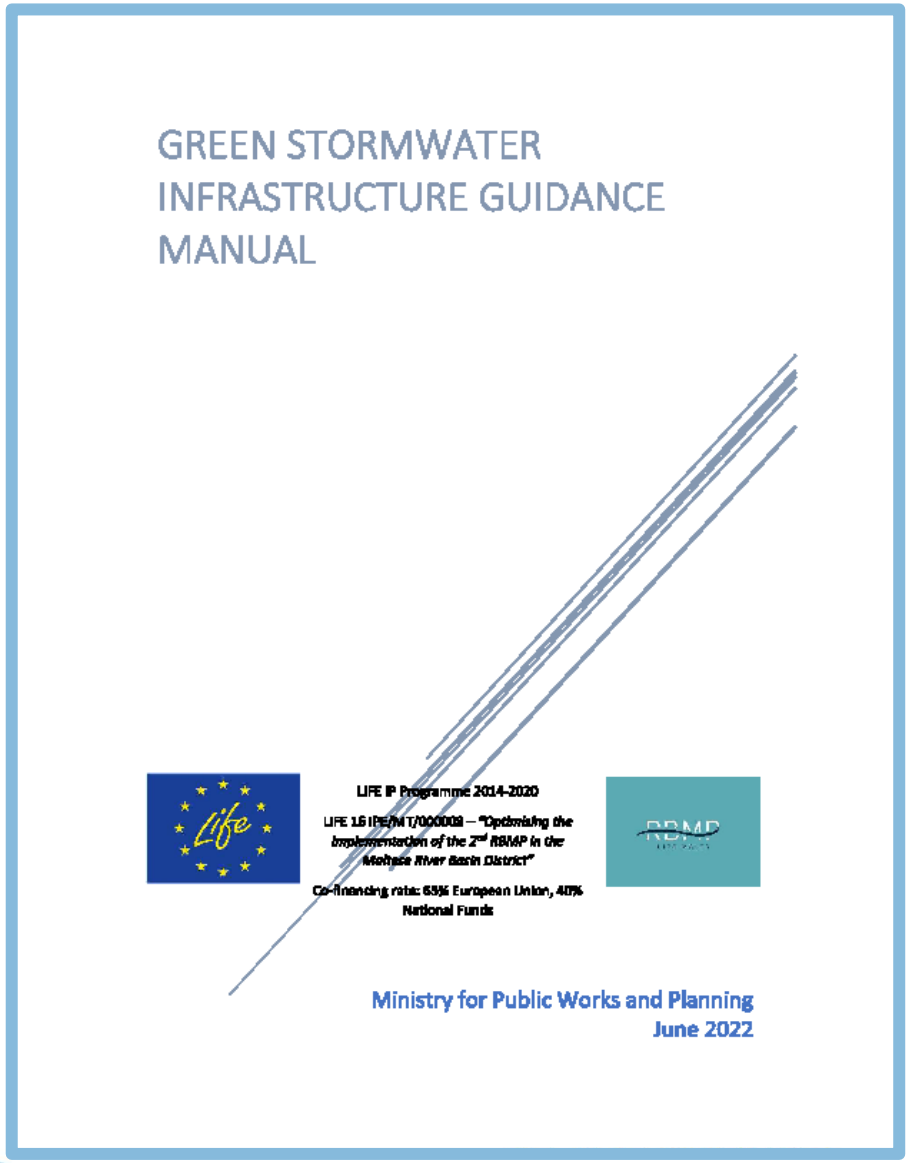
GSI Manual

- A resource for planners, policymakers etc. to support decisions for GSI use in Malta
- Identified rainwater harvesting techniques as promising GSI
- Highlighted innovative practices such as the use of green-roofs, bioretention systems and other examples



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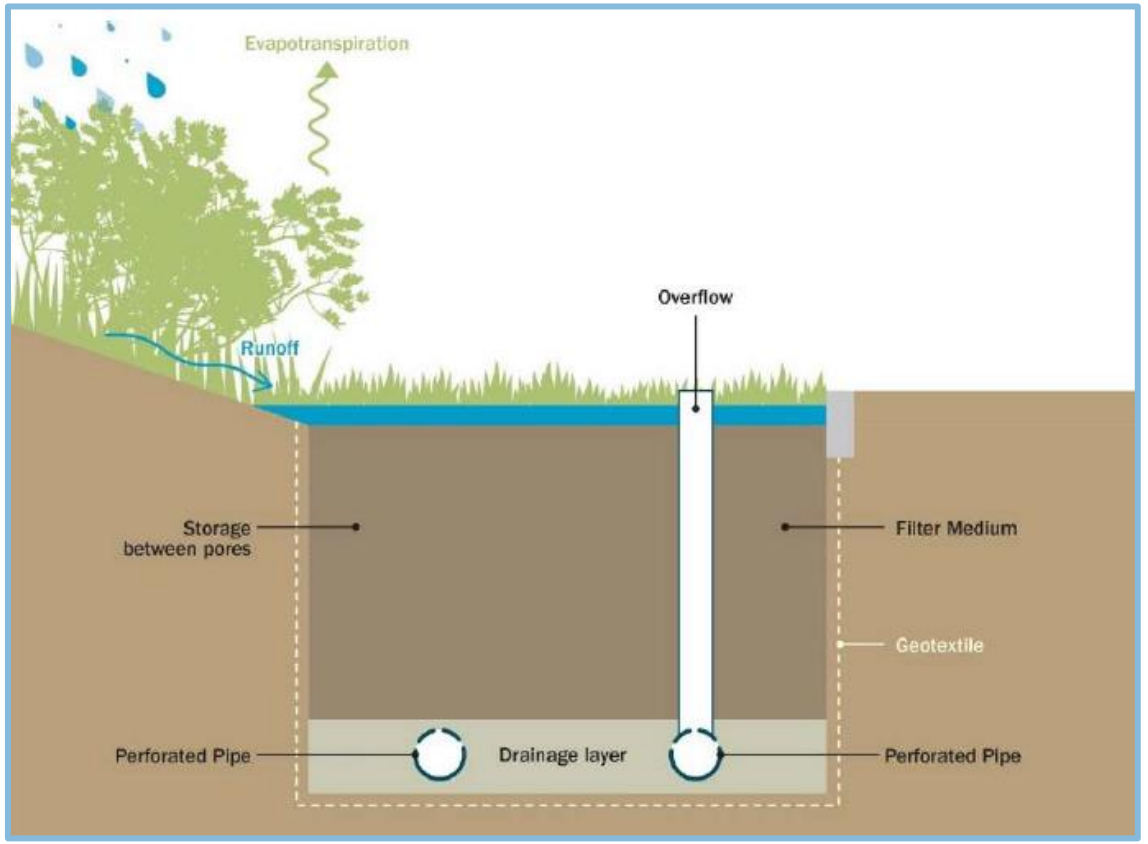

Image from GSI Guidance Manual

Bioretention Systems

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LIFE IP Programme 2014-2020
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Image from VIVACITY Ltd.

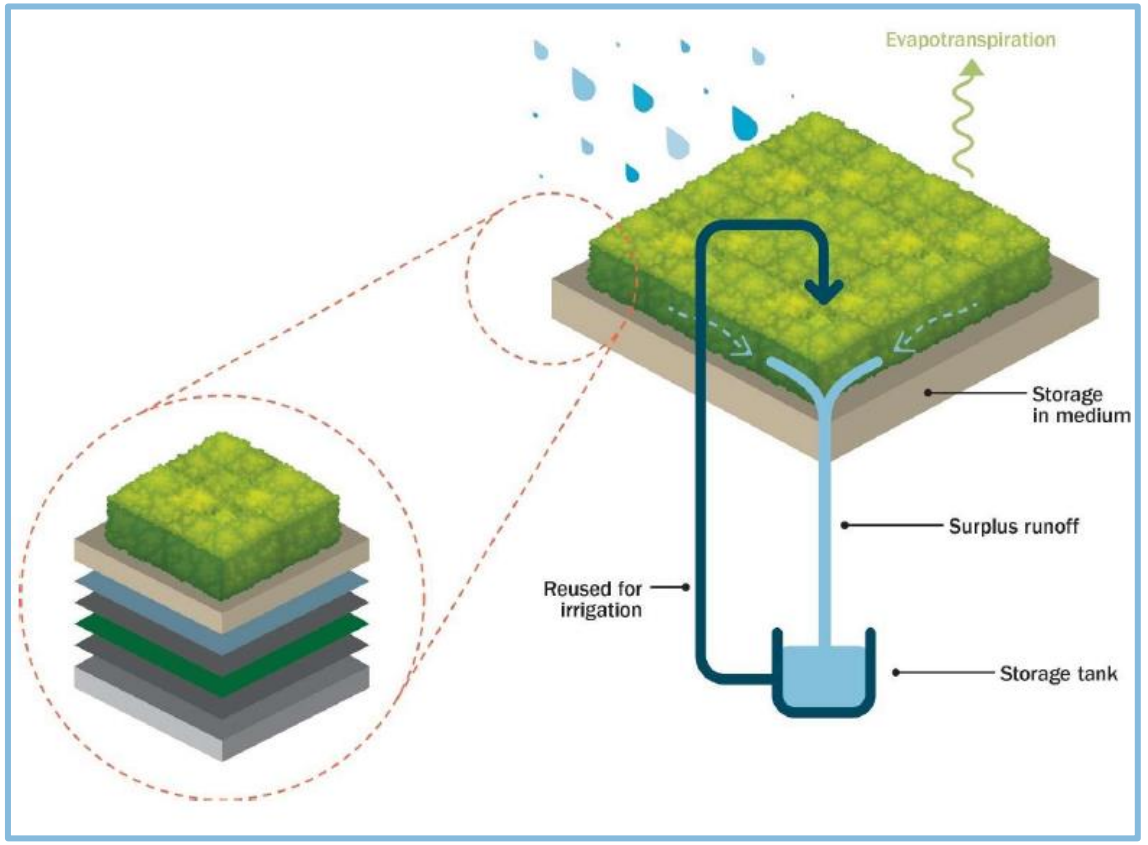

Image from GSI Guidance Manual

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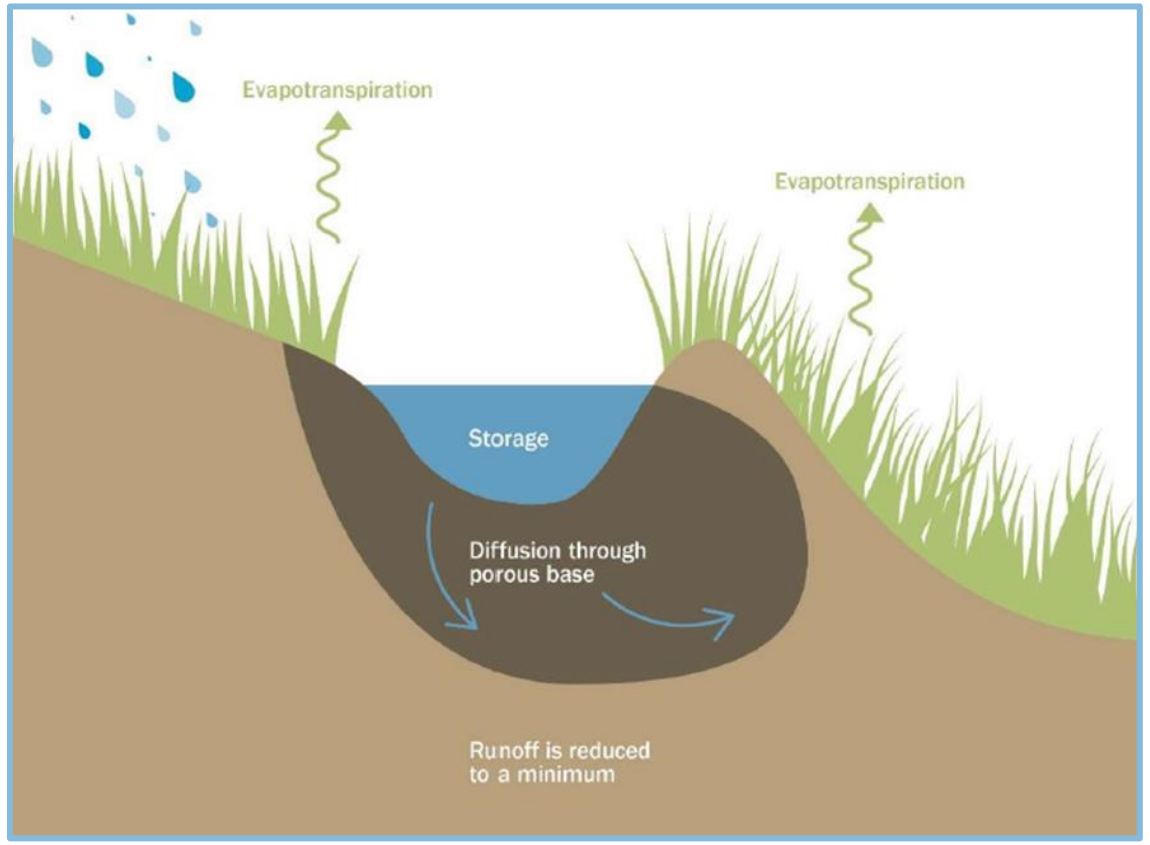
Green Roofs



Images from GSI Guidance Manual

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Swales

LIFE IP Programme 2014-2020
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Reconfiguration of public playgrounds

Pilot Study: Paola public garden and playground

Paola LC design plans

In a nutshell

Scientific discoveries and innovation come from combining different existing technologies and different perspectives in a unique way.

– Charles Koch –

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PARLIAMENTARY SECRETARIAT FOR EUROPEAN FUNDS

water services corporation

EU funds for Malta 2014-2020

Thank you!

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Operational Programme I – European Structural and Investment Funds 2014-2020
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Public Works Department

Sources

Newspaper Articles:

https://www.maltatoday.com.mt/news/national/121204/storm_helios_worst_is_yet_to_come_civil_protection_on_full_alert_as_met_office_issues_orange_warning#.ZGXFZnZBxD8

https://www.independent.com.mt/articles/2021-11-25/local-news/Police-warning-Avoid-low-lying-areas-incidents-reported-in-Zebbiegh-Burmarrad-6736238568

https://timesofmalta.com/articles/view/malta-is-becoming-too-dry-to-support-its-habitat.868810

https://timesofmalta.com/articles/view/weather-warning-torrential-rain-descends-malta.997599

https://timesofmalta.com/articles/view/third-season-of-dry-weather-fuels-maltas-desertification.668169

https://www.maltatoday.com.mt/comment/blogs/117915/how_much_of_malta_has_to_burn_to_ashes_before_we_start_taking_climate_change_seriously#.ZGXFwnZBxD9

Ta' Misqa:

http://qrendilocalcouncil.org.mt/poi/archaeology/misqa

Water Cisterns:

https://www.ilovefood.com.mt/features/the-great-siege/water-and-water-storage-during-the-knights-of-st-john/

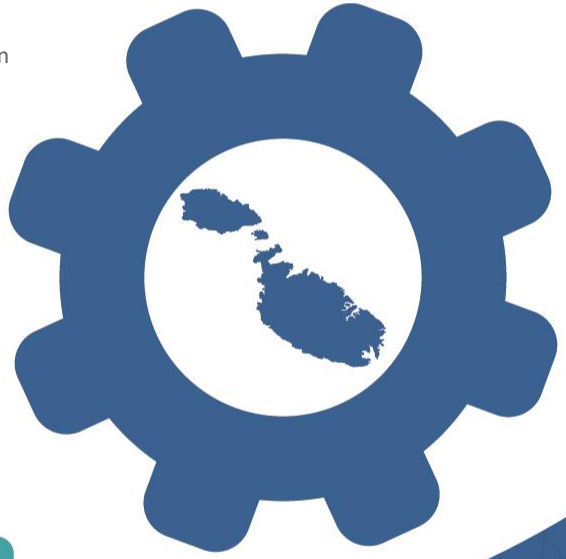
Alter Aqua:

https://www.maltatoday.com.mt/announcements/announcements/121919/2023_alter_aqua_project_aims_to_restore_historic_underground_reservoirs_in_the_three_cities_#.ZGODQXZBy3A

https://alteraqua.org/

Green Stormwater Infrastructure Manual:

https://meae.gov.mt/en/Public_Consultations/MTI/Pages/Consultations/GreenStormwaterInfrastructureGuidanceManual.aspx



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RAINWATER MANAGEMENT – AN UNTAPPED RESOURCE

MAY 19, 2023

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Community-centric rainwater management

Helping to prevent rainwater from entering the sewer network

Dr Sarah Bunney: s.bunney@exeter.ac.uk
sarah@ourrainwater.com

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Ofwat Innovation Fund …

'… £200 million Innovation Fund to grow the water sector's capacity to innovate, enabling it to better meet the evolving needs of customers, society and the environment.'

Thames Water
isle
love every drop anglianwater
Wessex Water YTL GROUP FOR YOU. FOR LIFE.
INDEPEN
South West Water
our rainwater when it rains it's yours
Ofwat

Project Aims …

- To work together in partnership with communities and stakeholders in target locations to encourage the capture and storage of rainwater.
- To understand community incentives, motivations and drivers in the use of rainwater management to reduce the amount of water flowing into the drainage system, reducing sewer spills from storm overflows and to store rainwater locally for periods of water scarcity.
- To develop and share a engagement strategy for community centric rainwater management.

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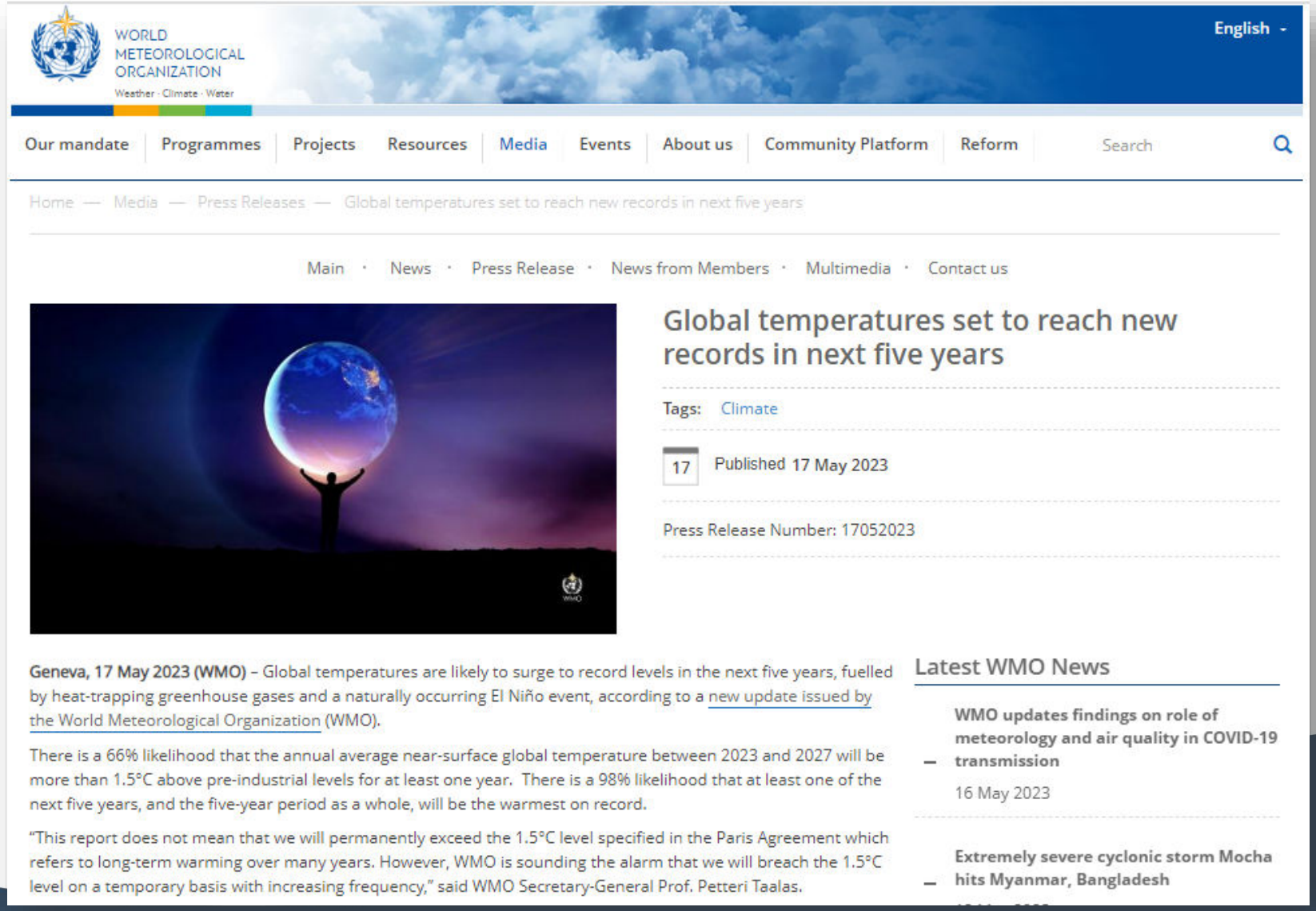
Our Climate is changing …



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Global temperatures set to reach new records in next five years

Tags: Climate

17 Published 17 May 2023

Press Release Number: 17052023

Geneva, 17 May 2023 (WMO) – Global temperatures are likely to surge to record levels in the next five years, fuelled by heat-trapping greenhouse gases and a naturally occurring El Niño event, according to a new update issued by the World Meteorological Organization (WMO).

There is a 66% likelihood that the annual average near-surface global temperature between 2023 and 2027 will be more than 1.5°C above pre-industrial levels for at least one year. There is a 98% likelihood that at least one of the next five years, and the five-year period as a whole, will be the warmest on record.

"This report does not mean that we will permanently exceed the 1.5°C level specified in the Paris Agreement which refers to long-term warming over many years. However, WMO is sounding the alarm that we will breach the 1.5°C level on a temporary basis with increasing frequency," said WMO Secretary-General Prof. Petteri Taalas.

Latest WMO News

- **WMO updates findings on role of meteorology and air quality in COVID-19 transmission**
  16 May 2023
- **Extremely severe cyclonic storm Mocha hits Myanmar, Bangladesh**

'There is a 66% likelihood that the annual average near-surface global temperature between 2023 and 2027 will be more than 1.5°C above pre-industrial levels for at least one year.'

As global temperatures rise extreme weather events such as flooding, droughts and heatwaves are expected to become more frequent …

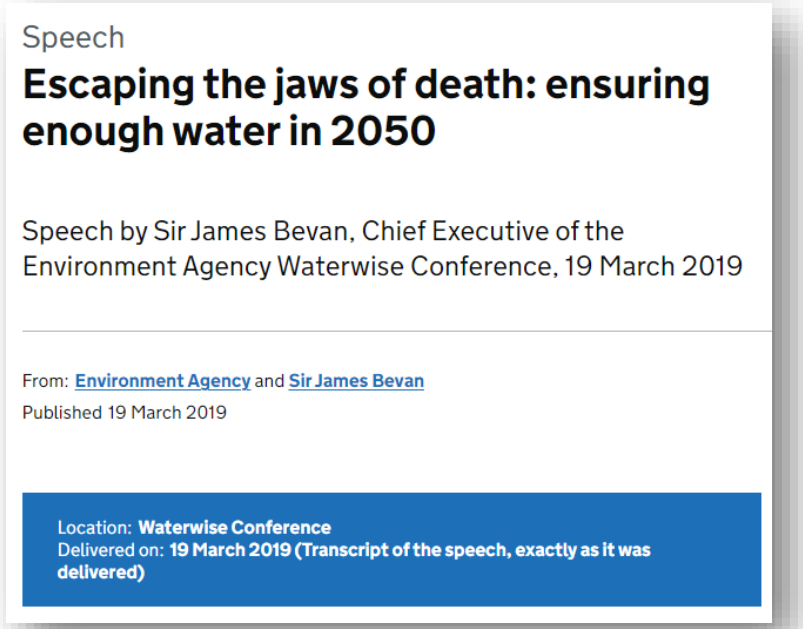
Our Climate is changing …

- Climate change and population growth are placing increasing pressure on water resources.
- '…unless we take action to change things, we will not have enough water to supply our needs …'

  James Bevan, CEO EA
- *'Stronger policies and urgent action is required'.*

  Climate Change Risk Assessment, 2017
- There is a high *'risk to public water supplies from reduced water availability'*

  Climate Change Risk Assessment, 2022


Speech

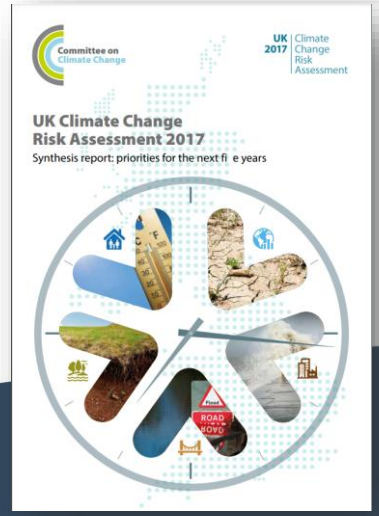
Escaping the jaws of death: ensuring enough water in 2050

Speech by Sir James Bevan, Chief Executive of the Environment Agency Waterwise Conference, 19 March 2019

From: Environment Agency and Sir James Bevan

Published 19 March 2019

Location: **Waterwise Conference**
Delivered on: **19 March 2019 (Transcript of the speech, exactly as it was delivered)**



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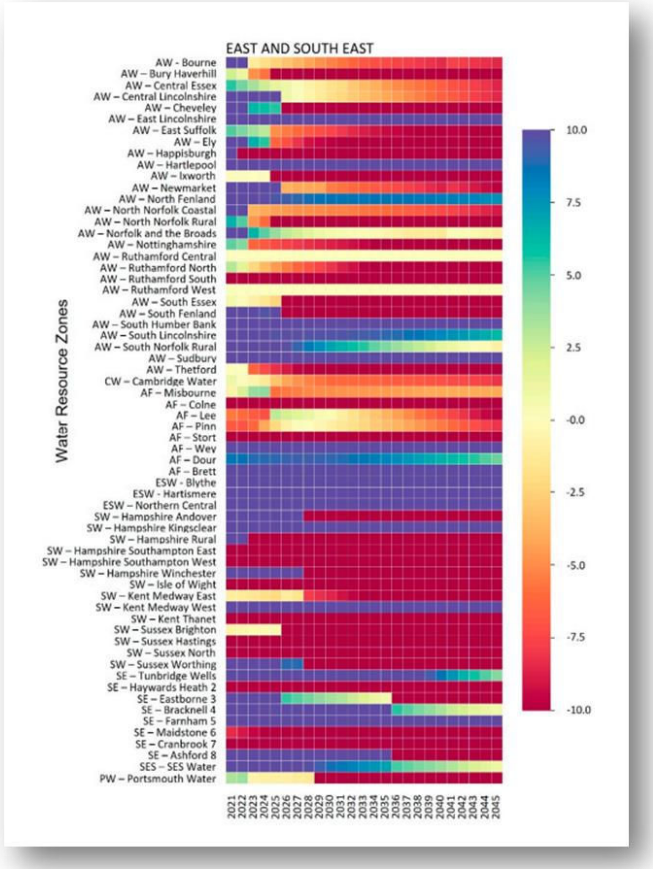
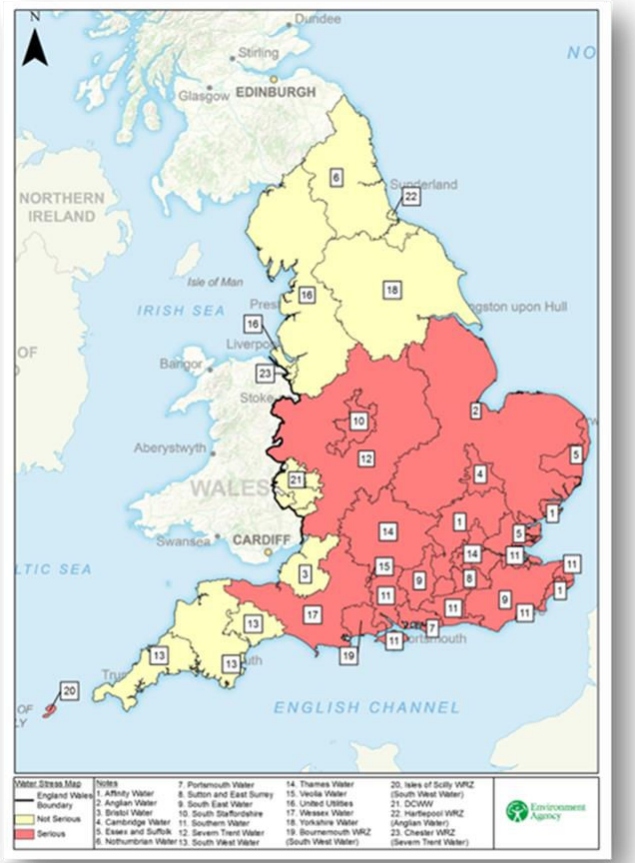
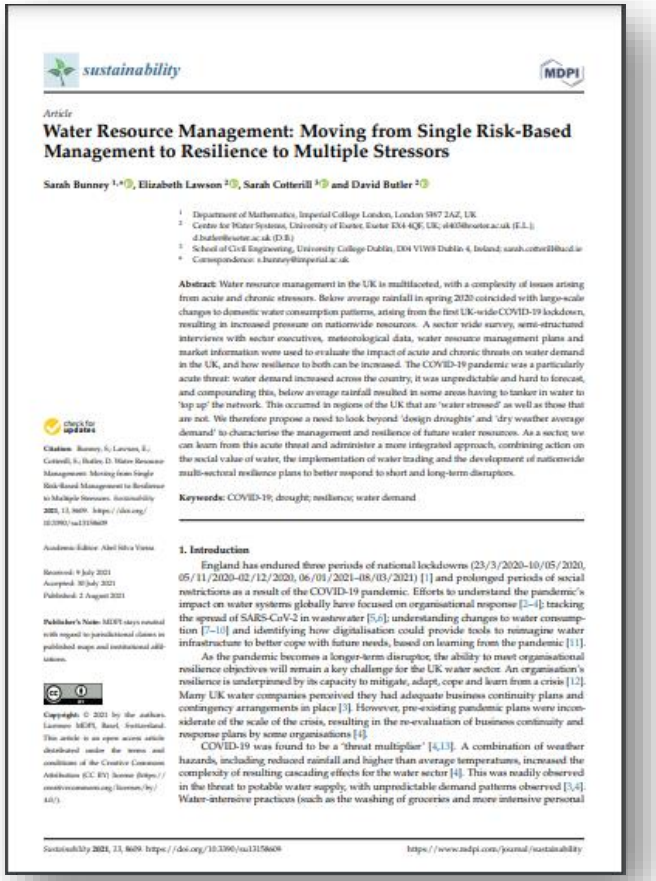
Water company forecasts show demand will start to exceed supply by 2030 …



Taken from Bunney et al, 2021: Water Resource Management: Moving from Single Risk-Based Management to Resilience to Multiple Stressors



Taken from Environment Agency: Water Stressed Areas 2021



sustainability

MDPI

Article

Water Resource Management: Moving from Single Risk-Based Management to Resilience to Multiple Stressors

Sarah Bunney [1,*], Elizabeth Lawson [2], Sarah Cotterill [3] and David Butler [2]

Abstract: Water resource management in the UK is multifaceted, with a complexity of issues arising from acute and chronic stressors. Below average rainfall in spring 2020 coincided with large-scale changes to domestic water consumption patterns, arising from the first UK-wide COVID-19 lockdown, resulting in increased pressure on nationwide resources. A sector wide survey, semi-structured interviews with sector executives, meteorological data, water resource management plans and market information were used to evaluate the impact of acute and chronic threats on water demand in the UK, and how resilience to both can be increased. The COVID-19 pandemic was a particularly acute threat: water demand increased across the country, it was unpredictable and hard to forecast, and compounding this, below average rainfall resulted in some areas having to tanker in water to 'top up' the network. This occurred in regions of the UK that are 'water stressed' as well as those that are not. We therefore propose a need to look beyond 'design droughts' and 'dry weather average demand' to characterise the management and resilience of future water resources. As a sector, we can learn from this acute threat and administer a more integrated approach, combining action on the social value of water, the implementation of water trading and the development of nationwide multi-sectoral resilience plans to better respond to short and long-term disruptions.

Keywords: COVID-19; drought; resilience; water demand

1. Introduction

England has endured three periods of national lockdowns (23/3/2020–10/05/2020, 05/11/2020–02/12/2020, 06/01/2021–08/03/2021) [1] and prolonged periods of social restrictions as a result of the COVID-19 pandemic. Efforts to understand the pandemic's impact on water systems globally have focused on organisational response [2–4]; tracking the spread of SARS-CoV-2 in wastewater [5,6]; understanding changes to water consumption [7–10] and identifying how digitalisation could provide tools to reimagine water infrastructure to better cope with future needs, based on learning from the pandemic [11].

As the pandemic becomes a longer-term disruptor, the ability to meet organisational resilience objectives will remain a key challenge for the UK water sector. An organisation's resilience is underpinned by its capacity to mitigate, adapt, cope and learn from a crisis [12]. Many UK water companies perceived they had adequate business continuity plans and contingency arrangements in place [3]. However, pre-existing pandemic plans were inconsiderate of the scale of the crisis, resulting in the re-evaluation of business continuity and response plans by some organisations [4].

COVID-19 was found to be a "threat multiplier" [4,13]. A combination of weather hazards, including reduced rainfall and higher than average temperatures, increased the complexity of resulting cascading effects for the water sector [4]. This was readily observed in the threat to potable water supply, with unpredictable demand patterns observed [3,4]. Water-intensive practices (such as the washing of groceries and more intensive personal

54% of the water resource zones in the East and South East are likely to be in water supply deficit in 5 years' time.

These locations have already been classified as 'serious' with regard to water stress …

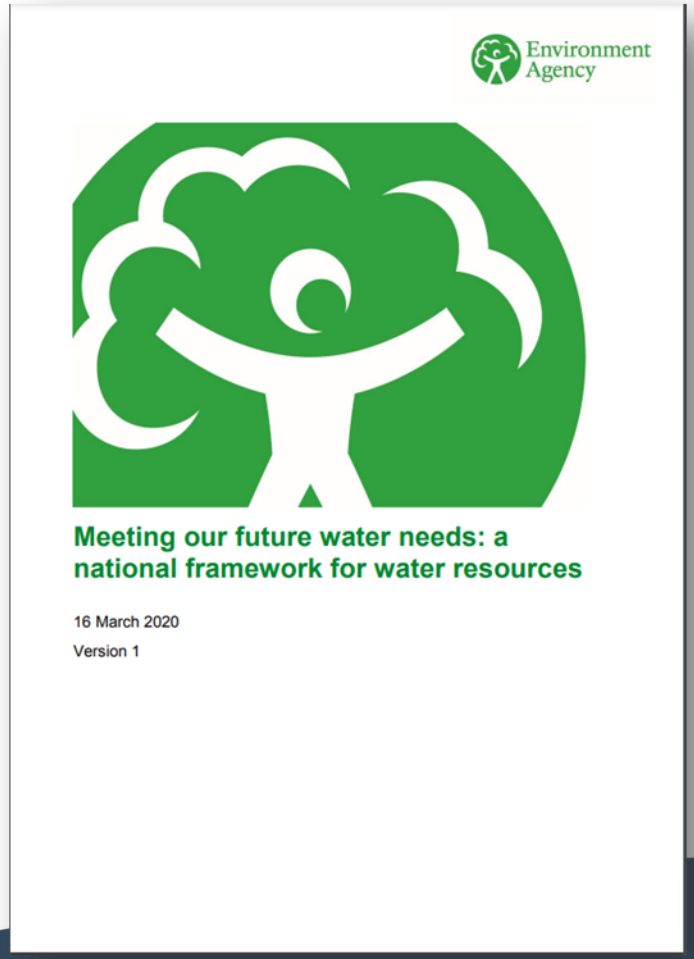
Our Climate is changing …

'If no action is taken between 2025 and 2050 over 3 billion litres per day (Ml/d) extra capacity is likely to be needed in England by 2050 to meet future pressures on public water supplies.'

Environment Agency 2020

Over 50% of the water demand will be required to secure water supplies within the South East of England.

Environment Agency 2020



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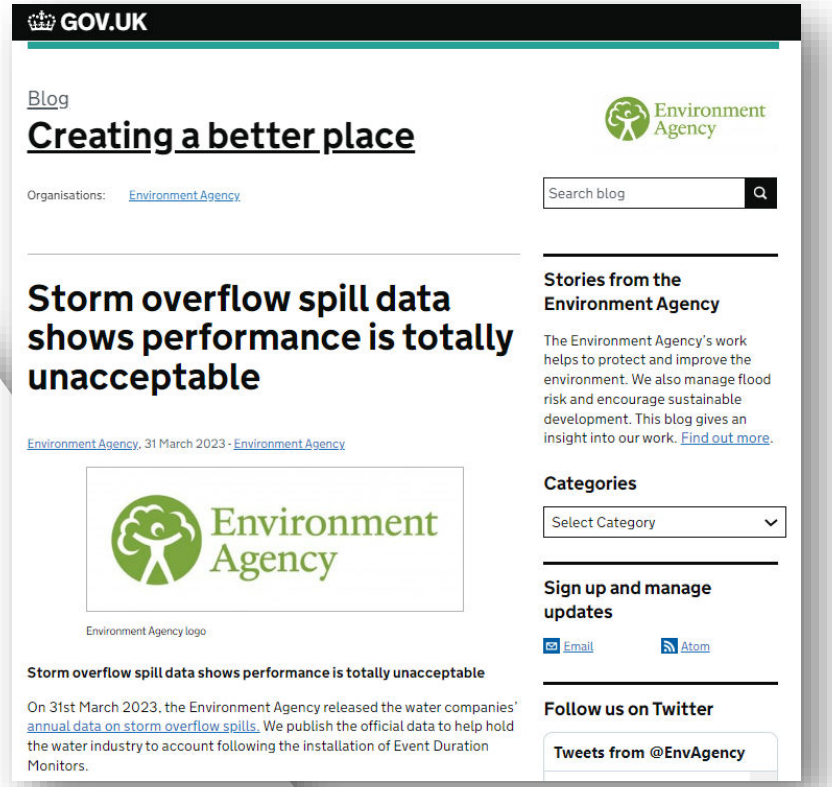
Stormwater Management …

Climate change, population growth and increasing urbanisation is placing significant pressure on an already overwhelmed sewerage and drainage system leading to surface water flooding and combined sewer overflows



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Rainwater Management …

Department for Environment Food & Rural Affairs

… responsible for improving and protecting the environment

Rainwater management is **key** to *'achieving a reduction in sewage discharges from storm overflows, reducing flood risk and improving water scarcity to ensure a healthy environment.'*

Defra, 2021

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Householder adoption is challenging …

Problems with uptake and scalability:

- A lack of awareness …
- … knowledge and
- … effective incentives

*'… people **don't know** what they need to do …'*

UK Water Company

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We are all part of the solution …

*'Water companies are not deliberately creating sewer spills it is a **wider problem** and there is more that **everyone** could do to help alleviate the pressure on the drainage system which would in turn, **help to reduce sewer spills**. If we could link what they are all doing to help reduce these spills, **we can support them to help us**.'*

UK Water Company

BBC Bunney Family Home News Sport Weather iPlayer Sounds

NEWS

Home | Cost of Living | War in Ukraine | Climate | UK | World | Business | Politics | Culture | Tech

Science & Environment

Plastic wet wipes ban planned in England to tackle pollution

3 April • Comments

GETTY IMAGES

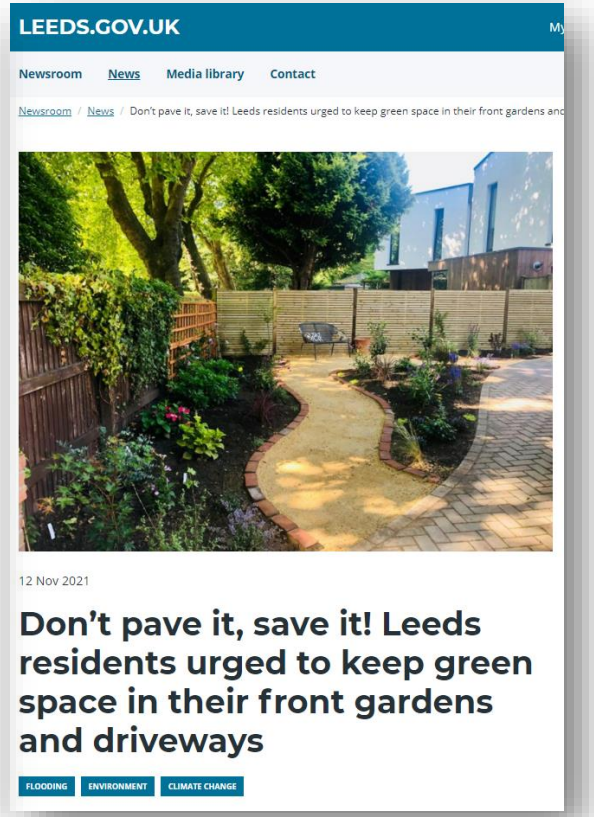
By Georgina Rannard & Justin Rowlatt

BBC News climate and science

Wet wipes containing plastic will be banned in England under plans to tackle water pollution, environment minister Therese Coffey has told BBC News.

The ban on plastic-based wipes should come into force in the next year following a consultation, Ms Coffey said.

It is part of a wider plan to improve water quality in England, where no river or waterway is considered clean.



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Newsroom News Media library Contact

Newsroom / News / Don't pave it, save it! Leeds residents urged to keep green space in their front gardens and

12 Nov 2021

Don't pave it, save it! Leeds residents urged to keep green space in their front gardens and driveways

FLOODING ENVIRONMENT CLIMATE CHANGE

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How do we engage and incentivise …

Software-as-a-service digital platform to facilitate customer sign-up for rainwater management systems …

our rainwater
when it rains it's yours

Our Rainwater sign-up guide

1. Visit ourrainwater.com

Search ourrainwater.com on your internet browser or, if you are on mobile, scan the QR code below:

2. Click to register interest

Once you have made it onto ourrainwater.com, click one of the register interest buttons located at the top and bottom of our home page.

register interest ⟶

contact us via email at info@ourrainwater.com

Community Engagement …

- Actively involved, ownership and a social responsibility
- Local knowledge and needs
- Delivery of sustainable solutions
- Awareness, challenging perceptions, behavioural change
- Social cohesion and empowerment
- Scalability and replicability

By working together in partnership with communities and stakeholders in target locations, we can achieve more **effective** and **sustainable** rainwater management practices that address the specific needs and contexts of the people they serve.

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Scenarios to explore potential barriers …

To understand community incentives, motivations and drivers in the use of rainwater management to reduce the amount of water flowing into the drainage system, reducing sewer spills from storm overflows and to store rainwater locally for periods of water scarcity.

- Does homeownership influence the level of homeowner engagement towards the adoption of rainwater management systems
- Does the type of flooding influence the level of homeowner engagement towards the adoption of rainwater management systems
- Is the level of homeowner engagement towards the adoption of rainwater management systems reduced in locations that have not flooded.
- Does property type influence the level of homeowner engagement towards the adoption of rainwater management systems
- Does property type influence the rainwater management system that can be installed

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Project deliverables …

- Quantify the holistic value of downpipe disconnection within target communities
- Understand the value of rainwater management for individual homeowners and communities – what are the motivations, drivers and barriers to adoption
- Develop and share a blueprint for community-centric rainwater management

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GOVERNMENT OF MALTA

MINISTRY FOR THE ENVIRONMENT, ENERGY AND ENTERPRISE

MINISTRY FOR THE ECONOMY, EUROPEAN FUNDS AND LANDS

PARLIAMENTARY SECRETARIAT FOR EUROPEAN FUNDS

water services corporation

EU funds for Malta 2014-2020

Dr Sarah Bunney: s.bunney@exeter.ac.uk
sarah@ourrainwater.com

Operational Programme I – European Structural and Investment Funds 2014-2020
"Fostering a competitive and sustainable economy to meet our challenges"
Project part-financed by the Cohesion Fund
Co-financing rate: 85% European Union Funds; 15% National Funds

Rainwater management perspectives from UK case studies

Dr Sarah Bunney, Dr Peter Melville-Shreeve.

UNIVERSITY OF EXETER
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Contact: pm391@ex.ac.uk

Speaking the Same Language?

From Rainwater Harvesting to Rainwater Management Systems

David Butler

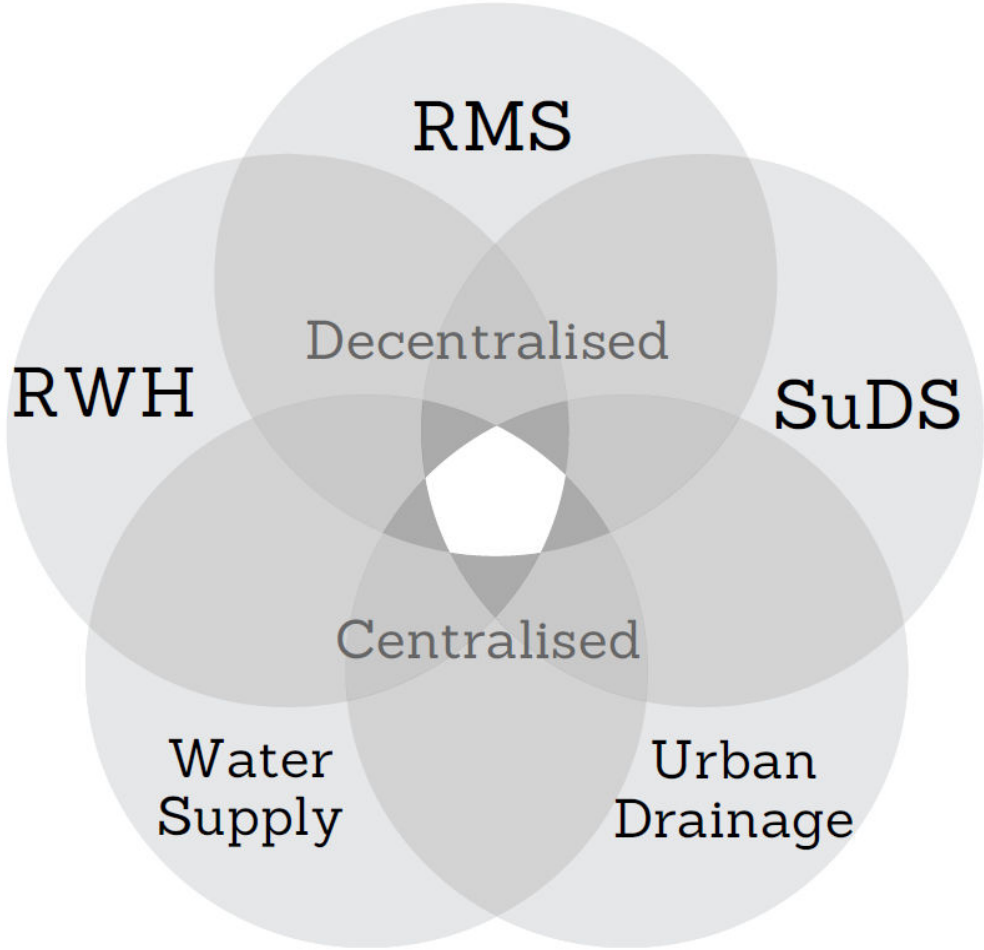
University of Exeter, Centre for Water Systems, Exeter, UK

Abstract

This keynote extended abstract investigates the recent shift in the drivers, objectives and application of rainwater harvesting. A review of historical rainwater harvesting technologies was undertaken and the context set for rainwater to be valued as an alternative water resource in specific circumstances. Recent research and exemplars were reviewed which suggest that the widespread use of the term rainwater harvesting, no longer captures the nuanced applications of rainwater capture and control technologies. A conceptual model was presented which sees rainwater management systems used as a term to cover installations and associated technologies and practices where rainwater harvesting features are also used to manage stormwater discharges. Global exemplars were identified where active / smart rainwater management systems have been successfully deployed to achieve wide ranging benefits. To evidence the broader benefits of rainwater management systems, a supply-demand analysis was used to investigate three different rainwater management types for a household in Palermo, Sicily. The abstract concludes with reflections on the future of rainwater management systems and the opportunities they could pose to increase urban resilience to threats such as water shortages, extreme hot weather, stormwater flooding, sewerage overflows, and a changing climate.

Rainwater Management Systems

are **Multi-Purpose**



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Multi-purpose Rainwater Management Systems

1) Why do we need multi-purpose systems?
2) What purposes can they be used for?
3) How can we design them?
4) How can we monitor and evaluate them?
5) How can we manage them from a virtual control room?

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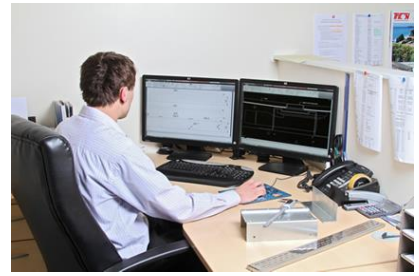
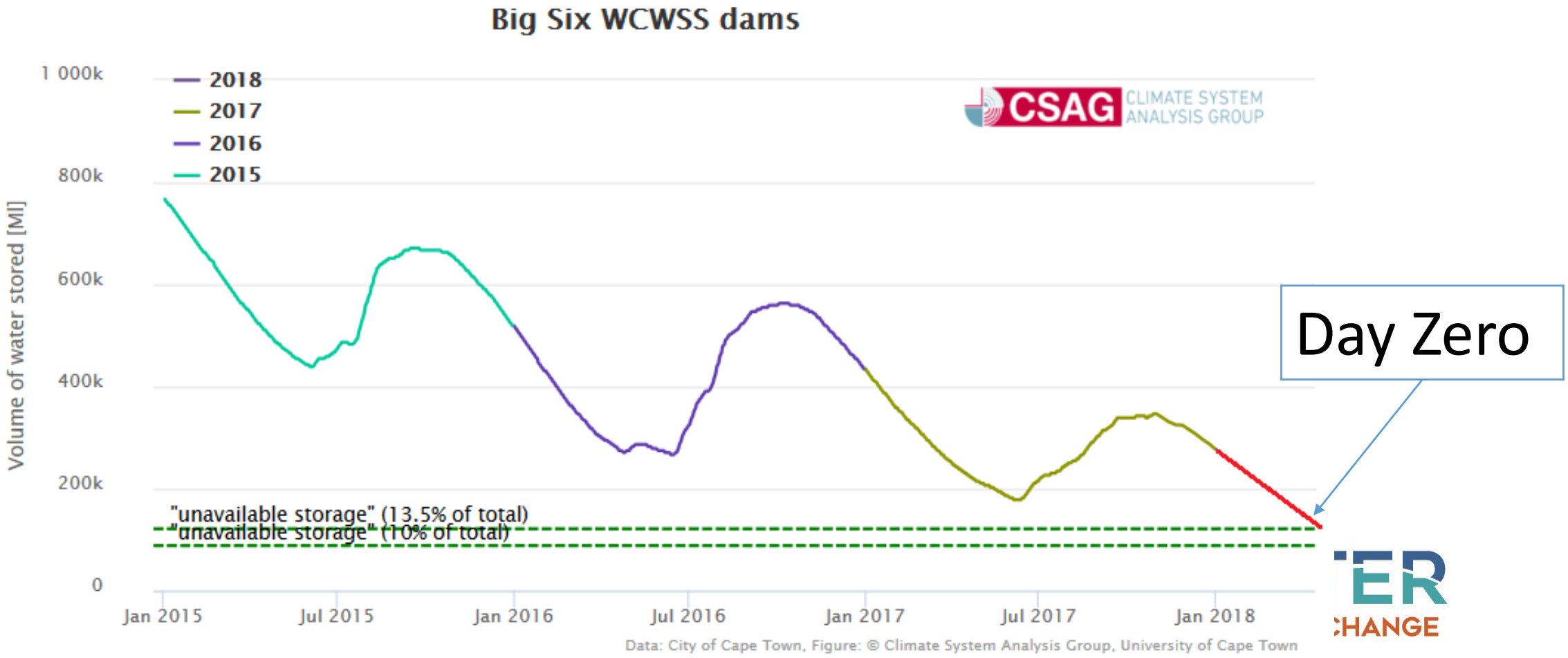
Single Purpose RWH:

Designing rainwater harvesting systems To reduce water demand





Contact: pm391@ex.ac.uk

Source: @AffinityWater Twitter

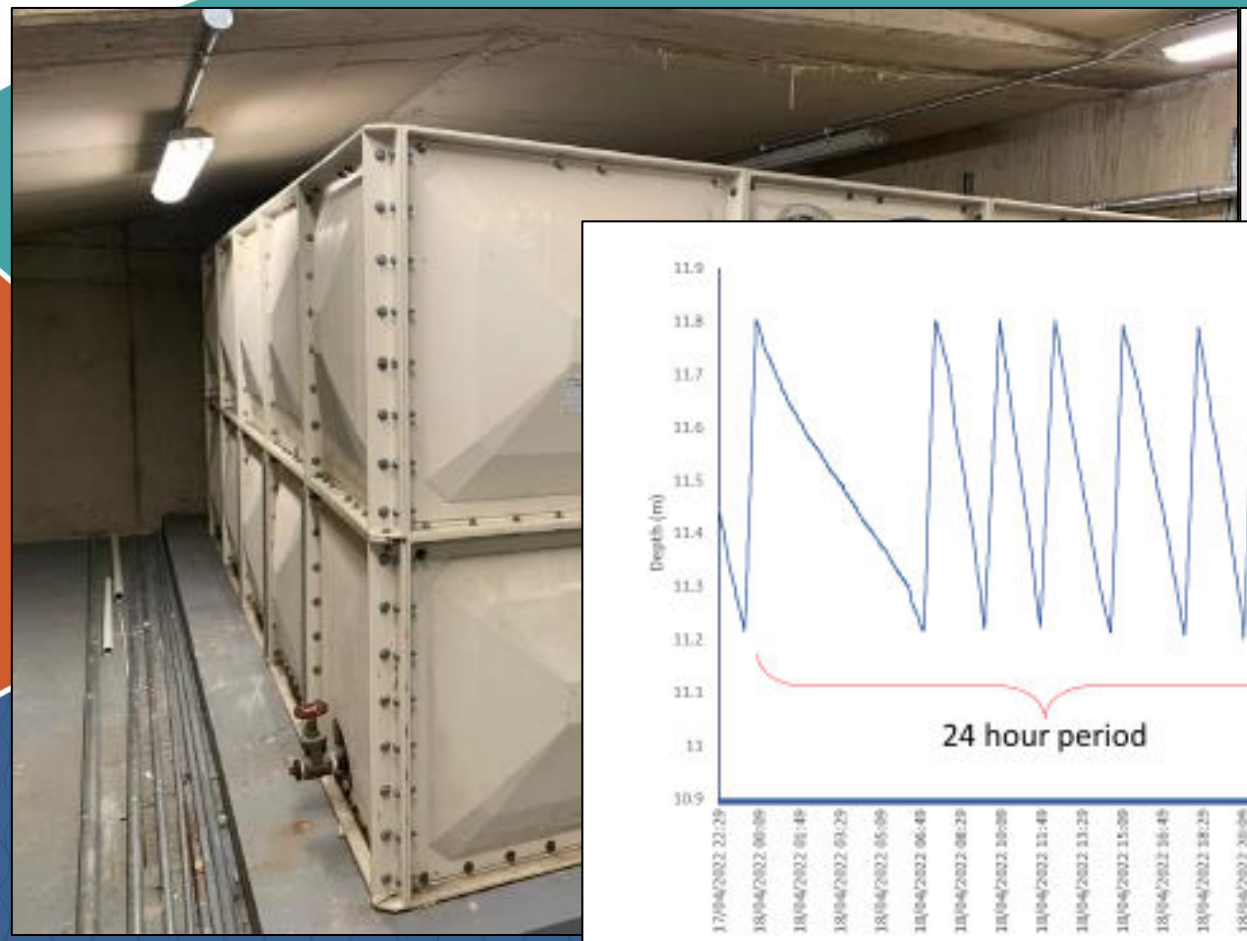
Designing SuDS systems to achieve single benefits

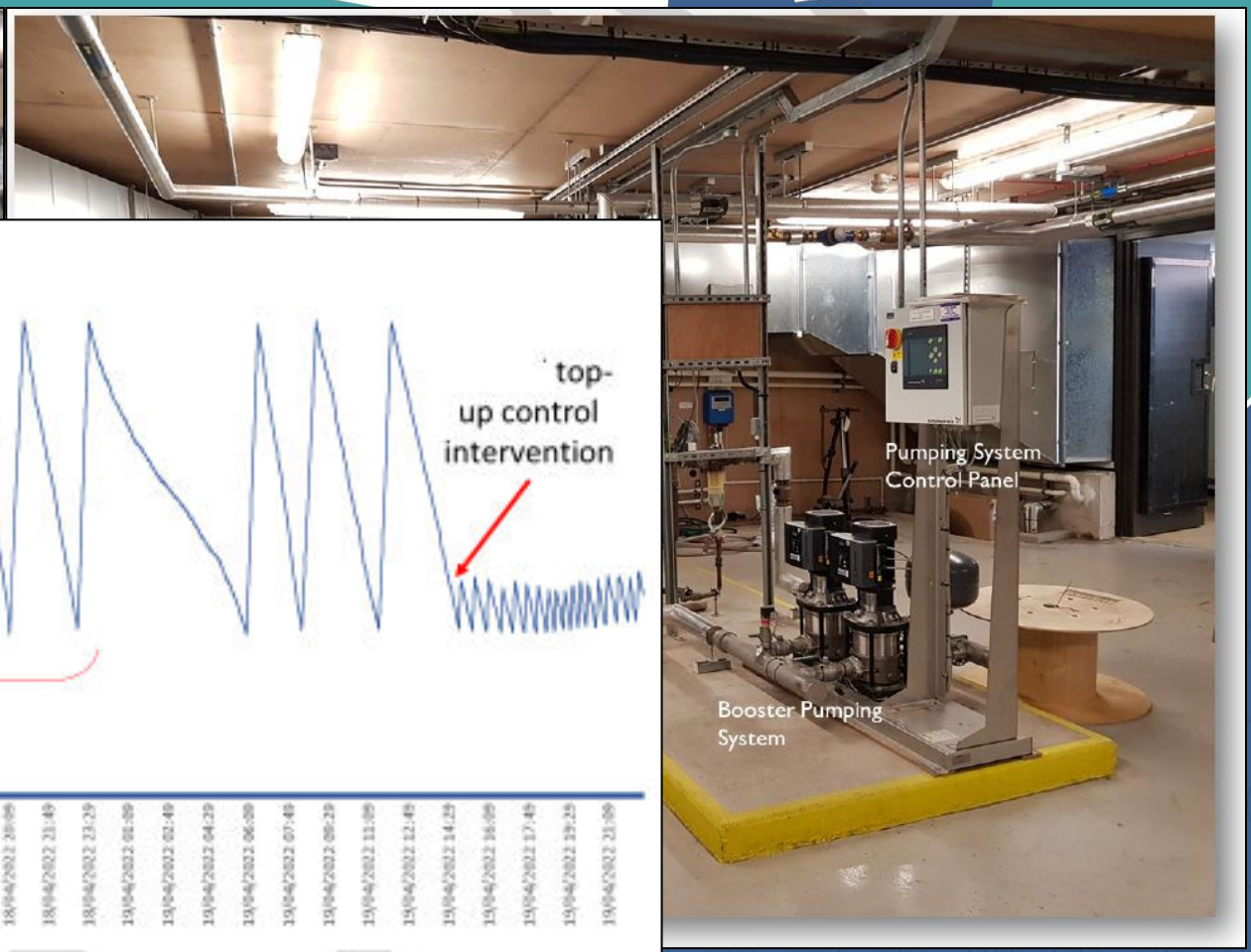
Minimal treatment benefits,
sterilised land and no water re-use?

Contact: pm391@ex.ac.uk

Case Study 1: London Intelligent Tank Control Pilot

Can we control drinking water tanks and rainwater tanks using Internet of things?





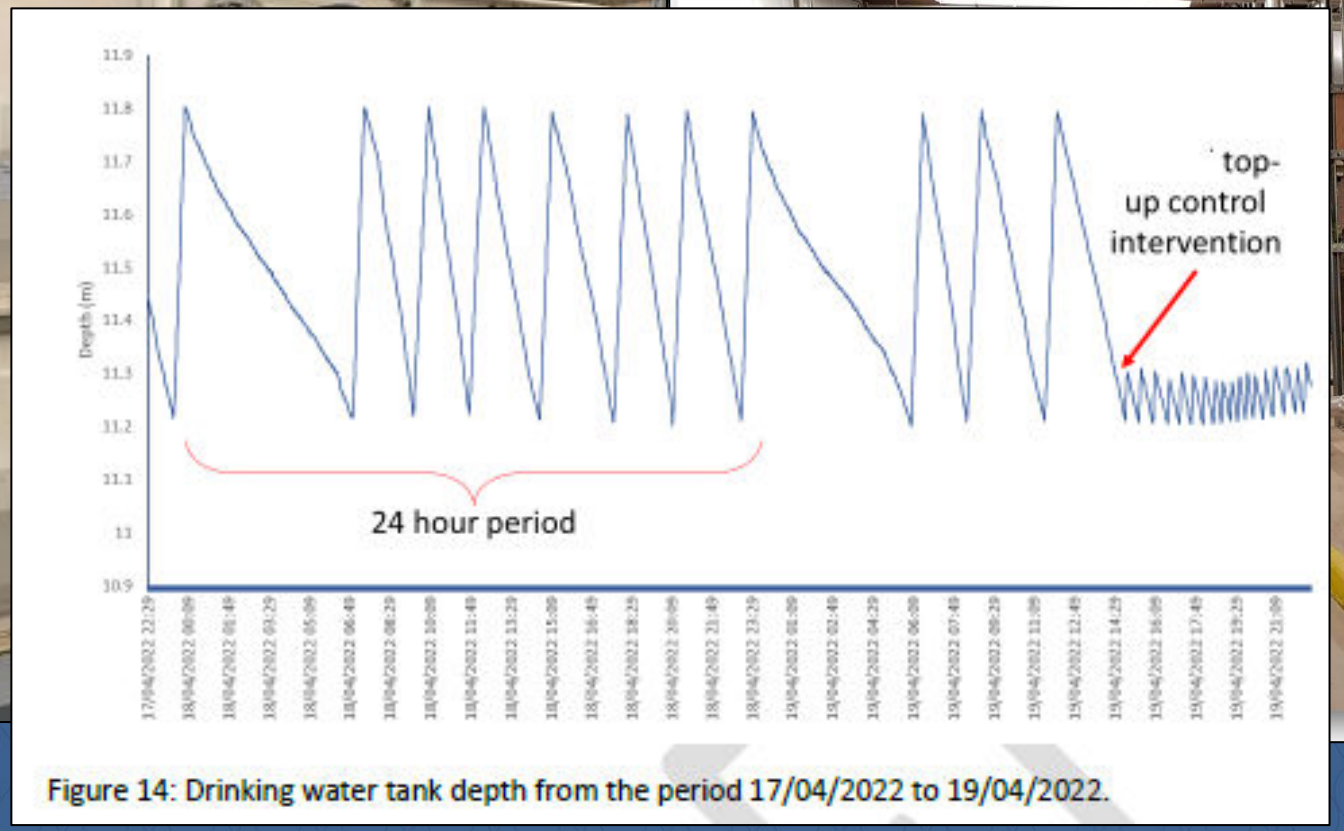


Figure 14: Drinking water tank depth from the period 17/04/2022 to 19/04/2022.

Contact: pm391@ex.ac.uk

Case Study 2: Island Rainwater Management

What can Intelligent Rainwater Management Systems offer Island Water Resource Managers?

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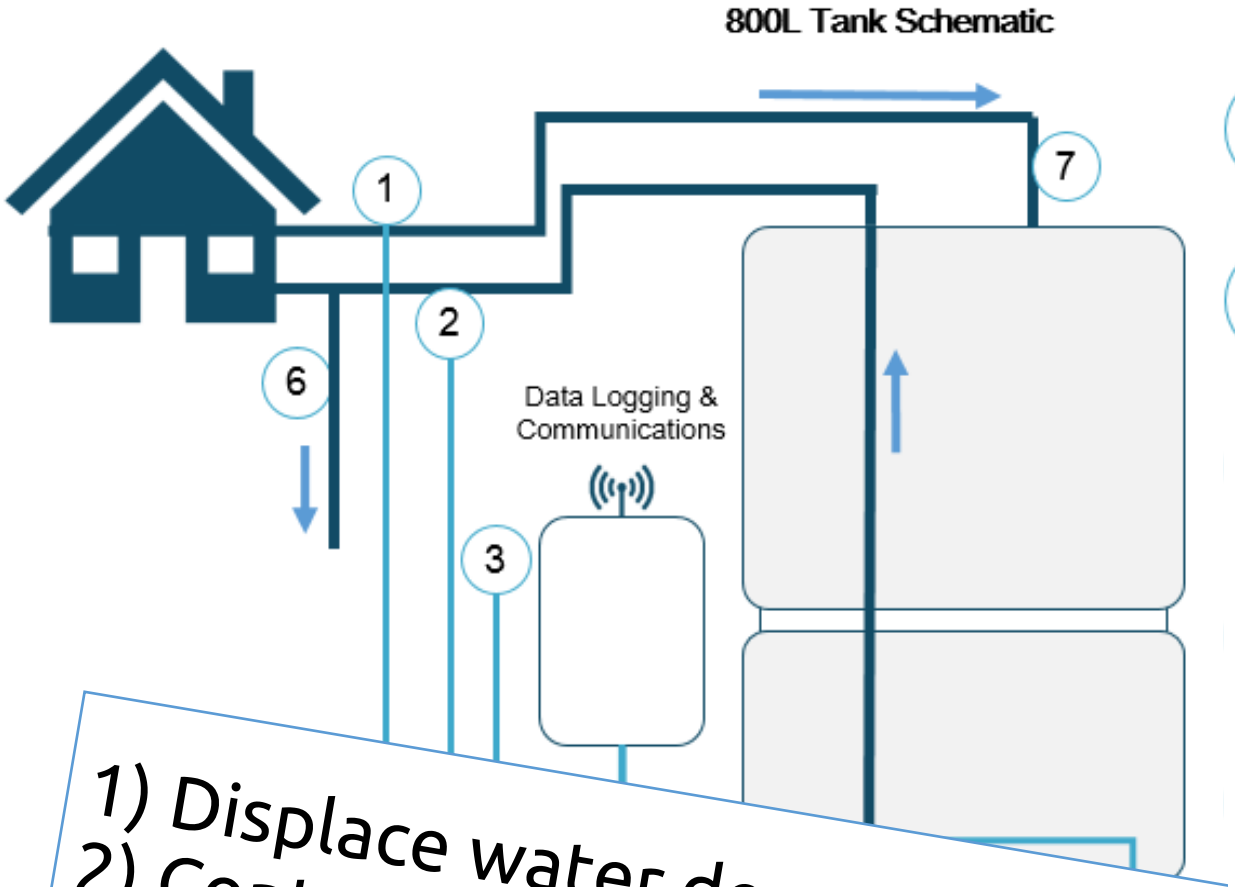
“Intelligent” RMS



Typical Logging Arrangement

Flow Sensor 1

1 Potable Water Backup Supply to RMS

Flow Sensor 2

2 Rainwater Supply to Household

1) Displace water demand?
2) Control stormwater discharges?
3) Refill overnight?

Trialling Intelligent RMS

1) 8 houses in Exeter, UK
2) 2 Isles of Scillies
3) Configured to drain **automatically** before storms (maximising stormwater capture / preventing stormwater spills).

4) Tanks can be **remotely filled** with mains water, to predictively manage water levels / storage (even during dry weather).

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Operating Intelligent RMS

Monitored output*

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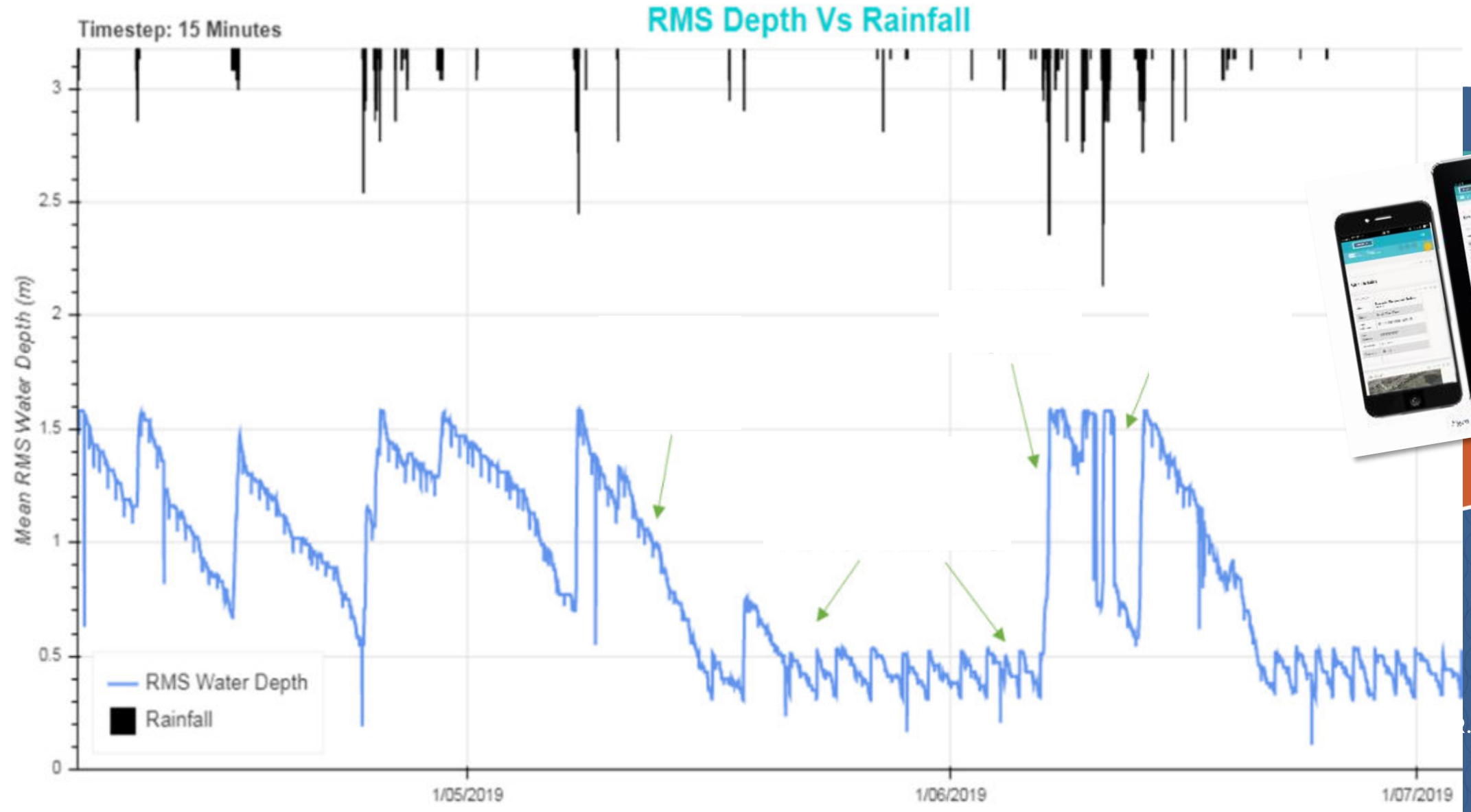

Watef UK Conference 2020 – Melville-Shreeve et al.

.ORG.MT

Installation Examples

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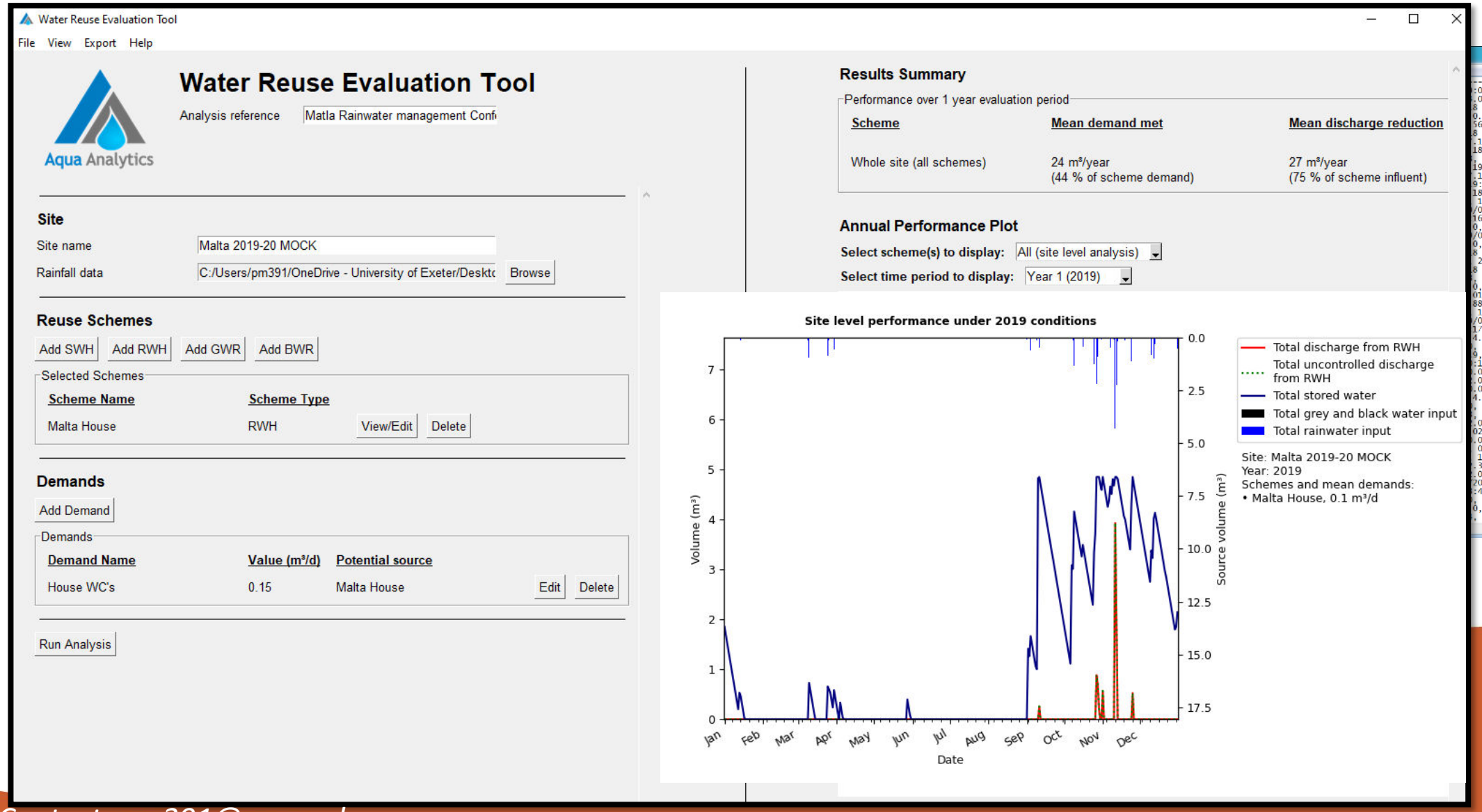
Insight from Design Tool: Rainwater Management System Evaluation



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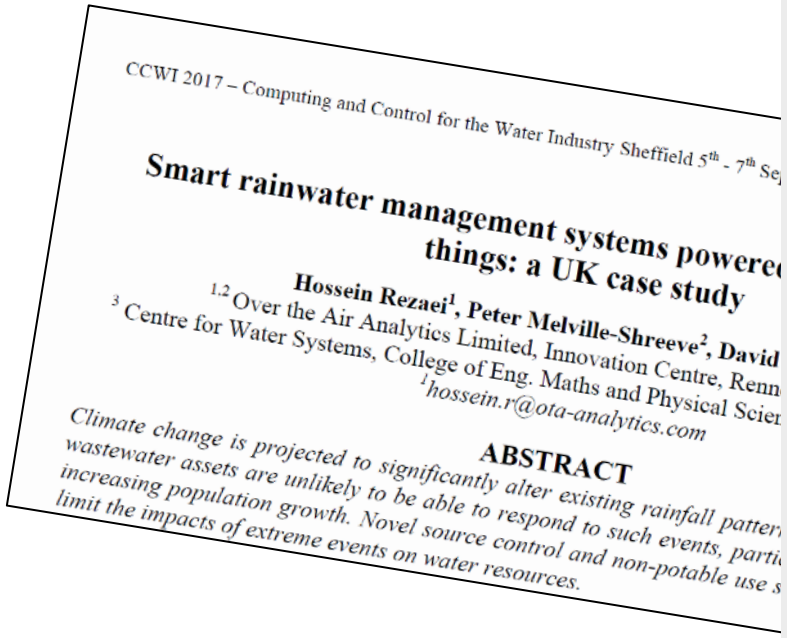
Challenge?

Establish Value Proposition in Local Context



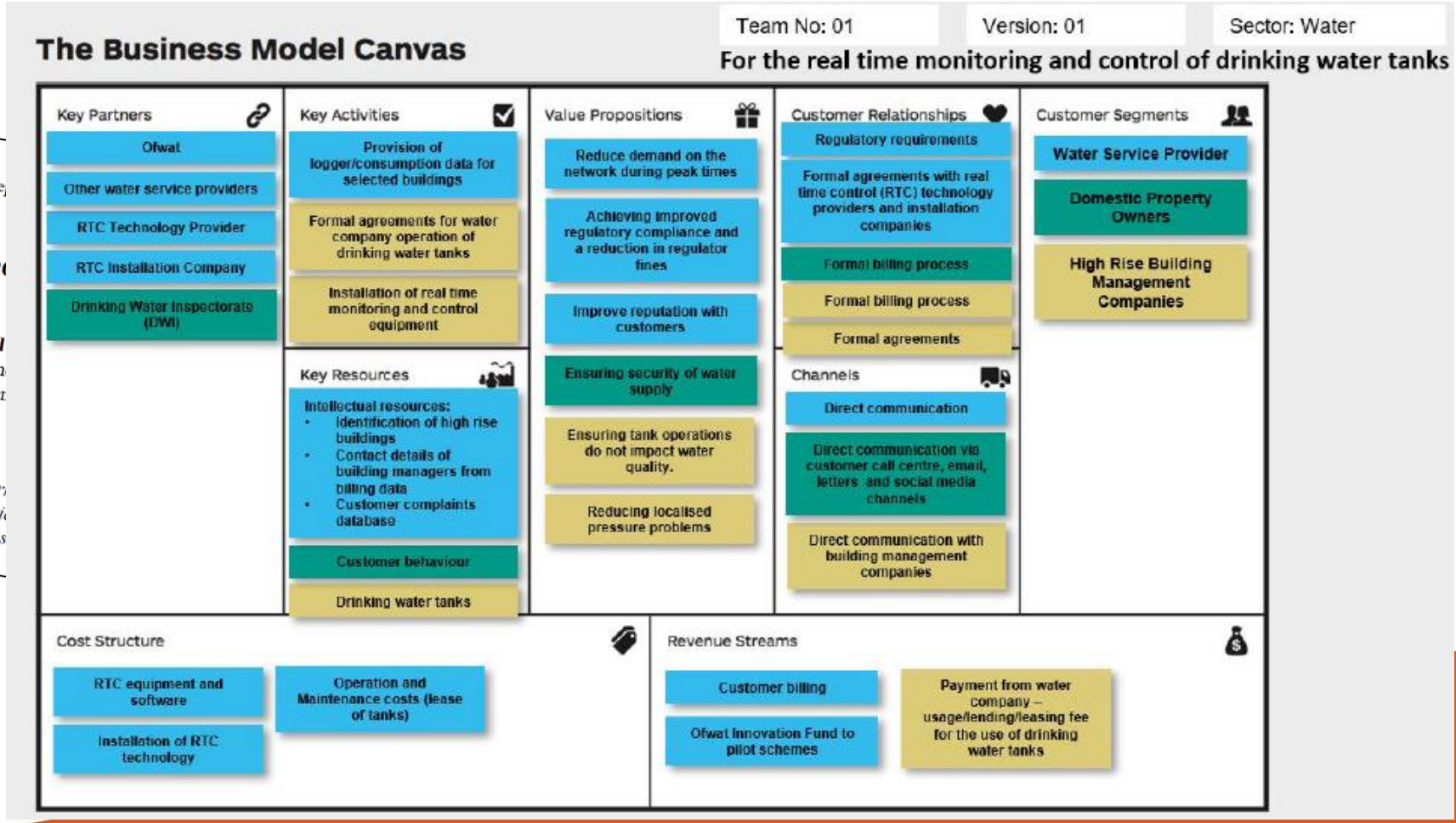
CCWI 2017 – Computing and Control for the Water Industry Sheffield 5th - 7th Se

Smart rainwater management systems powere things: a UK case study

Hossein Rezaei[1], Peter Melville-Shreeve[2], David
[1,2] Over the Air Analytics Limited, Innovation Centre, Renn
[3] Centre for Water Systems, College of Eng. Maths and Physical Scie
[1]hossein.r@ota-analytics.com

ABSTRACT

Climate change is projected to significantly alter existing rainfall patter wastewater assets are unlikely to be able to respond to such events, parti increasing population growth. Novel source control and non-potable use s limit the impacts of extreme events on water resources.



The Business Model Canvas

Team No: 01 | Version: 01 | Sector: Water

For the real time monitoring and control of drinking water tanks

Key Partners
- Ofwat
- Other water service providers
- RTC Technology Provider
- RTC Installation Company
- Drinking Water Inspectorate (DWI)

Key Activities
- Provision of logger/consumption data for selected buildings
- Formal agreements for water company operation of drinking water tanks
- Installation of real time monitoring and control equipment

Key Resources
- Intellectual resources:
  - Identification of high rise buildings
  - Contact details of building managers from billing data
  - Customer complaints database
- Customer behaviour
- Drinking water tanks

Value Propositions
- Reduce demand on the network during peak times
- Achieving improved regulatory compliance and a reduction in regulator fines
- Improve reputation with customers
- Ensuring security of water supply
- Ensuring tank operations do not impact water quality.
- Reducing localised pressure problems

Customer Relationships
- Regulatory requirements
- Formal agreements with real time control (RTC) technology providers and installation companies
- Formal billing process
- Formal billing process
- Formal agreements

Channels
- Direct communication
- Direct communication via customer call centre, email, letters and social media channels
- Direct communication with building management companies

Customer Segments
- Water Service Provider
- Domestic Property Owners
- High Rise Building Management Companies

Cost Structure
- RTC equipment and software
- Installation of RTC technology
- Operation and Maintenance costs (lease of tanks)

Revenue Streams
- Customer billing
- Ofwat Innovation Fund to pilot schemes
- Payment from water company – usage/lending/leasing fee for the use of drinking water tanks

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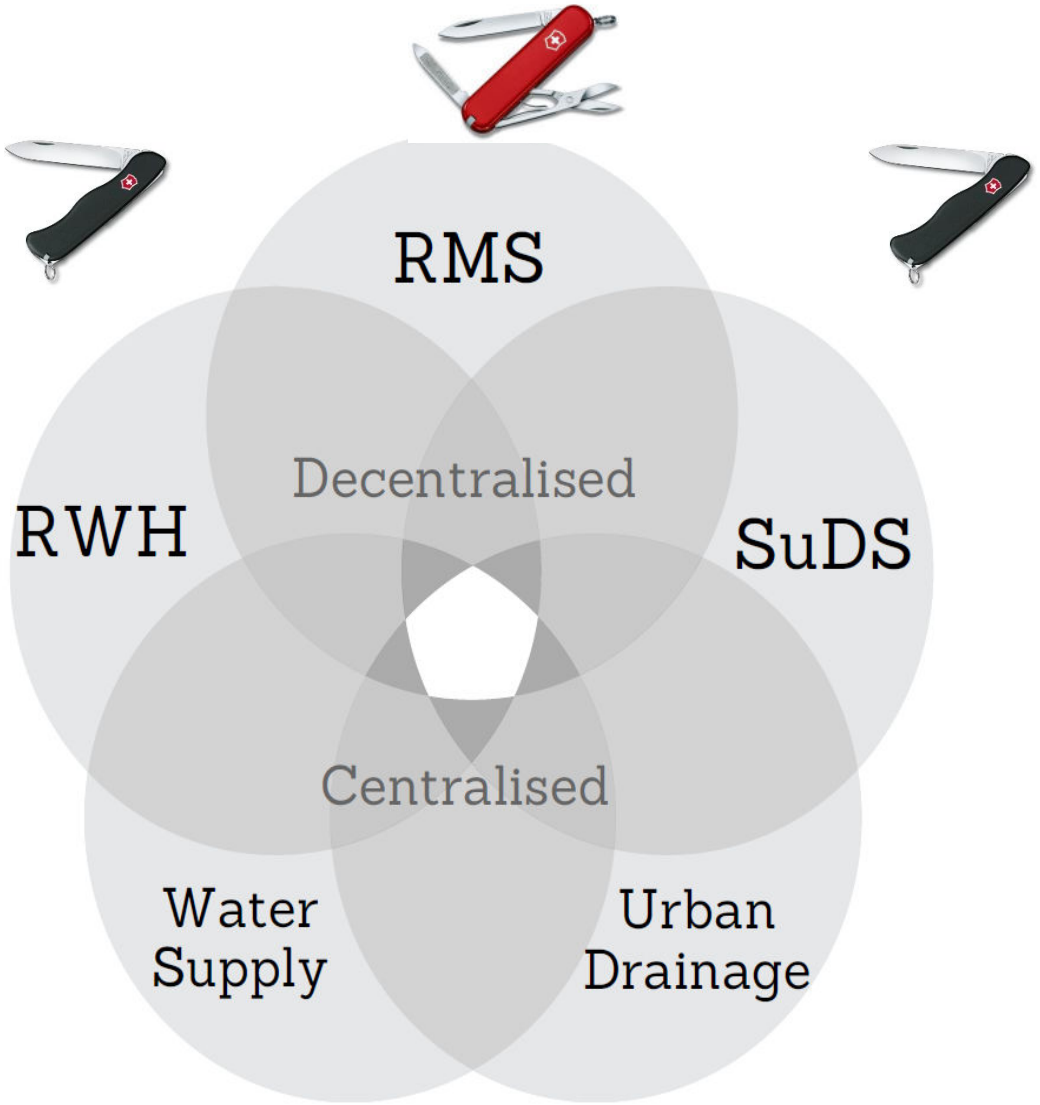
Contact: pm391@ex.ac.uk

Concluding thoughts

1) Target Multiple Benefit
2) Evaluation Tools
3) Monitoring Approaches
4) Real-time Data and Control
5) Start with needs-based value proposition



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Contact: pm391@ex.ac.uk

Rainwater management perspectives from UK case studies

Dr Sarah Bunney, Dr Peter Melville-Shreeve.

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Thank You For Hosting Us ☺

Contact: pm391@ex.ac.uk
S.bunney@Exeter.ac.uk

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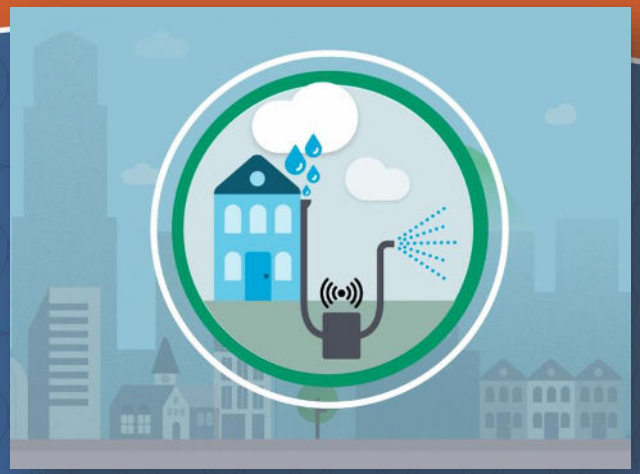

The Effect of Rain Water on the WSC Sewage Network

- Ing. Greta Zammit Muma
- Ing. Nigel Ellul
- Eng. Joseph Abela
- Trevor Giles Chircop Bray

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General Overview of WSC Sewage Network

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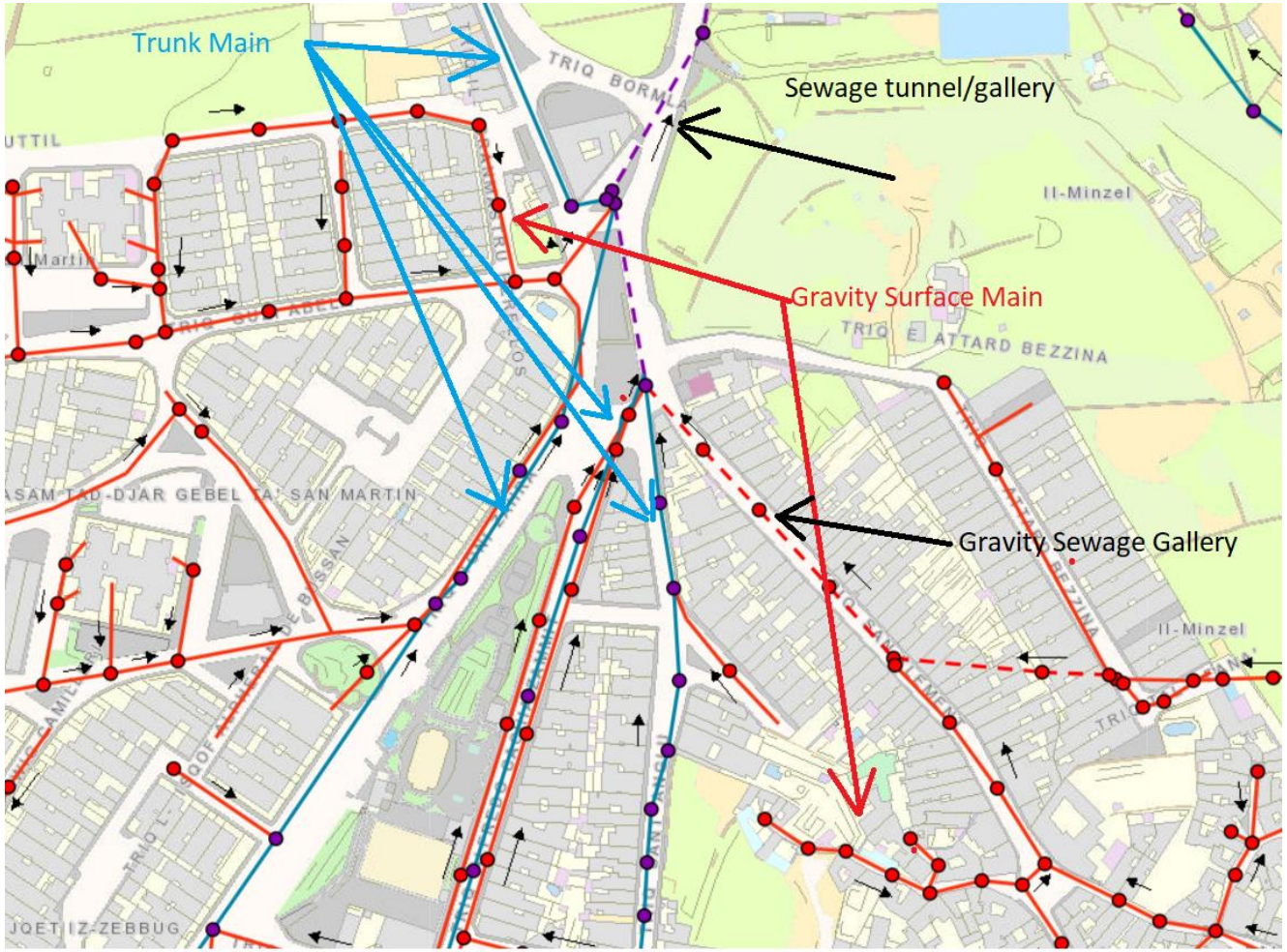
WSC Sewage Network

Gallery/Tunnel – Dotted Purple/Red lines

Trunk Sewer Main – Solid Blue lines

Gravity Surface Sewer – Red lines



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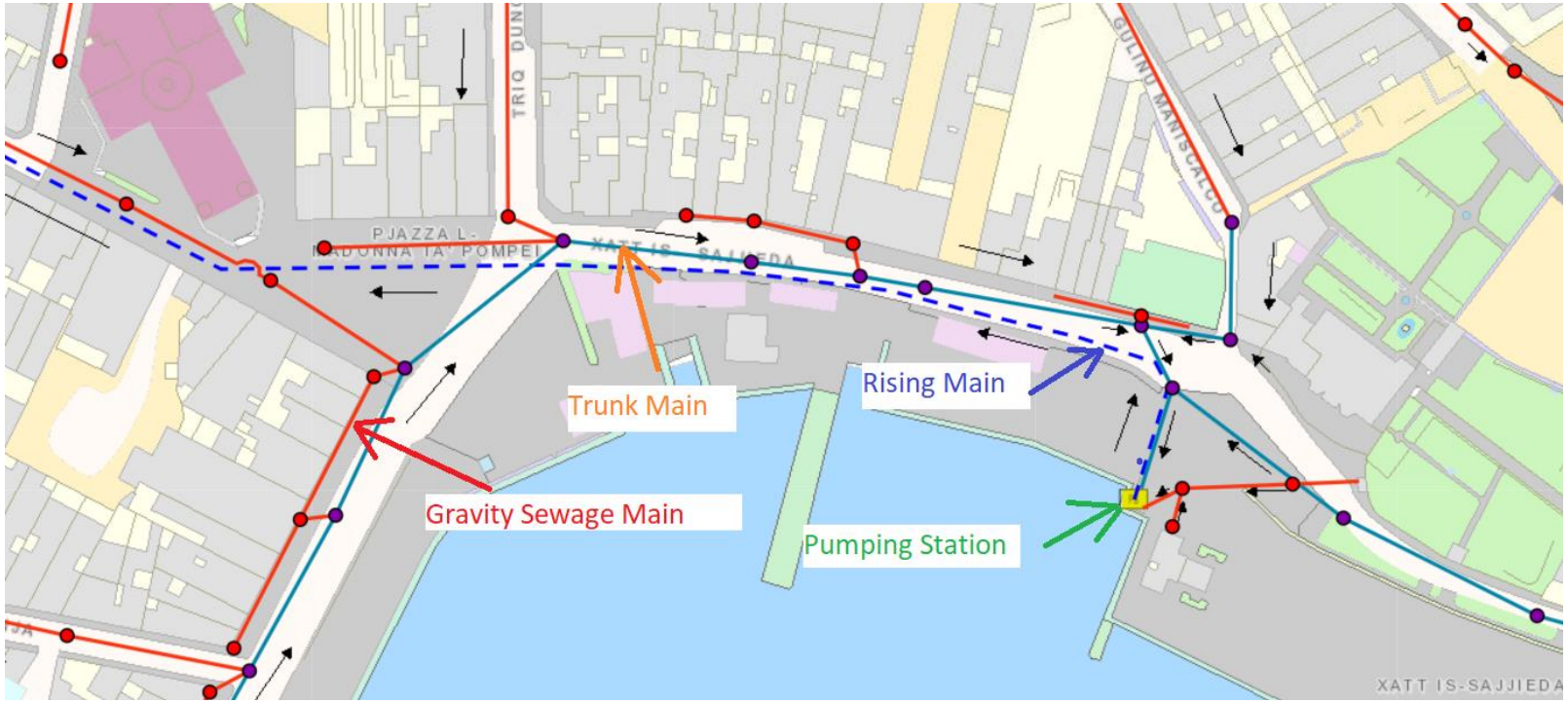
WSC Sewage Network

PS – Marked by Yellow Box

Rising Main – Dotted Blue Line

Trunk Sewer Main – Blue line

Gravity Surface Sewer - Red line



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Effects of Rain Water on the network

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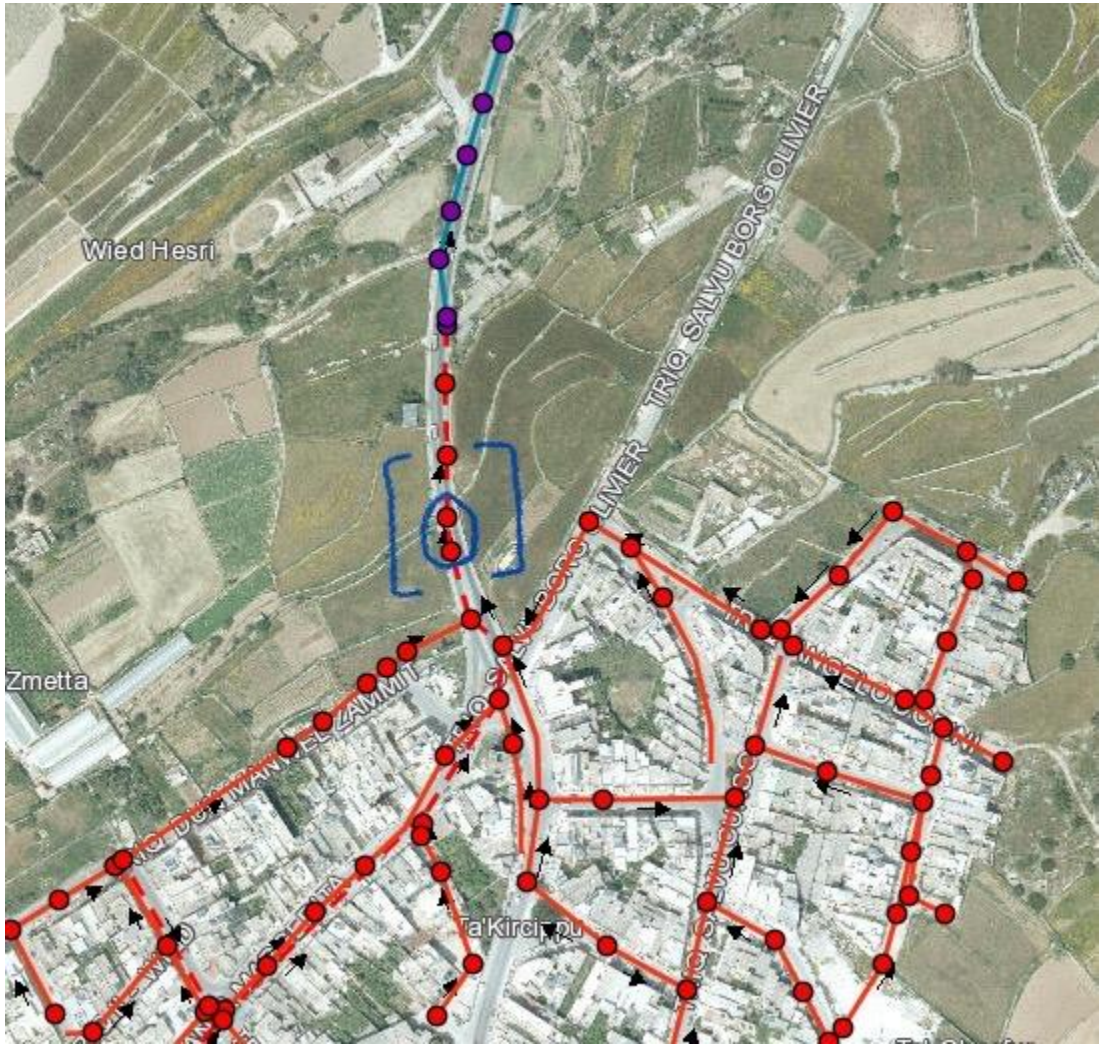
Rain Water Overflow

The following video will show an overflow of rain water from Siggiewi Sewage Gallery leading to Hal Qormi Sewage Gallery.

Sewage Gallery's typical size is 1.2m wide by 2m high.

Once there is an overflow, it usually means that the sewage gallery is full and backing up.



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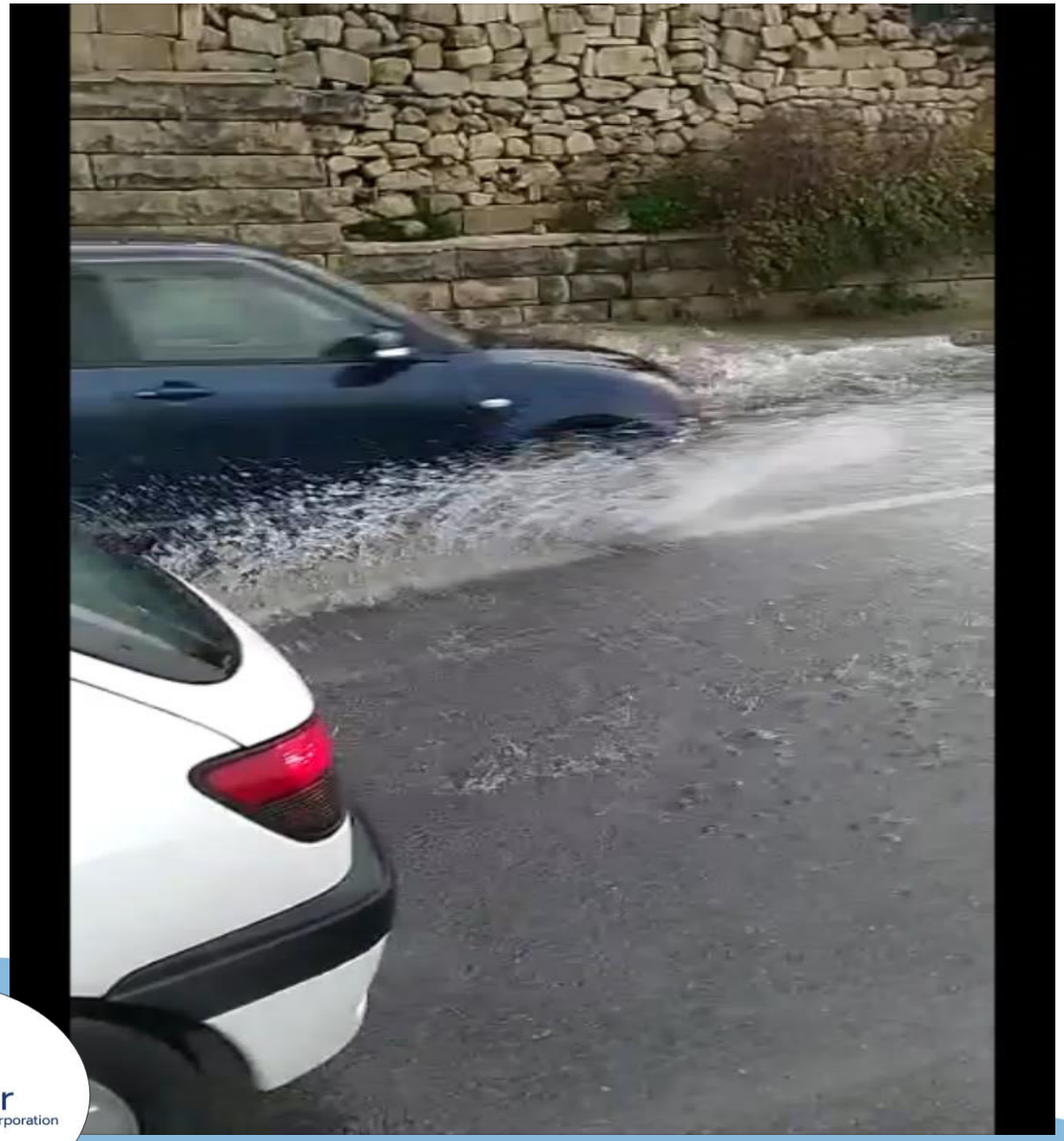

- Thousands of litres of rain water that ended up needlessly into the sewer system.

- This causes a number of problems:
  - **Inconvenience to pedestrians;**
  - **Hazard to drivers;**
  - **Loss of potentially reusable water**

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What is the cause?

- Illegal Rain water connections coming from all exposed areas {roofs, yards, balconies, shafts, outdoor areas, pools, yards etc} connected directly to the sewage pipe.
- During wet weather, such connections will cause great strain on **WSC SEWAGE** infrastructure.
- Sewage infrastructure is only designed for sewage not rain water!
- **Malta & Gozo does not have a combined sewage systems** hence rain water and sewage are two separate networks.
- Over compensation/engineering of **sewage** pipework will result in more problematic operational issues.

1.2m Storm Water Pipe being installed

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Damages to the network

- **Overloading of pumping stations:**
  - It takes several hours which may lead up to 2 days after rain fall for WSC Sewage network to recover from rain water influx;
  - Sewage pumping stations pump fresh water to Treatment plants;
  - Continuous non stop running of pumps (waste of electricity);
  - Increase of maintenance costs of Pumping stations;
- **Damages to:**
  - Sewage infrastructure (pipes, manholes, manhole covers);
  - Pumping station telemetry;
  - Sewage pumps;
  - 3rd parties;
  - Contamination of the environment;

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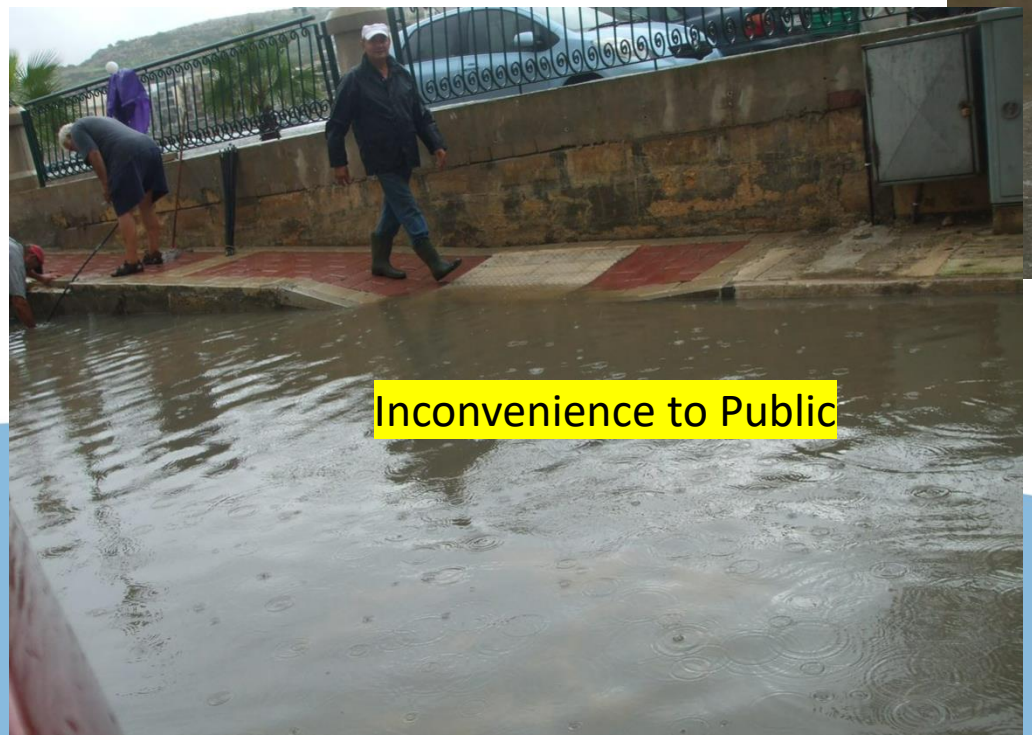
Consequences of rain water in WW Network

Overflowing manhole

Overflowing sewage & rain water in street & ending up into 3rd party property

Damage to road infrastructure & manhole



Inconvenience to Public

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Damages to 3rd Parties

Damage to manholes which spill waste water onto nearby fields

Back flow of sewage into households

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Abuse to our network

- An illegal Rain Water Discharge in Manhole.
- This resulted in an overflow from a manhole downstream of our network.

Cause

Effect

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Waste Water Treatment Plants & Pumping Stations

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WWTP – Brief Description

Gozo WWTP

6,000m³/ day
ASP – Intermittent Aeration

40,000 P.E.

	Limit (mg/L)	
BOD_5	25	Annual Average
COD	125	
TSS	35	

Barkat South WWTP

60,000m³/ day
BAF Filtration- Attached growth
8 Pre-DN +12 (C+N)
parallel lines

500,000 P.E.

	Limit (mg/L)	
BOD_5	25	Annual Average
COD	125	
TSS	35	

Sant Antnin WWTP

17,000m³/ day
MBBR

140,000 P.E.

	Limit (mg/L)	
BOD_5	25	Annual Average
COD	125	
TSS	35	

North WWTP

6,700m³/ day
ASP – Intermittent Aeration

44,000 P.E.

	Limit (mg/L)	
BOD_5	25	Annual Average
COD	125	
TSS	35	
TN	15	

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Storm Water Infiltration into Treatment Plants

Stormwater infiltration causes major problems in wastewater treatment plants:

- due to the increasing the volume of influent that the plants have to deal with and thus increasing treatment costs;
- reducing the effectiveness of wastewater treatment;
- increases the risk of untreated sewage overflows;

Since treatment of sewage is a biological process, the bacteria responsible are highly susceptible to changes in the influent water. Thus stability of the process is key to maintain the quality of effluent generated (New Water).

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Example of rain water flooding out of GOZO WWTP a short time after a storm.

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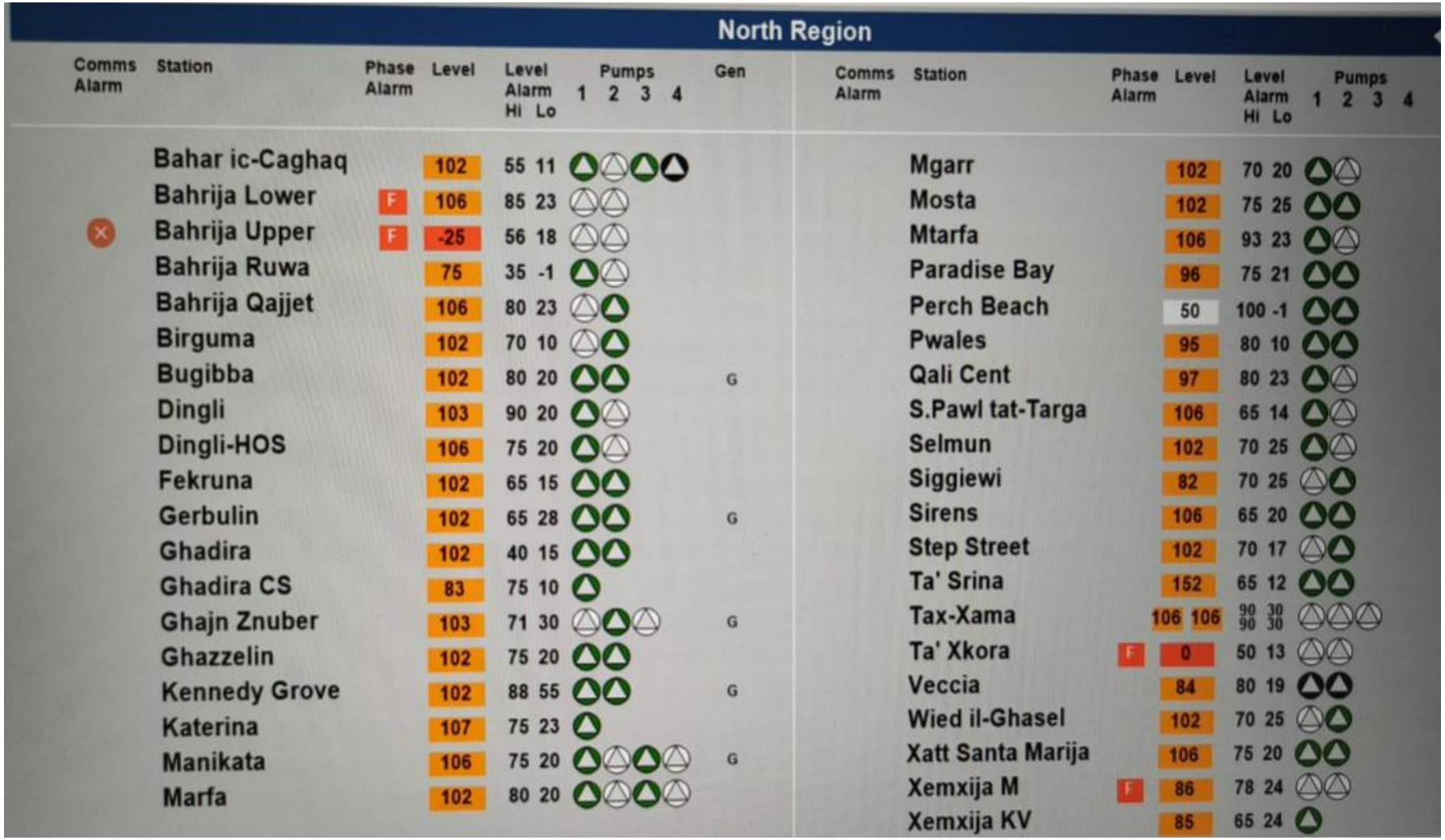
Pumping Stations

- Orange highlighted PS level shows that PS is overflowing to sea and or surrounding areas.

- Green pumps icons show number of pumps running.



North Region

Comms Alarm	Station	Phase Alarm	Level	Level Alarm Hi	Level Alarm Lo	Pumps 1	Pumps 2	Pumps 3	Pumps 4	Gen
	Bahar ic-Caghaq		102	55	11	▲	△	▲	◭	
	Bahrija Lower	F	106	85	23	△	△			
⊗	Bahrija Upper	F	-25	56	18	△	△			
	Bahrija Ruwa		75	35	-1	▲	△			
	Bahrija Qajjet		106	80	23	△	▲			
	Birguma		102	70	10	△	▲			
	Bugibba		102	80	20	▲	▲			G
	Dingli		103	90	20	▲	△			
	Dingli-HOS		106	75	20	▲	△			
	Fekruna		102	65	15	▲	▲			
	Gerbulin		102	65	28	▲	▲			G
	Ghadira		102	40	15	▲	▲			
	Ghadira CS		83	75	10	▲				
	Ghajn Znuber		103	71	30	△	▲	△		G
	Ghazzelin		102	75	20	▲	▲			
	Kennedy Grove		102	88	55	▲	▲			G
	Katerina		107	75	23	▲				
	Manikata		106	75	20	▲	△	▲	△	G
	Marfa		102	80	20	▲	△	▲	△	

Comms Alarm	Station	Phase Alarm	Level	Level Alarm Hi	Level Alarm Lo	Pumps 1	Pumps 2	Pumps 3	Pumps 4
	Mgarr		102	70	20	▲	△		
	Mosta		102	75	25	▲	▲		
	Mtarfa		106	93	23	▲	△		
	Paradise Bay		96	75	21	▲	▲		
	Perch Beach		50	100	-1	▲	▲		
	Pwales		95	80	10	▲	▲		
	Qali Cent		97	80	23	▲	△		
	S.Pawl tat-Targa		106	65	14	▲	△		
	Selmun		102	70	25	▲	△		
	Siggiewi		82	70	25	△	▲		
	Sirens		106	65	20	▲	▲		
	Step Street		102	70	17	△	▲		
	Ta' Srina		152	65	12	▲	▲		
	Tax-Xama		106 106	90 90	30 30	△	△	△	
	Ta' Xkora	F	0	50	13	△	△		
	Veccia		84	80	19	▲	▲		
	Wied il-Ghasel		102	70	25	△	▲		
	Xatt Santa Marija		106	75	20	▲	▲		
	Xemxija M	F	86	78	24	△	△		
	Xemxija KV		85	65	24	▲			

Table showing North Region Pumping stations amount to about 50% of the total.

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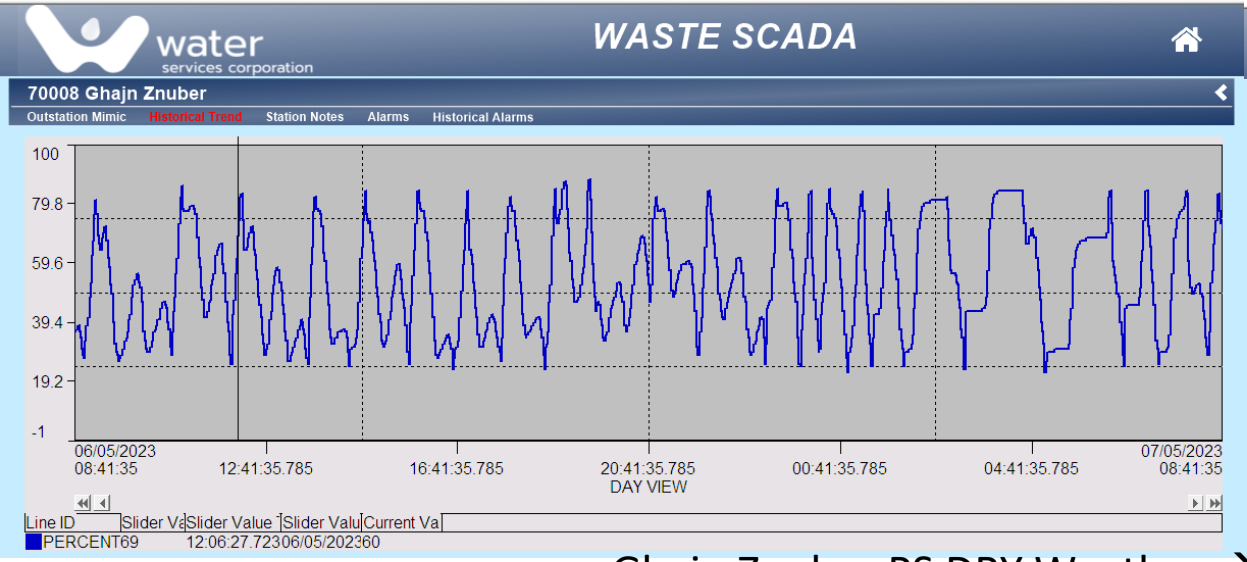
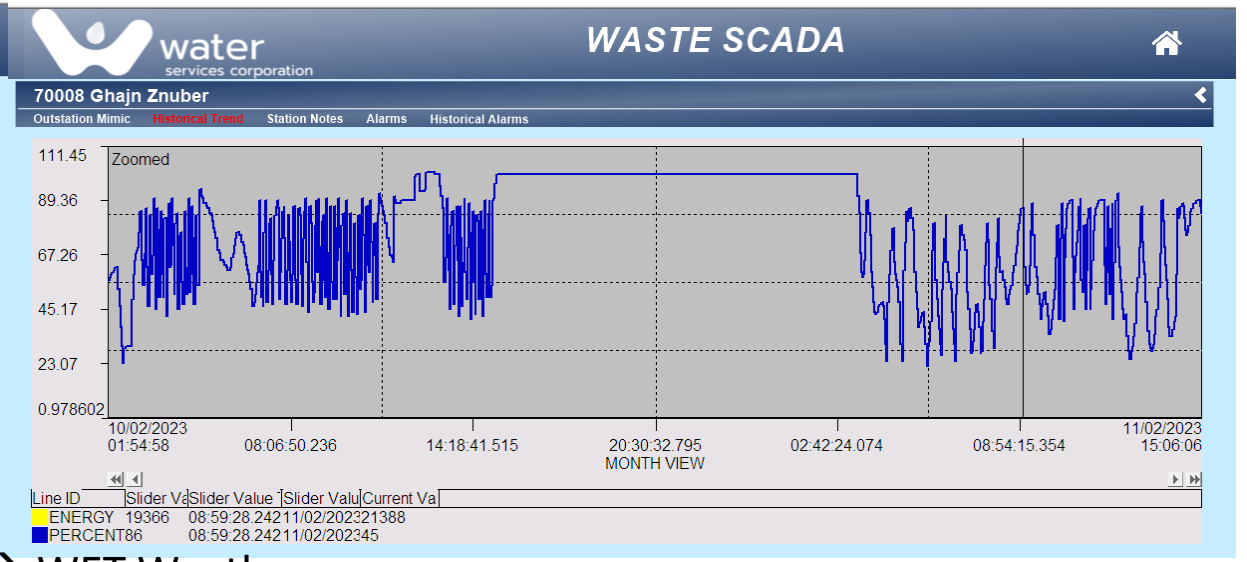
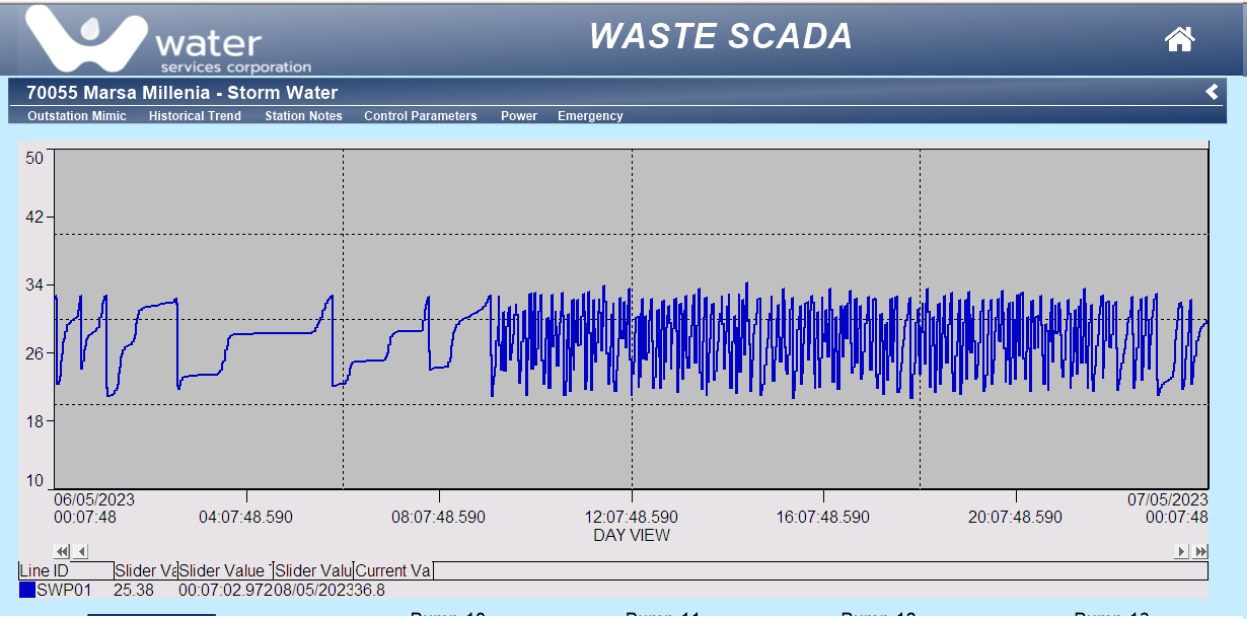
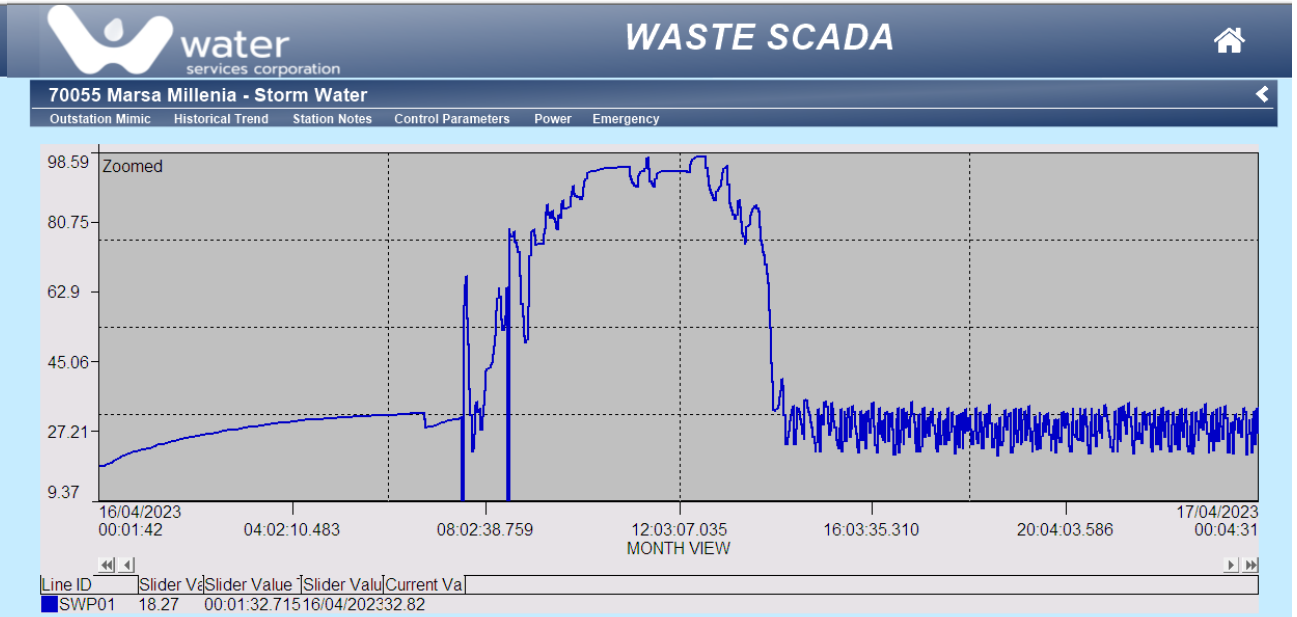


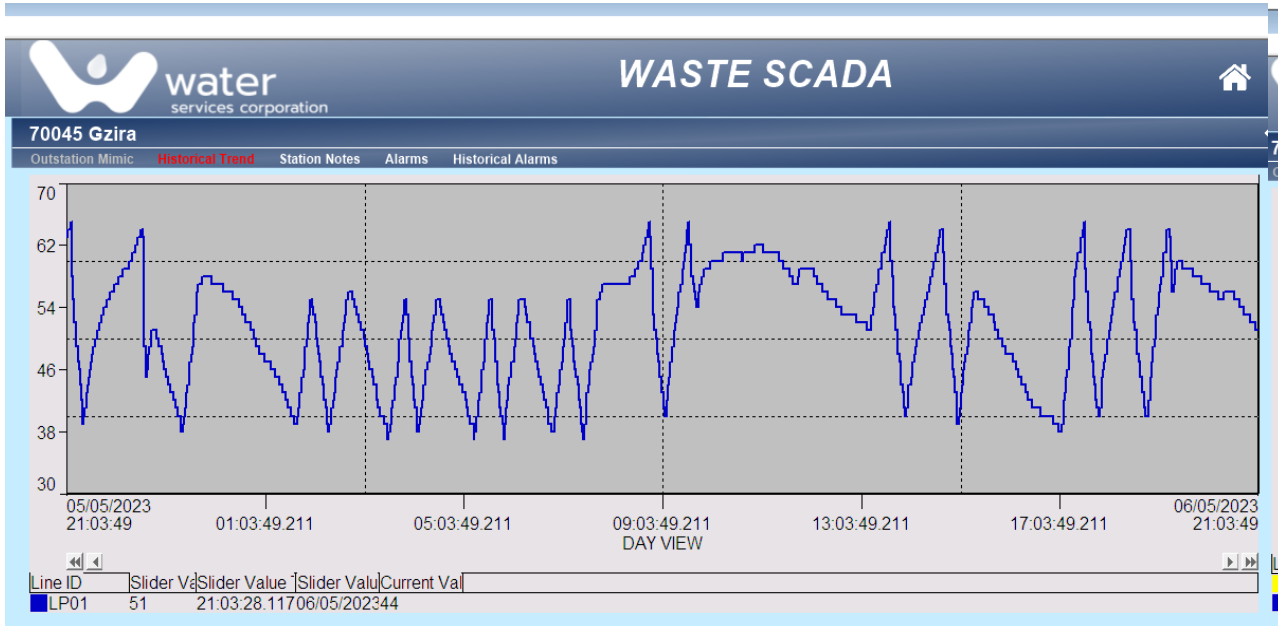


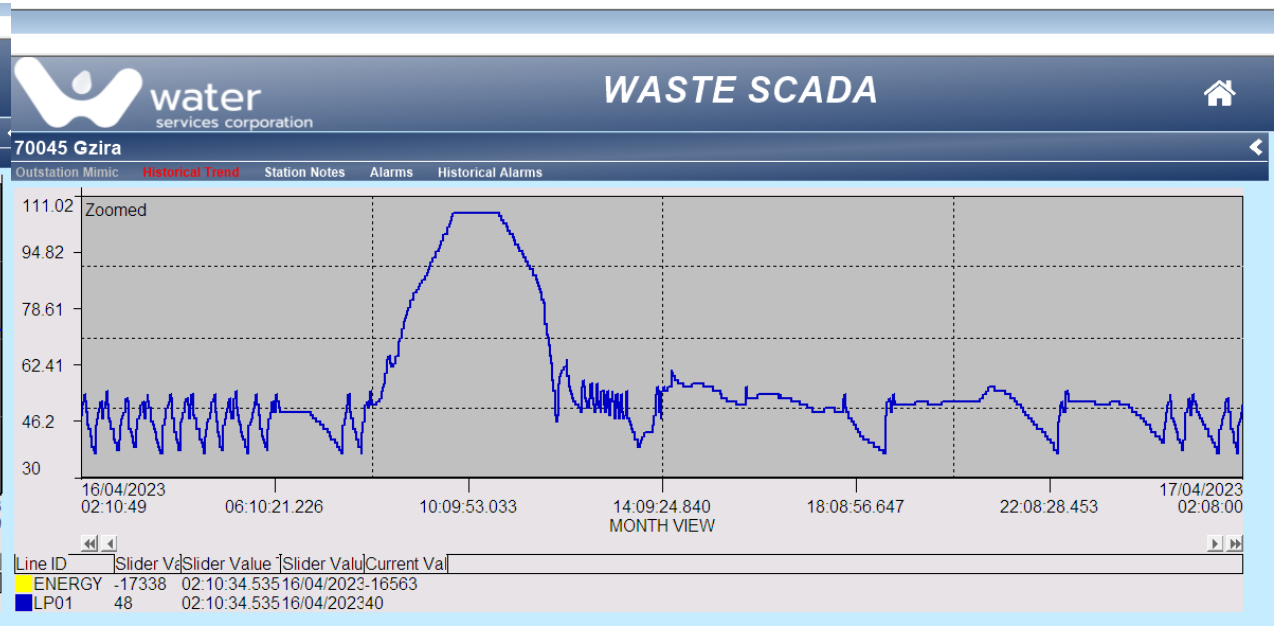
Ghajn Znuber PS DRY Weather → WET Weather



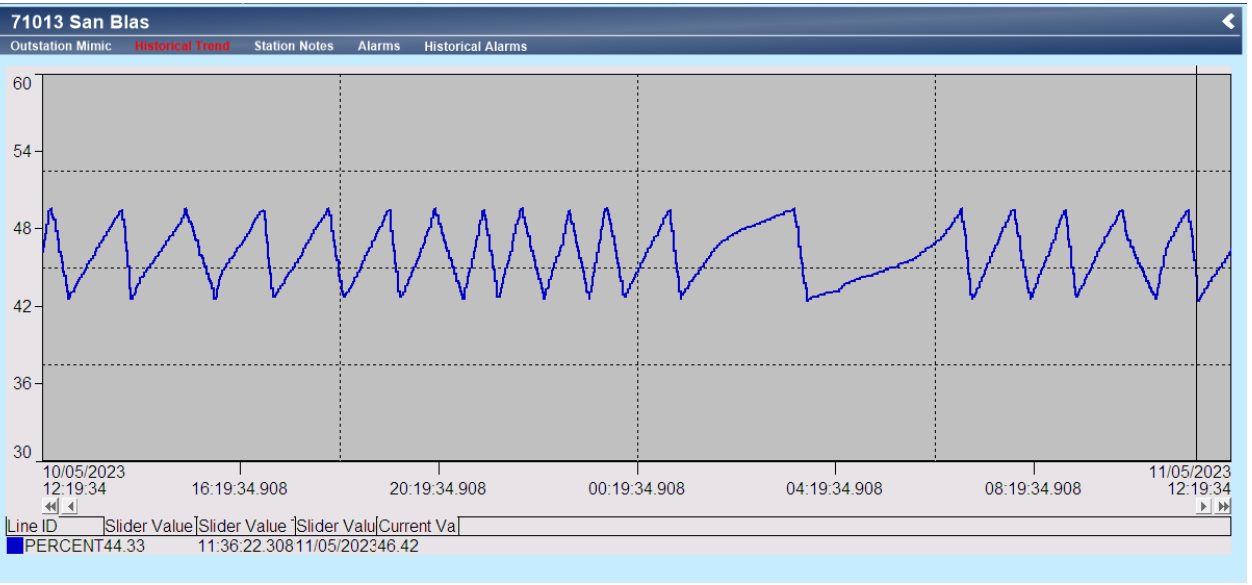


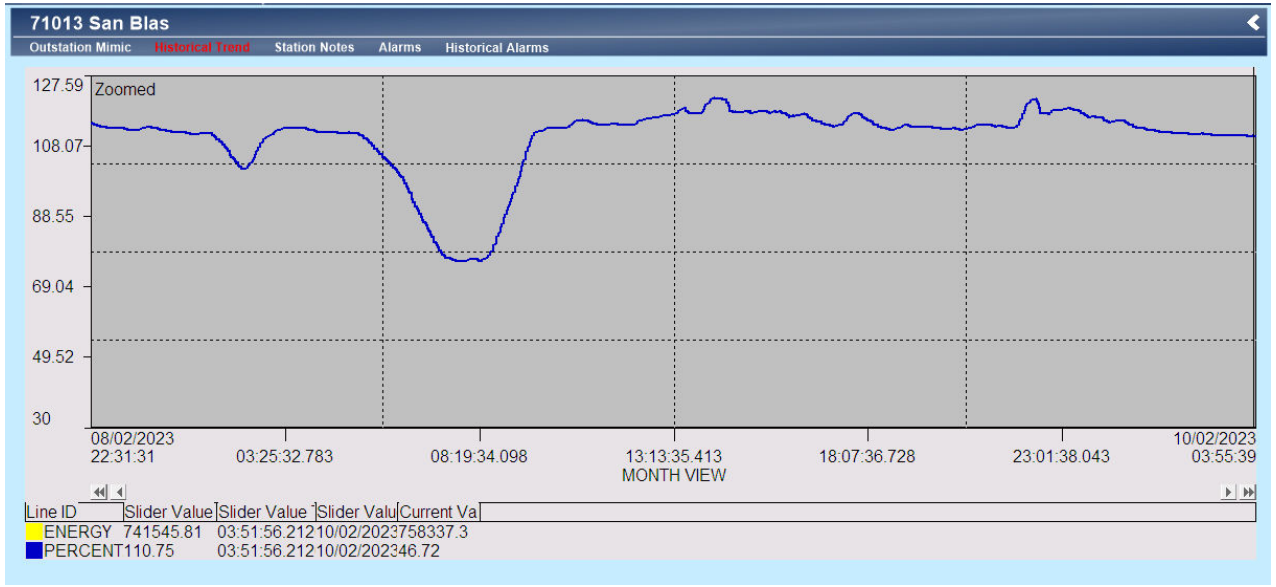
Marsa (1/2 of the PS) PS DRY Weather → WET Weather



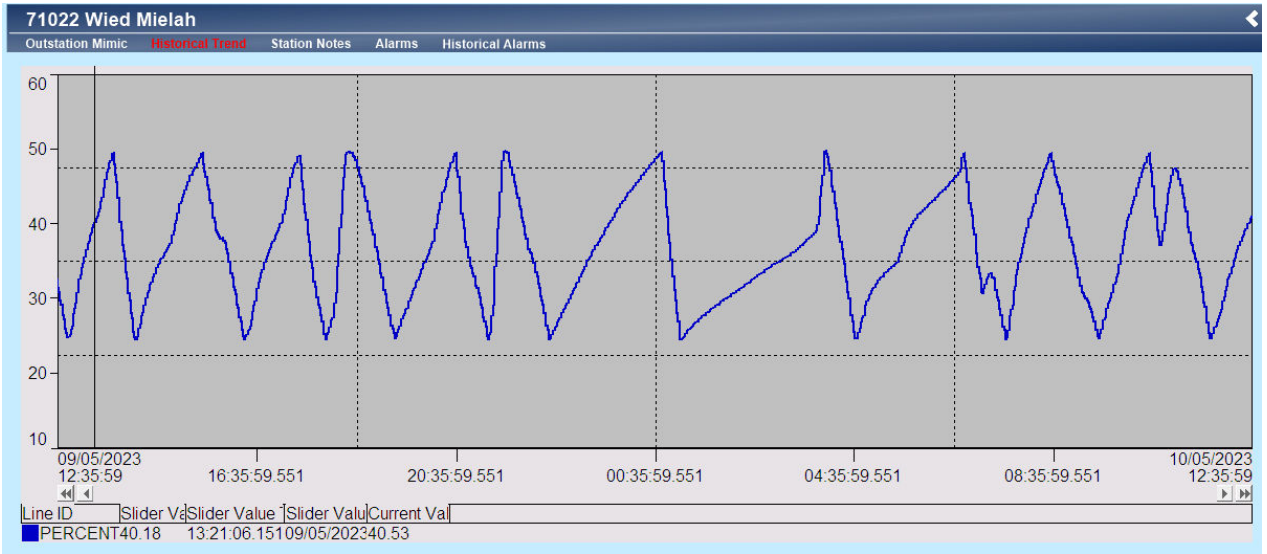


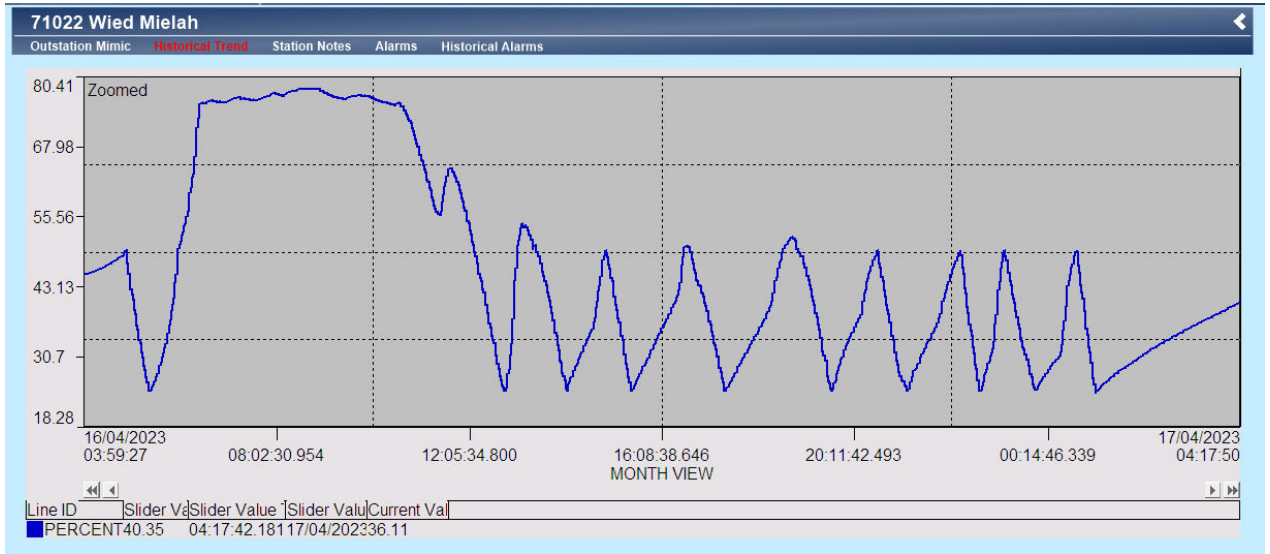
Gzira PS DRY Weather → WET Weather



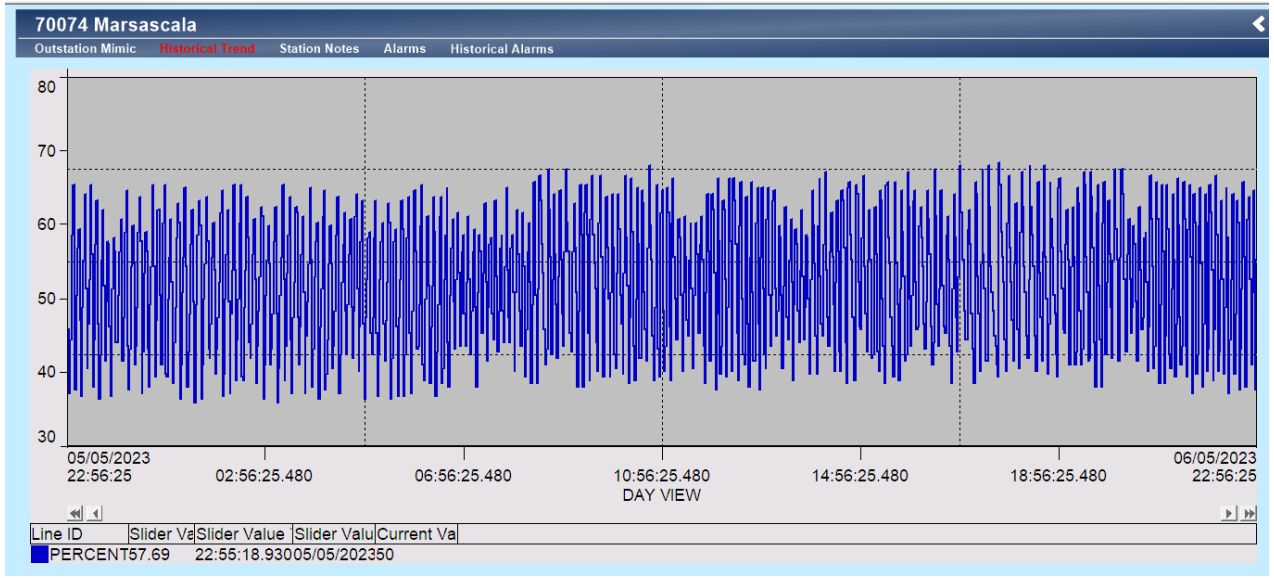


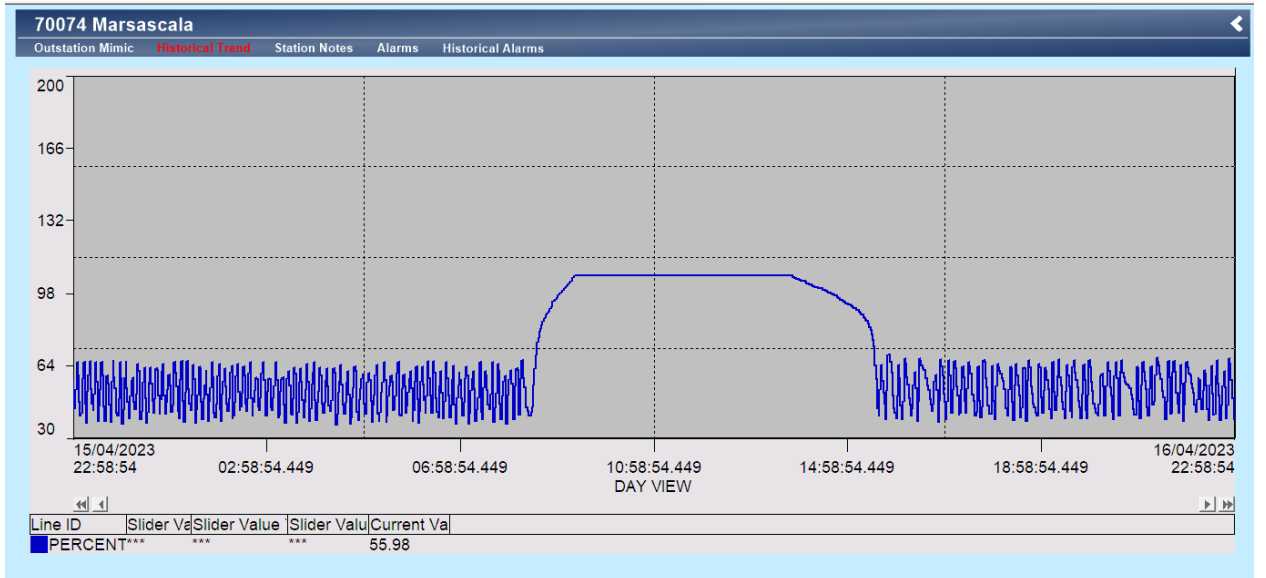
San Blas Gozo PS DRY Weather → WET Weather





Wied il-Mielah Gozo PS DRY Weather → WET Weather





Marsascala PS DRY Weather → WET Weather

This translates to ↑ ELECTRICAL COST

	Energy Consumption	Energy Cost €
Ghajn Znuber DRY Weather	2.5MWH	€225,000 Extra
Ghajn Znuber WET Weather	4.1MWH	
Tax-Xama DRY Weather	1.6 MWH	€60,000 Extra
Tax-Xama WET Weather	2 MWH	
Marsascala DRY Weather	463 KWH	€148,000 Extra
Marsascala WET Weather	1454 KWH	
Birzebbuga DRY Weather	1210 KWH	€105,000 Extra
Birzebbuga WET Weather	1942 KWH	
Marsa DRY Weather (1/2 PS)	2.2 MWH	€365,000 Extra
Marsa WET Weather (1/2 PS)	4.8 MWH	
San Blas DRY Weather	154kWH	€77,000 Extra
San Blast WET Weather	669kWH	
Wied il-Mielah DRY Weather	525kWH	€103,000 Extra
Wied il-Mielah WET Weather	1217kWH	

- Certain Pumping Stations receive sewage coming from other connected pumping stations with a dedicated catchment area.
- This means that there is double cost involved to pump sewage.
- Figures mentioned in the table depict information on a single day of rain. The values are approximate and are subject to change depending on the amount of rainfall and amount of pumps running.
- Table is only showing data for 7 PS out of ~ 100 PS operated by the WSC.

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What is being done?
Are there any Regulations/Outreach programmes in place?

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What is being done? Improvements

- Interest was expressed to solve road rain water runoff which eventually ended up in the WSC Sewage Network & 3rd parties.
- Co-ordination carried out to help solve the issue.
- A dedicated pipework carried out to divert road rain water runoff from sewage infrastructure to road surface runoff.
- Such amount of rain water can be reused. Sewage infrastructure cannot cater for such rain water flows.

Rain Water Catchment Area.

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Dedicated Rain Water Pipework

- 500mm; 315mm & 200mm pipework transferring rain water to road runoff.
- This has been diverted from the sewage main pipe.

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Other Projects carried out by other Entities

Large diameter Pipework dedicated for Storm Water installed

Storm Water installed next to Sewage Network {Dual Network}

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Guidance & Formal Communication

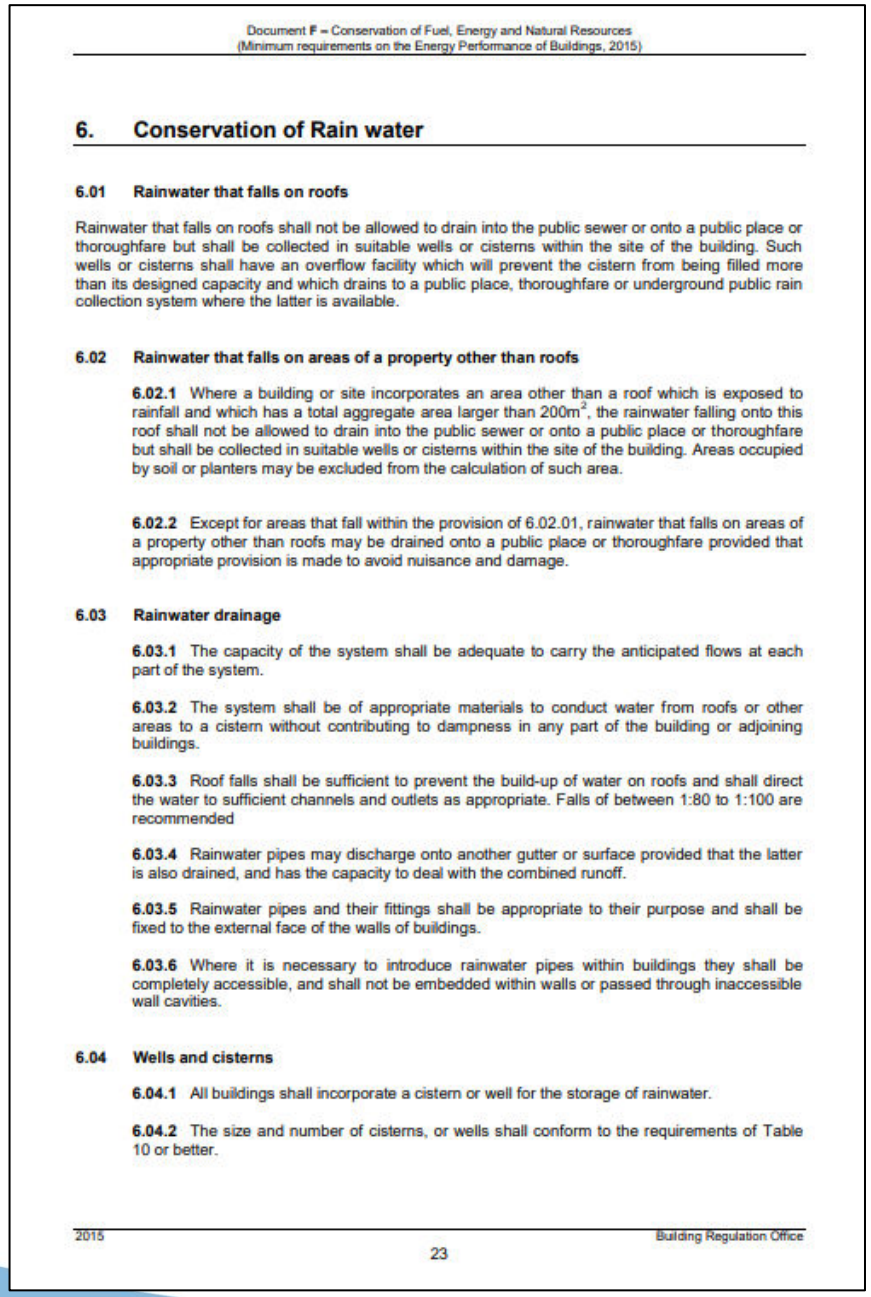
- BCA issued a Technical Guidance Document
  - Technical Guidance Document F
- There is a legal framework:
  - LEGAL NOTICE LN 47 OF 2018

L.N. 47 of 2018

BUILDING REGULATION ACT
(CAP. 513)
Energy Performance of Buildings Regulations, 2018

https://bca.org.mt/guidance-documents/

https://legislation.mt/eli/ln/2018/47/eng/pdf



6. Conservation of Rain water

6.01 Rainwater that falls on roofs

Rainwater that falls on roofs shall not be allowed to drain into the public sewer or onto a public place or thoroughfare but shall be collected in suitable wells or cisterns within the site of the building. Such wells or cisterns shall have an overflow facility which will prevent the cistern from being filled more than its designed capacity and which drains to a public place, thoroughfare or underground public rain collection system where the latter is available.

6.02 Rainwater that falls on areas of a property other than roofs

6.02.1 Where a building or site incorporates an area other than a roof which is exposed to rainfall and which has a total aggregate area larger than 200m^2, the rainwater falling onto this roof shall not be allowed to drain into the public sewer or onto a public place or thoroughfare but shall be collected in suitable wells or cisterns within the site of the building. Areas occupied by soil or planters may be excluded from the calculation of such area.

6.02.2 Except for areas that fall within the provision of 6.02.01, rainwater that falls on areas of a property other than roofs may be drained onto a public place or thoroughfare provided that appropriate provision is made to avoid nuisance and damage.

6.03 Rainwater drainage

6.03.1 The capacity of the system shall be adequate to carry the anticipated flows at each part of the system.

6.03.2 The system shall be of appropriate materials to conduct water from roofs or other areas to a cistern without contributing to dampness in any part of the building or adjoining buildings.

6.03.3 Roof falls shall be sufficient to prevent the build-up of water on roofs and shall direct the water to sufficient channels and outlets as appropriate. Falls of between 1:80 to 1:100 are recommended

6.03.4 Rainwater pipes may discharge onto another gutter or surface provided that the latter is also drained, and has the capacity to deal with the combined runoff.

6.03.5 Rainwater pipes and their fittings shall be appropriate to their purpose and shall be fixed to the external face of the walls of buildings.

6.03.6 Where it is necessary to introduce rainwater pipes within buildings they shall be completely accessible, and shall not be embedded within walls or passed through inaccessible wall cavities.

6.04 Wells and cisterns

6.04.1 All buildings shall incorporate a cistern or well for the storage of rainwater.

6.04.2 The size and number of cisterns, or wells shall conform to the requirements of Table 10 or better.

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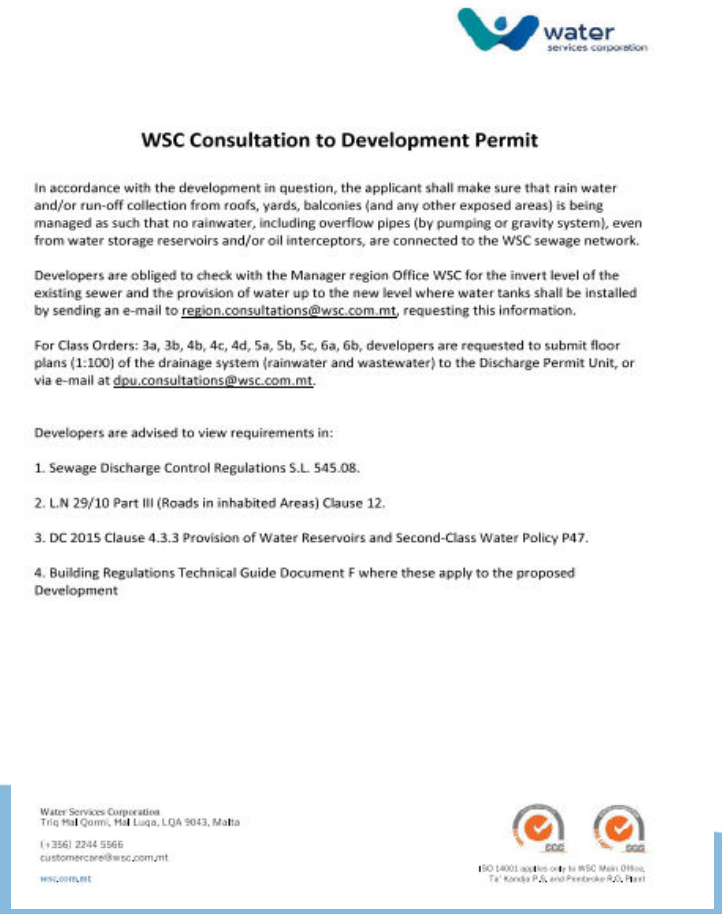
Communication with Entities

34a



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WSC Consultation to Development Permit

In accordance with the development in question, the applicant shall make sure that rain water and/or run-off collection from roofs, yards, balconies (and any other exposed areas) is being managed as such that no rainwater, including overflow pipes (by pumping or gravity system), even from water storage reservoirs and/or oil interceptors, are connected to the WSC sewage network.

Developers are obliged to check with the Manager region Office WSC for the invert level of the existing sewer and the provision of water up to the new level where water tanks shall be installed by sending an e-mail to region.consultations@wsc.com.mt, requesting this information.

For Class Orders: 3a, 3b, 4b, 4c, 4d, 5a, 5b, 5c, 6a, 6b, developers are requested to submit floor plans (1:100) of the drainage system (rainwater and wastewater) to the Discharge Permit Unit, or via e-mail at dpu.consultations@wsc.com.mt.

Developers are advised to view requirements in:

1. Sewage Discharge Control Regulations S.L. 545.08.

2. L.N 29/10 Part III (Roads in inhabited Areas) Clause 12.

3. DC 2015 Clause 4.3.3 Provision of Water Reservoirs and Second-Class Water Policy P47.

4. Building Regulations Technical Guide Document F where these apply to the proposed Development

Water Services Corporation
Triq Mal Qormi, Mal Luqa, LQA 9043, Malta

(+356) 2244 5566
customercare@wsc.com.mt

wsc.com.mt

- WSC always emphasised that rain water is not to be connected to sewer. This was as standard condition imposed by WSC **on all** Planning Authority permit applications.
- In May 2019 WSC started to request a declaration from a warranted Architect or Engineer to certify that the development in question is conformant to the Legal Notice LN 47 of 2018 & Technical Guidance Document F.
- Late 2021 WSC started carrying out sample inspections on buildings {residential & industrial} prior issuing the “no objections” for the compliance certificate in relation to WSC requirements.

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34a	WSC RESPONSE	21st February 2022	Valid	View

WSC Communication

Through social media, WSC is continually emphasising what is to be connected & what is to be discarded into the sewage network.

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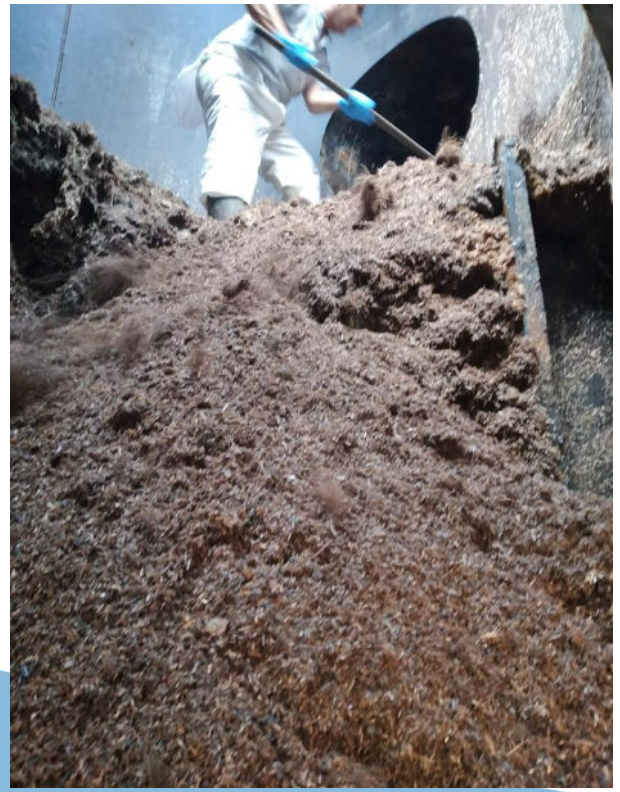
WSC Campaigns

- WSC launched the “PPP” Campaign to educate the public what should and should not be thrown into the sewers.

- This abuse causes like-wise affects as rain water discharge into the sewers

Examples of such abuse: Farm Waste discharged into Sewer



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Marsa PS – Effects of Abuse

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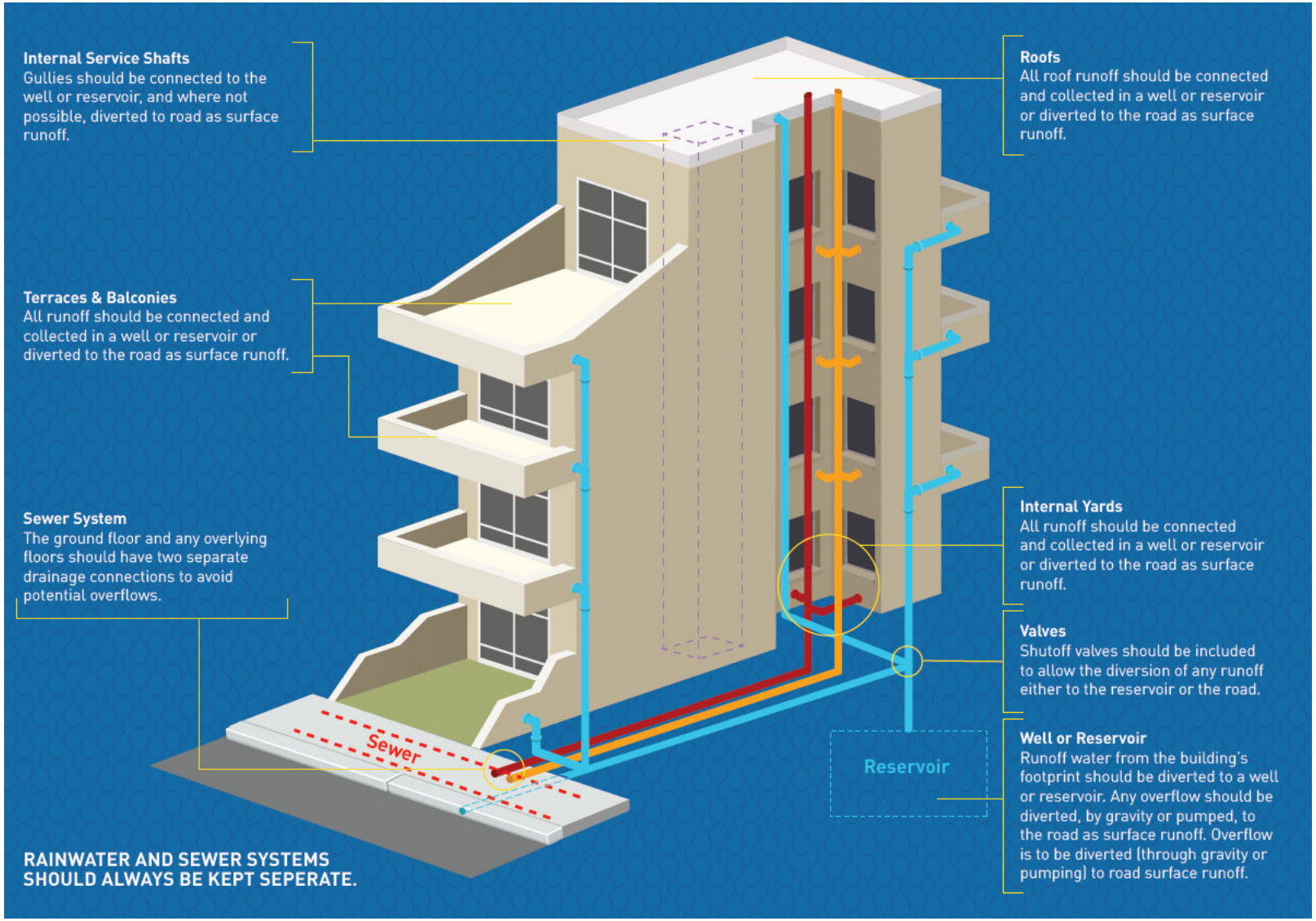
Guidance

- Exposed areas **cannot** be connected to the sewer.
- No manual shut off valves diverted to sewage are allowed.
- Sanitary & Laundry facilities, kitchens, RO water reject & pool/jacuzzi backwash can be discharged to sewer.



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GOVERNMENT OF MALTA

MINISTRY FOR THE ENVIRONMENT, ENERGY AND ENTERPRISE

MINISTRY FOR THE ECONOMY, EUROPEAN FUNDS AND LANDS

PARLIAMENTARY SECRETARIAT FOR EUROPEAN FUNDS

water services corporation

EU funds for Malta 2014-2020

Thank you for your Attention!

Any Questions?

For any further queries please contact us on:

✆ 8007 6400

✉ customercare@wsc.com.mt

Operational Programme I – European Structural and Investment Funds 2014-2020

"Fostering a competitive and sustainable economy to meet our challenges"

Project part-financed by the Cohesion Fund

Co-financing rate: 85% European Union Funds; 15% National Funds

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CONFERENCE ON

RAINWATER MANAGEMENT – AN UNTAPPED RESOURCE

RAINWATER MANAGEMENT

MAY 19, 2023

WATER.ORG.MT

HYDRAULIC MODELLING FOR RAINWATER MANAGEMENT

University of Exeter

Centre for Water Systems

Albert Chen

Personal Chair in Water and the Human Environment

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University of Exeter
Centre for Water Systems
CELEBRATING 25 YEARS
https://www.exeter.ac.uk/cws

OBJECTIVES

Designing assets, infrastructures, systems	Dynamics of flows for various conditions	What-if scenarios
Evaluating the effectiveness of interventions	Climate & Socioeconomic change	Adaptation strategies and planning

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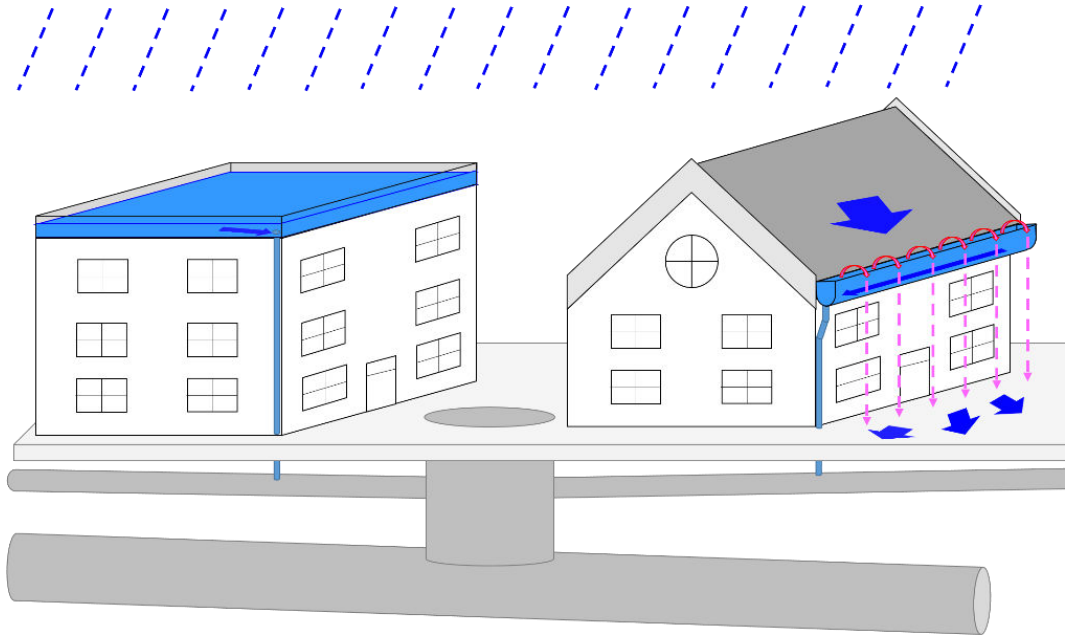
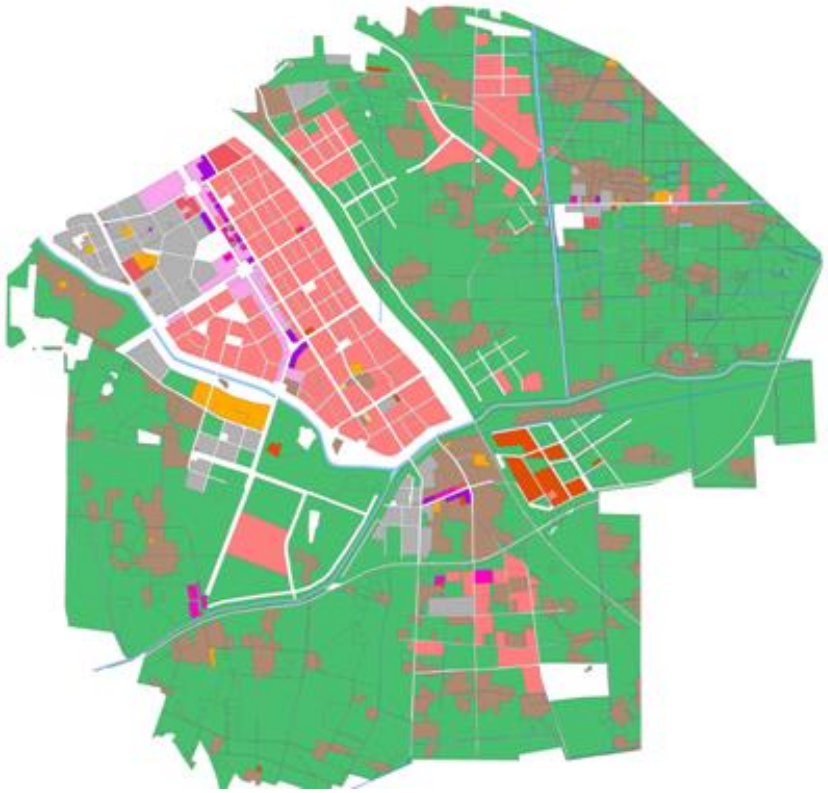
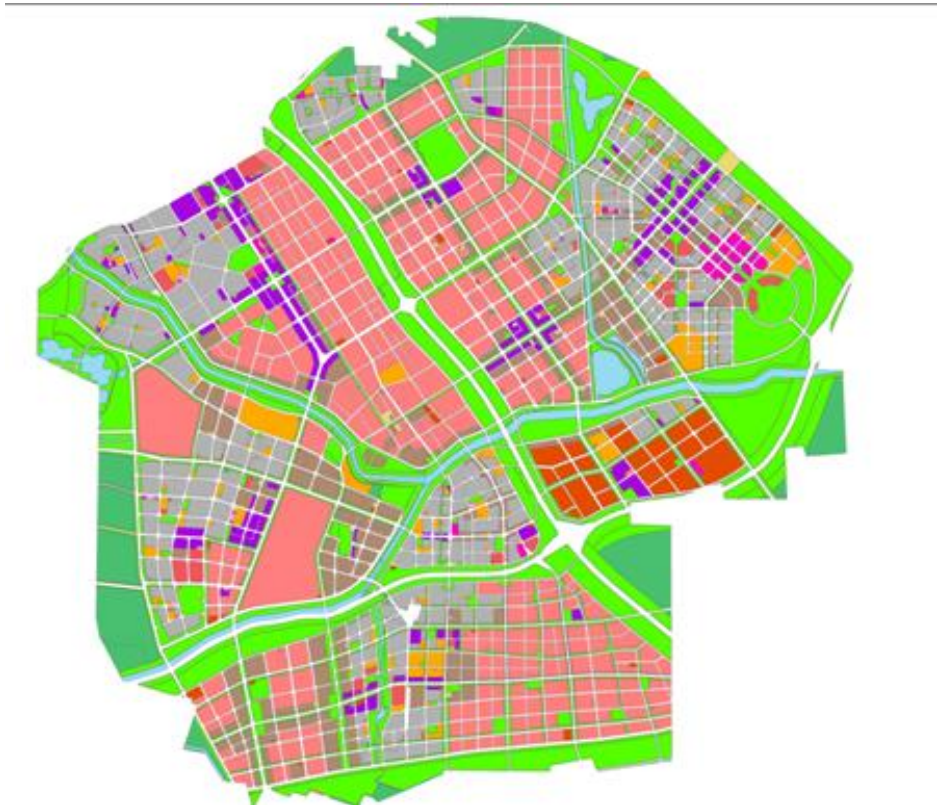
RAINFALL RUNOFF PROCESS



Chang et al. 2018 J Hydrology; Chang et al. 2015, J Hydrology

STRATEGIC PLANNING & POLICY MAKING





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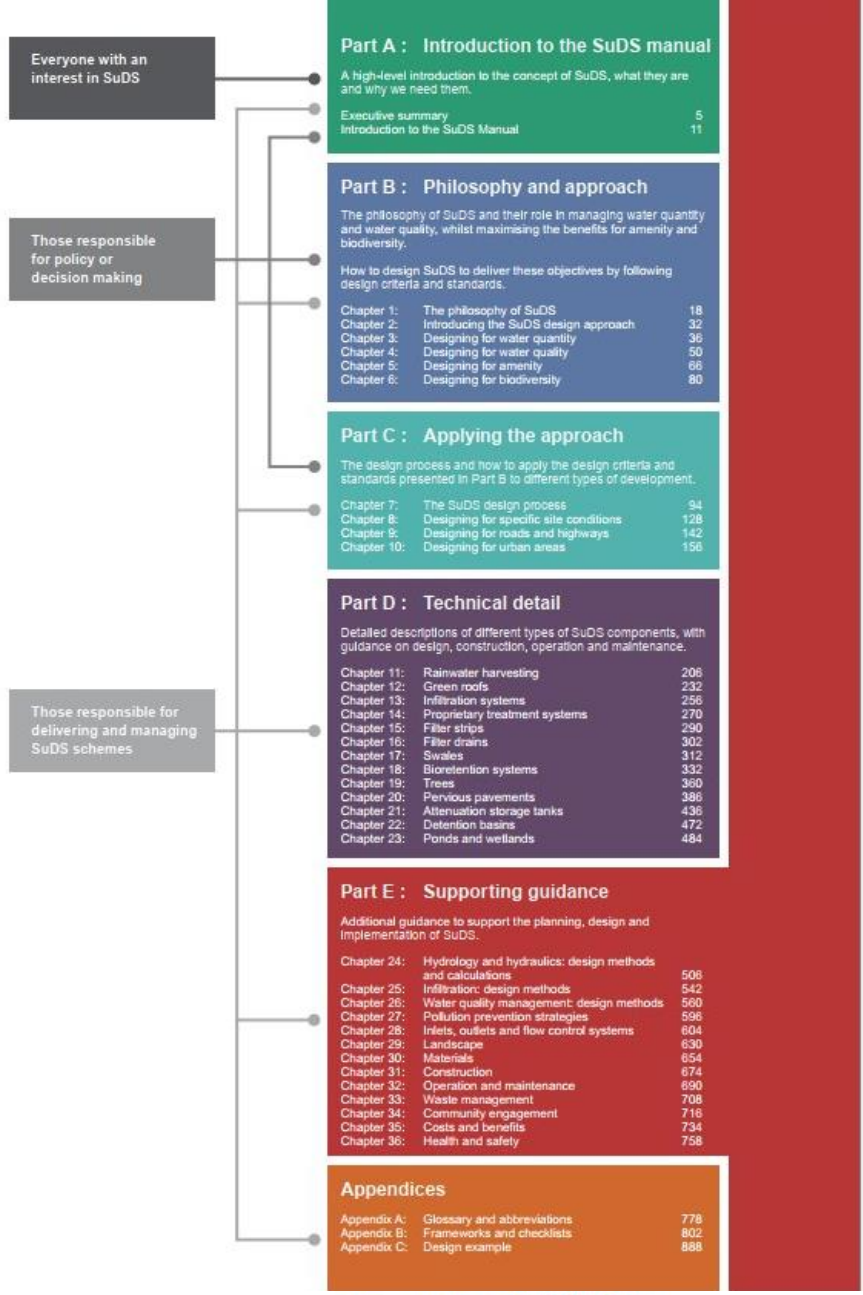
The SuDS Manual

Construction Industry Research and Information Association

Department for Environment Food & Rural Affairs

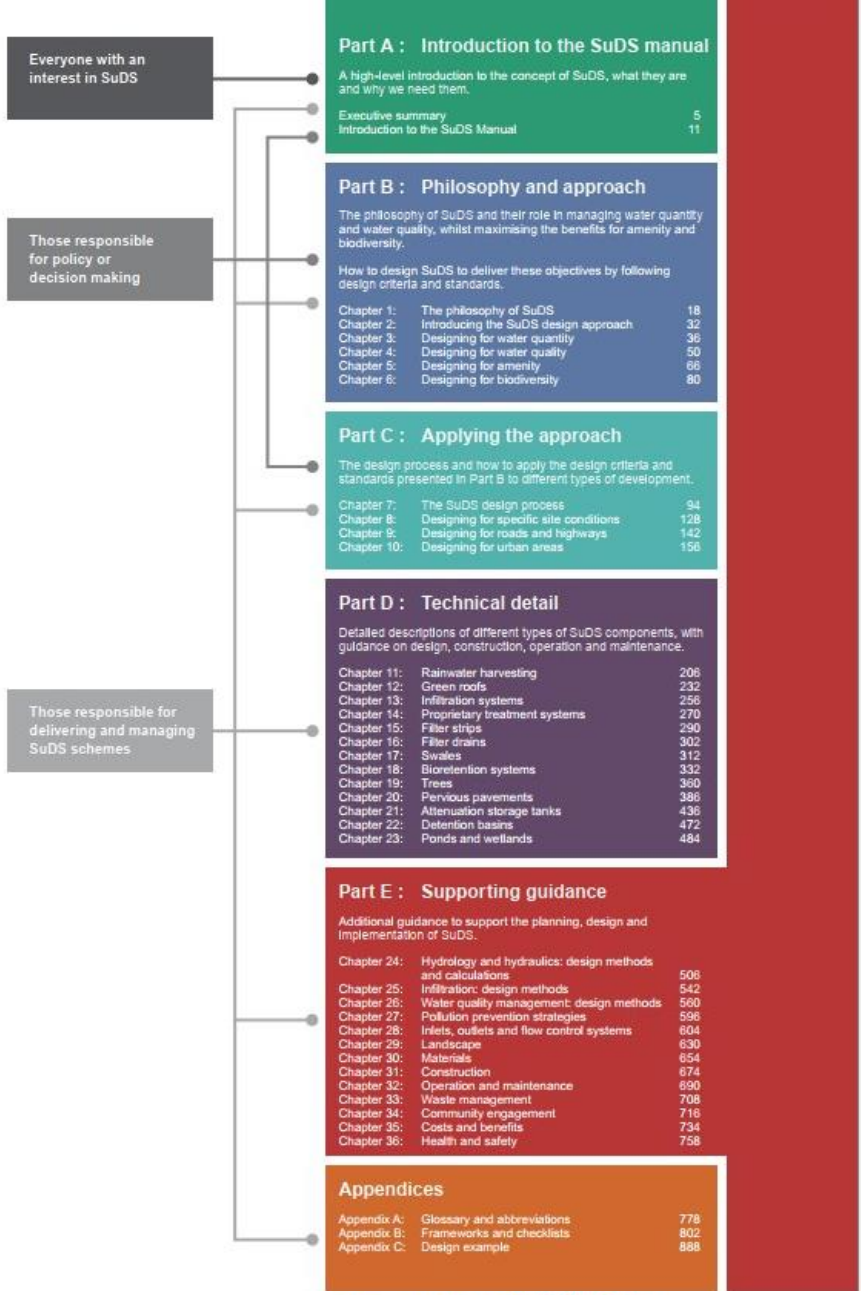
Part D : Technical detail

Detailed descriptions of different types of SuDS components, with guidance on design, construction, operation and maintenance.

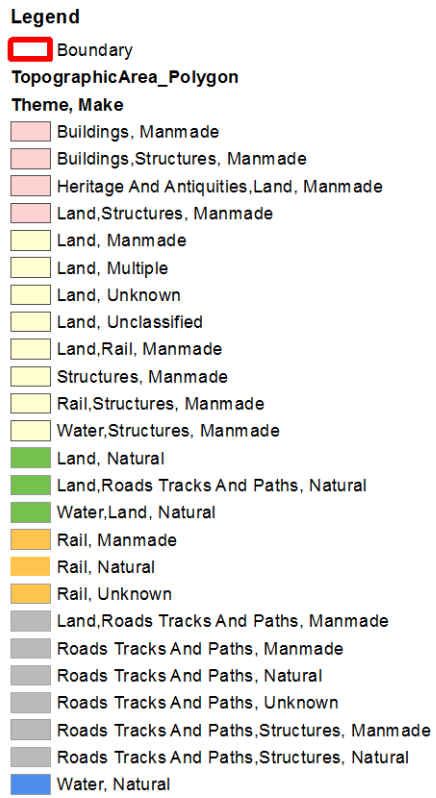


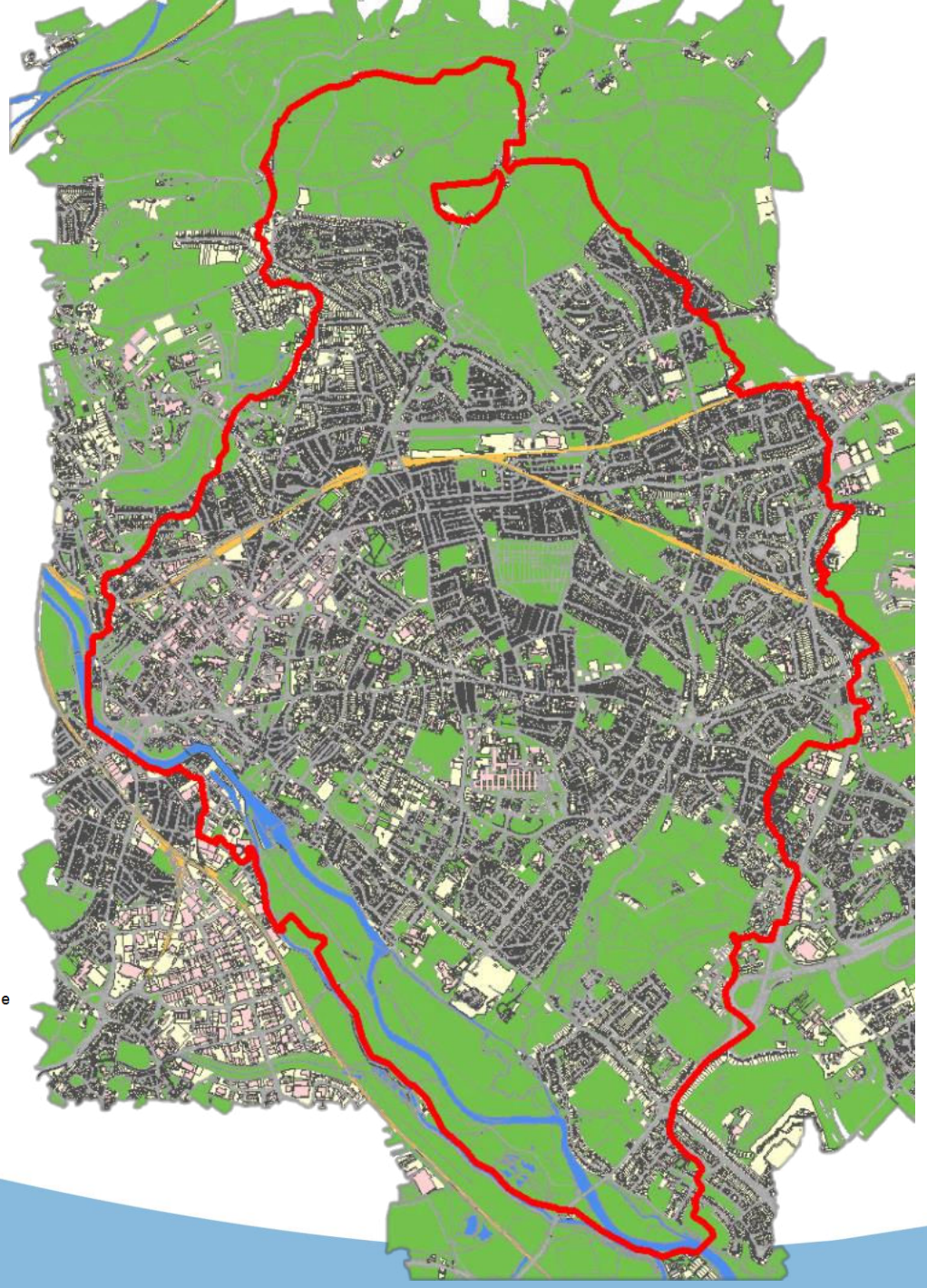
Part E : Supporting guidance

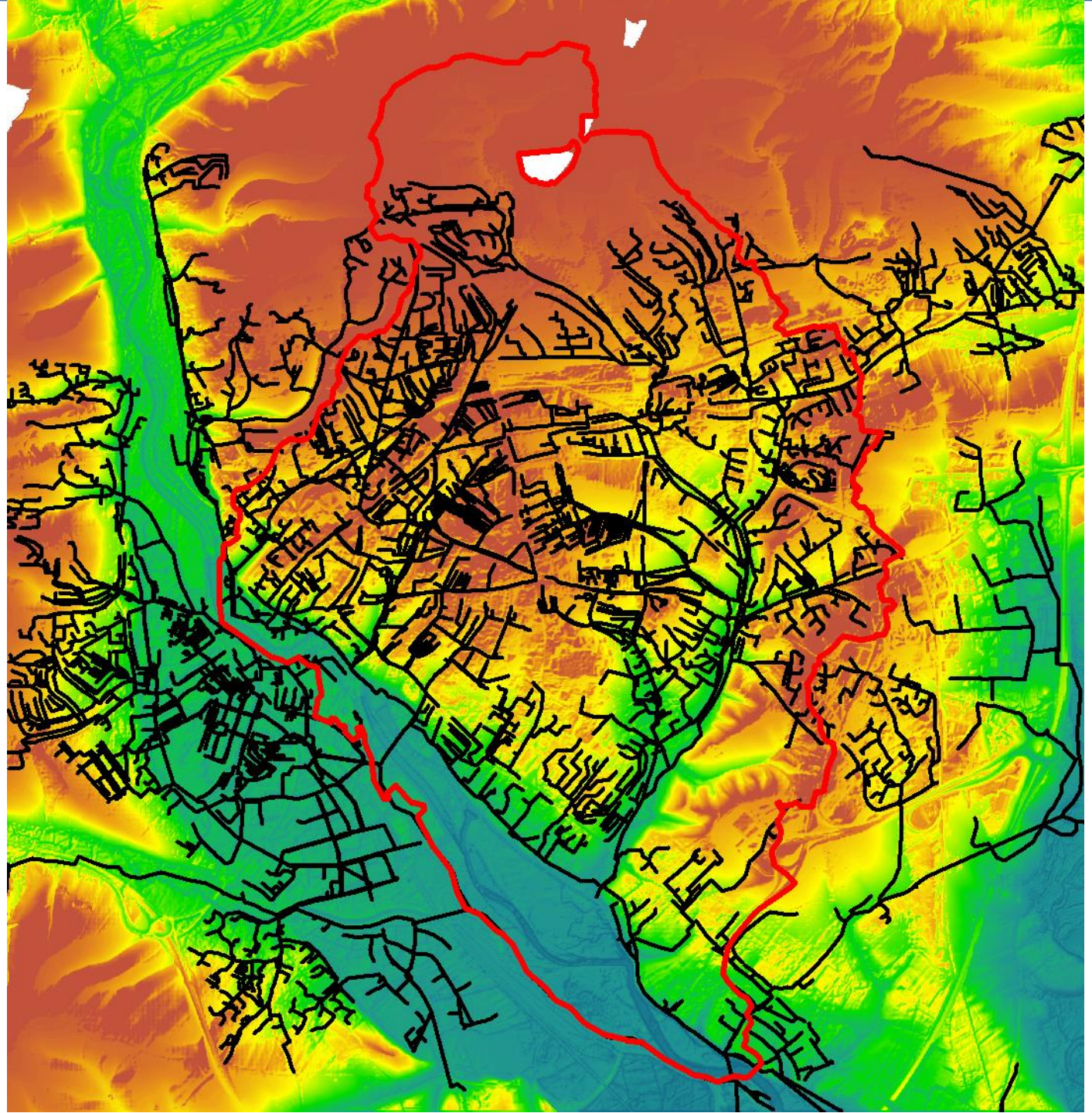
Additional guidance to support the planning, design and implementation of SuDS.



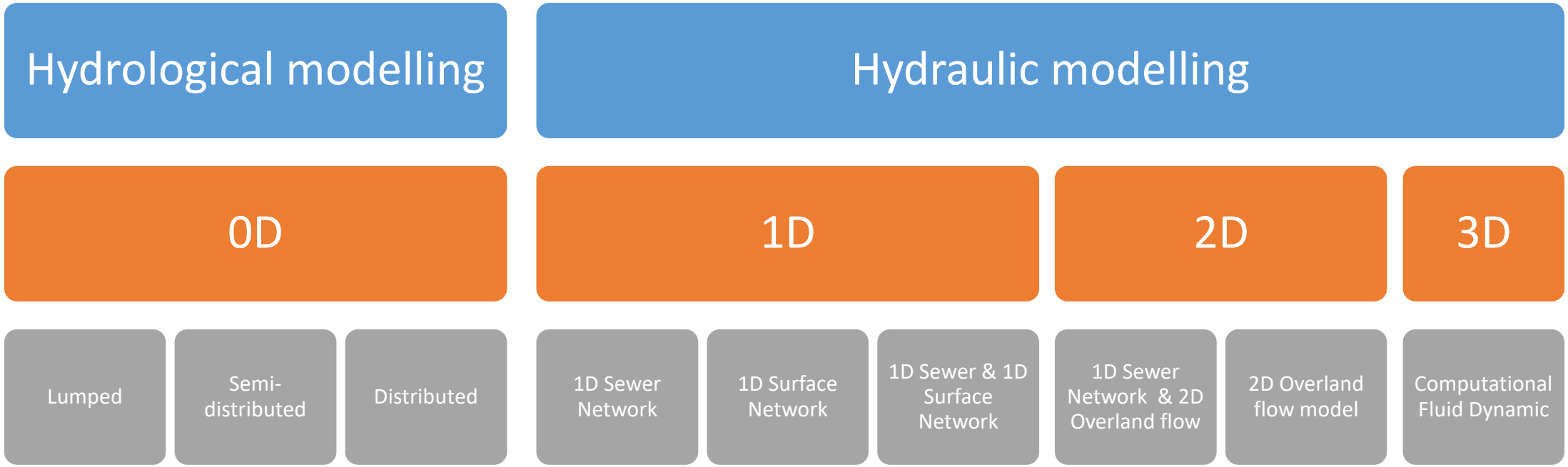
CATCHMENT/ SYSTEM MODELLING







MODELLING APPROACH



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MODELS

SWMM

Flood Modeller by Jacobs

InfoWorks ICM

MIKE by DHI

MIKE 11/21/Flood/Urban

Micro Drainage

XP swmm

XP storm

XP 2D

XP drainage

University of Exeter Centre for Water Systems

SIPSON/UIM, CAFLOOD

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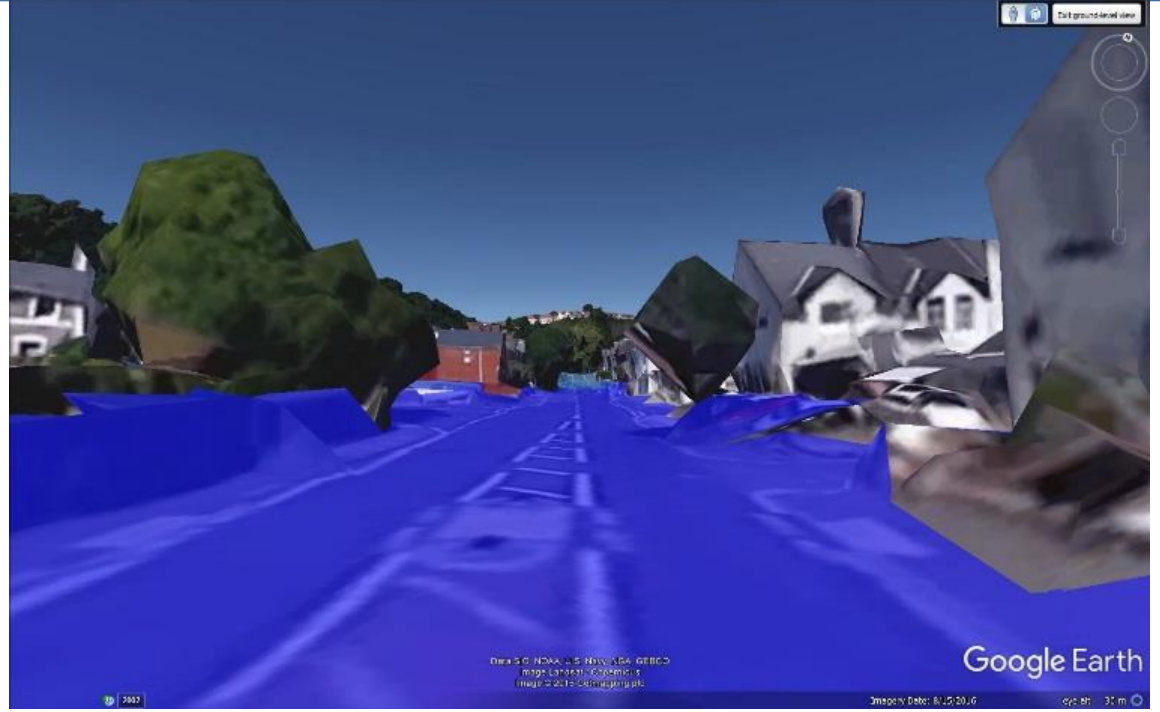
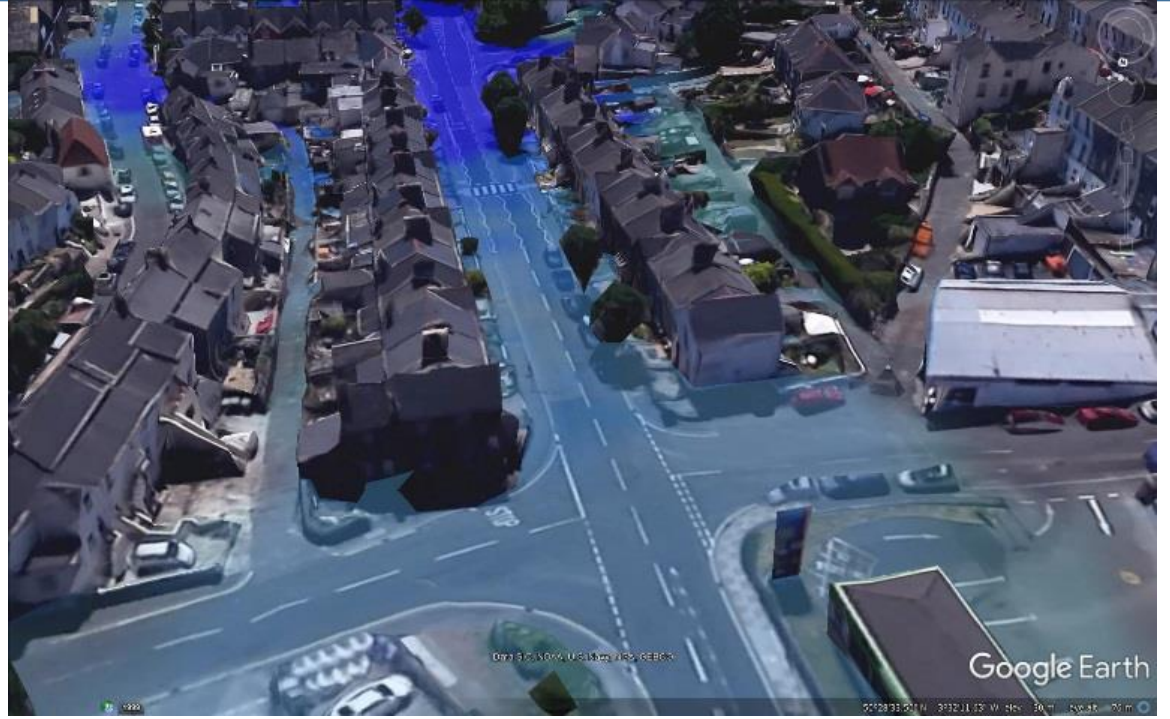
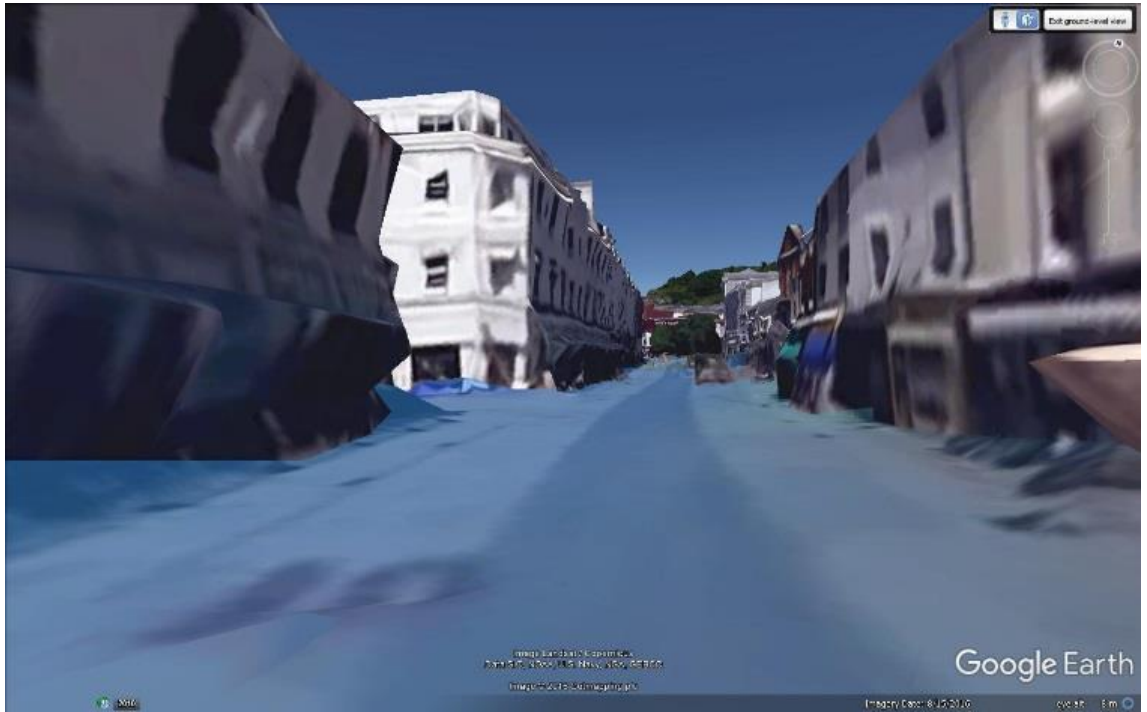
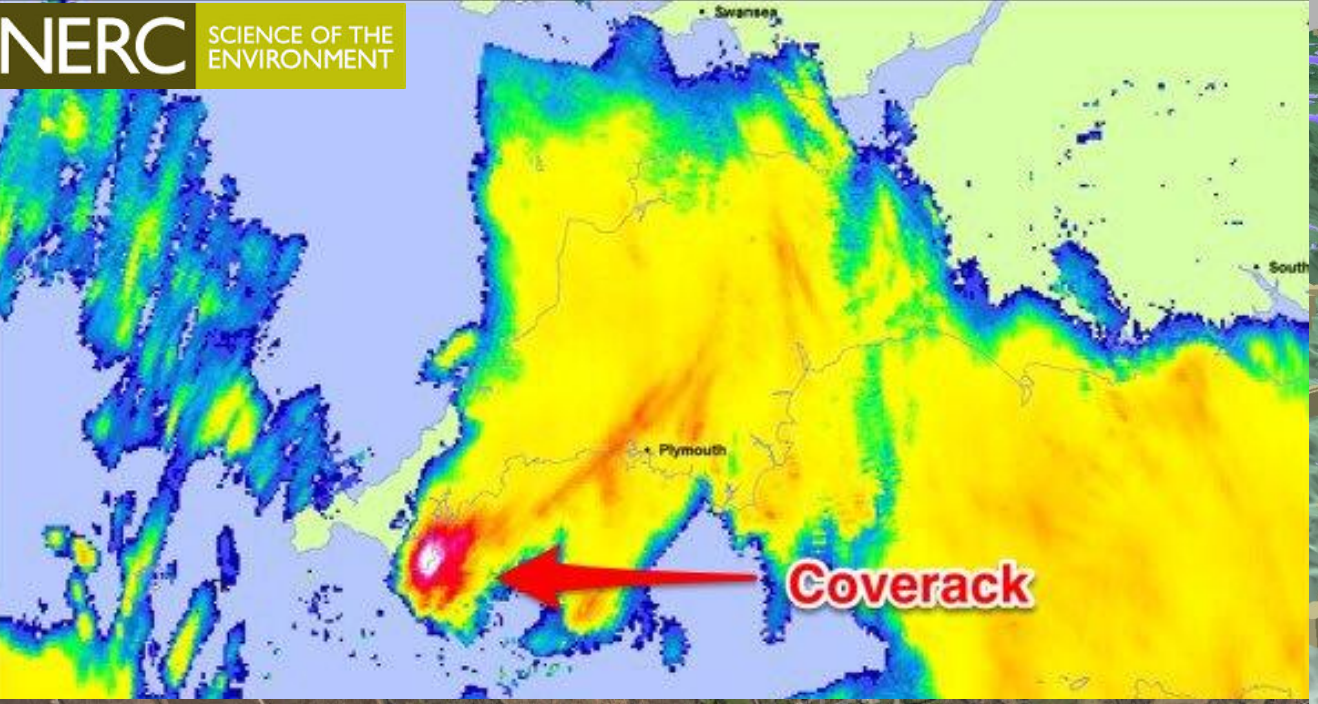
Substation
Road
Coach Station
Rail
Hospital
Local Government Office
Flooded substation
Flooded coach station
Flooded Hospital
Flooded local government
Electricity disruption
Heavy flooded road
Medium flooded road
Slightly flooded road
Buildings
<= 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.30
0.30 - 0.50
0.50 - 0.75
0.75 - 1
1.00 - 2.00
2 +
EU-CIRCLE
A pan-European frame
Critical Infrastructure

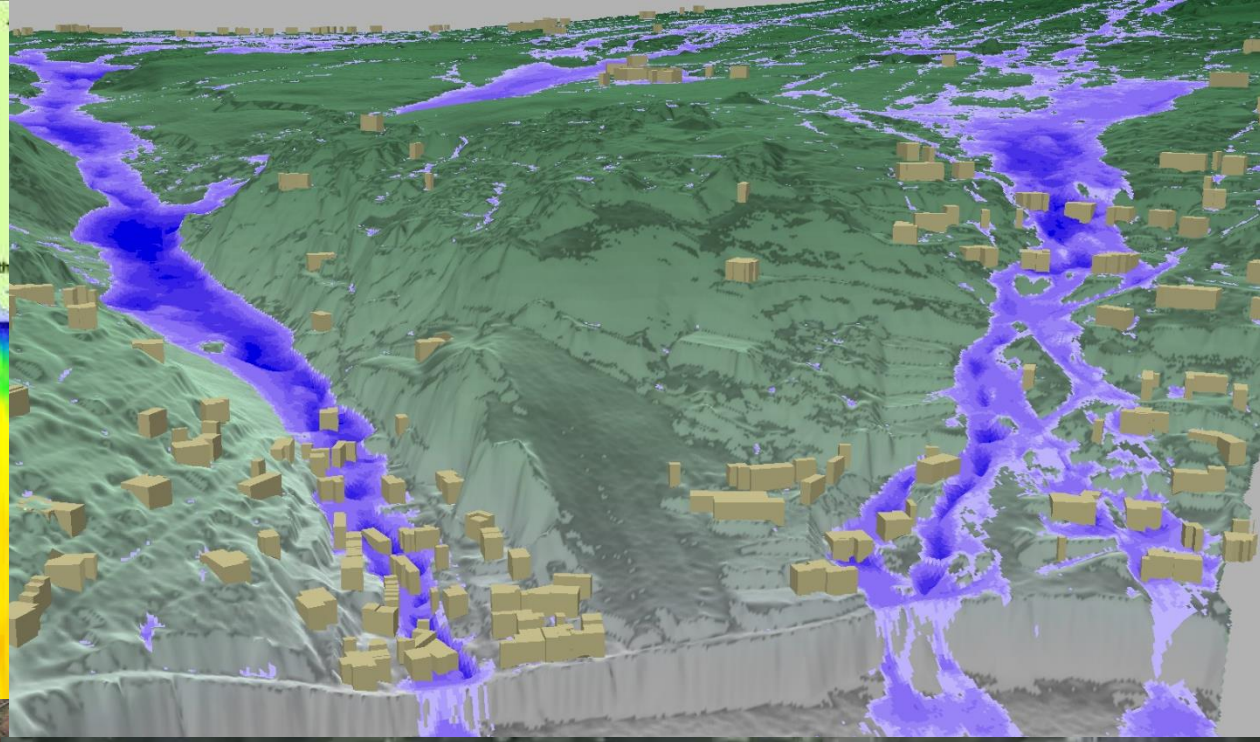

Google Earth

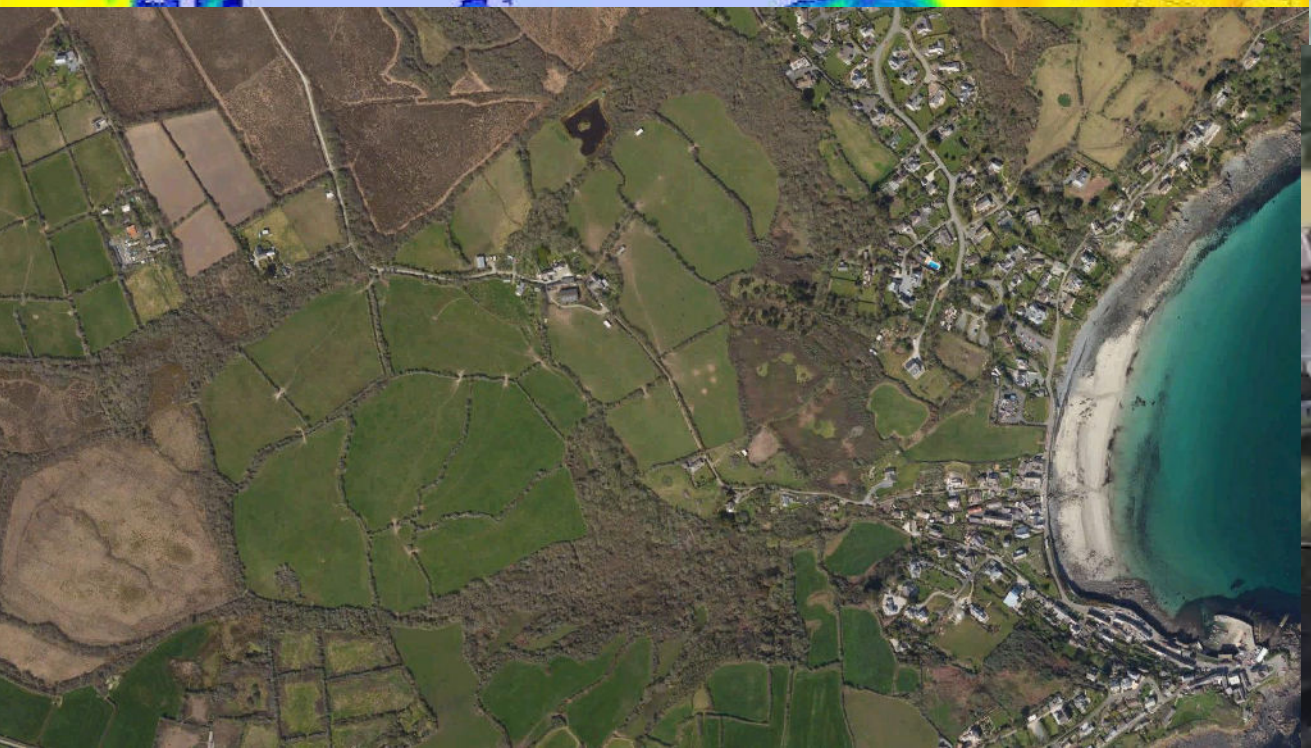

Google Earth


Google Earth


Google Earth

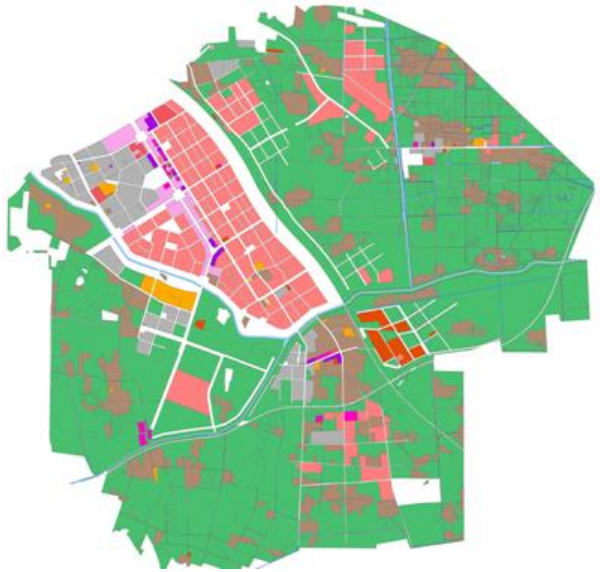

NERC
SCIENCE OF THE ENVIRONMENT
Swansea
Plymouth
Coverack

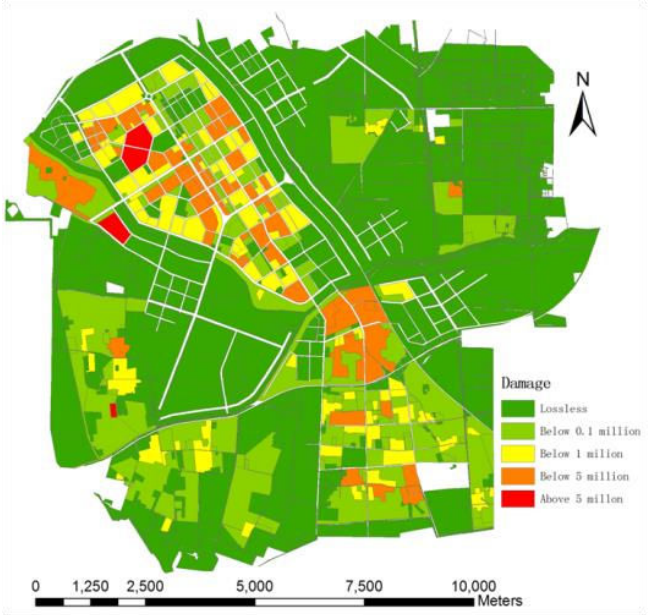




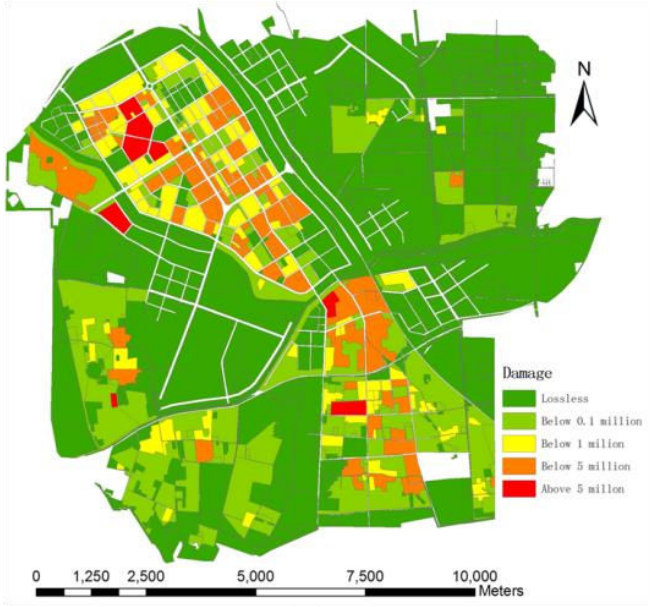

Facebook/Mark Newman via Storyful

PLANNING




N
Damage
Lossless
Below 0.1 million
Below 1 million
Below 5 million
Above 5 million
0 1,250 2,500 5,000 7,500 10,000
Meters

(a)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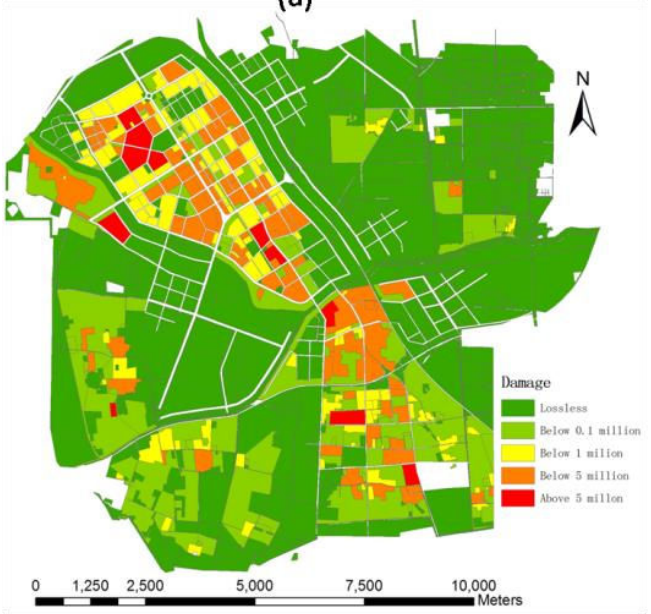
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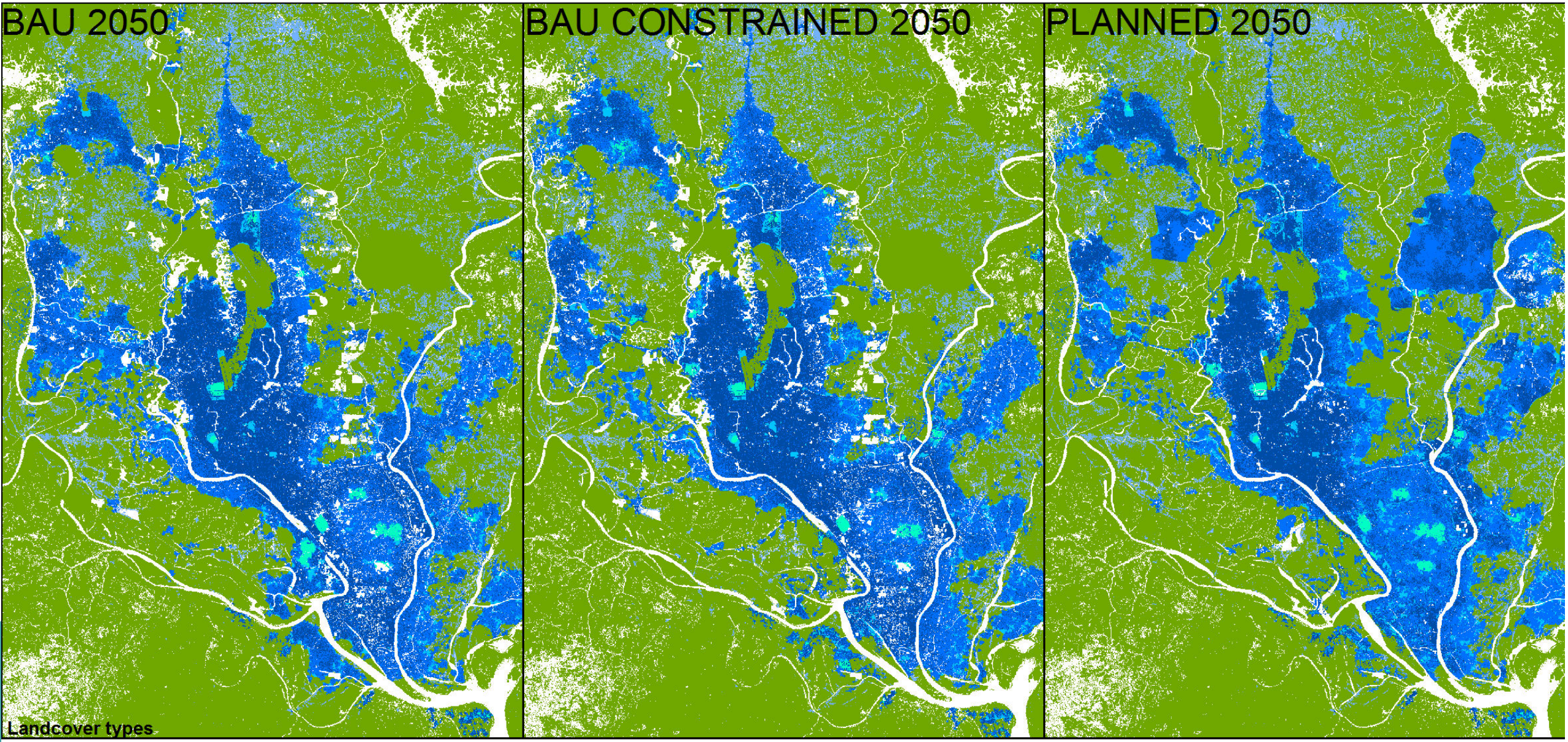
BAU 2050
BAU CONSTRAINED 2050
PLANNED 2050
Landcover types
Urban built-up
Suburban built-up
Rural built-up
Urbanized open land
Captured open land
Rural open land
Open water

BEYOND HYDRAULIC MODELLING

- Water quality and pollution
- Machine learning
- Internet of things
- Digital Twins

WATER
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ACKNOWLEDGEMENT

RECONECT

ARSINOE

RESCCUE

RESILIENCE TO COPE WITH CLIMATE CHANGE IN URBAN AREAS.

ICARIA

Improving climate resilience of critical assets

CORFU

FP7 Collaborative research on flood resilience in urban areas

EU-CIRCLE

A pan-European framework for strengthening Critical Infrastructure resilience to climate change

GOVERNMENT OF MALTA
MINISTRY FOR THE ENVIRONMENT, ENERGY AND ENTERPRISE
MINISTRY FOR THE ECONOMY, EUROPEAN FUNDS AND LANDS
PARLIAMENTARY SECRETARIAT FOR EUROPEAN FUNDS

water services corporation

EU funds for Malta 2014-2020

Contact

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@AlbertChen_CWS

AlbertChenExeter

University of Exeter
Centre for Water Systems

CELEBRATING 25 YEARS

Operational Programme I – European Structural and Investment Funds 2014-2020
"Fostering a competitive and sustainable economy to meet our challenges"
Project part-financed by the Cohesion Fund
Co-financing rate: 85% European Union Funds; 15% National Funds

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CONFERENCE ON

RAINWATER MANAGEMENT – AN UNTAPPED RESOURCE

MAY 19, 2023

WATER.ORG.MT

RAINWIIN- Rainwater Integrated Infrastructure Network

Kirsty Vella |

project green

WATER
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Operational Programme II (2014-2020)	• Cohesion Funds-Priority Axis-10: Investing in a more environmentally-friendly society.
Lead Partner	• Valley Management Unit- Project Green
Beneficiary Partner	• Public Works Department- Ministry for Planning and Public Works.
Non-Beneficiary Partners	• EWA

WATER
BE THE CHANGE

OVERVIEW

Project Objective

The RainWiiN Project (phase 1)consists of a proposal for a planning framework with action plans for the establishment of an integrated infrastructure network for rainwater management in five catchments in Malta

Project Components

ELEMENT 1:
Project Planning Framework

- Action plans
- Research

ELEMENT 2:
Pilot Project

- Pilot Site Selection
- Target: 45,000m^3

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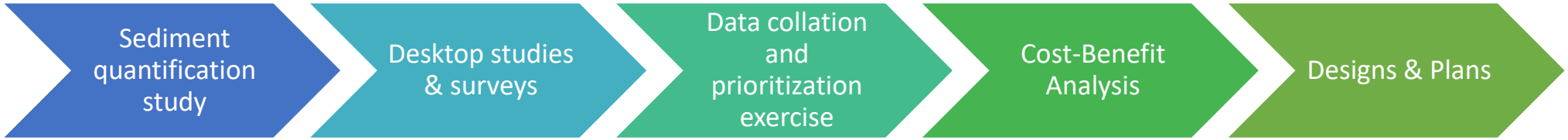
OUTPUTS

ELEMENT 1



ELEMENT 2

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ELEMENT 1

67 Reservoirs

68 Dams

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ELEMENT 1

4 Reservoirs

2 Dams

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The Pilot Site

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ELEMENT 2

1. 

Excavation of valley bed and construction of 8 new water retentions to increase effective water harvesting capacity by **45,000 m3**

2. 

Planting and maintenance of **30 different species** of trees and shrubs, amounting to around **2000 trees**.

3. 

Restoration of **one existent dam** and construction of **9 dams.**

4. 

Installation of **hydrological-monitoring** equipment

- weather station
- water level sensors

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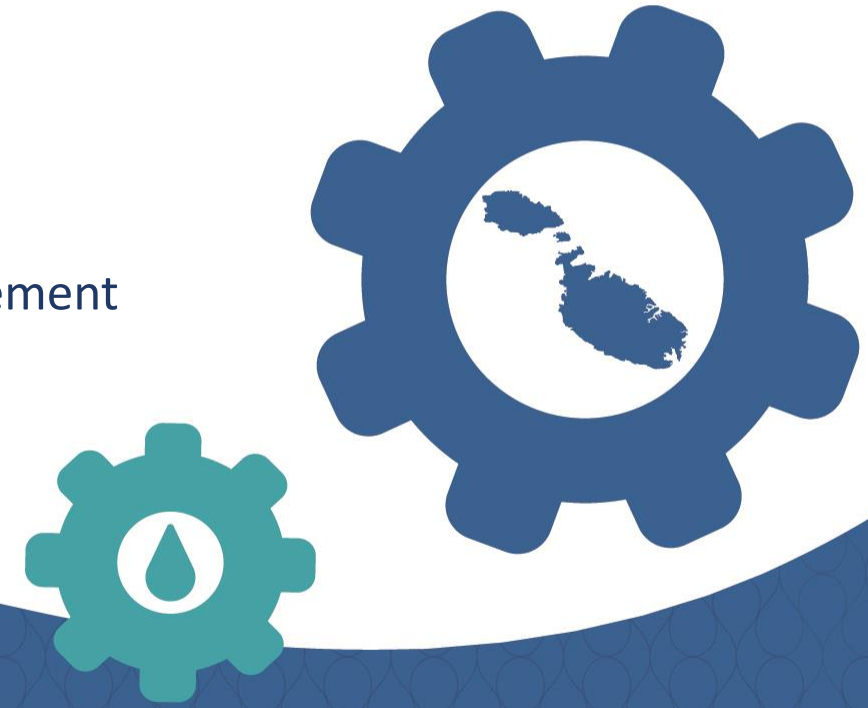
PHASE 2- MOVING FORWARD

1) **Identification of the value of services provided by local groundwater/rainwater infrastructure.**
    - Aids public entities to determine the overall value of investment required to optimize green and grey infrastructure.

2) **Obtain a feasibility assessment**
    - that level of investment can yield into tangible improvement of rainwater harvesting



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3. Research utilization in future projects

Wied Ghajn Mula

WATER
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Wied il-Ghajn

WATER
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GOVERNMENT OF MALTA

MINISTRY FOR THE ENVIRONMENT, ENERGY AND ENTERPRISE

MINISTRY FOR THE ECONOMY, EUROPEAN FUNDS AND LANDS

PARLIAMENTARY SECRETARIAT FOR EUROPEAN FUNDS

water services corporation

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Thank you for your attention!

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6. Images

Below one can find a number of images that were taken during the event.

6.1 Conference Area

The conference was held at the 5-Star Corinthia Palace Hotel offering full conference facilities and exhibition area.


WATER
WATER

6.2 Registrations

A registration desk was provided in order to greet the participants.

6.3 Merchandise

A table was set up with merchandise for the attendees.

6.4 Area for Lunch & Coffee Break

A secluded area was set up where a standing lunch and coffee break were provided.

6.5 Panel Speakers

Chairs were set up on stage for the speakers during the panel discussion.


RAINWATER MANAGEMENT – AN UNTAPPED RESOURCE