GREATER LONDON AUTHORITY

Royal Docks

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Royal Docks and Beckton Riverside

Integrated Water Management Strategy

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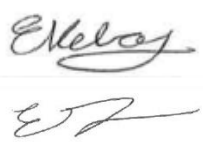
		Signature			
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Non-technical summary

Purpose and objectives

This document presents the Integrated Water Management Strategy (IWMS) for the Royal Docks and Beckton Riverside Opportunity Area. The IWMS provides a holistic and integrated assessment of future water demand scenarios, flood risk, and water infrastructure including water supply, foul and surface water drainage. The IWMS provides a framework to support the planning process and activities of infrastructure providers, such as water companies and developers. The geographic location and the extent of the OA is given in Figure 2.

The objectives of the IWMS are to understand current and future water-related challenges that may impact planned growth; to assess the delivery of water infrastructure in an integrated way – across the water cycle, and in relation to other sectors; to ensure that the proposed development across the OA results in sustainable water management and climate adaption; and to present outputs in a way that encourages tracking of delivery and adaptation to future changes.

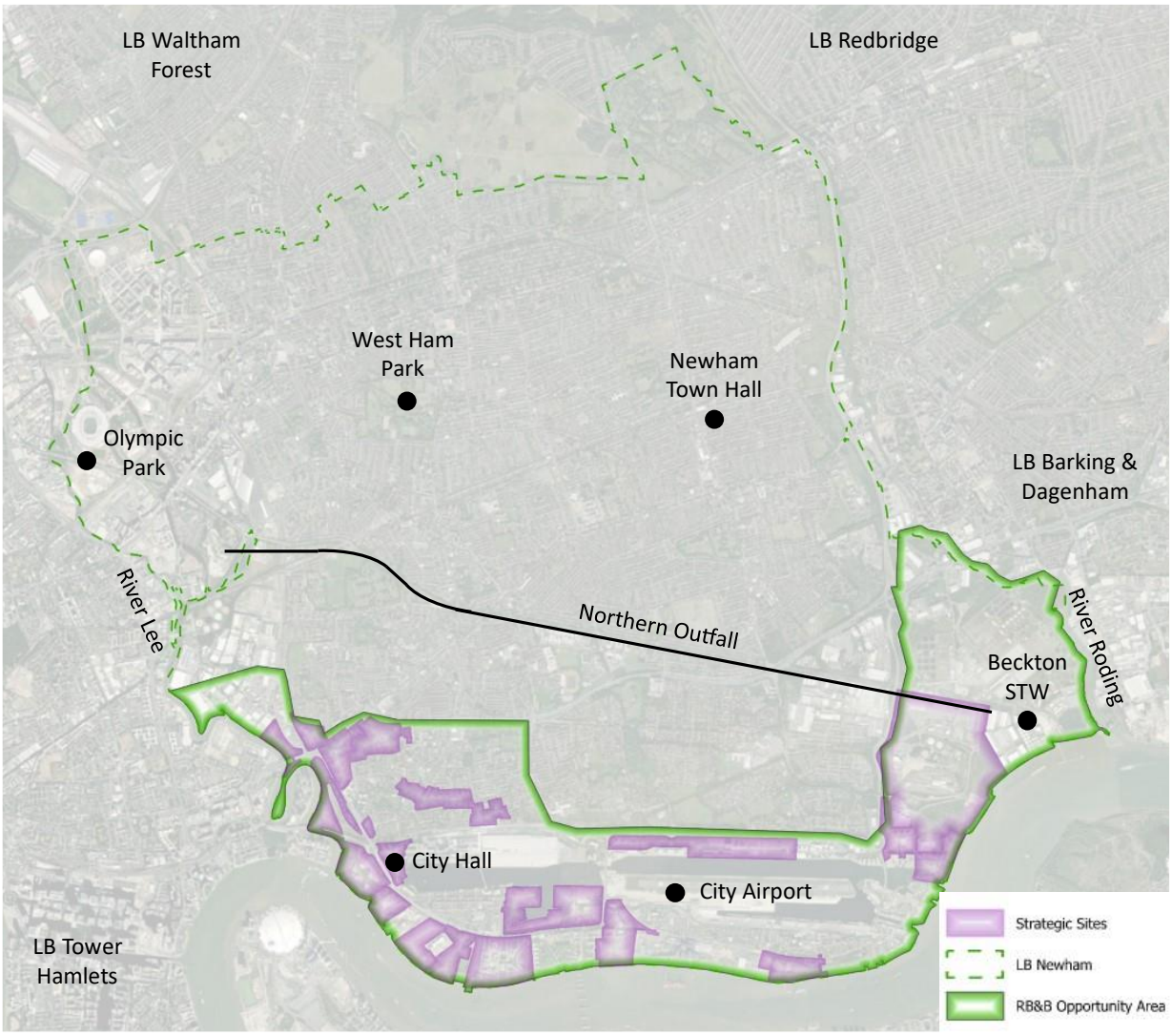

Figure 1: Map showing the London Borough of Newham, OA boundary, and Strategic Sites.

Approach

The approach has sought to follow best practice as well as learn from recent experience of IWMS within the GLA. A review of recent IWMS's by the GLA in particular noted the need for greater focus on policy and plans to support delivery of IWMS ambitions.

The project was guided with the help of a Steering Group comprising representatives from: Greater London Authority, London Borough of Newham, Environment Agency, Thames Water and Royal Docks Management Authority.

Working with the Steering Group a number of ambitions were defined to steer the focus of the IWMS. Core ambitions are summarised below:

Water

Promote local and integrated management of water resources, provide sufficient drainage network capacity, or mitigate capacity constraints and reduce the risk of flooding, and provide better protection to areas at risk of flooding.

Climate change

Minimise greenhouse gas emissions and adapt to the effects of climate change.

Biodiversity

Promote biodiversity net-gain and provide opportunities for people to come into contact with and appreciate wildlife and nature.

Delivery, operation, and maintenance

Minimise disruption as a result of option delivery and reduce costs of water management for consumers and developers.

Analysis

The role of the IWMS is to provide strategic guidance with a view to future conditions. A key ambition of the steering group is that that IWMS should consider and promote adaptability and resilience of the water system to future uncertainty. A number of scenarios were modelled to understand the water balance in the Opportunity Area under different conditions and to test the relative impact of different approaches towards meeting the IWMS ambitions.

- Two scenarios consider the water balance under baseline and a high growth trajectory.
- Two scenarios consider the impact of the water balance where interventions are focused on new developments (i.e., where planning is still possible, and developer delivery is an option) vs the impact where more ambitious interventions can be pursued including retrofit in the wider OA.
- A fifth scenario explores the Royal Docks surface water impact.

Key Insights

Growth and Supply Demand Balance

The supply demand balance will widen as a result of growth and reduced availability of water supply due to climate change and environmental constraints.

Water efficiency

The water demand from existing building stock is much higher than water demand from future growth illustrating the potential for retrofit water efficiency measures. Only half of existing households are metered.

Leakage reduction

The water resource zone (WRZ) of Thames Water is the single largest mechanism for reducing supply demand balance. However, leakage reduction is planned and managed across the Water Resource Zone – a far larger scale than the Opportunity Area.

Surface water management

Diversion of surface water runoff from combined sewers is a priority to manage the existing risk of surcharge and localised flooding. The topography and large portion of impermeable land-use in the Opportunity Area presents surface water flood risk to the Strategic Sites and should be mitigated through approaches to retrofit green-blue infrastructure. Sustainable Drainage solutions will need to manage the constraints due to ground conditions, including geology and certain areas of high ground water.

Royal Docks

The royal docks themselves are a major water asset which receive surface water run-off, are supplied with water from the Thames to maintain operational levels and are used as a recreational as well as commercial asset.

Water quality

A review of the sewer overflow operations from the published Event Duration Monitor (EDM) data indicated that there are instances of combined sewer overflow into the tidal rivers during storm events causing water quality impacts. However, the impact of diffuse pollution from roads and other sources is not easy to monitor.

Recommendations, Implementation & Monitoring

A review of recent IWMS's by the GLA in particular noted the need for greater focus on policy and plans to support delivery of IWMS ambitions. To respond to this, this RD&BR IWMS has introduced a Delivery strategy and Implementation toolkit as well as including clear recommendations where further technical work should be carried out to support specific planning and delivery of interventions.

Recommendations

1. Carry out review of TW leakage reduction plans within LBN to confirm expected timing, roll-out and impact on water supply. Review opportunities for accelerated leakage reduction activities to align with planned development or other infrastructure works in RD&BR.
2. Develop a clear and measurable retrofit strategy for increased roll out of metering, home visits and awareness campaigns to promote retrofit of metering, efficient fittings and rainwater harvesting. Identify priority opportunities for retrofit of interventions including publicly owned and community buildings including educational and healthcare facilities.
3. Set-up strategic sites IWMS forum. Carry out focussed engagement and detailed review of strategic site IWMS for alignment with IWMS ambitions. This review should include consideration of the role for NAVs to accelerate and improve IWMS outcomes on strategic sites.
4. Carry out a detailed drainage system risk assessment of knowledge, data, and performance in the OA. Build on analysis carried out in 2015 by LLFA to identify opportunity for betterment including where this can be delivered in parallel with Strategic Site development.
5. Consider approach and possible business case for management of the docks as a strategic water asset within the OA. This should include water balance management including leakage loss reduction and surface water attenuation, water quality, renewable energy (e.g., floating solar), and minimised pump operation.
6. Carry out a detailed review and assessment of water quality monitoring activity and evidence within the OA to identify need and opportunities for improvements to monitoring to assist improved management of water system.
7. Carry out a strategic reviews of IWMS partnership opportunities with relevant stakeholders, at least healthcare and education, to identify opportunities for efficient and coordinated review of integrated water management opportunities across their portfolios and aligned with their investment plans.

Delivery Strategy and Implementation Toolkit

The Delivery strategy and the Implementation toolkit outline how these recommendations can be implemented in the OA. The Delivery strategy is largely aimed at policy makers and local authorities, while

the Implementation toolkit can be used on a case-by-case basis by the parties delivering the interventions, such as developers.

Monitoring Strategy

The purpose of monitoring with relation to the IWMS is to help ensure that the recommended interventions are being implemented and are having the desired effect in order to realise the ambitions of the steering group. A monitoring strategy has been proposed.

Data collected and shared should be monitored against the predictions of their impacts produced by the scenario modelling in the IWMS. Additionally, information shared for monitoring should be used to assess the impact of interventions with regard to the ambitions set out in the IWMS. To minimise additional time requirements, these activities ideally should be aligned with existing monitoring activities, such as Authority Monitoring Report for the Local Plan.

Glossary

Term	Definition / units
AMP	Asset Management Period
Attenuation	A system that has been designed to hold back part of the peak flow caused by a rainfall event, therefore making the peak smaller and reducing the risk of flooding.
Blue green infrastructure (BGI)	A strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem service.
Catchment	The area of land, including the hills and mountains, woodlands, and buildings which water drains from, before flowing into a river, lake, or lough.
Climate Change	The rising average temperature of Earth's climate system, called global warming, is driving changes in rainfall patterns, extreme weather, arrival of seasons and more. Collectively, global warming and its effects are known as climate change.
Combined sewer overflows	Combined sewer overflows are pipes and pumps which allow excess flows of highly diluted wastewater which, in many cases passes through screens, to remove plastic and rags, to be returned into watercourses, rivers and the sea to help prevent homes and businesses from being flooded.
Combined sewers	These pipes carry both wastewater, from homes and businesses, and rainwater, which runs off from roads, drives and roofs (impermeable surface areas), to wastewater treatment works.
Drainage infrastructure	A term used to collectively describe all the assets with a drainage system.
Drainage network	A collective term to cover a system of open channels, watercourses or pipes that convey surface water.
DWMP	Drainage and Wastewater Management Plan
EA	Environment Agency
Flood Risk Assessment (FRA)	An FRA investigates the impact that a project will have watercourses and assesses the flood risk to the proposed project.
Fluvial flooding	Flooding from a river or watercourse.
Foul water sewers	These carry wastewater from homes and businesses to a STW.
FRMP	Flood Risk Management Plan
GIS	A geographic information system (GIS) is a framework for gathering, managing, and analysing data.

Term	Definition / units
GLA	Greater London Authority
IWMS	Integrated Water Management Strategy
LB	London Borough
LBN	London Borough of Newham
LFRMP	Local Flood Risk Management Plan
LLFA	Lead Local Flood Authority
LP	Local Plan
MCA	Multi-Criteria Analysis
Metric - Demand	litres or ML or l/s
Metric - Fluvial flows	m^3 or m^3/s
Metric - Land use	ha
Metric - Rainfall	mm or mm/hr
Metric - Supply	litres or ML or l/s
Metric - Surface water flows	m^3 or m^3/s
Metric - Wastewater flows	m^3 or m^3/s
Natural Flood Management	Natural Flood Management (NFM) is the alteration, restoration, or use of landscape features to reduce flood risk.
NAV	New Appointment and Variation
OA	Opportunity Area
OAPF	Opportunity Area Planning Framework
RBMP	River Basin Management Plan
RD&BR	Royal Docks and Beckton Riverside
RoDMA	Royal Docks Management Authority
Sewerage network	This term is used to describe all of the sewers, overflows, storm tanks and pumping stations that convey flow to either a STW or to a receiving water.
Sewerage pumping stations (SPS)	This is a structure to which foul and combined sewers discharge and includes pumps used to pump the sewage to another location, which could be to another sewer, pumping station or to a STW.
Sewerage treatment works (STW)	Sewerage treatment works have four main stages of treatment – preliminary, primary, secondary, and tertiary. The number of stages depends on what quality the treated wastewater needs to reach before it can be safely returned back into rivers or the sea. They discharge treated effluent from the main process and can also discharge surface water from storm tanks overflows.
Sewers	These are pipes that meet any of the 3 definitions below for surface water, foul, or combined sewers.
SFRA	Strategic Flood Risk Assessment

Term	Definition / units
SIWMS	Sub Regional Integrated Water Management Strategy
STW	Sewage Treatment Works (also see WWTW)
Surface water	This is caused by rainwater that falls on the ground, roofs, roads, pavements, and paths. It can either evaporate back into the air, infiltrate the ground, pond on the surface, or flow into a receiving water (such as a river, lake, or the sea) via a wide range of flow paths.
Surface water flooding	This is where surface water floods an area. Sometimes known as 'pluvial flooding'.
Surface water separation	Surface water separation is the practice of separating the combined, single pipe system into separate sewers for sanitary and storm water flows.
Surface water sewers	These carry rainwater that falls on roads, drives and roofs directly to a local watercourse, river, soakaway, or combined sewer.
Sustainable Drainage Systems (SuDS)	Drainage systems designed to mimic nature and typically manage rainfall close to where it falls.
SWMP	Surface Water Management Plan
WAFU	Water Available for Use
Wastewater	This is sewage plus other materials such as trade effluent (wastewater from commercial processes) and leachate (polluted water from landfill sites) that could also be discharged into sewers or directly to the sewer by a tanker.
Watercourse	Any channel or passage of whatever kind, whether natural or artificial, through which water flows.
WFD	Water Framework Directive
WRMP	Water Resource Management Plan
WRZ	Water Resource Zone
WWTW	Wastewater Treatment Works

Introduction

Purpose

This document presents the Integrated Water Management Strategy (IWMS) for the Royal Docks and Beckton Riverside Opportunity Area. The IWMS provides a holistic and integrated assessment of future water demand scenarios, flood risk, and water infrastructure including water supply, foul and surface water drainage. The IWMS provides a framework to support the planning process and activities of infrastructure providers, such as water companies and developers. The geographic location and the extent of the OA is given in Figure 2.

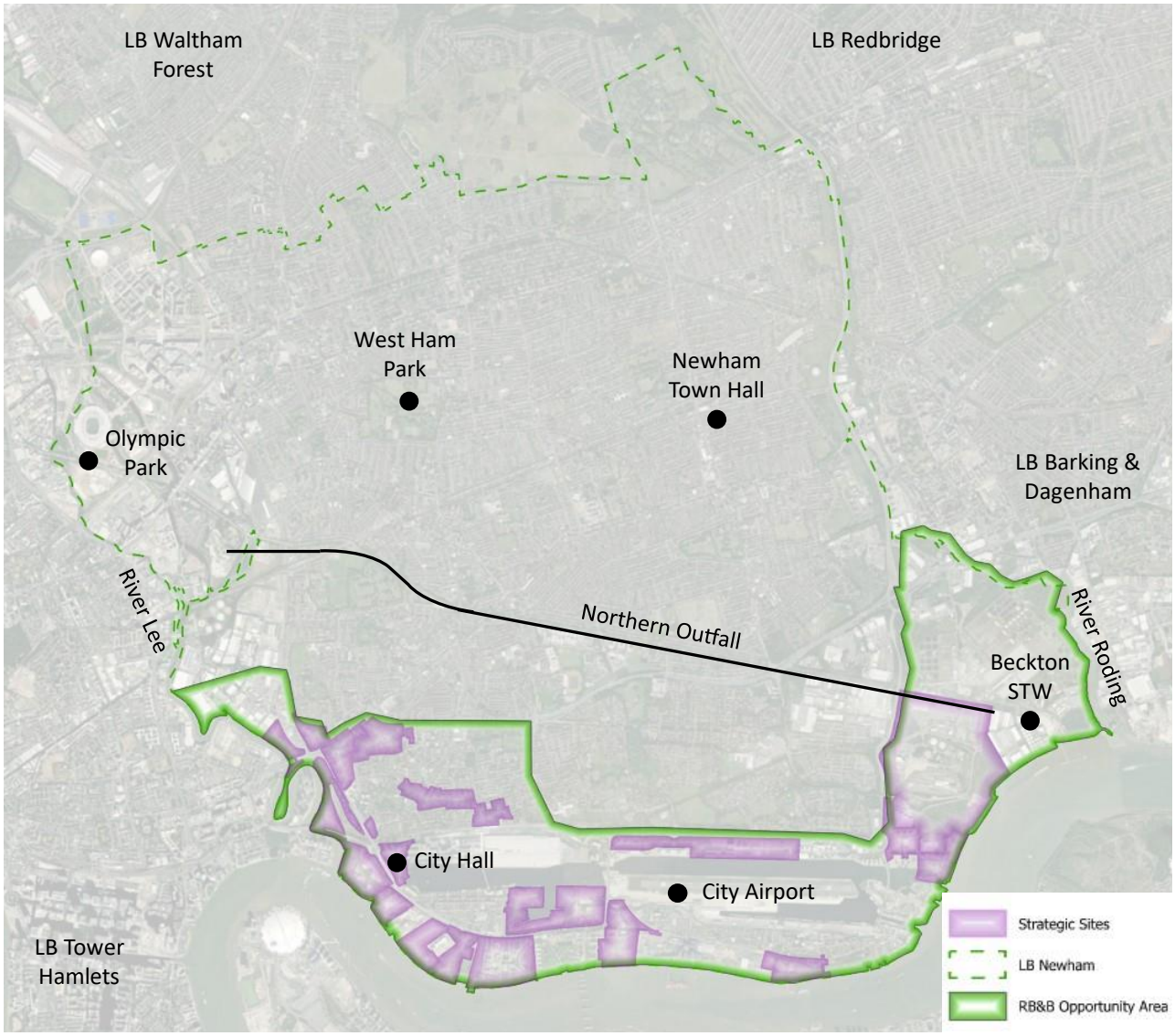

Figure 2: Map showing the London Borough of Newham, OA boundary, and Strategic Sites.

Objectives

The objectives of the IWMS are:

1. To develop an evidence-base of water infrastructure requirements, to help understand water-related barriers and constraints to expected levels of growth and development in the OA.
2. To examine opportunities to implement water infrastructure delivery that will enable development and recommend potential solutions to address identified barriers.

3. To seek to align water infrastructure delivery with development trajectories and transport, utility, and other infrastructure programmes, highlighting opportunities for collaboration; propose a preferred strategy that addresses barriers while maximising multiple benefits.
4. To present outputs in a way that encourages tracking of delivery and adaptation to future changes.
5. To ensure that the proposed development across the OA results in sustainable water management and climate adaption.

Approach

To evaluate options for the OA, a wider study area was considered for the IWMS. This study area was proposed to and agreed by the Steering Group.

The development of the IWMS was broken down into a variety of stages. The process is designed to be repeatable in other contexts outside of the RD&BR opportunity area. The flow chart given in Figure 4 shows the process, leading to Delivery strategy, Implementation toolkit, and Monitoring strategy which should be used together to ensure the objectives of the IWMS are met.

The approach has sought to follow best practice as well as learn from recent experience of IWMS within the GLA. A review of recent IWMS's by the GLA in particular noted the need for greater focus on policy and plan levels to support delivery of IWMS ambitions. To reflect this, the IWMS has introduced a Delivery strategy and Implementation toolkit as well as including clear recommendations where further technical work should be carried out to support specific planning and delivery of interventions.

Systems-based approach

Systems-based thinking has underpinned the IWMS methodology. This has been grounded in Arup's Deign With Water framework as illustrated in Figure 3. Design With Water supports an outcomes-led approach and emphasises the consideration of place-based needs and priorities, partnership working and shared value. At its heart is a whole-systems approach, working across multiple sectors, perspectives, and scales, bridging technical and non-technical disciplines.

Within the IWMS water-cycle assets have been considered as a series of linked place-based systems that can be applied at a range of scales, from households and communities to cities and catchments. Traditionally, these layers are designed and managed by separate sectors, agencies, and disciplines – but to deliver the best outcomes, they need to be considered as an integrated system.

This systems-based approach has been implemented through the IWMS, from the agreeing of ambitions, to defining the baseline, testing integrated water scenarios, and determining recommendations with joint ownership.

Figure 3: The Design With Water approach.

The sections below give a brief overview of each stage of the approach:

Set ambitions

The priorities and ambitions for the IWMS were developed, based on the insight provided by the baseline, and informed by existing and emerging policy. These were reviewed by the steering group to ensure alignment between stakeholders for future water-related growth and wider benefits. This stage provided a basis for consideration of interventions for use in the RD&BR IWMS. See Section 4.1.

Literature review

A review of the local strategic context and governance was completed. This was to ensure the IWMS aligns with the local policy environment and is not repeating work already completed for the local area. See Section 1.

Baseline review

A baseline review was undertaken to establish the existing situation. This included setting up the various models that would be utilised in the IWMS and using these to determine the key metrics. The baseline provides an understanding of the current constraints and opportunities. See Section 2.

Identification of opportunities

The literature review and baseline review were then used to identify opportunities for integrated water management interventions suitable for the OA. The intervention options came from categories developed using our experience in implementing integrated water management solutions. See Section 3.

Multi Criteria Analysis (MCA)

This led to an options appraisal stage, where options for intervention were reviewed to determine their suitability for RD&BR based on criteria derived from the ambitions of the IWMS. This stage provided a common understanding of opportunities and risks, including delivery, adaptiveness and wider benefits associated with each option. See Section 4.

Scenario testing

Scenario testing was carried out to explore the impact on the water balance for a range of scenarios. These focused on understanding the impact of growth uncertainty, level of ambition regarding retrofit, and opportunity for the Royal Docks as a strategic intervention. The scenarios are not plausible futures, but boundary conditions to provide additional insight to the analysis. See Section 5.

Recommendations

Specific recommendations for consideration by GLA and wider stakeholders have been made to support the next steps following on from this IWMS.

Delivery Strategy and Implementation Toolkit

This process of evidence gathering, analysis, and integration was used to inform the Delivery strategy and Implementation toolkit. These outputs describe how the recommendations for the IWMS can be implemented in the OA. The Delivery strategy is largely aimed at policy makers and local authorities, while the Implementation toolkit can be used on a case-by-case basis by the parties' delivering interventions, such as developers, local authorities, and private landowners. See Part 2 of the report.

As part of the IWMS, the associated developers for the strategic sites were engaged to inform the Delivery strategy and Implementation toolkit where appropriate. The purpose of this engagement was to encourage feedback and engagement on the proposed interventions. Where feedback was received, this was considered when developing the IWMS.

Figure 4 below provides an overview of the analytical process that has been followed through this IWMS and how this informs the Delivery Strategy, Implementation Toolkit and Monitoring Strategy.

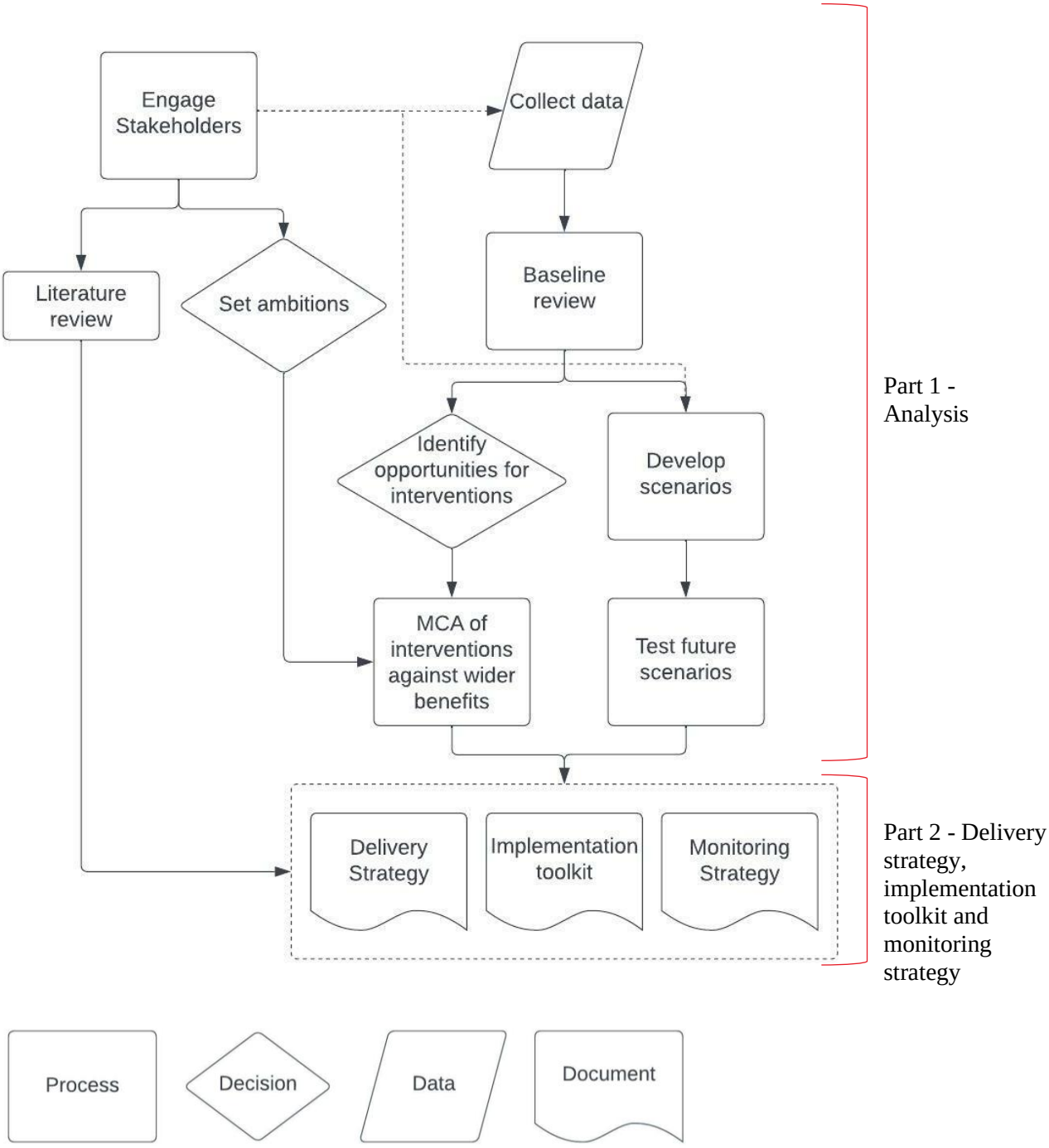

Figure 4: IWMS approach flowchart.

Key insights

The key insights gained from the analysis come from the integration of insights from the baseline review, the multi criteria analysis, and the scenario modelling. These then informed the IWMS, which can be implemented using the Delivery strategy and Implementation toolkit.

The key insights from the MCA are outlined in full detail in Section 4.4. The two key points can be summarised as:

- Rainwater Harvesting contributes well across many of the wider benefits outlined as ambitions by the steering group and so should be a priority for RD&BR.
- To ensure that the ambitions for biodiversity net-gain and improved health and wellbeing can be met, blue-green infrastructure should also be prioritised.

Additionally, the three points below summarise the key insights gained from the baseline review and scenario modelling.

1. Growth and supply demand balance

Growth will contribute to the increasing gap in supply and demand. However, the climate change related reduction in supply will have comparatively greater impact on the supply demand gap and the water neutrality ambitions for the area.

For further detail, see Section 2.1.

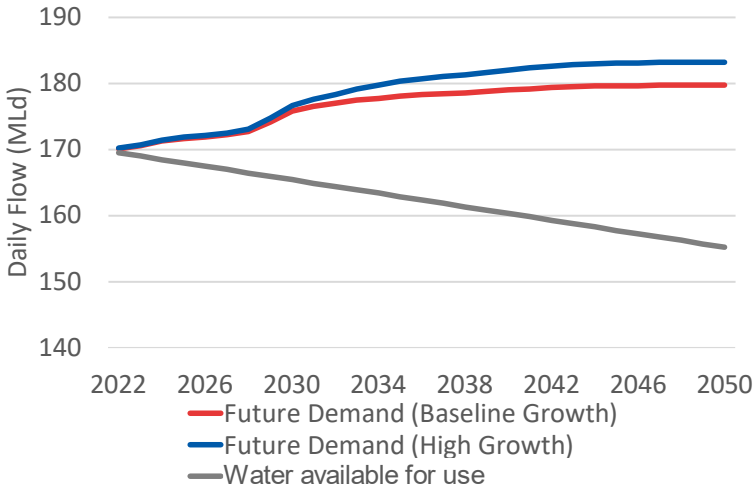

Figure 5: Supply demand gap without interventions.

2(a) Water efficiency

Existing Water demand in the OA is significantly greater than new demand from Strategic Sites in OA (170 MLd vs 13 MLd). Therefore, water efficiency retrofit in the OA has potential for greater impact than improving water efficiency at the Strategic Sites (12 MLd vs 3 MLd).

For further detail, please see Section 5.2.

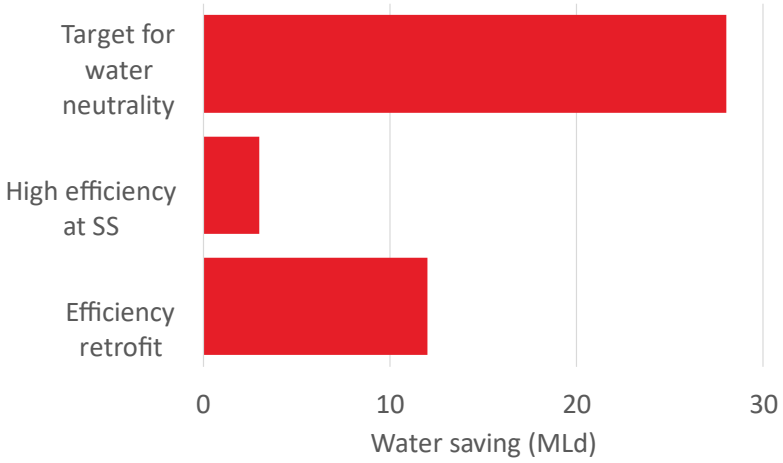

Figure 6: Water efficiency impact: Retrofit versus Strategic Sites.

2(b) Demand and leakage reduction

When compared to the impact of rainwater harvesting on Strategic Sites as well as existing buildings, water efficiency retrofit measures within the OA and pro-rated leakage reduction in the Water Supply Zone will make a greater contribution on bridging the supply demand gap and achieving water neutrality.

For further detail, see Section 5.2.

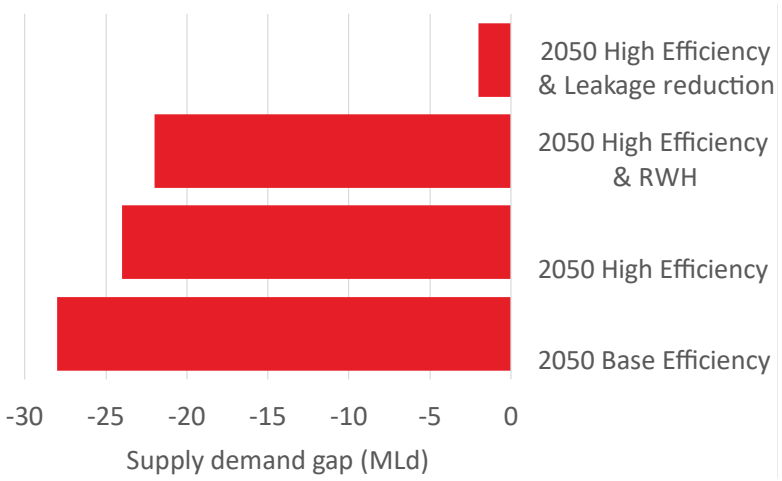

Figure 7: Supply deficit comparison.

3(a) Drainage capacity

The local drainage model review has highlighted that a source of local capacity constraint and sewer surcharge is surface water flows, which contributed to combined sewer overflows and water quality impacts. Diversion of surface water runoff from combined sewers is therefore a priority to manage this risk.

For further detail, see Section 2.1.

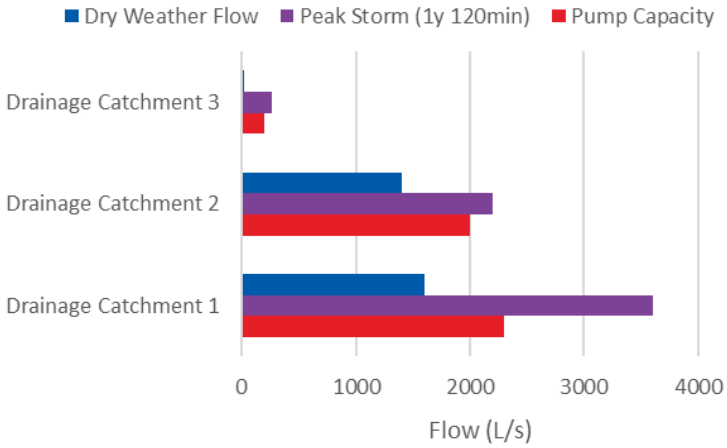

Figure 8: Capacity challenges due to stormwater runoff.

3(b) Surface water flooding and green infrastructure

Due to the topography of the area, there is a surface water flood risk to Strategic Sites. Roads and roofs account for 33 % of land cover and ~50 % of the surface water runoff. Retrofit of blue green infrastructure is the best way to meet multiple objectives of flood risk reduction, water quality improvement, and health & wellbeing benefits.

For further detail, see Section 2.1.

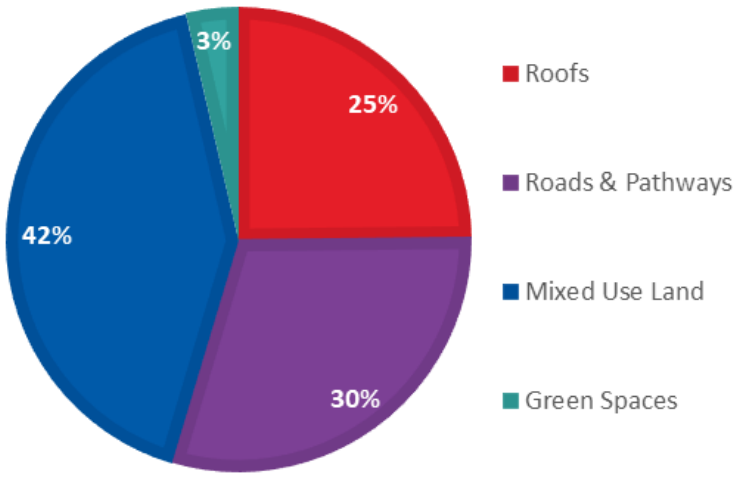

Figure 9: Percentage contribution to surface water runoff.

Following the analysis as part of this IWMS, a series of key recommendations have been developed and are summarised below:

	Recommendation	Lead
	Leakage reduction	
1	**Coordination of Leakage Reduction** Carry out review of TW leakage reduction plans within LBN to confirm expected timing, roll-out and impact on water supply. Review opportunities for accelerated leakage reduction activities to align with planned development or other infrastructure works in RD&BR.	Thames Water
	Water efficiency	
2	**Strategy for Retrofit Water Efficiency** Develop a clear and measurable retrofit strategy for increased roll out of metering, home visits and awareness campaigns to promote retrofit of metering, efficient fittings and rainwater harvesting. Identify priority opportunities for retrofit of interventions including publicly owned and community buildings including educational and healthcare facilities.	LBN Planning
	Strategic sites IWMS	
3	**Strategic Sites IWMS forum** Set-up strategic IWMS forum. Carry out focussed engagement and detailed review of strategic site IWMS for alignment with IWMS ambitions. This review should include consideration of the role for NAVs to accelerate and improve IWMS outcomes on strategic sites.	LBN Planning GLA
	Surface water management	
4	**Drainage Risk Management Review** Carry out a detailed risk assessment of drainage system knowledge, data, and performance in the OA. Build on analysis carried out in 2015 by LLFA to identify opportunity for betterment including where this can be delivered in parallel with Strategic Site development. This should include a specific review of the risk areas identified in the Hyder 2015 work.	LBN LLFA Thames Water
	Royal Docks	
5	**Approach to IWM in the Docks** Consider approach and possible business case for management of the docks as a strategic water asset within the OA. This should include water balance management including leakage loss reduction and surface water attenuation, water quality, renewable energy (e.g., floating solar), and minimised pump operation.	RoDMA
	Blue Green Infrastructure	
6	**Blue-Green Infrastructure Retrofit Strategy** Develop a clear and measurable strategy for retrofit land-use change of impermeable land to permeable through the implementation of blue-green infrastructure. Align targets with the wider targets of key stakeholders. By scaling Thames Water's and TfL's geographies down to the RD&BR OA, these stakeholder ambitions would relate to converting 2.5 ha/yr and 0.05 ha/yr across the Study Area – accounting for 67ha and 1.2 ha respectively by 2050.	LBN Planning LBN Highways LBN LLFA
	Water quality	
7	**Water Quality Monitoring Approach** A detailed review and assessment of water quality monitoring activity and evidence within the OA should be carried out to identify need and opportunities for improvements to monitoring to assist improved management of water system.	EA Thames Water
	Integration through the Infrastructure Delivery Plan	
8	**IWMS Partnership & Opportunity Reviews** Strategic reviews with relevant stakeholders, at least healthcare and education, to identify opportunities for efficient and coordinated review of integrated water management opportunities (such as water use efficiency measures, metering, water recycling) across their portfolios and aligned with their investment plans.	LBN Planning

Part 1 – Analysis

1. Context

1.1 Strategic context

Opportunity Area Planning Framework

The objectives of the IWMS need to align with the overall vision and principles for the Royal Docks and Beckton Riverside. These have been outlined in the Opportunity Area Planning Framework (OAPF) which include:

1. A lively, healthy place.
2. A connected, resilient place.
3. An enabled, innovative place.
4. An empowered, diverse place.

Supporting policy, legislation, and plans

The IWMS is supported and will be delivered by a variety of overarching or supporting policy, legislation, and plans as summarised in Table 1.

Table 1: Summary of overarching or supporting policy, legislation, and plans.

Document	Context
The London Plan	The London Plan 2021 is the Spatial Development Strategy for Greater London. It sets out a framework for how London will develop over the next 20-25 years and the Mayor of London's vision for Good Growth. The Plan is part of the statutory development plan for London, meaning its policies should inform decisions on planning applications across the capital. Borough Local Plans must be in 'general conformity' with the London Plan.
Opportunity Area Planning Framework	This Opportunity Area Planning Framework (OAPF) sets a 20-year planning strategy for the Royal Docks and Beckton Riverside OA up to 2041. It aims to: • Review the development opportunity in areas with good transport accessibility. • Present a strategy for industrial land. • Outline the opportunities associated with a future DLR extension to Beckton Riverside and how these could be supported. Considerations also include other key public transport investment in the area, e.g., DLR service improvements.
Newham Local Plan	Along with the London Plan, the Local Plan forms the Development Plan against which individual development proposals are assessed
Newham Climate Emergency Action Plan	The council has signed off an ambitious and far-reaching plan to address the global climate and health emergency. The Climate Emergency Action Plan seeks to ensure that as the world emerges from the Covid-19 crisis, any economic recovery should involve a major increase in investment and jobs that tackle the climate emergency. The Action Plan sets out what the council proposes to do across a range of areas.
Royal Docks Public Realm Framework	The Framework sets the vision for regeneration of the OA and sets out a roadmap for ensuring that the emerging totality is greater than the sum of the parts.
Royal Docks Design Guides	The Design Guides provide a unified handbook for wayfinding, lighting, and landscape, as well as guidelines for accessibility and inclusive design. They're a detailed toolbox for architects, developers, community groups and designers – or indeed anyone who is creating design and public realm work for the area.
Water Resources Management Plan (WRMP)	Thames Water's WRMP sets out the actions they will take to provide a secure and sustainable supply of water in London and the Thames Valley over the next 80 years. This is essential for everyday life, the wellbeing of the environment and economic growth.

Document	Context
Drainage and Wastewater Management Plan (DWMP)	Thames Water's DWMP sets out how wastewater systems, and the drainage networks that serve them, are to be extended, improved, and maintained to ensure they are resilient against future pressures such as climate change and population growth. It sets out long-term plans that will make sure that there is a resilient and sustainable wastewater service for the next 25 years, and beyond.
The Flood and Water Management Act 2010	The Flood and Water Management Act 2010 relates to the management of flooding and costal erosion risk. It outlines the roles and responsibilities for risk management in England and Wales.
The Flood and Water Management Act 2010 - Schedule 3	The Defra review for implementation of Schedule 3 to The Flood and Water Management Act 2010 was published on 10 January 2023. Its key recommendation is that we make sustainable drainage systems (SuDS) mandatory and progress with the necessary implementation phase. The review suggests detailed work on implementation will take place during 2023, with implementation expected sometime during 2024.
River Basin Management Plans (RBMPs)	River Basin Management Plans (RBMPs) - set the legally binding locally specific environmental objectives that underpin water regulation (such as permitting) and planning activities. Interventions within this IWMS can be found as programme of measures within the RBMPs, i.e., SuDS. There are many crossover measures between RBMPs and FRMPs such as nature-based solutions.
Flood Risk Management Plans (FRMPS)	FRMPs identify the risk from flooding and set out objectives and measures for managing that risk. In so doing, they aggregate information about all sources of flooding - and coastal erosion where appropriate - to better inform prioritisation, decision making and work programming.
London Flood Review	Thames Water commissioned the London Flood Review to examine the flash flooding that affected many parts of the capital in July 2021. The review has sought to better understand the extent and causes of these floods, to assess how the drainage systems performed, and to recommend how the increasing risks of future flooding events can be managed.
Newham's Local Flood Risk Management Strategy	Newham's Local Flood Risk Management Strategy (LFRMS) is an important tool to help understand and provide a clear framework to enable the council to manage flood risk within the borough while balancing the needs of the community, the economy, the environment, and availability of resources.
Strategic Flood Risk Assessment (SFRA).	The SFRA aggregates flood risk information to inform the local development framework and planning applications. The current SFRA (2015) has identified the OA and surrounding area is at fluvial and surface water flood risk as well as tidal flood risk (but protected by tidal defences). Newham is revising the SFRA, which may inform future use or update of this IWMS.
Surface Water Management Plan	The Surface Water Management Plan (SWMP) the preferred surface water management strategy for the borough. It contains agreed measures applicable to the local borough and wider river catchments. It is also relevant in the areas of flood risk management , biodiversity, and water quality.
TE 2100 Plan	TE2100 Plan has developed an adaptive strategy to manage and mitigate the future increase in risk due to sea level rise. The OA straddles the Thames Barrier and is protected by tidal defences that benefit from the Barrier and downstream flood defences. Their continued standard of service is a critical part of this plan and future tidal flood risk management in London.
Water industry national environment programme (WINEP)	The WINEP is the programme of actions water companies need to take to meet statutory environmental obligations, non-statutory environmental requirements, or delivery against a water company's statutory functions.

In order to build upon this supporting framework, an integrated approach to water is required in the development of the OA. This approach needs to minimise environmental impact, provide opportunities for the local community, and stimulate the economy.

Implementation of Schedule 3 of The Flood and Water Management Act 2010

During development of the IWMS, new policy has been announced recommending making SuDS mandatory to new developments in England. This was the result of the Government's review into the implementation of Schedule 3 of The Flood and Water Management Act 2010. The new approach will ensure SuDS are designed to reduce the impact of rainfall on new developments. Schedule 3 will mean that drainage systems are designed and approved at all stages of planning and will cover how they are adopted and by who.

The government will now consider how Schedule 3 will be implemented, subject to final decisions on scope, threshold, and process, while also being mindful of the impact on the development sector.

Additional detail regarding the strategic context for the IWMS can be found in Appendix B (Literature Review).

Subregional Integrated Water Management Strategy.

The GLA has also commissioned a Subregional Integrated Water Management Strategy (SIWMS) to better understand the use case of subregional-scale infrastructure planning, and how such a model can apply across London across all infrastructure types. Separate work on that SIWMS is ongoing and both workstreams are receiving ongoing attention to ensure alignment. The SIWMS will focus on a number of Boroughs across the north of London. This will include the Borough of Newham and the geographic extent of this IWMS. The extents of the SIWMS is shown in Figure 10.

Figure 10: Subregional Integrated Water Management Strategy extents.

Whilst the SIWMS is a pilot, the project is being undertaken in a changing wider context, that is characterised by an increased regulatory focus on strategic water planning and proposed changes to the land use planning system, where digital planning is expected to be at the forefront of future activities.

As the Royal Docks and Beckton Riverside OA lies within the boundary of the SIWMS, there has been ongoing collaboration throughout the production of the documents to ensure that these strategies are complimentary. Further information can be found in Section 1.5 of the Delivery strategy.

1.2 Governance

The project steering group provided insight at all stages of the project and provided key background information and available models for use in the project.

The IWMS is a collaborative piece of work and organisations in the steering group have the opportunity to input and shape the IWMS. Steering group members include Greater London Authority, the Environment Agency, Newham Council, Port of London Authority, Royal Docks Management Authority, Thames Water and Arup.

Throughout the course of the IWMS, the steering group acted as an advisory group that helped to direct the project.

1.3 Opportunity Area

The Royal Docks and Beckton Opportunity Area (OA), situated in the Thames Gateway, is one of the largest regeneration areas in London. Water has been key to the development of the area due to the Royal Docks. As the area undergoes further regeneration water will be important to enable this. An integrated approach to water is required to enable this development in a way that minimises environmental impact, provides opportunities for the local community and stimulates the economy.

1.4 Strategic growth areas

Seven strategic growth areas have been identified within the Royal Docks and Beckton Riverside OA. A high-level description and proposed growth of each of the strategic sites is provided in Figure 11 and Figure 12 respectively.

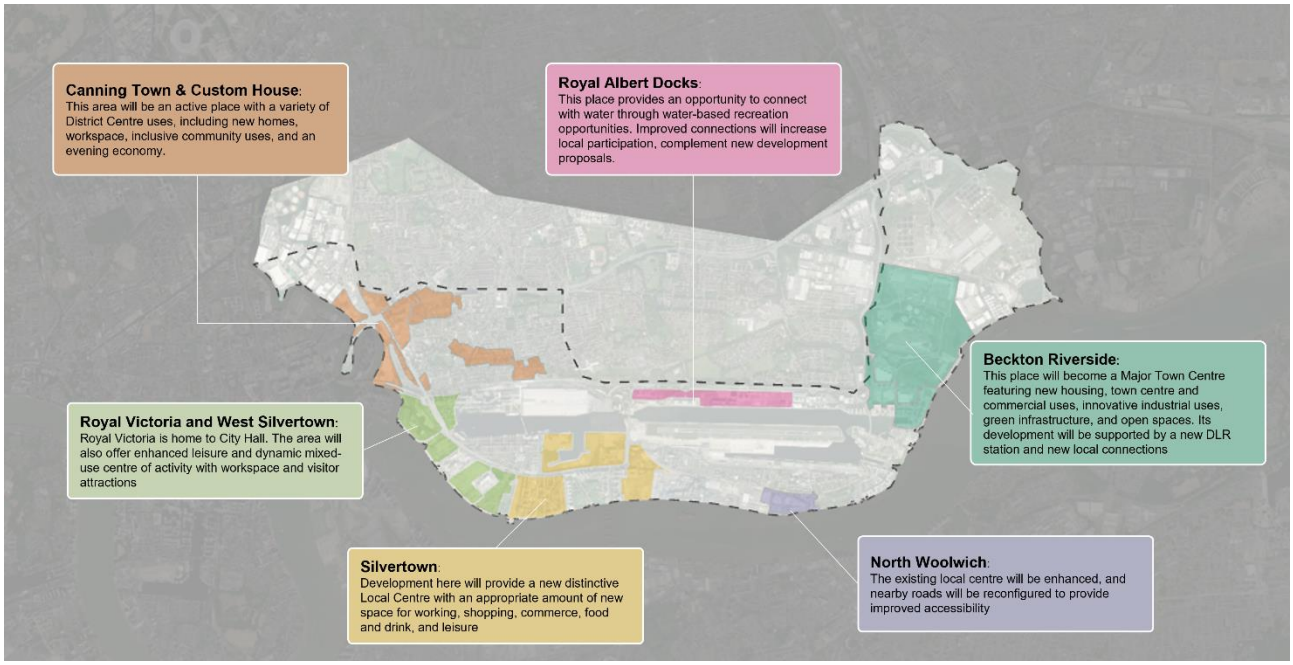

Figure 11: Strategic growth areas.

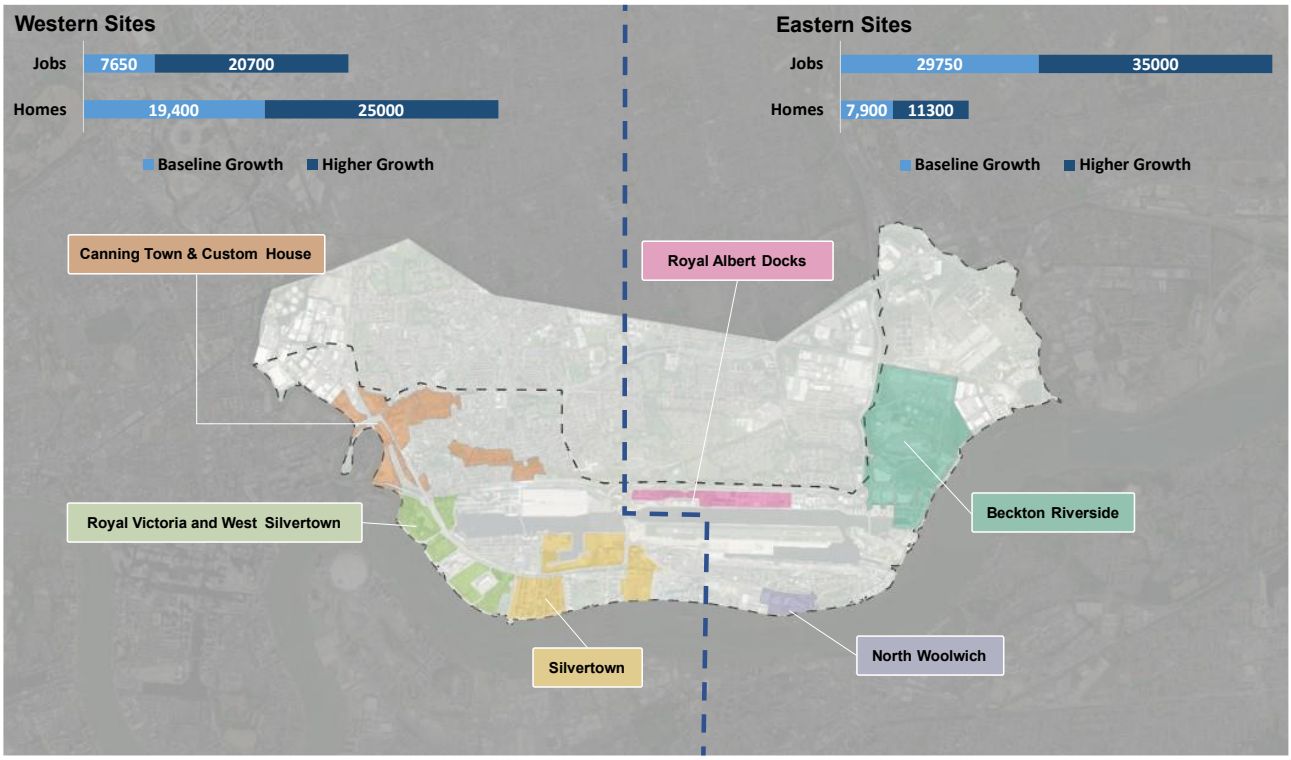

Figure 12: Population and job growth within the strategic growth areas.

2. Baseline review

2.1 Summary

Study area extents

The initial analysis highlighted that the OA boundary did not correspond to the local surface water drainage catchments, which extends to the Northern Outfall Sewer pathway north of the OA. To evaluate options to mitigate the surface water flood risks to the strategic sites in Canning Town area, a wider study area was considered. Figure 13 shows this IWMS Study Area that was proposed to and agreed by the Steering Group.

Water infrastructure

The historical importance of water in the area is reflected by the key infrastructure and landmarks in the vicinity of the OA. The Royal Albert Dock, the Royal Victoria Dock, and the King George V Dock (which together are known as the Royal Docks) collectively form the largest enclosed docks in the world. The OA is bounded on the west by the River Lee, the south by the River Thames and the east by the River Roding. Beckton sewage treatment works (STW), the largest sewerage treatment works in Europe, covers over 100 ha of area in the north-east of the OA. The Thames Gateway Desalination Plant is adjacent to Beckton STW. The Thames Barrier is also located to the south of the OA.

The location of these key landmarks is shown in Figure 13 below.

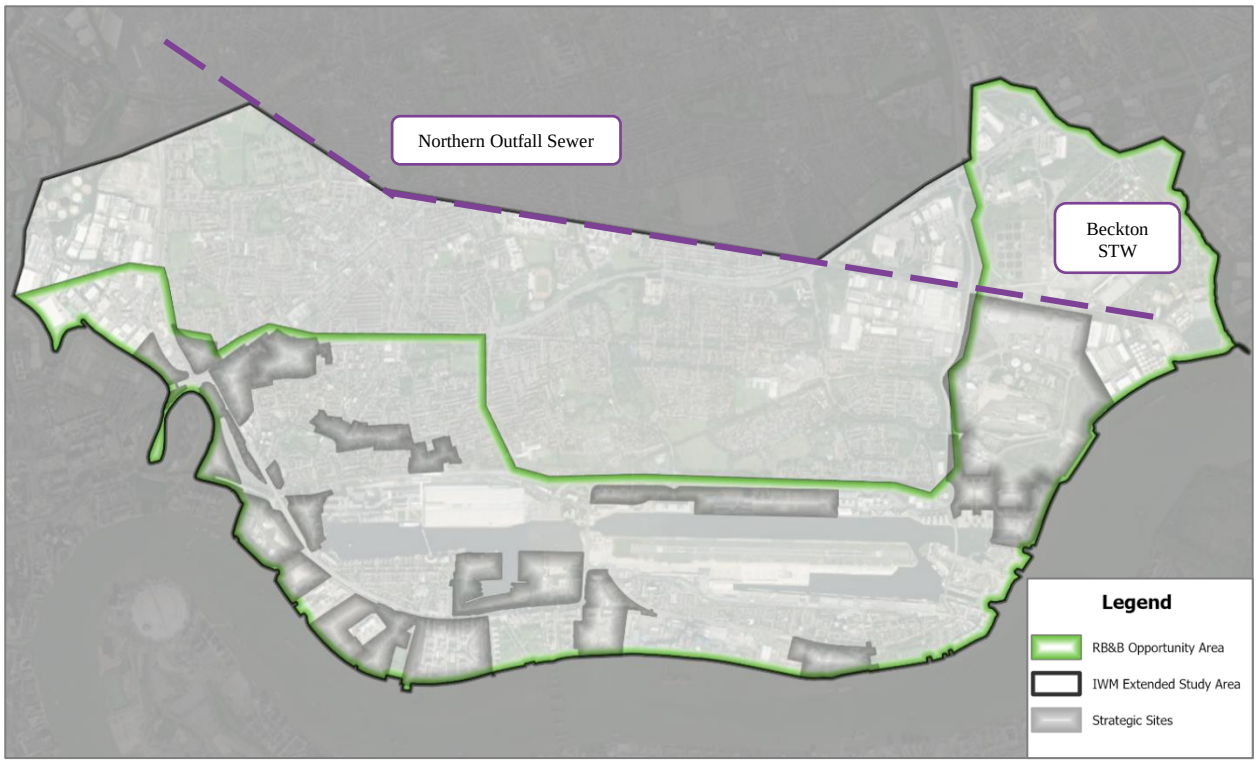

Figure 13: Relevant water infrastructure within and adjacent to the OA.

Water supply zones

The Thames Water District Metering Areas (DMAs) extend beyond other system boundaries as shown in Figure 14 below. Further extending the study area boundary to include the full DMA does not benefit the study. However, there is still value in considering the demand and demand reduction measures for the full DMA as it would provide benefits to the regional supply demand balance.

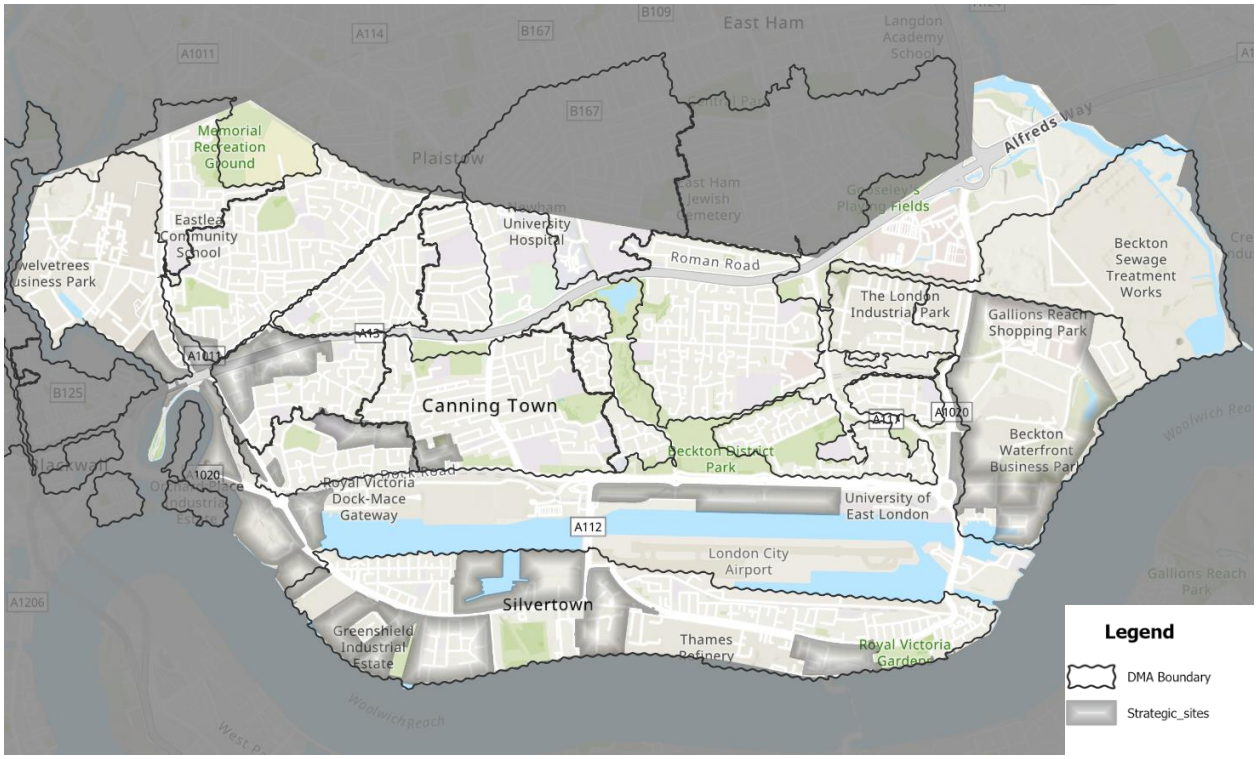

Figure 14: Water Supply DMA boundaries and study area.

Future water security

London will experience a supply / demand deficit in the future if no interventions are made. Thames Water WRMP predicts a deficit of 623 MLd (24 %) by 2100. The water utilities are planning new Strategic Resource options (SRO) to augment the supplies, e.g., Severn to Thames Transfer Scheme. However, there is a high level of uncertainty on when the schemes could come online, if approved. Figure 15 shows the current demand in the DMAs serving the OA (source: Thames Water and Arup demand projections), the increase in future water demands due to planned growth, and the reduction supply (prorated based on projections from WRMP) for the IWMS Study Area.

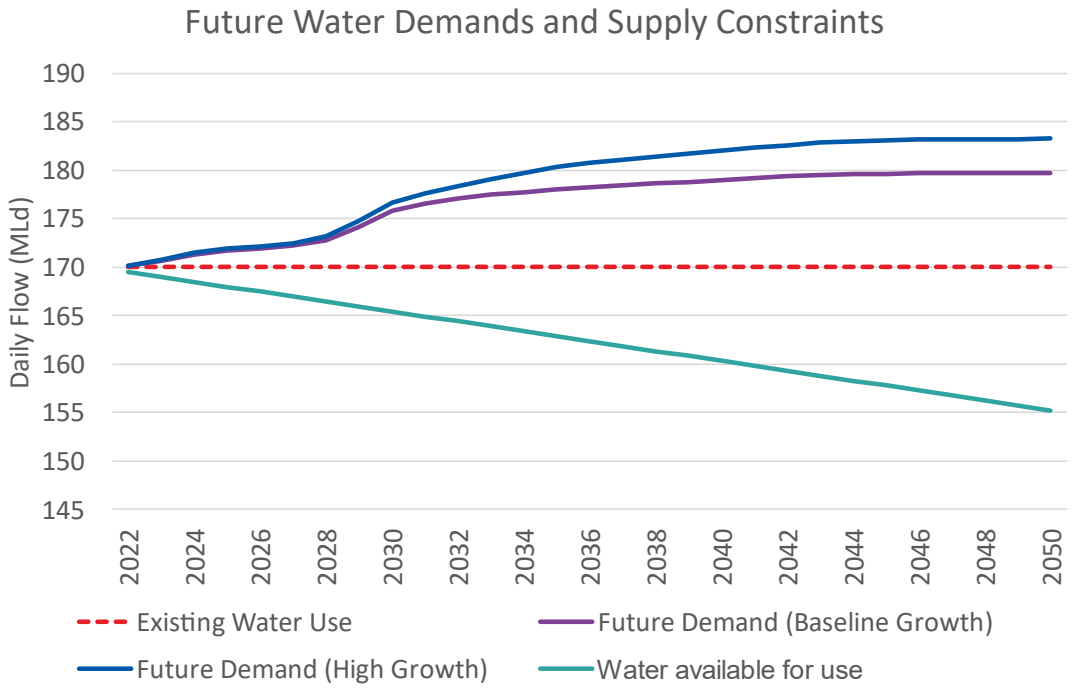

Figure 15: Graph showing future water demand and supply constraints.

This analysis has assumed a base case of supply/demand balance in 2022 with Thames Water potable water supplies meeting all water demands. Figure 16 shows the Sankey Diagram of the source to sink flows for the future 2050 scenario for LBN growth profile without any interventions. Although environmental restrictions for climate change will reduce available water supply, this reduction should be more than offset by reduced leakage losses through Thames Water leakage reduction activities.

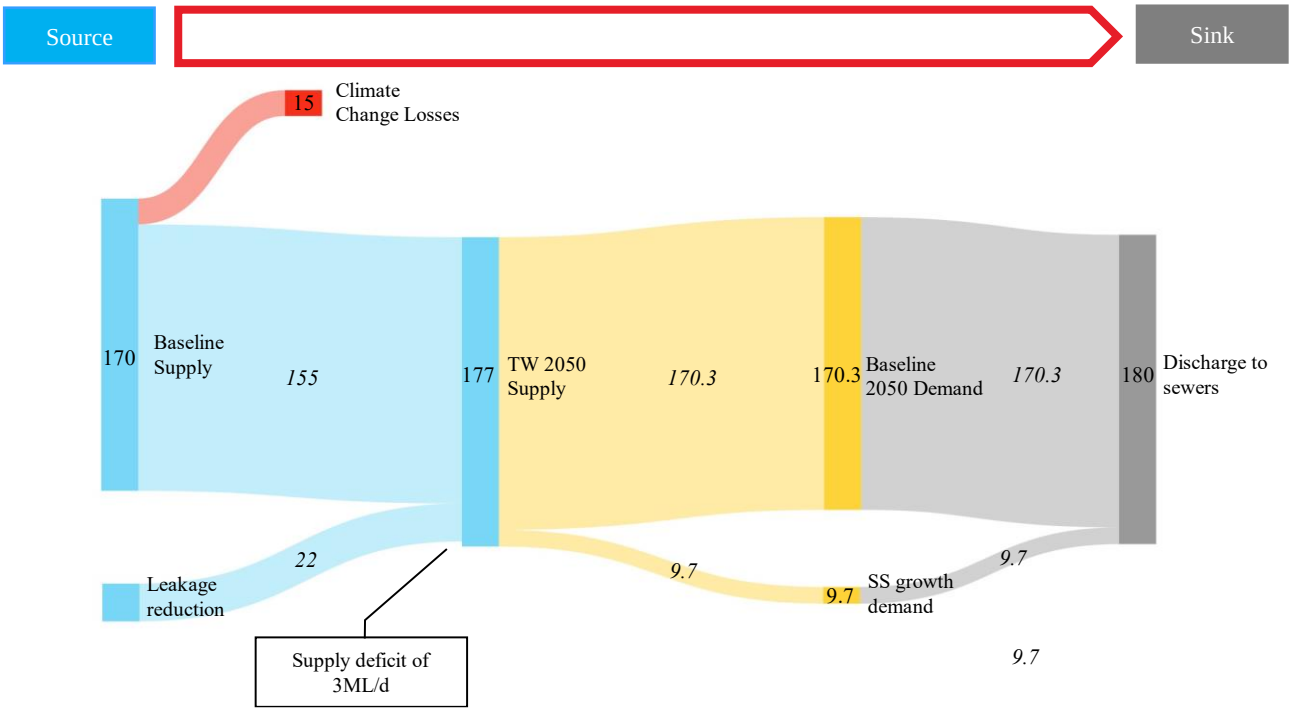

Figure 16: Sankey diagram showing baseline water balance in 2050 (all numbers MLd).

Water supply network

Thames Water have not advised of any specific capacity constraints in the OA in their Trunk Mains supply. Therefore, an increased demand on bulk water supply is not considered a constraint to development in the OA. Local reinforcements of the potable water supply network may be necessary for some developments. However, these are unlikely to hinder development in the OA. These improvements and upgrades should be aligned with other infrastructure delivery coordinated by GLA and Infrastructure Mapping Application (IMA).

Flood risk

Strategic sites within the OA have a varying level of flood risk from tidal, fluvial, and pluvial flooding. These flood risks have both onsite and offsite origins. There is limited opportunity to influence regional and sub-regional flood risk strategies (River Thames, River Lee, and Roding) but there is potential for pluvial flood risk management. Site level and area level flood risk management should be consistent with the strategies such as Thames Estuary TE2100 plan by Environment Agency. See Figure 17 for the fluvial flood risk map and Figure 18 for the flood risk zones.

Figure 17: Extent of fluvial flood risk accounting for climate change.

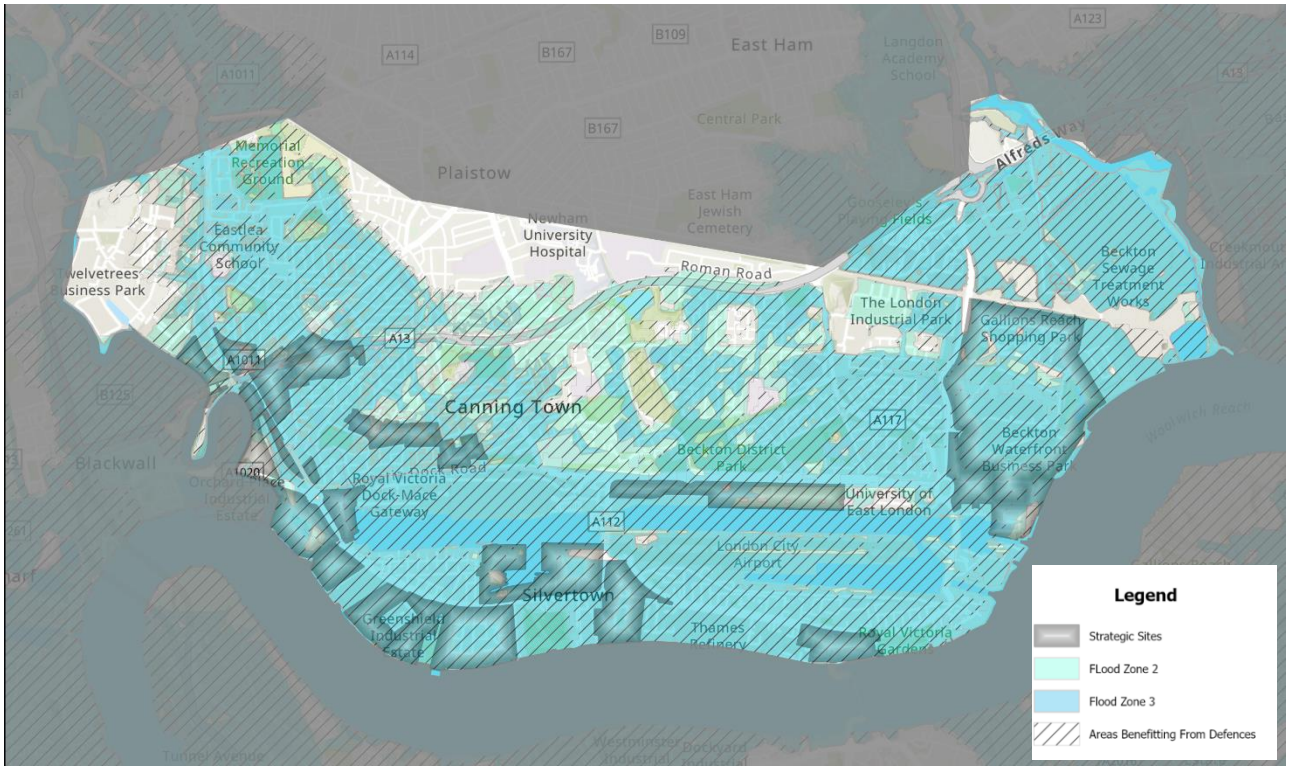

Figure 18: Flood zones and areas benefitting from flood defences.

For the context of local flood risk for the Strategic Sites, the IWMS has considered the 1 in 100 and 1 in 1000-year events. This was due to the close alignment of the IWMS with the planning policy.

It is noted that that surface water risk is not considered for the 1 in 30, which is the critical threshold for exceedance from sewers. However, the planning requirements for flood risk were given precedence over design capacity for the purposes of this study.

Topography

As shown by the light detection and ranging (LiDAR) results in Figure 19, the ground levels in the area North of the docks are lower than the retained water levels in the Royal Docks. This limits the opportunity for gravity flow of surface water towards the Docks or the River Thames. The direction of overland flow is toward River Lee into an area also at risk of fluvial flooding. Due to these factors, the topography contributes to the local surface flood risk).

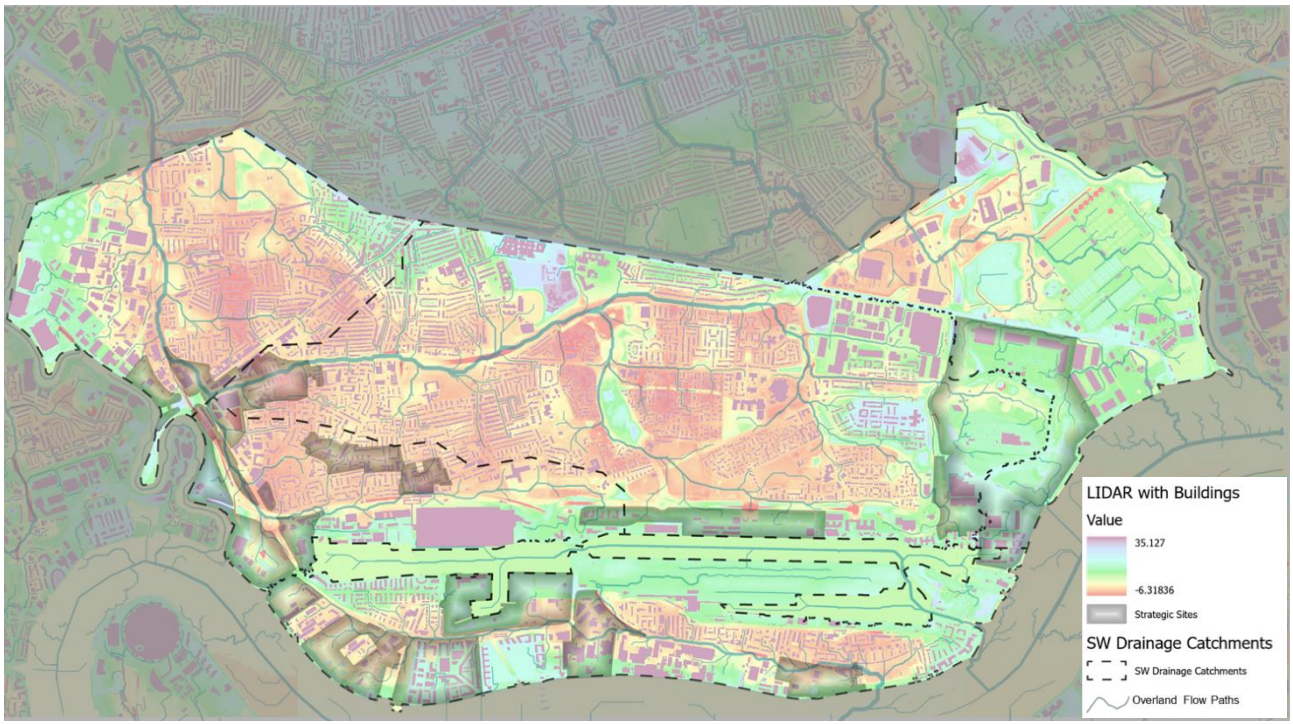

Figure 19: Topography of the OA and surrounding areas.

Combined sewers

The area does not have separated surface water drainage and the majority of surface water runoff enters combined sewers. This has implications on network capacity, sewer surcharge (as identified in DWMP) and energy consumption for conveyance. Reduction in the volume of surface water runoff would increase the headroom and reduce instances of sewer surcharges.

Drainage modelling

The Thames Water drainage model coverage for the area is very coarse and does not include local drainage network for the OA. See Figure 20 for the Thames Water drainage model extents.

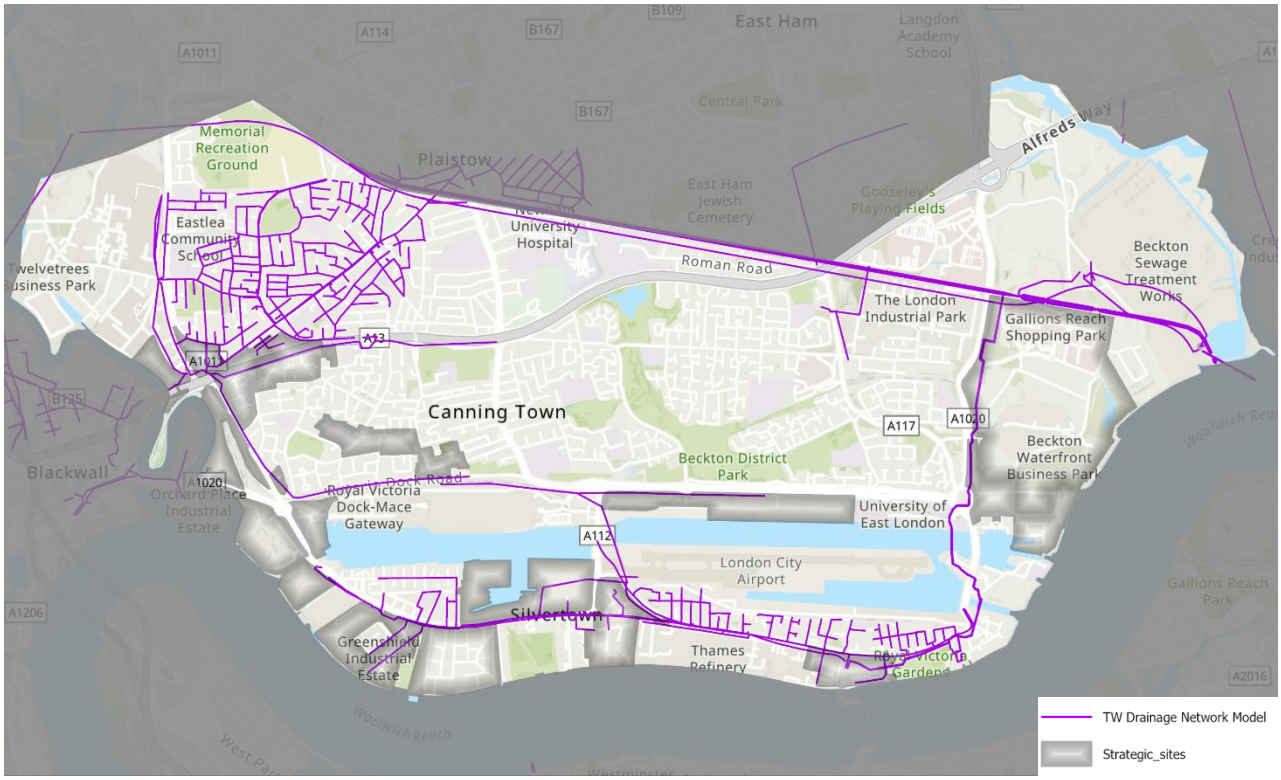

Figure 20: Drainage Model extent in the OA and Study Area.

Large aspects of the combined sewer network surcharge frequently and surface water inflows result in capacity constraints, as identified in the DWMP.

Due to limited access to the LLFA 2D drainage model and the coarse nature of the Thames Water drainage network model meant it was not possible for the IWMS to undertake a quantitative impact assessment of possible SUDS interventions. A simpler combined quantitative - qualitative approach was used to estimate the potential opportunity for sustainable drainage interventions. This approach estimated the potential reduction in storm flows through changes to land use.

The LLFA undertook a 2D pluvial flood risk analysis in 2015 (including 30 % climate change allowance) to review localised pluvial flood risk (GLA / LBN Drain London - London Borough of Newham, Surface Water Flood Risk Integrated Modelling Study – Silvertown, Hyder, May 2015). This study generally showed that the EA's flood map for surface water was a reasonable representation of surface water flood risk. A number of localised areas at risk were reviewed and recommendations made: North Woolwich Road (west) and Surrounds; North Woolwich Road Roundabout (CDA 036); Wythes Road and Drew Road (CDA 053); North Woolwich (Central); Royal Victoria Gardens.

Geology and infiltration

Ground conditions related to underlying geology mean that infiltration is unlikely to be possible for all strategic sites. However, there are some opportunities for infiltration throughout the OA. A strategic and targeted SuDS retrofit strategy would provide guidance to local SuDS measures. A detailed map of infiltration potential from Newham 2015 SFRA is shown in Figure 21.

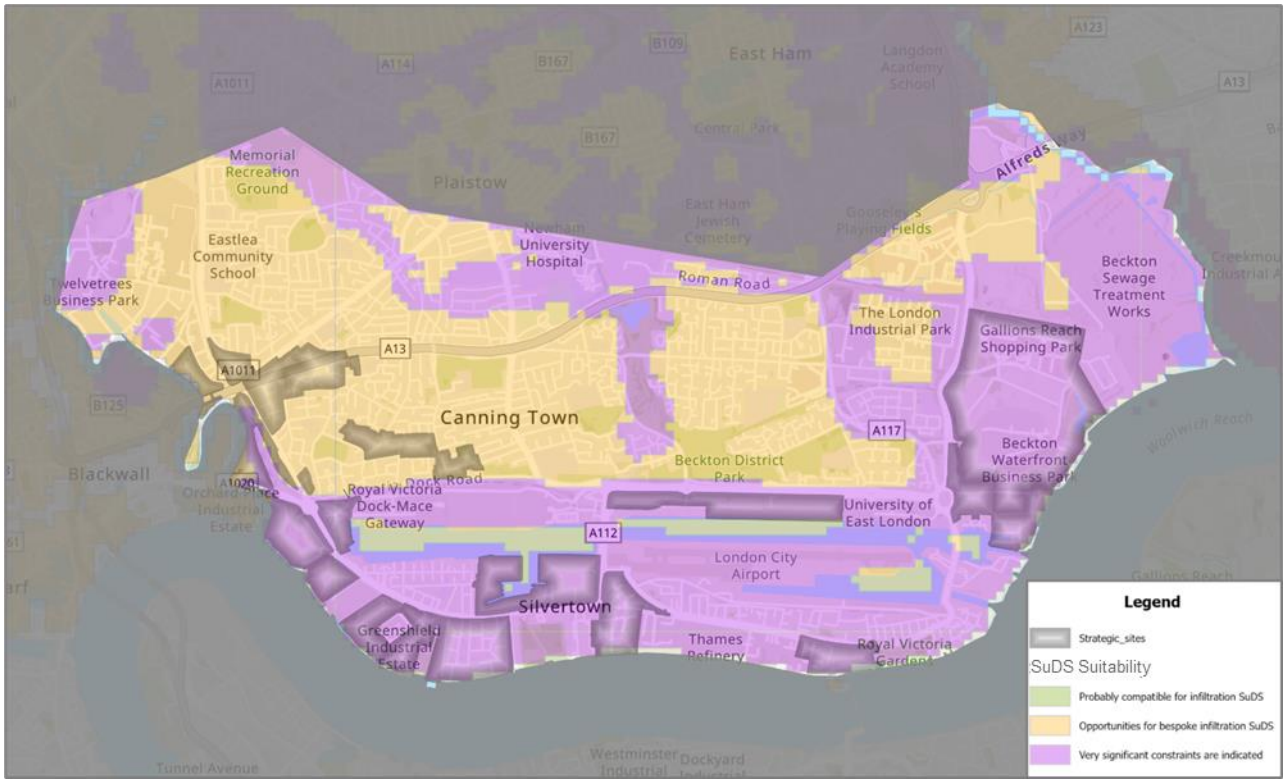

Figure 21: Infiltration potential in the OA.

Land use

OpenStreetMap and OS Open Map data was used to estimate current land uses in the area. Building roof areas, roads and pedestrian pathways were classified as impermeable surfaces. The areas classified as parks and green spaces were considered as permeable.

All other areas were considered mixed use land and considered as semi-permeable. These included front and back gardens, many of which have been paved over. It was not possible to obtain more accurate land use classification due to lack of supporting data.

There are large amounts of impermeable area across the OA. Rooftops account for 230 ha of land coverage and rooftop runoff accounting for approximately 18 % of the volume of local surface water flooding. Roads account for 276 ha land coverage with the road runoff accounting for approximately 15 % of the surface water volumes. A full break down of the land use areas is shown in Table 2 below.

The existing land coverage and estimated percentage of rainfall as runoff is shown in Figure 22.

Table 2: Land use areas

Land-use type	Area (ha)	Percentage of total land-use area	Runoff coefficient %
Impermeable			
Roads and hard surfacing	276	15 %	90 %
Roofs	230	18 %	90 %
Permeable			
Parks and green spaces	337	22 %	10 %
Mixed use land	644	42 %	60 %

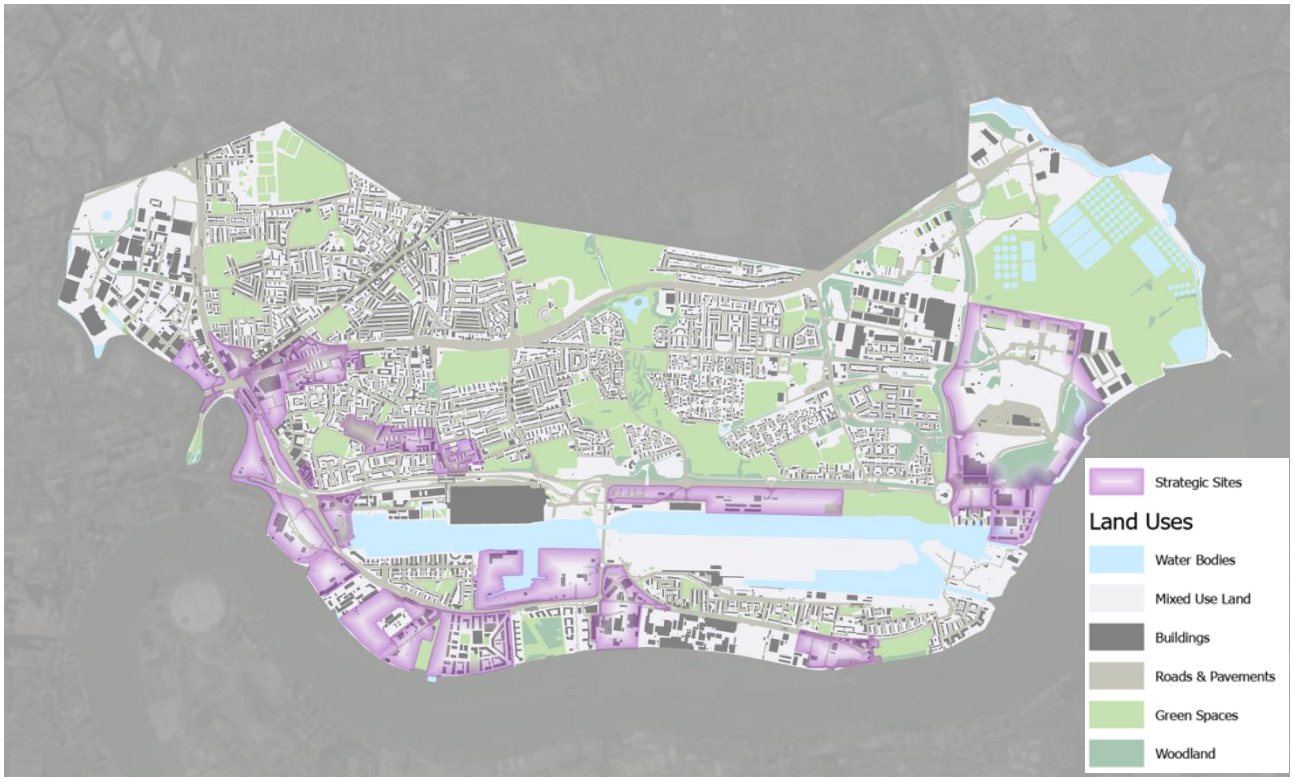

Figure 22: Existing land coverage across the OA.

Surface water management

The topography of the area is a major contributory factor to the surface water flood risk in the OA as shown in Figure 23. The map shows surface water ponding is predominant in areas on or around local roads that act as temporary detention storage until the combined sewer pumps can discharge the excess inflows either into the northern outfall sewer or into the tidal tributaries (as sewer overflows).

Where the riparian sites can discharge directly into the Thames or tidal tributaries, they are subject to tide locking. The duration of tide locking will increase with sea level rise, requiring provision of temporary detention storage as well as longer detention times. While difficult to achieve, there is an opportunity to provide dual purpose detention storage and rainwater harvesting tanks, in line with the London Plan drainage hierarchy.

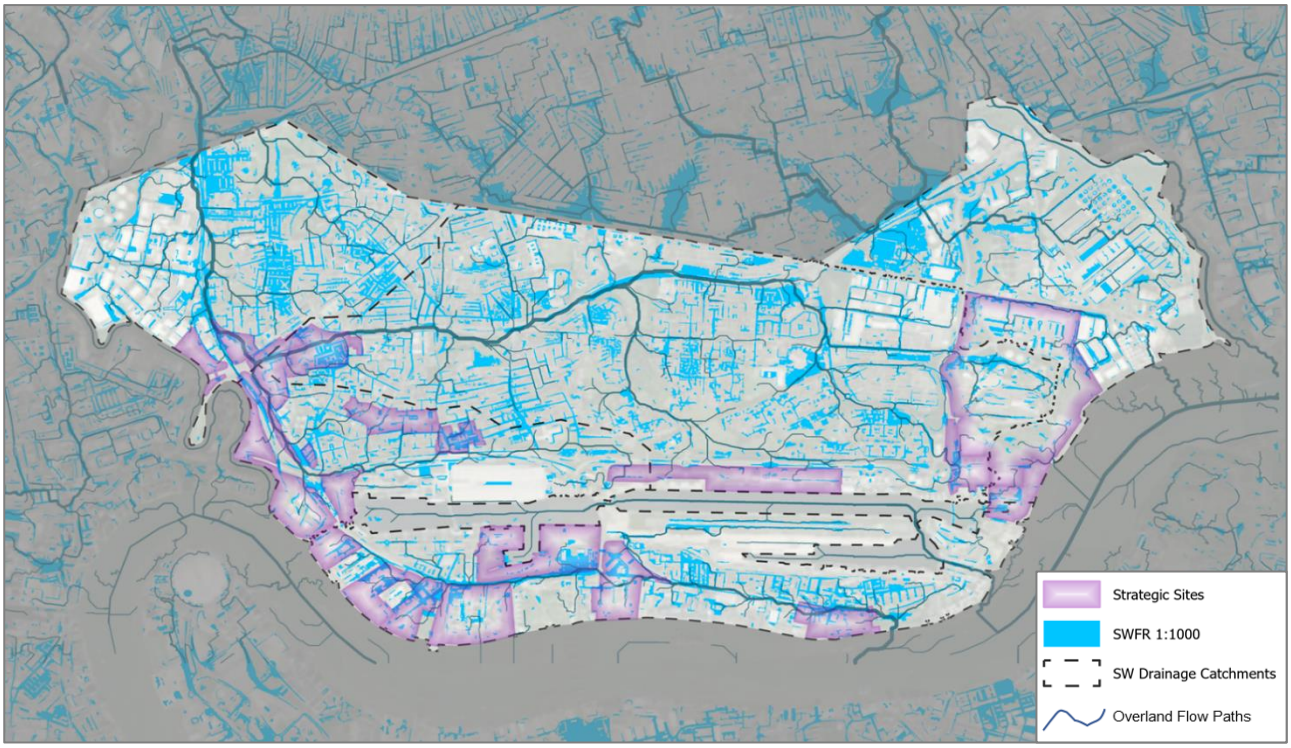

Figure 23: Surface water flood risk.

Energy consumption

The majority of the surface water runoff (~ 4 ML/year estimated, based on annual rainfall and contribution from each land use types) from the extended IWMS study area is conveyed by pumping via combined sewer into Beckton Sewage Treatment Works. Therefore, there is an energy and carbon implication from this conveyance and treatment of surface water. The IWMS notes the prospects for waste water heat recovery from Beckton STW and the potential to develop a heat network in the OA to utilise this heat.

In addition, 22 ML/year of river water is pumped into the Royal Docks to maintain water levels with further energy and carbon implications. There is an opportunity to divert some or all of the surface water runoff to the docks in effort to reduce volumes being pumped into the docks to save energy. Topography of the area and any possible variations in water quality would need to be considered in the suitability of this proposal as well as the charging regime for discharge to the docks.

Water meters

A high percentage of households and the majority of non-households in the OA are metered. 72 % of all water use in the area is metered: household accounts for 62 % of the overall water use in the area, 55 % of which is metered, whereas non-households account for 38 % of overall water use and 99 % of this consumption is metered. This will impact the amount of water efficiency reductions that are possible in the OA. There is an opportunity to accelerate the deployment of smart meters in the area in alignment with Water Neutrality ambitions. The water consumption and distribution of water meters across the OA is shown in Figure 24.

Table 3: Metered and unmetered water usage

Type of property		Total Daily Consumption (MLd)	Total
Household	Unmeasured	47.79	28 %
	Metered (Billed Consumption)	57.77	34 %
	Total	105.56	62 %
Non-Household	Unmeasured	0.72	<1 %
	Metered (Billed Consumption)	64.71	38 %
	Total	65.43	38 %

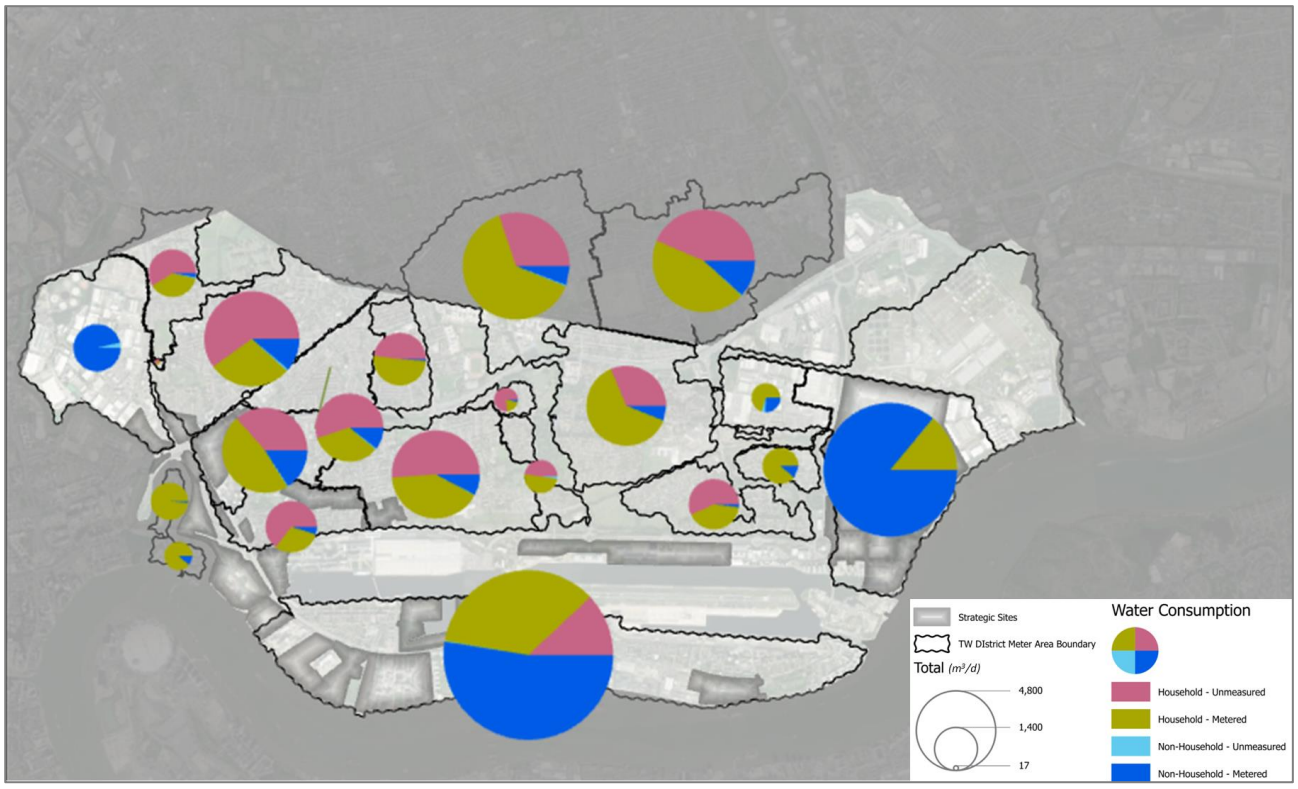

Figure 24: Water consumption by metered and unmetered premises in the OA.

Water reuse

The baseline review found no evidence that any significant water recycling or management of alternative supplies exists in the OA, except for some industrial water users adjacent to the River Thames.

Beckton STW, which is located within the OA, has a large potential for the implementation of blackwater reuse at a strategic scale across LBN and other boroughs. However, due to the scale of this scheme and the challenges with sequencing, this solution has not been considered in the IWMS. Additionally, there is currently an ongoing Beckton Water Reuse Scheme.

Water quality

There is little data or evidence regarding water quality issues within the OA. However, as the docks are used for recreational purposes, maintaining, and improving the quality of the water is important.

A review of the sewer overflow operations from the published Event Duration Monitor (EDM) data Indicated that there are instances of combined sewer overflow into the tidal rivers during storm events causing water quality impacts. The two discharge locations monitored by Thames Water are at Beckton and Henley Road https://www.thameswater.co.uk/edm-map.

The discharge of surface water to the dock is will also impact the quality of the detained water. This could lead to organic material, hydro-carbons, and other chemicals building up on the roads and entering surface water runoff. The presence of these pollutants can impact oxygen levels, resulting in a harmful effect to and even death of aquatic life.

While the Royal Docks is not a designated bathing site, it is used for recreational activities including open water swimming. Therefore, the water quality of the docks is linked to its recreational use and the impact of surface water flow alongside this must be considered.

2.2 Insights

Following the baseline review, the following observations were made to inform the recommendations within the IWMS:

- Given the extent of both the fluvial and tidal flood risk in the wider area, it is assumed that this will be managed at a strategic level. The IWMS recommendations would be to utilise strategies that have already been developed, such as Thames Estuary 2100 (TE2100) plan. Fluvial and tidal flood risk in the wider area should be considered as part of the SIWMS. Further, it is expected that new developments will be required to provide adequate fluvial flood defences as part of the development process.
- It is acknowledged that there will be an increasing gap in supply (at current levels) and demands. However, this impact is not restricted to just the OA and there are wider strategic measures being considered by the water utilities. For the purposes of this IWMS, it is assumed that any residual deficit, after accounting for per capita consumption reduction, will be met by these Strategic Water Resource Options.
- The coarse scale of the drainage model limits the quantitative evaluation of water management options being considered in the area. Therefore, a qualitative approach considering existing land uses and their contribution to local surface water runoff can provide insights on their impact potential. This approach relies on use of GIS land use mapping data. Further information on the outputs of this analysis for the OA can be found in Section 5.2.
- Existing site site-specific water demands are not available (due to data privacy issues). As quantification is not plausible, the IWMS will signpost where excess volumes may be available for such use. For example, residential sites with greywater reuse systems are likely to have excess non-potable supplies which could be supplied to neighbouring commercial and industrial sites.
- There is a significant volume of river water that is pumped into the Royal Docks at significant expense. There is an opportunity to meet some or all this demand using surface water runoff in the OA.

Use of topography and land use relationships are the most appropriate way to highlight the direct relationship of the Strategic Sites to their respective overland drainage catchments.

3. Opportunities assessment

3.1 Identification and selection

The baseline review informed the range of potential interventions that are suitable for the OA. These interventions then underwent a qualitative selection process that was reviewed and agreed with the Steering Group. This section outlines the process used to determine which interventions are most suitable for the OA.

We initially considered the broadest range of potential interventions that could be brought into the IWMS. To do this in a structured way, we grouped interventions under broad 'categories' and 'subcategories'.

Figure 25 shows an overview of the process used to filter interventions based on their relevance for the IWMS.

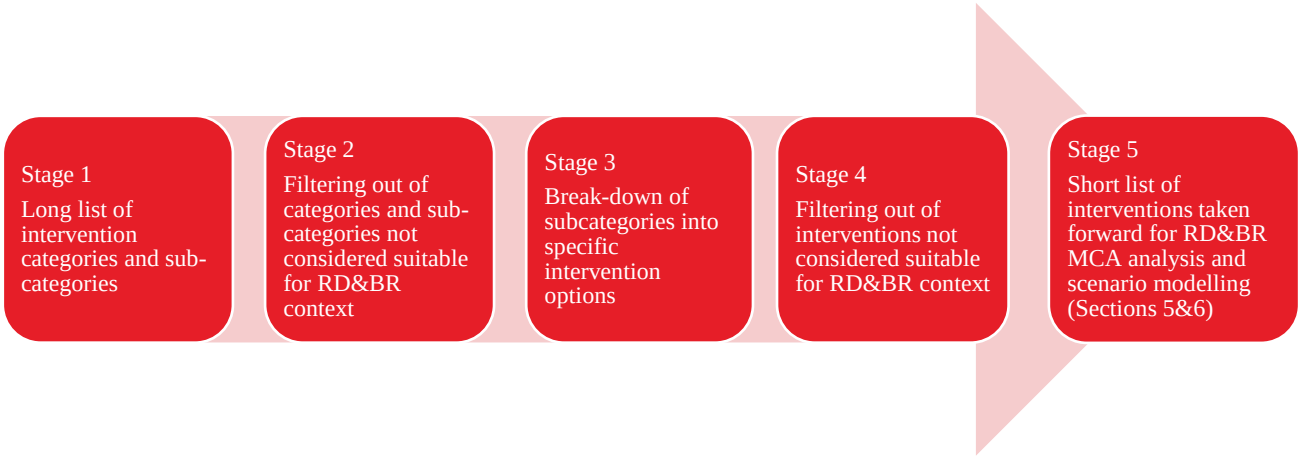

Figure 25: Flow chart showing process of screening interventions.

3.2 Shortlist of opportunities for interventions

Table 4 shows the final list of interventions which were derived as being suitable for the RD&BR IWMS. The full list of categories, sub-categories and options for interventions that were considered can be seen in Appendix D.

Table 4: Options for interventions.

Category	Sub-category	Intervention
Blue-green infrastructure	Runoff reduction	Bio-retention systems
		Blue roofs
		Channels and rills
		Detention basins
		Filter drains
		Green roofs
		Infiltration systems
Digital	Analytics	Bulk metering and submetering
		Smart tariffs and smart metering for units
Existing assets	Upgrades and maintenance	Leakage reduction
Hard engineering	Runoff reduction	Offline/online attenuation
Land management	Runoff reduction	Permeable paving / surfaces
		Royal Docks discharge
Water efficiency	Consumer goods	Low flow appliances
		Low Flow Taps & WC
Water resource	Greywater	Non-potable reuse of greywater
	Rainwater	Rainwater harvesting from roofs

4. Multi criteria analysis

4.1 Approach

The interventions determined as suitable for inclusion in the IWMS were then analysed using a multi-criteria analysis (MCA). An MCA is used to compare different options by assessing their impact against pre-determined criteria and objectives. In the IWMS, the criteria were derived with the help of the steering group from the ambitions discussed in the section below.

The ambitions outlined below were developed to concisely represent the different drivers and motivations of stakeholders. These were then used to develop the MCA criteria by which to assess the wider benefits of each intervention.

The primary ambitions of the IWMS are grouped and summarised below. Additional detail regarding the ambitions and the process by which they were developed can be found in Appendix C.

Water

- Promote local and integrated management of water resources.
- Promote water neutrality.
- Provide sufficient drainage network capacity or mitigate capacity constraints.
- Reduce pollutions, sewage overflows, and sewage spills to an acceptable level.
- Reduce the risk of flooding.
- Provide better protection to areas at risk of flooding.

Climate change

- Minimise greenhouse gas emissions.
- Mitigate the effects of climate change.
- Adapt to the effects of climate change.

Biodiversity

- No adverse effects to protected sites, habitats, and species.
- Promote biodiversity net-gain.
- Provide opportunities for people to come into contact with and appreciate wildlife and nature.

Delivery, operation, and maintenance

- Minimise disruption as a result of option delivery.
- Align with the delivery of other programmes and promote opportunities for collaboration.

- Reduce operational expenditure of water management.
- Reduce capital expenditure of water management.
- Reduce costs of water management for consumers and developers.
- Appreciate and promote the value of existing assets.
- Promote options that are deliverable using existing governance and perception.

Population and human health

- Protect human health from hazards or nuisance.
- Create conditions to improve health and reduce health inequalities.
- Protect human health from increased noise and vibration.
- Provide opportunities for recreation and exercise.

Capabilities

- Contribute to the development of local skills and employment.
- Contribute to the development of the capabilities of the steering group and other stakeholders.

4.2 Criteria

These ambitions were then formatted into criteria suitable to be used in the MCA. The criteria used to assess each intervention in the MCA is listed below:

To what extent:

- Does this option promote local management of water resources?
- Does this option promote water neutrality?
- Does this option facilitate water quality improvement?
- Does this option reduce the risk of flooding?
- Does this option promote bio-diversity net-gain?
- Does this option support improved health and wellbeing?
- Does this option contribute to the development of local skills and employment?
- Does this option help achieve net zero carbon?
- Does this option enable adaptation to the impacts of climate change?
- Does this option provide resilience against the impacts of climate change?
- Is this option deliverable?

The MCA provides a common understanding of the opportunities and risks associated with each option, and the extent to which they could contribute to the ambitions for the IWMS. Each intervention was assessed as to the extent it contributed to achieving each ambition. This assessment was based on expert professional judgement that was validated and approved by the steering group.

The meanings of a high, medium, or low score are outlined in Table 5 below.

Table 5: Assessment criteria ambitions.

Rating	Meaning	Definition
3	High	The option has a strong alignment with the ambition, with good evidence to support, and consensus among stakeholders
2	Medium	The intervention has the potential to contribute or to align with the ambition
1	Low	The intervention does not align with the ambition

4.3 Outputs

Figure 26 to Figure 42 below show the results of the MCA for each intervention, compared against the average for that criterion across all the interventions. These results are used to inform the IWMS, and the diagrams can be used when comparing different interventions to provide information on the wider benefits each has to offer.

The scores have been determined with implementation on new developments in mind. However, it is worth noting that the scores for the majority of criteria will still be applicable when considering each intervention for retrofit. The only criteria likely to differ between the contexts of retrofit and new developments is the deliverability of each intervention. Further details about the deliverability of interventions within both contexts is provided within the Delivery strategy.

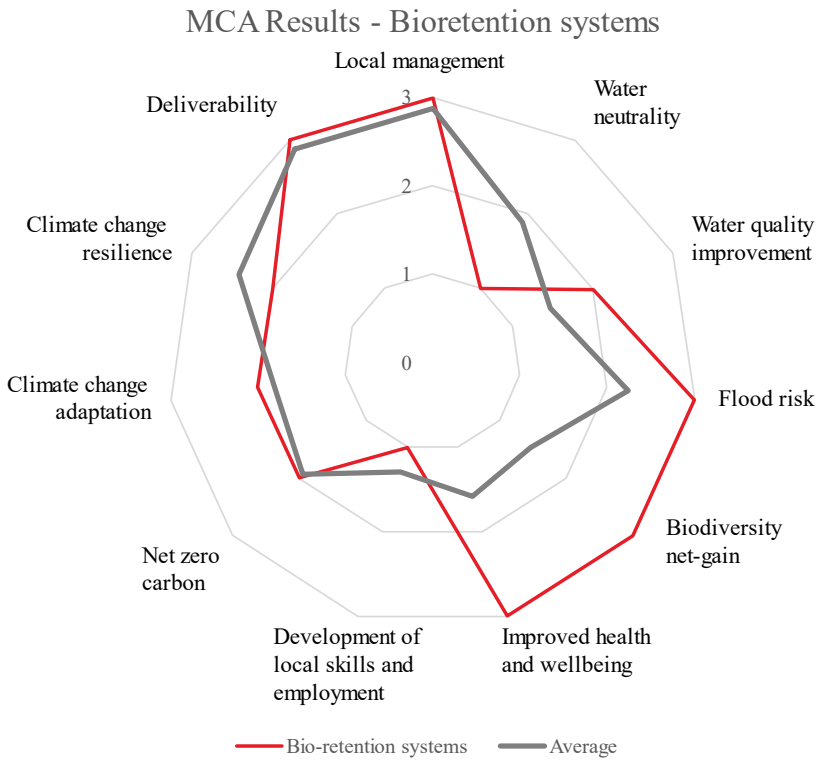

Figure 26: MCA results for bio-retention systems.

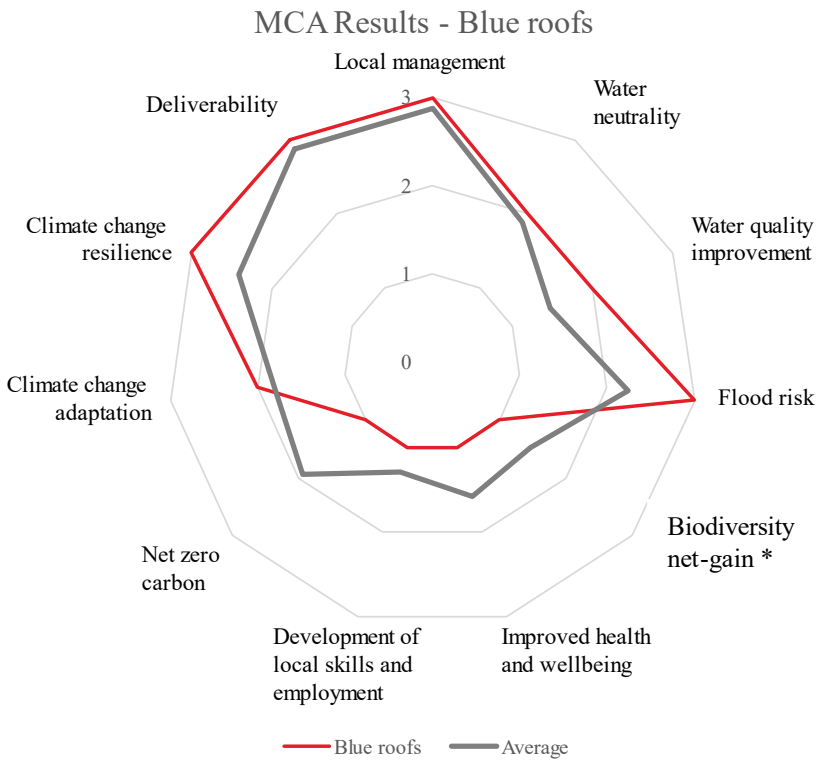

Figure 27: MCA results for blue roofs.

* Blue roofs have been given a score of 0 for Biodiversity net-gain because they do not directly provide biodiversity benefits. However, it is noted that Newham SuDS guidance requires that a blue roof be installed as a development of a green roof, which would therefore provide the biodiversity benefits associated with green roofs (see Figure 31).

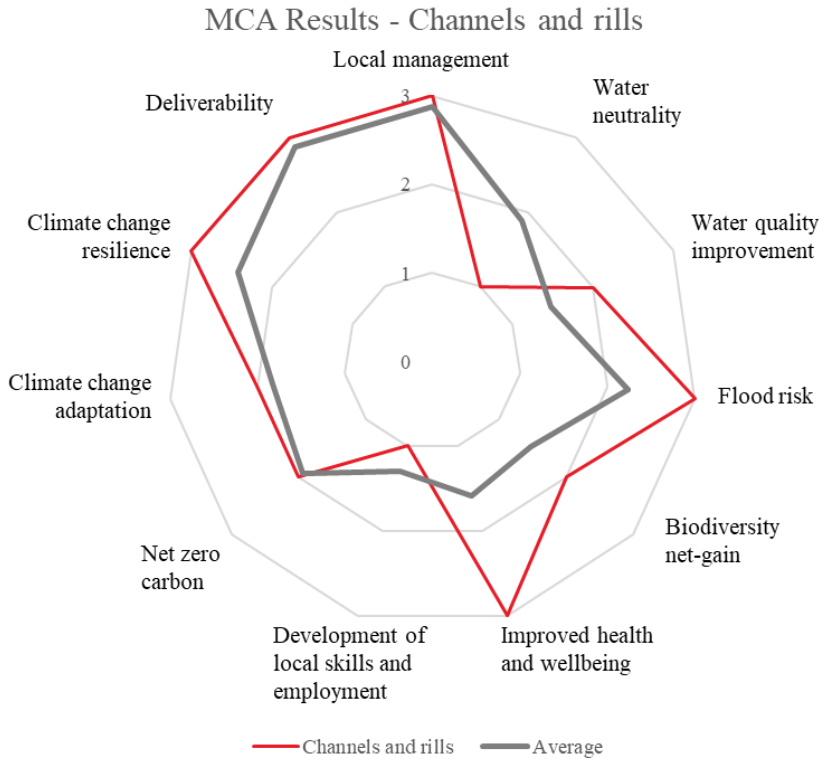

Figure 28: MCA results for channels and rills.

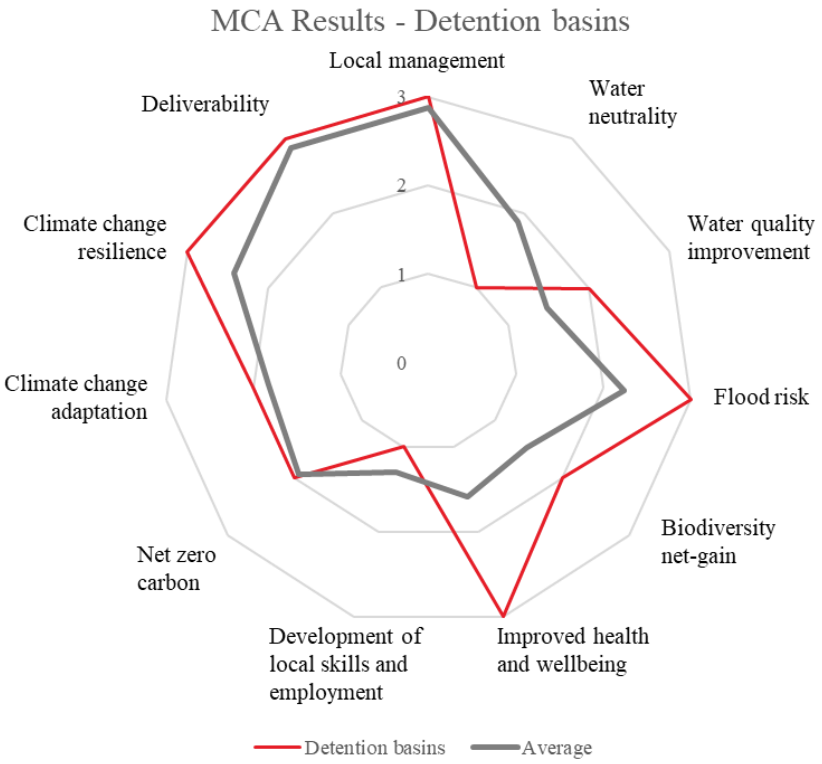

Figure 29: MCA results for detention basins.

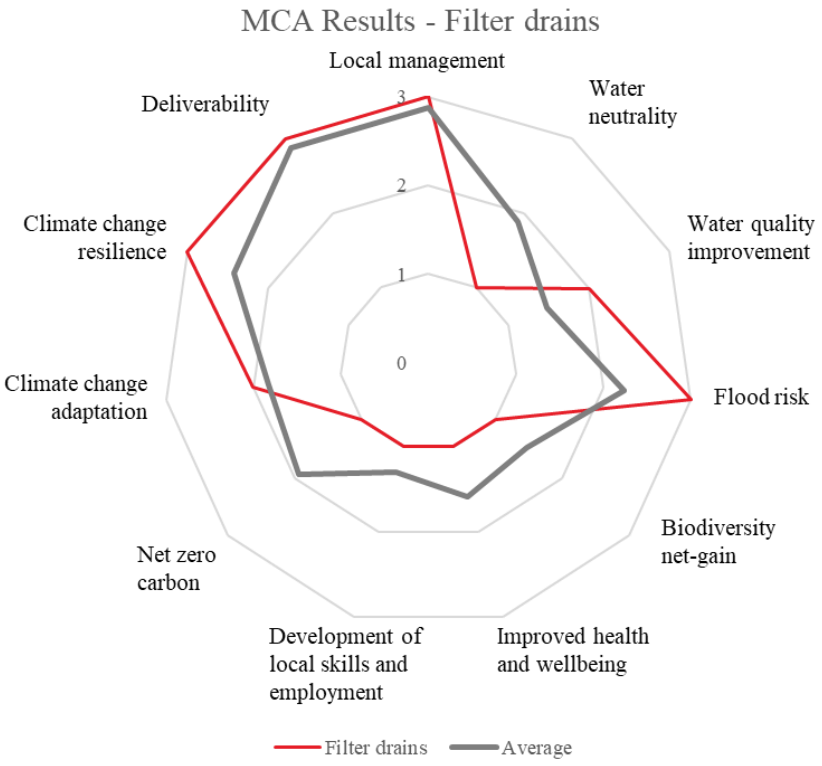

Figure 30: MCA results for filter drains.

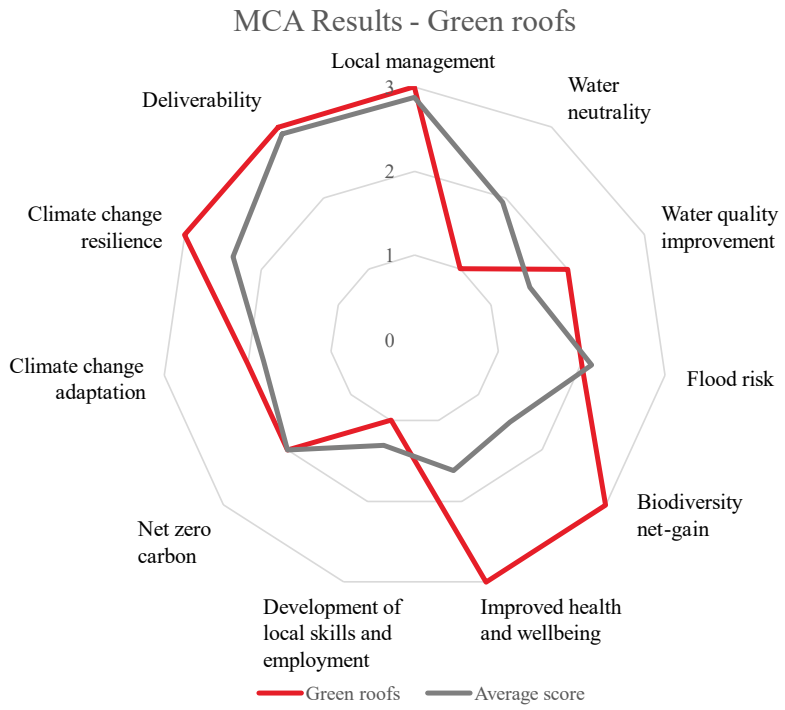

Figure 31: MCA results for green roofs.

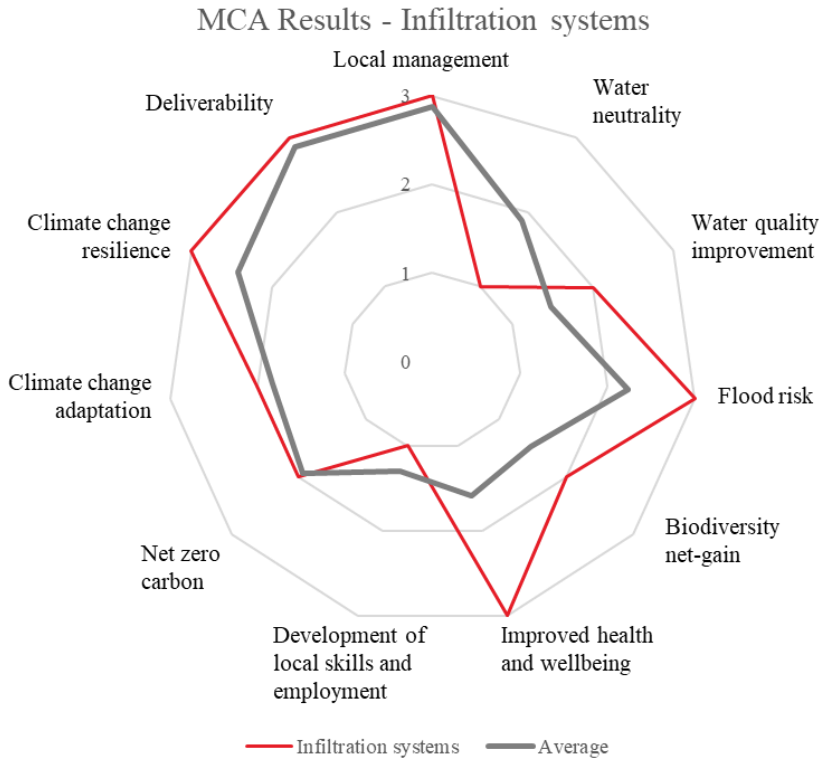

Figure 32: MCA results for infiltration systems.

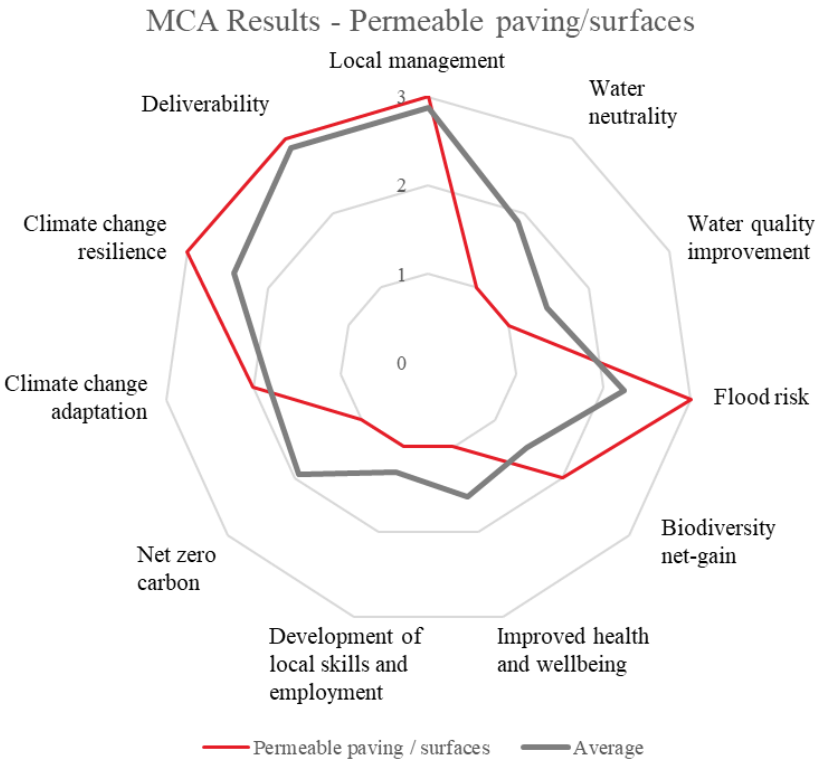

Figure 33: MCA results for permeable paving / surfaces.

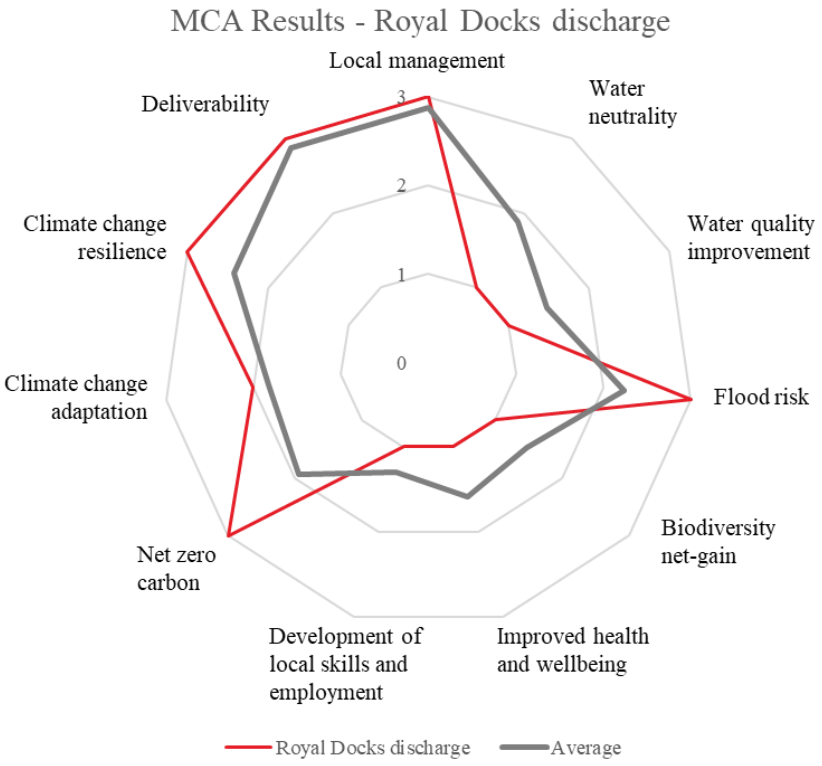

Figure 34: MCA results for surface water separation and discharge into Royal Docks.

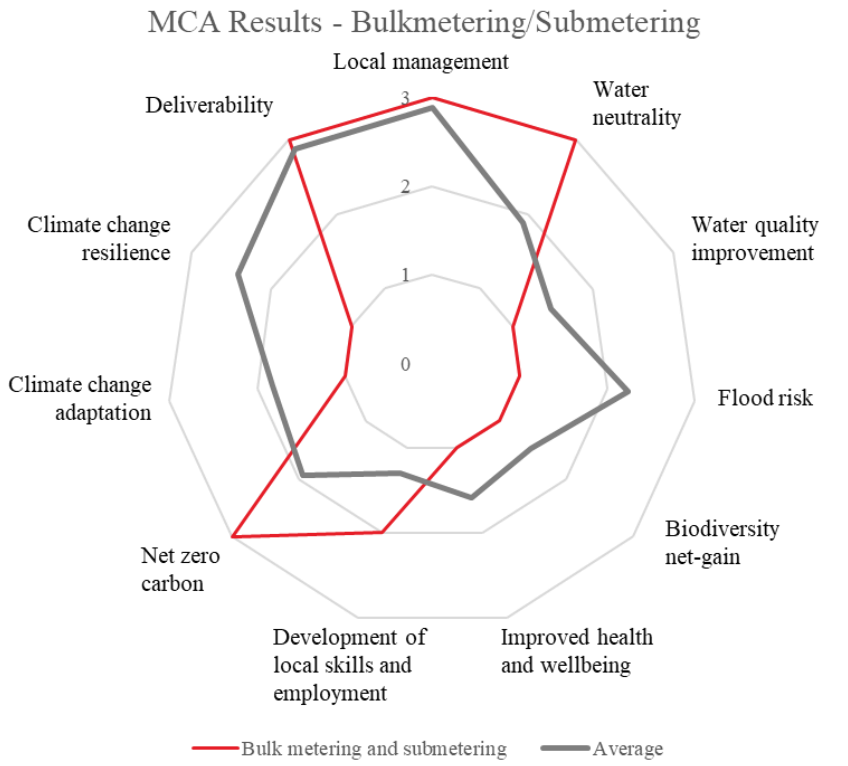

Figure 35: MCA results for bulk metering and submetering.

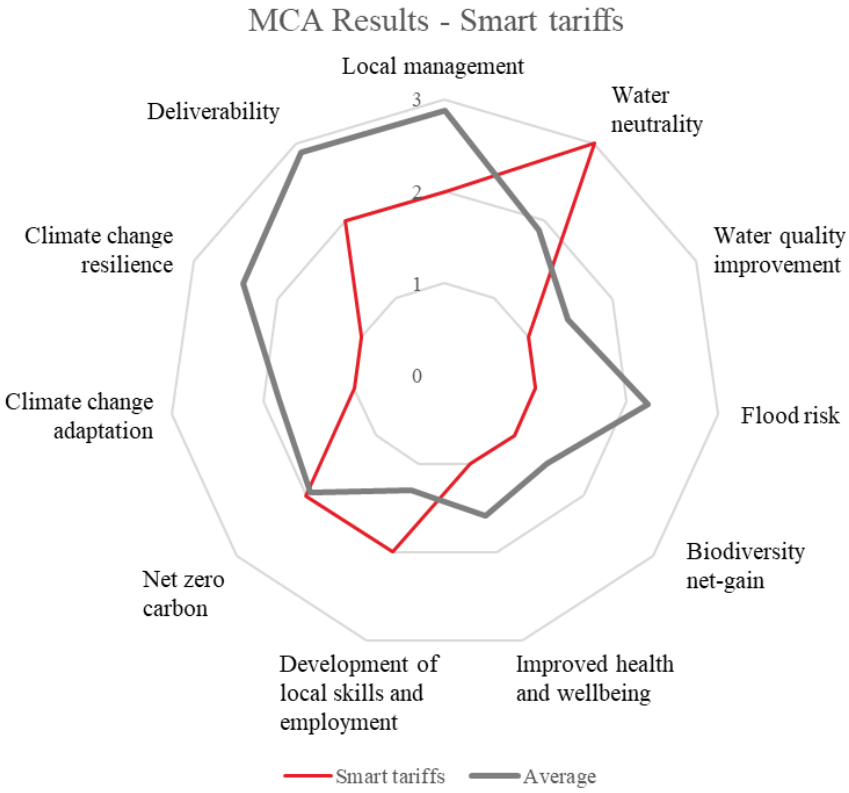

Figure 36: MCA results for smart metering and smart tariffs.

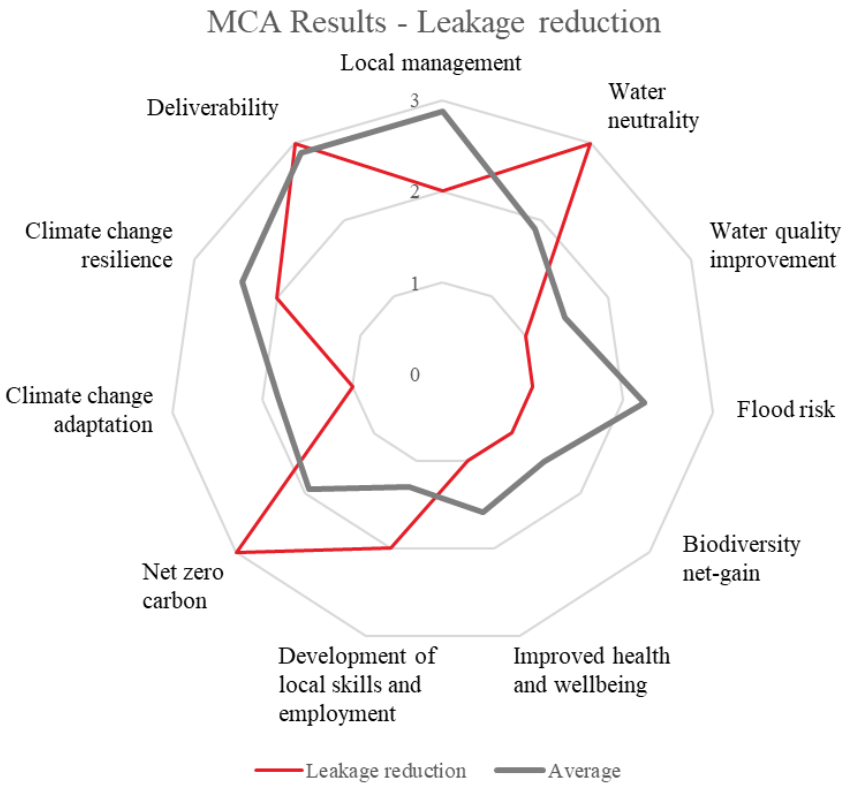

Figure 37: MCA results for leakage reduction.

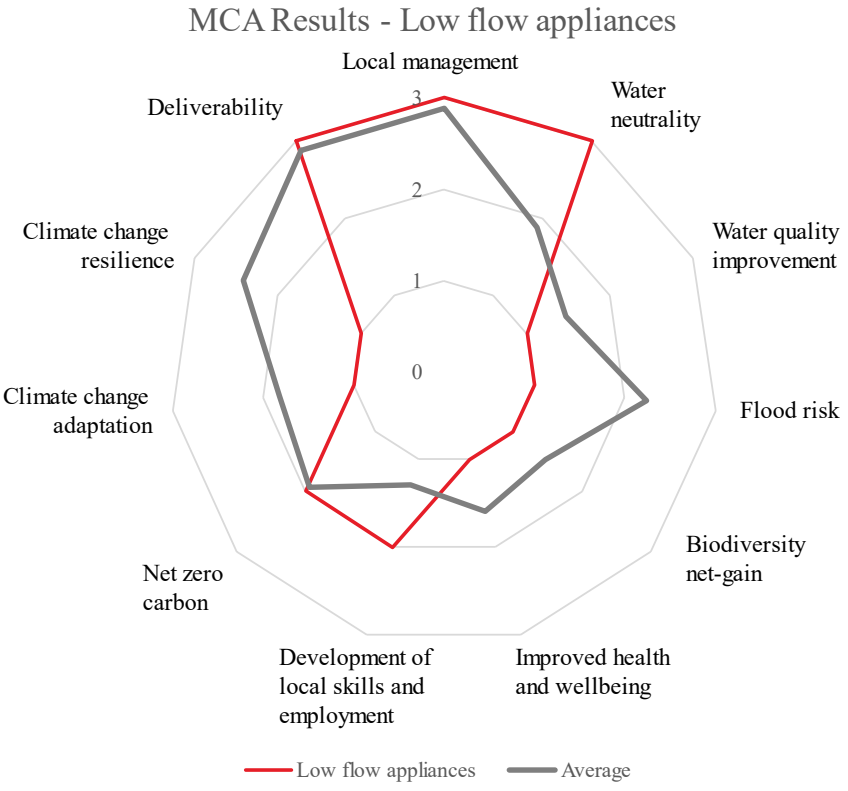

Figure 38: MCA results for low flow appliances.

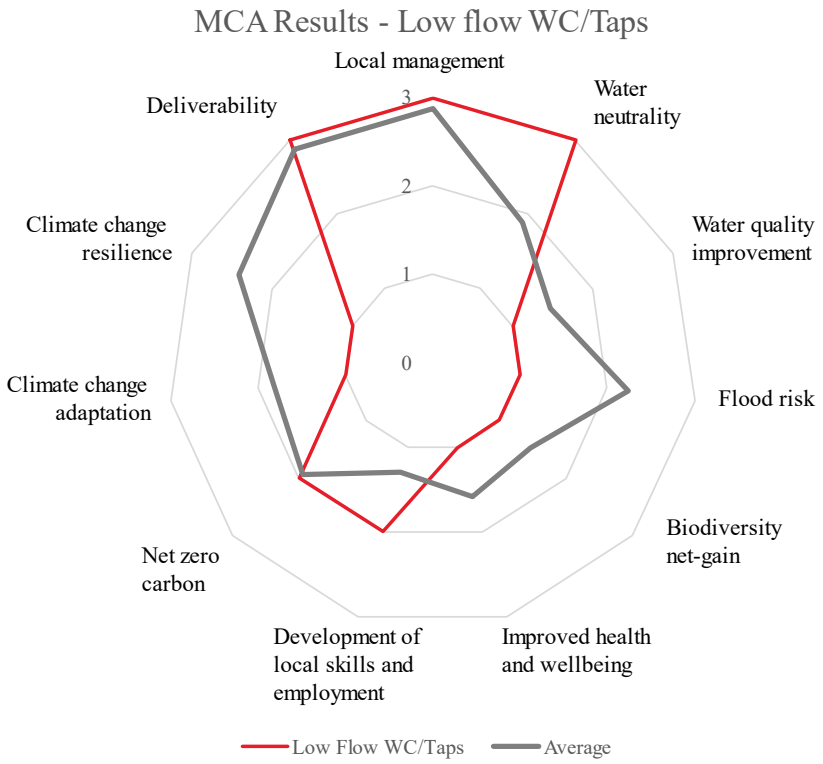

Figure 39: MCA results for low flow taps.

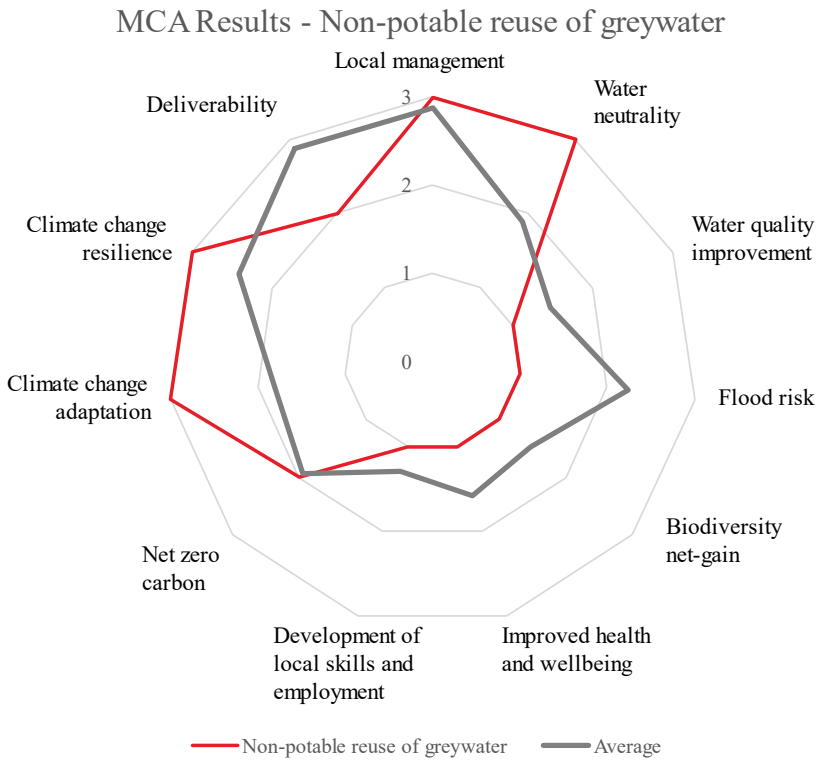

Figure 40: MCA results for non-potable reuse of greywater.

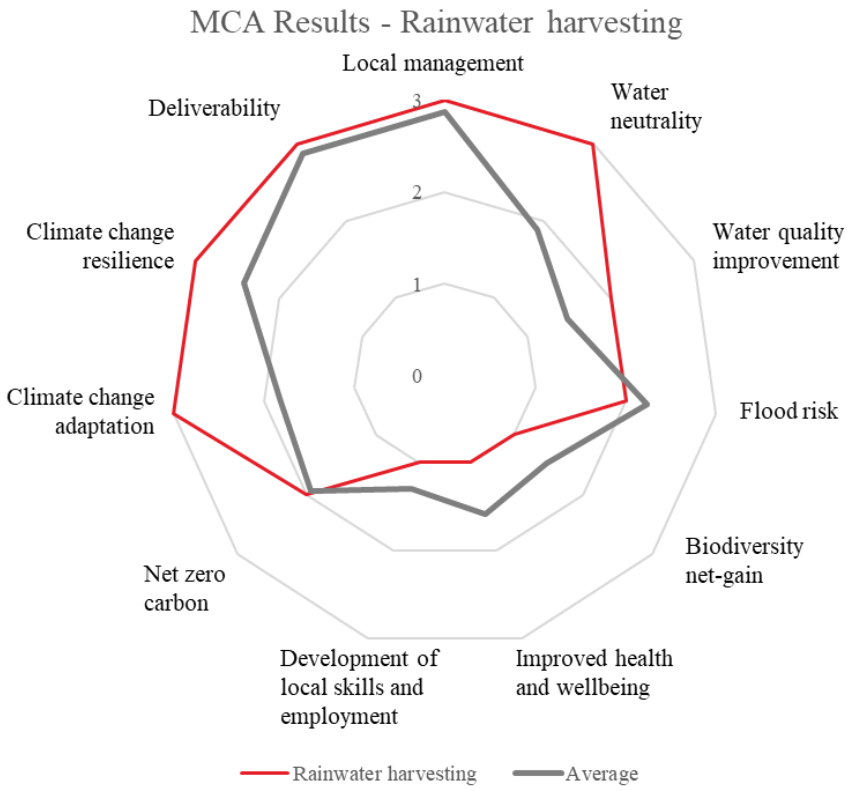

Figure 41: MCA results for rainwater harvesting.

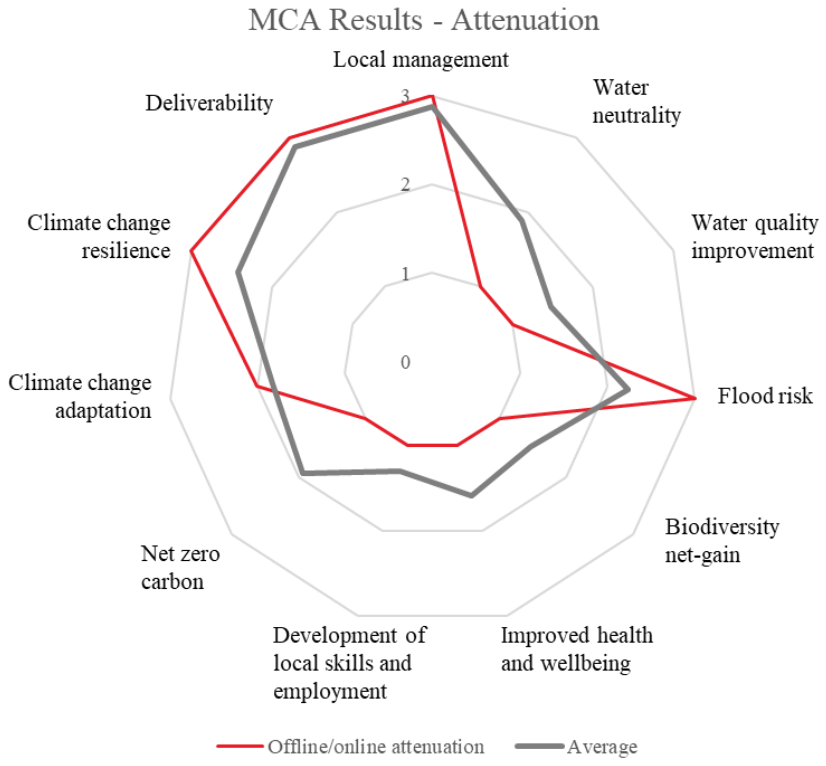

Figure 42: MCA results for attenuation.

4.4 Insights

The MCA demonstrates which interventions will offer the most 'wider benefits'. These benefits are based around the stakeholders' ambitions for the opportunity area. The four points below highlight the key insights gained from the MCA, which are then reflected in the following recommendations for the IWMS for RD&BR.

- Water efficiency measures have wider benefits for deliverability, local management, water neutrality and net zero carbon, but overall score lower than runoff reduction measures and alternative resources with relation to the overall wider benefit ambitions of the stakeholders.
- Rainwater harvesting scores well for its wider benefits across 5 ambitions: climate change adaption and resilience, deliverability, local management, and water neutrality. Additionally, it can contribute to reducing flood risk and working towards net-zero carbon. Therefore, this should be one of the priorities for RD&BR IWMS.
- To help achieve the ambitions for 10% biodiversity net-gain and improved health and wellbeing, blue-green infrastructure should also be prioritised where it supports these aims. Blue-green infrastructure improves the local environment, provides habitats for wildlife, and can contribute to flood risk reduction. Flooding was identified as a problem in the analysis due to the geography of the study area and addressing flooding was an ambition of the steering group.
- The MCA shows that hard engineering options for runoff reduction should also be implemented as they provide resilience against climate change, are deliverable, reduce flood risk and promote local management.

The outputs from this analysis were used together with the scenario modelling to explore the impact of interventions on the water balance. This results in an integrated approach to water management that looks at how each intervention can not only impact the water balance but can also help to achieve the wider ambitions for the area.

5. Scenario modelling

5.1 Approach

The role of the IWMS is to provide strategic guidance with a view to future conditions. A key ambition of the steering group is that that IWMS should consider and promote adaptability and resilience of the water system to future uncertainty.

The uncertainties identified by the steering group as having the most potential to impact integrated water management across the OA are:

- The level, type, and pace of growth within the OA (particularly considering the Baseline review).
- Climate adaption (manifesting principally as warmer drier summers, wetter milder winters, and increased intensity of precipitation).
- Delivery mechanisms and the level of ambition regarding potential interventions.

Adaptive planning approaches are increasingly being used in the water sector to address future uncertainty. However, to carry out quantitative adaptive planning analyses requires the consideration of specific risks (e.g., climate change impact on flood levels) and the targeting of defined outcomes or trigger points (e.g., timing of future technology availability). This level of analysis would not be proportionate in the context of the IWMS.

A pragmatic approach has been taken to consider adaptiveness and resilience to future uncertainties. The aspiration is to identify and prioritise 'least regret' interventions, in the face of the uncertainties that exist when targeting certain outcomes for the OA.

- General uncertainties have been considered within the MCA. For example, all options have been assessed for their adaptiveness and, separately, their resilience to the impacts of climate change.
- Uncertainty regarding growth and level of ambition are tested through the use of scenarios to model the impact of these uncertainties on the water balance using extreme 'boundary conditions':
  - Two scenarios consider the water balance under baseline and a high growth trajectory.
  - Two scenarios consider the impact of the water balance where interventions are focused on new developments (i.e., where planning is still possible, and developer delivery is an option) vs the impact where more ambitious interventions can be pursued including retrofit in the wider OA.
  - A fifth scenario explores how utilising the Royal Docks could impact surface water.

5.2 Analysis

Modelled interventions

In order to model the various scenarios, the interventions were filtered based on whether their impact on the water balance could be modelled meaningfully within the RD&BR context. Table 6 shows the options included in the IWMS, and whether they were modelled and why.

Table 6: Table showing which interventions were modelled and how.

Option	Modelled?	Proposed modelling method or reason for exclusion from IWMS
Bio-retention systems	Include	Too detailed to be modelled individually. Interventions have been combined and modelled as a holistic runoff control opportunity.
Blue roofs	Include	
Channels and rills	Include	
Detention basins	Include	
Filter drains	Include	
Green roof	Include	

Option	Modelled?	Proposed modelling method or reason for exclusion from IWMS
Infiltration basins	Include	
Soakaways	Include	
SuDS ponds	Include	
Swales	Include	
Bulk metering and submetering	No	Not relevant at OA scale. Wider Thames Water consideration.
Smart tariffs	No	Not relevant at OA scale. Wider Thames Water consideration.
Smart metering for units	Include	Included in demand assumptions as per current Thames Water plans to roll out in all suitable homes by 2035.
Leakage reduction	Include	Included as part of a general water supply assumption.
Offline/online attenuation	Include	Cover under wider runoff control opportunity, as too detailed to be modelled individually.
Permeable paving / surfaces	Include	
Royal Docks discharge	Include	Modified rational - excess from blue green to be diverted to Royal Docks.
Low flow appliances	Include	Cover under water efficiency allowance, as too detailed to be modelled individually.
Low Flow Taps	Include	
Low flow WC	Include	
Non-potable reuse of blackwater	No	
Non-potable reuse of greywater	Include	Too detailed. Included as part of a general water supply assumption.
Rainwater harvesting from roofs	Include	
Rainwater harvesting from surfaces	Include	

Scenario 1 and 2 – Impact of different growth projections

The objective of Scenario 1 was to evaluate the impact of planned growth, as per the London Borough of Newham's Local Plan and London SHLAA projections to 2041, on local infrastructure. This scenario represented the baseline analysis and demonstrated the outcome of a do-nothing approach. Therefore, no interventions were included in the scenario.

The objective of Scenario 2 was to evaluate the impact of a OAPF Higher Growth to 2041 scenario on local infrastructure. This scenario represented the GLA growth analysis shown in the Opportunity Area Planning Framework draft 2022 and demonstrated the outcome of a do-nothing approach. Therefore, no interventions were included in the scenario and water demand reflects Building Regulations standards. In both scenarios, residential and commercial demands were calculated using the following factors:

- 125 l/p/d residential (Building Regulations, Part G)
- 3.8 l/m^2/d non-residential (Building Services Research and Information Association [BSRIA]).

Impact from planned baseline and high growth scenarios

Scenarios 1 and 2 were run to understand the impact of different growth trajectories on the supply / demand balance under 'Business as Usual' conditions for interventions. As summarised in Figure 43 below, and tested through Scenario 1 and 2, reduced water availability in the future poses challenges to meeting existing demand. Any additional or accelerated Growth in the OA will increase the pressure on water resources and will impact any water neutrality ambitions.

Figure 43 shows the reduction in available water supply from Thames Water from 170 MLd to 155 MLd due to environmental water prioritisation. It also shows the increase in water demand from a baseline of 170 MLd to 180 MLd and 183 MLd for the baseline and high growth profiles respectively. This illustrates the imperative for local action to be taken to reduce the supply / demand deficit and associated impact on strategic water resources.

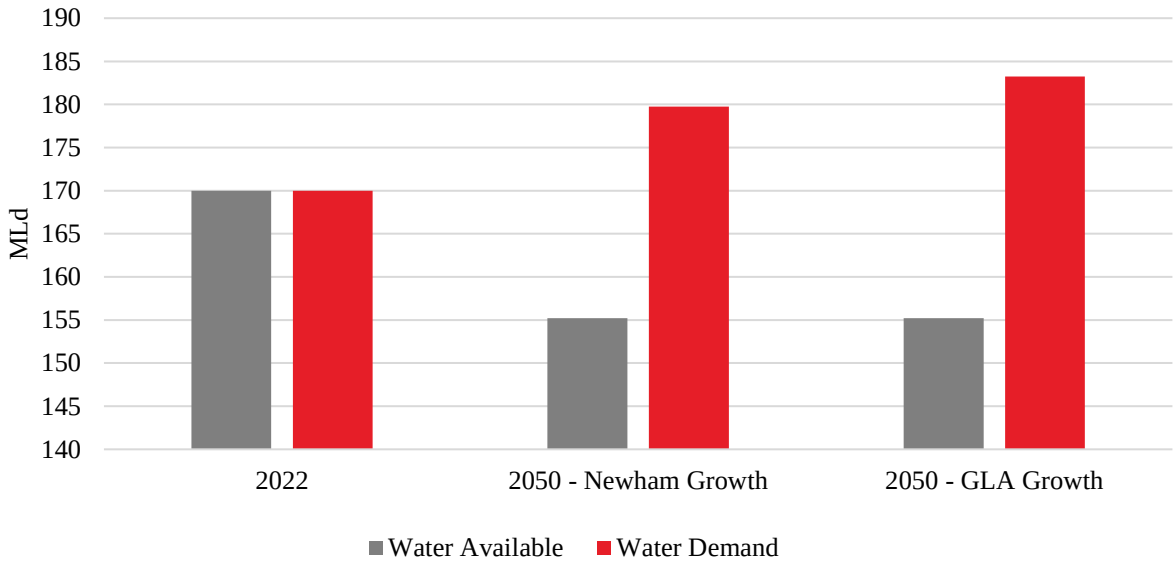

Figure 43: Water availability and future challenges.

Scenario 3 - Unlocking the Royal Docks and Beckton Riverside Opportunity Area.

The objective of this Scenario was to explore the potential for IWMS interventions to be implemented within the development of the strategic sites and to understand the potential impact on the IWMS water balance and ambitions. This scenario is summarised below in Figure 44.

As part of this scenario the following assumptions have been made:

- An ultra-efficient potable water use target for the new development of 85 l/p/d day and 2.6 l/m2/day total water consumption.
- Rainwater stormwater harvesting is assumed for 100 % of the strategic sites. (Roofs assumed to be 40% of site area).
- No green roofs assumed to estimate maximum rainwater harvesting potential.
- 100 % of the strategic sites with greywater reuse systems.
- An ambitious target of 50 % reduction in leakage by 2050 across the OA.

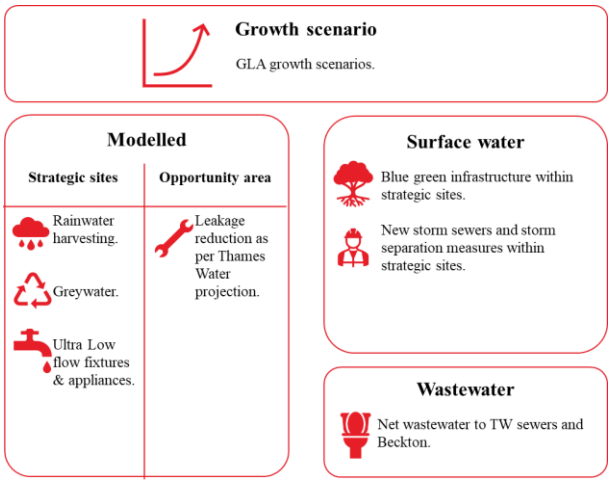

Figure 44: Summary of scenario 3.

Water use efficiency

85 lppd total water consumption was considered to set an ambitious boundary condition for water efficiency to test the potential impact on the water balance.

2.6 l/m2/d for commercial development has been set as an ambitious water demand.

Rainwater and surface harvesting

Both rooftop and surface Rainwater harvesting have been calculated using BS EN 16941:2018 standard. The simple approach in the standard was appropriate at a strategic scale where individual building layout and

occupancy information is not available. As the sites are expected to be densely developed, the IWMS has assumed that in strategic sites rooftops account for 40 % of site area and 60 % and ground surfaces. The IWMS has further assumed 600 mm annual rainfall, an 80 % capture coefficient for rooftops and 60 % for surface runoff (accounting for system losses).

Grey water recycling

The IWMS has considered an ambitious level of water recycling to understand a possible boundary condition for the level of impact that could be achieved. In reality implementation may be less that this due to delivery challenges.

Grey water availability in residential portions of strategic sites is 55 % of foul discharge (i.e., assumed theoretical grey water potential is maximised). NPW demand is 25 % of total demand. Therefore, typically there is a 50 % surplus of alternative supply to non-potable demand.

In commercial sites, grey water availability in strategic sites is 30 % of foul discharge and NPW demand is 60 % of total demand. Therefore, typically there is a 50 % deficit of alternative supply to non-potable demand.

For modelling simplicity, we have assumed wastewater flows are 100 % of potable demands (noting that these are small systems geographically and therefore limited losses in sewer networks). The IWMS has not considered efficiencies or synergies in mixed use developments or between neighbouring residential and commercial sites to balance supply and demand surpluses and deficits.

Leakage reduction has been assumed to be in line with 50 % reduction by volume by 2050 in line with Thames Water targets. It is noted that this benefit to the RD&BR water balance will be achieved through leakage reduction across Thames Water whole water resource zone.

Scenario 4 - Creating an integrated the Royal Docks and Beckton Riverside.

The aim of Scenario 4 is to consider the potential for integrated water management across both the strategic sites and through retrofit across the OA. This Scenario is summarised below in Figure 45.

As part of this Scenario the following assumptions have been made:

- Strategic site measures as per Scenario 3.
- 15 % water efficiency reduction through retrofit of existing homes. Rollout rate of 1.5 % per year of users.
- Rainwater harvesting retrofit in 100 % of existing buildings to estimate maximum potential volumes. (Actual retrofit potential may be less due to building designs).
- Blue green infrastructure retrofit on existing roads and built-up areas across the OA.

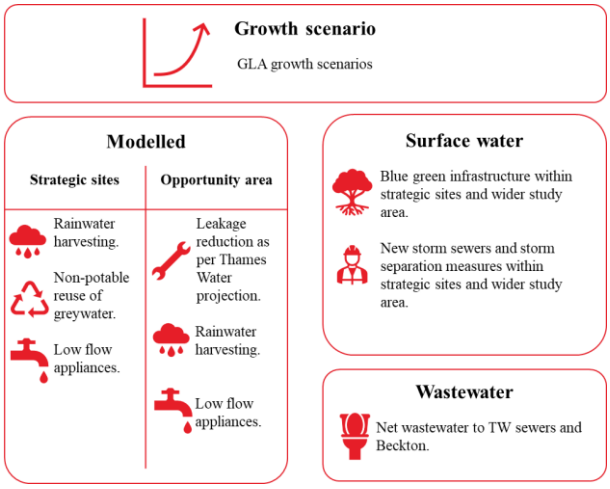

Figure 45: Summary of Scenario 4.

In addition to the strategic site interventions outlined in Scenario 3 above, the assumptions for the scenario 4 retrofit interventions are outlined below.

Efficient fittings

We have assumed an ambitious roll out of fixtures and fittings (1.5 % annually of the total properties in the DMA, calculated by volume) but have been conservative in the level of efficiency that can be gained on average (15 %) accounting for long term rebound effects (Evaluating the Effectiveness of Residential Water Efficiency Initiatives in England: Influencing Factors and Policy Implications). Establishing retrofit rates, through retrofit programmes or self-refurbishment, is complicated. Therefore, a roll out 1.5 % per year of existing building stock has been assumed as achievable target.

Rainwater harvesting (retrofit)

We have estimated building outlines from open street map and ordnance survey open map giving an approximate 18 % of the OA covered by buildings. We have assumed 100 % rainwater harvesting roll-out, deliverability testing an ambitious boundary condition for this intervention. Available supply is calculated using BS EN 16941:2018 standard assuming 600 mm annual rainfall, and 80 % capture coefficient.

Surface water blue green retrofit

We have not considered retrofit SuDS for alternative water supply within the supply / demand balance, recognising that this is too complex in reality. However, SuDS retrofit is considered through land use change for run-off reduction. Impermeable surfaces account for 33 % of the land cover (i.e., 506 ha) in the study area (see Table 2) and are the source of most of the runoff causing pluvial flooding. A specific land use conversion rate or target has not been assessed due to limitation of the drainage model coverage.

Impact of strategic sites interventions vs retrofit interventions

Scenario modelling allowed the testing of the effect of different interventions on the future water balance, to see what is necessary to mitigate the impact of growth demand on strategic water. We have used Sankey diagrams to breakdown the components of the water supply and demand balance of Scenarios 3 and 4 more clearly. These are shown in Figure 46 and Figure 47 below. The Sankey diagrams allow the comparison of the impact of strategic site interventions vs retrofit of interventions. A Sankey diagram is not used for Scenario 5 as this focuses on surface water management in relation to the docks.

Impact of strategic site interventions

Scenario 3 tested the impact on the water balance of pursuing ultra-water efficiency and re-use interventions within the strategic sites. Our analysis showed that an ambitious water efficiency programme in the strategic sites could reduce demand from 13Mld (Scenario 2) to 9Mld. Of the 9 Mld water demand increase by the strategic sites, 2.7 Mld demand could be met through non-potable water (NPW) supplies provided from rainwater and surface water harvesting as well as greywater recycling. This could result in potable water demand on the Thames Water mains supply being reduced from 13 Mld to 6.7 Mld (approximately 48 % reduction of strategic site demand, and 3.6% reduction in the demand on Thames Water for the Royal Docks Opportunity Area.)

We also estimate there could be up to 2.7 Mld excess alternative supply. Therefore, there may be further opportunity for better balancing of NPW supply/demand to further reduce the impact on potable water supply. This analysis gives an indication of the potential ambition for localised NPW management that should be explored within the development of the strategic sites.

Our analysis also demonstrates that if Thames Water leakage reduction targets are met in full, the RD&BR OA net demand on the Thames Water potable water supply (179 Mld) would reduce by up to 1% compared to the business-as-usual scenarios in Scenario 1 and 2 (180 Mld and 183 Mld respectively). Although this is small, it signifies an important step in improving sustainability and resilience of the water system through increased local management of water resources, whilst accommodating growth.

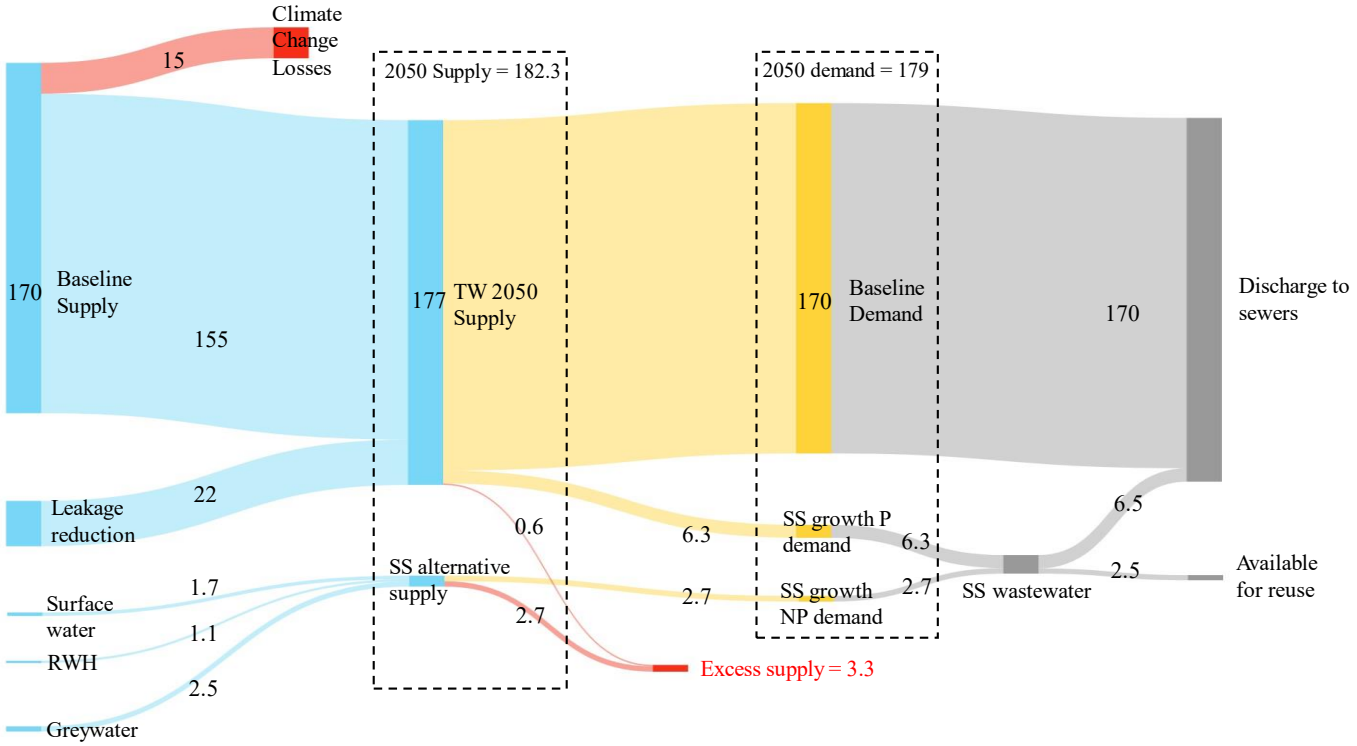

Figure 46: Sankey diagram showing Scenario 3 water balance (all numbers in ML/d).

Impact of OA retrofit interventions

Scenario 4 tested the impact on the water balance of pursuing retrofit interventions across the wider OA, in addition to interventions within the Strategic Sites.

The Sankey diagram shown in Figure 47 illustrates the same opportunities with respect to NPW as assessed in Scenario 3 and discussed above.

However, it also illustrates the significant opportunity for demand reduction through retrofit activities in the OA. This 7 % demand reduction (170 Mld to 158.6 Mld), when considered along with the potential for alternative supplies in the strategic sites, contributes to a potential total of 18.1 Mld that could be reduced from Thames Water strategic supply due to increased local management of water resources. This equates to a reduction in demand on Thames Water of 10.6 % relative to the 170 Mld baseline.

Retrofit rainwater harvesting contributes a relatively small 1 Mld to the water balance under the optimistic conditions that we have modelled suggesting rainwater harvesting may be worthwhile pursuing only where there are clear site-specific opportunities (i.e., suitable buildings).

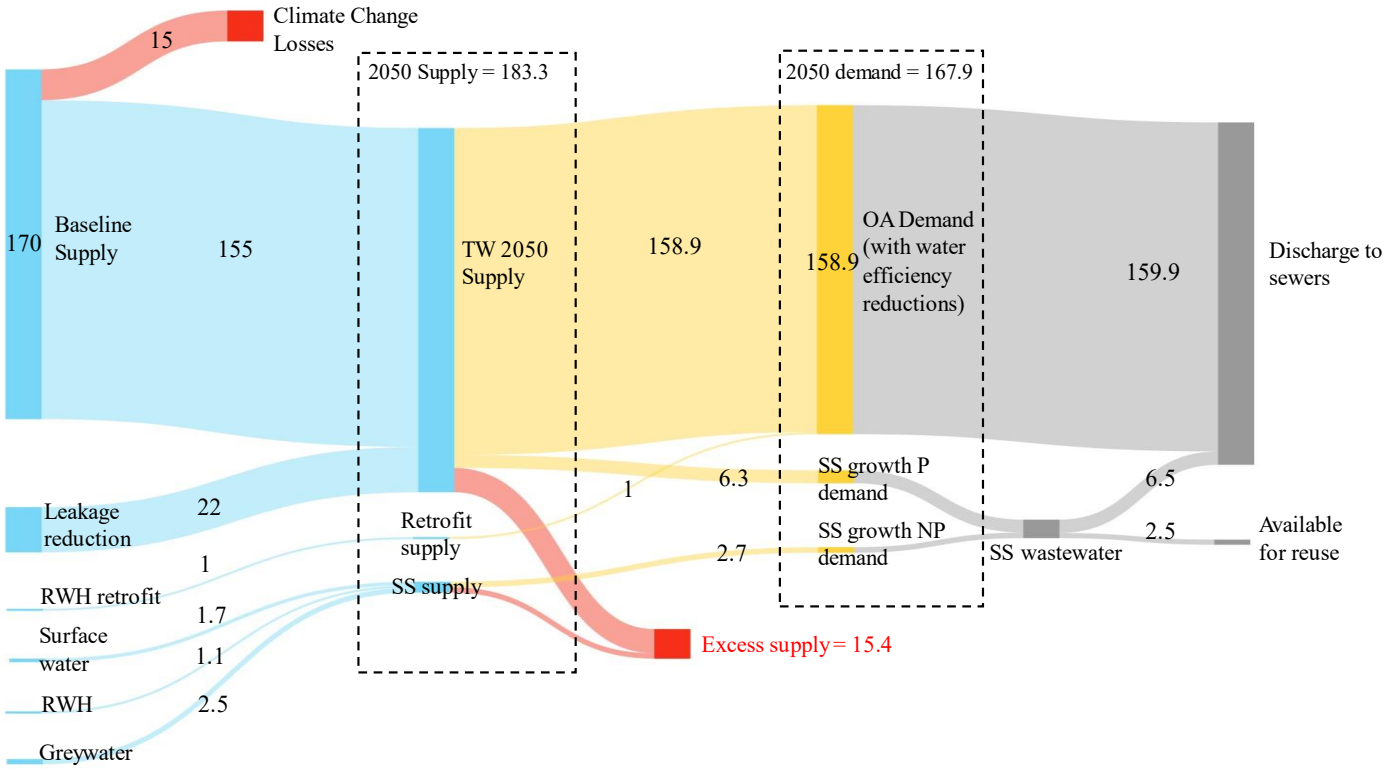

Figure 47: Sankey diagram showing Scenario 4 water balance (all numbers in MLd).

Scenario 5 - The role of the Royal Docks

The objective of the fifth scenario was developed to explore the potential for major surface water attenuation using the Royal Docks. The potential benefits of this approach are to reduce the costs and carbon of treating surface water at Beckton STW and reduce the carbon implication of pumping river water into the docks. It should be noted there are water quality considerations that would need to be considered when discharging surface water drainage into the docks.

This scenario is summarised below in Figure 48.

As part of this scenario the following assumptions have been made:

- Strategic site measures as per Scenario 3.
- 15 % water efficiency reduction through retrofit of existing. Rollout rate of 1.5 % per year of users.
- A new surface water sewer network in the OA to divert runoff to the Royal Docks.

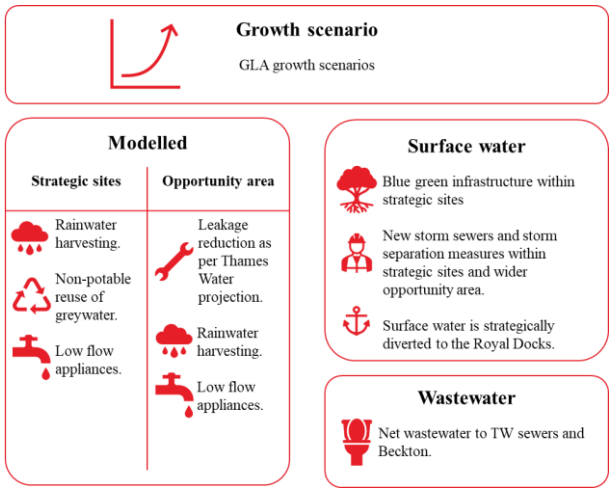

Figure 48: Summary of Scenario 5.

We carried out a basic analysis of average volumes of surface water run-off within the OA and within the gravity catchment of the docks themselves.

The tables below summarise the breakdown of average surface water volumes and their distribution between different drainage systems in the Study Area. The estimates of runoff assumptions based on guidance for Modified Rational Method but has not been tested or calibrated due to drainage model limitations.

The average total runoff from the study area is estimated at 4 Ml/year, though it would vary during wet and dry years. There is limited information on the sites that discharge into the Thames or docks currently, so it is assumed that all this runoff gets pumped to Beckton STW via the three sewage pumping stations.

The ground levels in relation to retained dock water level limit the sites that can discharge via gravity into the docks. Considering the sites adjacent to the docks, gravity flows would be less than 1 Ml/year.

Table 7: Surface water runoff pumped to Beckton via Abbey Mills and Unnamed PS.

	Building	Green	Land	Roads	Water	Woodland	Unknown
Coverage area (ha)	183	172	495.10	210	8.7	34.9	2.35
Runoff coefficient (%)	90 %	10 %	60 %	90 %	90 %	10 %	0 %
Annual runoff volume (ML)	1.0	0.1	1.8	1.1	0.05	-	-

Table 8: Surface water runoff pumped to Beckton via Barge House PS.

	Building	Green	Land	Roads	Water	Woodland	Unknown
Coverage area (ha)	44	106	152	62	41	27	3
Runoff coefficient (%)	90 %	10 %	60 %	90 %	90 %	10 %	0 %
Annual runoff volume (ML)	0.24	0.06	0.55	0.34	0.22	-	-

- Total surface water run-off in the study area is estimated to be 4 Ml/year.
- 22 Ml/year of river water is pumped into the Royal Docks.
- It is clear from this basic analysis that while discharging surface water runoff to the Royal Docks would be useful, the volume available would not be enough to meet the Royal Docks water demands. Additionally, the analysis shows that only a small area of the docks could drain into the dock by gravity. Any further drainage to the docks would need to be pumped and, although this may offer an opportunity to reduce the flow and carbon impact at Beckton of treating surface water, would be unlikely to be more efficient than the current Thames pumping scheme. Further consideration of potential for the docks to be used as a surface water sink should be analysed more specifically after the IWMS.

6. Conclusions

6.1 Overview

This section brings together the insight gained from the baseline review, options assessment, MCA, and scenario modelling. This includes conclusions and recommendations on priorities for the integrated water management of the RD&BR opportunity area.

Conclusions make up the main body of text while recommendations are shown in grey callout boxes.

It is important to note that although stakeholders suggested a range of ambitions for the IWMS, no specific targets for particular outcomes have been identified.

The Delivery strategy and the Implementation toolkit (found in Part 2 of this report) outline how these recommendations can be implemented in the OA. As explained in the introduction, the Delivery strategy is largely aimed at policy makers and local authorities, while the Implementation toolkit can be used on a case-by-case basis by the parties delivering the interventions, such as developers.

6.2 Water management

Water efficiency

The ambitious water efficiency targets that were explored in Scenario 3 indicated there could be up to a 6.7Mld reduction in demand on Thames Water supply if implemented by developers. However, as the Thames Water supply network is not currently constrained, and sewer flooding capacity issues re in relation to surface water management and not foul flows, and additional water efficiency measures increase costs for developers, it is considered unlikely that an ambitious water efficiency target over and above the London Plan would stand up to scrutiny in Royal Docks currently.

We believe that water efficiency in new buildings is currently best tackled through utility incentives such as the one announced by Thames Water in February 2022 that housing developers who commit to building new properties fitted with low water using devices like showers and washing machines and use rainwater or 'grey water' for toilet flushing and watering plants, will be offered discounts on the charges they pay Thames Water to connect to the public water supply.

Water efficiency retrofit can reduce demand by 11 MLd in the extended study area, which is greater than the Demand of 13 Mld (OAPF Higher Growth Projection). This nearly achieves Water Neutrality based on current water availability, but not when considering future reductions in water supply.

As indicated in Figure 49, leakage reduction could make 22 Mld available for use (based on an ambitious target of 50 % reduction in leakage). The combined effect of water efficiency retrofit, and leakage reduction can help achieve water neutrality based on future water availability.

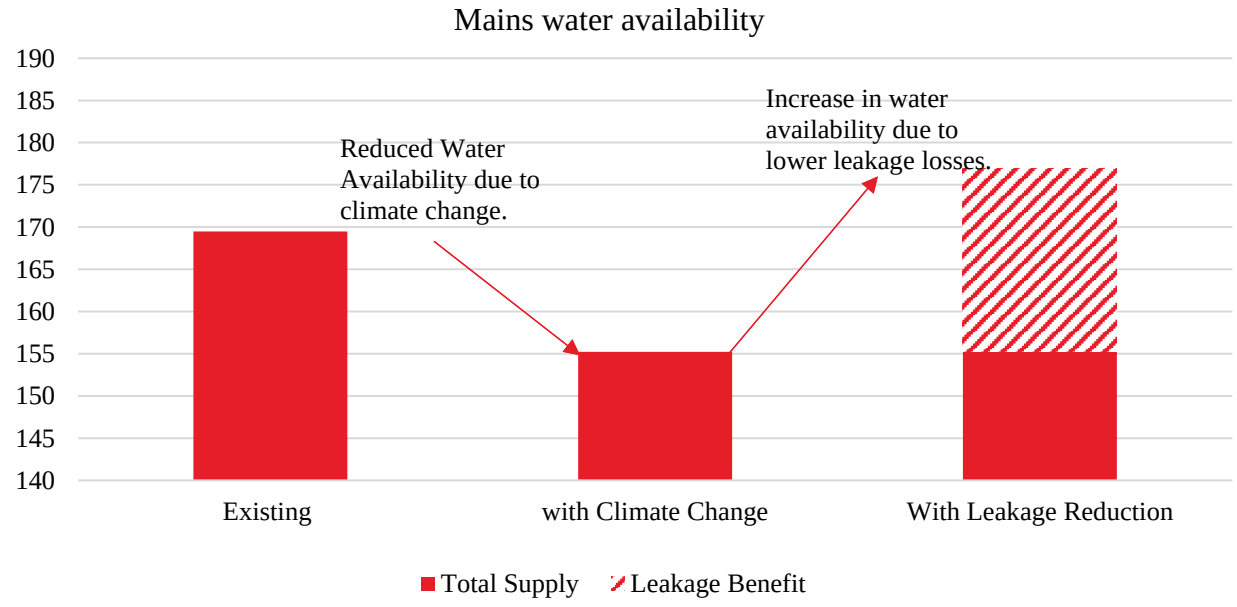

Figure 49: Benefit of achieving 50% reduction in leakage.

Greywater reuse has the potential to reduce water demands in homes and business by up to 30 % and 15 % respectively. For existing buildings, such retrofits are only viable during major refurbishment as separate greywater drainage will need to be installed. The additional costs of greywater systems (> £2000/unit) in area of high socioeconomic challenges will likely limit widespread adoption.

Supply demand balance comparison

Table 9 below summarises the comparison between the potable water demand and supply for each of the scenarios. Scenario 5 is omitted as it does not change any element of the potable water supply/demand balance, it only demonstrates surface water being transferred to the docks.

The tables clearly show that, by implementing the measures outlined in Scenario 3 and Scenario 4, a supply deficit can be avoided. Scenario 4 demonstrates that by implementing retrofit interventions along with efficiency and reuse interventions in the strategic sites, it can be possible to reduce the predicted demand despite additional development in the OA.

Table 9: Potable water supply demand balance summary

Scenario	Potable water demand (MLd)				Potable water supply (MLd)			Potable water supply/demand balance change
	Opportunity Area	Strategic sites	Total	Demand change relative to baseline	TW supply	Leakage reduction	Total TW supply	Potable water supply/demand balance change
Baseline	170	n/a	170		170		170	0 %
Scenario 1	170	*	180	5.9 %	155	22	177	-2 %
Scenario 2	170	*	183	7.6 %	155	22	177	-3 %
Scenario 3	170	6.3	176.3	3.7 %	155	22	177	0%
Scenario 4	158.9	6.3	165.2	-2.8 %	155	22	177	7 %

*strategic sites growth included under business-as-usual growth.

Local and integrated water management, water neutrality

- It is acknowledged that there will be an increasing gap in supply (at current levels) and demands.
- The goal to promote water neutrality within the OA is difficult to achieve. This is due to the fact the water resourcing is provided from outside the OA. The IWMS looks to combat this by promoting demand management within the OA, by securing the existing supply and by using alternative resources where available.
- Leakage reduction by Thames Water is the most significant 'lever' for reducing the strategic supply / demand deficit and burden on strategic water supply infrastructure compared to local interventions. There may be potential to coordinate leakage reduction activities with programmes of significant development work (such as strategic site development). Thames Water's leakage reduction programme is prioritised across their Water Resource Zone, however, further review of planned upgrades in the OA should be reviewed in case there is opportunity for alignment with other development activity within the OA.

Recommendation 1 – Coordination of leakage reduction

Carry out review of Thames Water leakage reduction plans within LBN to confirm expected timing, roll-out and impact on water supply. Review opportunities for accelerated leakage reduction activities to align with planned development or other infrastructure works in RD&BR.

- Although we do not believe there is a strong evidence to support reducing water demand targets below those of the London Plan, the opportunity to manage existing building stock should be reviewed.
- The level of water metering across the OA (34 % and 38 %, by volume, for household and non-household consumption) would suggest there is potential to pursue ambitious water efficiency targets for new development including the potential for offsetting through retrofit improvements to existing properties.
- We estimate that this level of retrofit could yield a 7 % (~11 MLd) reduction in potable water demand in the OA.

Recommendation 2 – Strategy for water efficiency retrofit

Develop a clear and measurable retrofit strategy for increased roll out of metering, home visits and awareness campaigns to promote retrofit of metering, efficient fittings and rainwater harvesting.

Identify priority opportunities for retrofit of interventions including publicly owned and community buildings including educational and healthcare facilities.

Water reuse

- Although site specific water demands are not available (due to data privacy issues), the mixed-use nature of many strategic sites means there may be potential for efficient treatment and recycling of rainwater harvesting and/or grey water to provide alternative water supplies for non-potable use.
- The IWMS estimates that 2.7 MLd of water demand in the strategic sites in theory could be non-potable and provided by locally managed alternative supplies. We also estimate there could be a further 3.3 MLd of alternative supplies available in case more ambitious use of non-potable demands can be achieved. Refer to Figure 46 for more information.

Recommendation 3 – Strategic Sites IWMS review

Set-up strategic IWMS forum. Carry out focussed engagement and detailed review of strategic site IWMS for alignment with IWMS ambitions.

This review should include consideration of the role for NAVs to accelerate and improve IWMS outcomes on strategic sites.

- The IWMS considers the potential of retrofit of rainwater harvesting to contribute to alternative water supplies as limited (1 Mld under optimistic modelling assumptions), and not a relative priority to pursue except in the case of building-specific opportunities. However, rainwater harvesting retrofit should be pursued generally across the OA as a contribution to surface water run-off reduction (See below).

Fluvial and tidal flood risk

- It is suggested that tidal and fluvial flood risk be considered holistically with flood risk in adjacent areas. This should include, but not be limited to, consideration of tidal and fluvial flood risk in the SIWMS.

Surface water flood risk and management

- There is significant surface water flood risk across the OA. The LLFA has undertaken a 2D overland flow modelling exercise to identify higher risk areas. However, the coarse scale and limited coverage of drainage model significantly limits the ability to quantify the impact of surface water management options, such as SUDS and Green Infrastructure, on drainage capacity of combined sewer network and resulting surface water flood risk.

- Tidal lock limits the potential to discharge to the Thames under certain conditions. This affects all of the OA during high tide levels every month.
- Due to the lack of model coverage, it is difficult to determine if there is sufficient drainage network capacity, or where to prioritise mitigation of capacity constraints. However, the stakeholder ambition to increase drainage adaptation and resilience as well as the wider benefits offered by improved drainage interventions means these should be pursued as a priority wherever resourcing and financing make this possible. Further collaboration between Thames Water and LBN LLFA is required to determine options to mitigate this risk, preferably as part of the revision of the Newham SFRA and Local Flood Risk Management Strategy.
- Review of surface water flood risk in strategic sites has focussed on 1:in 100-year event including climate change allowance (and 1:1000-year event as a proxy for flood risk without considering climate change) as the analysis focus was on the surface water component of IWMS for strategic sites. 1 in 30-year flood risk relates to design of exceedance from sewers and has not been assessed in the IWMS although it is noted that LLFA have modelling that covers this.
- The LLFA undertook a 2D pluvial flood risk analysis in 2015 (including 30 % climate change allowance) to review localised pluvial flood risk (GLA / LBN Drain London - London Borough of Newham, Surface Water Flood Risk Integrated Modelling Study – Silvertown, Hyder, May 2015). The status of the suggested interventions identified in this work should be reviewed. The case for targeted SUDS interventions should be prioritised in any options assessment.

Recommendation 4 – Drainage risk management review

Carry out a detailed risk assessment of drainage system knowledge, data, and performance in the OA. Build on analysis carried out in 2015 by LLFA to identify opportunity for betterment including where this can be delivered in parallel with Strategic Site development. This should include a specific review of the risk areas identified in the Hyder 2015 work.

- Consideration should be given to reviewing gravity drainage into the docks in more detail to confirm the potential catchment that could contribute, and the potential benefits in terms of reduced pumping into both the Royal Docks and to Beckton STW.

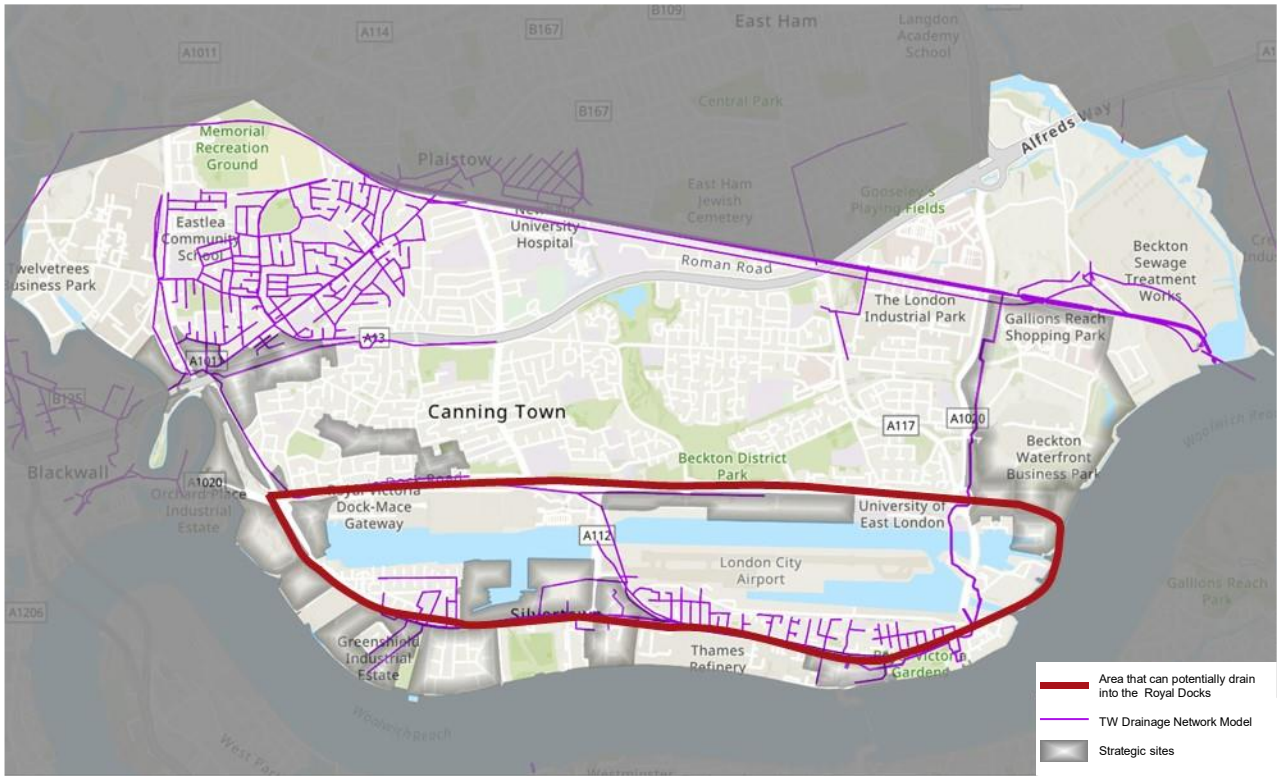

Figure 50: Area that can potentially drain via gravity into the Royal Docks.

Recommendation 5 – Approach to IWM in the Docks

Consider approach and possible business case for management of the docks as a strategic water asset within the OA. This should include water balance management including leakage loss reduction and surface water attenuation, water quality, renewable energy (e.g., floating solar), and minimised pump operation.

Surface water run-off reduction

- Reducing run-off into the drainage system through the implementation of blue green infrastructure should be a priority. This intervention is able to yield multiple benefits directly to the water system and more widely.
- Based on the MCA, blue green infrastructure interventions have the most additional benefits in relation to the stakeholder ambitions. However, hard engineering interventions such as attenuation and permeable paving should also be considered.
- Thames Water and TfL have their own ambitions for implementing blue-green infrastructure retrofit:
- Thames Waters DWMP states:

  "Delivering future resilience by working in partnership using nature-based solutions, is one of our stakeholders' key requirements for long-term planning. The DWMP SuDS programme will be the most ambitious to date increasing from the removal of 20 hectares of impermeable area per AMP in AMP6, to the removal of over 150 ha by 2030, ramping up to a total of over 7,000 ha by 2050, equivalent to 50 Hyde Parks. The SuDS programme will involve yet to be determined new partnership structures and a step change in partnership working, with the scale being ramped up over the next two AMPs to ensure programme deliverability."

- TfL's draft External Adaptation Plan has a similar recommendation:

"SuDS, such as green roofs, rain gardens or swales help to reduce surface water flood risk by storing and slowly releasing water rather than allowing it to flow rapidly into the drainage system. We have an MTS target for TfL and the boroughs to, each year, drain an additional effective surface area of 50,000 m^2 into SuDS features rather than conventional drains and sewers. Given the scale of the climate crisis and the need to install SuDS across the whole city, SuDS should be considered as a default design feature for any project that involves excavation or structural changes to a roof. Through our project management system (Pathway), TfL designers will be required to fully justify any instances where SuDS have not been included."

Recommendation 6 – Blue-green infrastructure retrofit strategy

Develop a clear and measurable strategy for retrofit land-use change of impermeable land to permeable through the implementation of blue-green infrastructure. Align targets with the wider targets of key stakeholders.

By scaling Thames Water's and TfL's geographies down to the RD&BR OA, these stakeholder ambitions would relate to converting 2.5 ha/yr and 0.05 ha/yr across the Study Area – accounting for 67 ha and 1.2 ha respectively by 2050.

Water quality

- In order to reduce pollutions, sewage overflows, and sewage spills to an acceptable level, it is proposed the surface water separation is prioritised across both the strategic sites and the OA where feasible. This should be aligned with development and other capital works.
- Blue-green infrastructure and rainwater harvesting should be prioritised as runoff reduction methods, as they are most likely to improve water quality.

Recommendation 7 – Water quality monitoring approach

A detailed review and assessment of water quality monitoring activity and evidence within the OA should be carried out to identify need and opportunities for improvements to monitoring to assist improved management of water system.

Partnership working

- Opportunities for partnership working should be considered to pursue strategic approaches to interventions. This should include reviewing the potential for retrofit in publicly owned or community facilities within the OA, especially those with available green space. For example, LBN's Infrastructure Delivery Plan identifies healthcare and education facilities as well as programmes for investment in new construction and refurbishment.

Healthcare

- The IDP notes that new healthcare developments will seek to achieve exemplary sustainability standards and energy efficiency to ensure improved operating costs over the lifetime of the building. Similar aspirations and targets should be set for water management at these facilities.
- The IDP notes that five practices across LBN have recently received NHSE/NELCCG funding for extensions, additional clinical rooms, and improvements grants, to the value of about £4m. Additionally, a new-build private practice has been created at Westbury Road. The IDP recommends that partnership working continues with NELCCG to identify development needs and support delivery, in line with other strategic objectives, facilitating and shaping the Estates Strategy/delivery plan. This work should include specific consideration of integrated water objectives outlines in this IWMS.

Education

- The IDP notes the need for LBN to continue to support the delivery of new schools/academies and expansion of existing schools when needed and in areas where pupil growth is forecast due to housing development, whilst managing the risk of over provision.
- This presents an opportunity to review the extensive portfolio of education facilities and land to identify opportunities for efficient implementation of integrated water interventions where appropriate.

Recommendation 8 – IWMS partnership and opportunity reviews

Strategic reviews with relevant stakeholders, at least healthcare and education, to identify opportunities for efficient and coordinated review of integrated water management opportunities (such as water use efficiency measures, metering, water recycling) across their portfolios and aligned with their investment plans.

Consider extending GLA sector-specific SuDS guidance to include wider integrated water management opportunities.

6.3 Wider benefits

- Currently, hard surfacing makes up 506 ha (33 %) of land area across the OA with potential to implement blue green infrastructure across this area, which would provide multiple benefits to support adaptation and provide wider benefits – air quality, biodiversity, urban heat, etc.

Climate change

- Sea level rise will increase the frequency and duration of tide lock periods, requiring more resilient surface water management strategies for the OA. This is most likely to be achieved by increasing surface water detention and attenuation measures within the OA.
- There is significant energy and carbon costs associated with pumping into the Royal Docks to maintain water levels. There is an opportunity to reduce this through draining of surface water to the docks where possible under gravity or where pumping efficiencies can be achieved compared to the exiting mechanism.
- Increasing green infrastructure can mitigate the effects of climate change.

Biodiversity

- Management of Royal Docks water quality needs to be considered to ensure aquatic environment is protected. Currently, the River Thames section is classed as having WFD moderate ecological status with both point and diffuse sources (wastewater and transport pollution) and physical modifications as primary reasons. While the Royal Docks aren't classified as water bodies under the WFD, the fact that they discharge to the River Thames means that all surface water discharges into the docks require adequate treatment, preferably a SuDS treatment train, to prevent pollutants entering the water bodies.
- Increase in blue green Infrastructure in the western part of the OA will mitigate the current deficit, create green corridors, and help improve the overall biodiversity in the area.
- Implementing blue green infrastructure will increase the tree canopy in line with biodiversity net gain aspirations.

Population and human health

- 85 % of the people in the OA self-reported good or better health in 2011 Census, with 11 % fair and 4 % bad state of health. However, large parts of the OA and IWM Study Area are classed as high on the index of multiple deprivation and social, economic, and environmental factors are considered by Public Health England as wider determinants of health that impact on people's mental and physical health.

- A lack of green spaces in parts of the OA and high air pollution levels will be key contributor to negative health and wellbeing outcomes. Healthy Places is key objective of the Mayor of London's current Health Inequalities strategy, and it recognises the role of green spaces and reduced air pollution and providing opportunities for recreation and exercise.

6.4 Summary of recommendations

The recommendation made in Section 6 are summarised in Table 10 below.

Table 10: Summary of IWMS recommendations

	Recommendation	Lead
	Leakage reduction	
1	**Coordination of Leakage Reduction** Carry out review of TW leakage reduction plans within LBN to confirm expected timing, roll-out and impact on water supply. Review opportunities for accelerated leakage reduction activities to align with planned development or other infrastructure works in RD&BR.	Thames Water
	Water efficiency	
2	**Strategy for Retrofit Water Efficiency** Develop a clear and measurable retrofit strategy for increased roll out of metering, home visits and awareness campaigns to promote retrofit of metering, efficient fittings and rainwater harvesting. Identify priority opportunities for retrofit of interventions including publicly owned and community buildings including educational and healthcare facilities.	LBN Planning
	Strategic sites IWMS	
3	**Strategic Sites IWMS forum** Set-up strategic IWMS forum. Carry out focussed engagement and detailed review of strategic site IWMS for alignment with IWMS ambitions. This review should include consideration of the role for NAVs to accelerate and improve IWMS outcomes on strategic sites.	LBN Planning GLA
	Surface water management	
4	**Drainage Risk Management Review** Carry out a detailed risk assessment of drainage system knowledge, data, and performance in the OA. Build on analysis carried out in 2015 by LLFA to identify opportunity for betterment including where this can be delivered in parallel with Strategic Site development. This should include a specific review of the risk areas identified in the Hyder 2015 work.	LBN LLFA Thames Water
	Royal Docks	
5	**Approach to IWM in the Docks** Consider approach and possible business case for management of the docks as a strategic water asset within the OA. This should include water balance management including leakage loss reduction and surface water attenuation, water quality, renewable energy (e.g., floating solar), and minimised pump operation.	RoDMA
	Blue Green Infrastructure	
6	**Blue-Green Infrastructure Retrofit Strategy** Develop a clear and measurable strategy for retrofit land-use change of impermeable land to permeable through the implementation of blue-green infrastructure. Align targets with the wider targets of key stakeholders. By scaling Thames Water's and TfL's geographies down to the RD&BR OA, these stakeholder ambitions would relate to converting 2.5 ha/yr and 0.05 ha/yr across the Study Area – accounting for 67ha and 1.2 ha respectively by 2050.	LBN Planning LBN Highways LBN LLFA
	Water quality	
7	**Water Quality Monitoring Approach** A detailed review and assessment of water quality monitoring activity and evidence within the OA should be carried out to identify need and opportunities for improvements to monitoring to assist improved management of water system.	EA Thames Water
	Integration through the Infrastructure Delivery Plan	
8	**IWMS Partnership & Opportunity Reviews** Strategic reviews with relevant stakeholders, at least healthcare and education, to identify opportunities for efficient and coordinated review of integrated water management opportunities (such as water use efficiency measures, metering, water recycling) across their portfolios and aligned with their investment plans.	LBN Planning

Part 2 – Delivery strategy and implementation toolkit

1. Delivery strategy

1.1 Introduction

The delivery strategy for the IWMS considers how the various options and interventions can be applied to achieve the desired ambitions. To facilitate this the implementation strategy is broken down in four sections as follows:

Policies and asset management plans

This section details how the selected interventions can be implemented across the Study Area, their delivery pathways (policy or operational plans) and it highlights whether current policies may need to be improved.

Strategic growth areas

This section outlines how the selected interventions can be implemented across specific sites within the OA. The potential for interventions is considered based on the planning status of the site.

Wider recommendations

This section outlines a range of recommendations for improved integrated water management beyond those considered in the preceding sections.

Limitations

This section details how options that were deemed outside the scope of the IWMS can be progressed.

1.2 Planning policies and asset management plans

Runoff reduction

Blue Green Infrastructure (BGI)

There is potential to implement blue-green infrastructure (BGI) runoff reduction interventions throughout the opportunity area. Although dry weather flow (sewage only) capacity is not an issue in the OA, surface water ingress into combined sewer is the primary contributor to sewer surcharges (Thames Water DWMP). As such, blue-green infrastructure should be considered as an important intervention for water management due to its wider benefits. It is important to note that not all blue-green runoff reduction interventions are suitable for implementation throughout the whole OA.

There is approximately 506 ha of impermeable surface in the study area that could be benefit from BGI interventions and reduce or divert runoff from combined sewers. The stated ambition by Thames Water (7000 ha by 2050) and TfL (5 ha/year) to retrofit BGI and SUDS across their operational areas equates to approximately 68 ha within the Study Area. The strategic sites, covering 266 ha of the Study area have further potential to implement BGI and SUDS measures on 50 % or more of their site area.

To delivery BGI on strategic sites, the GLA and LBN policies need to be ambitious. To deliver retrofit solutions, partnerships must be formed between Thames Water, GLA, LBN, TfL and developers and property owners. It will be important that knowledge of the wider benefits of each intervention is developed, for example using the information available in this IWMS. Maintenance is particularly important to enable sustained impact of blue-green infrastructure. Therefore, it is important to assign maintenance responsibilities before the delivery stage.

The potential delivery strategy for blue-green infrastructure is outlined in Figure 51.

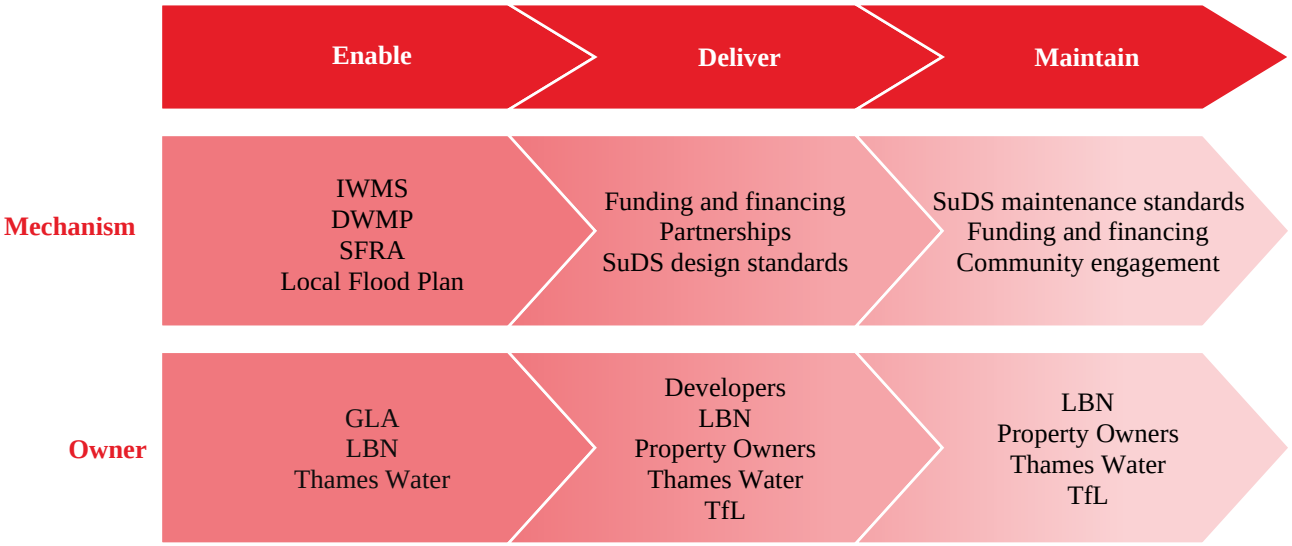

Figure 51: Delivery of blue-green infrastructure.

Delivery Pathways

Strategic sites:

BGI would be delivered through planning conditions, and therefore appropriate planning policies are critical.

- The London Plan policies (G 1, G 5, SI 13, SI 17) have an appropriate level of ambition to deliver the IWM recommendations outlined in Section 6.
- LBN (current Local Plan) policies SC3, SC4, INF6, SP3(C) would not be able to deliver the ambitions set for the IWMS. The Draft plan as material planning consideration should enable betterment than currently plausible.
- LBN (2022 Draft Local Plan) policies BFN1(5d), BFN2(2f & 3e), BFN4(1a), D1(1e), D2(2b & 2d), J4 (3d), GWS1, GWS2, GWS3, CE5, CE7, CE8, are supportive of the IWMS objectives. However, the following policies could be improved or strengthened.
  - CF4: Could reference surface water management policy.
  - J1: Could cross reference J4 for the need and delivery and maintenance of blue green Infrastructure.
  - GWS1 and GWS3: Could be strengthened with inclusion of ‘minimum area or % site’ targets for individual sites, aligning with London Plan urban greening factor recommendations. Alternatively, minimum green space provision across the local area may be set in Area Action Plans to enable more flexibility on retrofit provisions. It is noted that this is to be evidenced by the emerging green and blue infrastructure study, in the consultation local plan.
  - GWS5: Could be strengthened by cross referencing GWS1 and GWS3 and inclusion of green infrastructure and SUDS measures.
  - CE1, CE2 & CE4 should cross reference J4 and the provision of BGI for reduction in Urban Heat Island effect, and thus the need for cooling and respective energy and carbon implications.

Retrofit:

- The London Plan and Newham Draft plan do not address retrofit of BGI in existing urban realm.
- The retrofit of BGI in existing urban realm aligns with the strategic ambition of both TfL (5 ha/year across London) and Thames Water (7,500 ha across London by 2050) for surface water management Prorated to Study Area, this would mean 68 ha of BGI retrofit by 2050. RD&BR area could be prioritised to help it achieve exemplar case example.

- Thames Water and TfL should consider partnership approach to leverage their funding with other sources to further enhance the potential of BGI in the OA.

Hard engineering

There is potential to implement hard engineering runoff reduction measures throughout the opportunity area. These could be delivered in isolation, or preferably as part of a wider integrated SUDS and surface water flood risk management plan by the LLFA. Given the surrounding urban environment, this approach would aid the viability of retrofit solutions.

The potential delivery strategy for hard engineering is outlined in Figure 52.

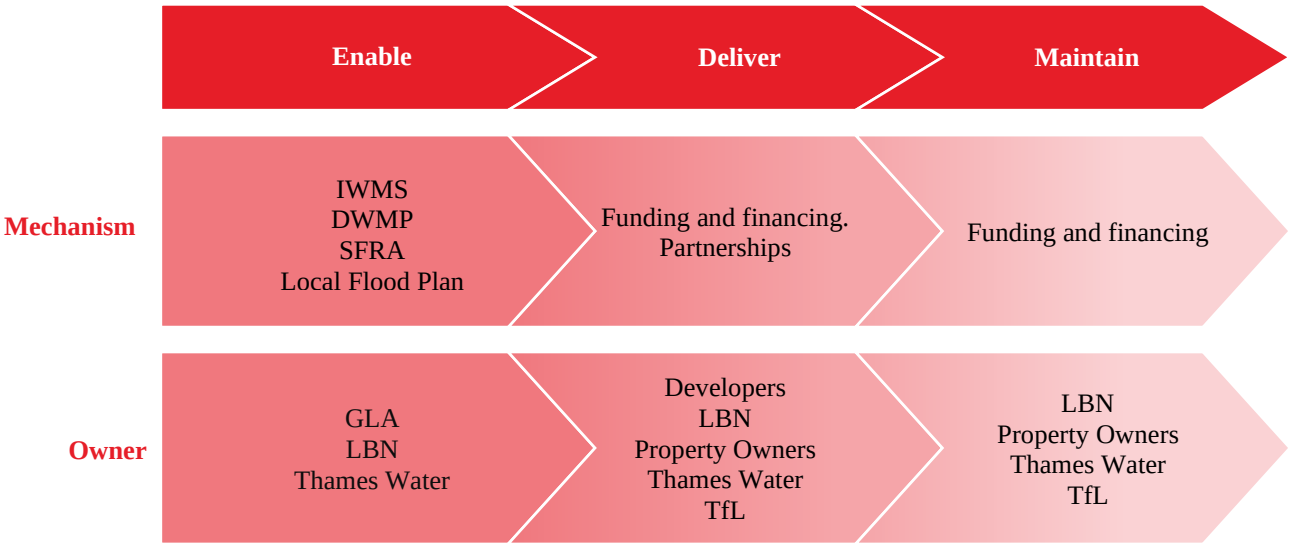

Figure 52: Delivery of hard engineering.

Delivery pathways

LBN: The Infrastructure Delivery Plan should be revised to enable delivery of the IWM ambitions and objectives. The trunk sewer network has adequate capacity to convey increase in wastewater flows in the area provided surface water ingress can be reduced or avoided altogether.

Hard Engineering solutions would enable the 'surface water separation and diversion' to Royal Docks if that strategy option were pursued. Alternatively, if BGI pathway was progressed, delays in wider retrofit of BGI in the OA may require more hard engineering solutions.

Thames Water should work with partners to improve the coverage and detail of the drainage model in the OA to get better understanding of the local asset improvement and capacity requirements. This should also enable establishing short-, medium- and long-term targets for SW diversion or retrofit BGI implementation.

Surface water separation and diversion

There is potential for surface water separation and diversion into the Royal Docks. Discharging surface water into the Royal Docks has multiple potential benefits for the OA including reducing emissions currently caused by pumping water into the docks. Additionally, The Royal Docks Management Authority (RoDMA) already has schemes with new developments around the docks, which could be replicated to enable expansion within the OA. However, the volumes of water that could be discharged into the Royal Docks would not meet all docks demands.

The potential delivery strategy for land management is outlined in Figure 53.

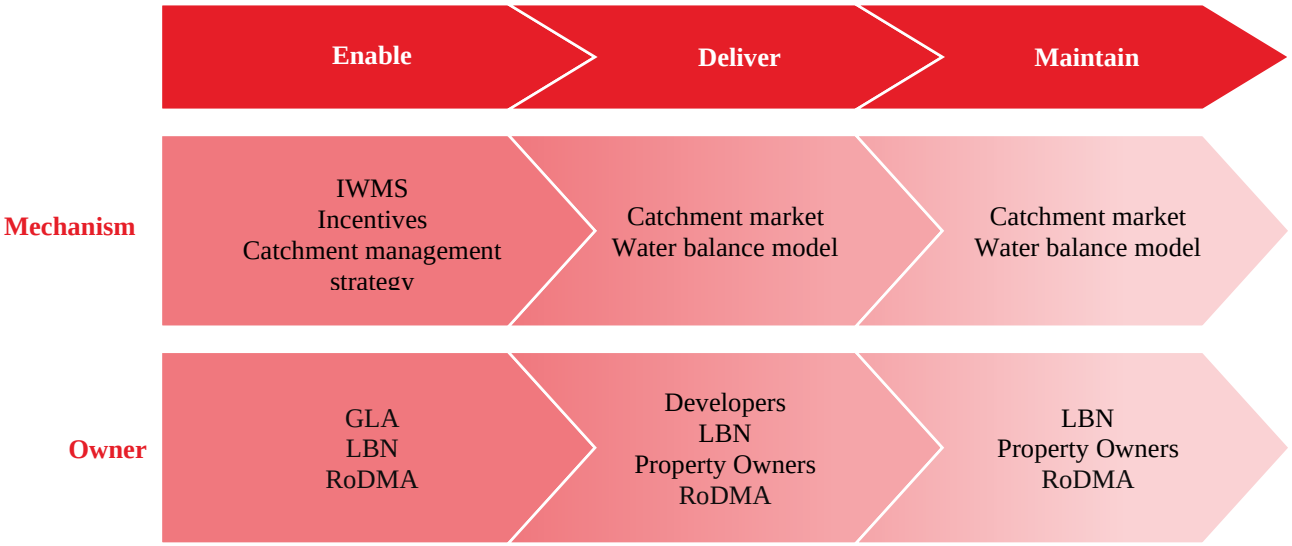

Figure 53: Delivery of land management.

Specific recommendations:
LBN (LLFA, Highways), TfL, Thames Water and RoDMA: in partnership, establishing the surface water management strategy, including feasibility assessment of the total surface water separation and diversion of surface water into Royal Docks. The strategy should also inform the local Infrastructure Delivery Plan.

This may also require involvement of local stakeholder groups and property owners. Therefore, community outreach would be important for project success.

Digital

Digital interventions have the potential to be retrofitted throughout the OA. Doing this would significantly improve water efficiency throughout the OA through leakage reduction and smart metering. Smart metering would enable engagement with customers and use of social norming techniques to reduce long term demands. Better monitoring of the water usage would provide better understanding of leakage losses and measures to address them could be prioritised.

The potential delivery strategy for digital interventions is outlined in Figure 54.

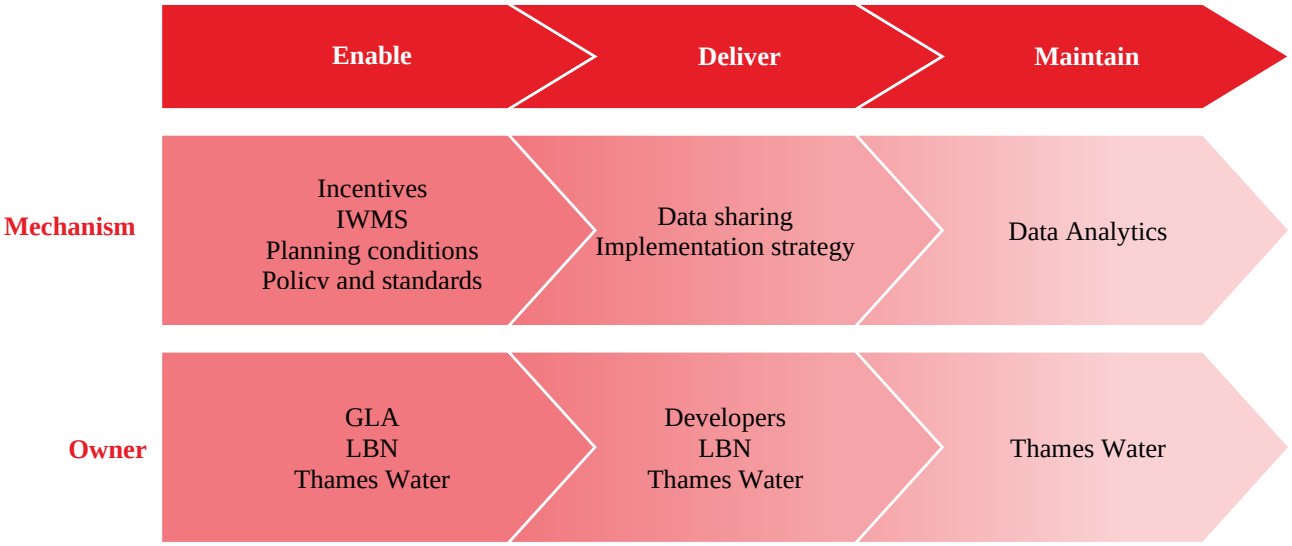

Figure 54: Delivery of digital interventions.

Delivery pathways

London Plan – SI 5 supports the provision of smart metering in new buildings as well as retrofitting. The delivery in new builds is clearly defined, whereas retrofitting pathway of smart meters is not defined. The policy could be supported by guidance on how retrofitting would be achieved or supported by GLA.

LBN Planning (Nov 22 Draft Local Plan) – Policy W4 supports the delivery of digital interventions / measures for the strategic sites. However, the draft plan does not specifically address retrofitting.

Thames Water (Business Plan and WRMP) – has current target of smart meter installation on all eligible properties by 2035. Thames Water should review the potential to prioritise smart meter retrofit in IWM Study Area to establish it as an exemplar.

Water efficiency

Leakage reduction – Asset upgrades and maintenance

There is potential to carry out upgrades and maintenance on existing water infrastructure throughout the OA. The current asset condition is not known therefore it is not possible to quantify the scale of upgrades or maintenance that would be required.

The potential delivery strategy for upgrades and maintenance is outlined in Figure 55.

Figure 55: Asset maintenance, renewal, and upgrades.

Delivery pathways

LBN could review and establish the Asset and Infrastructure renewal requirements as part of the Infrastructure Delivery Plan.

Thames Water should review their Asset Conditions and leakage assessment, and review potential to prioritise leakage reduction measures within the OA. However, as the whole of London Water Resource Zone is integrated, location of the leakage reduction is not critical to the benefits that can be realised. Any improvement plans within the OA should be communicated to the IMA team so information can be correlated, and project delivery coordinated.

Water efficiency (Strategic Sites, retrofits, and consumer goods)

Water efficiency measures in Strategic sites would be controlled through the planning process and there is potential to go beyond the higher water efficiency target on 105 lppd in Part G of the building regulations.

Developers are keen to showcase their environmental credentials and highlight sustainability and environmental performance rating of new buildings, and as such rating schemes like BREEAM and LEED provide external influence. Through conversations with developers, they have highlighted their preference on

higher efficiency fixtures and consumer goods in comparison to water reuse measures such as greywater systems (see following section for further commentary on this).

There is potential to retrofit water efficiency measures consumer goods throughout the OA. High water efficiency appliances should be included in all new developments, where they are being provided by the developers. Alternatively, energy and water savings that could be achieved from new appliances should be promoted to consumers in the OA.

The potential delivery strategy for consumer goods is outlined in Figure 56.

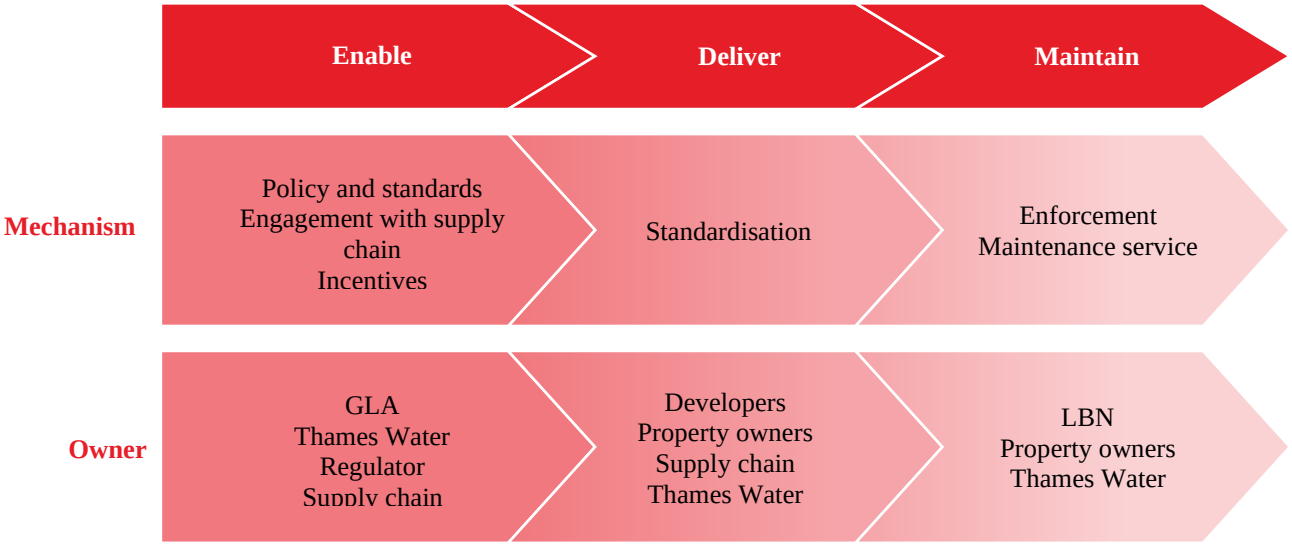

Figure 56: Delivery of consumer goods.

Delivery pathway

Strategic sites:

- London Plan policy SI 2 and SI 5 support water efficiency measures to 105 lppd higher efficiency targets in Part G Building Regulations.
- LBN (2022 Draft Local Plan) policies D1, CE5, and H11 are supportive of the IWMS objectives. However, the following policies could be improved or strengthened.
  - CE5 could also include water efficiency measures.
  - D1 : could be strengthened by establishing a local design standard for water efficiency that is better than the Part G of Building Regs.
  - H11 : could incorporate water efficiency measures that are higher than the efficiency measures proposed in Part G or go beyond it as exemplars.

Retrofit:

- London Plan and LBN Local plan do not address retrofit of existing properties. The London Plan and LBN Local Plan could be strengthened to include water efficiency offsetting in the OA as a means to achieve water neutrality.

Alternative resources

Water reuse

Greywater reuse should be considered for all new developments in line with the ambition to achieve water neutrality in the OA. However, it should be noted that the developers during discussions on their implementation have raised concerns about costs, impact to their profit margins, as well as potential concerns about liability. Developers, such as Lend Lease, who manage and sell residential units, have indicated

preference to include greywater systems only in those buildings that are or will be managed and maintained by them. This enables them to recoup costs as well as ensure that the systems are maintained.

There is potential to retrofit water reuse in the OA. The retrofit of non-potable greywater reuse systems should be considered for major refurbishments in the OA.

The implementation of a non-potable blackwater reuse system has more limited potential. This is due to three factors, (i) public perception, (ii) costly to implement on site level, and iii) the necessary technology is not widely utilised yet. As a result, site level blackwater schemes were not considered in the IWMS.

Beckton STW has potential to support a blackwater reuse scheme at OA level. However, Thames Water is considering a Strategic Water Reuse Scheme as part of the WRMP that will benefit wider London WRZ.

The potential delivery strategy for greywater reuse measures is outlined in Figure 57.

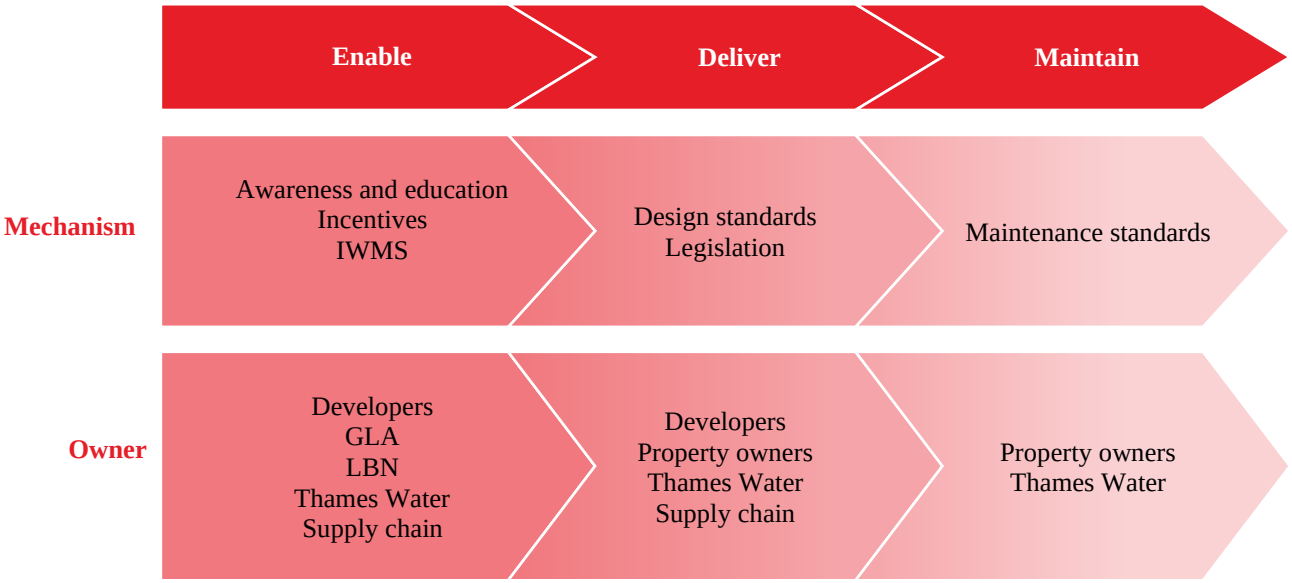

Figure 57: Delivery of greywater reuse.

Delivery pathway

Strategic Sites:

- London Plan policy SI 5 supports the inclusion of greywater reuse systems but does not require it.
- LBN (Nov 22 Draft Plan) policy CE1 supports the inclusion of greywater systems in new developments but does not require it. CE addresses circular economy but does not include water.
    - CE1: There is potential to strengthen the policy by requiring greywater reuse on all Strategic Sites in the OA. Alternatively, a more specific policy requirement could be established in an Area Action Plan.
    - CE5: There is potential to include or cross reference water efficiency in the policy.

Retrofit:

- Greywater reuse retrofit in normal residential units was identified as complex and costly.
- Greywater reuse retrofit should be considered during major refurbishment of existing buildings. Incentives may be necessary for homeowners to offset the costs. Major non-residential refurbishments are likely to require planning permission, and the planning policies in draft Local Plan would apply.

Rainwater harvesting

For Strategic Sites, an integrated rainwater harvesting, and storm water management solution would be an economical approach to addressing two challenges, water neutrality and tide-lock detention storage

requirements. The existing and proposed new planning policies would address the implementation in the Strategic sites. Developers have been keen to include integrated rainwater harvesting and stormwater detention storage system to optimise costs but have encountered resistance from Environment Agency. Greater clarity on the position of such integrated systems would be needed from the Environment Agency to address developer concerns.

There is also potential to retrofit rainwater harvesting systems in existing homes and businesses in the OA. As it will have minor impact on overall water demand, the primary benefit would be for surface water management and are likely to require incentives from GLA, Thames Water, Newham LLFA, and other organisations.

The potential delivery strategy for rainwater harvesting is outlined in Figure 58.

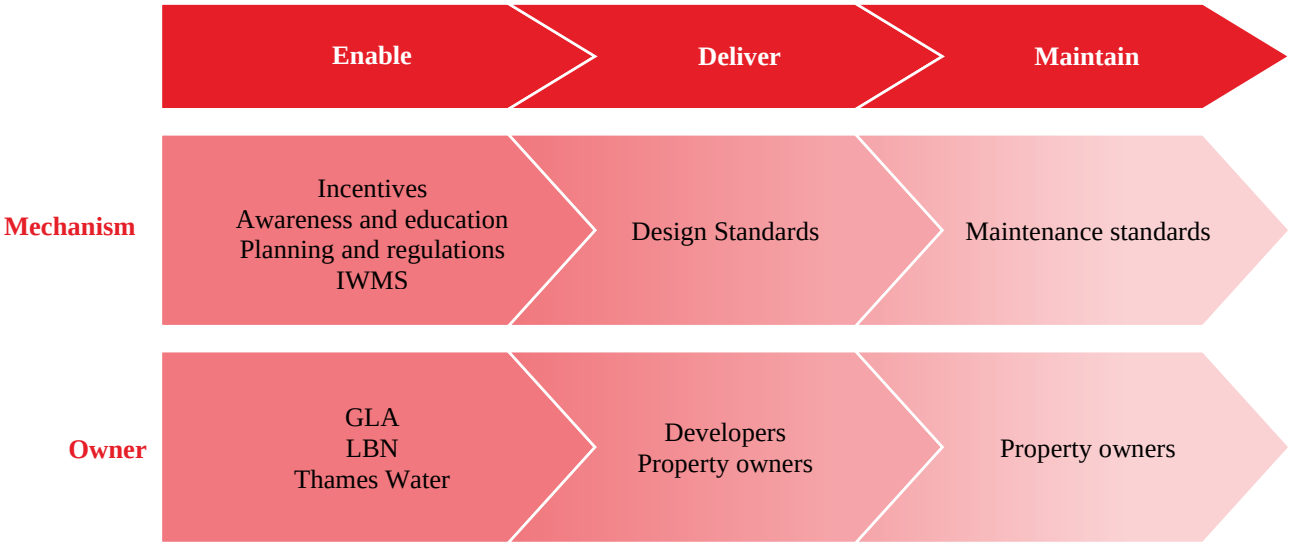

Figure 58: Delivery of rainwater harvesting.

Delivery Pathway

Strategic Sites:

- London Plan policy SI 5 supports the delivery of the IWMS recommendations.
- LBN (Nov 22 Draft Local Plan) policies support the inclusion of rainwater harvesting in new developments.

Retrofit:

- No current pathway exists for delivery of rainwater harvesting retrofits and would require new partnership models supported by the local surface water management strategy by the LLFA. Due to substantial costs of the systems, it may also require financial incentives for the property owners to implement such measures on their buildings.

1.3 Strategic growth areas

This section outlines the characteristics of each strategic growth area within the OA and summarises the IWM interventions that will be most suitable to them.

As part of the Delivery Strategy for the IWMS, the associated developers for the strategic sites were engaged where appropriate. The purpose of this engagement was to encourage feedback and engagement on the proposed interventions. Where feedback was received, this was considered when developing the Delivery Strategy.

Canning Town and Custom House

Characteristics

This area will be an active place with a variety of District Centre uses, including new homes, workspace, inclusive community uses, and an evening economy. The area is currently at various stages of development, with development either at masterplanning, on site or completed, as detailed in Table 11.

Table 11: Status of sites within Canning Town and Custom House.

Site	Developer	Status
Hallsville Quarter	Linkcity	Varies per phase
Brunel Street Works and Silvertown Way	Linden Homes	Complete
Limmo Peninsula	TBC	Masterplanning

Given the various stages of development in the area, the opportunities for the IWMS to inform development will also vary.

Hallsville Quarter

The extent of the Hallsville Quarter is shown in Figure 59 below:

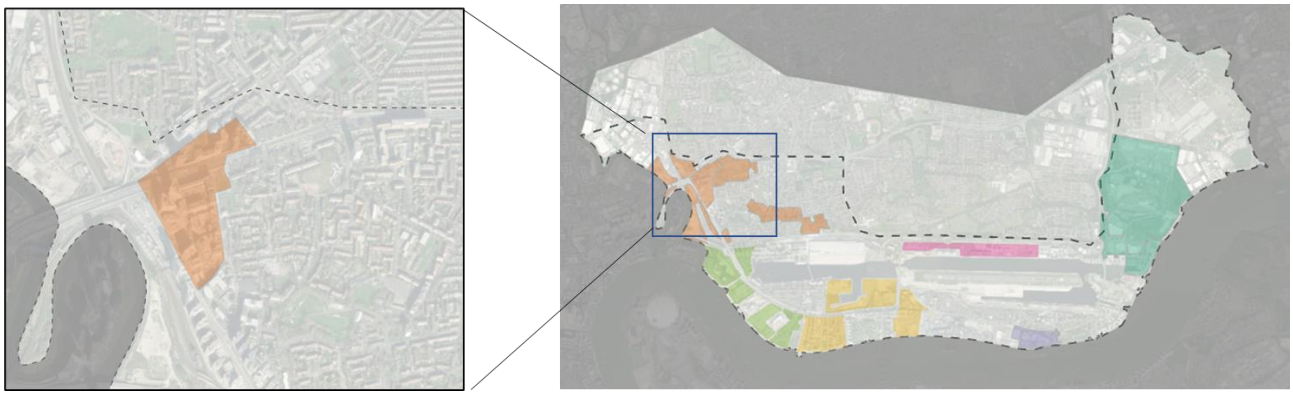

Figure 59: Extents of the Hallsville Quarter.

The site has limited open green spaces which account for 7 % of the site area (estimated from Open Street Map and OS Open Map datasets). There is both fluvial and tidal flood risk, including flood zone 3 with tidal defences. In terms of pluvial flood risk, 5 % of the site area is at risk in a 100-year event and 24 % of the site area is at risk in a 1000-year event. Ground conditions indicate there that are opportunities for infiltration on site.

As the Hallsville Quarter is either on site or complete the opportunities are limited. It is proposed that in addition to the interventions already included as part of these developments, that retrofit of appropriate interventions should be considered in this area as future capital works are progressed. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 12 below. Where development of the strategic sites is too advanced for the IWMS to inform the proposals, the interventions are listed as not applicable.

Table 12: Suitable interventions for the Hallsville Quarter.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Not applicable	Likely to be suitable
Blue roofs	Not applicable	Unlikely to be suitable
Channels and rills	Not applicable	Likely to be suitable
Detention basins	Not applicable	Likely to be suitable
Filter drains	Not applicable	Likely to be suitable
Green roofs	Not applicable	Unlikely to be suitable
Infiltration systems	Not applicable	Likely to be suitable
Permeable paving / surfaces	Not applicable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Unlikely to be suitable	Unlikely to be suitable

Intervention	Strategic Sites	Retrofit
Bulk metering and submetering	Not applicable	Likely to be suitable
Smart metering and smart tariffs	Not applicable	Likely to be suitable
Leakage reduction	Not applicable	Likely to be suitable
Low flow appliances	Not applicable	Likely to be suitable
Low flow taps & WCs	Not applicable	Likely to be suitable
Non-potable reuse of greywater	Not applicable	Unlikely to be suitable
Rainwater harvesting from roofs and surfaces	Not applicable	Likely to be suitable

Brunel Street Works and Silvertown Way

The extents of Brunel Street Works and Silvertown Way is shown in Figure 60 below:

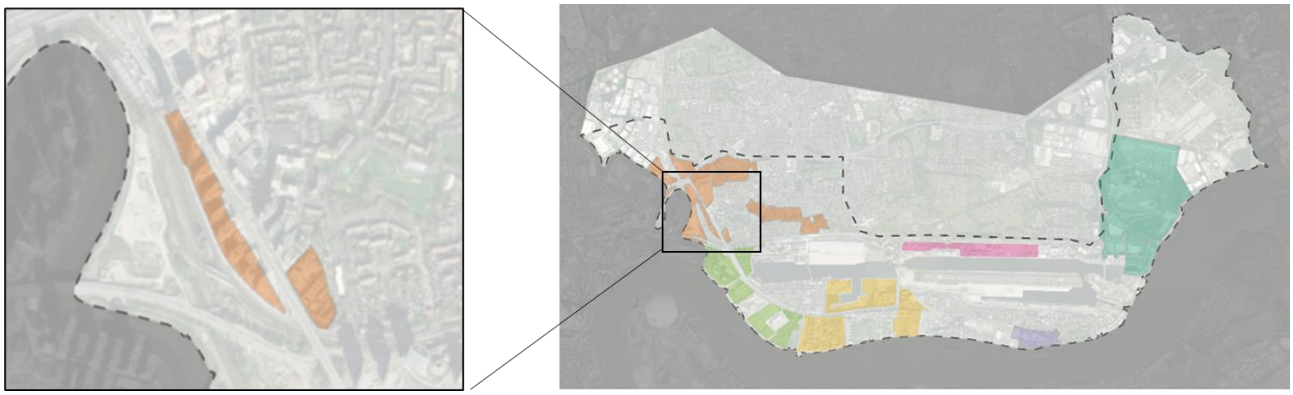

Figure 60: Extents of Brunel Street Works and Silvertown Way.

The site has no open green spaces which currently accounts for 0 % of the site area. There is both fluvial and tidal flood risk, including flood zone 3 with tidal defences. There is pluvial flood risk with 3 % of the site area at risk in a 100-year event and 14 % of the site area at risk in a 1000-year event. Ground conditions indicate there that are opportunities for infiltration on site.

As the Brunel Street Works and Silvertown Way are either on site or complete the opportunities are limited. It is proposed that in addition to the interventions already included as part of these developments, that retrofit of appropriate interventions should be considered in this area as future capital works are progressed. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 13 below. Where development of the strategic sites is too advanced for the IWMS to inform the proposals, the interventions are listed as not applicable.

Table 13: Suitable interventions for Brunel Street Works and Silvertown Way.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Not applicable	Likely to be suitable
Blue roofs	Not applicable	Unlikely to be suitable
Channels and rills	Not applicable	Likely to be suitable
Detention basins	Not applicable	Likely to be suitable
Filter drains	Not applicable	Likely to be suitable
Green roofs	Not applicable	Unlikely to be suitable
Infiltration systems	Not applicable	Likely to be suitable
Permeable paving / surfaces	Not applicable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Unlikely to be suitable	Unlikely to be suitable
Bulk metering and submetering	Not applicable	Likely to be suitable
Smart metering and smart tariffs	Not applicable	Likely to be suitable
Leakage reduction	Not applicable	Likely to be suitable
Low flow appliances	Not applicable	Likely to be suitable
Low flow taps & WCs	Not applicable	Likely to be suitable
Non-potable reuse of greywater	Not applicable	Likely to be suitable
Rainwater harvesting from roofs and surfaces	Not applicable	Unlikely to be suitable

Limmo Peninsula

The extents of the Limmo Peninsula is shown in Figure 61 below:

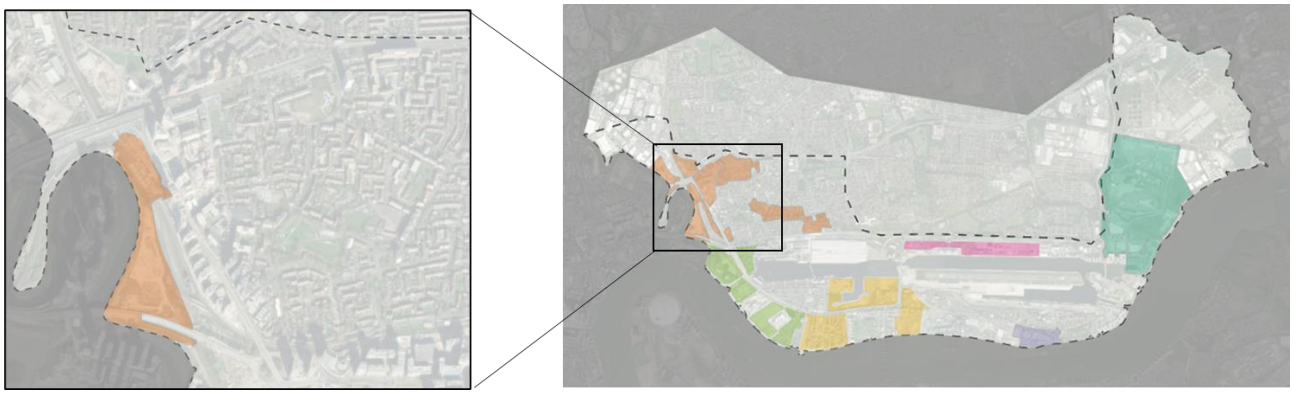

Figure 61: Extents of the Limmo Peninsula.

The site has no open green spaces which accounts for 0 % of the site area. There is both fluvial and tidal flood risk, including flood zone 3 with tidal defences. There is pluvial flood risk with 2 % of the site area at risk in a 100-year event and 11 % of the site area at risk in a 1000-year event. Ground conditions indicate there that are opportunities for infiltration on site.

The masterplan for the Limmo Peninsula is currently under development. Therefore, there is significant potential to inform the strategy for this site. It is recommended that blue-green infrastructure is prioritised on this site where applicable. This should include investigating the potential to infiltrate runoff rather than discharging with the River Lea or River Thames. Bulk metering and submetering using smart meters should be applied to all units. Demand reduction measures, such as low flow appliance, taps and WCs, should also be applied. Finally, the potential for alternative water resources should be considered, including the non-potable reuse of both blackwater and greywater and the non-potable use of rainwater harvesting. The steering group should proactively engage with the strategic plan for the site, to ensure that these opportunities are achieved. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 14 below:

Table 14: Suitable interventions for Limmo Peninsula.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Likely to be suitable	Likely to be suitable
Blue roofs	Likely to be suitable	Unlikely to be suitable
Channels and rills	Likely to be suitable	Likely to be suitable
Detention basins	Likely to be suitable	Likely to be suitable
Filter drains	Likely to be suitable	Likely to be suitable
Green roofs	Likely to be suitable	Unlikely to be suitable
Infiltration systems	Likely to be suitable	Likely to be suitable
Permeable paving / surfaces	Likely to be suitable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Unlikely to be suitable	Unlikely to be suitable
Bulk metering and submetering	Likely to be suitable	Likely to be suitable
Smart metering and smart tariffs	Likely to be suitable	Likely to be suitable
Leakage reduction	Likely to be suitable	Likely to be suitable
Low flow appliances	Likely to be suitable	Likely to be suitable
Low flow taps & WCs	Likely to be suitable	Likely to be suitable
Non-potable reuse of greywater	Likely to be suitable	Unlikely to be suitable
Rainwater harvesting from roofs and surfaces	Likely to be suitable	Likely to be suitable

Royal Victoria and West Silvertown

Characteristics

Royal Victoria and West Silvertown is home to City Hall. The area will offer a dynamic mixed-use centre of activity with workspace and visitor attractions. The area is currently at various stages of development, as detailed in Table 15.

Table 15: Status of sites within Royal Victoria and West Silvertown.

Site	Developer	Status
Thameside West	Keystone	Planning permission granted
Central Thameside West	-	Planning permission is pending

Given the stages of development in the area, the opportunities for the IWMS to inform development will be limited.

Thameside West

The extents of the Thameside West is shown in Figure 62 below:

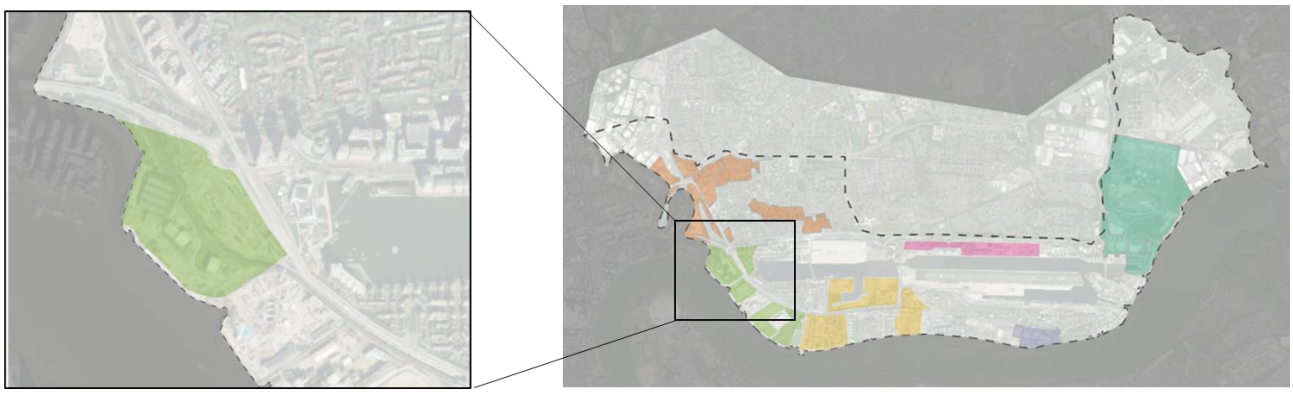

Figure 62: Extents of Thameside West.

The site has limited open green spaces which accounts for 0 % of the site area. The site has both fluvial and tidal flood risk, including flood zone 3 with tidal defences. There is pluvial flood risk with 3 % of the site area at risk of a 100-year event and 10 % of the site area at risk of a 1000-year event. Ground conditions indicate there that are limited opportunities for infiltration on site.

As Thameside West has outline planning there is reduced scope to inform the strategy for these sites. It is proposed that detailed design should consider how any new features can maximise the potential for integrated water management. This should include considerations as to how flood risk will be managed, how water demand will be metered, how water demand could be reduced, and how this demand could be offset using alternative resources. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 16 below. Where development of the strategic sites is too advanced for the IWMS to inform the proposals, the interventions are listed as not applicable.

Table 16: Suitable interventions for Thameside West.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Not applicable	Likely to be suitable
Blue roofs	Not applicable	Unlikely to be suitable
Channels and rills	Not applicable	Likely to be suitable
Detention basins	Not applicable	Likely to be suitable
Filter drains	Not applicable	Likely to be suitable
Green roofs	Not applicable	Unlikely to be suitable
Infiltration systems	Unlikely to be suitable	Unlikely to be suitable
Permeable paving / surfaces	Not applicable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Unlikely to be suitable	Unlikely to be suitable
Bulk metering and submetering	Likely to be suitable	Likely to be suitable
Smart metering and smart tariffs	Likely to be suitable	Likely to be suitable

Intervention	Strategic Sites	Retrofit
Leakage reduction	Likely to be suitable	Likely to be suitable
Low flow appliances	Likely to be suitable	Likely to be suitable
Low flow taps & WCs	Likely to be suitable	Likely to be suitable
Non-potable reuse of greywater	Likely to be suitable	Unlikely to be suitable
Rainwater harvesting from roofs and surfaces	Not applicable	Likely to be suitable

Central Thameside West

The extents of Central Thameside West is shown in Figure 63 below:

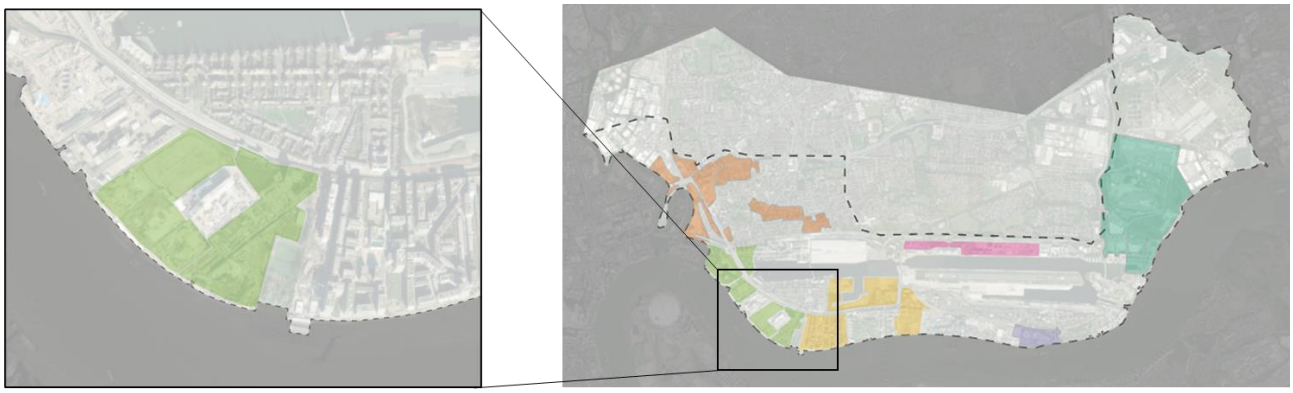

Figure 63: Extents of the Central Thameside West.

The site has limited open green spaces which account for 0 % of the site area. There is fluvial and tidal flood risk, including flood zone 3 with tidal defences. There is pluvial flood risk with 7 % of the site area at risk of a 100-year event and 20 % of the site area at risk of a 1000-year event. Ground conditions indicate there that are limited opportunities for infiltration on site.

For Central Thameside West, there is reduced scope to inform the strategy for these sites. It is proposed that detailed design should consider how any new features can maximise the potential for integrated water management. This should include considerations as to how flood risk will be managed, how water demand will be metered, how water demand could be reduced, and how this demand could be offset using alternative resources. In addition to this, it is recommended that a detailed analysis of the water demand requirements for the proposed data centre is undertaken to ensure that it does not negatively impact water supply across the OA and wider area. If this is the case, Thames Water has discretion over determining any connections request. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 17 below. Where development of the strategic sites is too advanced for the IWMS to inform the proposals, the interventions are listed as not applicable.

Table 17: Suitable interventions for Central Thameside West.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Not applicable	Likely to be suitable
Blue roofs	Not applicable	Unlikely to be suitable
Channels and rills	Not applicable	Likely to be suitable
Detention basins	Not applicable	Likely to be suitable
Filter drains	Not applicable	Likely to be suitable
Green roofs	Not applicable	Unlikely to be suitable
Infiltration systems	Unlikely to be suitable	Unlikely to be suitable
Permeable paving / surfaces	Not applicable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Unlikely to be suitable	Unlikely to be suitable
Bulk metering and submetering	Likely to be suitable	Likely to be suitable
Smart metering and smart tariffs	Likely to be suitable	Likely to be suitable
Leakage reduction	Likely to be suitable	Likely to be suitable
Low flow appliances	Likely to be suitable	Likely to be suitable
Low flow taps & WCs	Likely to be suitable	Likely to be suitable
Non-potable reuse of greywater	Likely to be suitable	Unlikely to be suitable

Intervention	Strategic Sites	Retrofit
Rainwater harvesting from roofs and surfaces	Not applicable	Likely to be suitable

Silvertown

Characteristics

Development here will provide a new distinctive Local Centre with an appropriate amount of new space for working, showcasing brand, research and development, manufacturing, education, retail, commerce, food and drink and leisure.

The area is currently at various stages of development, as detailed in Table 18.

Table 18: Status of sites within Silvertown.

Site	Developer	Status
Silvertown Quays	Lendlease	Masterplanning
Riverscape	Ballymore	On site or complete

Given the various stages of development in the area, the opportunities for the IWMS to inform development will vary.

Silvertown Quays

The extent of Silvertown Quays is shown in Figure 64 below:

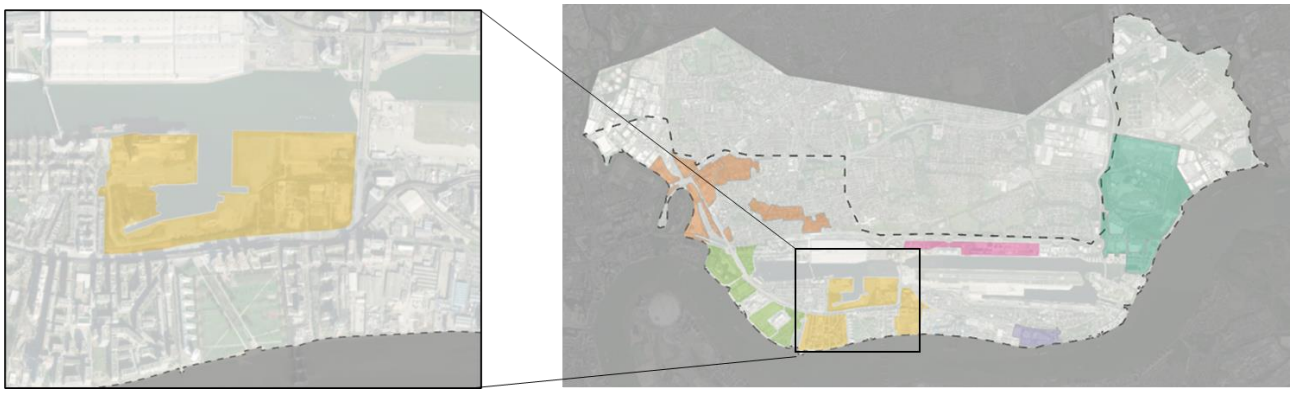

Figure 64: Extents of Silvertown Quays.

The site has limited open green spaces which account for 0 % of the site area. There is fluvial and tidal flood risk, including flood zone 3 with tidal defences. There is pluvial flood risk with 6 % of the site area at risk of a 100-year event and 16 % of the site area at risk of a 1000-year event. Ground conditions indicate there that are limited opportunities for infiltration on site.

There is significant potential to inform the strategy for Silvertown Quays. It is recommended that blue-green infrastructure is prioritised on this site where applicable. Infiltration is not expected to be feasible for the site. Bulk metering and submetering using smart meters should be applied to all units. Demand reduction measures, such as low flow appliance, taps and WCs, should also be applied. Finally, the potential for alternative water resources should be considered, including the non-potable reuse of both blackwater and greywater and the non-potable use of rainwater harvesting. The steering group should proactively engage with the strategic plan for the site, to ensure that these opportunities are achieved. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 19 below.

Table 19: Suitable interventions for Silvertown Quays.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Likely to be suitable	Likely to be suitable
Blue roofs	Likely to be suitable	Unlikely to be suitable
Channels and rills	Likely to be suitable	Likely to be suitable

Intervention	Strategic Sites	Retrofit
Detention basins	Likely to be suitable	Likely to be suitable
Filter drains	Likely to be suitable	Likely to be suitable
Green roofs	Likely to be suitable	Unlikely to be suitable
Infiltration systems	Unlikely to be suitable	Unlikely to be suitable
Permeable paving / surfaces	Likely to be suitable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Likely to be suitable	Likely to be suitable
Bulk metering and submetering	Likely to be suitable	Likely to be suitable
Smart metering and smart tariffs	Likely to be suitable	Likely to be suitable
Leakage reduction	Likely to be suitable	Likely to be suitable
Low flow appliances	Likely to be suitable	Likely to be suitable
Low flow taps & WCs	Likely to be suitable	Likely to be suitable
Non-potable reuse of greywater	Likely to be suitable	Unlikely to be suitable
Rainwater harvesting from roofs and surfaces	Likely to be suitable	Likely to be suitable

Royal Albert Docks

Characteristics

This place provides an opportunity to connect with water through water-based recreation opportunities. Improved connections will increase local participation, complement new development proposals. The development status of the area is detailed in Table 20.

Table 20: Status of sites within Royal Albert Docks.

Site	Developer	Status
Royal Albert Docks	No developer appointed.	Proposals under review.

Given the fact that the proposals for the site are under review, there is significant potential to inform the strategy for the area.

Royal Albert Docks

The extent of the Royal Albert Docks is shown in Figure 65 below:

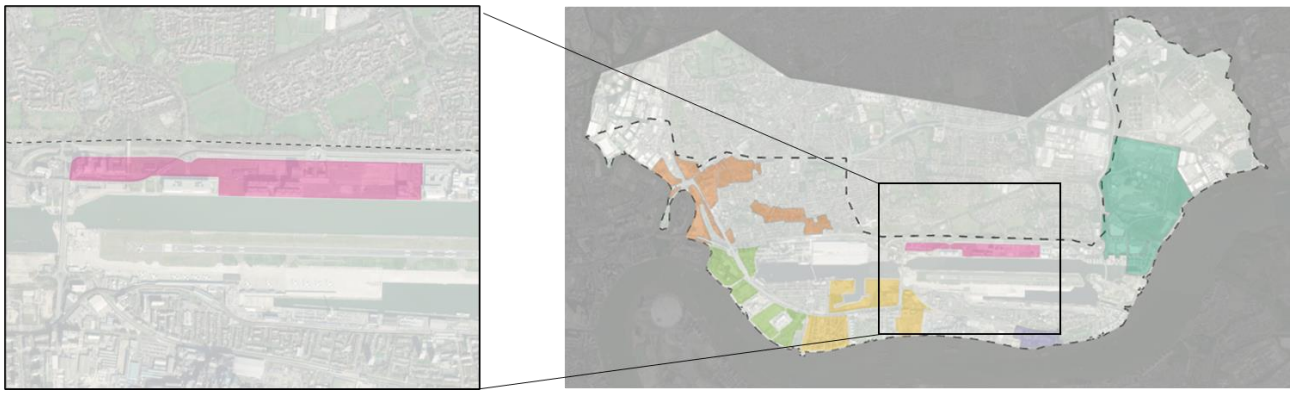

Figure 65: Extents of the Royal Albert Docks.

The site has limited open green spaces which account for 6 % of the site area. There is fluvial and tidal flood risk, including flood zone 3 with tidal defences. There is pluvial flood risk with 1 % of the site area at risk of a 100-year event and 4 % of the site area at risk of a 1000-year event. Ground conditions indicate there that are limited opportunities for infiltration on site.

There is significant scope to inform the development of the Royal Albert Docks. It is recommended that blue-green infrastructure is prioritised on this site where applicable. Infiltration is not expected to be feasible. Bulk metering and submetering using smart meters should be applied to all units. Demand reduction measures, such as low flow appliance, taps and WCs, should also be applied. Finally, the potential for alternative water resources should be considered, including the non-potable reuse of both blackwater and

greywater and the non-potable use of rainwater harvesting. The steering group should proactively engage with the strategic plan for the site, to ensure that these opportunities are achieved. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 21 below.

Table 21: Suitable interventions for Royal Albert Docks.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Likely to be suitable	Likely to be suitable
Blue roofs	Likely to be suitable	Unlikely to be suitable
Channels and rills	Likely to be suitable	Likely to be suitable
Detention basins	Likely to be suitable	Likely to be suitable
Filter drains	Likely to be suitable	Likely to be suitable
Green roofs	Likely to be suitable	Unlikely to be suitable
Infiltration systems	Unlikely to be suitable	Unlikely to be suitable
Permeable paving / surfaces	Likely to be suitable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Likely to be suitable	Likely to be suitable
Bulk metering and submetering	Likely to be suitable	Likely to be suitable
Smart metering and smart tariffs	Likely to be suitable	Likely to be suitable
Leakage reduction	Likely to be suitable	Likely to be suitable
Low flow appliances	Likely to be suitable	Likely to be suitable
Low flow taps & WCs	Likely to be suitable	Likely to be suitable
Non-potable reuse of greywater	Likely to be suitable	Unlikely to be suitable
Rainwater harvesting from roofs and surfaces	Likely to be suitable	Likely to be suitable

North Woolwich

Characteristics

The existing local centre will be enhanced, and nearby roads will be reconfigured to provide improved accessibility. As there is no major development proposed in North Woolwich, it is suggested that retrofit of appropriate interventions should be considered as the public realm improvement and any other future capital works are progressed.

North Woolwich

The extent of North Woolwich is shown in Figure 66 below:

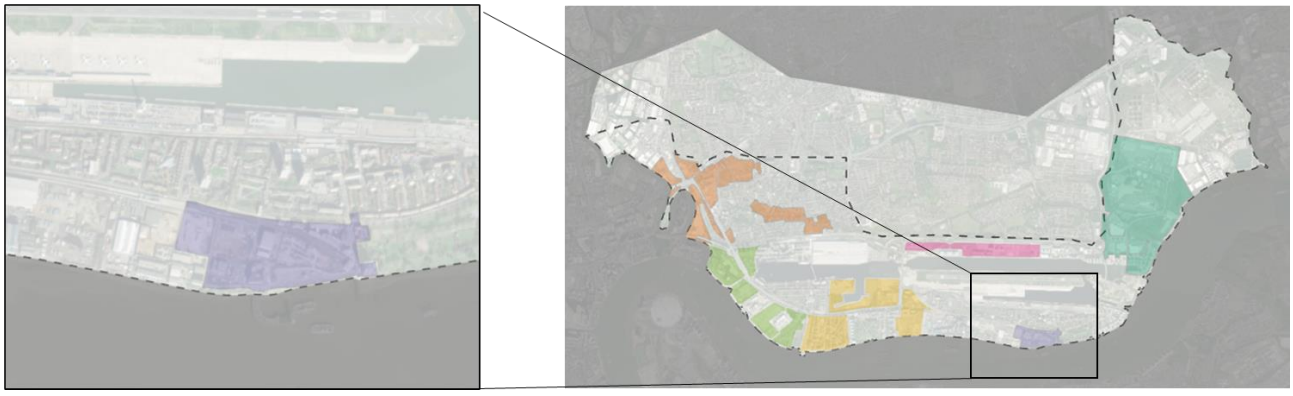

Figure 66: Extents of the North Woolwich.

The site has limited open green spaces which account for 0 % of the site area. There is fluvial and tidal flood risk, including flood zone 3 with tidal defences. There pluvial flood risk (6 % of the site area at risk of a 100-year event) and tidal flood risk (100 % of the site area at risk of a 1000-year event). Ground conditions indicate there that are limited opportunities for infiltration on site.

There is limited potential to inform strategic development within this area. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 22 below. Where development of the

strategic sites is too advanced for the IWMS to inform the proposals, the interventions are listed as not applicable.

Table 22: Suitable interventions for North Woolwich.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Not applicable	Likely to be suitable
Blue roofs	Not applicable	Unlikely to be suitable
Channels and rills	Not applicable	Likely to be suitable
Detention basins	Not applicable	Likely to be suitable
Filter drains	Not applicable	Likely to be suitable
Green roofs	Not applicable	Unlikely to be suitable
Infiltration systems	Unlikely to be suitable	Unlikely to be suitable
Permeable paving / surfaces	Not applicable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Unlikely to be suitable	Unlikely to be suitable
Bulk metering and submetering	Not applicable	Likely to be suitable
Smart metering and smart tariffs	Not applicable	Likely to be suitable
Leakage reduction	Not applicable	Likely to be suitable
Low flow appliances	Not applicable	Likely to be suitable
Low flow taps & WCs	Not applicable	Likely to be suitable
Non-potable reuse of greywater	Not applicable	Likely to be suitable
Rainwater harvesting from roofs and surfaces	Not applicable	Unlikely to be suitable

Albert Island

Characteristics

Development for this place will rejuvenate the eastern part of the OA. It will improve north/south routes, increase activity, and provide job and training opportunities. London and Regional Properties are developing Albert Island with work on site. As a result, there is limited potential to inform the strategy for the area.

Royal Albert Wharf

Ground conditions indicate there that are limited opportunities for infiltration on site.

There is limited scope to influence this development. It is proposed that in addition to the interventions already included as part of these developments, that retrofit of appropriate interventions should be considered in this area as future capital works are progressed. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 23 below. Where development of the strategic sites is too advanced for the IWMS to inform the proposals, the interventions are listed as not applicable.

Table 23: Suitable interventions for Royal Albert Wharf.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Not applicable	Likely to be suitable
Blue roofs	Not applicable	Unlikely to be suitable
Channels and rills	Not applicable	Likely to be suitable
Detention basins	Not applicable	Likely to be suitable
Filter drains	Not applicable	Likely to be suitable
Green roofs	Not applicable	Unlikely to be suitable
Infiltration systems	Not suitable	Unlikely to be suitable
Permeable paving / surfaces	Not applicable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Likely to be suitable	Likely to be suitable
Bulk metering and submetering	Not applicable	Likely to be suitable
Smart metering and smart tariffs	Not applicable	Likely to be suitable
Leakage reduction	Not applicable	Likely to be suitable
Low flow appliances	Not applicable	Likely to be suitable
Low flow taps & WCs	Not applicable	Likely to be suitable
Non-potable reuse of greywater	Not applicable	Unlikely to be suitable

Intervention	Strategic Sites	Retrofit
Rainwater harvesting from roofs and surfaces	Not applicable	Likely to be suitable

Beckton Riverside

Characteristics

This place will become a district / major centre featuring new housing, town centre and commercial uses, innovative industrial uses, green infrastructure, and open spaces. Its development will be supported by a new DLR station and new local connections. The status of the Beckton Riverside is detailed in Table 24.

Table 24: Status of sites within Beckton Riverside.

Site	Developer	Status
Beckton Riverside	NA	Masterplanning

As a result of the development stage for the Beckton Riverside, there is significant potential to inform the strategy for the area.

Beckton Riverside

The extents of the Beckton Riverside is shown in Figure 67 below:

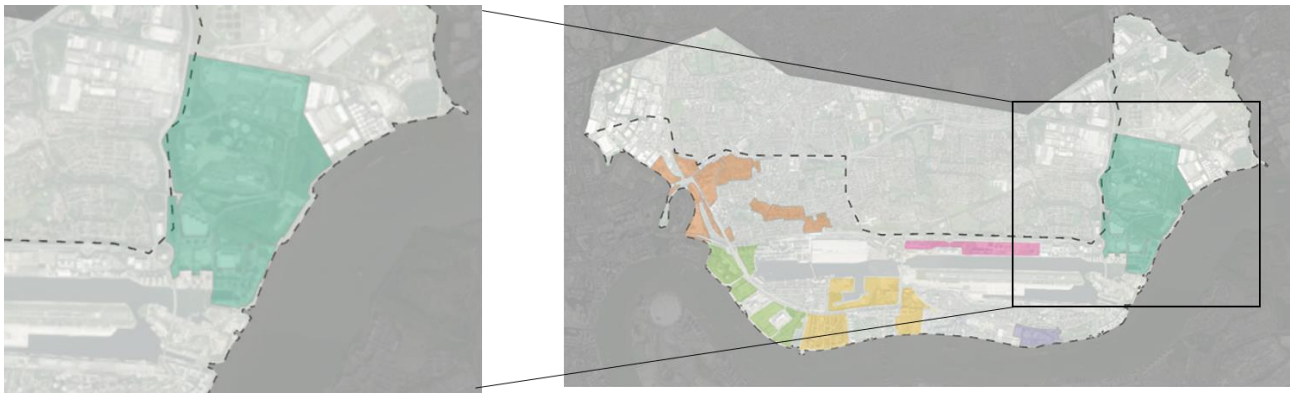

Figure 67: Extents of Beckton Riverside.

The site has limited open green spaces which account for 3 % of the site area. There is fluvial and tidal flood risk, including flood zone 3 with tidal defences. There is pluvial flood risk with 2 % of the site area at risk of a 100-year event and 12 % of the site area at risk of a 1000-year event. Ground conditions indicate there that are limited opportunities for infiltration on site.

There is significant scope to influence the Beckton Riverside. It is recommended that blue-green infrastructure is prioritised on this site where applicable. Infiltration is not expected to be feasible for the site. Bulk metering and submetering using smart meters should be applied to all units. Demand reduction measures, such as low flow appliance, taps and WCs, should also be applied. Finally, the potential for alternative water resources should be considered, including the non-potable reuse of both blackwater and greywater and the non-potable use of rainwater harvesting. The steering group should proactively engage with the strategic plan for the site, to ensure that these opportunities are achieved. The interventions suitable for the development of the strategic sites and for retrofit are indicated in Table 25 below:

Table 25: Suitable interventions for Beckton Riverside.

Intervention	Strategic Sites	Retrofit
Bio-retention systems	Likely to be suitable	Likely to be suitable
Blue roofs	Likely to be suitable	Unlikely to be suitable
Channels and rills	Likely to be suitable	Likely to be suitable
Detention basins	Likely to be suitable	Likely to be suitable
Filter drains	Likely to be suitable	Likely to be suitable
Green roofs	Likely to be suitable	Unlikely to be suitable
Infiltration systems	Unlikely to be suitable	Unlikely to be suitable

Intervention	Strategic Sites	Retrofit
Permeable paving / surfaces	Likely to be suitable	Likely to be suitable
Surface water separation and discharge into Royal Docks	Unlikely to be suitable	Unlikely to be suitable
Bulk metering and submetering	Likely to be suitable	Likely to be suitable
Smart metering and smart tariffs	Likely to be suitable	Likely to be suitable
Leakage reduction	Likely to be suitable	Likely to be suitable
Low flow appliances	Likely to be suitable	Likely to be suitable
Low flow taps & WCs	Likely to be suitable	Likely to be suitable
Non-potable reuse of greywater	Likely to be suitable	Likely to be suitable
Rainwater harvesting from roofs and surfaces	Likely to be suitable	Unlikely to be suitable

1.4 Wider recommendations

Bird risk

Bird risk

The IWMS encourages the consideration of biodiversity net-gain benefits when implementing water management interventions. However, it is noted that the presence of London City Airport within the OA means that this must be balanced with consideration of risk to birds due to low flight paths over the OA.

Awareness, education and understanding

Advertising

Advertising of the integrated water strategy and associated measures, both public and private to the general public, including information on how they can get involved/ contribute.

The IWMS recommends that the member of the steering group align their ongoing and future advertising campaign where possible to maximise the potential of each engagement.

Communications strategy

Developing a cross platform communications strategy from the local water provider and government bodies to supply a reliable and efficient source of information on the integrated water strategy and risk events in the area.

The IWMS recommends that the steering group consider the need to develop a regional communications strategy. This would help to ensure alignment between members in with regard to the method and type of information communicated to customers and citizens.

Engagement with institutions and academia

Development of links with local academic establishments and institutions to encourage involvement in the integrated water strategy features, including but not limited to site visits for students, educational programmes, access to data for academic studies, optimisation through collaboration with universities.

The IWMS encourages the steering group members continue to engage with institutions and academia to ensure that the regional benefits from the world class thought leadership that exists in London is showcased.

Education campaigns

Establishment of links with the local community to deliver educational campaigns to primary and secondary school pupils, particularly aiming to educate the local population on water consumption reduction techniques and the impact on the water cycle through school visits and the provision of educational resources to local schools. This could extent to schools assisting in the creation and maintenance of interventions.

The IWMS recognises that education is key to unlocking the potential for integrated water management within society. Therefore, it is recommended that the members of the steering group align their ongoing and future campaign where possible to maximise the potential of each engagement.

Public awareness campaign

Delivery of a public awareness campaign to inform the public of the benefits of an integrated water management strategy and how they can contribute to reducing the stress on existing water systems both now and in the longer term.

The IWMS recommends that the steering group align their ongoing and future campaign where possible to maximise the potential of each.

Digital

Event triggered maintenance

Monitoring of rainfall events, and implementation of protocols that mean that when an event of certain magnitude occurs, specific maintenance procedures must happen.

The IWMS proposes that the various members of the steering group consider the need, benefits, and practicalities of implementing event triggered maintenance in the wider region. It is suggested that any such measures should prioritise area with the greater risk.

Risk profiling

Method to help identify key hazards and risks in a system and therefore the control measures that should be put into place.

The IWMS recommends that the common and alignment risk profiling method is developed and deployed for the wider region. This would allow the steering group to consider where overlapping risks existing and work together to mitigate these.

Offsetting / credits

Requirement of developers to ensure construction of new developments does not result in an increase in overall water demands. Done by offsetting, new water connections being offset by on-site and off-site water conservation efforts, or credits, which can be bought in lieu of conservation activity or are earned when water conservation efforts achieve savings intended to offset the water consumption of a new service connection or development.

The IWMS recommends that the steering group consider the benefits that a catchment market or similar could bring. If implemented it is proposed that this should be at a regional scale, rather than for the OA.

Smart networks

An integrated set of products, solutions and systems that enable utilities to monitor and diagnose problems, prioritise, and manage maintenance issues and use data to optimize all aspects of the water distribution network remotely and continuously.

It is recommended that the steering group consider the benefits of smart networks, in particular within areas of high risk or on assets with historical maintenance challenges.

Integrated modelling

Modelling of the water system that combines socio-economic, infrastructure and natural systems. Therefore, it can capture the interactions between economic and population growth, water resource supply and depletion, and environmental changes.

The IWMS suggest that the steering group consider the need for integrated hydraulic modelling that could consider the integrated nature of the water system in more detail. It is suggested that such an approach should be trialled in an area where there is a significant the need a significant need for water management, but also

where the existing induvial model haves sufficient model coverage to allow and integrated model to be developed.

Flood warnings

Warning to residents/businesses if there is a likelihood of flooding from waterways or surface water. The IWMS proposes that the steering group could align their recourses to ensure that both their customers and citizens have as much warning as possible when flood events are expected. There is a particular need to prioritise notification of customers and citizens who are the most the vulnerable to these events.

Infrastructure Mapping Application

These improvements and upgrades should be aligned with other infrastructure delivery coordinated by GLA and Infrastructure Mapping Application. Coordinated delivery would help minimise roadworks and traffic disruption in the OA.

Land management

Overland flow management

Management of overland flows in exceedance routes that minimise the risks to people and property and avoids creating hazards to pedestrian and vehicular access and egress routes.

It is recommended that the use of overland flow manage to reduce flood risk is considered at a strategic level and provisions made within the planning framework to encourage publicly available land to be used in this way and existing green spaces such as Beckton Park.

Water efficiency

Thames Water Smarter Homes

Visits by Thames Water and partners to qualifying homes to help customers to reduce their water use by offering water saving advice and fitting water saving devices, such as efficient shower heads.

It is recommended that Thames Water continue to provide this service to customers to help them reduce their water use.

Thames Water Businesses visits

Visits by Thames Water and partners to qualifying businesses to help customers to reduce their water use by offering water saving advice and fitting water saving devices, such as efficient shower heads.

It is recommended that Thames Water continue to provide this service to customer to help them reduce their water use.

1.5 Limitations

In respect to the various needs that were deemed to be outside of the scope of the IWMS the following recommendations in Table 26 are proposed in order to progress these items.

Table 26: Recommendation for needs outside the IWMS scope limitations.

Category	Recommendations to progress related interventions
Coastal defences	A region wide approach to coastal defences should be taken. This may include consideration as part of the SIWMS and the delivery of the TE2100 plan.
Coastal restoration	A region wide approach to coastal restoration should be taken. This may include consideration as part of the SIWMS and the delivery of the TE2100 plan.

Category	Recommendations to progress related interventions
Consumer goods	A national approach to consumer goods should be taken. The members of the steering group may be best placed to use their collective standing to lobby for these changes, rather than doing this in isolation.
Government and regulators	The members of the steering group may be best placed to use their collective standing to lobby the government and the regulator.
Relocation	Relocation of property and infrastructure to areas without flood risk should be considered as part of the London Plan to ensure that strategic development is not proposed in areas of significant flood risk.
River conveyance	A region wide approach to river conveyance should be taken. This may include consideration as part of the SIWMS and the delivery of the TE2100 plan.
River defences	A region wide approach to river defences should be taken. This may include consideration as part of the SIWMS and the delivery of the TE2100 plan.
River restoration	A region wide approach to river restoration should be taken. This may include consideration as part of the SIWMS and the delivery of the TE2100 plan.
Upper catchment management	Upper catchment management would benefit to OA by potentially reducing flood risk A region wide approach to upper catchment management should therefore be taken that considers benefits in downstream areas. This may include consideration as part of the SIWMS.
Water resource - Blackwater	If the steering group wish to explore the potential for blackwater reuse, it is recommended that a standalone study be commissioned. This should include an assessment regarding public perception for the technology.
Water resource - Desalination	It is proposed that future water resources should be considered at a strategic level, including through Thames Waters WRMP.
Water resource - Freshwater	It is proposed that future water resources should be considered at a strategic level, including through Thames Waters WRMP.
Water resource - Groundwater	It is proposed that future water resources should be considered at a strategic level, including through Thames Waters WRMP.
Wastewater treatment	It is proposed that wastewater treatment strategy should be considered at a strategic level, including through Thames Waters DWMP. This will include proposed upgrades to Beckton STW to facilitate the Thames Tideway Tunnel and to resolve odour issues.

2. Implementation toolkit

The implementation toolkit summarises the key interventions being recommended in the IWMS supported by context, benefits derived from their implementation, appropriate locations, delivery mechanisms, and operation and maintenance considerations, and signposts to external guidance.

Case studies, where appropriate, have been included to provide greater context on the benefits that have been realised in projects elsewhere.

The benefits associated with the interventions have been broken down in the following categories:

Local management of water resources

Improves water quality

Flooding risk reduction

Promotes water neutrality

Improved health and wellbeing

Promotes biodiversity

Contributes to net zero agenda

Resilience and or adaption to climate change

Within the implementation toolkit the relevant benefits for each intervention are highlighted using the icons outlined above. Relevant icons for each intervention are shown in RED.

Table 27 below summarise which interventions would be suitable depending on the location that they would be implemented in. The table also differentiates between new development and retrofit projects. This will enable a focused approach to the use of the implementation toolkit.

When preparing the Implementation Toolkit, the associated developers for the strategic sites were engaged where appropriate. The purpose of this engagement was to encourage feedback and engagement on the proposed interventions. Where feedback was received, this was incorporated into Implementation Toolkit.

Table 27: Summary of suitable interventions by location type during new development

	New developments				Retrofit			
	Building	Highway	Public realm	Green space	Building	Highway	Public realm	Green space
Bio-retention systems		✓	✓	✓		✓	✓	✓
Blue roofs	✓							
Channels and rills		✓	✓			✓	✓	
Detention basins				✓				✓
Filter drains			✓	✓				
Green roofs	✓				✓			
Infiltration systems			✓	✓			✓	✓
Permeable paving / surfaces		✓	✓			✓	✓	
Surface water separation and discharge into Royal Docks		✓	✓			✓	✓	
Bulk metering and submetering	✓							
Smart metering and smart tariffs	✓				✓			
Leakage reduction	✓				✓			
Low flow appliances	✓				✓			
Low flow taps & WCs	✓				✓			
Non-potable reuse of greywater	✓							
Rainwater harvesting from roofs and surfaces	✓	✓	✓	✓	✓		✓	

2.1 Runoff reduction

Figure 68: SuDS case study (Image source: Susdrain)

Case Study - Woodberry Down Regeneration, London

A regeneration scheme in London where a SuDS management train has been integrated into the design and implementation of the project, which is situated next to two reservoirs.

The SuDS management train consists of:

- Source control: green and brown roofs, rainwater harvesting, permeable paving, biodiverse and pollinator centric planting, tree planting (c. 300 trees), Pre-treatment/conveyance: river and reservoirs with surrounding wetland.
- Regional control: Planted basins and infiltration trenches, cellular storage tanks.
- Local discharge: utilisation of the adjacent reservoirs for discharge.

Partnership work has helped to secure the success of the scheme, and early engagement was important for design success. The maintenance of completed areas are split between London Borough of Hackney Parks and Open Spaces and London Borough of Hackney Highways with a small area around each building maintained by the Berkeley Estates Management Team.

Bio-retention systems

Figure 69: Example of bio-retention system (Image source: Nine Elms Council)

Case Study –Missing Link Rain Garden, Vauxhall Walk, London SE11 5HL

Rain gardens were installed with the intention of improve walking and cycling connections between Vauxhall and Nine Elms, whilst reducing the risk of flooding by taking rainwater from the street drains and re-directing it into the rain gardens.

The outcome has been an improved streetscape, improved pedestrian, and cyclist safety, and reduced hard paved area contributing to surface water runoff. The project was delivered as part of TfL and The Mayor of London's Pocket Park programme, and was delivered by the not-for-profit organisation, Streetscape.

Figure 70: Rain gardens installed in Waltham Forest (Source: Meristem Design)

Case Study – Waltham Forest SuDS

SuDs features were implemented across several locations within the borough of Waltham Forest. The largest is the section of Forest road running between Tottenham Hale and Blackhorse Road is now proudly lined with over 600 m^2 of rain gardens, with a cycle path to both side, and a view to the Wetlands. The main benefits have been to target and improve both roads and homes that are known to flood. Rain gardens are also used as a wildlife corridor, biodiversity booster, barrier to cars outside schools, to soften traffic noise, to slow traffic, enrich commutes and bring communities together.

Several of the schemes were implemented by Meristem Design (see link to website below for more information). The first of the schemes worked on by them was the Coppermill scheme in October 2021. The schemes have overall improved pollution and biodiversity and added community value, whilst functioning as effective SuDS in the areas where they have been implemented. See link for further details:https://www.meristemdesign.co.uk/forest-road-waltham-forest.

Description

Runoff is redirected into a vegetated area that enables the infiltration, storage, and evapotranspiration of it. The system intercepts and filters surface water run-off, providing storage for stormwater, reduced runoff rate and reduced pollution in runoff.

Benefits

Appropriate context/locations

Bio-retention systems will be most easily implemented into contexts where strategic development is taking place and considered early on in the feasibility stages. However, it is also possible to retrofit a bio-retention system, which often occurs alongside public realm or highway improvement schemes.

Delivery mechanisms and owner

Bio-retention systems would be delivered through a variety of mechanisms:

- Planning policy,
- Developer proposals,
- Capital works such as street works retrofit.

For the strategic sites, delivery is most likely to be owned by the developer. However, across the OA bio-retention systems could be delivered by developers, Thames Water, the London Borough of Newham, TfL, or even by private landowners. Additionally, as shown in the case study above, bio-retention systems provide opportunities for community engagement and could be delivered by not-for-profit schemes and organisations. This is the case for both development and retrofit.

Operation and maintenance

The operation and maintenance should be the responsibility of Thames Water, the London Borough of Newham, TfL, or the private landowner, depending on the owner of the land which the bio-retention system is on. Maintenance also provides an opportunity for community engagement.

Resources

Refer to SuDS guidance for design. Specific documents relevant to RD&BR:

- GLA: Reimagining rainwater in parks and green spaces.
- Royal Docks: Landscape Design Guidance.
- CIRIA: The SuDS Manual – publication C753.
- TfL: SuDS in London – a guide.
- GLA: SuDS Sector Guidance.

Blue roofs

Figure 71: Podium deck blue roof in dense urban development, Middledock, Salford (image: abg geosynthetics).

Case Study – Podium Deck Blueroof, Middlewood Locks, Salford,

The 9,500 m^2 catchment area of the development discharges to the newly renovated balancing basins that service the confluence of adjacent canals and the River Irwell. An extensive podium drainage landscaping design was required to meet the site's strict discharge limits and reduce the impact of surface water run-off to less than that of the pre-developed brownfield land.

The system is designed for a 1-in-100 storm event plus 30 % allowance for the effects of climate change and provides attenuation of surface water runoff to prevent increase in flood risk from the development.

Description

Blue roofs control the release of water from rainfall by temporarily storing and releasing it at a controlled rate. They can be installed on the roof of a building or under paving. Some solutions may provide some water quality improvements. They are not suitable for long term water storage.

Benefits

Appropriate context/locations

It is most appropriate to implement blue roof systems alongside development. Will require flat roofs or podium level surfaces to attenuate the runoff.

Delivery mechanisms and owner

Delivery will be by the developer of strategic sites. Will require collaboration of architecture and engineering teams to develop a suitable solution for specific sites.

Retrofit may possible during major refurbishment of a building.

Operation and maintenance

The operation and maintenance blue roofs would be the responsibility of the private landowner.

Recommendation for RD&BR

Suited for dense high-rise developments in the OA. It should be considered as a design option by developers.

Resources

Refer to SuDS guidance for design. Specific documents relevant to RD&BR:

- GLA: Reimagining rainwater in parks and green spaces.
- Royal Docks: Landscape Design Guidance.
- CIRIA: The SuDS Manual – publication C753.
- TfL: SuDS in London – a guide.
- GLA: SuDS Sector Guidance.

Channels and rills

Figure 72: Example of a channel (Source: Arup).

Description

Shallow open surface water channels that capture runoff at the start of a SuDS train, allow deposition of sediment and convey the runoff to downstream SuDS features (see Woodberry down case study on page 87 for example). They can also be used in between SuDS features as connectors. They collect water, slow it down and provide storage for silt and oil that is captured. Planting in channels and rills can visually enhance the urban landscape and offer biodiversity and amenity value.

Benefits

Appropriate context/locations

Where possible, the implementation of channels and rills should be aligned with other strategic development. However, it is also possible to retrofit channels and rills, with retrofit most suitable for drained area with adjacent open or green space.

Delivery mechanisms and owner

Strategic sites (new): where they are possible, will be delivered by developers.

IWM Study Area (retrofit): Delivery by: (i) Newham (LLFA and Parks) as part of delivered as part of surface water flood risk management strategy; (ii) by TfL as part of asset management and of TfL operated roads; (iii) by Thames Water as part of their Business Plan.

Operation and maintenance

Strategic sites: By landowner or their management agents as per O&M plan.
IWM Study Area (retrofit): As part of Asset Operations and Management Delivery plans by Newham, TfL, and Thames Water, or their respective agents.

Relevance to RD&BR

There is limited potential for their inclusion in the Strategic Sites.
There is potential for their inclusion in retrofit SUDS Strategy in parts of the wider IWMS Study Area.

Resources

Refer to SuDS guidance for design. Specific documents relevant to RD&BR:

- GLA: Reimagining rainwater in parks and green spaces.
- Royal Docks: Landscape Design Guidance.
- CIRIA: The SuDS Manual – publication C753.
- TfL: SuDS in London – a guide.
- GLA: SuDS Sector Guidance.

Detention basins

Figure 73: Example of a detention basin at Parkview Terrace, Llanelli (Source: Arup).

Case Study – Parkview Terrace, Llanelli

Welsh Water investment of £4.3 million went to a RainScape project in and around Parkview Terrace in Llanelli in South Wales. The project implemented a large swale on a grassed area, which is designed to attenuate 200m3 of rainwater. As part of the work new manholes, pipework and kerb drainage were installed in a number of streets near to the swale. The work was completed in 2017.

Description

Vegetated or non-vegetated basins that are designed to hold runoff from impermeable surfaces and allow sediments and pollutants to settle. Do not generally enable infiltration. Can serve other functions such as playing fields, recreational areas, and open space. Can be planted with trees/bushes to provide wildlife habitat

Benefits

Appropriate context/locations

Where possible, the implementation of detention basins should be aligned with development and prioritised through a site wide attenuation strategy. However, it is also possible to retrofit detention basins to systems that are unattenuated, with retrofit most suitable for drained areas with adjacent open or green space.

Delivery mechanisms and owner

Strategic sites (new): delivered by the developer as part of site flood risk management provision to meet planning requirements.

IWM Study Area (retrofit): Delivery by: (i) Newham (LLFA and Parks) delivered as part of surface water flood risk management strategy; (ii) by TfL as part of asset management and of TfL operated roads; (iii) by Thames Water as part of their Business Plan.

Operation and maintenance

Strategic sites (new): unless transferred to Local Authority or Thames Water, likely to be operated and maintained by landowner or their agent.
IWM Study Area (retrofit): As part of Asset Operations and Management Delivery plans by Newham, TfL, and Thames Water, or their respective agents.

Relevance to RD&BR

Strategic sites: The riparian sites discharging into the tidal rivers would require temporary storage during tide-lock periods. Both vegetated and non-vegetated detention basins are one option to provide this storage.
IWM Study Area: There is potential for their inclusion in retrofit SUDS Strategy in parts of the wider IWMS Study Area.

Resources

Refer to SuDS guidance for design. Specific documents relevant to RD&BR:

- GLA: Reimagining rainwater in parks and green spaces.
- Royal Docks: Landscape Design Guidance.
- CIRIA: The SuDS Manual – publication C753.
- TfL: SuDS in London – a guide.
- GLA: SuDS Sector Guidance.

Filter drains

Figure 74: Example of a filter drain (Source: Arup).

Description

A filter drain is a trench lined with a geotextile and filled with gravel into which runoff water is led, either directly from the drained surface or via a pipe system. Provides some filtration of runoff (sediment, organic matter, and oil residues) as well as a reduced run off rate and runoff storage.

Benefits

Appropriate context/locations

Filter drains should be implemented alongside development. Retrofit is challenging as it requires alterations to the existing drainage mechanism.

Delivery mechanisms and owner

Strategic sites (new): delivered by the developer as part of site flood risk management provision to meet planning requirements.

IWM Study Area (retrofit): Delivery by: (i) Newham (LLFA and Parks) as part of delivered as part of surface water flood risk management strategy; (ii) by TfL as part of asset management and of TfL operated roads; (iii) by Thames Water as part of their Business Plan.

Operation and maintenance

Strategic sites (new): unless transferred to Local Authority or Thames Water, likely to be operated and maintained by landowner or their agent.
IWM Study Area (retrofit): As part of Asset Operations and Management Delivery plans by Newham, TfL, and Thames Water, or their respective agents.

Resources

Refer to SuDS guidance for design. Specific documents relevant to RD&BR:

- GLA: Reimagining rainwater in parks and green spaces.
- Royal Docks: Landscape Design Guidance.
- CIRIA: The SuDS Manual – publication C753.
- TfL: SuDS in London – a guide.
- GLA: SuDS Sector Guidance.

Green roofs

Figure 75: Example of a green roof (Source: Bristol Council SuDS Case Studies https://www.bristol.gov.uk/files/documents/2709-woe-suds-case-study-04-barton-hill-green-roof/file).

Case Study – Barton Hill School Bristol

The two adjacent green roofs covering the primary school were built in 2007. They have a large visual impact in an area dominated by high-rise flats and was built with the aim of being used as a learning tool for the pupils. The project was funded and coordinated by Community at Heart (the New Deal for Communities in Bristol).

The green element of the roof cost £56k. Maintenance has proven to be minimal with cost incorporated into the general ground keeping of the site.

Description

Green roofs are vegetated layers that sit on top of waterproofed roof surfaces of a building. They are multi-beneficial as they can reduce stormwater runoff, as well as improving air quality and supporting biodiversity. Stormwater runoff is reduced by the vegetation absorbing rainwater and then releasing it by evapotranspiration. The rainwater that is not retained is detained, increasing the time to peak, and slowing peak flows.

Green roofs will reduce the volumes of rainwater that can be harvested for internal use, therefore careful consideration will be needed for site water neutrality and storm attenuation requirements.

Benefits

Appropriate context/locations

Green roofs are best implemented in new developments. Retrofit on existing buildings is possible. However, it will require structural assessments, therefore suited during major refurbishments.

Delivery mechanisms and owner

Strategic sites (new): delivered by the developer as part of site flood risk management provision to meet planning requirements.

IWM Study Area (Retrofit): delivered by the contractor during major refurbishment as part of site flood risk management provision to meet planning requirements.

However, across the OA bio-retention systems can be delivered by developers or by private landowners. This can be encouraged by incentives or planning conditions set by the local authority. This is the case for both development and retrofit.

Operation and maintenance

Strategic sites (new): likely to be operated and maintained by landowner or their agent as part of building Asset Operations or Maintenance Delivery plans.

Recommendation for RD&BR

Strategic sites: Green roofs should be promoted on all new developments by the planning authority. However, they should be considered as part of both site water balance (rainwater harvesting) and surface water management strategies.

Resources

Refer to SuDS guidance for design of bio-retention systems. Specific documents relevant to RD&BR:

- GLA: Reimagining rainwater in parks and green spaces.
- Royal Docks: Landscape Design Guidance.
- CIRIA: The SuDS Manual – publication C753.
- TfL: SuDS in London – a guide.
- GLA: SuDS Sector Guidance.

Infiltration systems

Figure 76: Example of soakaway (Source: Arup).

Figure 77: Example of an infiltration basin (Source: Arup).

Description

An infiltration basin and soakaways allow water to infiltrate gradually into the ground. Performance relies on permeability of soil and depth of water table and may require an overflow if rainfall events exceed the design capacity (see Woodberry down case study on page 87 for example).

Benefits

Appropriate context/locations

Where possible, the implementation of infiltration systems should be aligned with development and prioritised through a site wide drainage strategy. However, it is also possible to retrofit infiltration basins to systems that are unattenuated, with retrofit most suitable for drained areas with adjacent open or green space.

Delivery mechanisms and owner

Implementation of infiltration systems can be delivered through a variety of mechanisms. For the strategic sites, this is most likely to be by the developer. However, across the OA infiltration basins can be delivered by developers, Thames Water, the London Borough of Newham, TfL, or even by private landowners. This is the case for both development and retrofit.

Operation and maintenance

Infiltration basins
Soakaways:

Relevance for RD&BR

These measures are likely to only be suited for only a few strategic sites in Canning Town as part of ‘bespoke’ solutions (see Figure 22).
There is retrofit potential for retrofit in the wider area that drains towards Canning Town to reduce level of surface water flood risk (see Figure 20)

Resources

Refer to SuDS guidance for design. Specific documents relevant to RD&BR:

- GLA: Reimagining rainwater in parks and green spaces.
- Royal Docks: Landscape Design Guidance.
- CIRIA: The SuDS Manual – publication C753.
- TfL: SuDS in London – a guide.
- GLA: SuDS Sector Guidance.

Permeable paving / surfaces

Figure 78: Example of permeable paving (Source: Arup).

Description

Installed as part of a SUDS, permeable paving systems reduce runoff by allowing water to be absorbed into the surface, and filter water by trapping pollutants in a dub-base or geo-textile. There are two main types of permeable paving system, infiltration when surface water is directed via voids within solid paving, and porous when water is drained directly through the surface. See Woodberry down case study on page 87 for example.

Benefits

Appropriate context/locations

Where possible, the implementation of permeable paving should be aligned with other strategic development. However, it is also possible to retrofit permeable paving.

Delivery mechanisms and owner

Strategic sites: enabled through planning process. Delivered by site developer.

Retrofit: by LLFA or Thames Water as part of surface water flood risk management strategy in the OA.

Operation and maintenance

Strategic sites: Landowners or their agents would be responsible.
Retrofit in OA: landowners or LLFA would be responsible for the O&M.

Recommendation for RD&BR

Strategic sites: Permeable paving should be considered for all pedestrianised areas as part of site surface water management strategy.
OA: Where appropriate, permeable paving should be considered as part of Surface Water Flood Risk Management Strategy.

Resources

- CIRIA: The SuDS Manual – publication C753.

Surface water separation and discharge into Royal Docks

Figure 79: The Royal Docks (Source: Arup).

Case Study – Burry Port Dock

Arup developed a local catchment strategy for the town of Burry Port. This resulted in 5 hectares of impermeable area (surface water) being separated from combined sewers and diverted to wetlands and the new dock via an innovative new triple siphon beneath the railway line. Through collaboration with the council, this solution enabled the current long sea outfall to be decommissioned as a sewer outfall. The solution saved Welsh Water £4m on pending outfall enhancement and a further £4.8m vs. a traditional storage solution.

The project was completed for client Welsh Water in 2019. It took 18 months and cost £6.2 million to construct.

Description

Using the Royal Docks to discharge surface water into. Reducing the need for water to be pumped in as it is currently and reducing stress on the system.

Benefits

Appropriate context/locations

This option would be most suitable for new developments around the Royal Docks. Effective only if minimal pumping is required to direct surface water into the docks. While retrofit of existing drainage infrastructure may be feasible, the use of the Royal Docks as a receiving water body for surface water discharges would require a strategic effort focused on new developments.

Delivery mechanisms and owner

Strategic use of the Royal Docks for the discharge of surface water would need the approval of the Royal Docks Management Authority. For the strategic sites, implementation of this policy would need to be supported by the developer. However, across the OA developers, Thames Water, the London Borough of Newham, TfL, or even by private landowners could all discharge to the Royal Docks. This is the case for both development and retrofit.

Operation and maintenance

The operation and maintenance would most likely be the responsibility of the Royal Docks Management Authority.

Recommendation for RD&BR

Opportunities for surface water separation and diversion into the Royal Docks should be promoted for all sites adjacent to the docks.

Resources

N/A

2.2 Digital

Bulk metering and submetering

Description

Bulk metering and sub metering is the installation of additional meters onto pipes to gather water flow data to help find leaks. A bulk meter is a large meter that is fitted to pipes that supply large blocks of flats. A submeter is installed in a specific area of a site or piece of equipment.

Benefits

Appropriate context/locations

Suitable for retrofit and for new developments. Specifically suitable for large developments to monitor internal leaks.

Delivery mechanisms and owner

Implementation of bulk metering and submetering can be delivered through a variety of mechanisms. For the strategic sites, this is most likely to be by the developer. However, across the OA bulk metering and submetering can be delivered by developers or Thames Water in the case of retrofit. Incentives and planning requirements could be provided by local authorities.

Operation and maintenance

The operation and maintenance of the meters is likely to be the responsibility of Thames Water.

Recommendation for RD&BR

All new developments to consider bulk metering as well as sub-metering at development scale to enable better monitoring of water uses and losses on site.

Resources

News Article – Thames Water smart metering in Wandsworth (Click for link)

Smart metering and smart tariffs

Description

Installation of smart meters into properties, which automatically transfer water use data to water companies and charge customers only for the water they use. The data about water use and charge is displayed real time in the customers home, encouraging a reduction in water use. Allows better collection of data on water demand and effective management of water usage for users by helping them understand and control their water consumption. Can also help to identify leaks or inefficient appliances.

Benefits

Appropriate context/locations

Across strategic sites as well as existing residential and non-residential buildings in the OA and IWM Study Area.

Delivery mechanisms and owner

Implementation of smart tariffs would be delivered through Thames Water. This would need to be rolled out across the OA.

Operation and maintenance

The operation and maintenance would likely to be the responsibility of Thames Water.

Recommendation for RD&BR

All new developments to consider unit level smart metering to enable better monitoring of water uses on site and enhanced engagement with the customers.
Thames Water to consider the OA as priority area for metering and smart metering of existing homes and businesses in the OA and IWM study area.
Thames Water and EA to engage with Ofwat on potential to introduce smart tariffs.

Resources

- Smart WAter Network (SWAN) Forum.
- BIM4Water British Water Forum.
- UKWIR smart metering and smart networks for leakage management.

Leakage reduction

Description

Reduction in effective water consumption by fixing leaking appliances, installing leakage monitors in pipes, and managing pressure within the network to reduce leak losses.

Benefits

Appropriate context/locations

There is limited information about locations within the OA. The measures to be as per TW's WRMP and Business Plans.

Delivery mechanisms and owner

Achieving leakage reduction targets is the responsibility of Thames Water. This is likely to be delivered as part of major asset refurbishment and renewal plan across wider London WRZ.

Property level leakage reduction would be responsibility of respective property owners and delivered as part of their normal property maintenance responsibilities. Thames Water or retail water supplier may offer incentives.

Operation and maintenance

For municipal water supply assets, O&M delivered as part of TW's normal operations

Recommendation for RD&BR

Engagement with existing property owners on site level leakage monitoring and reduction.
Thames Water to deliver leakage reduction in London WRZ as part of their WRMP and Business Plan.

Resources

- Thames Water WRMP.
- Ofwat Leakage Targets.

2.3 Water efficiency

Low flow appliances

Case Study – Glandore Serviced Offices, Belfast

Glandore is a company that provides serviced offices for a variety of customers. Glandore worked with the Consumer Council to reduce their water consumption by making simple and low-cost changes to the existing infrastructure and changing their approach to managing water use. This included installing sensor operated urinal controls, and pulse action shower heads in the in-house showers. Additionally, they implemented other water management practices such as quickly repaired running toilets and taps and carrying out regular servicing on filtered water taps.

This simple approach has led to savings of about 7,000 litres of water or £20.00 per working day, and typical daily consumption per person is now less than 50 litres.

Description

Installation of appliances such as washing machines and dishwashers that are designed to maximise water efficiency and reduce water usage in a home or business.

Benefits

Appropriate context/locations

Strategic sites as well as existing ones.

Delivery mechanisms and owner

Implementation of low flow appliances can be delivered through a variety of mechanisms. For the strategic sites, this is most likely to be by the developer or the property. This is also the case across the for both new development and upgrade. Thames Water can potentially play a role in supporting the implementation of these practice.

Operation and maintenance

Operation and maintenance would be the responsibility of the property owner, or the manufacturer.

Recommendation for RD&BR

Engagement with developers for inclusion in new builds.
Engagement with residents on replacing old inefficient appliances with water efficient ones.

Resources

N/A

Low flow taps & WCs

Description

Installation of low flow taps and WCs that are designed to maximise water efficiency and reduce water usage in a home or business.

Benefits

Appropriate context/locations

While it is possible to retrofit developments with low flow WCs, specification of low flow fitting are best suited to new development.

Delivery mechanisms and owner

To be included in all new builds by the developer.

Operation and maintenance

Operation and maintenance would be the responsibility of the property owner, or the manufacturer.

Recommendation for RD&BR

Inclusion of water efficiency targets in local plan.
Retrofit programmes by Newham and Thames Water (or retail water suppliers), possibly with support of charities, in existing homes and businesses.

Resources

- The Building Regulations 2010 Part G Sanitation, hot water safety and water efficiency.
- The Water Efficiency Calculator.
- Bathroom Manufacturers Association.

2.4 Alternative resources

Non-potable reuse of greywater

Description

The recycling of greywater for non-potable uses.

Benefits

Appropriate context/locations

The inclusion of the non-potable reuse of greywater as a water resource is best suited for new development, given the cost and difficulties associated with retrofit.

Delivery mechanisms and owner

Implementation of greywater reuse systems can be delivered through a variety of mechanisms. For the strategic sites, this is most likely to be by the developer.

However, across the OA greywater reuse retrofit can be delivered by developers or by private landowners. However, retrofit into occupied properties can challenging and there likely to be only suitable during major refurbishment.

Operation and maintenance

The operation and maintenance should be the responsibility of private landowner.

Recommendation for RD&BR

Strategic sites: delivered by site developers and enabled through the planning process.

Retrofit: Through incentives (financial or otherwise) to existing property owners.

Resources

- BS 8525-1:2010 Greywater Systems: Code of practice.
- BS 8525-2:2011, Greywater Systems: Domestic greywater treatment equipment. Requirements and test methods.
- BS 8595:2013 Code of Practice for Selection of Water Reuse Systems.
- Ricardo: Independent review of the costs and benefits from rainwater harvesting and grey water recycling options in the UK (page vi)

Note that information on the cost and economic benefits of installing non-potable reuse systems can be found in the independent review done by Ricardo (see link below). The table below summarises the key findings:

Collection area	Example building types	Costs: CAPEX + OPEX ('000 £)	Water cost savings ('000 £)	Private net benefits ('000 £)	Societal benefits ('000 £)	Total net benefit ('000 £)
Small (<500m^2)	Standalone dwellings, Houses, Bungalows;	£12 - £19	£1 - £19	-£9 - £26	£21 - £77	**£10 - £100**
Medium (500 – 2000m^2)	Some larger houses or two semi-detached houses;	£25 - £38	£8 - £200	-£17 - £150	£50 - £163	**£35 - £340**
Large (2000 – 5000m^2)	Row of terraced houses or blocks of flats;	£20 - £35	£7 - £150	-£15 - £120	£35 - £335	**£20 - £450**
Very Large (>5,000m^2)	Large scale residential developments (including hybrid developments)	£35 - £60	£70 - £340	-£17 – £280	£30 - £920	**£14 – £1,200**

Figure 80: Table summarising costs and benefits of greywater reuse system (Source : Ricardo independent review)

Figure 81: Case study (Browning's Close) for rainwater harvesting (image source - Google Maps).

Case Study – Browning's Close Social Housing, Gloucestershire

A rainwater harvesting system was included in this development of 7 homes for client Markey Construction for Cottsway Housing Association. The inclusion of rainwater harvesting enabled the client to achieve Level 4 of the Code for Sustainable Homes.

The system is designed around a single 10,000-litre tank supplying all 7 properties on the site. The harvested water is pumped to a small individual header tank in each dwelling. The header tanks are designed to take water from the rainwater store as long as it is available, but to automatically revert to running from mains water when the main tank runs low, or in the event of power failure.

- Usage: WCs in 7 houses.
- Estimated usage: 400 litres/day.
- Average annual rainfall: 800 mm.
- Roof area: 300 m^2.
- Expected annual rainwater collection: 146,000 litres.
- Capital cost: £ 9,500.

Case Study – IKEA, Belfast

The store's huge 30,000 square metre roof harvests rainwater throughout its entirety and uses it to flush the store's 49 toilets. It is estimated that this mains water saving amounts to around 20 million litres per year.

Description

The collection and storage of rainwater from roofs or surfaces for reuse in various ways, for example domestic heating, or watering of green spaces.

Benefits

Appropriate context/locations

Rainwater harvesting from roofs is suitable for both new developments and as a retrofit solution. For new developments, rainwater can be integrated to provide an alternative water supply. Retrofit can also be provided simply through the provision of water butts, however with a lower level of integration.

Delivery mechanisms and owner

Strategic sites: Delivered by site developers and enabled through the planning process.**

Retrofit: Through incentives (financial or otherwise) to existing property owners.

Operation and maintenance

The responsibility would rest with the property owner or their agents.

Recommendation for RD&BR

Rainwater harvesting should be delivered as part of surface water management strategy in Strategic sites. Retrofit should be promoted and incentivised in the wider OA as part of LLFA and Thames Water led surface water flood risk reduction strategy.

Resources

- BS EN 16941-1:2018 Code of Practice for Rainwater Harvesting.
- BS 8595 Code of Practice for Selection of Water Reuse Systems.
- Ricardo: Independent review of the costs and benefits from rainwater harvesting and grey water recycling options in the UK (page iv)

Note that information on the cost and economic benefits of installing rainwater harvesting systems can be found in the independent review done by Ricardo (see link below). The table below summarises the key findings:

Collection area	Example building types	Costs: CAPEX + OPEX ('000 £)	Water cost savings ('000 £)	Private net benefits ('000 £)	Societal benefits ('000 £)	Total net benefit ('000 £)
Small (<500m²)	Standalone dwellings, Houses, Bungalows;	£12 - £19	£1 - £19	-£9 - £26	£21 - £77	**£10 - £100**
Medium (500 – 2000m²)	Some larger houses or two semi-detached houses;	£25 - £38	£8 - £200	-£17 - £150	£50 - £163	**£35 - £340**
Large (2000 – 5000m²)	Row of terraced houses or blocks of flats;	£20 - £35	£7 - £150	-£15 - £120	£35 - £335	**£20 - £450**
Very Large (>5,000m²)	Large scale residential developments (including hybrid developments)	£35 - £60	£70 - £340	-£17 – £280	£30 - £920	**£14 – £1,200**

Figure 82: Table summarising costs and benefits of greywater reuse system (Source: Ricardo independent review)

Note: Through engagement with developers, The IWSMS notes that it can be difficult to implement rainwater harvesting in residential developments. This is due to the following challenges:

- Rainwater is not suitable to replace all water usage in residential settings.
- The turbidity of rainwater compared to potable water can create perception issues with residents. As a result, education campaigns are required to support the implementation of rainwater harvesting.
- The use of rainwater can require a separate water system within the building. This can result in increased capital cost and embodied carbon.
- Rainwater harvesting requires additional space within the building that is often needed for other general uses (bins, bikes, plant, active frontage, entrances).
- Locating rainwater harvesting on roofs or in basements can impact the design, construction, and operation of the building.

3. Monitoring strategy

The purpose of monitoring with relation to the IWMS is to ensure that the recommended interventions are being implemented and are having the desired effect in order to realise the ambitions of the steering group by:

- Meeting future water demand.
- Better managing surface water flood risk.
- Improving water quality
- Delivering green infrastructure.
- Providing improved and equitable access to green space and wellbeing.

The recommendations focus on developing strategies to address key water challenges highlighted through the IWMS research and analysis. As part of these strategies, quantified targets (and associated trigger points) should be established as far as possible for stakeholder activity (e.g. timeframes for carrying out actions) as well as water system outcomes (e.g. rate of water meter retrofitting).

Data collected and shared should be monitored against the predictions of their impacts produced by the scenario modelling in the IWMS. Additionally, information shared for monitoring should be used to assess the impact of interventions with regard to the ambitions set out in the IWMS. To minimise additional resource requirements, these activities ideally should be aligned with existing monitoring activities, such as Authority Monitoring Report for the Local Plan.

3.1 Structure

Data sharing will be crucial to ensuring that the impacts of the IWMS are monitored successfully. Currently data sharing is not eagerly practiced between stakeholders within the steering group. In order to assess progress against the ambitions of the steering group all parties must be willing to share their data with one another. Therefore, we recommend that an information and data sharing agreement is entered into by the key stakeholders of this IWMS. Data and information that should be shared includes:

Policy and strategy

- Inclusion status of recommendations in Local Development Frameworks, Area Action Plans. (Update on relevant revision cycles / annual update). Owner: Newham
- Inclusion of measures in Water Company Business Plans. (Update on relevant revision cycles). Owner: Thames Water
- EA and LLFA tidal, fluvial, and pluvial flood risk management strategy recommendations for OA (Update when strategies revised). Owner: LLFA

Planning

- Number of applications with conditions aligned with IWMS Recommendations (quarterly update). Owner: Newham Planning
- Water efficiency targets included in planning conditions (quarterly update). Owner: Newham Planning
- Area of SuDS measures proposed in planning application in Strategic sites (quarterly update). Owner: Newham Planning
- Area of SUDS measures proposed in the OA and Study Area by LLFA, TfL and Thames Water (quarterly update). Owner: LLFA

- Water efficiency retrofit projects planned in the OA and IWM Study Area (annual update). Owner: Thames Water
- Asset upgrades and renewal in OA (quarterly update). Owner: Thames Water for Water, GLA for other Assets (via IMA)

Project implementation

- Progress of developments within strategic sites (Quarterly Updates). Owner: Newham Planning
- Water efficiency measures delivered in strategic sites (post implementation inspection by LPA). Owner: Newham Planning
- Thames Water leakage reduction projects in the OA and / or London WRZ and supporting leakage reduction data. (Annual update). Owner: Thames Water.
- Number of homes and businesses where water efficiency retrofits were carried out (annual update). Owner: Thames Water
- Thames Water's water consumption data by DMA to monitor and track impact assessment of interventions. (annual update). Owner: Thames Water
- Area of SuDS delivered in Strategic sites and wider study area (annual update). Owner: LLFA

Other

- Number of CSO instances, their related volumes and volumetric contribution from OA (quarterly or annual updates). Linked to Ofwat reporting requirements for Outcomes indicator 7, 8 and 10. Owner: Thames Water.

3.2 Trigger points

Trigger points are needed to enable effective implementation of a monitoring strategy.

Trigger points can relate to governance (stakeholder activity) of the IWMS, and sub-strategies developed through the recommendations.

Trigger points can also relate to specific water system outcomes (such as rate of metering or SUDS retrofit) based on targets established through appropriately detailed and quantified strategies.

Based on the level of evidence that has been gathered during this IWMS it has not been possible to established specific and quantified trigger points and it is recommended that trigger points are developed as far as possible as part of the strategies that have been recommended to be developed as a result of this IWMS.

3.3 Review process

Reviewing the impacts of the IWMS can be achieved through successfully managing the monitoring strategy and reflecting on the data that is produced. This should be done at regular intervals, frequent enough that trigger points can be identified early enough to alter the alter the approach.

Section 3.1 above has recommended some frequency for data and information updates. These can be shared in tabular format with reference to strategic site reference or geospatial location as attributes to enable visualisation in the IMA or GIS desktop software.

The review process should be made up of a feedback loop of data comparing the progress of developments with the implementation of interventions and impacts of these compared to the predictions made through scenario modelling in the IWMS. We recommend that the impacts of the IWMS are reviewed quarterly against the aspirations for the IWMS, and that the steering group convenes to discuss how this could be improved in future.

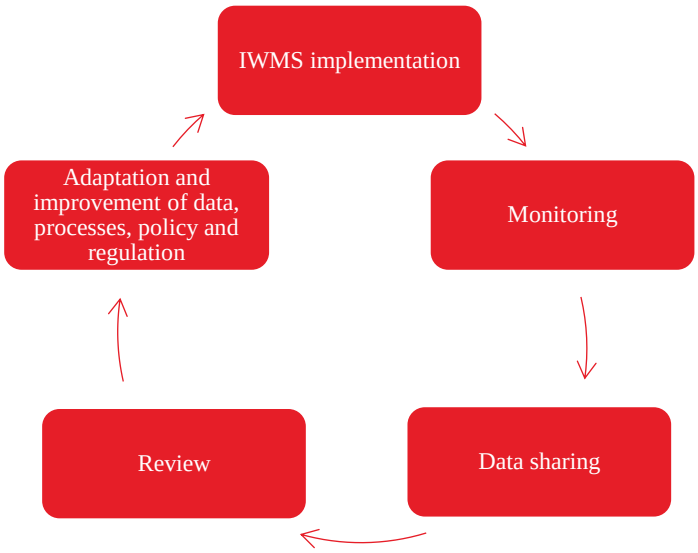

Figure 83: Review process

Appendix A – Terms of Reference (Tor)

A.1 ToR

Appendix B – Literature review

B.1 Literature review

Appendix C - Ambitions

C.1 Ambitions

To be able to work towards an Integrated Water Management Strategy, it is important to understand the different drivers and motivations of stakeholders. By seeking out alignment of interests, whilst appreciating the need to mitigate tensions where there are differences, we can identify the core areas of common ground around which the IWMS can be formed.

A session was held with the Steering Group to build on the objectives outlined in the Terms of Reference and develop a fuller understanding of collecting ambitions for water in the OA. This understanding of ambitions has informed the IWMS methodology including, our approach to identifying and appraising intervention options as well as structuring the scenarios to test key uncertainties.

Appendix D – Full list of options for interventions

D.1 Options for interventions

An initial screening removed sub-categories that are not appropriate for the IWMS; either because they were not relevant in the RD&BR context, or they are covered by other work such as the SIWMS. These have been marked as 'No'. Where the sub-category is considered relevant to the IWMS but inappropriate for detailed analysis, these are shown as 'Signal'. 'Include' signifies that the sub-category will be assessed in the IWMS.

Following this, a specific list of intervention options was made for each sub-category. Whether or not an intervention was included was based on their suitability for the RD&BR context, and alignment with the broad ambitions of the steering group. The full list of possible interventions can be found in Appendix I-1.

Table 28: Full list of interventions considered for signalled or included sub-categories.

Category	Sub-category	Option	Relevant for RD&BR	Modelled?
Awareness, education & understanding	Advertising	Advertising	Signal	No
Awareness, education & understanding	Communications strategy.	Communications strategy.	Signal	No
Awareness, education & understanding	Engagement with Institutions and Academia	Engagement with Institutions and Academia	Signal	No
Awareness, education & understanding	Ongoing education campaigns	Ongoing education campaigns	Signal	No
Awareness, education & understanding	Public awareness campaign	Public awareness campaign	Signal	No
Awareness, education & understanding	Public consultation	Public consultation	Signal	No
Awareness, education & understanding	Technical training on policy & approach	Technical training on policy & approach	Signal	No
Awareness, education & understanding	Website	Website	Signal	No
Blue-green infrastructure	Runoff reduction	Grip-Blocking	No	No
Blue-green infrastructure	Runoff reduction	Natural flood management	No	No
Blue-green infrastructure	Runoff reduction	Bio-retention systems	Include	Include
Blue-green infrastructure	Runoff reduction	Wetlands	No	No
Blue-green infrastructure	Runoff reduction	Woodland planting	No	No
Blue-green infrastructure	Runoff reduction	Blue roofs	Include	Include
Blue-green infrastructure	Runoff reduction	Channels and rills	Include	Include
Blue-green infrastructure	Runoff reduction	Detention basins	Include	Include
Blue-green infrastructure	Runoff reduction	Filter drains	Include	Include
Blue-green infrastructure	Runoff reduction	Green roofs	Include	Include
Blue-green infrastructure	Runoff reduction	Green wall/screen	Include	Include
Blue-green infrastructure	Runoff reduction	Infiltration basins	Include	Include
Blue-green infrastructure	Runoff reduction	Soakaways	Include	Include
Blue-green infrastructure	Runoff reduction	SuDS ponds	Include	Include
Blue-green infrastructure	Runoff reduction	Swales	Include	Include
Digital	Analytics	Bulk metering and submetering	Include	Include
Digital	Analytics	Smart tariffs	Include	Include
Digital	Monitoring	Smart metering for units	Include	Include
Digital	Analytics	Event triggered maintenance	Signal	No
Digital	Analytics	Loss Monitoring and Leak Detection Systems	No	No
Digital	Analytics	Risk profiling	Signal	No
Digital	Artificial intelligence	Control automation	No	No
Digital	Artificial intelligence	Offsetting / credits	Signal	No
Digital	Artificial intelligence	Smart networks	Signal	No
Digital	Connectivity	Integrated modelling	Signal	No
Digital	Forecasting	Flood warnings	Signal	No
Digital	Forecasting	Pollution warnings	Signal	No
Digital	Monitoring	CSO monitoring	Signal	No
Existing assets	Upgrades and maintenance	Increased inspection and maintenance of drainage infrastructure	Signal	No
Existing assets	Upgrades and maintenance	Increased inspection and maintenance of watercourses	Signal	No

Category	Sub-category	Option	Relevant for RD&BR	Modelled?
Existing assets	Upgrades and maintenance	Proactive Infrastructure Maintenance Strategy	Signal	No
Existing assets	Upgrades and maintenance	Combined flow attenuation	Signal	No
Existing assets	Upgrades and maintenance	CSO redesign, replacement, or closure	Signal	No
Existing assets	Upgrades and maintenance	Increase capacity of sewers	Signal	No
Existing assets	Upgrades and maintenance	Misconnection resolution	Signal	No
Existing assets	Upgrades and maintenance	Pumping station upgrades	Signal	No
Existing assets	Upgrades and maintenance	Storm water pumping upgrades	Signal	No
Existing assets	Upgrades and maintenance	Hydrocarbon separators	Signal	No
Existing assets	Upgrades and maintenance	Trash screens	Signal	No
Existing assets	Upgrades and maintenance	Increase storm water storage capacity	Signal	No
Existing assets	Upgrades and maintenance	STW upgrades	No	No
Existing assets	Upgrades and maintenance	New storm sewers	Signal	No
Existing assets	Upgrades and maintenance	Storm separation	Signal	No
Existing assets	Upgrades and maintenance	Leakage reduction	Include	Include
Hard engineering	Property level defences	Property level defences	Signal	No
Hard engineering	Runoff reduction	Offline/online attenuation	Include	Include
Land management	Overland flow management	Overland flow management	Signal	no
Land management	Runoff reduction	Permeable paving / surfaces	Include	Include
Land management	Runoff reduction	Royal Docks discharge	Include	Include
Water efficiency	Consumer goods	Low flow appliances	Include	Include
Water efficiency	Consumer goods	Low Flow Taps	Include	Include
Water efficiency	Consumer goods	Low flow WC	Include	Include
Water efficiency	Consumer goods	Recycling Showers	No	No
Water efficiency	Developers	HVAC Condensate Recovery	No	No
Water efficiency	Developers	Landscape Water Use - Use of Native Water Resilient Plants	No	No
Water efficiency	Developers	Low flow irrigation systems	No	No
Water efficiency	Developers	Public Spaces - Water Efficient use for Washdown of External Areas	No	No
Water efficiency	Developers	Public Realm - Optimised Water Features	No	No
Water efficiency	Households	TWUL Smarter Homes	Signal	No
Water efficiency	Non-households	Evaporative Cooling Efficiency	No	No
Water efficiency	Non-households	Non-potable water for boat activities	No	No
Water efficiency	Non-households	Recycling Car Wash	No	No
Water efficiency	Non-households	TWUL Businesses visits	Signal	No
Water resource	Alternative resources	Non-potable reuse of blackwater	Include	Include
Water resource	Greywater	Non-potable reuse of greywater	Include	Include
Water resource	Rainwater	Rainwater harvesting from roofs	Include	Include
Water resource	Rainwater	Rainwater harvesting from surfaces	Include	Include
Water resource	Alternative resources	Groundwater from dewatering	Signal	No
Water resource	Alternative resources	Royal Docks abstraction	No	No

Appendix E – Multi Criteria Analysis

E.1 MCA results