Isle of Man Government

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Department of Infrastructure

Draft Manual for Manx SuDS

Technical Guidance for Sustainable Drainage Systems on the Isle of Man

Manual for Manx SuDS: Technical Guidance for Sustainable Drainage Systems on the Isle of Man

Final document for public consultation

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Abbreviations

CIRIA	Construction Industry Research and Information Association
DEFA	Department of Environment, Food and Agriculture
DoI	Department of Infrastructure
FRA	Flood Risk Assessment
mAOD	Metres above Ordnance Datum
SAB	SuDS Approving Body
SuDS	Sustainable Drainage Systems
WFD	Water Framework Directive

1 Introduction

Sustainable Drainage Systems (SuDS) are a sustainable alternative to traditional piped drainage systems, which help to manage flood risk to homes, businesses, roads and services. They control the amount of rainfall and pollutants that flow off paved surfaces and enter the Island's rivers, and eventually the sea. Well-designed SuDS also contribute to our resilience to climate change and provide habitats for native wildlife on the island. They also provide places for communities to meet, play, exercise and enjoy nature.

Surface water drainage should be one of the first aspects considered when assessing whether a site is suitable for development, or when considering works to an existing property. This allows the design of effective drainage strategies, which maximise the benefits of SuDS to people and the environment.

Early engagement and consultation on surface water drainage with the relevant bodies at pre-application stage is also key to reducing the risk of design conflicts and planning objections. This includes the Department of Environment, Food and Agriculture (DEFA), Planning and Building Control Directorate, the Department of Infrastructure (DoI) Flood Management Division and Highway Services, and Manx Utilities.

This document sets out the Isle of Man Government's expectations for SuDS designs on the Island, providing guidance on how to meet the Isle of Man SuDS Design Standards which are set out in the SuDS Planning Policy Statement.

1.1 Purpose of this document

The Manual for Manx SuDS is published by the Isle of Man Government's DoI. The guidance is intended to assist the Government, developers and property owners to deliver SuDS which:

- are appropriate to the island, its geology and hydrology;
- deliver social, environmental and financial benefits;
- aim to meet a range of sustainability and place-making objectives;
- are clearly presented at planning stage, enabling an efficient review and approval process; and
- have clear responsibilities for future maintenance and management.

This guidance is primarily intended for practical use by those looking to undertake development requiring SuDS as defined in the SuDS Planning Policy Statement, as well as designers of surface water drainage systems. However, the guide is also relevant to all those involved in the master-planning, design, approval, construction, and maintenance of new development, and may also assist those considering the incorporation of SuDS within smaller developments.

The Isle of Man Government expects this guidance to be used in the design of SuDS for all relevant types of development. The DoI Flood Management Division, Manx Utilities, DoI

Highway Services, and DEFA Planning and Building Control Directorate will use the new guidance to ensure that surface water drainage is managed appropriately and in accordance with national policy and industry best practice for SuDS, as well as the latest national and local planning policy.

However, this document is not intended as a detailed design guide. The CIRIA SuDS Manual C753 (2015) is recommended for this purpose, and relevant chapters of the manual, and other reference documents are signposted throughout this document.

2 Background to SuDS

2.1 What are SuDS?

SuDS are a way to manage surface water by mimicking the way that rainwater drains in a natural landscape. Traditionally, rain falling on roads, roofs, and pavements has been collected in underground pipes and transferred as quickly as possible to the nearest sewer or river. However, this has contributed to flooding and pollution within rivers.

SuDS aim to **slow the flow** of water, by:

- **Source control** – intercepting rain close to where it falls on roads, roofs and pavements;
- **Re-using water** – collecting rainwater and re-using it in homes and buildings;
- **Allowing water to soak (Infiltration)** – allowing rain to soak into the ground;
- **Moving water (Conveyance)** – moving water along the ground surface; and
- **Storing water (Attenuation)** – storing water on the surface or below ground.

There are a wide range of SuDS components that either reuse water, allow water to soak into the ground, move water, or store water. A SuDS system has several interconnected components, which form part of a management train. The management train should begin with managing rainwater as close to where it falls as possible ('source control').

2.2 What are the benefits of using SuDS?

The primary benefits of SuDS are often seen as managing water quantity and quality. SuDS techniques help to manage flooding during storms and also naturally filter pollution (such as silt and petrol/diesel), preventing it from entering rivers and the sea.

However, well-designed SuDS provide a host of social, environmental and financial benefits for residents and developers. They create spaces for wildlife and places for people to enjoy and make developments more resilient to climate change.

The benefits of SuDS design are summarised within the CIRIA SuDS Manual as the ‘four pillars of SuDS’, and involve management of:

- Water quantity;
- Water quality;
- Amenity; and
- Biodiversity.

There are many benefits for developers in integrating well-designed SuDS, to help meet several requirements for a site, as set out below.

- Ensure Isle of Man planning policy requirements are met.
- Use multi-functional SuDS features to meet several planning policy requirements at once (e.g. biodiversity, amenity, green infrastructure, flood risk, drainage).
- Avoid delays in the planning process and reduce risk of drainage systems needing re-design at a late stage.
- Reduce flood risk and damage to property both on-site and off-site.
- Contribute to providing habitats and providing **Biodiversity Net Gain** for new developments.
- **Improve water quality** in environmentally designated sites (Ramsar, Special Areas of Conservation (SAC), Area of Special Scientific Interest (ASSI)).
- Reduce drinking water and garden watering demand (through **water-re-use**).
- Reduce costs as well-designed SuDS are cheaper and easier to maintain than 'traditional drainage'. **Management costs can be saved**, as maintenance can be carried out as part of standard landscape contracts.
- Provide green spaces, which benefit the **health** and **wellbeing** of communities.
- Contribute to making developments attractive places to live.

2.3 Why are SuDS a requirement on the Isle of Man?

The Isle of Man faces the dual risks of water scarcity in drier months, and excess water resulting in flooding to most settlements. SuDS provide an opportunity to manage existing flood risk on the Island, by controlling the rate and volume of surface water leaving a developed site and slowing the flow of water entering watercourses in downstream communities. Harvesting rainfall within SuDS for re-use in homes and gardens, or allowing it to infiltrate into the ground, also provides an opportunity to manage water resources in drier months.

Above-ground, vegetated SuDS provide opportunities to create habitats that support native species on the Island and enhance existing designations and protected sites of national and international importance. More information on the policy context for SuDS and when they are required is available in the SuDS Planning Policy Statement.

3 Characteristics of the Isle of Man

3.1 Location

The Isle of Man is located in the central part of the Irish Sea, equidistantly between Ireland and Britain. It spans 572 km^2 in area, with a coastline covering over 160km.

There are four distinct areas of the island (as defined in the 2016 Strategic Plan), based on a principal town. These are:

- Douglas and the East;
- Ramsey and the North;
- Peel and West; and
- The South.

Over half of the Island's population is concentrated on the eastern side of the Island, either along the coast, or along the valley between Douglas and Peel.

This section sets out the characteristics of the Isle of Man, and how this may present opportunities and constraints for SuDS.

3.2 Topography

The Isle of Man has a varied and distinctive landscape. A mountain range extends from south west to north east through the centre of the Island, and includes the highest point on the Island, Snaefell (621 metres above sea level). The mountain range is split by a central valley, which extends from Douglas to Peel, with wide rolling plains located in the north and south of the island. A map of the Island topography can be found in Appendix B.1.

3.3 Geology and soils

The geology of the Island is dominated by the Manx Group Slate geology, which forms the central hills of the Island. Sandstone and conglomerate forms the eastern coastline, extending to the south west point at Port Erin and Port St Mary, and forms a narrow band to the north of Ramsey, as well as to the north of Peel, and on St. Michael's Island. An area of limestone bedrock is located in the south of the Island, between Castletown and Derbyhaven. Small pockets of Felsic rock are located in the south and north east of the Island, and a band of Sandstone/Limestone is located in the south, around Ballasalla. A map of the bedrock geology on the Island can be found in Appendix B.2.

The majority of the centre and east of the Island is overlain by a surface geology of glacial till, which can have varying permeability. A band of clay, silt and sand is located in the mountain valley between Peel and Douglas, as well as in the north of the Island, around Dhoor and The Curraghs. Sands and gravels dominate the northern portion of the island, from Ramsey to The Ayres, as well as the western coastline around Peel, and the southern coastline. A map of the surface geology on the Island can be found in Appendix B.3.

There are five soil types on the Island, shown in Appendix B.4:

- Slate, flagstones and shales – the predominant soil type;
- Limestone – concentrated in the south of the Island;
- Peel Limestone and Neb gravels – to the north and east of Peel;
- Glacial deposits – in the north of the Island, from Ramsey to The Ayres; and
- Peat deposits – in the mountain valley between Peel and Douglas, as well as in the north of the island.

The variable bedrock and surface geology highlight the importance of undertaking site-specific ground investigations and infiltration testing to determine conditions on site and inform SuDS designs.

3.4 Coastal geomorphology

The coastline of the Isle of Man is very varied, with steep rocky cliff faces on the north east coast, and high sandy cliffs in the north west. However, the coastline is also fragile and sensitive to change, and climate change is expected to impact the Island's coastline. The coastline close to Kirk Michael is an area of particular focus, and there is a proposed Coastline Management Zone for the area. Groundwater can have a significant influence on ground stability within known areas of potential instability and landslide risk. Therefore, SuDS features which encourage infiltration into the ground are unlikely to be acceptable within Coastal Management Zones.

With the exception of urban areas along the coast, the rest of the coastal landscape is highlighted in planning policy as being important for landscape and nature conservation reasons and contains some ASSIs.

3.5 Flood risk

There is a history of wave overtopping and tidal flooding on the Isle of Man, for example in Coastal Ramsey, Douglas Bay, and Castletown. The river catchments on the Island are short in length and relatively steep, so fluvial flooding tends to be flashy and short-lived. Surface water flooding is also a key risk in urban areas, including Douglas Bay, Peel, Laxey, and Port Erin.

Notable recent flood events occurred in early 2014 and early December 2015. In 2014, coastal flooding affected the Island's towns, including Castletown, Douglas, Laxey, Ramsey, Peel, Port St Mary and Gansey. In early December 2015 fluvial and surface water flooding affected many areas of the Island, including Douglas, Laxey, Colby, St Mark's, Glen Vine, Port Erin, Crosby, Union Mills, Kirk Michael and Ramsey. The event also highlighted the risk of landslides on the island and the potential impact on infrastructure routes.

SuDS provide an opportunity to manage existing flood risk, by controlling the rate and volume of surface water leaving a site and slowing the flow of water entering watercourses in downstream communities.

3.6 Hydrogeology and water resources

Much of the Island is underlain by geology with limited permeability, and although there are substantial Limestone deposits, these are not well bedded enough to allow aquifers to form, and, therefore, there are few deep groundwater resources. Instead, surface water resources are used to meet water demand, through a system of dams and reservoirs.

Although current water resources are deemed capable of meeting present supply demand, the Isle of Man Climate Change Scoping Study identified that annual effective runoff is expected to be reduced in low-lying areas in the north and south of the island. In addition, increases in evaporation are expected to impact water levels in reservoirs. However, winter runoff is predicted to increase across the Island, with the greatest increase expected in the central uplands.

SuDS provide an opportunity to manage surface water resources, through harvesting rainfall for re-use in homes and gardens, and by encouraging rainwater to drain into the ground, recharging rivers.

3.7 Habitat and biodiversity

The Isle of Man has both nationally and internationally important wildlife species and habitats, including important marine habitats. The Island currently has the following designations and protected areas:

- Areas of Special Scientific Interest;
- Nature Reserves under the ownership and/or management of the Manx Wildlife Trust;
- Areas of Special Protection for Birds and Bird Sanctuaries;
- Areas of ecological importance or interest afforded protection under the Area Plans and the 1982 Order;
- One RAMSAR site - Ballaugh Curragh; and
- Over 2000 acres of National Trust Land designated under the Manx Museum and National Trust Act 1959.

The Ayres at the northern point of the Island has been designated a National Nature Reserve, as well as an Area of Special Scientific Interest. The locations of these sites can be viewed on the Island Environment maps.

Above-ground, vegetated SuDS provide opportunities to create habitats that support native species on the Island and enhance existing designations and protected sites.

4 Isle of Man SuDS Design Guidance

4.1 Background

The Isle of Man SuDS Design Standards set out the requirements for surface water drainage strategies and SuDS designs submitted within planning applications. The standards are underpinned by the following series of principles for SuDS on the Isle of Man:

- Characteristics of the Island;
- Managing flood risk;
- Achieving the 'four pillars of SuDS' (water quantity, water quality, biodiversity and amenity);
- Managing water resources; and
- Climate change adaptation.

The sections below provide guidance on SuDS Design to meet the Isle of Man Design Standards and Principles.

The SuDS Principles and Design Standards for the Isle of Man are set out in the SuDS Planning Policy Statement.

4.2 Design guidance for specific SuDS components

Table 4-1 provides links to detailed design standards for specific SuDS and drainage components. These include the relevant sections of the CIRIA SuDS Manual, Manx Sewers for Adoption, and other guidance documents.

Where SuDS and drainage components are proposed to be submitted for adoption, see specific guidance on design requirements from Manx Utilities (Manx Sewers for Adoption) or DoI Highways (Manual for Manx Roads).

Table 4-1: Relevant detailed design standards for SuDS and drainage components

Drainage Component	Description	Relevant detailed design standards
Rainwater harvesting	Systems that collect runoff from roofs or other impermeable surfaces and make it available for non-potable use.	CIRIA SuDS Manual (C753) Chapter 11
Water butts	Barrel connected to a roof downpipe, used to collect and store rainwater. Attenuation provided by water butts is not taken into account when calculating the storage volume for the site.	CIRIA SuDS Manual (C753) Chapter 11
Green roofs	Planted soil layer on the roof of a building. Water is intercepted, stored in soil and absorbed by	CIRIA SuDS Manual (C753) Chapter 12

Drainage Component	Description	Relevant detailed design standards
	plants. Ideal for storing the 'interception' or 'everyday event' (first 5mm rainfall). Maintenance requirements must be considered.	CIRIA Building Greener (C644D): Guidance on the use of green roofs, green walls and complementary features on buildings
Soakaways	A below ground structure into which surface water is conveyed and infiltrated into the ground. May be concrete structures with holes or modular crate units. Source control with minimal land take but provides no nature-based benefits.	CIRIA SuDS Manual (C753) Chapter 13 BRE Digest 365 Soakaway Design
Filter drains	Shallow trenches filled with stone/gravel, which temporarily store runoff below the ground surface. Provide attenuation, conveyance and treatment by filtration.	CIRIA SuDS Manual (C753) Chapter 16
Filter strips	Vegetated strips of land which treat runoff by filtering and allowing settlement of pollutants.	CIRIA SuDS Manual (C753) Chapter 15
Permeable surfacing	Runoff is allowed to soak through roads and parking areas, either through gaps between the paving blocks or through porous blocks. Water can be stored in the gravel sub-base and infiltrated where ground conditions allow. Permeable surfacing may not be adoptable by DoI Highways Services, and consultation will be required to confirm this.	CIRIA SuDS Manual (C753) Chapter 20 BS 7533-13:2009 Pavements constructed with clay, natural stone or concrete pavers
Swales	Vegetated channel with shallow side slopes used to convey and store runoff and provide treatment by filtration.	CIRIA SuDS Manual (C753) Chapter 17
Detention basins	Landscaped depression with an outlet that restricts flows, designed to fill during a rainfall event. Usually dry between events. Should be used in	CIRIA SuDS Manual (C753) Chapter 22

Drainage Component	Description	Relevant detailed design standards
	combination with source control methods to allow sufficient water treatment.	
Infiltration basins	Vegetated depression to collect and store runoff, allowing it to infiltrate into the ground.	CIRIA SuDS Manual (C753) Chapter 13
Bioretention systems	Landscaped depressions which allow runoff to pond temporarily on the surface, filtering it through vegetation and engineered soils, to allow storage and pollutant removal.	CIRIA SuDS Manual (C753) Chapter 18
Silt removal devices	Remove silt, sediment and debris from surface water runoff prior to runoff reaching downstream SuDS components. Appropriate design can result in reduced maintenance requirements.	CIRIA SuDS Manual (C753) Chapter 26 British Water How To Guide: Applying the CIRIA SuDS Manual (C753) Simple Index Approach to Proprietary/Manufactured Stormwater Treatment Devices
Ponds	Permanent water bodies used to provide attenuation and treatment of runoff.	CIRIA SuDS Manual (C753) Chapter 22
Wetlands	Similar to ponds, provide both storage and treatment, but on a larger scale. Wetland vegetation helps to enhance treatment and increase biodiversity.	CIRIA SuDS Manual (C753) Chapter 23
Geocellular / modular storage	Systems that allow below ground storage, conveyance and infiltration. Maintenance requirements must be considered.	CIRIA SuDS Manual (C753) Chapter 21
Inlets and outlets	Provide hydraulic control and an opportunity to reduce maintenance requirements. Includes vortex controls, orifice controls and weirs.	CIRIA SuDS Manual (C753) Chapter 28 British Water How To Guide: Applying the CIRIA SuDS Manual (C753) Simple Index Approach to Proprietary/Manufactured

Drainage Component	Description	Relevant detailed design standards
		Stormwater Treatment Devices
Separators / Interceptors	Used to prevent hazardous chemical and petroleum products entering water bodies or drainage systems. Maintenance requirements must be considered.	CIRIA SuDS Manual (C753) Chapter 14 British Water How To Guide: Applying the CIRIA SuDS Manual (C753) Simple Index Approach to Proprietary/Manufactured Stormwater Treatment Devices BS EN 858-1:2002 Separator systems for light liquids
Pipes, subsurface drainage and storage	Oversized pipes and drainage features used to provide below ground attenuation.	Manx Sewers for Adoption 2003
Conventional drainage	Traditional pipe and manhole drainage system.	Manx Sewers for Adoption 2003
Pumping stations	Generally not accepted for use in surface water drainage systems. Can only be used where there is no other practicable method of surface water drainage, and it must be demonstrated how the risk of pump failure will be mitigated.	CIRIA SuDS Manual (C753) Chapter 24 Manx Sewers for Adoption 2003

4.3 Overcoming challenges in designing SuDS on the Isle of Man

SuDS can be implemented on any development site. Certain site conditions may require adjustments to design, or the type of components used, but even the most challenging sites should integrate SuDS in some form. Development proposals will be regarded favourably for maximising benefits and including multi-use features, rather than focussing on water quantity alone. Previously developed, or 'brownfield' sites, provide an opportunity to significantly improve the amenity and biodiversity value of the land, and its resilience to climate change, through the use of SuDS.

Section 3 provided a background to the characteristics of the Island, and how these may influence SuDS design, with supporting maps provided in Appendix B. Appendix A provides guidance on the most commonly raised site constraints and how they can be overcome with good planning and design.

Appendix C contains an Urban Drainage Suitability Tool designed to help identify the most appropriate type of SuDS based on their suitability in meeting each of the 'four pillars of SuDS'.

4.4 Retrofitting SuDS

As well as being delivered through new development, SuDS can also be incorporated into existing urban developments via a process known as 'retrofitting'.

Where drainage and sewer networks have capacity restrictions, SuDS can be used to disconnect the existing drainage system, direct it into a watercourse, or allow it to infiltrate into the ground.

This can be achieved at a range of scales, for example, rainfall from the downpipe of a house can be diverted into a green roof or raingarden, rather than the sewer system. During redevelopment of a town centre, runoff from pavements and roads can be drained into swales or permeable paving, rather than into the highway drainage network.

Retrofitting SuDS provides an opportunity not only to remove rainfall from the sewer network, but also to remove concrete and hard surfaces. This helps to create green spaces and to make public spaces in towns and cities better places for people and wildlife to live.

Opportunities to retrofit SuDS are most likely to be realised when they are considered early in any redevelopment or renovation plans. This may require close co-operation between developers, planners, and risk management authorities.

When planning redevelopment or refurbishment, which will not significantly change a site layout, consider opportunities to:

- remove existing surface water connections from foul or combined sewers - this can also enable capacity within the foul or combined sewers to allow additional foul flows;
- replace old, impermeable paved surfaces with permeable paving surfaces or connect them to new filter drains or bio-retention areas as part of re-landscaping; and

- use features such as permeable paving and raingardens to provide off-street parking, where front gardens are being converted for parking, without causing additional runoff onto the road.

4.5 Other legislation and policies which SuDS can help meet

As well as meeting planning requirements for the management of surface water in new developments, SuDS can help to meet the following Isle of Man legislation and policies:

- Building Control Act 1991 (gov.im)
- Building Regulations 2014 Schedule 1, Part H (gov.im)
- Climate Change Act 2021 (gov.im)
- Isle of Man Climate Change Plan 2022 - 2027 (tynwald.org.im)
- Coastline Management Act 2005 (gov.im)
- Flood Risk Management Act 2013 (gov.im)
- Highway Act 1986 (gov.im)
- The Isle of Man's First Biodiversity Strategy 2015 - 2025 (gov.im)

5 SuDS design process

5.1 Introduction

Considering surface water management within the site design from the outset of the planning process is key to the successful design and delivery of SuDS.

This section sets out the stages of the SuDS design process for a development site, as follows (and summarised in Figure 5-1):

1. Set design objectives for surface water management;
2. Concept design;
3. Outline design; and
4. Detailed design.

Detailed, step-by-step guidance on the SuDS design process is available in the CIRIA SuDS Manual (C753) (Section 7).

5.2 Set design objectives for surface water management

First, the objectives for managing surface water within the development site should be established. Addressing surface water management at an early stage allows it to be linked to the development objectives for the site, which ensures that it is considered throughout the site design process. It also maximises the opportunities for multi-functional SuDS, which are an effective way to meet multiple planning requirements for a site. These opportunities are limited when surface water management is incorporated at a late stage in site design.

Site-specific objectives should be set in line with Isle of Man policy requirements, as set out in the Strategic Plan, the Isle of Man SuDS Design Standards, as well as environmental assessments for the site, including the Flood Risk Assessment. Objectives may include (but are not limited to):

- managing flood risk;
- managing pollutants in runoff, and improving the water quality of receiving water bodies;
- providing amenity value to existing and new communities;
- re-using water, to improve water security;
- meeting climate change resilience needs; and
- habitat and biodiversity requirements (including biodiversity net gain).

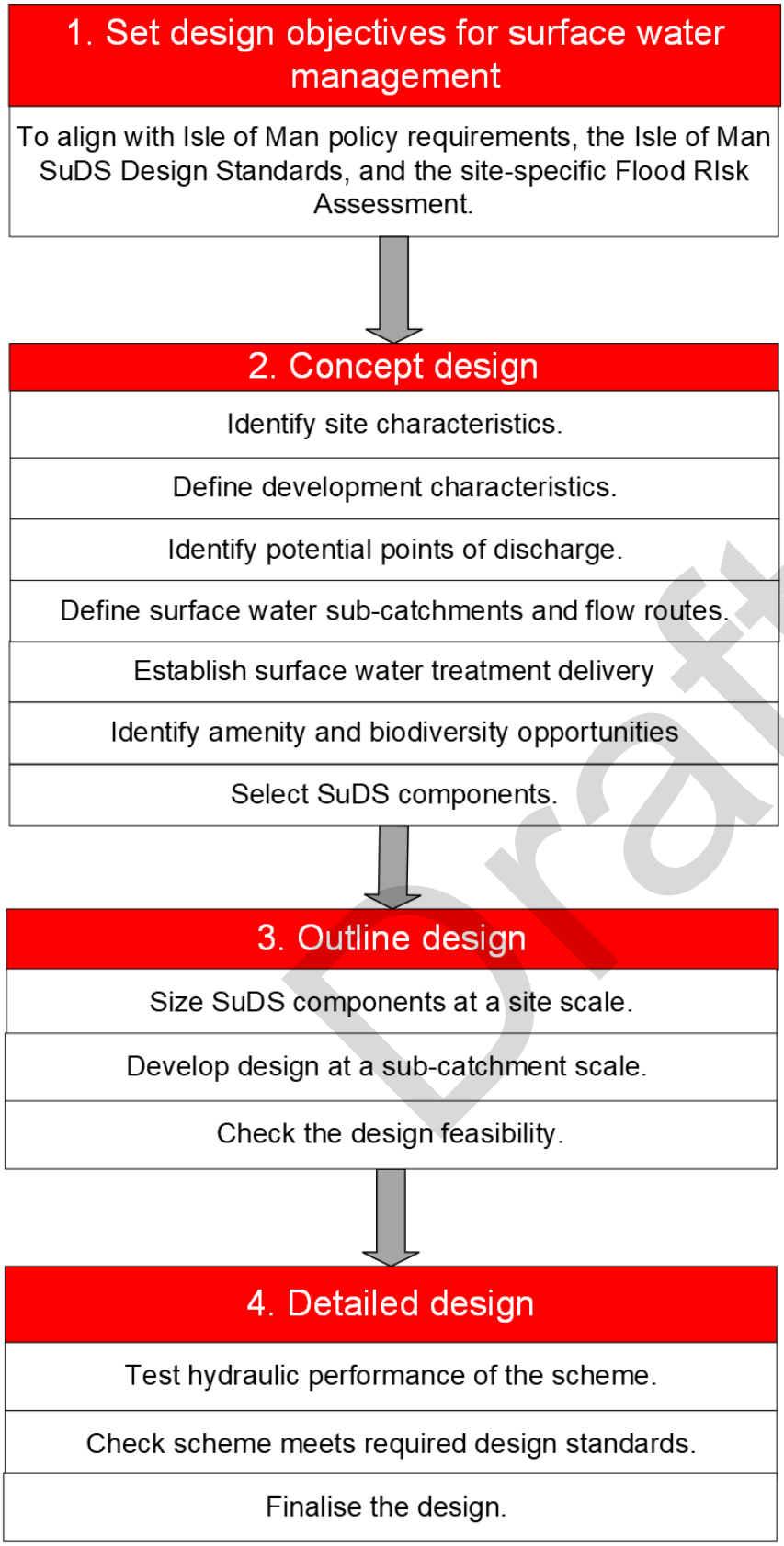


Figure 5-1: Overview of SuDS design process

5.3 Concept design

The surface water management objectives inform the concept design of SuDS for the site. The aim of the concept design is to assess the opportunities and constraints for SuDS, and to identify potential SuDS components, as well as their linkage across the site, to provide the required storage and treatment of surface water. For larger sites, a masterplan may be prepared, to inform future land use and development.

The function and land-take associated with SuDS needs to be considered from the outset, to avoid designers having to retrofit SuDS into constrained spaces within a fixed development layout. Considering SuDS at this stage also maximises their financial benefits, such as cheaper drainage construction costs and a potentially more desirable development. Seeking advice from DEFA Planning and Building Control Directorate, DoI Flood Management Division, Manx Utilities and DoI Highways early in the concept design process will help to avoid costly issues or redesigns at a later stage.

Detailed guidance on the concept design and Masterplanning process for SuDS is available in the CIRIA SuDS Manual (C753) (Section 7) and Water. People. Places (AECOM, 2013)

As part of the concept design / Masterplanning stage:

- Identify site characteristics and current drainage arrangements
  - This includes topography, geology and soils, existing watercourses and drainage networks, infiltration potential, flood risk, and local habitats.
  - The assessment may need to be informed by site-specific ground investigations, such as topographic surveys, infiltration testing and ground investigations. The DoI indicative surface water flood risk maps can help to identify existing surface water flow paths within the site.
  - Infiltration testing should be carried out at an early stage in the process so that the potential for soakaway based SuDS, or not, can be determined.
- Define development characteristics
- Identify potential points of discharge locations
  - The choice of appropriate discharge locations for the proposed drainage system should align with the discharge hierarchy set out in the Isle of Man SuDS Standards, first considering water re-use and infiltration.
- Define surface water sub-catchments, flow routes and storage
  - Defining sub-catchments within the site, based on flow routes and development areas within the site, helps to identify smaller areas of the site within which to manage surface water runoff.
  - Within each sub-catchment, locations for conveying and storing water can be identified, keeping water at or near the surface, where possible.
- Establish surface water treatment delivery
  - Identify the pollution hazards associated with the different land use areas proposed within the site, and the level of surface water treatment required for

these land uses. Guidance can be found in Chapter 26 of the CIRIA SuDS Manual (C753).

- Identify amenity and biodiversity opportunities
  - In consultation with the Ecologist for the development, understand the existing site and local habitats, and how SuDS components can support or create these habitats.
  - Identify areas of green space or proposed public open space, where SuDS can be incorporated to enhance the amenity value of the site.
- Select SuDS components
  - SuDS components should be selected to intercept, convey, store and treat surface water runoff generated within each sub-catchment.
  - See Table 7.1 of the CIRIA SuDS Manual (C753) for a summary of the different types of SuDS components, and their relative merits for managing water quantity, water quality, amenity and biodiversity.

5.4 Outline design

The outline SuDS design should be developed alongside the agreed layout of the development. It involves optimising the concept design, including calculating runoff rates and volumes from the site, sizing SuDS components, and confirming any assumptions made at concept stage.

As part of the outline design, the following aspects should be considered:

- Size SuDS components at a site scale
  - Calculate surface water runoff rates and volumes for the site in its pre-development and post-development states. Estimate the allowable peak discharge rates and volumes to which runoff from the development site will need to be controlled (see the Isle of Man SuDS Design Standards in Section 2.2. of the SuDS Planning Policy Statement for guidance), and the volume of surface water to be attenuated on site to meet these requirements.
  - Determine the infiltration potential of the site. Site-specific infiltration testing (to BRE365 Digest methodology) is likely to be required to confirm the capacity, where infiltration is proposed.
- Develop the design at a sub-catchment scale
  - Distribute attenuation storage between sub-catchments and size SuDS components accordingly.
  - Determine how flow will be controlled at a sub-catchment scale, before leaving the site.
- Check the design feasibility.
  - Consider exceedance of SuDS components and how exceedance flows can be safely managed within the site.
  - Establish the proposed route of adoption for the SuDS network. Evaluate the requirements of the approving body for the drainage system (to be discussed

with Manx Utilities and DoI Highways, where SuDS adoption is feasible), and align the SuDS design to these requirements.

5.5 Detailed design

The detailed design stage should refine the SuDS design in line with the final development layout. It will be submitted for planning approval and should provide the Planning Authority, DoI Flood Management Division, and the adopting authority, with a full understanding of how the scheme will operate. Section 6.3 outlines the detailed design documentation which is expected to be submitted to support a planning application.

Once approved, the detailed design will also be submitted to contractors and the adopting authority for costing and construction, as well as future adoption and maintenance.

Where the outline design stage is omitted, the considerations outlined in Section 5.4 should be undertaken as part of the detailed design.

- Test the hydraulic performance of the scheme.
  - The testing should identify the worst case condition for each component of the system for all design return periods. This may involve using hydraulic design software.
  - Evaluate and design exceedance routes and ensure that people and property on the site remain safe.
- Check that the scheme meets the surface water management objectives and the Isle of Man SuDS Design Standards.
- Finalise the design.
  - Refine the sizing of SuDS components and flow control arrangements.
  - Produce a construction method statement and maintenance plan.
  - Provide specifications for materials used in the design and construction of the drainage scheme, in line with the requirements of the adopting authority.

6 Planning approval

6.1 Introduction

As part of a planning application, applicants are expected to provide a surface water drainage strategy which evidences the approach to managing surface water drainage on the site using SuDS. It should also evidence how the proposed SuDS design meets each of the Isle of Man SuDS Design Standards, in managing flood risk and delivering wider benefits (water quality, biodiversity and amenity).

Where SuDS are required for the development types set out in Section 3.2 of the SuDS Planning Policy Statement all surface water drainage details must be resolved prior to submitting a planning application. It must not be assumed that SuDS can be dealt with as a condition or reserved matter.

Figure 6-1 outlines the responsibilities of the key groups involved in the delivery of SuDS, from inception to implementation.

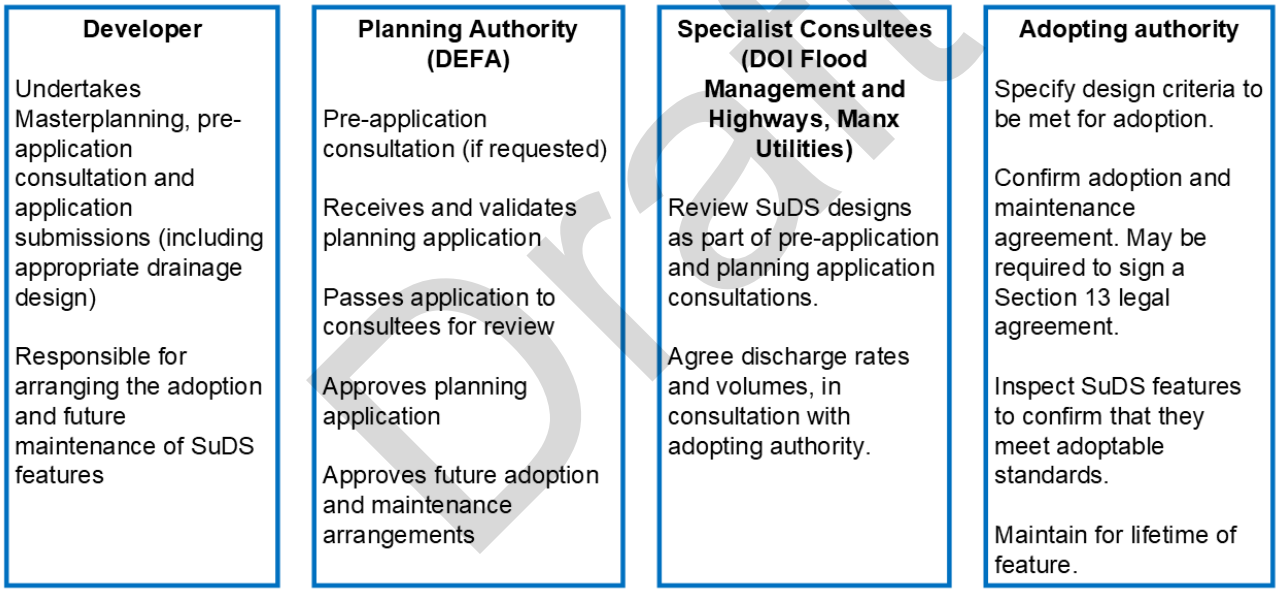


Figure 6-1: Responsibilities of organisations in the delivery of SuDS

6.2 Assessment of SuDS within a planning application

Figure 6-2 provides an overview of the SuDS review and approval process within the planning system. Full details on the planning application process are available on the Isle of Man Government website.

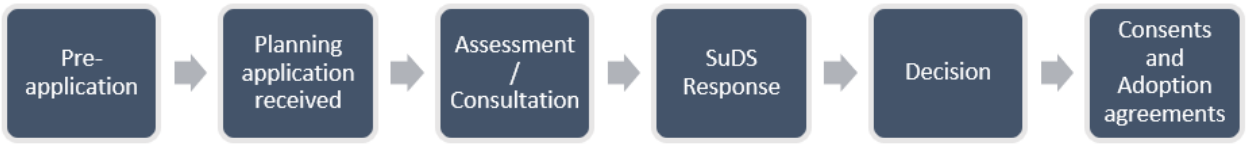


Figure 6-2: Process of SuDS review and approval in the planning system

6.2.1 Pre-application

Applicants are encouraged to discuss SuDS details as early as possible, preferably as part of pre-application discussions, including with key consultees - DEFA Planning and Building Control Directorate, DoI Flood Management Division and Highway Services, and Manx Utilities. Table 6-1 identifies the specialist consultees to be consulted on SuDS within the planning process.

Early discussions will ensure that expectations for surface water management, climate change allowances, adoption and maintenance are clearly understood at the outset. This will minimise the risk of delays and objections arising during the planning approval process.

6.2.2 Planning application received

Sufficient information must be submitted with a planning application to demonstrate that the Isle of Man SuDS Design Standards have been met. A suitable assessment of flood risk also needs to be submitted, in accordance with the requirements of the Flood Risk Planning Policy Statement. This will normally comprise at least an outline design and, depending on the nature of the scheme, may require the detailed design.

6.2.3 Assessment / Consultation

DEFA Planning and Building Control Directorate will consult DoI Flood Management Division on the planning application, to gain advice on surface water drainage proposals for the site. DoI Flood Management Division may in turn consult DoI Highway Services and Manx Utilities

Before assessing the submitted application, the DoI Flood Management Division will determine whether sufficient information has been provided by the applicant to fully consider the impact of the proposal on flood risk within and beyond the site. Failure to provide the required level of detail may result in an objection being raised to the planning application.

The application will be reviewed against the Isle of Man SuDS Design Standards, as well as the Manx Utilities and/or DoI Highway Services design requirements, where these organisations are proposed as an adopting authority for the site drainage.

6.2.4 SuDS response

Once the planning application has been reviewed, DoI Flood Management Division (in consultation with DoI Highway Services and Manx Utilities) will provide a SuDS recommendation to DEFA Planning and Building Control Directorate, taking one of the following forms:

- no interests;
- no objection to the planning application;
- no objection to the planning application, but requesting conditions that should be attached to any planning permission; and
- objection to the planning application.

Table 6-1: Consultees for planning applications

Organisation	Role	When to consult	How to consult
Isle of Man Government - DEFA (Planning)	Planning Authority	On planning applications for all types of development.	Details on how to apply for pre-application advice or planning permission can be found within the Pre-application Advice Service guide.
Isle of Man Government - Department of Infrastructure (Flood Management Division)	Flood Risk Management Authority Land Drainage Authority	Consult on SuDS design and flood risk within development proposals. On surface water drainage proposals for full planning applications. Discharge of surface water to certain Main Rivers, which are the responsibility of the Drainage Division.	The Flood Management Division welcomes early discussions with developers around surface water drainage and flood risk relating to major developments. Please contact iomfloodhub@gov.im to arrange this.
Manx Utilities	Sewerage undertaker Flood Management Authority for sewerage	Early consultation with Manx Utilities and the Planning Authority will be required before developing the site layout or masterplan (plan showing the general layout of key elements on the site). To ensure a viable drainage strategy, Manx Utilities must be contacted before submitting a planning application. This will allow agreement of	Contact Manx Utilities at developers@manxutilities.im

Organisation	Role	When to consult	How to consult
		any connections and discharge rates into the public sewer network, as well as adoptable SuDS design standards.	
Isle of Man Government - Department of Infrastructure (Highway Services)	Highways Authority	Consult if SuDS will impact on adopted public highways or if discharge of surface water to highway drainage is proposed. Statutory consultee engaged where a development proposal has an impact on the highway network.	Contact the Highways and Asset Management Team at highwaysdevelopmentcontrol@gov.im

6.2.5 Decision

The approval of SuDS within a planning application will be determined by DEFA Planning and Building Control Directorate, who will base their decision on the material planning considerations relevant in each case, taking into account the recommendations made by the DoI Flood Management Division and Highways Services, Manx Utilities, and other consultees. Approval may be dependent on a series of planning conditions, which may need to be discharged prior to commencement of development.

Where a Section 13 legal agreement is required, this must be signed before the decision notice is issued. The legal agreement may relate to commuted sums for the provision/maintenance of SuDS. The Operational Policy on Section 13 Agreements provides details of when agreements may be required.

6.3 Surface water drainage strategy requirements for planning application submission

Where SuDS are required for the development types set out in Section 3.2 of the SuDS Planning Policy Statement a detailed drainage strategy must be submitted with a planning application. It must meet the Isle of Man SuDS Design Standards, and will require the following **minimum** information:

Drawings (with north arrow and scale identified), including:

- site location plan;
- site layout plan, specifying the proposed development area;
- site plan showing existing surface water flow routes, land drains, highway drainage systems, sewers and watercourses;
- site plan showing exceedance flow routes in relation to proposed layout and drainage systems, in the event that SuDS features are blocked, or the design capacity is exceeded;
- detailed site layout of the proposed drainage system with sub-catchment areas;
- detailed design drawings and construction details, to include details of inlets, outlets and flow controls; and
- long and cross section drawings for the proposed drainage system, including design levels.

Survey, including:

- topographical survey of the catchments draining the site, to include existing drains, sewers and watercourses (levels to be taken in relation to Douglas02 Datum);
- ground investigations, (including groundwater and contamination), and infiltration tests, where infiltration is proposed; and
- surveys of any existing drainage systems or water bodies to which the SuDS may discharge.

Assessments, including:

- an assessment of flood risk;
- details of the existing site layout, drainage system and catchment areas;
- details of the existing geology and hydrogeology;
- details of SuDS proposals;
- information to support the chosen runoff destination and reasons why any destinations of higher priority have not been proposed;
- locations of existing and proposed outfalls;
- pre-development rates and volumes of surface water runoff discharged from the site;
- proposed (post-development) rates and volumes of surface water runoff discharged from the site;
- on-site surface water attenuation (storage) requirements, and evidence of how the storage will be provided;
- design calculations demonstrating how the SuDS system will function;
- full design calculations and design parameters; and
- any requirements for temporary drainage features or discharge points during construction.

Plans, including:

- details of who is to be responsible for the long term maintenance of the drainage system, including adoption arrangements; and
- in the event that areas of open water and confined space entry are proposed, a Health and Safety plan considering these elements.

The following plans may also be required for some drainage schemes at the planning application stage or may be conditioned as part of the approval process:

- A Construction Method Statement for the drainage system (see Section 7.1 for further details).
    - To include suitable construction details and details of connections (including flow control devices) to watercourses, sewers, public surface water sewers, highway drains and drainage systems. Landscape planting scheme, if proposing vegetated drainage system.
- A Maintenance and Operation Plan setting out how to maintain the full drainage system following construction (see Section 7.4 for further details).
- A Landscape planting scheme, if proposing vegetated drainage systems.

6.4 Other consents required

Surface water drainage systems may require a series of other consents, which are separate to the planning process, and should be considered at an early stage. The requirement for consent from the relevant authority applies even if planning approval has been granted.

Consents are required:

- Where discharge into a watercourse, water body or sewer is proposed.
- Before piping/culverting or obstructing a watercourse, whether permanent or temporary.
- If as part of the construction of development, works are planned near to any watercourse.
- For repairs to certain existing structures and maintenance works.

The following sections set out potential consents that may be required from the Flood Management Division, Manx Utilities, and the Building Control authorities.

6.4.1 Works to watercourses

The Flood Risk Management Act 2013 sets out that consent must be sought from the DoI Flood Management Division for works that may affect any watercourse. Further details can be found on the Isle of Man Government website (IoM FloodHub), and include:

- development will not normally be allowed within 9 metres of any watercourse to protect the aquatic and bankside habitat and species;
- in addition to requiring planning approval, any works likely to impact on a watercourse (e.g. bank repairs, erection of structures such as bridges, culverts) also require the consent of the **Flood Management Division**; and
- if the watercourse is a designated watercourse under the Flood Risk Management Act 2013, consent is required before planting of trees and shrubs or erection of any structure within 9.1m of either bank.

6.4.2 Connection/diversion of a sewer

Early engagement with Manx Utilities is recommended, before submission of a planning application, where new connections or diversion of public sewers is proposed.

For new connections into the public sewer network, written consent must be obtained from Manx Utilities, under Section 4 of the Sewerage Act 1999. New connections should be made to Manx Utility standards, and works will be inspected to ensure this. An application for connection to a public sewer must be submitted, with guidance available on the Manx Utilities website.

No diversion can be carried out on a public sewer without written agreement from Manx Utilities. An application for diversion of a public sewer must be submitted, with guidance available on the Manx Utilities website. An adoption agreement will also be required with Manx Utilities, under Section 8 of the Sewerage Act 1999.

6.4.3 Building Control

In addition to development plans being reviewed as part of a planning application, plans will need to be submitted to Building Control, to confirm that they are appropriate and meet regulations (Building Regulations 2014 Schedule 1, Part H for surface water drainage).

Building regulations approval is a separate process to planning approval. Works will be inspected by Building Control at key construction stages, as well as on completion of construction, upon which a completion certificate will be issued, if the development meets regulation requirements. There are three Building Control authorities on the Isle of Man: Douglas, Onchan and for all other settlements, DEFA.

7 Implementation

7.1 Construction

Construction of SuDS requires care and a contractor with a good understanding of their purpose and function. This is particularly important for the phasing of SuDS within the multiple stages of construction typical of larger development sites.

Surface water runoff and pollution must be managed during the construction phase, to avoid a detrimental impact on flood risk and water quality downstream. Before construction of SuDS can take place, full details are needed of the site conditions and the design details of each component. This must include how the construction of SuDS fits into wider construction works on the site.

A Construction Method Statement must be prepared and approved at planning application stage, before SuDS construction works can commence. It should contain the following:

- Who will be responsible for construction.
- How and when SuDS will be built, in relation to the overall site construction programme, including phasing of development.
- Evidence that works will be completed early in the process, and a proposed strategy for sediment control and site drainage during construction.
- If not possible, evidence must be provided that sufficient remediation of SuDS features will take place after construction.
- Consideration of ecological and water quality impacts.
- Emphasis of the differences between traditional construction activities.
- Constraints on site works and how other works will be co-ordinated with SuDS.
- A clear process of as-built SuDS inspections and sign off.

The CIRIA C768 Guidance on the construction of SuDS should be consulted in the design and construction of all SuDS on the Isle of Man.

7.2 Inspection of works

The developer, or their appointed representative, is responsible for the day-to-day supervision of the agreed works.

Where SuDS schemes are proposed to be submitted for adoption by Manx Utilities or DoI Highways, inspections will be carried out by representatives from the relevant adopting organisation as work progresses, to check that the works are being constructed in accordance with the agreed drawings and adoption requirements.

If problems arise with the proposed works, the representatives from Manx Utilities or DoI Highways may discuss possible solutions, but it will remain the responsibility of the developer's representatives to ensure that the works are completed in accordance with the terms of the agreement.

7.3 Adoption

For SuDS to be effectively managed and maintained, clear arrangements need to be in place to specify which organisation is responsible. Adoption arrangements are key to the feasibility of a drainage strategy and can significantly influence the design and location of SuDS features within a development site.

SuDS schemes submitted for adoption will need to meet specific design requirements of the adopting organisation. Before SuDS are adopted, documentation must be submitted to the adopting authority to confirm that the features have been constructed as designed. All proposed discharge rates and volumes must be agreed with the DoI Flood Management Division, before reaching an adoption agreement with any organisation.

It is expected that SuDS for larger developments will be adopted by Manx Utilities or (where relating to highways) DoI Highways Services. Where SuDS are also open space or biodiversity features there may be other bodies who may be willing to adopt (e.g. Local Authorities). However, it is not recommended that SuDS features are adopted by private management companies or homeowners, as the maintenance of the features for their lifetime (100-years) cannot be guaranteed.

The type of SuDS that Manx Utilities will adopt will be determined on a case-by-case basis and early consultation is recommended to establish whether they are likely to adopt a SuDS feature. DoI Highways Services will consider the adoption of SuDS that are designed to accommodate highways drainage alone and are constructed to agreed standards and timescales. At present, they do not consider the adoption of permeable paving. A commuted lump sum will be required from the developer, to fund the long-term maintenance of the SuDS features.

Following construction, the adopting body (whether Manx Utilities, DoI Highways Services or another body) should arrange inspections of the works, prior to adoption. An as-built topographic survey of the system should be completed after construction, although this will not normally be controlled through the planning system.

7.4 Maintenance

Maintenance is critical to the effectiveness and success of SuDS, for example ensuring that the system drains effectively, and the created habitats sustain wildlife. These requirements should be considered from the outset of the design process and cover the lifetime of the development.

Shallow surface SuDS features, with easily visible inlets and outlets, are preferred, where problems can be easily identified and systems designed to prevent blockages.

A Maintenance and Operation Plan should be submitted with planning applications(or in some cases may be conditioned)and prepared at an appropriate level of detail for the scale of development. This will demonstrate that the proposed SuDS can be easily and safely maintained by the adopting organisation. Note that different adopting authorities, such as Manx Utilities and DoI Highways Services, may have additional maintenance design requirements for adoptable SuDS.

A Maintenance and Operation Plan should include the points set out below.

- Details of the required regular, occasional, and remedial maintenance activities for all SuDS features on the site. The plan should be tailored to the actual SuDS features planned for the site and how they should be maintained in the specific setting of the development. The feature-specific maintenance tables in Chapter 32 of the CIRIA SuDS Manual can be used to inform the plan, but simply reproducing them is not acceptable.
- Estimated costs for the specified maintenance activities.
- Details of any establishment maintenance activities required over the first 5 years.
- Locations of access points for maintenance of the SuDS features.
- Identification of a specified management authority for each SuDS feature for the lifetime of the development and details of adoption arrangements.
- Where multiple maintenance organisations are identified, details of how maintenance plans will be coordinated to maintain performance of the SuDS network will be required.
- Details of how the maintenance plans will be communicated effectively to residents. This should include what SuDS are present and:
    - how they work;
    - what defects to look out for; and
    - who to contact in the event of a problem.

A Appendix A: Overcoming challenges in delivering SuDS on the Isle of Man

A.1 Introduction

SuDS can be implemented on any development site. Certain site conditions may require adjustments to design or the type of components used, but even the most challenging sites must integrate SuDS in some form. Development proposals will be regarded favourably for maximising benefits and including multi-use features, not just focussing on water quantity. Previously developed, or 'brownfield' sites, provide an opportunity to significantly improve the amenity and biodiversity value of the land, and its resilience to climate change, through the use of SuDS.

The following sections provide guidance on the most commonly raised site constraints and demonstrate how they can be overcome with good planning and design.

A.2 Flood Risk

Flood risk can come from various sources: fluvial (river) flooding, tidal, pluvial (surface water) flooding, sewer systems and high groundwater levels. Despite the challenges that flooding can cause for development, it can also provide opportunities. Understanding the causes and impacts of flooding on a site can allow natural flow paths and flood extents to be harnessed and incorporated into the design.

A.2.1 Fluvial and tidal flood risk

Advice should be sought from the DoI Flood Management Division regarding fluvial and tidal flood risk to individual development sites on the Isle of Man. Flood risk may be identified using the indicative flood maps for fluvial and tidal flood risk.

An FRA should be completed, where required, to ensure that the site is safe and does not increase flood risk elsewhere (e.g. compensation for loss of floodplain storage). National Flood Risk Policy and the Isle of Man Flood Risk Assessment Guidance provide full details of managing flood risk within development.

SuDS design considerations:

- Storage for runoff from the development in extreme events should be located out of the floodplain.
- Floodplain areas can provide treatment for more frequent events, as long as floodplain capacity is not reduced. The effects of modelled fluvial water levels, frequency, duration and velocities on performance of SuDS components, and the risk of damage by erosion should be considered.
- Design for a high groundwater table.
- Consider maintenance implications of silt deposition from a flood event.

- Design attenuation SuDS with a sufficient drain-down time (to half-empty within 24 hours) following a storm event to allow for it to receive runoff from subsequent events.

A.2.2 Surface water and ordinary watercourse flood risk

Advice should be sought from the DoI Flood Management Division regarding flood risk from surface water and Ordinary Watercourses. Surface water flood risk may be identified using the indicative flood maps for surface water flood risk. Flood risk from smaller watercourses and land drainage ditches may also be indicated by this surface water mapping.

The identification of local surface water flood risk should not be a constraint, as well-designed SuDS can improve flood risk both on and off the site.

SuDS design considerations:

- Assess and design for additional surface water flows and volumes entering the site.
- Design for natural drainage pathways - existing surface water flow routes should be identified and integrated into the exceedance design for the site.
- Communication and collaboration with neighbouring land owners and stakeholders.

A.2.3 Groundwater flood risk

Site investigations, informed by local flooding incidents and DoI Flood Management Division flood investigations, should be undertaken to identify if the site is prone to high groundwater levels. Infiltration testing and groundwater monitoring should be undertaken on sites identified as at high risk throughout the winter months and should take account of the wetness of that winter and also historic groundwater levels. High groundwater levels during extreme wet periods may render infiltration SuDS ineffective and pose a direct pollution risk to groundwater. If levels are very high, groundwater may enter the SuDS feature and reduce the storage capacity and structural integrity of the design.

SuDS design considerations:

- The base of an infiltration system should be located at least 1m above the likely maximum water table. *Groundwater quality protection must be considered for infiltration SuDS where the seasonal water table is high.*
- Avoid locating below-ground features such as tanks below the maximum groundwater level, as pressure loads are likely to be high.
- Shallow surface features such as swales, ponds and permeable pavements can be lined with an impermeable layer to isolate SuDS from groundwater.
- Advice should be sought from the DoI Flood Management Division regarding areas at risk. On-site ground investigations are required prior to the design and construction of infiltration SuDS or deep storage features.

A.2.4 Discharges to groundwater

The quality of discharges to groundwater must be considered, particularly to limit pollution of the underlying geology. Where infiltration SuDS are proposed for anything other than clean roof drainage, a risk assessment may be required to demonstrate that pollution of groundwater will not occur.

SuDS design considerations:

- Shallow surface features such as basins, swales, ponds and permeable paving can be lined with an impermeable layer to prevent infiltration.
- Additional treatment stages or proprietary treatment systems to improve water quality before infiltration can be provided.

A.3 Receiving surface waters

When planning a new outfall to a watercourse or works to the bed or banks of a channel, a consent will be required. Works within 9.1m of a watercourse will require a watercourse consent from the DoI Flood Management Division (see 6.4.1).

An environmental permit is not currently required to discharge uncontaminated runoff from public roads and small parking areas to surface water bodies, if it has been treated by a SuDS system.

SuDS design considerations:

- Provision of additional treatment stages or proprietary treatment systems to improve water quality.

A.4 Protected habitats

There are large numbers of designated sites on the Isle of Man, and SuDS designers should be aware of their species and habitat needs.

Developments within designated sites and protected areas should liaise with DEFA, to determine any water quality requirements for surface water discharged from the development site. All environmental designation areas can be viewed on the Island Environment maps.

A.5 Topography

A.5.1 Flat site

SuDS rely on gravity to transfer water around the site and meet outlet levels without being affected by downstream water levels, meaning flat sites can be problematic.

SuDS design considerations:

- Green roofs, rainwater capture and reuse, and permeable paving can be used as normal on flat sites
- Water can be kept on the surface using conveyance methods of kerbs, shallow rills and swales.
- Design should be based on small sub-catchments with storage and conveyance managed close to source. Hydraulic head will build up locally and push water out of the system.
- The use of pumps in SuDS design is not an acceptable or sustainable solution. If it is not possible to design a solution without using pumping, then this is considered an exception.

A.5.2 Steep site

Steep slopes (>5%) can generate high flow velocities and pose problems of water by-passing drainage features, scour, erosion and in severe cases health and safety issues. Permeable paving becomes ineffective on steep gradients, and infiltrated water can re-emerge further downslope, causing slope instability.

SuDS design considerations:

- Green roofs, rainwater capture and reuse can be used as normal on steep sites.
- Features such as permeable paving, bioretention areas, swales and wetland can be terraced or designed to follow contours.
- Design should be based on small sub-catchments with storage and conveyance managed close to source.
- Erosion protection can be provided for steep conveyance features such as waterfalls, stones set into the bed of channels etc.
- Check dams can be placed in swales to slow velocities.
- Geotechnical investigations should be undertaken to make sure that infiltration will not cause instability.

A.6 Coastal stability

Areas of the Isle of Man coastline are likely to be affected by coastal change over the next 100 years, in particular the Kirk Michael coastline. Within known areas of potential ground instability and coastal landslide risk, groundwater has a significant influence on ground stability. Therefore, SuDS features which encourage infiltration into the ground are not recommended within catchments draining into unstable coastlines.

SuDS design considerations:

- Engage early with DEFA Planning Officers and DoI Flood Management Division to discuss constraints at the site.
- SuDS features must not use infiltration and must be lined to prevent ingress of surface water into the underlying geology.
- Seek early advice from a geo-technical professional.

A.7 Contaminated land

Water infiltrating through affected soils can mobilise contaminants and pose a pollution risk to groundwater. Excavation and disposal of contaminated soils is expensive, and SuDS may compromise remediation measures in place to protect residents from contamination. However, contaminated land will not be accepted as a reason to exclude SuDS.

Once the location and depth of contamination has been established, SuDS designs can be adapted to prevent mobilisation of contaminants, for example by restricting infiltration to uncontaminated areas, and to avoid creating pathways for pollutants to enter surface water or groundwater.

SuDS design considerations:

- Green roofs and rainwater capture and reuse can be used as normal on contaminated sites
- Seek early advice from a geo-environmental professional so that drainage design and remediation strategies for contamination can be integrated (e.g. capping layer can be extended beneath SuDS).
- Suitability of infiltration systems will depend on testing the leaching potential of contaminants. Infiltration may be possible at depth, below the contaminated layer. Alternatively, contaminated soil around soakaways can be removed and replaced.
- If infiltration is not possible, shallow surface features such as basins, swales, ponds and permeable pavements can be lined with an impermeable layer to prevent infiltration.
- Materials should be assessed for durability when exposed to contaminants (as for any other construction material in this situation).
- Use of shallow surface features can reduce the need to excavate contaminated ground.

A.8 Low permeability

Soils/geology with low permeability are often cited as a reason not to include SuDS, but in reality, almost all SuDS components can still be used, with some modifications.

SuDS design considerations:

- All SuDS except infiltration systems can be used on low permeability sites. Above ground components should be used to provide the required attenuation and treatment.
- Greenfield runoff rates tend to be high on low permeability geologies, so attenuation requirements should be more manageable.
- Permeable paving may require an underdrain.
- Infiltration may be possible at greater depth below a low permeability soil layer. Deep infiltration systems must be designed to ensure they will not have an adverse effect on groundwater.

A.9 High permeability

A small area in the south of the island is underlain by limestone geology (Section 3.3). There is a potential for infiltration systems to cause solution of limestone over time, leading to sink holes or settlement of foundations at infilled solution features.

SuDS design considerations:

- Seek early advice from a geo-technical professional.
- Place infiltration features at sufficient distance from foundations.

A.10 Limited space

It may be perceived that site profitability will be reduced by the land-take associated with larger surface SuDS, such as swales and ponds/wetlands. Brownfield developments in particular, may be restricted in terms of space or existing infrastructure.

There are a range of space-efficient SuDS techniques. Source control is a key concept, and opportunities can be maximised where strategic SuDS design is considered at an early stage and all available public and private space is utilised (e.g. verges, small pockets of grass or paving). Incorporating SuDS into landscaping can significantly enhance the amenity value of brownfield sites for residents. High density housing will not be accepted as a reason to exclude SuDS.

Design considerations:

- Green roofs, rainwater capture and reuse, infiltration systems, permeable paving, bioretention areas, tree pits and micro-wetlands are all possible on space-restricted sites.
- Non-trafficked paved areas can be made permeable (pavements/footpaths, parking).
- Rills, channels and depressions can be built into the hardscape and planted to provide water features.
- Swales, filter strips, ponds and large wetlands are less suitable.
- Access to existing underground infrastructure, such as utilities, will need to be considered in the design.

A.11 Brownfield sites

Brownfield sites are often targeted for redevelopment on the island, but there is a perception that they are unsuitable for SuDS. In contrast, SuDS that deliver multiple benefits are of particular importance on these sites, where they can help to manage existing flood risk and water quality issues and contribute towards regeneration of urban areas. Existing brownfield sites also often provide niche habitats for invertebrates, which can be enhanced by incorporating vegetated SuDS features, such as green roofs.

The majority of SuDS components can be adapted to suit the requirements of brownfield sites, including contaminated land, space constraints, and compacted soils with poor infiltration potential.

Design considerations:

- Permeable paving can be used to replace areas of hardstanding, although this may not be accepted for adoption by DoI Highways. Hard landscaped depressions, ponds and rills can be used to provide both storage and attractive features for people and wildlife.
- Use of shallow surface features can reduce the need to excavate contaminated ground or areas congested with below-ground services.
- Existing drainage infrastructure can be reused, subject to condition and capacity.

A.12 Commercial sites

SuDS must be used to manage surface water on commercial sites, such as retail parks and business parks, for the lifetime of the development. SuDS offer a number of advantages to commercial developments including making them more attractive to customers and businesses; helping them to meet minimum environmental standards; making them resilient to climate change; encouraging wildlife and biodiversity; and providing savings on heating and cooling and maintenance costs.

Design considerations:

- Green roofs, rainwater capture and reuse, infiltration systems, permeable paving, bioretention areas, tree pits and micro-wetlands are all possible on commercial sites.
- Green roofs on large commercial buildings provide insulation and absorb UV radiation, reducing heat in summer and retaining heat in winter. They also protect the roof membranes from UV radiation, increasing their lifespan.
- Large roofs are also an opportunity for rainwater harvesting and re-use.
- Large car park areas provide opportunities for permeable paving and filter strips to treat pollution, but also vegetated surface features such as swales and tree pits which bring multiple benefits.
- Ponds and wetlands can provide attractive amenity spaces for workers and customers.

A.13 Industrial sites / high pollution risk

Care must be taken when designing SuDS for some commercial and industrial sites, particularly where storage, handling or use of hazardous substances occurs (for example, garage forecourts, coach and lorry parks/turning areas and metal recycling/vehicle dismantling facilities).

Design considerations:

- Runoff from 'safe' areas (e.g. roofs or car parks) should be separated and drained through SuDS.
- SuDS such as swales, permeable paving and bioretention areas can be lined if there is a risk of contamination.
- Runoff from areas with a high risk of contamination from hazardous substances should be separated, contained and dealt with as industrial waste.
- Discharges of surface water run-off to ground at pollutant storage sites will be subject to risk assessment and provision of acceptable effluent treatment.

A.14 Health and safety considerations

Designers have responsibilities under the Construction (Design and Maintenance) Regulations 2003 (CDM) to eliminate, reduce or control foreseeable risks during construction, maintenance and use of a structure.

As SuDS are no more hazardous than natural waterbodies, health and safety concerns are not accepted as a reason for their exclusion in development. Potential health and safety risks can be overcome through good SuDS design and should be balanced against the benefits for health and well-being. Public perception of risk can be addressed through community engagement and education.

A.15 Affordability

The costs of SuDS are generally lower than conventional piped and tanked drainage (Defra, 2011). Where SuDS are integrated into the design at an early stage, they become part of the above-ground landscaping and building design, and there is less need for expensive hard-engineered solutions, such as over-sized pipes and underground storage.

Full lifetime costs should be taken into account at an early stage so that charges are not prohibitive to a development's overall viability. SuDS have low maintenance costs over their lifetime, with surface features like swales able to be maintained within landscape maintenance contracts. However, the costs of replacing/refurbishing permeable paving can be high.

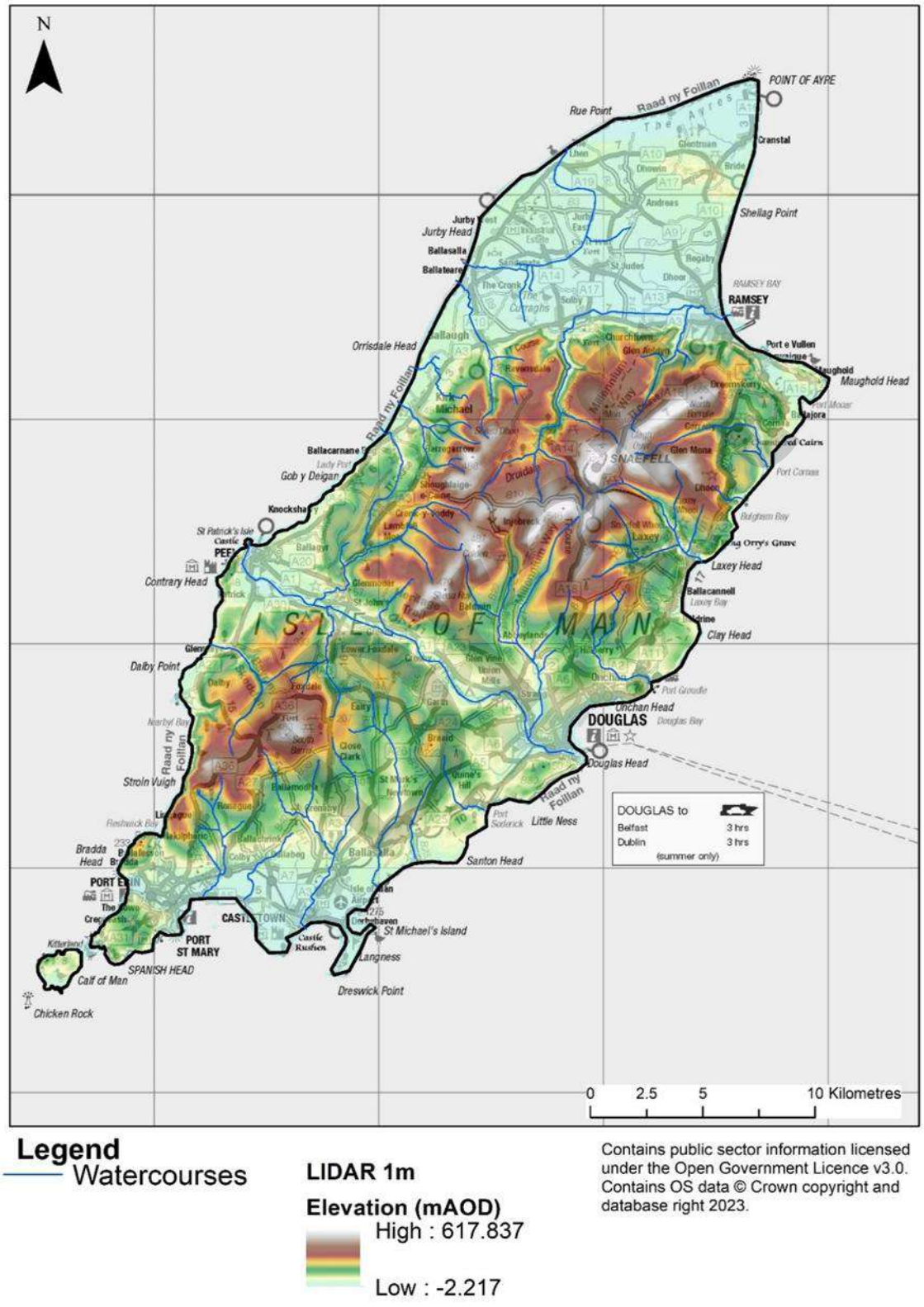
The multiple benefits of SuDS should not be underestimated when assessing costs and benefits, as they can make SuDS schemes attractive to other organisations, who may be able to offer partnership funding opportunities and engage local communities.

SuDS design considerations:

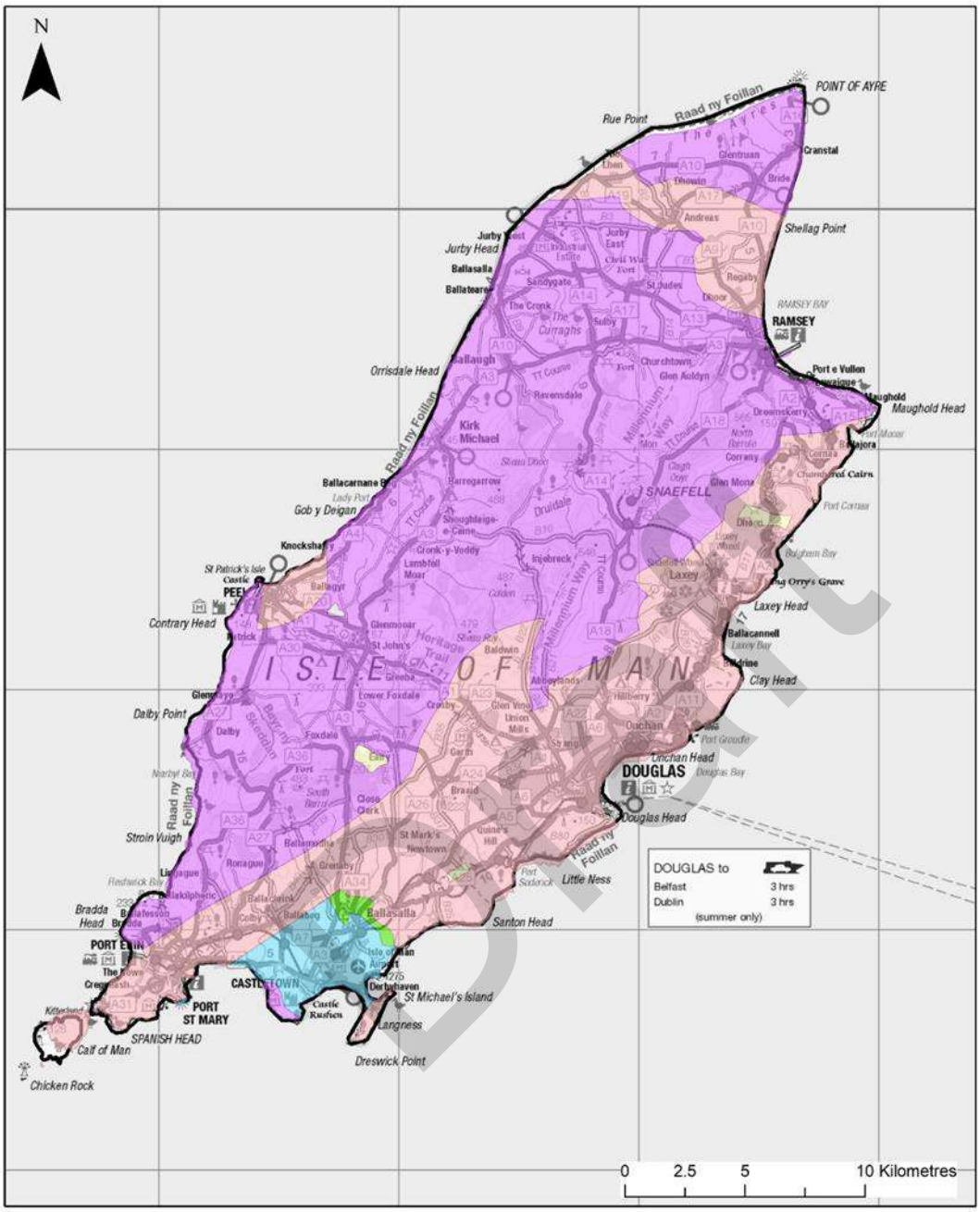
- Consider SuDS design at an early stage and consult with all stakeholders to identify funding opportunities.
- Prioritise source control and surface systems to avoid hard engineered and deep excavated solutions.
- Choose low maintenance designs, which can be maintained under standard landscaping contracts.
- Deal with waste on-site.
- Involve the community in maintenance.
- Fully assess the wider benefits when evaluating a SuDS scheme (e.g. CIRIA SuDS Manual Table 35.1, CIRIA B£ST Evaluation Tool)

B Appendix: Maps

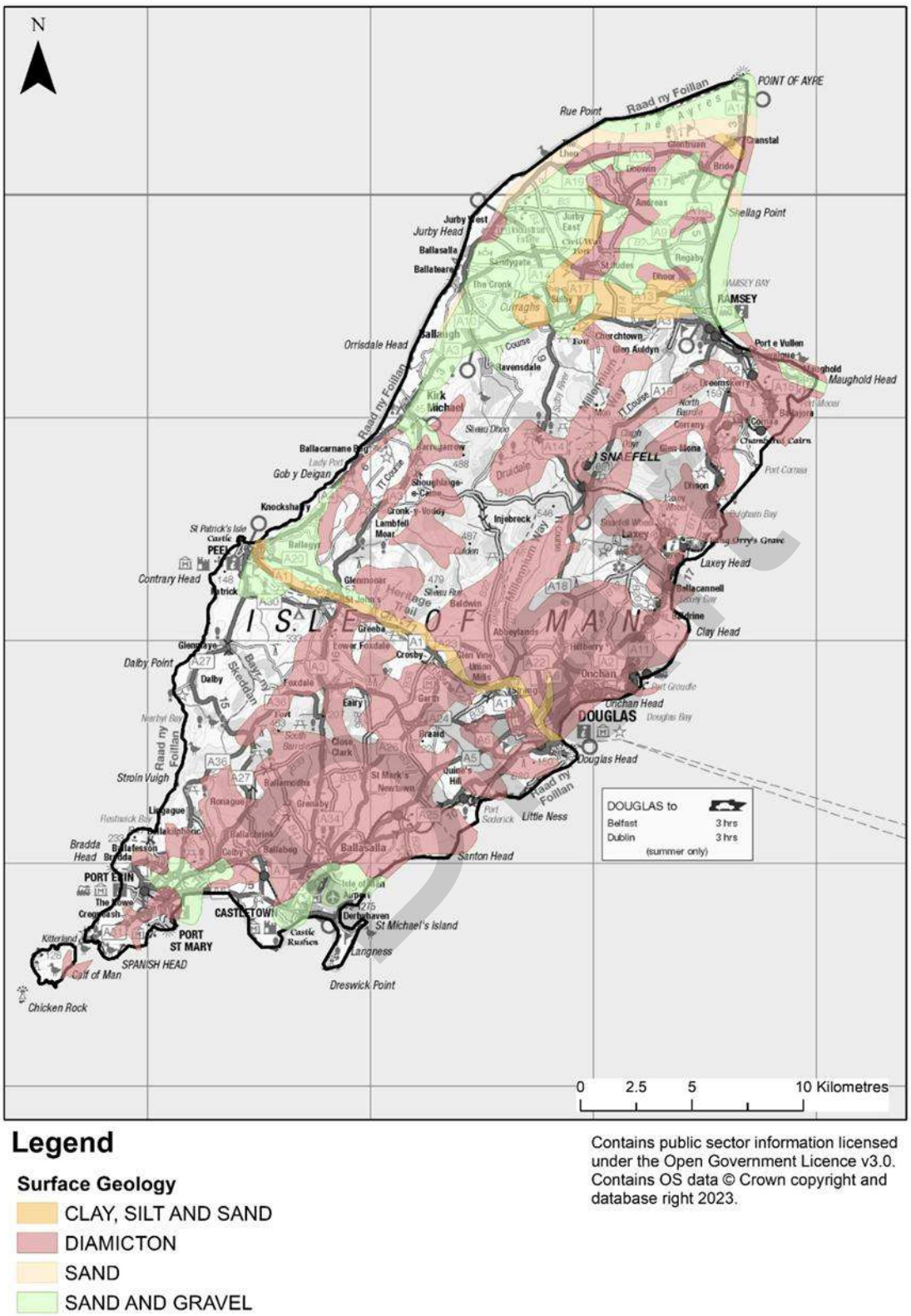
B.1 Topography of the Isle of Man



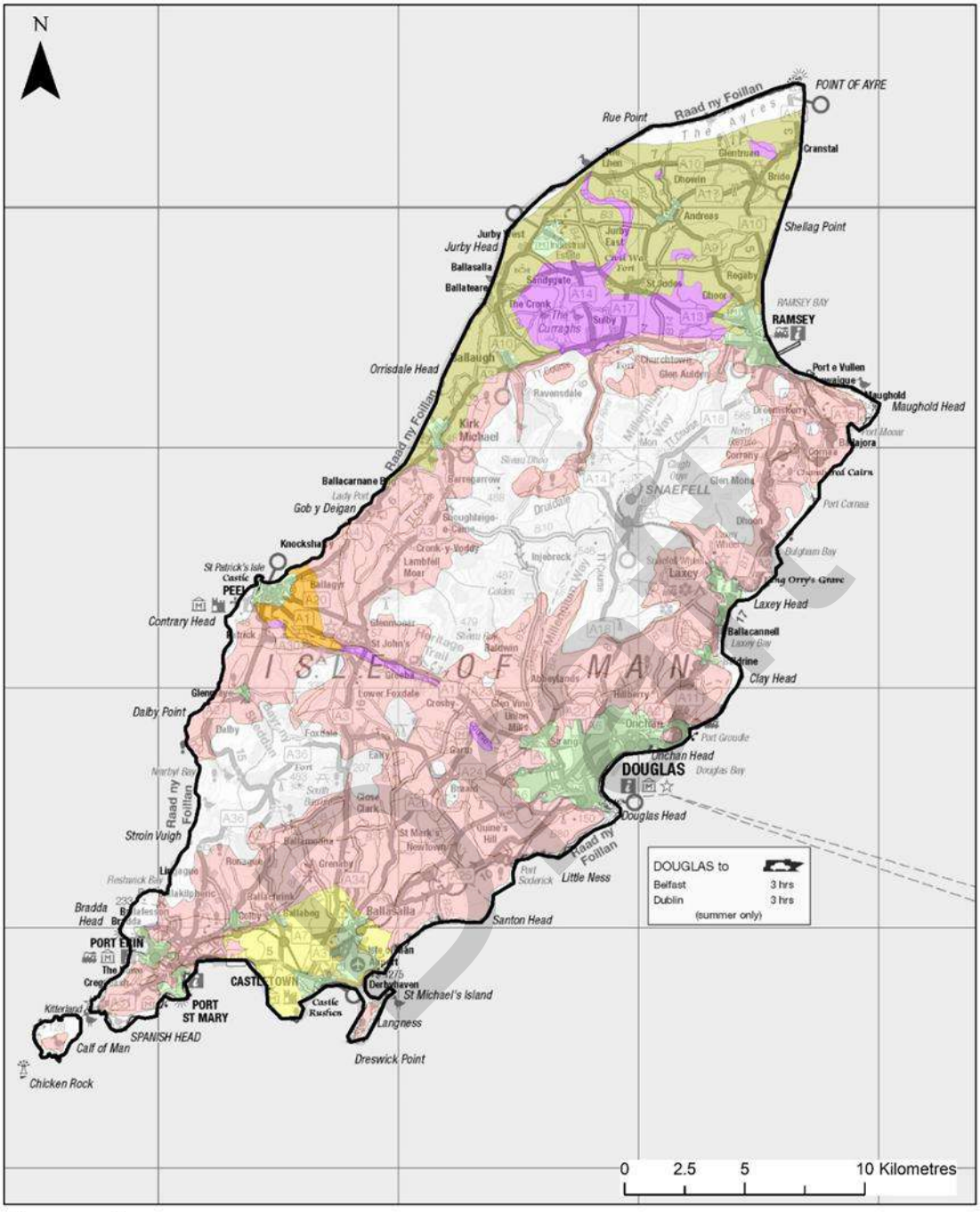
B.2 Bedrock Geology of the Isle of Man



B.3 Surface Geology of the Isle of Man



B.4 Soils of the Isle of Man



Legend

Soil group

- A - Slates, flags and shales
- B - Limestone
- C - Peel sandstone & Neb gravels
- D - Glacial deposits
- E - Peat deposits
- Coastal and Upland
- Urban

C Appendix C: JBA's Urban Drainage Suitability Tool

General Suitability				Landuse Suitability								Water Quantity Suitability	Water Quality Suitability						Environmental Benefits		Cost Suitability	
															Removal Treatment Potential							
SUDS Group	Technique	Suitability Conditions	Management Train Suitability	Low Density (1)	Residential (1 to 2)	Local Roads (2)	Commercial (2 to 3)	Industrial (2 to 3)	Construction Site (1)*	Brownfield (1)	Contaminated Land (3 to 4)		Water Quality Removal Technique	Pollutants Removed	TSS	Heavy Metals	Nutrients	Bacteria	Fine Suspended Sediments & Dissolved Pollutants	Community Appeal	Habitat Creation Potential	Maintenance	Capital
Retention	Retention pond	A, F	Site control, regional control	Y	Y	Y	Y	Y	Y	Y	Y	Detention, infiltration*, water harvesting	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	M	M	M	H	H!	H	M	M
	Subsurface storage		Conveyance, site control	Y	Y	Y[1]	Y[1]	Y[1]	Y	Y	Y[1]	Conveyance, detention	Sedimentation*, filtration*	Nutrients, sediments, metals, hydrocarbons	L	L	L	L	L	H	L	L	M
Wetland	Shallow wetland	B, D, F, I	Conveyance*, site control, regional control	Y	Y	Y	Y	Y	N	Y	Y	Conveyance*, detention, infiltration*, water harvesting	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	M	H	M	H	H!	H	H	H
	Extended detention wetland	B, D, F, I	Conveyance*, site control, regional control	Y	Y	Y	Y	Y	N	Y	Y	Conveyance*, detention, infiltration*, water harvesting	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	M	H	M	H	H!	H	H	H
	Pond / wetland	B, D, F, I	Conveyance*, site control, regional control	Y	Y	Y	Y	Y	N	Y	Y	Conveyance*, detention, infiltration*, water harvesting	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	M	H	M	H	H!	H	H	H
	Pocket wetland	B, D, H	Conveyance*, site control, regional control	Y	Y	Y	Y	Y	N	Y	Y	Conveyance*, detention, infiltration*, water harvesting	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	M	H	M	H	M!	H	H	H
	Submerged gravel wetland	B, D, F, I	Conveyance*, site control, regional control	Y	Y	Y	Y	Y	N	Y	Y	Conveyance*, detention, infiltration*, water harvesting	Sedimentation, filtration, adsorption, biodegradation, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	M	H	M	H	L	M	M	H
	Wetland channel	B, D, F, I	Conveyance*, site control, regional control	Y	Y	Y	Y	Y	N	Y	Y	Conveyance*, detention, infiltration*, water harvesting	Sedimentation, filtration, adsorption, volatisation, precipitation, uptake by plants, de-nitrification	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	M	H	M	H	H!	H	H	H
Source control	Green roof	G, H	Prevention, pre-treatment, source control	Y	Y	N	Y	Y	N	Y	Y[1]	Detention	Filtration, adsorption, volatisation, precipitation, uptake by plants, de-nitrification, biodegradation	Sediments, hydrocarbons, metals, pesticides, chlorides, cyanides, organic matter, BOD, nutrients	N/A	N/A	N/A	N/A	H	H	H	H	H
	Rain water harvesting	H	Prevention, conveyance*, source control	Y	Y	N	Y	N	N	Y	Y[1]	Conveyance*, detention*, infiltration, water harvesting*	Sedimentation*, filtration*, adsorption*, biodegradation*, volatisation*, precipitation*, uptake by plants*, de-nitrification*	Chlorides, sediments, hydrocarbons, metals, pesticides, chlorides, cyanides, organic matter, BOD, nutrients	M	L	L	L	N/A	M!	L	H	H
	Pervious pavement	C, D	Prevention, source control, site control*	Y	Y	N	Y	Y	N	Y	Y*	Detention, infiltration, water harvesting*	Sedimentation, filtration, adsorption, biodegradation, volatisation	Sediments, hydrocarbons, metals, pesticides, nutrients, cyanides, organic matter, BOD,	H	H	H	H	H	M	L	M	M
Infiltration	Infiltration trench	C, H, J	Conveyance*, source control, site control	Y	Y	Y	Y	N	N	Y	Y[1]*	Conveyance*, detention, infiltration	Filtration, adsorption, biodegradation, volatisation	Sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	H	H	M	H	M	L	L	L
	Infiltration basin	C, F, J	Site control, regional control	Y	Y	Y	Y	N	N	Y	Y[1]*	Detention, infiltration	Filtration, adsorption, biodegradation, volatisation	Sediments, hydrocarbons, metals, pesticides, cyanides, nutrients, organic matter, BOD	H	H	H	M	H	H!	M	M	L
	Soakaway	C, H, J	Source control	Y	Y	Y	Y	N	N	Y	Y*	Infiltration	Filtration, adsorption, biodegradation	Sediments, hydrocarbons, metals, nutrients, pesticides, organic matter, BOD	H	H	H	M	H	M	L	L	M
Filtration	Surface sand filter	C, D, F, K	Pre-treatment, site control, regional control*	N	Y	Y	Y	Y	N	Y	Y	Detention, infiltration*	Filtration, adsorption, biodegradation, volatisation, precipitation	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	H	H	M	H	L	M	M	H
	Sub-surface sand filter	C, D, H, K	Pre-treatment, site control, regional control*	N	Y	Y	Y	Y	N	Y	Y	Detention, infiltration*	Filtration, adsorption, biodegradation, volatisation, precipitation	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	H	H	M	H	L	L	M	H
	Perimeter sand filter	C, D, H	Pre-treatment, site control, regional control*	N	N	Y	Y	Y	N	Y	Y	Detention, infiltration*	Filtration, adsorption, biodegradation, volatisation, precipitation	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	H	H	M	H	L	L	M	H
	Bioretention / filter strip	C, D, F, H	Pre-treatment, source control	Y	Y	Y	Y	Y	N	Y	Y	Conveyance*, detention*, infiltration*	Sedimentation, filtration, adsorption, biodegradation	Nutrients, sediments, hydrocarbons, metals, pesticides, organic matter, BOD,	H	H	H	M	H	H	H	H	M
	Filter trench	A, C, D, H	Conveyance, source control, site control*	Y	Y	Y	Y	Y	N	Y	Y	Conveyance, detention	Filtration, adsorption, biodegradation, volatisation	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	H	H	H	M	H	M	L	M	M
Detention	Detention basin	A, C, F, K	Site control, regional control	Y	Y	Y	Y	Y	Y	Y	Y	Detention	Sedimentation, filtration*, adsorption*, biodegradation, uptake by plants*	Nutrients, sediments, hydrocarbons, metals, pesticides, cyanides, organic matter, BOD	M	M	L	L	L	H!	M	L	L
Open channels	Conveyance swale	C, E, F, H, J	Conveyance, pre-treatment, site control	Y	Y	Y	Y	Y	Y	Y	Y	Conveyance*, detention*, infiltration*	Sedimentation, filtration, adsorption, uptake by plants*, biodegradation	Nutrients, sediments, hydrocarbons, metals, pesticides, organic matter, BOD	H	M	M	M	H	M!	M	L	L
	Enhanced dry swale	C, E, F,H, J	Conveyance, pre-treatment, site control	Y	Y	Y	Y	Y	Y	Y	Y	Conveyance*, detention*, infiltration*	Sedimentation, filtration, adsorption, uptake by plants*, biodegradation	Nutrients, sediments, hydrocarbons, metals, pesticides, organic matter, BOD	H	H	H	M	H	M!	M	L	M
	Enhanced wet swale	B, E, F, H, J	Conveyance, pre-treatment, site control	Y	Y	Y	Y	Y	Y	Y	Y	Conveyance*, detention*, infiltration*	Sedimentation, filtration, adsorption, uptake by plants*, biodegradation	Nutrients, sediments, hydrocarbons, metals, pesticides, organic matter, BOD	H	H	M	H	H	M!	H	M	M

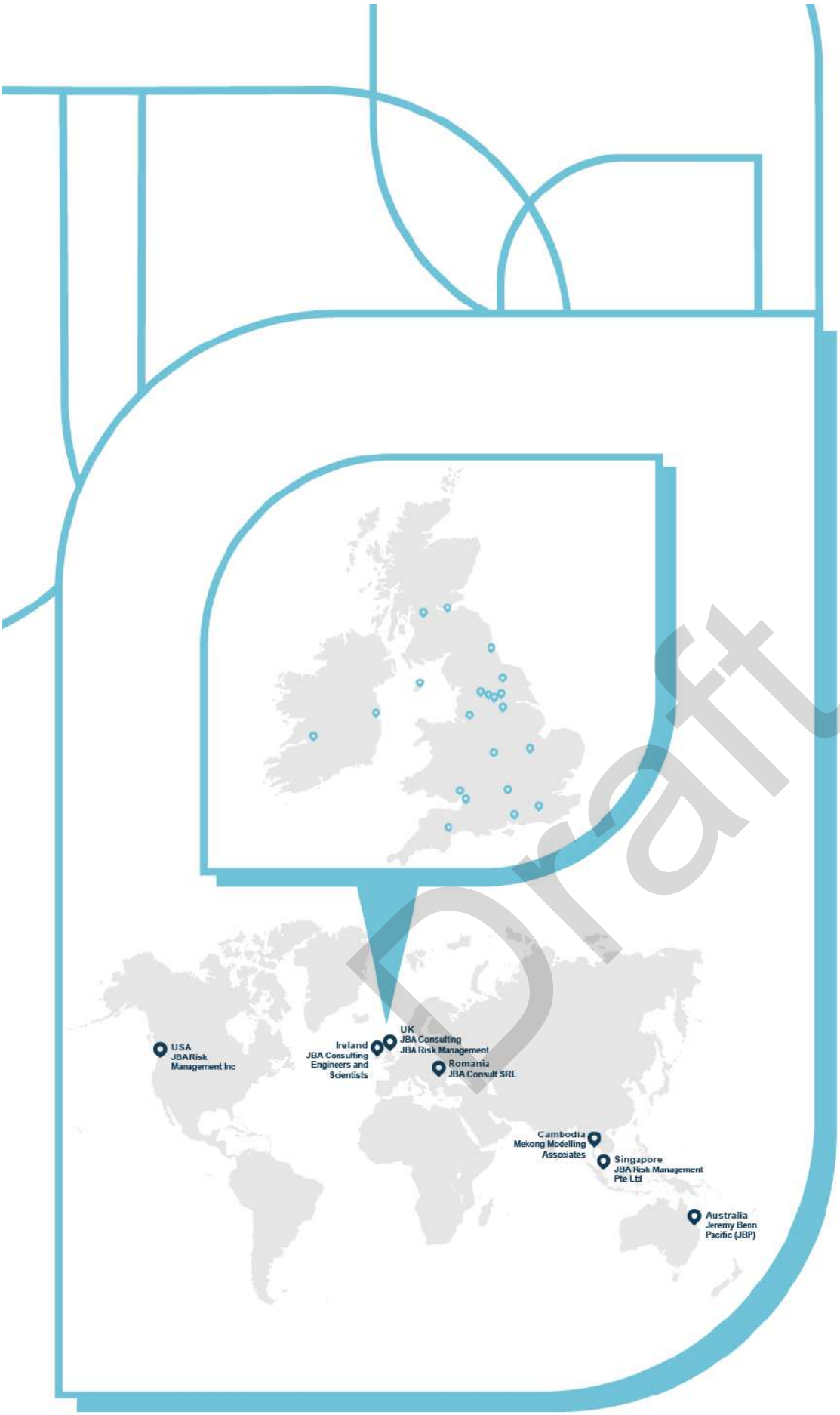
JBA's Urban Drainage Suitability Tool (JUD SUIT)

Key

Item	Description
Blue outline	Infiltration-dependent components; will only work with permeable soil
	Not suitable / not applicable
	Potentially suitable providing that design prevents mobilisation of contamination
	Suitable
Y	Yes
N	No

L	Low	D	Slope should not exceed 5%
M	Medium	E	Follows contours for slope greater than 5%
H	High	F	Only suitable for large spaces
A	Liner is required for permeable soil	G	A roof has to be able to support 2 KN/m2 for extensive, 7 KN/m3 for semi-intensive and 10 KN/m3 for intensive configurations.
B	Surface base flow may be required	H	Not suitable if area draining into SUDS is more than 2 ha
C	Minimum depth to water table shouldn't be less than 1 m	I	Only suitable where high flows are diverted around SUDS component for area of more than 2 ha

J	Only if available head is less than 1 m	!	There may be some public safety concern associated with open water which needs to be addressed at the design stage.
K	Only if available head is between 1 and 2 m		
1	One treatment train stage may be sufficient		
*	Some opportunities, subject to design		
*	Will require draw-down and rehabilitation following construction activity, prior to use as a permanent drainage system.		
(...)	Number of treatment train stages required.		



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