Appendix 3
Stormwater Management Plan Part 2: Sustainable Drainage Systems (SuDS) Strategy

Comhairle Contae Fhine Gall
Fingal County Council

Kinsaley Local Area Plan

Stormwater Management Plan:
Part 2: Sustainable Drainage Systems (SuDS) Strategy

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APPENDIX A SITE LOCATION MAP

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1. INTRODUCTION

1.1 Commission

Roughan & O'Donovan Consulting Engineers (ROD) was commissioned by Fingal County Council (FCC) to prepare a Surface Water Management Plan to supplement the Kinsaley Local Area Plan (LAP). As part of this commission, a Sustainable Drainage Systems (SuDS) Strategy for the proposed LAP has been developed. The LAP will set out the local land use and planning policy and provide a strategy for the future planning and sustainable development of the area.

1.2 Scope

The scope of this report is as follows:

- Review of the existing surface water drainage network in respect of SuDS for current situation, future scenario with all live planning permissions built and with all proposed development and infrastructure in place as set out in the Fingal Development Plan 2017-2023.
- Prepare a SuDS Strategy with recommendations regarding appropriate SuDS systems and devices for the implementation of the SuDS strategy for all proposed development within the Kinsaley LAP boundary.
- Incorporate the effects of Climate Change, soil type and groundwater into the SuDS Strategy.
- Determine the effects on and of flooding, groundwater and surface water drainage system in the LAP area due to the incorporation of the SuDS Strategy.
- Make recommendations on the discharge rate to be applied across the Local Area Plan Lands and as to the future development and sustainable drainage of the Plan lands.
- Liaison with Consultants completing the Strategic Environmental Assessment (SEA), Appropriate Assessment and Fingal County Council.

1.3 Study Area

1.3.1 Overview

Kinsaley village is located in North County Dublin approximately 2.8km east of the M1 motorway and 3km west of the Irish Sea. The village has a strong visual identity and landscape quality formed by the Sluice River, running west-east through the village, and by the stone walls and mature trees associated with the nearby Abbeville Demesne. The R107 Malahide Road runs north-south to the west of the existing village. Chapel Road runs east-west through the village and forms a junction with the R107 at the Parish Church of St. Nicholas of Myra, a Protected Structure. The village is located mid-way between Malahide to the north and Balgriffin to the south. Refer to Figure 1.1 below.

Figure 1.1 Kinsaley LAP Hinterlands

The topography of the LAP lands to the north of the Sluice River generally fall from north to south from a level of approximately 12mOD to 7mOD. The topography of the lands to the south of the Sluice River generally fall from south to north from a level of approximately 21mOD to 7mOD.

1.3.2 Catchment Description

The LAP study area lies within the catchment of the Sluice River and is approximately 3km west of the Baldoyle Estuary, as outlined in Figure 1.2. This river drains to the Baldoyle Estuary prior to discharging to the Irish Sea.

The Sluice River rises to the north of Dublin Airport and flows through Kinsaley into the head of Baldoyle Bay. Its lower course is meandering, with embankments constructed before the 1830’s to curtail tidal flooding. It has a catchment area of approximately 17.8km^2.

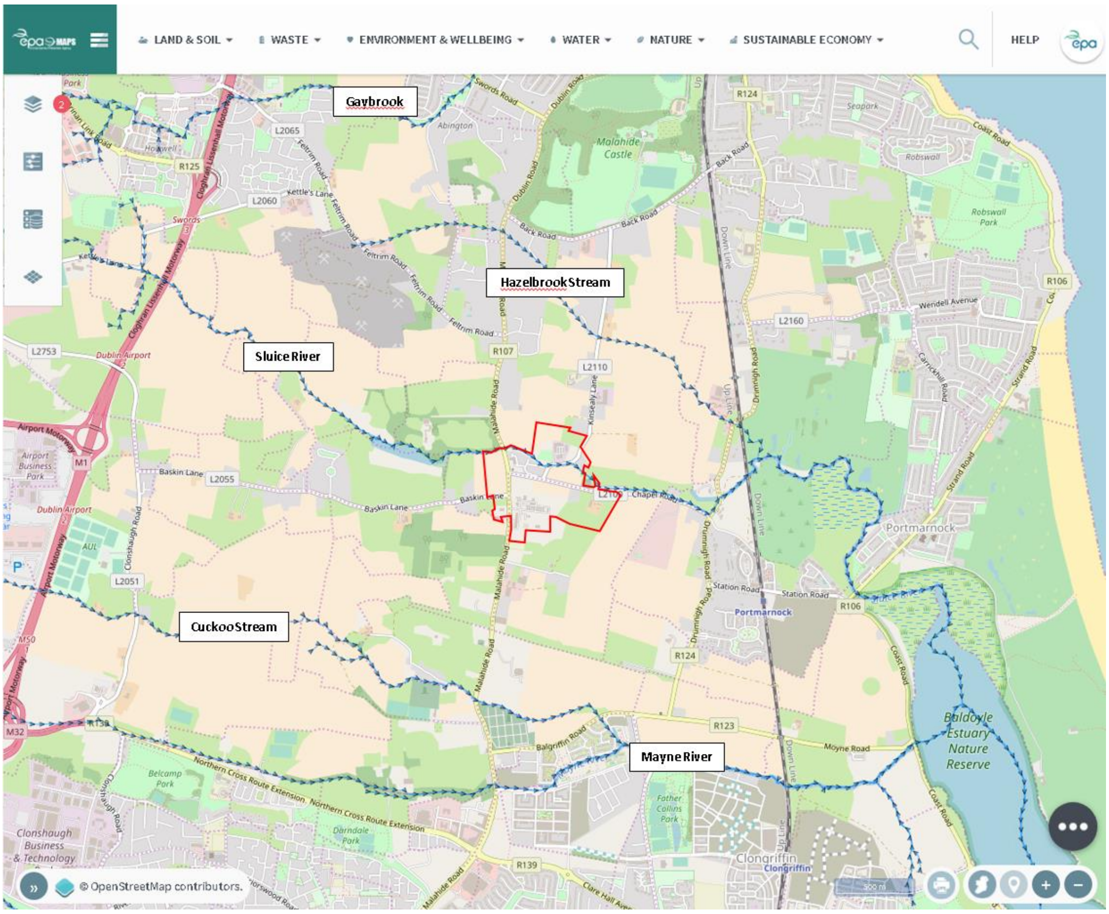


Figure 1.2 Watercourses around the Kinsaley LAP area (EPA Catchments.ie)

Irish Water records indicate two surface water outfalls to the Sluice River, located on Kinsaley Lane and at the St. Olave's Development. Outfalls to the river have also been identified from the Malahide Road, Emsworth Park and Coopers Wood residential housing developments.

1.3.3 Environment

There are no Natura 2000 sites located within the study area; however, the Natura 2000 sites Baldoyle Bay (SPA and SAC) are 2.4km east of Kinsaley LAP

Under Article 6(3) of the EU Habitats Directive, an "appropriate assessment" (AA) is required where any plan or project, either alone or 'in combination' with other plans or projects, could have an adverse effect on the integrity of a Natura 2000 site.
Natural Heritage Areas (NHAs) are sites of national importance for nature conservation and are afforded protection under planning policy and the Wildlife Acts, 1976-2012. Proposed NHAs (pNHAs) are published sites identified as of similar conservation interest but have not been statutorily proposed or designated. The nearest NHA/pNHAs to the study area are:

- Sluice River Marsh (proposed NHA), ~ 1.5km east of Kinsaley LAP
- Feltrim Hill (proposed NHA), ~1.2km north-west of Kinsaley LAP

Therefore, the management of flood risk within the LAP study area must have regard to potential negative impacts to this environment.

1.4 Proposed Development

The Kinsaley area comprises two main zonings with a further two zonings on small areas in the Fingal Development Plan 2017 – 2023 as outlined in Figure 1.3 and Table 1.1 below.

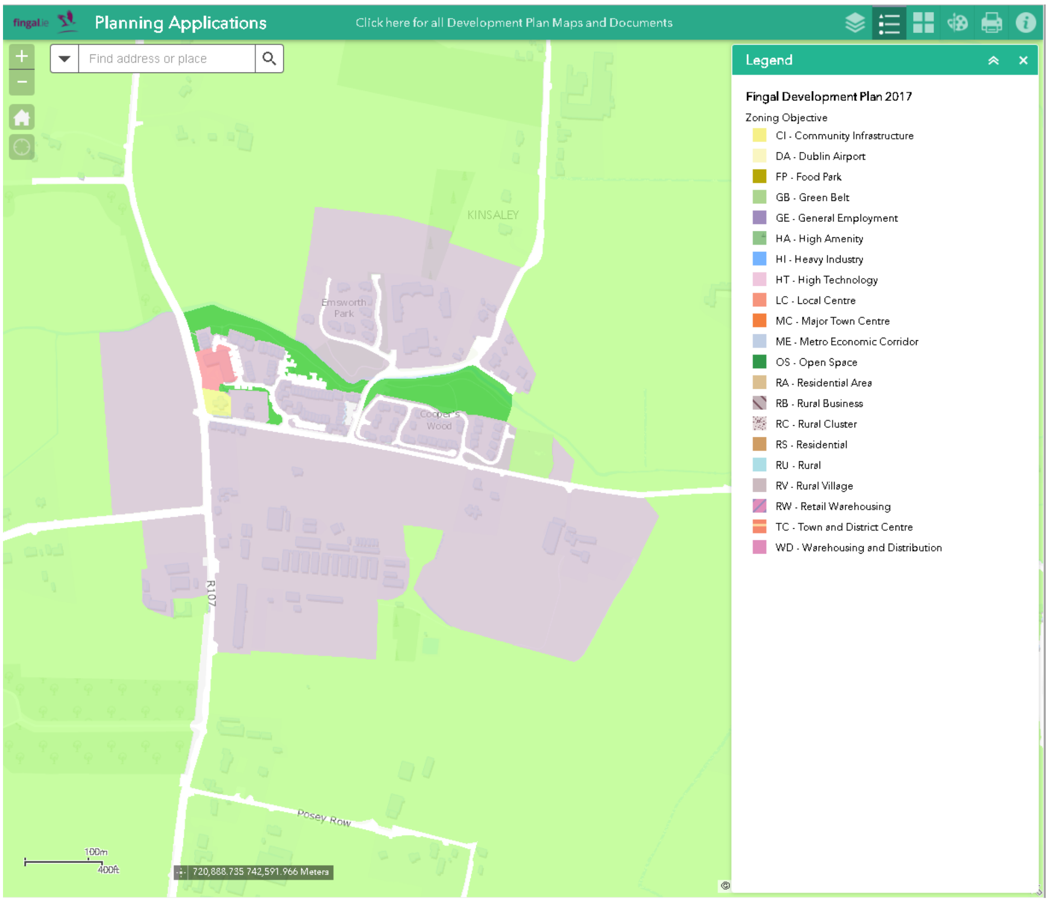


Figure 1.3 **Kinsaley Zoning Objectives (Fingal Co Co Development Plan 2017 – 2023)**

Table 1.1 ***Kinsaley Zoning Objectives***

Objective	Description	Area
RV - Rural Village	Protect and promote the character of the Rural Village and promote a vibrant community in accordance with an approved Local Area Plan, and the availability of physical and community infrastructure	Majority of Kinsaley village
OS - Open Space	Preserve and provide for open space and recreational amenities.	Existing open space within the LAP study area. The riparian corridor either side of the Sluice River is zoned as open space.
CI - Community Infrastructure	Provide for and protect civic, religious, community, education, health care and social infrastructure	Parish Church of St. Nicholas of Myra (Protected Structure)
LC - Local Centre	Protect, provide for and/or improve local centre facilities	Mixed-use facilities in the centre of Kinsaley village

It is a specific objective of the current County Development Plan (2017 – 2023) to implement the R107 Malahide Road Realignment, Balgriffin Bypass Scheme. Approximately 280m of this proposed road improvement scheme is within the LAP boundary to the north west of the LAP.

2. SUDS OVERVIEW

2.1 Introduction

The SuDS philosophy is to mimic the natural hydrological cycle by promoting; infiltration, evaporation, evapotranspiration, the harvesting of rainwater at source and the temporary storage of water (ponding), through the construction of a combination or series of components to form a ‘management train’. Whilst there is no internationally agreed definition for SuDS – as the understanding of the SuDS philosophy correlates to the extent to which it is embedded in policy and practice over time, the three ‘pillars’ of sustainable stormwater management practice are generally accepted as;

(i) Reducing the rate and quantity of stormwater discharge,

(ii) Improve the quality of stormwater discharges and receiving water bodies and

(iii) Provide amenity and biodiversity value.

Consideration of the sensitivity of the surrounding environment and downstream water quality is fundamental to the successful implementation of SUDS systems, particularly as we face into the uncertainties of a changing climate.

2.2 Benefits of SuDS

Traditional surface water drainage design is relatively simple, using the Rational method to size pipes to ensure that surface water is removed as quickly as possible to ensure flooding does not take place on the road itself. Unfortunately, this philosophy is flawed as, in more rapidly transferring the surface water downstream, it provides the potential for flooding of other areas. This accelerated run-off gives rise to higher flood levels and the corresponding loss of groundwater recharge results in reduced low flows in rivers thus increasing environmental vulnerability. In addition, the pollution in the run-off is conveyed into the natural environment.

SuDS offer multiple benefits over traditional drainage practices managing discharge rates, volumes and diffuse pollution as well as providing the flexibility for adaption to future drainage needs through a modular implementation. Climate change predictions suggest that some types of extreme events will become more frequent, such as heat waves, flooding caused by extreme rainfall and drought. The SuDS approach is more robust and adaptable than the traditional approach of underground piped drainage systems. In shallow surface based systems, such as swales, water levels rise gradually and visibly. When the capacity of the SuDS feature is exceeded, the excess water can be directed to safe storage zones. This allows the general public, and road owners and operators to prepare for flood events more effectively. Conversely, flooding from underground piped drainage systems can occur suddenly and rapidly when the design capacity is exceeded. Furthermore, shallow, visible surface based systems can be designed to offer greater flexibility to adapt to Climate Change. SuDS systems can enhance more readily and cheaply, compared to underground drainage systems. Lower River flows; caused by drought, result in reduced dilution of pollutants following rainfall events. The treatment of surface water runoff, through SuDS, helps to protect and enhance the quality of receiving watercourses.

2.3 Factors Influencing the Design of SuDS

There is no unique solution and each situation has to be evaluated on its own merits and suitable SuDS solutions applied, although the means to achieving these objectives are many and varied. Factors such as site suitability, available space, cost, maintenance regimes and community acceptance must be considered to ensure successful implementation. The various SuDS features can generally be categorised as ‘hard’ SuDS and ‘soft’ SuDS. Soft SuDS resemble natural features and include techniques such as swales, ponds and wetlands. Hard SuDS are more similar to traditional drainage methods, but incorporate SUDS principles. Examples of these are permeable pavements and proprietary SUDS features such as filtration systems and vortex separators.

2.4 The Management Train

The individual components described above do not constitute SuDS, if applied in isolation. The SuDS philosophy, and effective stormwater management in general, requires a series of SuDS features, linked together, to form a stormwater management system to treat and attenuate surface water runoff as close to the source of runoff as possible, before being conveyed downstream for further treatment and storage.

3. OPPORTUNITIES FOR SUDS SYSTEMS IN A CHANGING CLIMATE

The principal treatment processes in a SuDS system are Sedimentation and Biodegradation.

3.1 Sedimentation

Sedimentation is one of the primary removal mechanisms in SuDS. Most pollution in stormwater runoff is attached to sediment particles and therefore the removal of sediment will achieve a significant reduction in pollution loading to receiving water bodies. Sedimentation is achieved through the reduction in flow velocities to a level at which the sediment particles fall out of suspension.

3.2 Biodegradation

Biodegradation is a natural biological treatment process that is a feature of several SuDS systems - systems that are subject to both wet and dry conditions. In addition to the physical and chemical processes of SuDS systems, biological treatment may also occur. Microbial communities may be established in the ground using the oxygen within the free-draining materials and the nutrients supplied with the inflows, to degrade pollutants such as hydrocarbons and grease.

The level of bioremediation activity will be affected by environmental conditions such as temperature and the supply of oxygen and nutrients. It also depends on the physical conditions within the ground such as the suitability of the materials for colonisation.

'Wet and Dry' SuDS Systems Perform Best

The presence of vegetation adds a physical filtration aspect to SuDS systems. In the case of filter strips leading to swale/basins, the majority of hydrocarbons are removed by the first stage. If vegetation has been affected by drought, this element of the treatment train will be absent (in a worst-case scenario or significantly diminished at best). Maintenance of filter strips, swales and detention basins typically involve grass cutting. It is worth noting that hydrocarbons are also broken down by UV light in a process called photolysis, but where increasing levels of contaminants are building up in the soil (in the swale, basin, pond or wetland) the affected soil is likely to require removal and will more than likely be classified as contaminated waste.

The most recent published literature suggests that ponds and wetlands do not seem to benefit from the enhanced biological treatment of hydrocarbons found in the oxygen-rich conditions of the swales and basins (which are not designed to hold a permanent volume of water). Nonetheless, ponds and wetlands have been utilised extensively as the default treatment system serving roads and motorways in Ireland and UK, with little supporting literature to justify such initiatives.

In the selection of the most resilient and enduring suds systems, this fact is important:

only the suds features that experience <u>both wet and dry conditions</u> benefit from this added biological treatment - ponds and wetlands are proposed as polishing stage options as part of a treatment train.

The temperature dependence of these aerobic microbes (responsible for this additional layer of treatment) means that the chemical and biological treatment mechanisms found in SuDS systems are enhanced with increasing temperature.

3.2.1 The Benefits of Vegetative Systems

The successful implementation of bioremediation systems requires the establishment of appropriate plants and /or microorganisms at the containment site. Factors to be considered include: (i) selection of appropriate plant species, (ii) the influence of contaminants on seed germination, (iii) the use of native versus non-native plants and (iv) the effectiveness of inoculating contaminated soils with microorganisms. Furthermore, the plant species must be well adapted to the soil and climate of the region, making soil characteristics, length of growing season, average temperature and annual rainfall important considerations in plant-assisted bioremediation/biodegradation planning. The rate of microbial degradation generally doubles for every 10 degree centigrade increase in temperature.

Indirect benefits include enhanced soil quality through improvements in soil structure, increased porosity and therefore water infiltration, providing nutrients, accelerating nutrient cycling and increasing soil organic carbon. The use of plants also stabilises the soil thus preventing erosion and direct human exposure.

3.3 SuDS Objectives

3.3.1 Quantity Control Processes

Several techniques can be implemented to control the quantity of runoff from a development. Each technique presents different opportunities for stormwater control, flood risk management, water conservation and groundwater recharge.

a) Infiltration

- Soaking of water into the ground

- Most desirable solution to runoff management as it restores the natural hydrologic process
- Impacted by groundwater vulnerability and infiltration ability of subsoil

b) Detention / Attenuation

- Slows down surface water flows before their transfer downstream
- Usually achieved through use of a storage volume and constrained outlet
- Should be above ground
- Reduces peak flow rate but total volume of runoff remains the same

c) Conveyance

- Transfer of surface runoff from one place to another
- Through grassed channels/trenches and pipes
- Transfer essential for managing flows and linking SuDS components
- Uncontrolled conveyance to a point of discharge in the environment not considered sustainable

d) Water Harvesting

- Direct capture and use of runoff on site for domestic or irrigation, overflowing/discharging to adjoining SuDS component(s)
- Contributes to Flood Risk Management

3.3.2 Quality Control Processes

A number of natural water quality treatment processes can be exploited within SuDS design. Different processes will predominate for each SuDS technique and will be present at different stages in the treatment train (*Refer to Section 3.5*).

a) Sedimentation – reducing flow velocities to a level at which the sediment particles fall out of suspension;

b) Filtration & Biofiltration – trapping pollutants within the soil or aggregate matrix, on plants or on geotextile layers;

c) Adsorption – pollutants attach or bind to the surface of soil or aggregate particles;

d) Biodegradation – Microbial communities in the ground degrade organic pollutants such as oils and grease;

e) Volatilisation – transfer of a compound from solution in water to the soil atmosphere and then to the general atmosphere;

f) Precipitation – transform dissolved constituents to form a suspension of particles of insoluble precipitates;

g) Plant Uptake – removal of nutrients from water by plants in ponds and wetland;

h) Nitrification – Ammonia and ammonium ions can be oxidised by bacteria in the ground to form nitrate which readily used as a nutrient by plants;

i) Photolysis – The breakdown of organic pollutants by exposure to ultraviolet light.

3.3.3 Amenity & Biodiversity Processes

SuDS provides opportunities to create attractive landscaping features which offer a variety of amenity/biodiversity. The following are the main SuDS components offering aesthetic, amenity and ecological benefits *(Refer to Section 6 for details on each technique)*

Primary Processes:

a) Blue/Green Roofs
b) Grassed channels/Swales
c) Filter strips
d) Bioretention Areas
e) Vegetated swales and detention basins
f) Infiltration Basins

Benefits subject to design:

a) Ponds
b) Wetlands

3.3.4 Water Quality

There are no Q Value monitoring points outlined along the Sluice River on the Environmental Protection Agency's online map viewer database. Transitional water quality readings between 2010 – 2012 indicate that the transitional waters where the Sluice River meets the Baldoyle Estuary, approximately 2km downstream of Kinsaley, were of "Eutrophic" status indicating that there was high nutrients and plant growth in these waters.

The Water Framework Directive Monitoring Programme became operational in 2006. The introduction of Water Framework Directive has been a key driver in the implementation of SuDS. For the most recent monitoring period (2010 – 2015), the Sluice River has not been assigned a quality status. The status of the Balydoyle Estuary is also currently unassigned.

Although readily available information was not available at the time of writing, the implementation of SuDS as part of future development within the LAP should ensure that the quality and quantity of discharge from future development to the river will not negatively impact the existing condition of the river, moreover, the adoption of SuDS systems in all new developments, the retrofitting of SuDS and the protection of existing floodplains shall assist in the attainment of our objectives under the Water Framework Directive.

3.4 Effects of Climate Change

The effects of climate change need to be considered when designing and preparing maintenance regimes for SuDS features. Sedimentation is one of the primary removal mechanisms in SuDS. As discussed above in Section 3.1, this is achieved through the reduction in flow velocities to a level at which particles fall out of suspension. However, care must be taken through design and appropriate maintenance regimes to ensure the risk of re-suspension is minimised during extreme rainfall events.

The level of biodegradation activity that occurs within SuDS features will be affected by environmental conditions such as temperature and the supply of oxygen and nutrients. It is also depending on the physical conditions within the ground such as the suitability of the materials for colonisation.

3.5 SuDS Techniques

In addition to the objectives above, in order to replicate the natural drainage system, a 'Management Train' is required. The Management Train sets a hierarchy of SuDS techniques which should be implemented in series as follows:

(iv) Prevention – prevent runoff and pollution

(v) Source Control – control runoff at or close to the source

(vi) Site Control – management of surface water in the site/local area

(vii) Regional Control – management of surface water from a number of sites together

Various SuDS components have different capabilities regarding the objectives outlined above and are more suited to certain stages of the Management Train. The principle of the Management Train is that wherever possible, surface water should be managed locally in small, sub-catchments rather than being conveyed to and managed in large systems further down the catchment. Table 3.1 below contains examples of SuDS techniques for Source, Site and Regional controls. *(Refer to Section 6 for details on each technique).*

Table 3.1 SuDS Techniques for Source, Site & Regional Control

Source Control	Site Control	Regional Control
Rainwater Harvesting	Permeable Paving	Detention Ponds/Basins
Green Roofs	Bioretention Strips	Retention Ponds/Basins
Permeable Paving	Infiltration Trenches	Wetlands
Bioretention Strips	Filter Drains	Infiltration Basins
Filter Drains	Filter Strips	Detention Basins
Infiltration Trenches	Swales	Petrol Interceptors*
Filter Strips	Sand Filters	
Soakaways	Infiltration Basins	
Blue Roofs	Detention Basins	
Swales	Petrol Interceptors*	

*Use of Petrol Interceptors should be avoided except where the potential for hydrocarbons entering the surface water drainage network is particularly high. Treatment of surface water runoff should be provided through the use other SuDS techniques.

3.6 Modular SuDS Components

Management trains for new and existing developments should facilitate the construction of future SuDS components and/or provide for future enhancements to existing SuDS components – to mitigate the risk of flooding caused by more extreme rainfall events and risk of pollution due to lower baseflow in receiving waters.

Modular components can include:

- Additional physical SuDS features e.g. swales, basins and ponds and/or;
- Enhancements to existing SuDS features by upsizing and/or;
- Introducing vegetation and/or;
- Management actions e.g. changing the maintenance regime in response to findings of a monitoring regime.

Subject to the findings of a monitoring regime, it may be found that more frequent maintenance of the SuDS components (e.g. grass cutting, disposal of contaminated soil and planting) may negate the requirement for additional SuDS components.

4. REVIEW OF EXISTING DRAINAGE NETWORK IN RESPECT OF SUDS

This section outlines the various SuDS techniques, existing and proposed in either live planning applications or development proposals, within the Kinsaley LAP area. Information has been gathered from a review of planning applications in Kinsaley, Fingal Development Plan 2017-2023, and a site visit undertaken on the 31st August 2018.

Development in Kinsaley is predominantly residential. Recent construction occurred during 2006 (St. Olave's / Abby Well) and 2015 (Cooper's Wood and Emsworth Park). Implementation of SuDS techniques by Local Authorities typically began following the publication of the Greater Dublin Strategic Drainage Strategy (GDSDS) in 2005.

4.1 Current Scenario

Table 4.1 Impact of Existing SuDS Techniques on Existing Drainage Network

Development	SuDS Techniques	Comment	Impact on Existing Network
Cooper's Wood	Roadside Swales	Roadside swales to the north of the development draining roads within the estate	Reduces potential runoff to existing network via infiltration. Removal of potential urban pollutants
	Probable Permeable Paving	Paving stones at site but planning application shows macadam	Reduces potential runoff to existing network. Removal of potential urban pollutants
	Underground attenuation	To east of site.	Prevents increase in peak flow rate in drainage network as a result of development
Emsworth Park	Cascading Roadside Swales	Swales are draining parts of the roads within the estate	Reduces potential runoff to existing network via infiltration. Removal of potential urban pollutants
	Roadside Basin	To north east of site. Road runoff drains to the basin.	Provides attenuation and prevents increase in peak flow rate in drainage network as a result of development
	Permeable Paving	Permeable paving on driveways allows partial infiltration of surface water to subsoil	Reduces potential runoff to existing network. Removal of potential urban pollutants
	Underground attenuation	The south west of the site.	Prevents increase in peak flow rate in drainage network as a result of development

4.2 Future Scenario – Live Planning Applications / Currently Under Construction

Table 4.2 Impact of SuDS Techniques in Live Planning Applications on Existing Drainage Network (i.e. planning permission already granted) / Sites currently under development

Development	SuDS Techniques	Comment	Impact on Existing Network
Housing Development south of Chapel Road, opposite Kinsaley Lane, residential and childcare scheme (Under Construction) Planning Reference: *F16A/0511*	Surface Water Attenuation	Hydrobrakes at connection points to existing network. Underground attenuation systems. Detention Basins.	Prevents increase in peak flow rate in drainage network as a result of development.
	Infiltration Trenches	Infiltration trenches in back gardens and adjacent to roadways, discharging to piped network	Reduces runoff rate, volume and pollutants entering drainage network.
	Permeable Paving	Permeable paving on driveways allows partial infiltration of surface water to subsoil	Reduces potential runoff to existing network. Removal of potential urban pollutants.
	Petrol Interceptor	Petrol interceptor located at Kinsaley Lane / Chapel Road	Prevents hydrocarbons entering existing drainage network
Construction of 101 bedroom residential care facility, Kinsaley Lane (Granted permission) Planning Reference: *F16A/0202*	Rainwater Harvesting	Units for use in building.	Reduces runoff volume entering the surface water drainage network.
	Surface Water Attenuation	Hydrobrakes at connection points to existing network. Retention ponds.	Prevents increase in peak flow rate in drainage network as a result of development.
	Filter strip / swale	Located along proposed access road.	Reduces runoff rate, volume and pollutants entering drainage network.
	Petrol Interceptor	Petrol interceptor located at south of site.	Prevents hydrocarbons entering existing drainage network

Development	SuDS Techniques	Comment	Impact on Existing Network
Construction of 101 dwellings consisting of 2 bed, 3 bed and 4 bed houses, Chapel Road (Granted permission) Planning Reference: F16A/0464	Permeable Paving	Permeable paving on driveways allows partial infiltration of surface water to subsoil	Reduces potential runoff to existing network. Removal of potential urban pollutants.
	Surface Water Attenuation	Hydrobrakes at connection points to existing network. Detention basins.	Prevents increase in peak flow rate in drainage network as a result of development.
	Petrol Interceptor	Petrol interceptor located at north of site.	Prevents hydrocarbons entering existing drainage network
Construction of a craft centre, Malahide Road (Granted permission) Planning Reference: *F16A/0491*	Permeable Paving	Permeable paving to parking spaces. Access road to consist of self-draining gravel on a stabilisation grid. Permeable paving to be constructed in plaza area.	Reduces potential runoff to existing network. Removal of potential urban pollutants.
	Infiltration Blanket	Runoff from parking bays and roofs to be directed to infiltration blankets.	Reduces runoff rate, volume and pollutants entering drainage network.

4.3 Future Scenario – Proposed Development and Infrastructure as per Fingal Development Plan 2017-2023 if built

Proposals for Kinsaley, as a village within the Metropolitan Area, in the Fingal Development Plan 2017-2023 include the following to protect and promote:

- Village character through preparation of a Village Development Framework Plan,
- A sustainable mix of commercial and community activity within an identified village core which includes provision for appropriate sized enterprise, residential, retail, commercial, and community facilities,
- The water services provision within the village,
- Community services which allow residents to meet and interact on a social basis, and include churches, community and sports halls, libraries and pubs,
- A mix of housing types and tenure which will appeal to a range of socio-economic groups,
- Retail activity, consistent with the Fingal Retail Strategy, in the form of village shops which will meet the needs of the local community,
- A public realm within the village which allows people to circulate, socialise and engage in commercial activity in a manner which balances the needs of all involved,
- The provision of Green Infrastructure, including natural, archaeological and architectural heritage, and green networks within the village,
- Zoning objective which aims to protect the special character of Rural Villages and provide for improved village facilities,

- Careful consideration of future development (ensure it does not expand rapidly, putting pressure on services and the environment and creating the potential for unsustainable travel patterns).

4.4 Sustainable Water Management

It is a specific objective of the current Fingal County Development Plan to require all Local Area Plans to protect, enhance, provide and manage green infrastructure in an integrated and coherent manner, which includes sustainable water management. This can be achieved through the implementation of the SuDS Protocol, (which will be discussed further in Section 6) along with natural floodplain management. It is a specific objective to establish riparian corridors free from new development along significant watercourses, including the Sluice River. Along the Sluice River, a 30m wide riparian buffer strip is required from top of bank to either side of all watercourses is required as a minimum. The provision of such buffer strips will:

- Preserve water quality by filtering sediment from runoff before it enters the river;
- Protect the river bank from erosion;
- Provide an undeveloped flood plain to accommodate flood waters during extreme flooding events (Refer to Kinsaley Strategic Flood Risk Assessment Flood Maps);
- Provide food and habitat for fish and wildlife;
- Preserve open space and aesthetic surroundings.

The primary impact on the existing surface water drainage network will be as a result of new development within the LAP boundary. Integration of SuDS techniques within these new developments will be required to ensure that the capacity of the existing network is not exceeded, and the quality of surface water runoff is not negatively impacted by the development. As discussed further in Section 6, it is recommended that runoff from private developments be managed at source, by limiting discharge to 2l/sec/ha and by providing attenuation for the 1 in 100 year rainfall event, including an allowance for climate change, within the curtilage of all proposed development plots. Runoff from public infrastructure such as roads and landscaped areas should be managed within the public realm, by also limiting discharge to 2l/sec/ha and by providing attenuation for the 1 in 100 year rainfall event, including an allowance for climate change of 20%. These SuDS features should also convey the attenuated flows from individual private plot. As discussed later in Section 6, runoff from roads and parking bays in public areas should be treated by a minimum of two SuDS components prior to discharge to receiving watercourses / sewers.

Based on the existing surface water drainage network and topographic levels obtained from contour mapping provided by FCC, it is likely that the majority of the LAP lands will outfall to the Sluice River. Where the new surface water drainage network for the LAP lands is connecting to the existing surface water network in Kinsaley, the capacity of the existing network will need to be established at these locations and discharge from the developments limited to acceptable flow rates. The quality of any runoff from any new development will need to be such that the existing water quality and flow regime is not negatively affected.

5. SUDS SELECTION

5.1 Land use

The majority of land within the LAP area is Zoned Objective RV – '*Protect and promote the character of the Rural Village and promote a vibrant community in accordance with an approved local area plan and the availability of physical and community infrastructure'*. Potential lands for future development currently within the Kinsaley LAP zoned RV are outlined in Table 5.1 below and in Appendix A.

Table 5.1 Potential lands for future development within the LAP Zoned Objective RV

Site Ref	Location	Name	Approximate size (ha)
1	Kinsaley Lane	Kinsaley Lane Development Area	2.5
2	Malahide Road	Garden Centre Development Area	1.3
3	Malahide Road (Teagasc Site)	Former Teagasc Development Area	6.5
4	Malahide Road	Malahide Road West Development Area	4.0
5	Malahide Road	Malahide Road East Development Area	0.26
6	Chapel Road	Kinsaley House Development Area	6.5

Site 4 is located on the southern bank of the Sluice River. Future development on these sites should incorporate the provision of a riparian corridor along the river, as per Fingal County Councils current development plan objectives.

5.2 Site Characteristics

The various site characteristics which influence SuDS techniques are outlined below. The site characteristics have been obtained from a desktop study of LiDAR and Contour maps, Ordnance Survey maps and Geological Survey of Ireland (GSI) maps. *Refer to Appendix B for relevant maps.*

5.2.1 Soils

The soil in Kinsaley generally consists of Limestone Till (Carboniferous), Limestone Sand and Gravels (Carboniferous), and Bedrock at surface with some Alluvium in the flood plain of the Sluice River. There are no GSI records showing the depth to bedrock. Localised ground investigation will need to be undertaken to determine the depth to bedrock at each development area. The aquifer vulnerability increases within the LAP borders in a south-west to north-east direction from moderate to extreme. *Refer to Appendix B.*

5.2.2 Area Draining to SuDS Component

The Kinsaley LAP lands comprise approximately 39.8ha in total, with varying; land uses, ecological characteristics, topography, subsoil permeability, historical development and with some areas at risk of flooding, therefore, a carefully selected Management Train of various SuDS components will be required to effectively manage surface water runoff.

5.2.3 Minimum Depth to Water Table

Typically, some SuDS techniques require a minimum 1m depth of soil between the maximum water Table level and the base of the device (e.g. Soakaways). Localised ground investigation will need to be undertaken to determine the depth to groundwater at each development area.

5.2.4 Site Slope

The slope of the lands within the LAP Area is diverse but generally slopes towards the Sluice River. The majority of the LAP area has gentle slopes less than 5% towards the Sluice River.

In steeper sections, swales can be routed along contours or fitted with cascades to reduce the effective gradient. Ponds and basins are not usually located in areas with slopes >5%, although tiered systems can be effective in treating runoff but need to be carefully designed.

5.2.5 Available Head

Based on existing levels in the proposed development areas, available head is unlikely to be an issue for any SuDS solutions.

5.2.6 Available Space

Given the extent of undeveloped land within the LAP, there should be significant available space to incorporate SuDS features as part of any future development. Planning applications granted on lands that are currently undeveloped have made an allowance for the inclusion of SuDS features.

5.3 Catchment Characteristics

5.3.1 Aquifers used for Public Water supply

The majority of Kinsaley is underlain by Poor Aquifer – Bedrock is Generally Unproductive except for Local Zones. In the south-eastern part Kinsaley is underlain by Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones. This suggests a reasonable depth to groundwater. This is expected based on the coastal location of the area. There are no GSI or EPA Source Protection Zones in the vicinity of the LAP area. GSI records show no wells within the LAP lands. *Refer to Appendix B*.

5.3.2 Surface Waters used for Public Supply

The watercourses in the area do not appear to be used for surface water abstraction.

5.3.3 Coastal / Estuarial Waters

According to the SuDS Manual (2015) and Greater Dublin Strategic Drainage Study (GDSDS), discharge to coastal waters do not typically require attenuation as there will be no deterioration in flood risk as a result of an increase in runoff. However, it will be necessary to provide a combination of source controls, site controls and regional controls as part of the Kinsaley surface water drainage system to protect and enhance the receiving costal / estuarine waterbodies. This will help achieve our obligations under the Water Framework Directive.

It will be necessary to provide a combination of SuDS systems within the curtilage of all new individual development plots and proposed public areas (to be taken-in-charge) as part of all new developments. This approach should be adopted in tandem with Fingal County Council Policy, to protect and enhance floodplains (as identified in the Strategic Flood Risk Assessment for the Kinsaley LAP), to ensure high water quality from runoff into these downstream areas.

5.3.4 Receiving Waters that act as Formal Recreational / Amenity Facilities

The following recreational / amenity facilities in receiving waters from Kinsaley have been identified:

- Burrow Beach located approximately 5.0km south east of Kinsaley;
- Portmarnock Beach located approximately 3.0km east of Kinsaley.

5.3.5 Requirements for Sustainable Water Management / Water Conservation Measures

The provision of rainwater harvesting for landscaping purposes shall be provided in all residential developments. Any commercial, educational or institutional buildings shall provide rainwater harvesting for non-consumption purposes (eg. flushing toilets).

5.3.6 Habitat – Dependent Flow Regime

As part of any future development within the LAP boundary, discharging to the existing surface water network should not exceed 2l/sec/ha. This shall be implemented via SuDS measures and on-site attenuation, ensuring that there is no significant impact on the existing flow regime of the Sluice River, and through the protection and enhancement of existing Floodplains.

5.3.7 Flood Risk

Proposed surface water drainage networks should be designed such that runoff is limited to 2l/sec/ha. *Refer to Kinsaley LAP Flood Risk Assessment*.

5.4 Quantity and Quality Performance

In selecting suitable SuDS components for a SuDS management train, the quantity of runoff and quality performance for various SuDs techniques should be assessed:

- Source Control techniques are most effective in reducing run off volume
- Open Channels and Detention Basins provide the best hydraulic control for large flows (1% AEP), and water quality benefits.
- Permeable paving, Infiltration and Filtration techniques (filter strips, swales, grassed channels) are most effective for water quality treatment
- Subsurface storage systems offer limited potential for water treatment.

5.5 Community, Environmental and Amenity Performance

Community and environmental factors for various SuDS techniques include Maintenance Regime, Community Acceptability, Construction and Maintenance Costs and Habitat Creation Potential.

Detention Basins and Swales (particularly Conveyance Swales) typically provide the most cost effective SuDS solution while also incorporating the potential for habitat creation.

The implementation of wetlands will typically promote habitat creation and are generally accepted by communities as they provide valuable open space for visual and recreational enjoyment, however capital and maintenance costs can be relatively high.
There may be some public safety concerns associated with SuDS techniques involving open water, however good design and education can help minimise these

concerns. This can be achieved through 'demonstration projects' and initiatives to educate local residents of the benefits of SuDS systems and natural floodplain management approaches as a means to tackle flood risk, particularly in response to climate change and the adverse environmental effects of uncontrolled contaminated stormwater runoff from urban developments. The SuDS approach also offers benefits to the health and wellbeing of citizens.

6. SUDS STRATEGY

6.1 SuDS Protocol for New Development

As part of any future development within the Kinsaley LAP, the developing authority should adapt the following protocol. This protocol will provide guidance for assessing the resilience of SuDS to climate change during periods of drought, flash flooding, temperature extremes and periods of persistent rainfall and to propose appropriate resilient SuDS strategies to manage stormwater runoff arising from severe rainfall events now and into the future. An overview of this protocol is outlined in Figure 6.1 below.

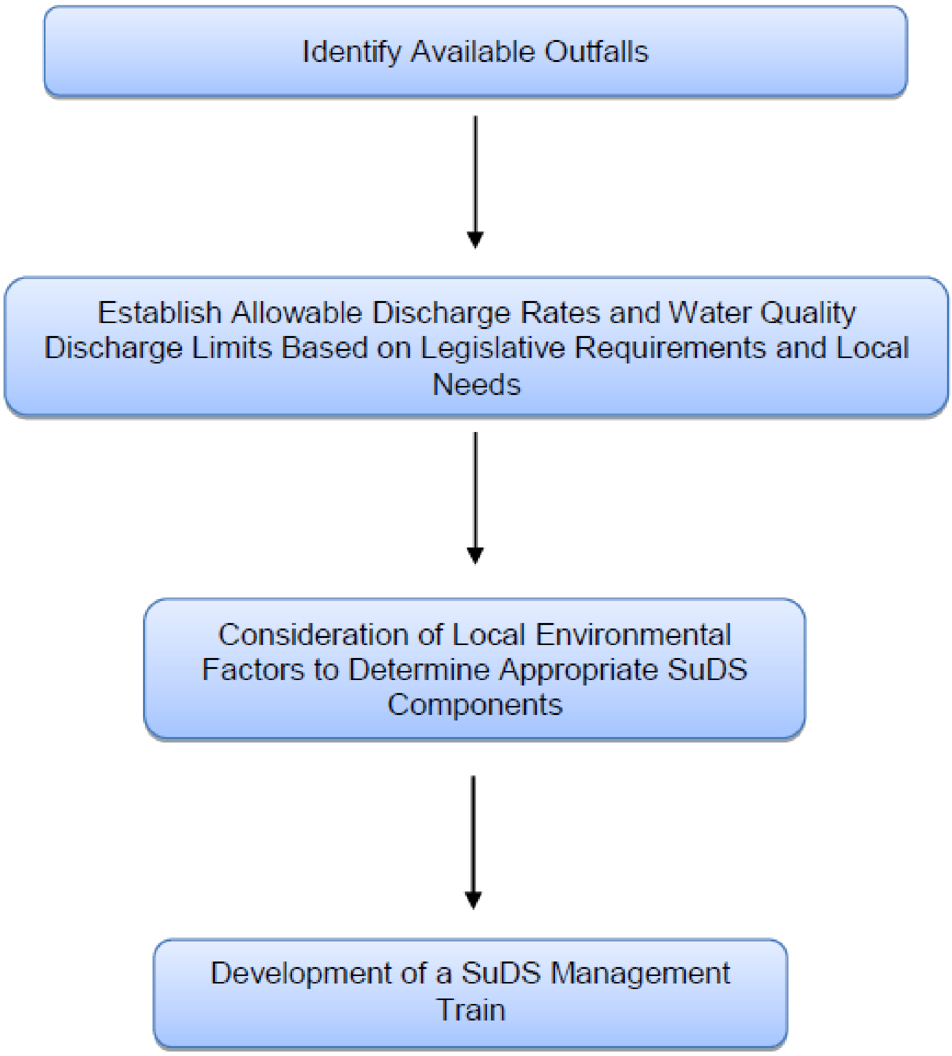


Figure 6.1 Recommended SuDS Protocol to Be Adapted

6.2 Management Train

A Management Train is usually required when developing a SuDS strategy. A Management Train sets a hierarchy of SuDS techniques which are subsequently linked together. Each technique employed contributes in different ways and degrees to the overall drainage network. The scale and number of components required will depend on the respective catchment characteristics and likely concentration of pollutants in the inflow. Considering the scale of proposed developments, a combination of carefully designed and appropriately maintained source controls, site controls and possibly regional controls are required as part of the surface water drainage system to ensure high water quality from runoff into these area.

Following a review of all the information presented in previous sections, a selection of some SuDS techniques suitable for inclusion in the Kinsaley LAP are described below. Given the extent of potential development lands within the LAP and that source and site control devices should be utilised on these lands, regional control measures may not be required.

6.3 Source Controls

6.3.1 Water Butts

Water Butts are small, offline storage devices designed to collect runoff from roofs. They are the most common means of harvesting rainwater for garden use and have a typical capacity of less than $0.5m^3$. Two-stage devices can provide some storage volume for attenuation using a throttled overflow, however poor maintenance can lead to blockages.

Table 6.1 Advantages of Water Butts

Advantages
Ease of installation (new and retrofit)
Inexpensive
Provides water for non-potable means – typically garden use
Suitable for all developments

Figure 6.2 Domestic Water Butt (Susdrain.org)

Water Butts are recommended for all residential properties.

6.3.2 Rainwater Harvesting

Rainwater harvesting involves collection of rainwater from roofs and hard surfaces, similar in principle to Water Butts but generally on a much larger scale. Collected water is typically used for non-potable purposes such as irrigation, flushing toilets and washing machines. The size of the harvesting tank depends on catchment area, seasonal rainfall pattern, demand pattern and retention time. Stormwater attenuation can also be provided by additional storage capacity in the tank.

Table 6.2 Advantages of Rainwater Harvesting

Advantages
Reduced demand of mains water
Can provide source control of stormwater runoff

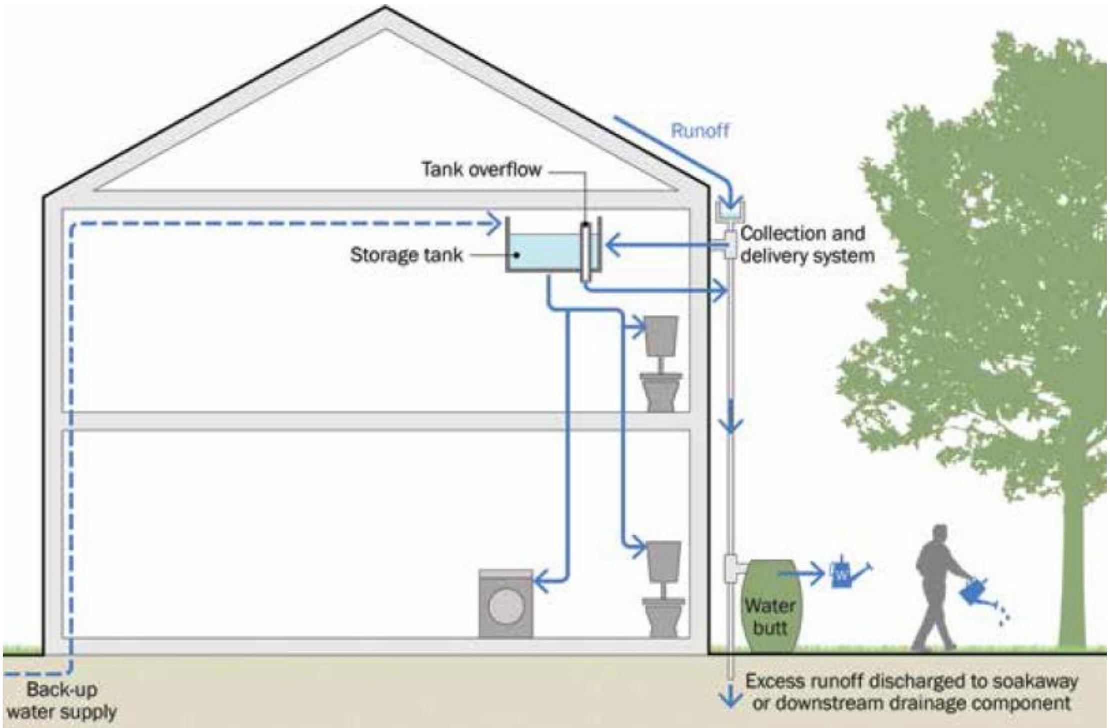


Figure 6.3 Rainwater Harvesting Schematic (CIRIA 753)

Rainwater Harvesting is recommended for use in commercial, industrial and educational buildings.

6.3.3 Permeable Pavements

Permeable pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater infiltrate through the surface and into the underlying layers where it is subsequently infiltrates to the ground and/or is collected and conveyed to the drainage network. Permeable pavements are most suitable for areas with light traffic loads and volume. The pavement generally caters for rainwater which lands directly on its surface but in certain cases, can accept runoff from other impermeable areas, such as Water Butts, Modified Planters or directly from rainwater goods and paved areas.

Table 6.3 Advantages of Permeable Paving

Advantages
Peak flow reduction
Runoff volume reduction
Effective in removing urban runoff pollutants
No additional land space requirements
Low maintenance costs
Good community acceptability

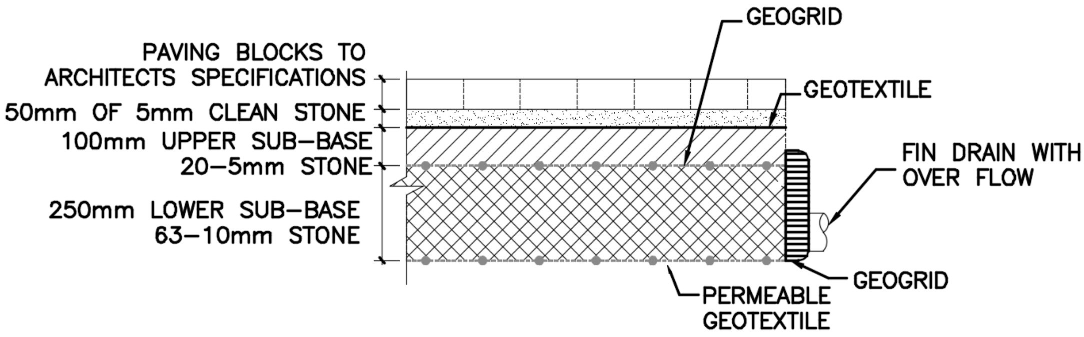


Figure 6.4 Typical Permeable Paving Detail

Permeable paving is recommended for all residential and commercial parking spaces. Lightly trafficked roads should be considered for permeable block paving. Detailed site investigation will be required to determine if total, partial or no infiltration to groundwater is possible.

6.3.4 Green / Blue Roofs

Green Roofs comprise a multi-layered system which covers the roof of a building with vegetation and landscaping over a drainage layer. Blue Roofs comprise a porous surface that is explicitly designed to store water. Both systems are designed to intercept and retain precipitation which reduces the volume and rate of surface water runoff. Both systems can be integrated on a variety of roof types and sizes, although larger roof areas are typically more cost effective. They are particularly suited to flat / gently sloping roofs on commercial buildings, sports centres, schools, apartment blocks and other similar buildings.

Table 6.4 Advantages of Green / Blue Roofs

Advantages
No additional land take
Ecological, aesthetic and amenity benefits
Good removal of atmospherically deposited pollutants
Provides further insulation to buildings
Runoff storage provided at source

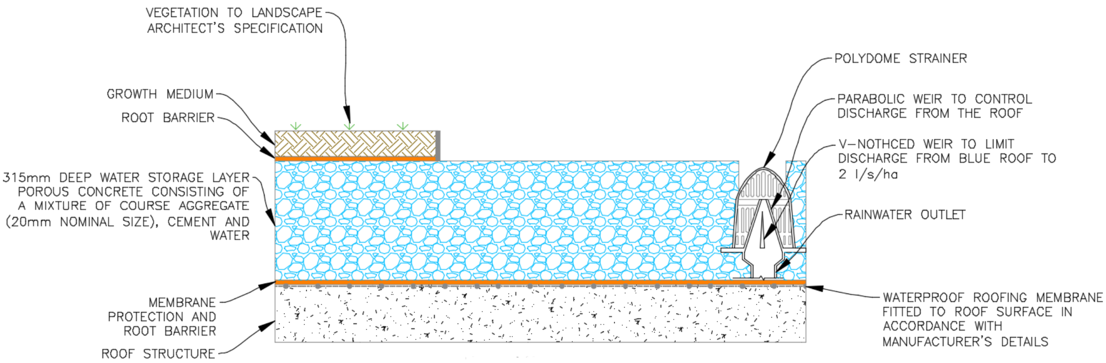


Figure 6.5 Typical Green / Blue Roof Schematic

6.3.5 Green Walls

Green Walls are walls that have plants growing on, or integrated within them, providing a living and self-regenerating cladding system. Green walls can comprise climbing plants supported by the wall, hanging plants which hang from suspended planters or plants growing within them.

Table 6.5 Advantages of Green Walls

Advantages
Can occupy much greater surface area than green roofs
High amenity & biodiversity benefits
Improves thermal efficiency of building
Good removal of atmospherically deposited pollutants

Figure 6.6 Green Wall (CIRIA C644, 2007)

6.3.6 Filter Drains

Filter drains are shallow excavations backfilled with granular material that create temporary subsurface storage for either filtration or infiltration of stormwater runoff. Filter drains can contain a perforated pipe at the base to convey runoff to further SuDS components in the Management Train.

Table 6.6 Advantages of Filter Drains

Advantages
Can reduce runoff rates and volumes
Significant reduction in pollutant load
Easily incorporated into site landscaping

Figure 6.7 Example Filter Drain

Subject to appropriate ground conditions, filter drains are recommended for draining residential back gardens and other small grassed areas where subsoil permeability is low. Filter drains can also be used to drain carriageways. The base of the filter drain should be a minimum 500mm above highest expected groundwater table level.

6.3.7 Soakaways

Soakaways are excavations that are filled with a void-forming material that allows the temporary storage of water before it soaks into the ground. They are generally suited for small catchments, such as within the curtilage of a dwelling. Many soakaways are now constructed with geocellular units, as these units provide good overall storage capacity.

Table 6.7 Advantages of Soakaways

Advantages
Minimal net land take
Provides groundwater recharge
Good volume reduction and peak flow attenuation
Easy to construct and operate

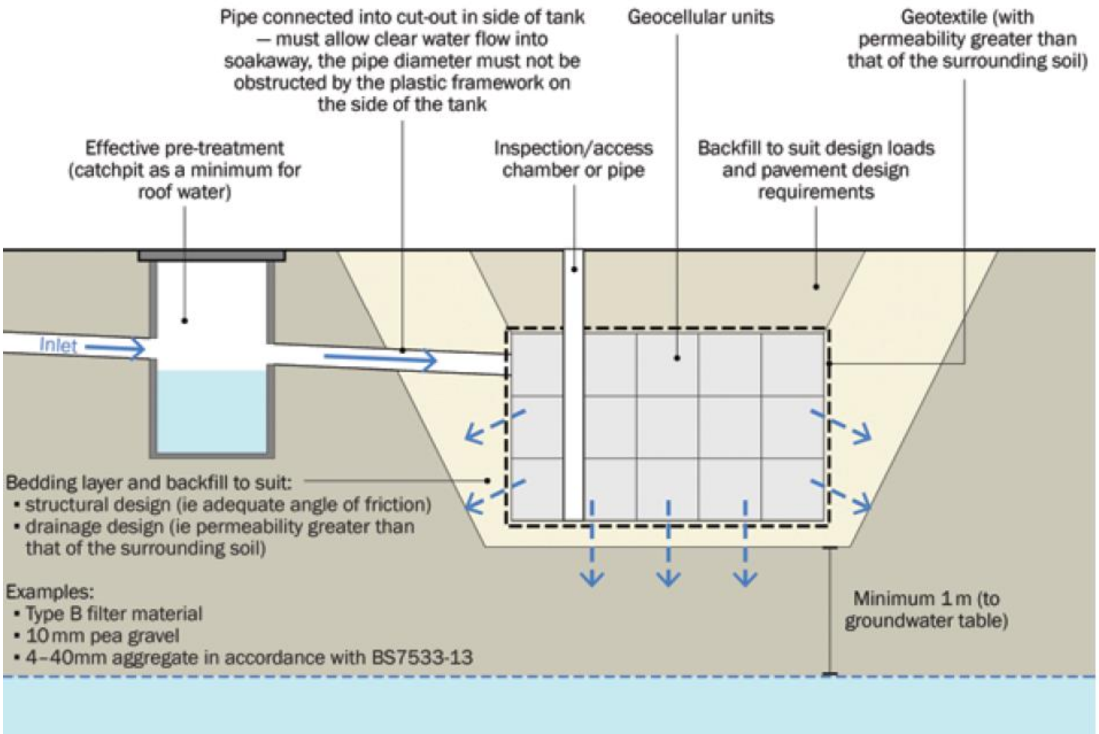


Figure 6.8 Typical Schematic of a Soakaway (SuDS Manual, 2015)

Subject to appropriate ground conditions, soakaways are recommended for draining residential gardens and other small grassed areas where subsoil permeability is low.

6.4 Site Controls

6.4.1 Swales

Swales are broad, shallow, vegetated drainage channels which can be used to convey or store surface water. Swales are generally suited for small catchments with impermeable areas. They are typically provided along roads in grass verges. Swales can be designed for infiltration to subsoil or detention and conveyance to another stage in the management train. Conveyance can be in the open channel or in a perforated pipe within a filter bed below the base of the channel.

Table 6.8 Advantages of Swales

Advantages
Good removal of pollutants
Easy to incorporate into landscaping
Peak flow reduction
Runoff volume reduction (depending on design)

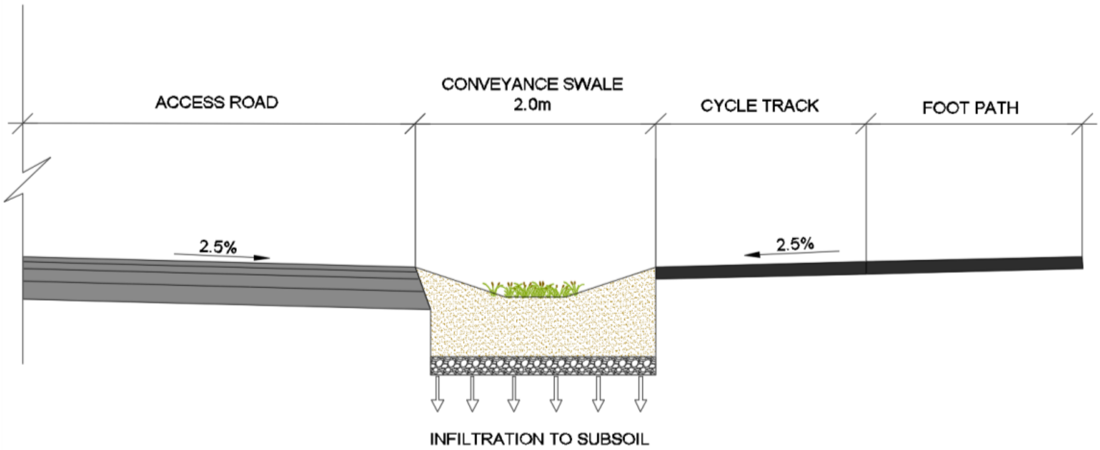


Figure 6.9 Typical Swale Schematic

Figure 6.10 Example Roadside Swale – Emsworth Park, Kinsaley

Swales are recommended to cater for runoff from access roads, providing water treatment and reduction in peak flow. Depending on local subsoil conditions, dry swales are recommended which provide infiltration and further reduce runoff volume. Where vehicle and pedestrian access is required across a swale, a causeway can be provided. The levels at the outer swale banks will be higher than at the centre of the crossing point. This drop in level acts as an exceedance route for runoff from the swale during extreme rainfall events.

Figure 6.11 Example Causeway for Access Across Swale (Robert Bray Associates)

6.4.2 Bioretention Areas / Modified Planters

Bioretention areas are stormwater controls that collect and treat stormwater runoff. The runoff is treated using soils and vegetation in shallow landscaped basins to remove pollutants. Treated runoff can be collected and conveyed further downstream and/or allowed infiltrate into the subsoil. Part of the runoff volume will be removed by evaporation and plant transpiration.

Table 6.9 Advantages of Bioretention Areas / Modified Planters

Advantages
Very good removal of pollutants
Runoff volume and peak flow reduction
Flexible layouts possible
Can be aesthetic landscaping features

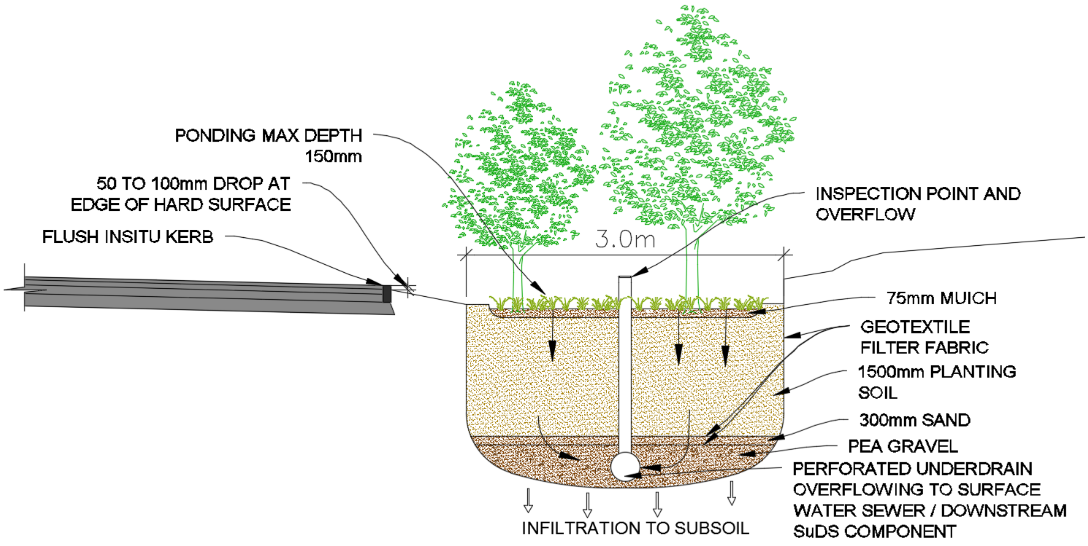


Figure 6.12 Bioretention Area Schematic

Figure 6.13 Example Roadside Bioretention Area (Portlandoregon.gov)

Bioretention areas are recommended to cater for runoff from residential neighbourhoods and car parks.

6.4.3 Detention Basins

Detention Basins are dry basins that attenuate stormwater runoff by providing temporary storage with flow control of the attenuated runoff. Detention basins are generally applicable to most types of developments. In residential areas they are normally dry and often function as a recreational facility, e.g. sports fields or play grounds. They may be constructed such that surface runoff is routed through them during storm events with an outflow restriction (online), or such that runoff typically bypasses the detention basin until a design storm event occurs when runoff is received by a flow diverter or overflow and temporarily stored until the inflow recedes below a design level (offline). Small permanent pools at the outlet can enhance water treatment quality.

Table 6.10 Advantages of Detention Basins

Advantages
Can cater for wide range of rainfall events
Simple to design and construct
Potential for dual use
Easy to maintain

Figure 6.14 Example Detention Basin (SuDS Manual, 2015)

6.5 Regional Controls

6.5.1 Ponds

Ponds are basins which have a permanent depth of water. They can be constructed in an existing depression, by excavating a new depression or by constructing embankments. Runoff which enters the pond is detained and treated by settlement and often biological uptake before outfalling. Ponds should contain the following features:

- Sediment Forebay – This may not be required if previous SuDS techniques are implemented upstream
- Permanent pool – This minimum volume of water (excluding losses due to infiltration and evaporation) will remain throughout the year. The main treatment associated with the pond occurs in this pool.
- Temporary Storage Volume – An additional storage volume within the pond to provide flood attenuation for design events.
- Aquatic Bench – A shallow zone around the perimeter of the pool to support wetland planting which provides biological treatment, ecology, amenity and safety benefits.

Table 6.11 Advantages of Ponds

Advantages
Good removal of pollutants
High potential ecological, aesthetic and amenity benefits

Figure 6.15 Example Landscaped Pond

Ponds are recommended at the end of proposed surface water drainage networks following previous SuDS techniques in the Management Train. Outflow from any proposed ponds may be restricted at times due to high tide levels and as such may require additional attenuation volume. Inclusion of several independent cells is encouraged which will enhance biodiversity, improve water quality levels and provide a more environmentally effective management programme.

6.5.2 Constructed Wetlands

Constructed Wetlands comprise of shallow ponds and marshy areas which are designed primarily for stormwater treatment but can also provide some attenuation above the permanent water level. Well designed and maintained wetlands can offer significant aesthetic, amenity and biodiversity opportunities. Constructed wetlands require a continuous baseflow to support a plant-rich community. Wetlands should contain the following features:

- Shallow, vegetated areas of varying depths
- Permanent pools or micropools
- Small depth range overlying permanent pool in which runoff control volumes are stored
- Sediment forebay
- Emergency spillway
- Maintenance access
- Safety bench

Table 6.12 Advantages of Constructed Wetlands

Constructed Wetlands
Good removal of pollutants
High potential ecological, aesthetic and amenity benefits

Figure 6.16 Example Constructed Wetland

Constructed Wetlands are recommended at the end of proposed surface water drainage networks following previous SuDS techniques in the Management Train. Their primary objective should be treatment, not attenuation. Outflow from any proposed ponds may be restricted at times due to high tide levels and as such may require additional attenuation volume. Inclusion of several independent cells is encouraged which will enhance biodiversity, improve water quality levels and provide a more environmentally effective management programme. Permanent pond volume should be provided in accordance with CIRIA C753 'The SuDS Manual'.

6.6 Recommended Management Train for Undeveloped Areas

Recommended SuDS features that should be utilised as part of a management train for undeveloped areas for residential, commercial, industrial and educational uses are outlined below:

SuDS Protocol for Residential Developments:

For all future residential developments:

- runoff within the curtilage of the property boundary shall pass through at least one SuDS component prior to discharging to downstream SuDS components within the public realm.
- Storage for the 100 year event (as a minimum) including a 20% increase in rainfall intensity for climate change shall be provided within the curtilage of the property boundary, with a maximum discharge rate of 2l/s/ha.
- Runoff from public areas (such as roads, parking bays, hard and soft landscaped areas and footpaths) shall pass through at least two SuDS components prior to discharging to the final downstream detention/retention/polishing SuDS components within the public realm.
- The Final SuDS Components located in the public realm shall comprise basins/ponds/wetlands (as appropriate), prior to discharge to the Sluice River or local surface water sewer.
- Storage for the 100 year event (as a minimum) including a 20% increase in rainfall intensity for climate change shall be provided for runoff from the public realm, with a maximum discharge rate of 2l/s/ha.

In addition, a 30m wide riparian buffer strip shall be provided from top of bank to either side of the Sluice River.

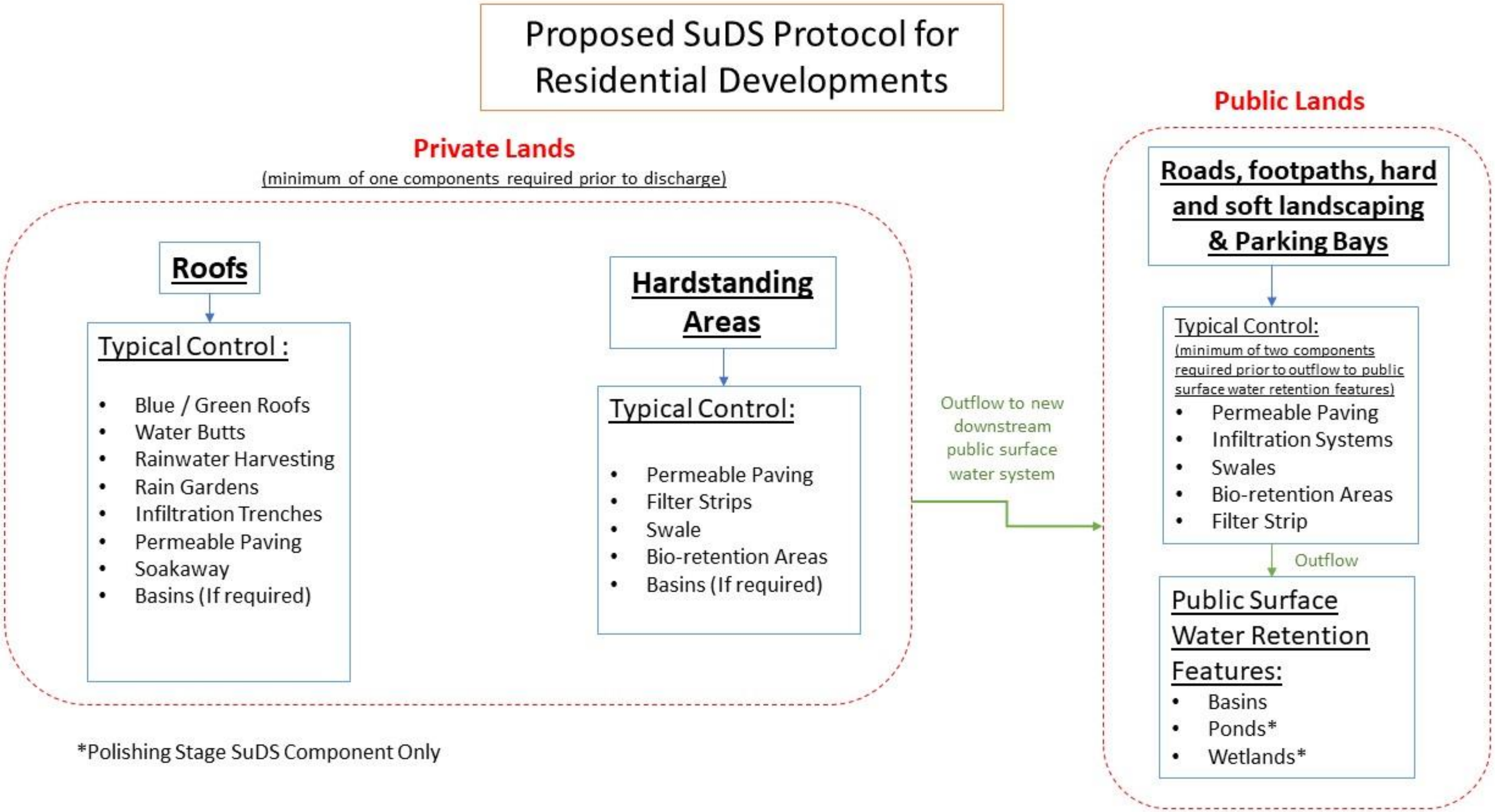


Figure 6.17 Proposed SuDS Features to Be Utilised for Residential Development Management Train

Commercial, Industrial, Educational and Apartment Developments:

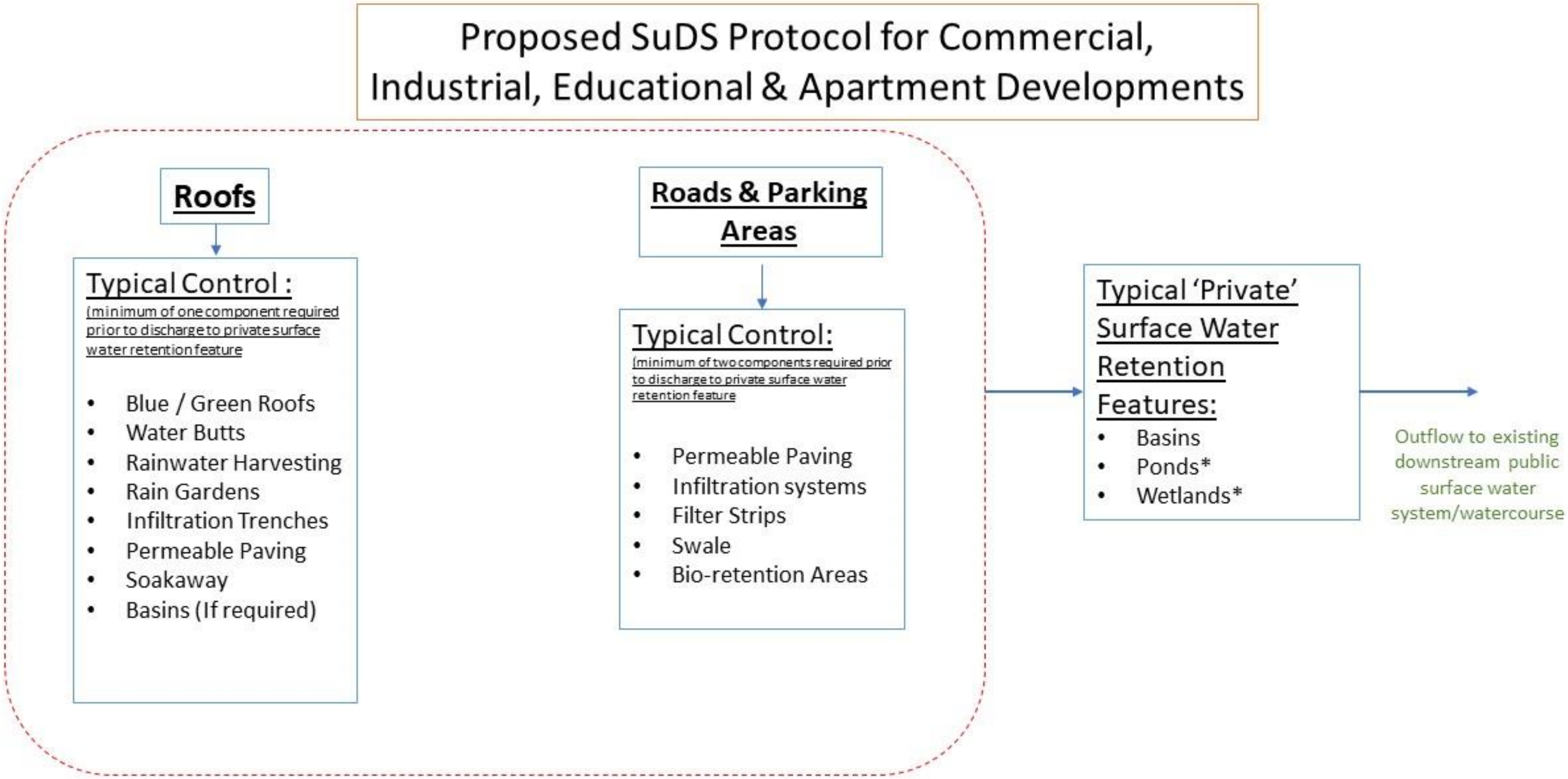
For all future commercial, industrial, educational and apartment developments:

- runoff from roofs shall pass through at least one SuDS feature prior to discharge to on-site surface water retention features.
- Blue/green roofs shall be provided to store the 100 year event with an allowance for Climate Change.
- runoff from roads and parking areas shall past through at least two SuDS features prior to discharge to the final on-site surface water retention features.

The final 'Private' surface water retention features shall comprise basins/ponds/wetlands (as appropriate), prior to discharge to the local surface water sewers/watercourses.

Storage for the 100 year event (as a minimum) including a 20% increase in rainfall intensity for climate change shall be provided for runoff from the developments, with a maximum discharge rate of 2l/s/ha.

In addition, a 30m wide riparian buffer strip shall be provided from top of bank to either side of the Sluice River.



*Polishing Stage SuDS Component Only

All new industrial/commercial and apartment developments shall incorporate blue / green roofs to attenuate the 1 in 100 year (incl. climate change) rainfall event.

Figure 6.18 Proposed SuDS Features to Be Utilised for Industrial, Commercial & Educational Development Management Train

If the R107 Malahide Road Realignment, Balgriffin Bypass (Specific Objective of current County Development Plan) is to be implemented, which is proposed to pass through the north western corner of the LAP lands, it is recommended that filter strips, swales and detention basins (as a minimum) be utilised to cater for runoff from the proposed road, providing water treatment and reduction in peak flow.

6.7 SuDS Retrofitting

There are opportunities for SuDS retrofitting throughout the LAP, however, this would be difficult to implement on existing private development. This is due to a lack of knowledge on the societal benefits of SuDS (economic, ecological, health and well-being, amenity etc.) by the general public. SuDS measures that could be implemented on existing private development include permeable paving on driveways, installation of rainwater harvesting systems and the provision of vegetated systems such as swales and bioretention areas within private gardens.

7. IMPACT OF SUDS STRATEGY

7.1 Runoff Quantity

Increase in the area of hardstanding within the development areas will result in an increase in the total runoff quantity due to reduced infiltration of surface water to ground. This increase will be minimised through the use of rainwater harvesting and evaporation and transpiration from open channels / ponds and vegetation respectively.

7.2 Runoff Quality

Management of runoff quality is important in order to protect existing water quality in receiving waters. The proposed SuDS Strategy implements a Management Train whereby runoff will pass through a series of SuDS techniques prior to outfall. Each technique will provide different treatment processes – settlement, filtration, removal of nutrients, removal of heavy metals and biological treatment through vegetation.

7.3 Amenity and Biodiversity

The lands in Kinsaley available for new development currently consist primarily of farmland with a mix of grass and tillage farms, the existing Teagasc facility and the garden centre lands on Malahide Road. The proposed SuDS Strategy will introduce a variety of features to promote and enhance amenity and biodiversity in the area. Tree plantings will be incorporated within Bioretention Areas. Ponds/Wetlands should be designed with an emphasis on ecology. Ponds should contain multiple pools fed by cleaner surface water runoff from surrounding grassland or scrub. This will allow a wider range of plants and animals to exploit the overall pond development. A variety of local (c.30km) pond plants should be included to maximise habitat structural diversity. A mix of open, lightly shaded and densely shaded areas will also add to the diversity of habitats available.

7.4 Flooding

Implementation of the SuDS Strategy will reduce peak flow runoff of the proposed development and minimise the risk of flooding. Ponds located in low lying areas will need to be designed to provide additional attenuation volume as it may not be possible to outfall during periods of extreme tidal events. *Refer to Kinsaley LAP Strategic Flood Risk Assessment*.

7.5 Groundwater

It is expected that the infiltration capacity of the soil within the LAP will be generally good as the LAP lands are within Soil Class 2, as identified in the Flood Studies Report. Infiltration SuDS techniques may be favourable as part of this SuDS Strategy. As a result of the proposed development, there will be a significant increase in the area of hardstanding within the LAP, resulting in a loss of surface water infiltration to the underlying subsoil. Where possible, infiltration SuDS techniques should be implemented to minimise the effect of the development and replicate the natural hydrological process. Site specific ground investigations should be undertaken when determining the infiltration capacity for future development sites.

7.6 Surface Water Drainage Network

The majority of land zoned for new development will require construction of new surface water drainage networks. These networks should discharge at the downstream end of the existing networks where possible. It is recommended that the SuDS Protocol described above is adapted for all sites and that a SuDS Management Train is developed for all future development sites, prior to discharging to the Sluice River.

8. CONCLUSIONS

- As part of new development in the LAP lands, new surface water drainage networks will be required.
- SuDS measures will be required as part of these new developments to ensure the quantity, quality and ecological/biodiversity value of downstream water bodies are protected and enhanced, to assist in achieving our obligations under the WFD.
- The protocols outlined in this report for the various land uses should be adopted as a minimum, in accordance with Fingal County Council policy, and overarching national and EU legislation.

9. RECOMMENDATIONS

1) New surface water drainage networks will be required as part of developments within lands available for development. These networks should be designed in accordance with this SuDS Strategy, CIRIA C753 'The SuDS Manual' and the Greater Dublin Strategic Drainage Systems (GDSDS).

2) Provide an undeveloped flood-plain to accommodate flood waters during extreme flooding events through the provision of a riparian corridor along the Sluice River – refer to the Strategic Flood Risk Assessment for the Kinsaley LAP.

3) For all future residential developments:
   - runoff within the curtilage of the property boundary shall pass through at least one SuDS component prior to discharging to downstream SuDS components within the public realm.
   - Storage for the 100 year event (as a minimum) including a 20% increase in rainfall intensity for climate change shall be provided within the

curtilage of the property boundary, with a maximum discharge rate of 2l/s/ha.

- Runoff from public areas (such as roads, parking bays, hard and soft landscaped areas and footpaths) shall pass through at least two SuDS components prior to discharging to the final downstream detention/retention/polishing SuDS components within the public realm.
- The Final SuDS Components located in the public realm shall comprise basins/ponds/wetlands (as appropriate), prior to discharge to the Sluice River or local surface water sewer.
- Storage for the 100 year event (as a minimum) including a 20% increase in rainfall intensity for climate change shall be provided for runoff from the public realm, with a maximum discharge rate of 2l/s/ha.

4) For all future commercial, industrial, educational and apartment developments:
   - runoff from roofs shall pass through at least one SuDS feature prior to discharge to on-site surface water retention features.
   - blue/green roofs shall be provided to store the 100 year event with an allowance for Climate Change.
   - runoff from roads and parking areas shall past through at least two SuDS features prior to discharge to the final on-site surface water retention features.
   - The final ‘Private’ surface water retention features shall comprise basins/ponds/wetlands (as appropriate), prior to discharge to the local surface water sewers/watercourses.
   - Storage for the 100 year event (as a minimum) including a 20% increase in rainfall intensity for climate change shall be provided for runoff from the developments, with a maximum discharge rate of 2l/s/ha.

5) A Management Train should be incorporated during the design stage whereby surface water should be managed locally in small sub-catchments rather than being conveyed to and managed in large systems further down the catchment.

6) Water Butts, Rainwater Harvesting, Rain Gardens and Permeable Paving are recommended for use in all residential developments.

7) Any Industrial, Commercial and Educational developments and Apartment blocks should incorporate rainwater harvesting for re-use and should incorporate blue / green roof structures.

8) Subject to subsoil permeability, filter drains may be required to drain residential gardens and other small green areas within future developments. Runoff from green areas should, where possible, infiltrate directly to groundwater.

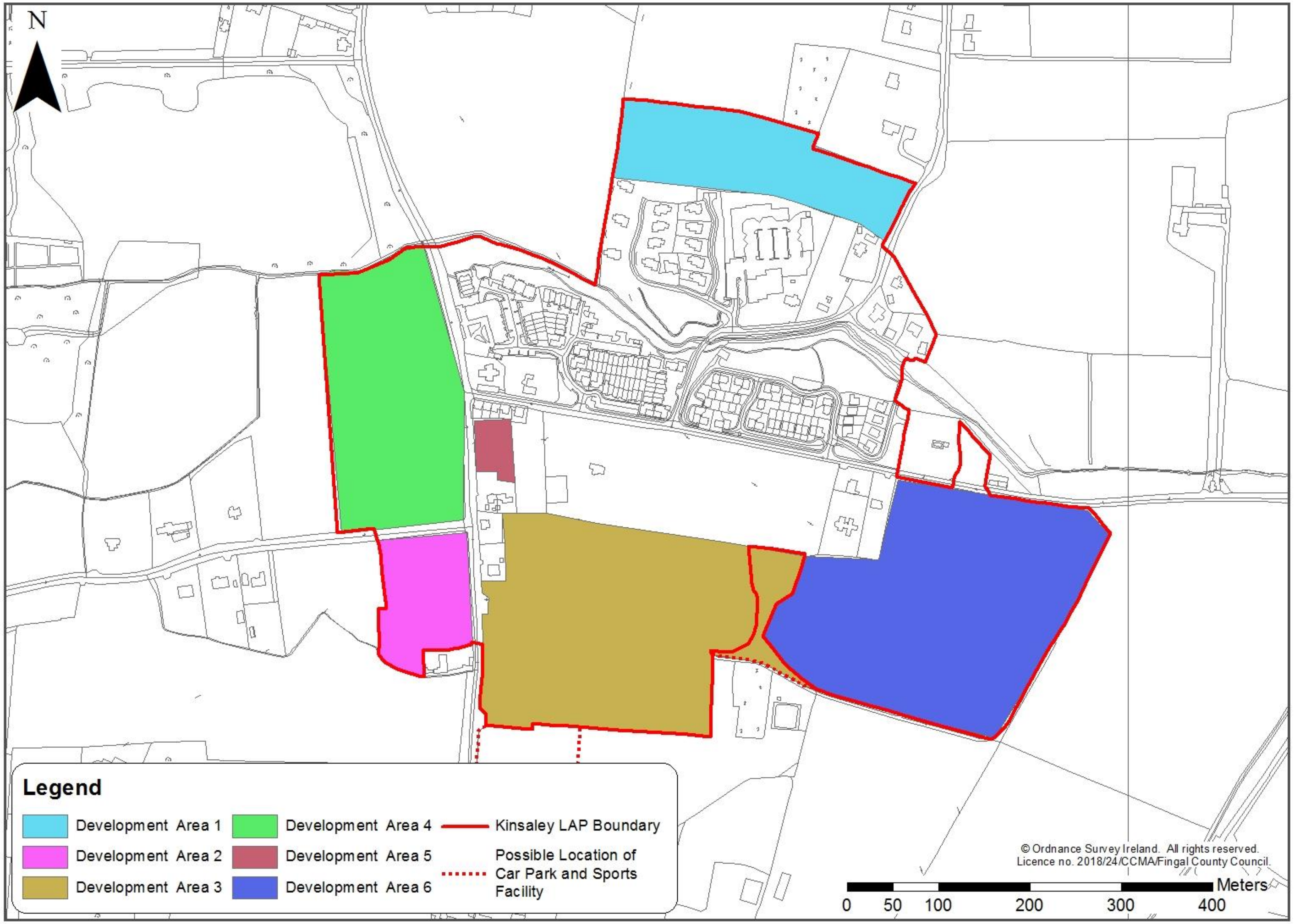
9) Runoff from development lands should be limited to 2l/sec/ha. Attenuation should be provided for the 1% AEP rainfall event plus an allowance for Climate Change in accordance with regional drainage policy.

10) The relevant authorities should promote the benefits of SuDS retrofitting to the general public.

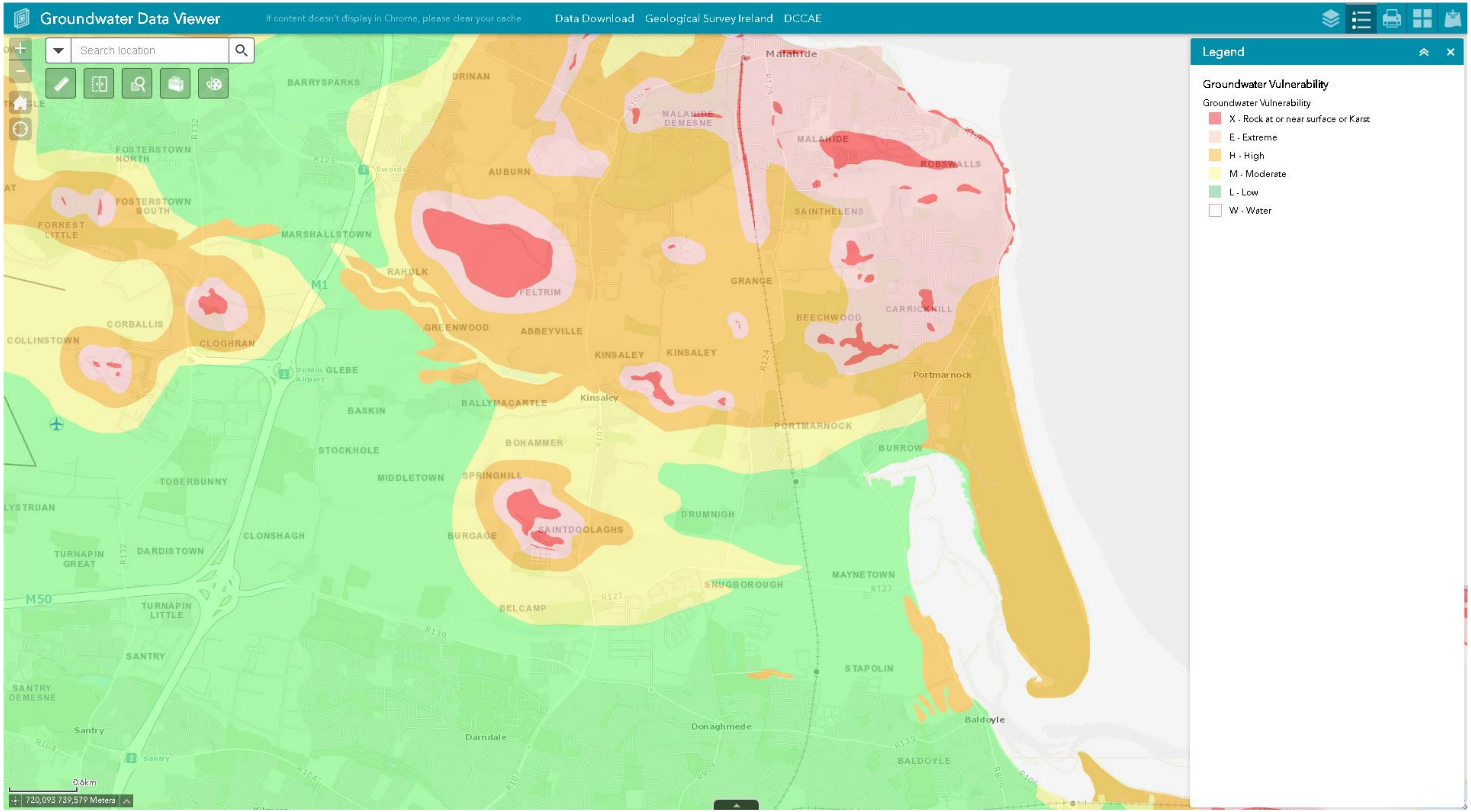
11) No residential development shall occur within the 0.1% AEP Fluvial or Tidal Flood Extent, including defended areas. Refer to Kinsaley LAP Flood Risk Assessment for flood extent mapping.

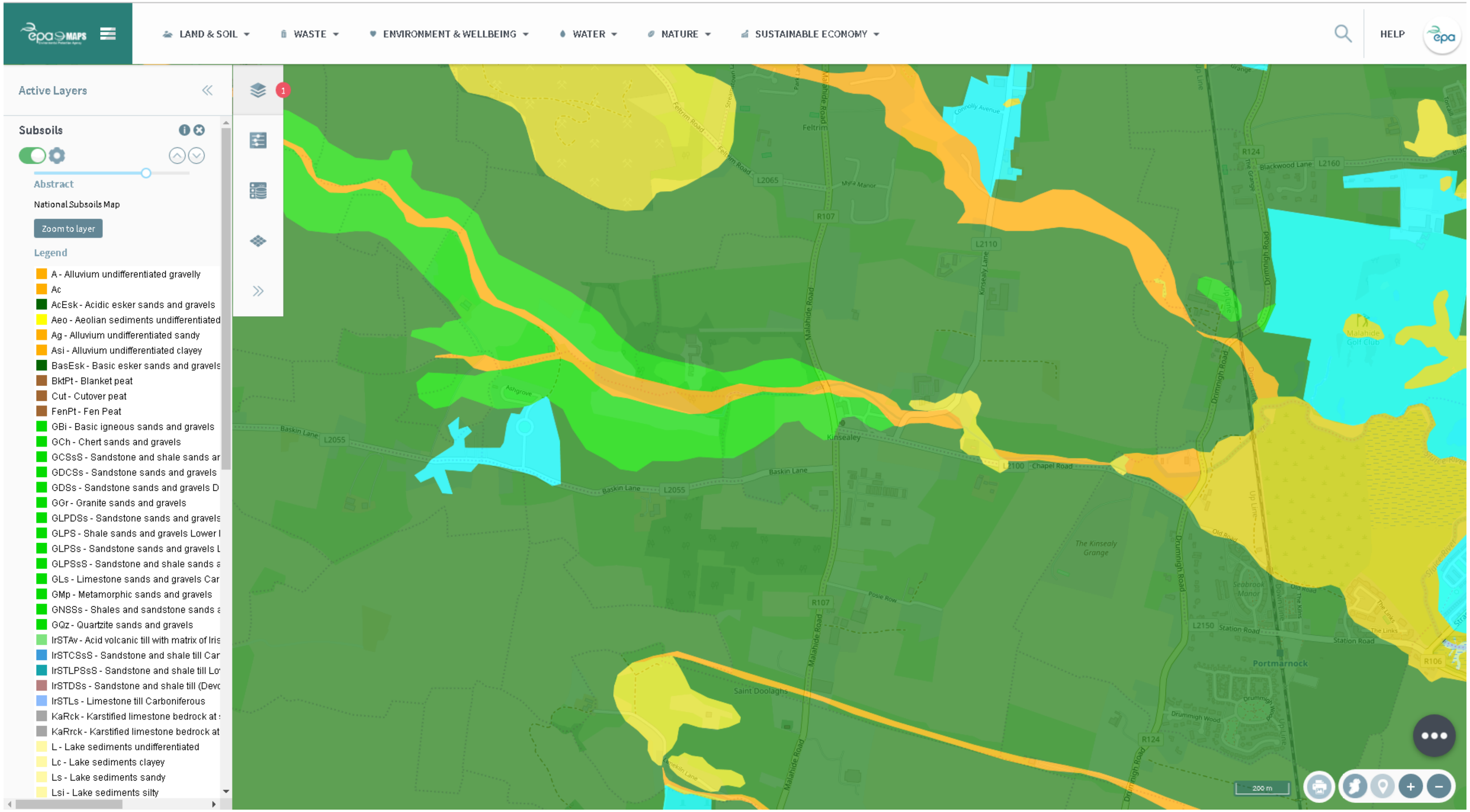
12) Management trains for new and existing developments should facilitate the construction of future SuDS components and/or provide for future enhancements to existing SuDS components – to mitigate the risk of flooding caused by more extreme rainfall events and risk of pollution due to lower baseflow in receiving waters.

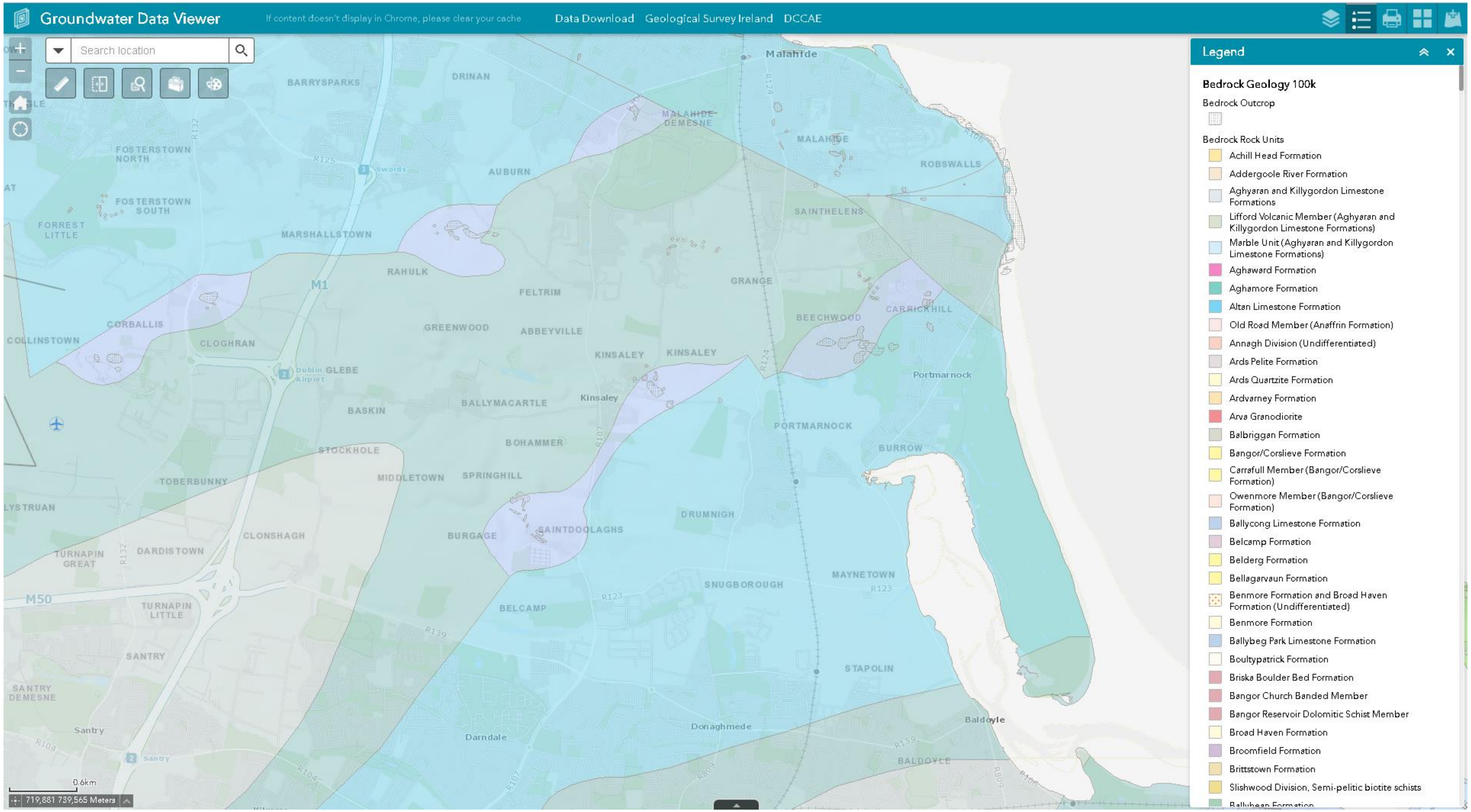
APPENDIX A
SITE LOCATION MAP

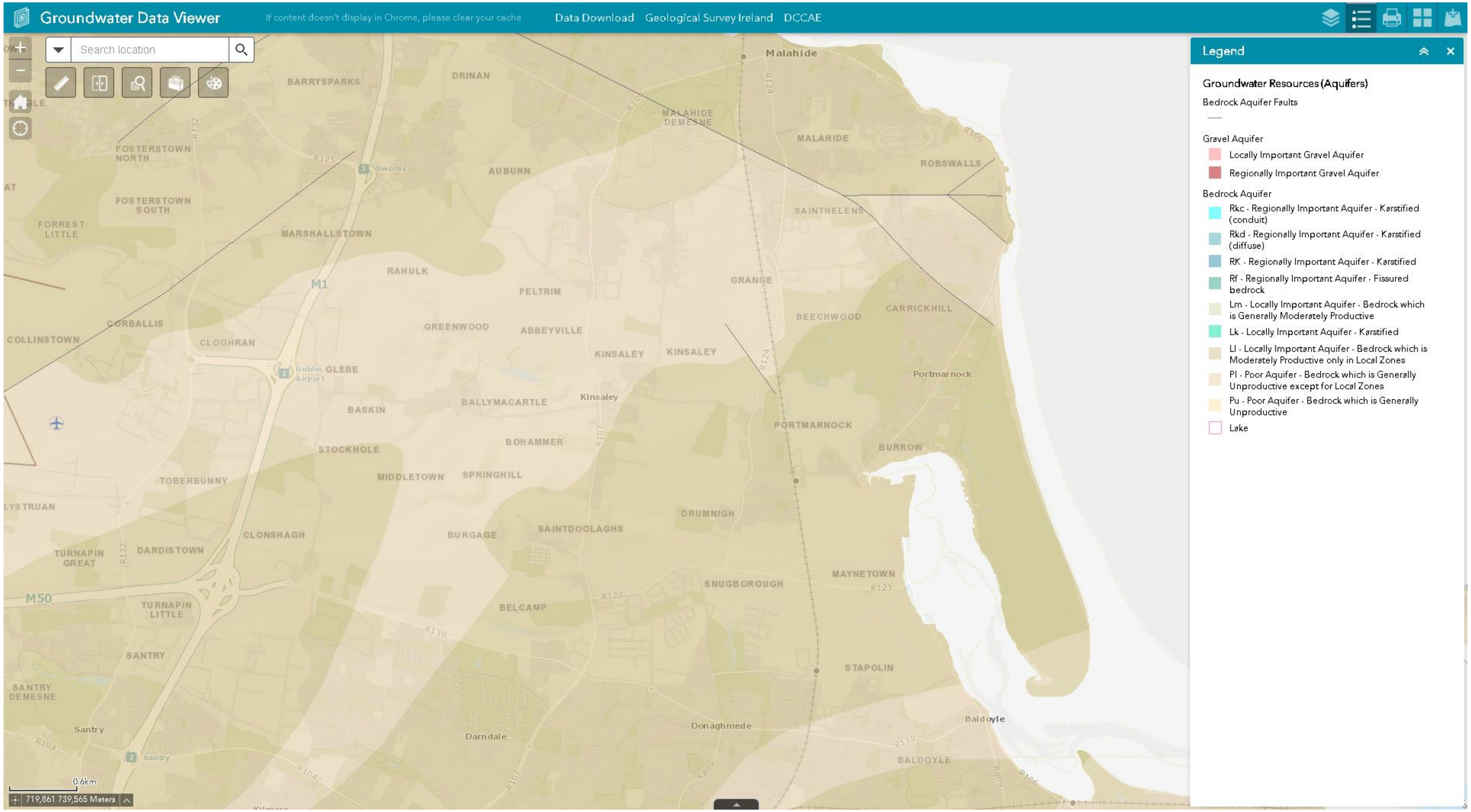

N
Legend
Development Area 1
Development Area 2
Development Area 3
Development Area 4
Development Area 5
Development Area 6
Kinsaley LAP Boundary
Possible Location of Car Park and Sports Facility
© Ordnance Survey Ireland. All rights reserved.
Licence no. 2018/24/CCMA/Fingal County Council.
Meters
0 50 100 200 300 400

APPENDIX B
GSI MAPS


Groundwater Data Viewer
If content doesn't display in Chrome, please clear your cache
Data Download
Geological Survey Ireland
DCCAE
Search location
Legend
Groundwater Vulnerability
Groundwater Vulnerability
X - Rock at or near surface or Karst
E - Extreme
H - High
M - Moderate
L - Low
W - Water
Malahide
MALAHIDE DEMESNE
MALAHIDE
ROBSWALLS
SAINTHELENS
GRANGE
BEECHWOOD
CARRICKHILL
Portmarnock
PORTMARNOCK
BURROW
KINSALEY
Kinsaley
DRINAN
AUBURN
FELTRIM
RAHULK
ABBEYVILLE
GREENWOOD
BALLYMACARTLE
BOHAMMER
SPRINGHILL
SAINTDOOLAGHS
BURGAGE
DRUMNIGH
SNUGBOROUGH
MAYNETOWN
BELCAMP
STAPOLIN
Baldoyle
BALDOYLE
Donaghmede
Darndale
BARRYSPARKS
FOSTERSTOWN NORTH
FOSTERSTOWN SOUTH
FORREST LITTLE
MARSHALLSTOWN
CORBALLIS
COLLINSTOWN
CLOGHRAN
GLEBE
BASKIN
STOCKHOLE
MIDDLETOWN
TOBERBUNNY
CLONSHAGH
DARDISTOWN
TURNAPIN GREAT
TURNAPIN LITTLE
SANTRY
SANTRY DEMESNE
Santry
M1
M50
0.6km
720,093 739,579 Meters


LAND & SOIL
WASTE
ENVIRONMENT & WELLBEING
WATER
NATURE
SUSTAINABLE ECONOMY
HELP
Active Layers
Subsoils
Abstract
National Subsoils Map
Zoom to layer
Legend
A - Alluvium undifferentiated gravelly
Ac
AcEsk - Acidic esker sands and gravels
Aeo - Aeolian sediments undifferentiated
Ag - Alluvium undifferentiated sandy
Asi - Alluvium undifferentiated clayey
BasEsk - Basic esker sands and gravels
BktPt - Blanket peat
Cut - Cutover peat
FenPt - Fen Peat
GBi - Basic igneous sands and gravels
GCh - Chert sands and gravels
GCSsS - Sandstone and shale sands ar
GDCSs - Sandstone sands and gravels
GDSs - Sandstone sands and gravels D
GGr - Granite sands and gravels
GLPDSs - Sandstone sands and gravels
GLPS - Shale sands and gravels Lower I
GLPSs - Sandstone sands and gravels L
GLPSsS - Sandstone and shale sands a
GLs - Limestone sands and gravels Car
GMp - Metamorphic sands and gravels
GNSSs - Shales and sandstone sands a
GQz - Quartzite sands and gravels
IrSTAv - Acid volcanic till with matrix of Iris
IrSTCSsS - Sandstone and shale till Car
IrSTLPSsS - Sandstone and shale till Lo
IrSTDSs - Sandstone and shale till (Devo
IrSTLs - Limestone till Carboniferous
KaRck - Karstified limestone bedrock at
KaRrck - Karstified limestone bedrock at
L - Lake sediments undifferentiated
Lc - Lake sediments clayey
Ls - Lake sediments sandy
Lsi - Lake sediments silty
Kinsealey
Baskin Lane
Chapel Road
Station Road
Portmarnock
Saint Doolaghs
Malahide Road
Drumnigh Road
200 m


Groundwater Data Viewer
If content doesn't display in Chrome, please clear your cache
Data Download
Geological Survey Ireland
DCCAE
Search location
Legend
Bedrock Geology 100k
Bedrock Outcrop
Bedrock Rock Units
Achill Head Formation
Addergoole River Formation
Aghyaran and Killygordon Limestone Formations
Lifford Volcanic Member (Aghyaran and Killygordon Limestone Formations)
Marble Unit (Aghyaran and Killygordon Limestone Formations)
Aghaward Formation
Aghamore Formation
Altan Limestone Formation
Old Road Member (Anaffrin Formation)
Annagh Division (Undifferentiated)
Ards Pelite Formation
Ards Quartzite Formation
Ardvarney Formation
Arva Granodiorite
Balbriggan Formation
Bangor/Corslieve Formation
Carrafull Member (Bangor/Corslieve Formation)
Owenmore Member (Bangor/Corslieve Formation)
Ballycong Limestone Formation
Belcamp Formation
Belderg Formation
Bellagarvaun Formation
Benmore Formation and Broad Haven Formation (Undifferentiated)
Benmore Formation
Ballybeg Park Limestone Formation
Boultypatrick Formation
Briska Boulder Bed Formation
Bangor Church Banded Member
Bangor Reservoir Dolomitic Schist Member
Broad Haven Formation
Broomfield Formation
Brittstown Formation
Slishwood Division, Semi-pelitic biotite schists
Malahide
MALAHIDE DEMESNE
MALAHIDE
ROBSWALLS
SAINTHELENS
GRANGE
BEECHWOOD
CARRICKHILL
Portmarnock
PORTMARNOCK
BURROW
BARRYSPARKS
DRINAN
AUBURN
FOSTERSTOWN NORTH
FOSTERSTOWN SOUTH
FORREST LITTLE
MARSHALLSTOWN
RAHULK
FELTRIM
M1
CORBALLIS
COLLINSTOWN
CLOGHRAN
GREENWOOD
ABBEYVILLE
KINSALEY
KINSALEY
GLEBE
Kinsaley
BASKIN
BALLYMACARTLE
BOHAMMER
STOCKHOLE
MIDDLETOWN
SPRINGHILL
TOBERBUNNY
LYSTRUAN
DRUMNIGH
SAINTDOOLAGHS
BURGAGE
CLONSHAGH
TURNAPIN GREAT
DARDISTOWN
M50
TURNAPIN LITTLE
SNUGBOROUGH
MAYNETOWN
BELCAMP
SANTRY
SANTRY DEMESNE
STAPOLIN
Santry
Darndale
Donaghmede
Baldoyle
BALDOYLE
0.6km
719,881 739,565 Meters


Groundwater Data Viewer
If content doesn't display in Chrome, please clear your cache
Data Download
Geological Survey Ireland
DCCAE
Search location
Legend
Groundwater Resources (Aquifers)
Bedrock Aquifer Faults
Gravel Aquifer
Locally Important Gravel Aquifer
Regionally Important Gravel Aquifer
Bedrock Aquifer
Rkc - Regionally Important Aquifer - Karstified (conduit)
Rkd - Regionally Important Aquifer - Karstified (diffuse)
RK - Regionally Important Aquifer - Karstified
Rf - Regionally Important Aquifer - Fissured bedrock
Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
Lk - Locally Important Aquifer - Karstified
Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
Pu - Poor Aquifer - Bedrock which is Generally Unproductive
Lake
Malahide
MALAHIDE DEMESNE
MALAHIDE
ROBSWALLS
BARRYSPARKS
DRINAN
FOSTERSTOWN NORTH
FOSTERSTOWN SOUTH
AUBURN
FORREST LITTLE
MARSHALLSTOWN
SAINTHELENS
RAHULK
FELTRIM
GRANGE
BEECHWOOD
CARRICKHILL
M1
CORBALLIS
COLLINSTOWN
CLOGHRAN
GREENWOOD
ABBEYVILLE
KINSALEY
Portmarnock
GLEBE
BASKIN
BALLYMACARTLE
Kinsaley
PORTMARNOCK
STOCKHOLE
BOHAMMER
BURROW
TOBERBUNNY
MIDDLETOWN
SPRINGHILL
DRUMNIGH
CLONSHAGH
BURGAGE
SAINTDOOLAGHS
TURNAPIN GREAT
DARDISTOWN
MAYNETOWN
SNUGBOROUGH
M50
TURNAPIN LITTLE
BELCAMP
SANTRY
STAPOLIN
SANTRY DEMESNE
Santry
Darndale
Donaghmede
Baldoyle
BALDOYLE
0.6km
719,861 739,565 Meters