Guidance Note (AG060.01)

Sustainable Drainage System (SuDS) Design Guidance

*** Guidance Notes provide best practice implementation advice policy, standards and procedures. Guidelines are not mandatory, but their adoption is expected ***

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Document Approval

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Document Revision History

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1	31/08/2021	Rachel Wray Jacqueline Diaz-Nieto Amber Bullen Phil Atkinson David Hanson Mark Russell	First Version. Principles taken from Smith (2015) Sustainable drainage design and operation guidance. (YW Strategy document)
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1. Introduction

1. This document provides design guidance to develop the Scope of retrofit capital projects up to Gate 3 of the AMP 7 Engineering Design Approach (EDA) as well as for external developers designing and constructing SuDS devices for the adoption by Yorkshire Water.

2. The scope of this design guidance is Sustainable Drainage Systems (SuDS) that are designed to be owned and/or maintained by Yorkshire Water in accordance with clauses A6.11 and A6.19 of the Codes for Adoption (2020). Where Yorkshire Water is involved in the delivery of SuDS assets that will not be the future responsibility of Yorkshire Water; the designer shall refer to and apply relevant local standards and design guidance (including that for Surface Water Removal).

3. Yorkshire Water recommends and endorses the use of SuDS to manage surface water. SuDS that meet the definition of a sewer in Codes for Adoption Part C – Design and Construction of New Surface Water Drainage Systems. (DCG) shall be designed and constructed in line with the DCG and this Design Guidance.

4. The aim of this Design Guidance is to set out the key principles for design of SuDS assets to be vested in Yorkshire Water via Developer Services and delivered through Yorkshire Water's AMP7 capital programme.

5. SuDS design and construction is a fast-developing area and is likely to evolve over time. To reflect this, this document will also be updated periodically.

2. Design Principles

6. Designers shall ensure that the community, environment and local wildlife are considered in the SuDS design. SuDS design should consider requirements for urban design that may be specified by the Local Planning Authority (LPA), particularly in relation to landscape, visual impacts, aesthetics, biodiversity and amenity.

7. Particular attention is required to ensure that the (first flush volume) post rainfall water from hard surfaces has been intercepted and managed. The management train is an important concept in SuDS design (CIRIA Report C753, Section 26.8) which has not featured as prominently in conventional piped drainage. The management train employs drainage techniques in series to reduce pollution, and control flow rates and volumes as water flows through SuDS assets before releasing it to the wider environment or the downstream system.

8. Surface water runoff from sites with a pollution hazard must not flow directly into ponds, wetlands or open waters. The SuDS design should consider the near source interception of pollutants such as oil and other hydrocarbons as well as metals. It should then consider the management train approach to provide on-site sediment management to prevent polluted surface water runoff from leaving the sub-catchment and/or site. The SuDS should protect both the morphology and water quality of the receiving waters.

9. An understanding of landscape care should inform how the SuDS assets are designed (CIRIA Report C753 Chapter 29 Landscape). SuDS assets shall be simple, robust and easy to manage and maintain. The designer shall ensure that a management plan as set out in DCG Part C11 is produced as part of the design. SuDS should be managed using landscape and watercourse maintenance techniques in preference to gully and pipe cleaning methods.

10. Yorkshire Water recommends and endorses the hierarchy of connection which is cited in the following national guidance and planning documents:

    a. Design and Construction Guidance v2. Part C.3.12

    b. Building Regulations – Rainwater Drainage Part H3

    c. Planning Practice Guidance – Flood risk and coastal change paragraph 80

11. The hierarchy of connection considers various opportunities to manage surface water with the last resort being to discharge to a combined sewer. N.B. Surface water shall in no circumstances be discharged to a foul sewer.

12. Consultation with the lead local flood authority (LLFA), local planning authority (LPA), Environment Agency (EA), Internal Drainage Board (IDB), Riparian Owner(s), the local community, politicians and user groups is required at the earliest possible stage in the solution development for any proposed SuDS (i.e. concept design stage).

13. Each site will have unique characteristics, and these should guide the selection of the most appropriate SuDS assets. SuDS asset selection (i.e. Swales, Rills, Bioretention Systems, Ponds, Wetlands, Basins, Tanks, Infiltration Trenches, Filter Drains or Soakaways) should be undertaken with relevant stakeholders.

14. Water should be kept at or near the surface (i.e. not in pipes). This reduces the need for deep excavations. SuDS design should aim to collect water on the surface. If buried pipes are used as a collection system into a SuDS asset, the SuDS asset which the pipes discharge into, will be deeper compared to a SuDS asset which receives water from a collection system which is on the surface (e.g. rills and swales). Existing surface drainage pathways should be incorporated into the design.

15. Smaller features with a shallow head and volume of water are given preference. 'Keep It shallow' is a good approach. “Pipe to pond” drainage systems shall be avoided.

16. SuDS should be designed to mimic natural drainage and for buried infiltration assets, preference shall be given to shallow infiltration systems with a low catchment area draining to the infiltration component.

17. SuDS design philosophy is such that pollution is managed at source. This management shall, however, not involve deep infiltration systems which are a risk

of contamination to groundwater. Further down the SuDS management train infiltration systems shall remain shallow.

3. Design Details

3.1. Regulatory / Statutory Obligations

18. The necessary permits and agreements for the method of discharge to the watercourse shall be obtained from the LLFA, Local Authority, Environment Agency, Internal Drainage Board, Canal and Rivers Trust or the riparian owners as appropriate. Checks should be made of any potential receiving surface waters' environmental designations and discharge constraints and consents.

19. The limiting and/or peak discharge rates at the final point of discharge shall be agreed in writing with the relevant authority. Evidence of the third-party agreement for discharge to their system is required. Where the connection is back into the combined sewer, the required rates and volumetric conditions for discharge into the combined sewer shall be agreed with Yorkshire Water.

20. Appropriate flood risk assessments shall be applied to determine resilience levels achievable in the case of surface water flooding by the SuDS asset design. SuDS within a functional floodplain should take full consideration of the likely influence of river water levels, and existing flood protection measures on the design performance. A combined fluvial and surface water flood risk probability assessment may be required. Depending on the location and information available through existing high-level risk assessments (e.g. Environment Agency' Flood Map for Planning)), the combined probability assessment may also need to consider sewer, groundwater and tidal flooding. A more detailed assessment may then be required with data/models/GIS files available from the Environment Agency.

21. Flooding can occur in relation to failure of a significant component of the SuDS. The design process shall consider the local consequences of failure and take appropriate steps to mitigate any subsequent flood risk.

22. The SuDS shall not adversely impact off-site flood risk (sewer, surface water, fluvial or groundwater flooding).

3.2. Design Process

23. SuDS that are designed to be operated by Yorkshire Water as a "sewer" or "lateral drain" shall be designed in accordance with **Part C Design and Construction of New Surface Water Drainage Systems** (Codes for Adoption, 2020) and hereafter referred to as the DCG.

24. The designer shall refer to:

- Part C – Design and Construction of New Surface Water Drainage Systems (Codes for Adoption, 2020).

- Non-Statutory Technical Standards (NSTS) for Sustainable Drainage: Practice Guidance (2015)
- CIRIA C753 The SuDS Manual (2015).
- CIRIA Report C635 Designing for Exceedance in Urban Drainage – Good Practice (2006)
- CIRIA Report C768 Guidance on the Construction of SuDS (2020)
- Building Regulations. Drainage and Waste Disposal: Approved Document H
- National Planning Policy Framework (NPPF)
- Planning practice guidance – Flood risk and coastal change.

25. Good SuDS design involves using landscape features placed in a sub-catchment to which the SuDS feature either acts as a source control, conveyance or storage for rainfall runoff from rainfall within that sub catchment. The SuDS devices in each sub catchment of a larger catchment act in unison to manage the rainfall runoff and as such where there are conveyance devices, there are additional storage or infiltration devices downstream. This SuDS management train often makes it a very different system to that of traditional pipes.

26. SuDS design requires four stages as outlined in CIRIA Report C753 Chapter 7 – The SuDS design process.

a. Stage 1: Set surface water management objectives. For example:

   i. Understand planning and conservation designations.

   ii. Understand discharge constraints and water quality objectives for receiving points of discharge

   iii. Set hydraulic performance specifications.

b. Stage 2: Conceptual design (initial design and layout). For example:

   iv. Identify potential for infiltration to ground.

   v. Identify effective point of discharge.

   vi. Identify water quality risk management objectives.

   vii. Select the SuDS assets for the management train.

c. Stage 3: Outline Design (sizing and optimisation). For example:

   viii. At this stage, the individual SuDS components should be sized, and their designs refined. Any assumptions made at the conceptual design stage,

such as infiltration capacities, groundwater levels and existing sewerage infrastructure and capacities, should be confirmed, using robust investigation methods.

ix. Required storage volumes should be distributed between sub-catchments, estimates should be made of required conveyance and exceedance flow rates and checks should be made that the proposed sediment management and treatment components are adequate. Any required flow control components should be defined and scoped.

x. The health and safety risk assessment and outline operation and maintenance plan are required at this stage.

d. Stage 4: Detailed Design (testing and finalising scheme). E.g.

xi. Test the hydraulic performance of the SuDS.

xii. Refine sizing and flow controls.

xiii. Finalised H&S and O&M

3.3. Hydraulic Design

27. Hydraulic design of SuDS for new developments shall be in accordance with DCG Section C6 Hydraulic Design and for both retrofit and new designs Chapters 3 and 24 of CIRIA Report C753.

28. Yorkshire Water has the following explanatory notes associated with the following DCG clauses:

- DCG Clause C6.1.4: The designer shall demonstrate to Yorkshire Water that any upstream inlets allow the design flows to reach the SuDS asset for all design return periods for which the SuDS asset is designed to function and perform.
- DCG Clause D6.1.4: Yorkshire Water is not obliged to accept land drainage into or through the SuDS. Where it is not possible to avoid land drainage interacting with Yorkshire Water's SuDS assets, the designer must present proposals for approval by Yorkshire Water that outline how existing land drainage will be managed.

29. The infiltration rates of leaky storage/attenuation assets shall not be taken into account in design calculations (i.e. assume no infiltration from leaky assets).

30. Permeability factors for non-adoptable SuDs assets (e.g. pervious pavements) that interact with Yorkshire Water's SuDS assets shall be as stated in DCG Clause D6.3.

31. Exceedance from the site (i.e. events that exceed the design criteria) should be evaluated and exceedance routes incorporated into the design (refer to CIRIA report C635).

32. Where a design is subject to the LPA planning process, the hydraulic design parameters specified by the planning authority shall be used. For SuDS design that is not subject to the LPA planning process, the input parameters for use in the hydraulic design are:

- Design horizon shall be based on the asset life.
- An appropriate allowance for climate change and urban creep shall be included The design should ensure that flood plain storage is not displaced and that flood plain conveyance routes are not impeded.
- Design flood protection frequency (e.g. 1 in 30 or 1 in 100-year rainfall event) shall be specified for the design and agreed with Yorkshire Water.

33. SuDS which discharge to tidal water will need to take account of the "tide locking", storm surge or submergence of the outfall. An appropriate allowance for sea levels over the lifetime of the development shall be incorporated.

34. Storage SuDS shall be designed to half empty within 24 hours for design rainfall events up to the 1:30 year event. If the design period is greater than the 1:30 year event, agreement is required from the relevant approval body for longer half emptying times.

35. The SuDs shall be designed to achieve the agreed hydraulic performance criteria (i.e. permissible method of discharge, limiting or peak discharge rates, volumes and frequencies) set out and agreed with the relevant authority responsible for the effective point of discharge. The SuDS shall be designed to operate without flooding for the agreed performance criteria.

36. Drainage simulation models shall be used for hydraulic design testing. The scheme shall be tested hydraulically to identify the worst-case hydraulic conditions for each component for all the design return periods. The designer shall test the performance of each of the SuDS components for the worst case design rainfall events **and** also using relevant long (e.g. 10 years+) time series rainfall (TSR) data to evaluate the performance under varying emptying regimes, catchment wetness and infiltration performance.

37. The designer shall demonstrate to Yorkshire Water that the scheme meets the design criteria and agreed standards:

- Interception is delivered for all hard-standing areas.
- Peak rates of runoff for low return period events are adequately controlled.
- Peak rates of runoff for high return periods (including appropriate climate change and urban creep allowances) are adequately controlled
- Volumes of runoff for high return period events are adequately controlled

- High return period events (including appropriate climate change and urban creep allowances) do not pose an unacceptable risk to people or property as a consequence of the SuDS.

- The flow velocities and depths for regular events allow the required water quality objectives to be delivered.

38. The designer shall provide Yorkshire Water with complete hydraulic design parameters, calculations (including model files) for the overall scheme and individual SuDS assets to demonstrate the performance of the storage and conveyance assets. The hydraulic calculations shall outline the methods used to determine design flows and volumes.

39. The operation and maintenance plan must identify the maintenance activities and frequencies required to ensure that the hydraulic function and performance is conserved for the lifetime of the asset.

3.4. Landscape Design

40. The designer must understand landscape design as well as drainage engineering principles to ensure the drainage system works effectively and provides environmental enhancement.

41. The SuDS design shall consider both hard and soft landscape measures thereby integrating urban design with the planning conditions and maintenance requirements.

42. Landscape design shall be in accordance with principles set out in Chapter 29 in CIRIA Report C753.

43. Landscape and planting shall be designed for minimal risk of silt mobilisation, reduced pollution to the environment and low maintenance requirements such as “no mow” requirements.

44. The designer shall ensure that a landscape management plan as set out in DCG Part C11 is produced as part of the design.

3.5. Design Specification

45. Table 1 summarises the design specifications for assets to be owned by Yorkshire Water.

Table 1 : Design Guidance for SuDS assets to be owned by Yorkshire Water as sewers or lateral drains

Asset Type	Design Guidance / Specifications
Any of the asset types listed below which is an **infiltration component**	• DCG Section C7.1.2 Infiltration Components • Chapter 25 Infiltration: design methods in CIRIA Report C753 The SuDS Manual • CIRIA Report C753 Checklist B6 Infiltration Components
Swale	• DCG Section C7.3 Swales • Chapter 17 Swales in CIRIA Report C753 The SuDS Manual • CIRIA Report C753 Checklist B13 Swales
Rill	• DCG Section C7.4 Rills
Bioretention System	• DCG Section C7.5 Bioretention Systems • Chapter 18 Bioretention Systems in CIRIA Report C753 The SuDS Manual • CIRIA Report C753 Checklist B15 Bioretention System
Pond or Wetland	• DCG Section C7.6 Ponds and Wetlands • Chapter 23 Ponds and Wetlands in CIRIA Report C753 The SuDS Manual • CIRIA Report C753 Checklist B21 Ponds and Wetlands
Basin	• DCG Section C7.7 Basin • Chapter 22 Detention Basins in CIRIA Report C753 The SuDS Manual • CIRIA Report C753 Checklist B19 Basins
Tank (including geocellular systems)	• DCG Section C7.8 Tanks • Chapter 21 Attenuation Storage Tanks in CIRIA Report C753 The SuDS Manual • CIRIA Report C737 Structural and Geotechnical Design of Modular Geocelluar Drainage Systems • CIRIA Report C753 Checklist B17 Tanks
Infiltration Trench or Filter Drain	• DCG Section C7.9 Infiltration Trenches and Filter Drains • Chapter 13 Infiltration Systems in CIRIA Report C753 The SuDS Manual
Soakaway	• DCG Section C7.10 Soakaways • Chapter 13 Infiltration Systems in CIRIA Report C753 The SuDS Manual • CIRIA Report C753 Checklist B11 Infiltration Trenches and Filter Drains
Outfall Structure	• DCG Section C7.11 Outfall Structures • Chapter 28 Inlets, outlets and flow control systems in CIRIA Report C753 The SuDS Manual • CIRIA Report C753 Checklist B11 Infiltration Trenches and Filter Drains
Flow Control Device	• DCG Section C7.12 Flow Control Devices • Chapter 28 Inlets, outlets and flow control systems in CIRIA Report C753 The SuDS Manual *** NOTE: refer to Part C.12.3.b and c. The minimum opening size is 50 mm only in circumstances where the design prevents debris

	entering the system. If an opening size below 100 mm is proposed, **Yorkshire Water requires a clear written explanation to accompany the drawings**, which explains how the management train approach has been adopted throughout the layout of the site to avoid debris arriving at the outlet flow control device. The design of control devices and size of controls must be agreed with Yorkshire Water.

3.6. Easements and Boundary of Responsibility

46. SuDS assets shall be designed so that the boundary of Yorkshire Water's responsibility is clearly defined on site. DCG Part C7 provides details of Yorkshire Water's boundary of responsibility for each of the SuDS assets that classify as sewers. Negotiations may be required to discuss and agree land ownership and/or easement arrangements for the purpose of defining the Yorkshire Water's boundary of responsibility.

a. **Swales**. C7.3.2. It will include the sides and base of the channel, and vegetation that is part of the function of the swale and any under-drainage including any liner, check dam, flow control or erosion control measures.

b. **Rills**. C7.4.2. It will include the material forming the sides and base of the channel and any check dam or flow control device.

c. **Bioretention Systems**. C7.5.3. It will include the whole area used for temporary ponding of water and the inlet and outlet structures and any engineered soil structures, including the vegetation.

d. **Ponds and Wetlands**. C7.6.4. This will include the inlet and outlet structures (including flow controls) and the entire area of the pond, including any banks that are designed to retain water, any storage below the ground surface, impermeable lines and under drains.

e. **Basins**. C7.7.3. This will include the inlet and outlet structures (including flow controls) and the entire area of the basin including any banks that are designed to retain water, any storage below the ground surface, impermeable liners and under drains.

f. **Infiltration Trenches and Filter Drains**. (apply DCG Clause C7.10.3) This will include the whole structure up to the external face, including any external rubble fill or membrane

g. **Soakaway**. C7.10.3. This will include the whole structure up to the external face, including any external rubble fill or membrane.

47. SuDS Assets designed to be owned by the Yorkshire Water as "sewers" and "lateral drains" shall ensure the following easements are in place:

a. SSG Appendix E. Fourth Schedule. Available at: https://www.water.org.uk/wp-content/uploads/2020/02/SSG-App-E-MSAA-v1-251019.doc

b. Requirements for Easements (April, 2020). Available at: https://www.yorkshirewater.com/media/2396/requirements-for-easements.pdf

48. Discharge easements are required for exceedance routes, and protection of exceedance routes from future changes in land use.

49. SuDS assets that are not Yorkshire Water's responsibility (but that may be a connected part of the drainage system) are private systems and the responsibility of a third party. Designers shall ensure that any SuDS design not to be adopted by Yorkshire Water and down stream of the adoptable SuDS asset takes into account the consequences of failure to maintain private SuDS assets.

50. Copies are required of the legal agreements detailing the responsibilities and maintenance arrangements for private SuDS assets connected (downstream) to SuDS assets owned by Yorkshire Water.

51. The management and maintenance plan shall provide clear identification of ownership, responsibility and access easements for each SuDS asset.

52. The designer shall ensure that the easements and access arrangements comply with the asset security and operational access requirements as set out by the YW Physical and Electronic Security Team (utilising the Security Risk Assessment (SRA) process) who will ensure advice aligns with DEFRA and the Government Security Advisor for asset security. Yorkshire Water shall be consulted at the outline design stage regarding the proposed arrangements.

3.7. Amenity Provisions

53. Amenity provisions include furniture and fixtures such as; benches, play equipment, stepping stones, bridges, bird or insect hotels etc.

54. Amenity provisions can be installed above buried SuDS assets (e.g. geocellular structures) and on surface SuDS (e.g. basins) that are the responsibility of Yorkshire Water, where the following conditions are met:

a. The amenity provisions are not owned, operated or maintained by Yorkshire Water and provisions are in place for third party ownership and maintenance.

b. Installation of the amenity provision(s) does not impact on the structural integrity of the asset. .

c. The amenity provisions are within the conditions set out by the model sewer adoption agreement (Fourth Schedule – rights and covenants to be incorporated in a Deed of Grant of Easement).

d. The amenity provisions do not impede compliance with the Asset Security Assessment results, a mandatory requirement to comply as set out by the YW Physical and Electronic Security Team (utilising the Security Risk Assessment (SRA) process) who will ensure advice aligns with DEFRA and the Government Security Advisor for asset security and operational access.

e. The amenity provisions do not impede the hydraulic function and performance of the asset.

f. The amenity provisions and associated SuDS devices have been subject to an industry recognised Health and Safety assessment by a competent person to be provided to Yorkshire Water

55. Yorkshire Water must be provided with copies of the legal agreements for third party ownership and maintenance for any amenity fixtures above or on Yorkshire Water SuDS assets.

3.8. Signage and Fences

56. As per DCG Clause C6.3.3, where signage is required, appropriate signage fixing points with the Yorkshire Water's branded corporate identification signs shall be provided.

57. If H & S risk assessments identify the requirement for warning signage, agreement is then required with Yorkshire Water. CIRIA report C753 in particular advises that signage should be provided when an area fills with water intermittently

58. Signage shall also be provided to describe how the SuDS devices manage flood risk.

59. Any fencing requirements should be assessed in accordance with the CDM risk assessment carried out at the design stage. Any fencing shall be provided in accordance with BS 1722 Fences and be a minimum height of 1100mm.

4. Control and Monitoring

60. The design of flow control devices shall be agreed with Yorkshire Water. In most cases a passive flow control system is adequate and there are no further requirements for active control and monitoring.

5. Appendices

5.1. Appendix 1 – Abbreviations

The following abbreviations have been used throughout this document:

CfA	Codes for Adoption
DCG	Design and Construction Guidance
EA	Environment Agency
IDB	Internal Drainage Board
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NPPF	National Policy Planning Framework
SPZ	Source Protection Zone
SSG	Sewerage Sector Guidance
SuDS	Sustainable Drainage System

5.2. Appendix 2 – Definitions

61. Not applicable at this time.

5.3. Appendix 3 – Supporting information

62. Not applicable at this time.

5.4. Appendix 4 – Technical Approval/Output to scope

63. An output table shall be filled in to ensure that the outputs we want to see are definitely passed forward. The Technical Approval/Output to Scope shall include populated checklists as detailed in DCG Part C3.1.6. The templates to use for your checklists are available on the CIRIA SusDrain webpage.

64. Key checks required by the design team at the Technical Approval/Output to Scope stage include:

- Sufficient information is provided regarding the hydraulic design criteria, assumptions, and a suitable hydraulic simulation model is available for design and sizing of assets.
- Water quality design criteria: Is effective upstream source control achieved? (use of a management train for sedimentation management and that the impact of the surface water quality before release to the environment has been given due consideration). Refer to **DCG Part C7.1.1 Sediment management**.

- Confirmation of permission to discharge surface water and agreed flow rates (and volumes where necessary) with the relevant authority. Is there an effective outfall, i.e. infiltration to ground, watercourse or surface water sewer? Refer to **DCG C3.4.d effective point of discharge**.

- Flood risk assessment for the site: Is there an effective exceedance design? (i.e. where do flows go when the asset design is exceeded?). Refer to **DCG Part C6.5 Exceedance Management**.

- Does the design include a maintenance and management plan? Refer to **DCG Part C11 Maintenance.**

- Confirmation of principles of ownership, accessibility and operational requirements. Are the requirements for asset security, access and easements clearly defined? Refer to the **Model Sewer Adoption Agreement** (Fourth Schedule) and the Engineering Specification (Asset security assessments).

5.6. Appendix 5 – Change Log

65. Changes to this Design Guidance are logged in the table below.

Section	Date	Brief Description of Amendment