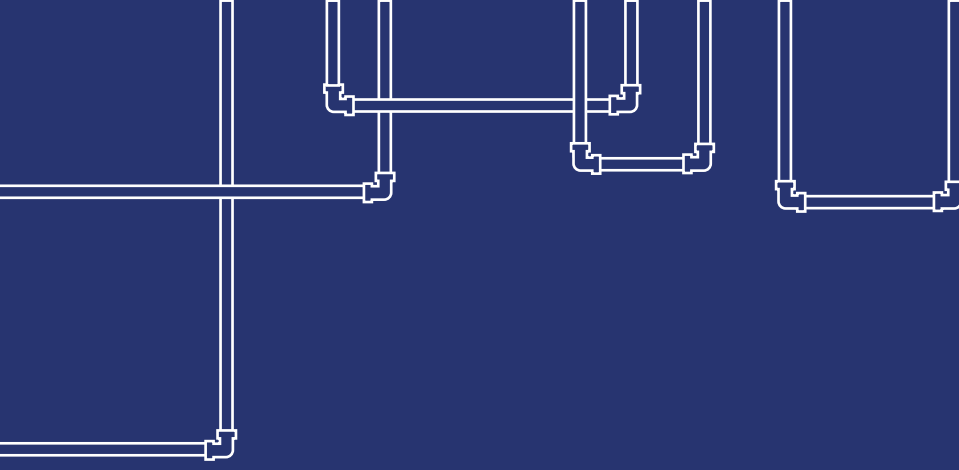




Delivering what matters

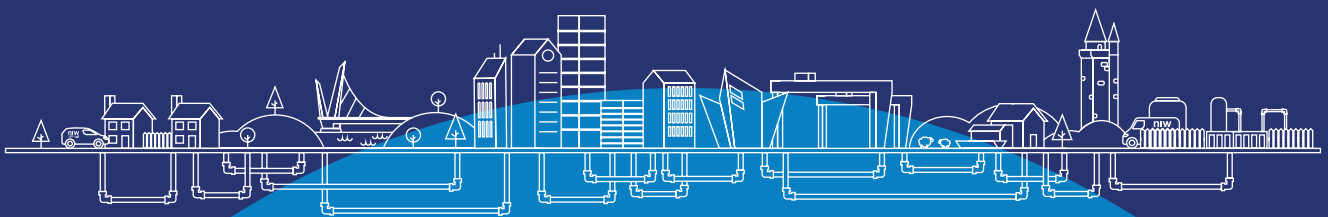


Sewers for Adoption Northern Ireland

2nd Edition

A Design and Construction Guide for Developers

August 2026



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Feedback arrangements

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Electronic copies may be obtained from Northern Ireland Water at <https://www.niwater.com/services-for-developers/>

Foreword

The Sewers for Adoption Second Edition Northern Ireland takes account of recent changes to the legislation and aims to provide improved clarity on Northern Ireland Water's requirements for approval and vesting of new wastewater infrastructure. Guidance is set out for the required technical standards for selection of new materials, and a new section has been included to provide guidance about adoptable sustainable drainage systems.

This guidance manual is intended to support developers, designers and other parties involved in development in Northern Ireland with the technical standards, general principles and procedure, for the design, appraisal, construction and vesting of sewerage infrastructure. This manual is controlled within Northern Ireland Water's policy document management system.

In reviewing and updating this guidance we understand that supporting new development and property has a national water industry perspective and we have worked closely with the WRc plc to ensure, where appropriate, there is close alignment and adoption of best practice with the latest version of 'Sewers for Adoption', as accepted by the United Kingdom water companies. There are, however, areas where Northern Ireland policy and legislative requirements require a different approach to wastewater infrastructure, and these have been included in this manual.

This manual provides developers with technical standards applicable to sewers, lateral drains, associated works and guidance on sustainable drainage systems (SuDS) which will vest in Northern Ireland Water. Supplementary documents are available at <https://www.niwater.com/services-for-developers/> which further clarify the process of vesting of new assets under an Article 161 Agreement, and should be read in conjunction with Sewers for Adoption Second Edition Northern Ireland.

This manual also includes guidance on the new legislation introduced by the Northern Ireland Assembly in March 2016. The key objective of the new legislation is to manage lateral drain and sewer connections communicating with a public sewer to eliminate 'private sewers'; provide better management of surface water from premises, and enable adoption of specified Sustainable Drainage Systems. This is a major step forward in managing public drainage systems for the servicing of new development and affording protection to public health and the environment. There is also acknowledgment that delivering effective sustainable drainage needs the mutual assistance of all those engaged in urban development and its infrastructure to deliver real solutions.

The important changes effective from 23rd May 2016, include approval for all sewers and lateral drains connecting directly or indirectly to a public sewer network is conditional upon a sewer adoption agreement, and associated bond security being in place before any connection is made to a public sewer. The right to refuse a surface water connection to a combined public sewer where there is a suitable alternative means of disposal by means of sustainable drainage systems. The sewer undertaker may vest specified sustainable drainage structures. Connections may be refused where the sewers and drains proposing to connect to the public sewer are not constructed to the required specified standard.

In association and agreement with the Department's Water and Drainage Policy Division, Sewers for Adoption Second Edition Northern Ireland, is available in electronic format on Northern Ireland Water's web page. This will enable improved industry-wide accessibility and provides a mechanism for enabling updates and making continual improvements to reflect changes in policy or technical standards. Any addendums, updates, etc., will be published in electronic information format and located on www.niwater.com

Developers Services, Northern Ireland Water

This document has been developed by Northern Ireland Water with input from Developer Services, Operations and Asset Delivery, and with support from WRc

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Part 1

General

1.1 Definition of terms

In this Guide:

1. **'2006 Order'** means the Water and Sewerage Services (Northern Ireland) Order 2006.
2. **'2016 Act'** means the Water and Sewerage Services Act (Northern Ireland) 2016.
3. **'Adoption'** is the process whereby sewers are vested in Northern Ireland Water and subsequently maintained at its expense.
4. **'Article 161 Agreement'** is the agreement between the Developer and Northern Ireland Water in accordance with Article 161 of the 2006 Order as amended by the 2016 Act, whereby Northern Ireland Water agrees to adopt the sewer system constructed by the Developer at some time in the future provided it is constructed in accordance with the agreement.
5. **'Attenuation storage'** is drainage network capacity for the purpose of reducing flow rates.
6. **'Bond'** is a guarantee provided on behalf of the Developer that they will complete the sewer system to the required standard and within a defined timeframe to enable them to be adopted by Northern Ireland Water. The bond sum represents a percentage of the Northern Ireland Water's assessment of the cost of constructing the sewers. The period of the bond covers the construction period and the maintenance period until such time as the sewers have been adopted by Northern Ireland Water.
7. **'Bond Agreement'** means an agreement under which a provider agrees to act as a Surety by undertaking, subject to the conditions set out in the Bond Agreement, to pay a sum or sums of money to the Northern Ireland Water, or perform other obligations, in connection with certain construction and maintenance works that are to be carried out by or on behalf of the Developer.
8. **'Curtilage'** – the curtilage is the area of land around a building or group of buildings which is for the private use of the occupants of the buildings. For this purpose, typically:
 - a) detached, semi-detached and terraced houses are each considered as a separate curtilage;
 - b) where a building contains a number of flats, the whole block of flats are considered as one curtilage;
 - c) Separate commercial properties sited on land privately owned by a single body (e.g., a shopping centre, airport terminal, retail park, etc.) will be considered as a single curtilage if the commercial properties share the site access and facilities.
9. **'Demarcation chamber'** is an inspection chamber placed on the drain, at or within the boundary of the property on the lateral drain and will remain in private ownership.
10. **'Developer'** is the organisation named as such in the Article 161 Agreement that is planning designing and constructing the sewer system to be adopted.
11. **'Disposal main'** is the treated effluent pipe from a sewage treatment works.
12. **'Drain'** is a pipeline within a single curtilage property is usually underground and designed to convey foul or surface water from buildings and paved areas associated with those buildings to the boundary of the property.
13. **'Final Adoption Certificate'** means the certificate issued by Northern Ireland Water certifying that the Works have been constructed in accordance with this Agreement and that all defects notified to the Developer following inspections have been remedied to the Northern Ireland Water's satisfaction.
14. **'Flow control'** – is a device installed in a surface water sewer to control the discharge of water at a reduced flow rate to an approved discharge point to a public storm water sewer or a watercourse.
15. **'Inspection chamber'** is a chamber that does not permit personnel entry and has working space only at ground level.
16. **'Land Owner'** means the owner of the land where it is proposed to lay drainage, to be offered for adoption.
17. **'Lateral drain'** is the section of pipework between the demarcation chamber, or the boundary of the property it serves, and the sewer.
18. **'Maintenance Period'** means the period from the date of issue of the Preliminary Certificate of Completion until the Works are vested in Northern Ireland Water.
19. **'Manhole'** is a chamber that permits personnel entry and has working space at sewer level.

20. **'Northern Ireland Water'** (NI Water) is the sole Water and Sewerage Undertaker for Northern Ireland in accordance with the Water and Sewerage Services (Northern Ireland) Order 2006, as amended in the Water and Sewerage Services Act (Northern Ireland) 2016, (hereinafter referred to as the 2006 Order, and the 2016 Water Act respectively) and includes any agent appointed to act on its behalf.
21. **'On-line storage'** is attenuation storage through which all flow passes, including dry weather flow.
22. **'Preliminary Certificate of Completion'** means the certificate issued by Northern Ireland Water on satisfactory completion of the Works at the start of the Maintenance Period.
23. **'Rising main'** is a sewer through which foul sewage and/or surface water is pumped.
24. **'Sewer'** is a pipeline, usually underground, designed to convey foul sewage and/or surface water runoff from more than one property.
25. **'Site'** means the Green Land and other land (if any) on, under, in or through which the Works are proposed to be executed.
26. **'Surety'** is the organisation providing the Bond.
27. **'Vesting'** is the formal transfer of ownership and responsibility of sewers from the Developer to Northern Ireland Water at the end of the adoption process.
28. **'Works'** means all the Sewers, Lateral Drains, pumping stations, waste water treatment works and accessories, specified in the Article 161 Agreement.
29. For the avoidance of doubt, the auxiliary verbs shall, should, may, can and must as used in this Guide have the following meanings (see also Clause 1.2.3):
 - a) **Shall** indicates a requirement of this document.
 - b) **Should** indicates a recommendation of this document.
 - c) **May** indicates permission is given in this document.
 - d) **Can** indicates a physical possibility.
 - e) **Must** indicates an external constraint required by a source other than this document.
30. **"Green" land Map** means a map 1:1250 / 1:2500 showing the area of land owned by the Developer, where drainage will be laid, outlined in green.
31. **"Red" land Map** means a map 1:1250 / 1:2500 showing the area of land served by the drainage constructed by the Developer (inclusive of third party lands) outlined in red.

1.2 Application

1. All Article 161 applications are submitted and managed through the Northern Ireland Water Self Service Portal from Approval to Final Adoption
2. This Guide is for use by developers undertaking new development when planning, designing and constructing conventional foul and surface water gravity sewers, lateral drains, pumping stations (including, but not limited to, the rising mains), and wastewater treatment works intended for adoption under an Article 161 Agreement.
3. In accordance with the 2006 Order as amended by the 2016 Act, developers must as a condition of approval to communicate (connect) directly or indirectly with a public sewer network enter into an Article 161 Agreement for the future adoption / vesting of foul and surface water gravity sewers, lateral drains, pumping stations and rising mains.
4. There should be no departure from its provisions except where formally confirmed by Northern Ireland Water in writing, such departures being technically justifiable or representing advances in knowledge. However, being a Guide, the use of the word "shall" has generally been avoided except in the Civil Engineering Specification. Legal force is given to the Guide by the Agreement which includes the Drawings and Specification. A Civil Engineering Specification is included in Part 3.
5. Where there is a significant element of non-conventional or structural design included in the proposals, specialist technical vetting could be necessary by Northern Ireland Water. In these cases, Northern Ireland Water can extend the period for assessing the application above that given in guidance available at www.niwater.com/services-for-developers/ and can vary other provisions in this Guide.
6. This Guide covers new sewers and lateral drains only, and should not be used as a definitive design manual for all sewerage-related construction such as rehabilitation, etc. In these cases, the appropriate industry reports, recommendations, guides, etc., should be used.

7. Northern Ireland Water can adopt sewers, drains, pumping stations, and wastewater treatment works that are not connected to the public sewer, and encourages Developers to offer these for Adoption.
8. If pumping stations include a pump rated over 30 kW, different specifications shall apply and detailed discussions should be held with Northern Ireland Water at an early stage.
9. This Guide includes the provisions laid out in the 2006 Order as amended by the 2016 Act for the adoption of lateral drains, sewers and associated works subject to the conditions of the Order/Act.
10. Northern Ireland Water has no statutory duty to, and does not accept connections from land drainage, groundwater, or watercourses.
11. Petrol and oil interceptors should not be considered for inclusion in the Works to be covered by agreements made under Article 161 of the 2006 Order.
12. Details of any contaminated land in the area of the site should be submitted to Northern Ireland Water before any application is made for an adoption Agreement, as protective measures can be required at the design stage. Failure to disclose this information can affect the ability of Northern Ireland Water to progress an Article 161 Agreement and can ultimately result in its refusal to adopt the sewers.
13. Northern Ireland Water is committed to the sustainable management of the environment and aims to meet fully its legal obligations. To this end, all suppliers and manufacturers should comply with the following:
 - i) The manufacturing process should maximise the use of non-solvent based substances that do not emit volatile organic compounds.
 - ii) The preferred product should be made from recycled material and should not develop ozone-depleting substances during manufacture.
 - iii) The use and/or creation of substances included in the UK Red List (DoE, 1988) of toxic substances should be avoided during the manufacturing process.

1.3 Ownership of works

1. For the avoidance of doubt, any Works constructed under an Article 161 Agreement remain the responsibility of the Owner until such Works are vested in Northern Ireland Water at the end of the adoption process.

1.4 The Agreement

1. As a condition of Adoption of sewers, lateral drains, pumping stations, and wastewater treatment works in accordance with Article 161 Agreements, the Developer must enter into a formal agreement with Northern Ireland Water. This agreement should be entered into prior to the commencement of work on-site.
2. There should be no divergence from the Article 161 Agreement by any party, except for the completion of information in the Agreement such as the details of the parties, inspection fees, Surety amount, etc. Any attempt to vary the model wording can delay its completion and increase legal and administrative costs.
3. The sewers, and any other Works for adoption, are usually constructed in the Developer's freehold land. The Agreement requires on-site and off-site landowners to join in, to ensure that any off-site sewers are laid with the consent and knowledge of all parties. The ownership of land and access/easement rights to pumping stations, wastewater treatment works, sewers and other Works (including rights to discharge to balancing areas) should be transferred, confirmed or exercised on or before adoption. All parties should endeavour to complete these matters during the Maintenance Period. If at all possible, transfers for freehold land for pumping stations should commence once the site has been granted preliminary adoption. This will allow the land transfer process to proceed during the maintenance period and completed on receipt of an application and granting of final adoption.
4. For the avoidance of doubt, by entering into an Article 161 Agreement the Developer should be aware that they are responsible for ensuring that the Works are properly and safely constructed. Northern Ireland Water has a duty to inspect the Works to ensure that they conform to this Guide and the Agreement.
5. Guidance Notes for the Agreement is available at: [Article 161 Agreement \(niwater.com\)](https://www.niwater.com/article-161-agreement).

1.5 Procedure

1. The Developer should consult Northern Ireland Water and all other relevant bodies at the earliest opportunity, and preferably before an application for planning permission is made, so that it can be determined how the proposals can be served. To assist Developers a Pre-Development Enquiry service is offered advising of the availability and proximity of public water and sewer infrastructure to service the proposed development lands.

2. It is the Developer's responsibility to ensure that all Northern Ireland Water's requirements including its specific requirements including (but not limited to) Northern Ireland Water safety policy and a hazardous zone classification for pumping stations are met. These policies are available upon request from Northern Ireland Water.
3. It is important that correct and complete information is submitted when making an application. Developers should use the checklist in Table 1.1 which indicates which information is mandatory and which is supplementary. The timescales for Northern Ireland Water's responses will not come into effect until a full technical submission with appropriate information has been provided.
4. Statutory Approvals and Relevant Information shall be obtained and provided where applicable, these may include approvals to discharge surface water to a watercourse and permission to construct a headwall from Department for Infrastructure Rivers; a Water Order Consent for waste water pumping stations / treatment works from The Department of Agriculture, Environment and Rural Affairs (DAERA) Northern Ireland Environment Agency (NIEA), planning consents from the local Planning Authority and where appropriate private streets determination from the Department for Infrastructure Roads.
5. The adoption process and timescales are available on Northern Ireland Water's website at [Article 161 Agreement \(niwater.com\)](https://www.niwater.com/article-161-agreement)
6. In the event of a complaint/dispute arising from the design and construction of the Works, the same may be referred for determination to Northern Ireland Water's complaints procedure.
7. If Northern Ireland Water fails to give a decision within two months, has refused an application, or gives a decision with which the Developer disagrees, the Developer may initially appeal under Article 162 of the Order 2006 to the Consumer Council for Northern Ireland, and secondly Northern Ireland Authority for Utility Regulation or pursue arbitration under the provisions of S.17 of the First Schedule to the Agreement, where applicable. The results of any determinations will be circulated to Northern Ireland Water, the Department for Infrastructure and the Construction Employers Federation.

Table 1.1 Aid to making a sewer adoption (A161 Approval Assessment) technical submission

Note: Mandatory information (shown in **bold** type) includes, but is not limited, to the list below.

Information Required	SCALE OR DATE	NOTES
Developer's Programme Expected Completion Date of Construction		
Location Plan	1:1250 (or 1:2500 can be accepted)	Ordnance Survey based map with the site boundary clearly indicated in red and relative to an existing feature. Any other land owned by the applicant should be shown with a blue line around its boundaries, and if a public right of way exists within or adjoining the site, it should be outlined in green.
Site Plan showing: All levels related to OS Benchmark (Belfast datum) Site boundary and works extent Roads Sewers and lateral drains (coloured as per Appendix VI) Pumping stations including compound Wastewater treatment works including compound and associated pipelines Rising mains Existing sewers Road gullies/highway drains Watercourses SuDS installations Site contours Private drainage Flood routing Proposed buildings Ground floor levels <i>The following information can also be required:</i> <i>Storage/attenuation</i> <i>Outfalls/headwalls</i> <i>Borehole locations</i> <i>Contaminated land reports</i> <i>Existing trees and proposed landscaping</i>	1:500	
Longitudinal Sections (sewers and rising mains) showing: Existing levels Proposed cover and invert levels Pipe material Pipe strength Pipe diameters Bedding classification and details Air valves and washouts Groundwater/watercourse levels Flow controls <i>The following information can be required:</i> <i>Existing services</i> <i>Borehole information</i>	1:500 horizontal 1:100 vertical	

Information Required	SCALE OR DATE	NOTES
Hydraulic Model Design: Digital Hydraulic Model file and results (.pfd, .iddx or .mdx) Foul water Surface water (including impermeable area plan)		
Construction Details showing: Manholes Demarcation chambers (at boundary of private property, and located in private property) Pumping stations Manhole schedules Sustainable drainage system (in accordance with Northern Ireland Water policy) <i>The following information can be required:</i> Ancillaries	1:20	
Pumping Station Information showing: General arrangement details Wet well capacity/storage/time to spillage Rising main capacity Surge calculations Structural calculations and drawings Mechanical and Electrical documentation Flotation check Pump manufacturer's design Pump head discharge curve Emergency overflow details and consent Geotechnical investigation report	1:20/1:50	
Wastewater Treatment Works Information showing: General arrangement details Proposed unit specification Structural calculations and drawings Mechanical and electrical documentation Flotation calculations Maintenance schedule Emergency overflow details and consent Investigation report investigation		
Statutory Consents and Other Permissions: Discharge consents/licences to watercourses, canals, etc. Water Order consents for emergency overflows from wastewater pumping stations Permission and Rights to lay pipes on third party land Copy of planning consent		
Details of Land Transfers and Ownership: ACE 1:1250 / 1:2500 map with the boundary of the area served by all of the drainage constructed by the Developer (inclusive of drainage constructed by the Developer in third party lands) clearly indicated in red. Greenland Map, 1:1250 / 1:2500 map, with only the boundary of the area of land that the Developer owns and where they have constructed drainage, clearly indicated in green.	1:2500 1:200	Permissions of ownership, including any necessary rights of access, of all land conveyed to Northern Ireland Water is required as a signed legal submission.

Information Required	SCALE OR DATE	NOTES
CDM Regulations NI 2016 Requirements: It is likely that the majority of development sites will be bound by the Construction (Design and Management) Regulations (Northern Ireland) 2016, or any subsequent legislation. Much of the information required to approve an Article 161 adoption, including the supplementary information listed above, should be readily available to one or more of: • the Client; • the Designer; • the Planning Supervisor; or • the Principal Contractor, appointed by the Client as competent, responsible persons under the Regulations. Before any Northern Ireland Water staff visit the Site for inspections, Northern Ireland Water shall be provided with details of: • the Designer; • the Planning Supervisor; and • the Principal Contractor.		Ensure F10 – Notice of Construction Project is displayed on-site prior to commencement of work.

1.6 Inspections

1. During construction of the Works, Northern Ireland Water may carry out inspections to check compliance with the Agreement. If improper work, materials or variations are found, Northern Ireland Water will notify the Developer without delay (to be confirmed in writing) and defects should be remedied or substituted with the minimum of delay.
2. The Developer, or representative, should be present at any inspections carried out by Northern Ireland Water and should provide personnel, plant and equipment to comply with all reasonable safety requirements of Northern Ireland Water whilst carrying out such inspections.
3. Northern Ireland Water can require trial pits to be dug at the expense of the Developer to ascertain the depth, location and type of sewers and lateral drains where these have been backfilled in advance of inspection of works.

1.7 Phased release of 50% of the bond security

1. When the sewer installation works are complete, in keeping with the Northern Ireland Water approved drainage layout, including:
 - a) construction of all sewers and manholes etc
 - b) where all properties have been constructed to at least roof level,
 - c) the development roads have been constructed to a minimum of base course,
 but the development drainage system is not yet eligible for an application for a Preliminary Certificate of Completion you may apply for a 50% reduction of the Northern Ireland Water Bond Surety.

Please note that a 50% bond reduction cannot be considered for a site that incorporates a Wastewater Pumping Station, Wastewater Treatment Works or Geocellular Structure.

1.8 Preliminary certificate and maintenance period

1. When the sewer installation works are complete, in keeping with the Northern Ireland Water approved drainage layout, including :
 - a) construction of all sewers and manholes etc
 - b) where all properties have been constructed to at least roof level,
 - c) the development roads have been constructed to a minimum of base course,
 - d) a minimum of 51% of the premises served by the sewers are occupied (allowing for all sewer lines to be live),
 - e) provided 'as-constructed' drawings of the Works, depending on "h)" below. These records should use the standard symbols in Appendix VI;
 - f) provided operating instructions and maintenance manuals;

- g) carried out pressure jetting of sewers (in accordance with the Manual of Drain and Sewer cleaning published by WRC);
- h) completed any highway construction proposed above the sewer except for its final surfacing. Manhole covers should be either set to finished road levels or appropriate road levels; and
- i) confirmed all Temporary Works and materials have been removed.

Upon receipt of the request for the Preliminary Certificate, Northern Ireland Water will carry out inspections as detailed at [Article 161 Agreement \(niwater.com\)](#)

2. If after the inspection it has been established that the drainage has not been laid as per the approved layout, or improper work or materials are found, you will be required to resubmit an application to allow us to reassess the design. A legal agreement in the form of a Deed of Covenant may be required to ensure that future property owners are made aware of their responsibilities or impacts associated with the drainage system that were not covered under the approved drainage design. If a Deed of Covenant is required, it will be drafted by our External Solicitor in agreement with your solicitor, where the Developer will be responsible for paying our External Solicitor's legal fees directly.
3. Where a visual (internal) inspection of remedial works is not possible, an additional CCTV/internal survey should be carried out. Where this is necessary, the cost of this shall be borne by the Developer.
4. Once any remedial works have been completed to the satisfaction of Northern Ireland Water, Northern Ireland Water should issue the Preliminary Certificate to the Developer within two weeks. Land procedures for conveyancing of any pumping station or wastewater treatment works should then commence to transfer the land/site to Northern Ireland Water ownership before the issue of the Final Adoption Certificate.
5. The Developer is then required to maintain the Works for a period, specified by Northern Ireland Water, normally a minimum period of 12 months until they are vested in Northern Ireland Water.
6. Wastewater treatment works shall demonstrate compliance with their discharge permits for the twelve-month maintenance period prior to Adoption.
7. At any time prior to vesting, in the event that the Developer fails to carry out the remedial works within nine weeks of Northern Ireland Water providing the remedial report, Northern Ireland Water may, at its discretion, subject to prior notice (of at least two weeks, except in the case of an emergency) in writing to the Developer and Surety, carry out those remedial works (see Article 161 Agreement, First Schedule S.11) and recover the costs.

1.9 Final certificate and vesting

1. At the end of the maintenance period, it is no longer a requirement to submit an application for Final Adoption, as you will receive a notification via the Northern Ireland Water Self Service Portal, of Northern Ireland Water's intention to arrange a mutually suitable date / time for inspection. The developer should supply the personnel to lift the manhole covers as required.
2. When outstanding works, and issues, such as
 - a) completion of land transfer or easement agreements
 - b) intervening downstream drainage systems between the Works and the receiving public sewer that were not adopted
 are completed a Final Certificate of Adoption will be issued and the associated drainage system shall be transferred to and vested in Northern Ireland Water Limited from the date of authorisation.
3. If there are no identified remedial works required or following the satisfactory completion of remedial works NIW should issue the Final Certificate within four weeks from the date of inspection confirming that there are no outstanding remedial works.

1.10 Recovery of Northern Ireland Water's costs

1. Northern Ireland Water incurs costs in carrying out various activities in the course of the appraisal, authorisation, inspection and adoption procedure which normally include technical vetting, processing the Article 161 submission, and various methods of inspection or survey. Costs are based on the current Scheme of Charges as found on the Company's web site at: [Services for Developers \(niwater.com\)](#)

Note: The estimated cost of the Works is to be based on a current schedule of rates produced by Northern Ireland Water.

2. The fees are assessed by Northern Ireland Water and issued to the Developer in advance of the Agreement and should be paid before the Agreement is authorised and released. If the agreement made under Article 161 of the 2006 Order is on terms to which the Developer objects, they can appeal under Article 162 of the 2006 Order (see Section 1.5 of this Guide).
3. Fees relating to such specialist services are outside the scope of the Sewers for Adoption administration fees and can be charged to the Developer by Northern Ireland Water, as agreed.
4. Reasonable legal fees are charged and recovered at cost, or by a standard charge calculated to be non-profit-generating.
5. Fees are based upon the assumption that the design submission and the construction of the Works are of a conventional nature and are in accordance with the recommendations set out in this Guide. In the event that the submission or the construction of the Works falls below these standards, Northern Ireland Water reserves the right to recover additional costs incurred in the administration of the Agreement arising from the rechecking of Drawings or calculations, Site visits for rechecking substandard work, CCTV/internal resurveys or associated sewer cleansing. Additional charges can also be levied for costs relating to changes to the Works arising from approved variations and/or unforeseeable circumstances, e.g. adverse ground conditions.
6. Where a scheme has been designed and prepared for an agreed layout and is subsequently redesigned in whole or in part to suit any amendment introduced by the Developer, all additional costs incurred by Northern Ireland Water can be recharged to the Developer.

1.11 Obligation of Surety

1. The Developer is required to provide a Security (bond) (i.e. from a Surety e.g. an independent bank or financial institution, or cash) to be party to the Agreement who will be liable for a sum, as defined in the current Scheme of Charges. Such security may be called upon to complete or repair the sewers, lateral drains and works that are the subject of the Agreement in the event the Developer fails or is unable to fulfil their obligations under the terms of the Agreement.
2. Alternative or separate Surety arrangements provided by the Developer and/or Surety are not acceptable. The Surety shall be party to the standard Model Form of Agreement to ensure that the Works can be completed and vested as soon as practicable.
3. Where a Security is called in, Developers should be aware that this can affect their ability to obtain similar Securities in the future against Article 161 Adoption Agreements. Any private agreement between the Surety and the Developer is not the concern of Northern Ireland Water and the existence of such an Agreement will not release the Surety from their obligations to Northern Ireland Water.
4. When sewers are installed to a satisfactory specified standard 50% of the security will be released, if applied for by the Developer; when the Preliminary Certificate is issued following the submission of the Preliminary Adoption application, the 70% security will be released. Following a 12 Month maintenance period a Final Adoption will automatically be generated and on successful completion the remainder of the security will be released. Phased release of the security at these stages of the adoption process is subject to there being no land transfer issues.

1.12 Statutory consents and other permissions

1. The Developer must obtain all necessary Statutory Consents and other Permissions. Relevant bodies might include:
 - a) consent of the Pollution Control Authority (DAERA, Department of Agriculture, Environment and Rural Affairs Environment Agency) for emergency overflows and contaminated waters;
 - b) permission of the Department of Infrastructure Rivers to discharge to watercourses and controlled waters;
 - c) the Crown, Northern Ireland Railways, Airport Authorities, Local Authorities, or MOD, etc., where special permission can be required for land owned by them;
 - d) permission to cross third party lands. Third Party landowners and downstream developers will be required to sign the Article 161 Agreement; and
 - e) Local Planning Authority Consents for the construction of above-ground structures.
 - f) Building control approval for individual SuDS within the boundary of single curtilage properties or pumping stations serving single curtilage properties.

2. The Article 161 application shall include the planning approval reference for the Site; however, early consultation with Northern Ireland Water is advised initially by means of the submission of a [*Pre-Development Enquiry \(PDE\) application, Pre-Development Enquiry Multi Unit Developments & Commercial \(niwater.com\)*](#). If there are constraints you will be asked to submit an Impact Assessment Application for Water, Wastewater or Odour and NIW will work with you to identify potential solutions, [*Impact Assessment - Multi Unit Developments / Impact Assessment - Development Encroachment Odour Assessment*](#).

1.13 Highway drainage

1. Northern Ireland Water is not obliged to accept runoff from newly constructed highways into the public surface water sewerage system. The Developer should note that acceptance of this runoff into the public surface water sewerage system is by agreement only, which will not be unreasonably withheld.
2. Northern Ireland Water has a separate formal agreement for such discharges from designated private streets. This Agreement is formally between the Department for Infrastructure Roads and Northern Ireland Water but, prior to adoption of the highway (private streets), the Developer as Owner is party to the Agreement.

1.14 Pumping stations

1. Pumping stations will only be considered for adoption where the Developer can satisfy Northern Ireland Water that the alternative of a gravity sewer is clearly uneconomic based on whole-life costs. Any such proposals should be discussed in advance with Northern Ireland Water. See Section 2B. Provision of Pumping Stations.

1.15 Wastewater treatment works

1. Wastewater treatment works will be considered for adoption where the wastewater treatment works serves at least two properties where:-
 - a) connections to the public sewer network are not approved due to the unavailability of the public sewerage system for a period in excess of two years,
 - OR
 - b) The wastewater treatment works is part of a proposed drainage system serving a rural development
2. Surface water should not be connected upstream of the wastewater treatment works.
3. Wastewater treatment works should comply with Northern Ireland Water asset standards. These are available on request via CustomerEngagementTeam@niwater.com

1.16 Management of surface water

1. Northern Ireland Water's policy is to better manage surface water run-off from new development and redeveloped areas by supporting sustainable development and protecting the environment from the risk of sewer flooding from extremes of climate, population growth and urban creep. Removal of surface water and control of surface water discharge to existing combined sewer networks will also reduce pressures on, and can lessen the impact of pollution from combined sewer overflows, while freeing up capacity in existing sewer networks for future development.
2. All new development and redevelopment sites shall be designed and constructed with separate foul and surface water systems. The use of storm attenuation sustainable drainage systems (SuDS) are encouraged to control surface water run-off, prevent pollution and out of sewer flooding. Northern Ireland Water also encourages developers to consider how surface water run-off volumes can be reduced and how sustainable features may be integrated throughout their schemes.
3. Sustainable drainage systems are drainage solutions that provide an alternative to the direct channelling of surface water through networks of pipes directly or indirectly to watercourses. SuDS can imitate natural drainage systems to reduce surface water flooding, improve water quality and enhance the amenity and biodiversity value of the environment.
4. Northern Ireland Water may adopt specified sustainable drainage structures designed to receive surface water for the purposes of controlling the volume of surface water from development to a public storm water sewer or watercourse. Surface water connections to the public sewer network may be refused where alternative means of disposal is achievable.
5. Where SuDS are proposed, Northern Ireland Water should be involved early in the design process in discussions with all relevant parties to agree ownership and responsibility for the facility.

6. A range of SuDS techniques are available which aim to deal with the issues of water quantity, water quality and social amenity. Particular consideration should be given by developers to removal of surface water at source or as close to source as is practical.
7. Strategic Planning Policy Statement for Northern Ireland (2015) suggests the planning system should help to mitigate and adapt to extremes of climate by working with natural environmental processes, for example through promoting the development of green infrastructure and the use of SuDS to reduce flood risk and improve water quality.
8. Planning and Flood Risk, Planning Policy Statement 15 (PPS 15) sets out the planning policy to minimise flood risk to people, property and the environment. The policy states that 'appropriately scaled and supported SuDS can, in the right circumstances, offer developers the opportunity to proceed with developments which would otherwise be refused because of the increased flood risk they would pose.
9. SuDS structures shall in all cases fully comply with the SuDS Manual (CIRIA Publication C753), CIRIA C737 Structural and Geotechnical Design of Modular Geo-cellular Drainage Systems (CIRIA Publication C737), and CIRIA Guidance on the construction of SuDS (CIRIA Publication C768) which are available at <http://www.ciria.org/>.
10. The developer shall design the system(s) for ease of access and efficient maintenance of the system(s), with a view to minimising future operational and maintenance costs, and must provide a safe operating environment for operational maintenance and a safe environment for the local community.
11. Where it is necessary to provide adoptable attenuated structures within the sewer system, the favoured method, in accordance with Northern Ireland Water's Sustainable Drainage Policy, is the use of properly-designed specified SuDS, e.g. on-line over-sized pipe storage; approved geo-cellular structures and box culverts with suitable approved flow control devices (see Sections 2.7 and 2.15).
12. All flow control devices shall be installed and operating before off-site discharge is made.
13. Northern Ireland Water does not adopt above-ground attenuation facilities. Where it is deemed necessary for a developer to attenuate flows and it is agreed that this should be provided by above-ground attenuation, then some or all of the following safeguards will be required:
 - a) a hydraulically-free inlet;
 - b) a high-level weir at the outlet set below the invert level of the incoming sewer(s);
 - c) adequate administrative arrangements for the future maintenance of the facility (e.g., Management Company, Local Authority etc.);
 - d) a Deed of Grant of Rights to discharge water into the attenuation facility in perpetuity.

1.17 Control of pollution

1. The Developer should maintain the integrity of separate sewer systems and is responsible for any flooding and/or pollution as a result of blockages, pumping station breakdown, cross-connections, or other failures up to the time at which they are adopted.

1.18 General design

1. The Developer is responsible for all aspects of the design of the sewer system.
2. The design should generally follow the guidance in this Part and the principles laid down in the publications listed in Appendix I.

1.19 Existing public sewers within the site

1. As soon as a diversion of an existing public sewer is envisaged as part of the development, the Developer should contact Northern Ireland Water to agree if the diversion is feasible, and whether it can be carried out as part of the Article 161 Agreement or if a separate application is required under Article 247.
2. Where the Developer wishes to close existing public sewers within their Site, the Developer should contact Northern Ireland Water to agree the required arrangement.

1.20 Connections to existing public sewers

1. It is an offence to connect to the public sewer without first obtaining the consent of Northern Ireland Water.
2. Subject to the provisions under Article 163 of the 2006 Order as amended by Section 6 of the 2016 Act, there is no absolute entitlement for anyone to have their drains or sewers connected to existing public sewers. Connections to the public sewer network are approved conditionally upon the developer progressing Article 161 Application to

Northern Ireland Water's satisfaction.

3. Any development is deemed to be served if it is within 20 m of a public sewer and an Application to Communicate with the Public Sewer is approved. Where a development is further than 20 m from a public sewer, Northern Ireland Water can extend the public sewer to a suitable connection point agreed with the Developer through the appropriate application.
4. Where development sewers and drains are to be adopted, an Agreement under Article 161 2006 Order as amended by the 2016 Act must be obtained before a connection is made to the public sewer. Failure to first obtain a sewer adoption agreement before connecting to the public sewer is an offence and may be subject to financial penalties.
5. Surface water connections to combined sewers may be permitted, by agreement, only where there is no practicable alternative (see Section 2.7).
6. The Developer should be aware that particular conditions can be imposed for connections to brick sewers, large diameter sewers or other sewers where adverse conditions make construction of a manhole difficult. Northern Ireland Water can elect to make the connection at the Developer's expense. This should be taken into account when designing the system.
7. Any work proposed to be carried out within, or adjacent to, existing public sewers may only be undertaken with the prior agreement of Northern Ireland Water. Northern Ireland Water's health and safety procedures for working in public sewers shall be observed.
8. The Developer should establish, by means of trial pits, that the proposed connection point to the existing public sewer can be constructed alongside other utility services that are present or proposed. If required, copies of the trial pit log(s) should be provided to Northern Ireland Water with the design.

Part 2 Design

Part 2A - Sewers

2.1 Separate systems

1. Separate foul and surface water sewer systems shall be provided.
2. Where no dedicated foul and / or surface water sewer exists, these may be [requisitioned](#).
3. Watercourses or land drainage shall not be directly or indirectly connected to the public sewer system.
4. Submission of development drainage systems in simulation software shall be clear and unambiguous. A copy of the hydraulic model and results shall be made available for each development. Representation of the hard surfaces draining to the network shall be accurately detailed for the relevant sections of the drainage system and all manholes included in the model.

2.2 Layout of sewers and rising mains

1. The requirements to limit flood risk (see Section 2.6) can have an impact on the layout of the drains and sewers.
2. Sewers, lateral drains and rising mains should not be laid in enclosed private land, as far as practicable. Preferably sewers and lateral drains should be laid in highways or public open space. The preferred priority order for the location of a sewer is:
 - a) Within a highway or public open space.
 - b) Where this is not achievable, the sewer may be considered for installation within a front garden.
 - c) As a last resort, the sewer may be considered for installation within a rear garden.

It should be noted that a flow control device will not be permitted within a front or rear garden under any circumstances and it may also be deemed that critical sewers can only be located in a highway or public open space for ongoing maintenance reasons. Sewers may be deemed critical for a variety of reasons.

Applicants must provide clear and robust evidence demonstrating why the sewer cannot be located within the highways or public open space, in accordance with the priority order set out above.

3. New sewers or lateral drains should not be located closer to any building or structure than 3 m or 1.5 times the depth (whichever is the greater) except with the consent of Northern Ireland Water (see Figure 2.1).
4. New structures and buildings shall not be constructed over sewers.
5. Rising mains should be a minimum of 4 m from any structure. The location of valves and chambers on rising mains should be positioned as best practically possible as to not disadvantage landowners without compromising the function of the asset.
6. Sewers and lateral drains should not be located closer to existing or proposed trees than the minimum planting distances in Figure 2.2, except where special protection measures are provided in accordance with Clause 2.10.4.
7. Adoptable tanks, box culverts, geo-cellular elements, and similar adoptable structures situated within 6 m of the highway can require Technical Approval Schedule (TAS) Approval by DFI Roads before they can be considered for Adoption by Northern Ireland Water.
8. When in a highway, the outside of the sewer should be in the vehicle carriageway (not footpath) and be at least 1 m from the kerb line. The outside of manholes should be at least 0.5 m from the kerb line.
9. As far as practicable, rising mains should be laid in straight lines. Where bends are used, they should be pre-formed long radius bends, and have appropriate anchor blocks. Bends should be located in places where the location of the bend can be adequately marked with a marker post (see Section 2.13).
10. Land use surveys, 'walk over', corrosion, soil chemistry and resistivity surveys should be carried out to determine the routing, material used, and the degree of corrosion protection required for rising mains in contaminated or aggressive soils.
11. Typical layouts are shown in Figures 2.3 to 2.6.
12. The design of landscaping should be undertaken at the same time as the design of the drains and sewers so that the impact of tree roots on sewers and drains can be considered. A sewer or lateral drain should not be located closer to

trees/bushes/shrubs than the canopy width at mature height. A tree should not be planted directly over sewers or where excavation onto the sewer would require removal of the tree. (See Figure 2.2) The following shallow rooting shrubs are generally suitable for planting close to sewers and lateral drains:

- *Berberis candidula*; (Paleleaf barberry)
 - *Berberis julianae*; (Wintergreen barberry)
 - *Ceanothus burkwoodii*; (Californian lilac 'Burkwoodii')
 - *Cotoneaster dammeri*; (Bearberry cotoneaster)
 - *Cotoneaster skogho/m*; (*Cotoneaster x suecicus*, 'Skogholm')
 - *Cytisus* varieties or *Sarothamnus*; ((Common or Scotch) Broom)
 - *Euonymus japonica*; (Japanese spindle)
 - *Euonymus radicans*; Variety of *Euonymus* (Fortune's spindle or wintercreeper)
 - *Mahonia* varieties; can be included in the genus *Berberis*, most common name is *M. aquifolium* (Oregon grape)
 - *Potentilla* varieties; most varieties are types of cinquefoil. Also includes Common tormentil, silverweed and barren strawberry
 - *Skimmia japonica* ; (*Skimmia*)
 - *Spiraea japonica*; (Japanese spirea or Japanese meadowsweet)
 - *Veronica* varieties; (Speedwell)
 - *Viburnum davidii*; (David viburnum)
 - *Viburnum tinus*; (*Lauristinus*)
13. Where it is proposed to lay pipes in third party land, agreement should be obtained from the owner of the land surface as to acceptable levels of predicted settlement, prior to the construction. The construction techniques should be selected to ensure that the maximum settlement is within the agreed limits.

Figure 2.2

Minimum planting distances

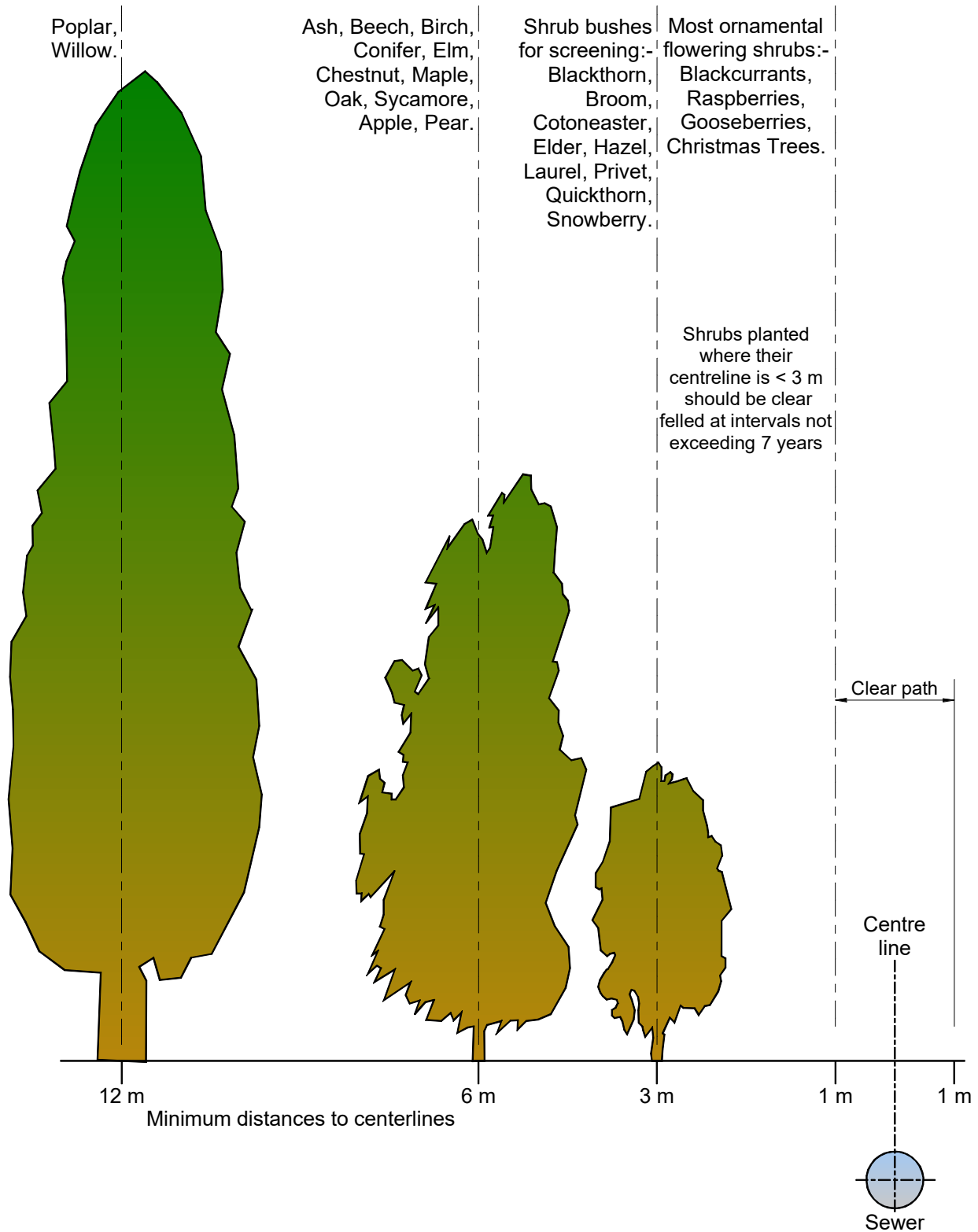
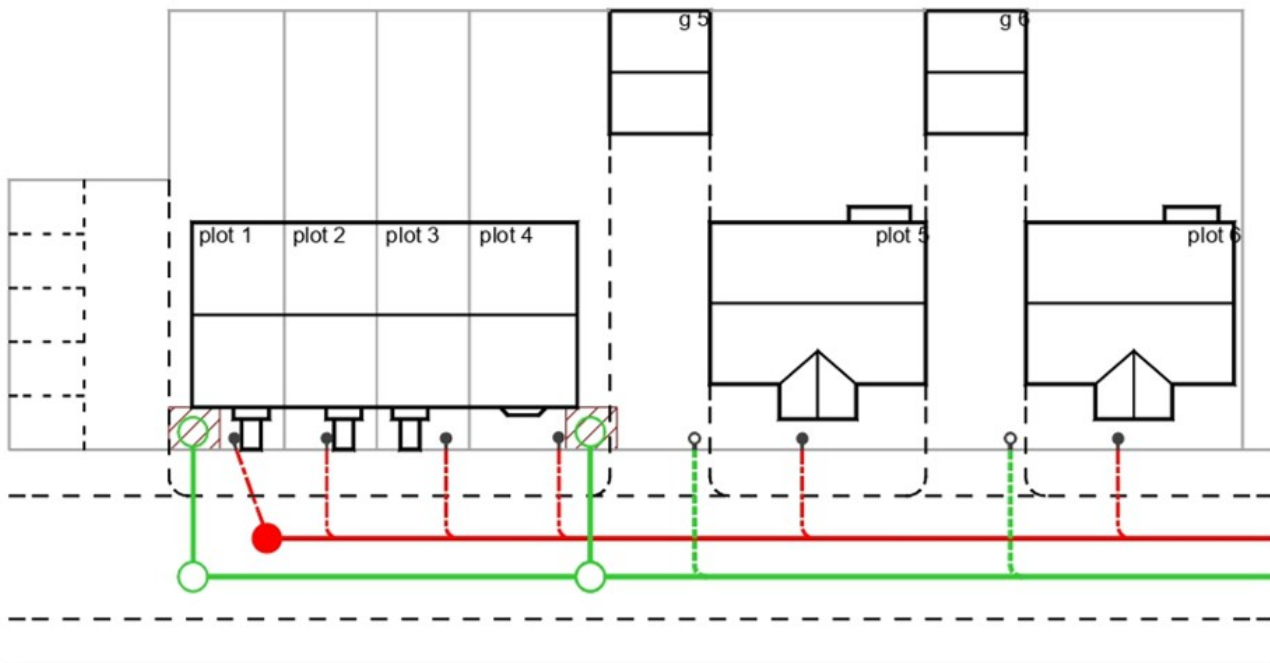


Figure 2.3 **Layout drawing – Lateral drain connection**



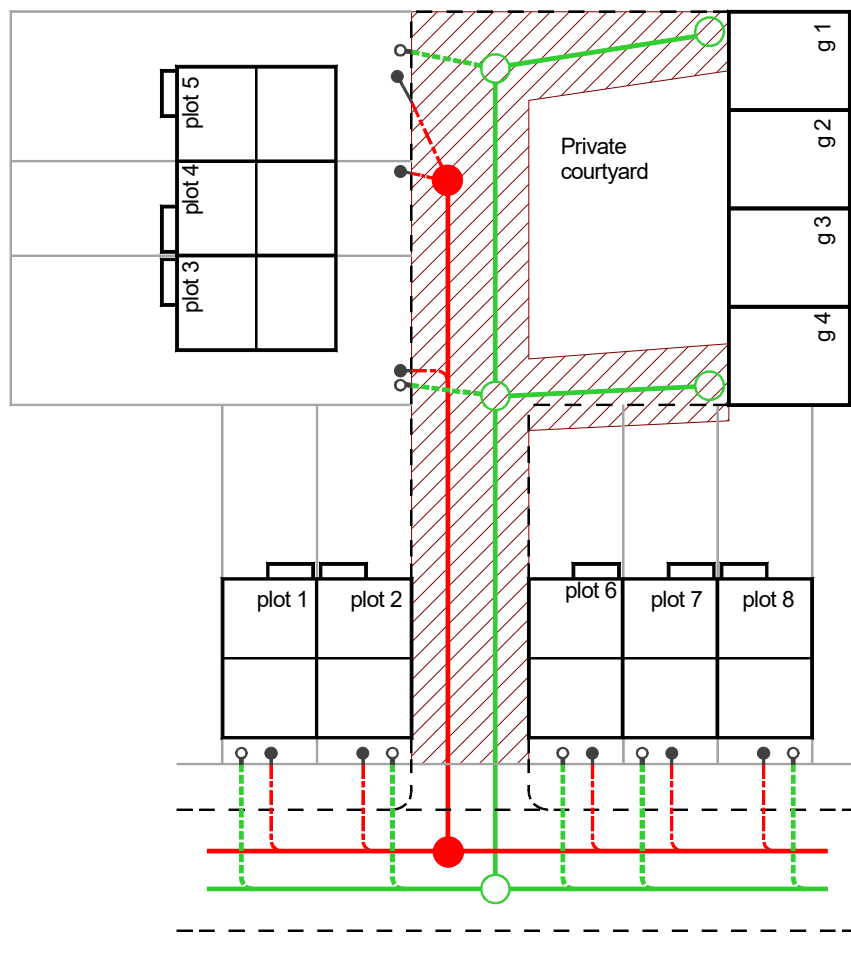
Key:

All pipe to be a minimum of 150 mm diameter, unless noted otherwise

- Foul sewer
- Surface water sewer
- Foul drain (Private) 100 mm diameter
- Surface water drain (Private) 150 mm diameter
- Foul lateral 100 mm diameter
- Surface water lateral 150 mm diameter
- Foul sewer manhole
- Surface water manhole
- Foul demarcation chamber (Private)
- Surface water demarcation chamber (Private)
- Protected Strip: 3 m (or 1.5 times the depth, whichever is the greater) either side of the pipe

NOTE:

1. This layout refers to a site where the sewers are within a public area being considered / offered for Private Streets Determination with the Roads Authority.
2. The courtyard is a common public area with shared maintenance responsibility, therefore, the Lateral Drains **should** be included on the drainage layout issued for approval.

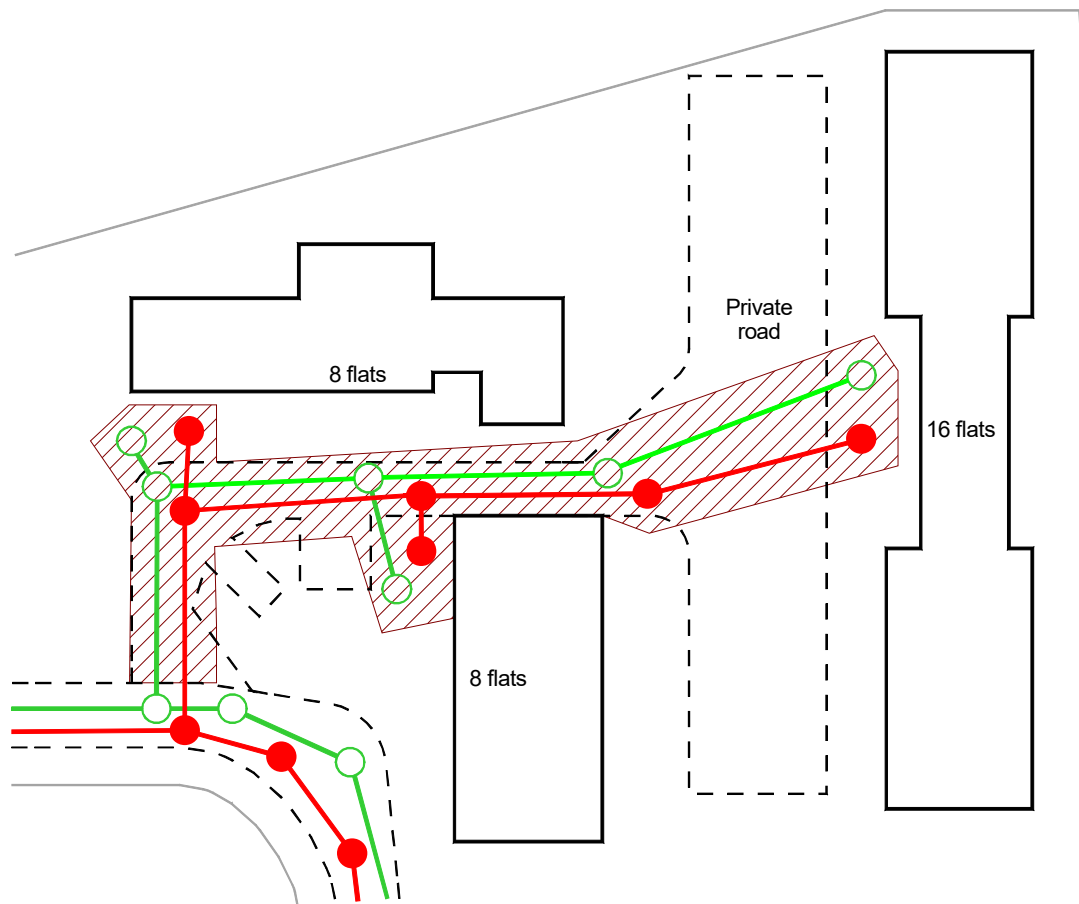
Figure 2.4 Layout drawing – Private courtyard/mews**Key:**

All pipe to be a minimum of 150 mm diameter, unless noted otherwise

—	Foul sewer
—	Surface water sewer
---	Foul drain (Private) 100 mm diameter
---	Surface water drain (Private) 150 mm diameter
---	Foul lateral 100 mm diameter
---	Surface water lateral 150 mm diameter
●	Foul sewer manhole
○	Surface water manhole
●	Foul demarcation chamber (Private)
○	Surface water demarcation chamber (Private)
 	Protected Strip: 3 m (or 1.5 times the depth, whichever is the greater) either side of the pipe

NOTE:

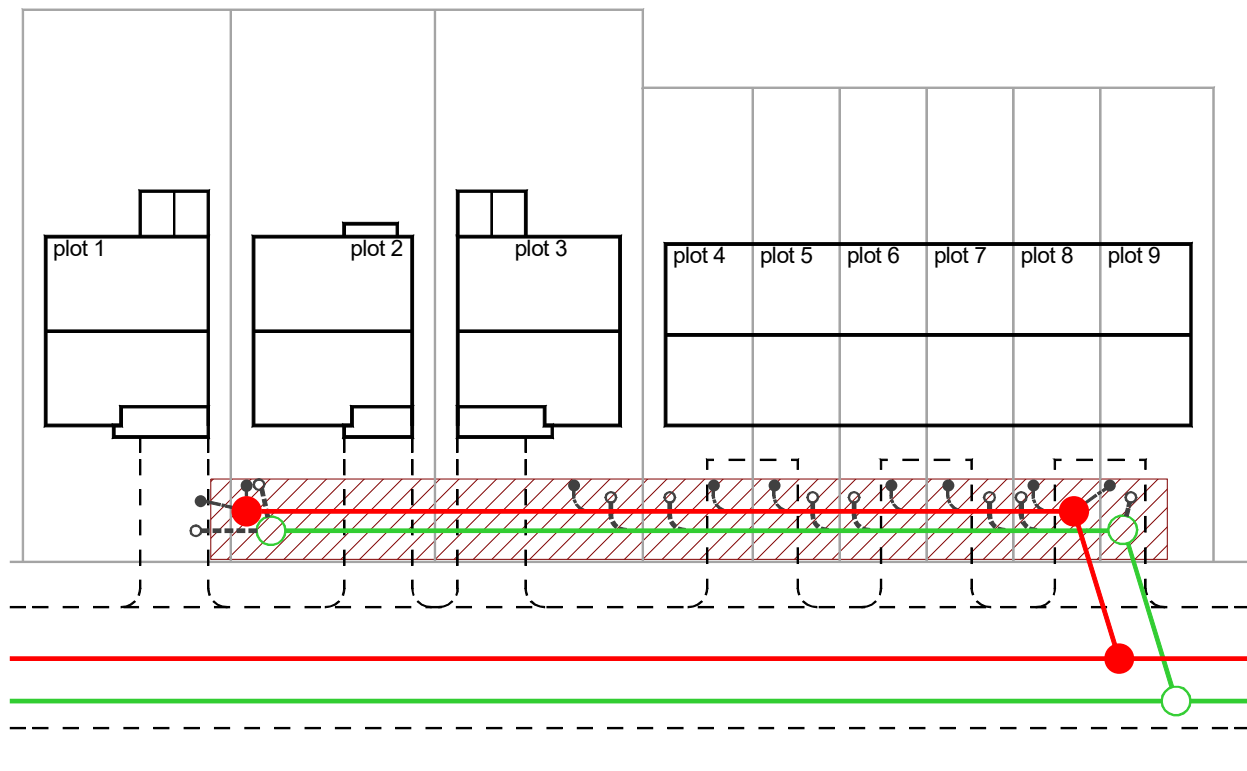
1. This layout refers to a site where the site courtyard is not being considered/offered for Private Streets Determination with the Roads Authority.
2. The courtyard is a common public area with shared maintenance responsibility, therefore, the Lateral Drains **should** be included on the drainage layout issued for approval.

Figure 2.5 Layout drawing – Private cul-de-sac/flats**Key:**

All pipe to be a minimum of 150 mm diameter, unless noted otherwise

- Foul sewer
- Surface water sewer
- - - - - Foul drain (Private) 100 mm diameter
- - - - - Surface water drain (Private) 150 mm diameter
- . - . - Foul lateral 100 mm diameter
- . - . - Surface water lateral 150 mm diameter
- Foul sewer manhole
- Surface water manhole
- Foul demarcation chamber (Private)
- Surface water demarcation chamber (Private)
- ▨ Protected Strip: 3 m (or 1.5 times the depth, whichever is the greater) either side of the pipe

NOTE: This layout refers to a site where the roads are not being considered/offered for Private Streets Determination with the Roads Authority

Figure 2.6 Layout drawing – Rider sewer**Key:**

All pipe to be a minimum of 150 mm diameter, unless noted otherwise

—	Foul sewer
—	Surface water sewer
---	Foul drain (Private) 100 mm diameter
---	Surface water drain (Private) 150 mm diameter
---	Foul lateral 100 mm diameter
---	Surface water lateral 150 mm diameter
●	Foul sewer manhole
○	Surface water manhole
●	Foul demarcation chamber (Private)
○	Surface water demarcation chamber (Private)
▨	Protected Strip: 3 m (or 1.5 times the depth, whichever is the greater) either side of the pipe

NOTE:

1. This layout refers to a site where the Rider Sewers are not within a public area being considered/offered for Private Streets Determination with the Roads Authority. The Lateral Drains in this instance will remain private and the responsibility of the Developer if they have not made other arrangements for their maintenance. Therefore, they should be colour coded as above for information only.
2. It should be noted that a flow control device will not be permitted within a front or rear garden under any circumstances and it may also be deemed that critical sewers can only be located in a highway or public open space for ongoing maintenance reasons. Sewers may be deemed critical for a variety of reasons.
3. Applicants must provide clear and robust evidence demonstrating why the sewer cannot be located within the highways or public open space, in accordance with the priority order set out within section 2.2.2 above.

2.3 Depths of sewers and lateral drains

1. Minimum depths of cover to the crown of pipes without protection (see Section 2.10) should be as follows:
 - a) 0.75 m for gardens and open spaces without any possibility of vehicular access;
 - b) 0.9 m for agricultural land;
 - c) 1.2 m for driveways, footpaths, streets, highways and parking areas with unrestricted access to HGVs.
2. The invert of any pipeline should be a minimum of 150 mm above the foundations of any structures within 3 m or 1.5 times the depth of the pipe, whichever is greater.
3. The structural design of the pipeline should take account of loading from the passage of construction plant, as well as normal design loading.

2.4 Minimum pipe sizes

1. The minimum size for a foul gravity sewer shall be 150 mm nominal internal diameter.
2. The minimum size for a foul lateral drain for a single domestic property shall be 100 mm nominal internal diameter.
3. The minimum size for a surface water gravity sewer should be 150 mm.
4. The minimum size for a surface water lateral drain should be 150 mm.
5. The minimum internal diameter of a rising main should be 80 mm.

2.5 Hydraulic design – Foul sewers and lateral drains

1. The design flows for gravity sewers for residential developments should be taken as 4000 litres/unit dwelling per 24 hours or calculated using the discharge unit method of calculation (see BS EN 12056-2).
2. The following design flows for industrial development should be used where the actual details of flows are unknown:
 - a) Domestic flow element calculated in accordance with BS EN 12056-2, or in the absence of appropriate information, 0.6 litres/second per hectare of developable land. See also BS EN 16933-2 or BS EN 752:2017.
 - b) Trade effluent flow should be based on a metered water supply to a premise similar to that proposed, or should assume 0.5 litres/second per hectare for normal industry and 1 litre/second per hectare for wet industry. Where the proportion of wet industry is unknown, an average flow of 0.75 litres/second per hectare should be used.
 - c) To obtain the total design flow, the domestic design flow should be added to the trade effluent design flow.
3. Any foul sewer serving up to 10 dwelling units in a development should have a minimum gradient of 1:60. All other sewers within the development should have a minimum gradient of 1:150.
4. To provide a self-cleansing regime within foul gravity sewers, the minimum flow velocity should be 0.75 m/s at one-third design flow.
5. Lateral drains should have a minimum gradient of 1:40.
6. These parameters are not to be taken as a norm when the topography permits steeper gradients. Hydraulic studies indicate that these requirements might not necessarily achieve a self-cleansing regime. When a choice has to be made between gravity sewerage and pumped sewerage, these criteria should not be regarded as inflexible and the Developer should consult Northern Ireland Water.
7. The roughness value (k_s) for foul gravity sewer design should be 1.5 mm.

2.6 Hydraulic design – Surface water on site

1. An appropriate flow simulation method based on the Wallingford Procedure should be used for hydraulic design.
2. The system should be designed under pipe full conditions to accept a 1 in 2 year rainfall event without surcharging above pipe soffit. Where consequences of flooding are severe, for example where basements exist or are proposed, sewers should be designed to accept a 1 in 5 year rainfall event without surcharging.
 - a) An allowance of an additional 10% to the rainfall intensity hyetograph values provided by the Flood Estimation Handbook should be made to provide for urban creep.
 - b) An allowance of an additional 10% to the rainfall intensity hyetograph values provided by the Flood Estimation Handbook should be made to provide for climate change, unless climate change is otherwise accounted for.
3. The system should also meet the flood protection requirements (see 2.8).
4. Surface water sewer design should include runoff from roofs, paved areas and, subject to the agreement of Northern Ireland Water, streets (including verges) and other public paved areas. For these areas, an

impermeability of 100% should generally be assumed. They should not be designed to take runoff from other areas or land drainage for which satisfactory and separate arrangements should be agreed with the Department of Infrastructure Rivers Agency and confirmed to Northern Ireland Water.

5. The minimum velocity should be 1 m/s at pipe full flow.
6. The roughness value (k_s) for surface water sewer design should be 0.6 mm.

2.7 Control of surface water discharges

1. The Developer is encouraged to have early discussions with Northern Ireland Water to ensure that a sustainable approach to the management of surface water from the site is applied.
2. Surface water drainage should be discharged in the following order of precedence:
 - i) to an infiltration drainage system, where practicable (This will not be adopted by Northern Ireland Water), or
 - ii) to a watercourse or other water body where practicable, or
 - iii) to a surface water sewer or other drainage system discharging to a watercourse or other water body, where practicable, or
 - iv) exceptionally, by agreement with Northern Ireland Water, to a public combined sewer.
3. Connection of surface water to a foul sewer is not permitted.
4. The system should be designed to ensure that the flow rate meets the relevant discharge consent.
5. The management of surface water will be subject to PPS 15 Planning and Flood Risk, where there will be a requirement for a Flood Risk Assessment (FRA) in managing surface water. Issues with regard to Northern Ireland Water's specific site constraints will be detailed to the Developer for inclusion in the FRA.

2.8 Hydraulic design – Protection against flooding

1. The system should be designed and constructed: -
 - a) Surface water drainage shall be designed for runoff from roofs, paved areas, designated private streets and, subject to the agreement of Northern Ireland Water, road verges and other hard-standing areas; an impermeability (runoff) coefficient of 100% shall be assumed.
 - b) To ensure a freeboard of at least 300 mm in a 1 in 30 year rainfall event, so as not to flood any part of the site; and
 - c) To ensure a freeboard of 300 mm from finished floor level in a 1 in 100 year rainfall event so as not to flood properties in any part of the development or off the site.
 - d) Wastewater pumping station control panels and kiosks should be designed and constructed to ensure they are not affected by a 1 in 200 year rainfall event.
2. Developers should design for exceedance and demonstrate flow paths and the potential effects of flooding resulting from blockages, pumping station failure or from storm events exceeding the design criteria.
3. An additional increase in the paved surface area of 10% should be assumed for all areas to allow for future urban expansion (i.e., property extensions and additional paved area) when designing the drainage system.
4. An allowance of an additional 10% to the rainfall intensity hyetograph values provided by the Flood Estimation Handbook should be made to provide for climate change.
5. Developments which utilise SuDS, shall use appropriate analytical tools to demonstrate the required level of flood protection performance.
6. Any underground storage to attenuate surface water should be sited within the system being offered for adoption.
7. Surface water pumping stations should only be used where there is no other practicable method of surface water drainage removal and an adequate design for exceedance flood route is provided in the event of pumping station failure. Where a Developer proposes to construct a surface water pumping station, early discussions should be held with Northern Ireland Water.
8. Flood exceedance routes for pumping station failure should be adequate to ensure no flooding of properties on or off the Site during a 1 in 30 year rainfall event.

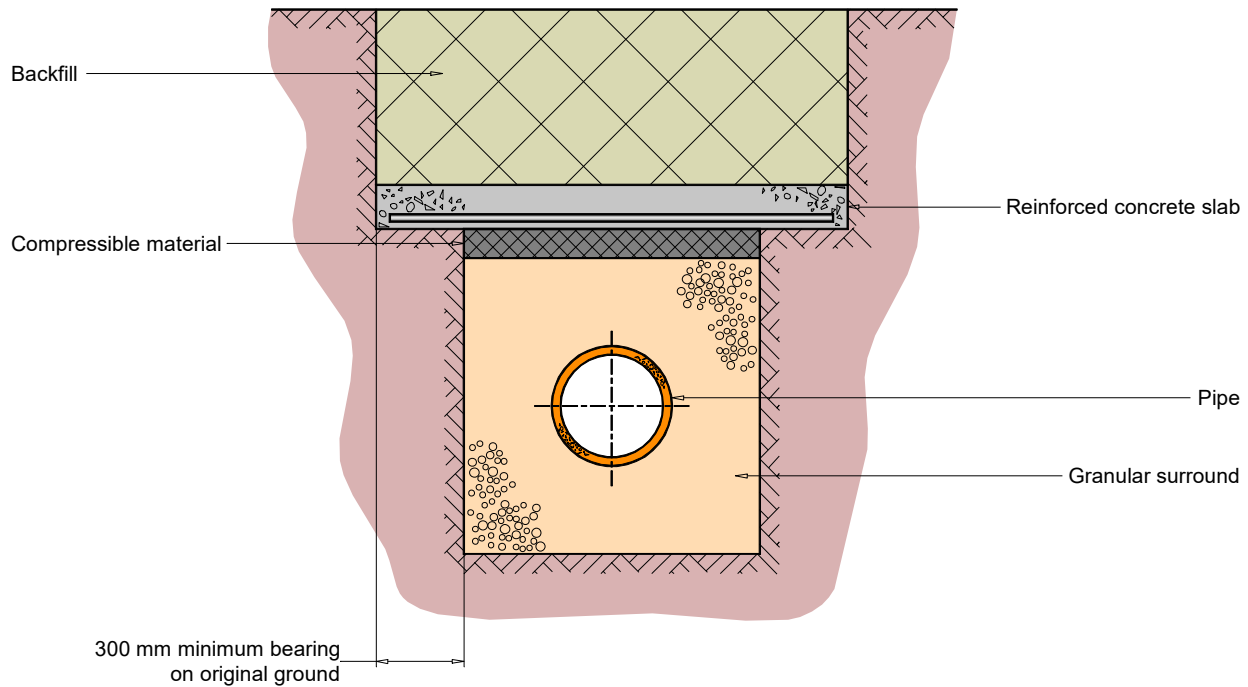
2.9 Hydraulic design – Rising mains

1. The flow velocity of the rising main should be in the range 0.75 – 1.8 m/s.
2. The roughness value (k_s) used for the design of the rising main should be shown in the calculations submitted and should be in accordance with 'Tables for the Hydraulic Design of Pipes, Sewers and Channels: Current Edition' published by HR Wallingford,

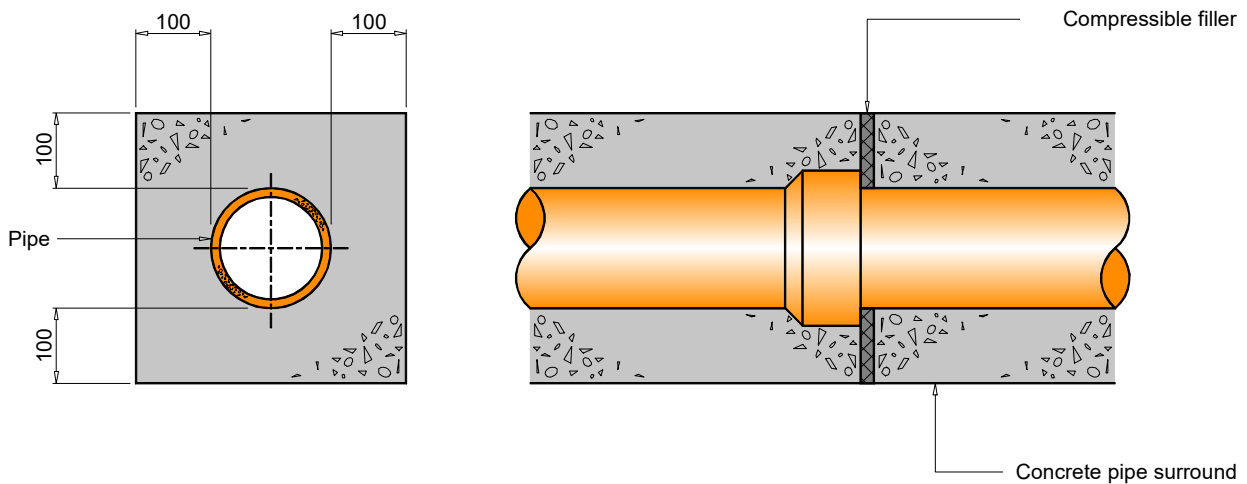
- i.e., for mean velocities up to 1.1 m/s $k_s = 0.3 \text{ mm}$; and
 for mean velocities between 1.1 and 1.8 m/s $k_s = 0.15 \text{ mm}$.
3. A rising main should be laid to a minimum gradient of 1:500 rising and 1:300 falling, with sewage-type air release valves provided at high points to facilitate air removal. However, a continuously rising pipeline without air valves is preferred. For rising mains longer than 500 m, the following factors should be considered:
 - a) Retention time and septicity. Where septicity is likely to occur, consideration should be given to reduction of retention times. Chemical dosing may only be used as a last resort due to the increased operational costs associated with it.
 - b) Effect of hydraulic surge and cyclic loading on fatigue life of the material. Copies of calculations/reports on surge analysis should be sent to Northern Ireland Water.
 - c) The effect of air coming out of solution at high points in the system. It can be necessary to include air release valves.
 - d) The drawing in of air after running pumps 'on shore'. It can be necessary to include air release valves.
 - e) Provision should be made for access for cleansing.
 - f) Washout facilities should be provided for safely controlling and disposing of any discharge at any low points, in accordance with Northern Ireland Water Environment Management System Regulations.
 - g) On sewer rising mains, hatchboxes should be provided at maximum of 500 m intervals and/or at all high/ low points.
 4. In all cases, consideration should be given to installation of a separate manhole and short section of gravity sewer at the end of the rising main to enable the flow to gravitate to a manhole on the existing public sewer. Detailed design of the entry arrangements should ensure that sewer maintenance operations can be undertaken at the manhole without difficulty and to avoid turbulence which could cause aerosol formation, surcharge or flooding.
 5. Where the drainage from a single property is pumped, the rising main should discharge upstream of the demarcation chamber and the lateral drain should be a gravity pipeline.

2.10 Structural design

1. Buried pipes should be designed in accordance with BS EN 1295-1; further guidance on this, including simplified design tables, can be found in BS 9295.
2. If the depth of cover to the crown of the pipe is less than the values recommended in Clause 2.3.1, permission should be agreed with Northern Ireland Water and where applicable written confirmation from DFI Roads to provide one of the following protection measures:
 - a) A concrete slab in accordance with Figure 2.7;
 - b) A concrete surround with flexible joints, in accordance with Figure 2.8; or
 - c) A ductile iron pipe.

Figure 2.7 Protection of pipes laid at shallow depth

Not to scale. Dimensions are in millimetres. All dimensions are minimums.

Figure 2.8 Concrete surround with flexible joints

Not to scale. Dimensions are in millimetres. All dimensions are minimums.

3. The structural design of all pipes should take into account the possible incidence of punching shear. The design should ensure that no vertical load is imposed by structures such as shafts onto non-load bearing components such as the pipes.
4. Where there is a risk of tree root intrusion (see Clause 2.2.12 and Figure 2.2), the sewer should be constructed from Black polyethylene with welded joints or be protected with a third-party approved proprietary solution.
5. Plastics pipes should have jetting resistance as defined in WIS 4-35-01.

6. The structural design of rising mains should take account of the surge pressures as well as the hydrostatic pressures.
7. Joints on rising mains should either be restrained and end-load resistant, or securely anchored with thrust blocks.
8. Rising mains should be made from black polyethylene or ductile iron.
9. Rising mains in above-ground locations should be made from ductile iron.

2.11 Provision of access points

1. Access points are required to gain entry to a sewer or drain for maintenance or inspection and includes any manhole, inspection chamber or rodding eye. These should be sited with due regard to other public utility services.
2. A manhole chamber should be built:
 - a) at every change of alignment, gradient or pipe material;
 - b) at the head of all sewers;
 - c) at every junction of two or more public sewers;
 - d) wherever there is a change in the size of the sewer;
 - e) at every junction of a public sewer with a private sewer serving at least three properties;
 - f) the distance between manholes should not be greater than 60m for up to 150mm sewers and 90m on all other sewers;
 - g) Demarcation chambers should be located within 1 metre of the curtilage of the private property at the upstream end of each lateral drain and not within the public highway or footpath.
3. Manholes should be designed for safe access and egress. The minimum clear opening into any manhole should be 675 mm x 675 mm.
4. Inspection chambers should be designed to afford reasonable access for equipment to carry out maintenance activities. Inspection chambers should be designed to deter personnel access.
5. Northern Ireland Water will not adopt brick filled manhole covers.

2.12 Design of manholes

1. Any pipe and associated access upstream of the demarcation chamber is a private drain and should be constructed to building regulations standards.
2. Figures 2.9 to 2.13 show typical details of access points with depths from cover level to soffit of pipe not exceeding 6 m, including backdrops. No significant departure from these should be made without approval by Northern Ireland Water.
3. In exceptional cases, where access is required at a greater depth than 6 m, the details should be agreed in advance with Northern Ireland Water.
4. Where the manhole is associated with a surface water attenuation arrangement, the chamber should be designed as part of that structure.
5. Manhole diameters should be in accordance with Table 2.1.

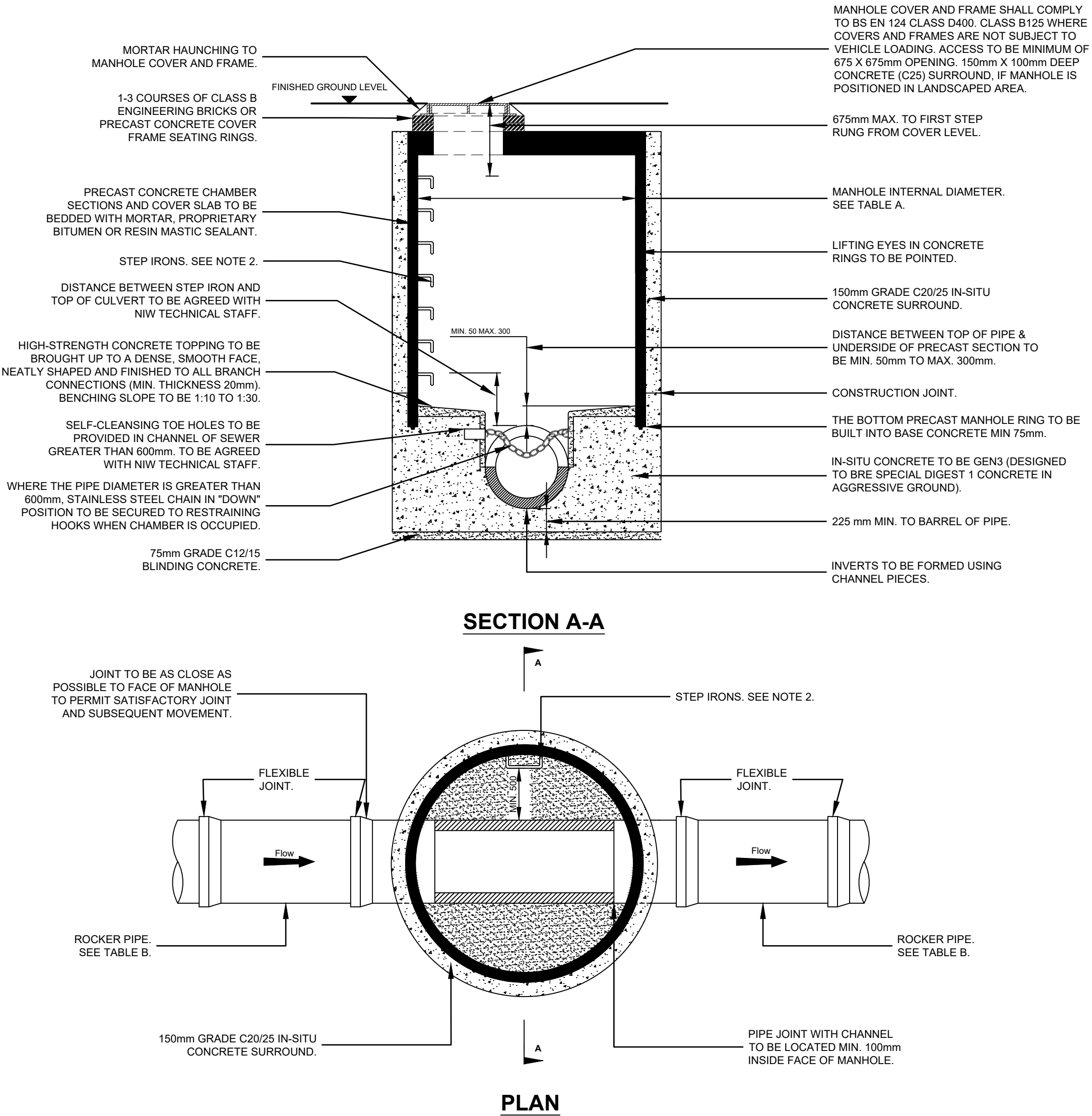
Table 2.1 Manhole diameters

Nominal diameter of largest pipe in manhole (mm)	Minimum nominal internal diameter of manhole (mm)
150 - 300	1200
375 - 450	1350
525 - 600	1500
675 - 900	1800
Greater than 900	Pipe diameter + 900

6. The height of a NIW C manhole, Figure 2.11 (benching to slab soffit) should normally be in excess of 2000 mm. When this is impracticable, NIW A, Figure 2.9 and NIW B, Figure 2.10 manholes are preferred, subject to an absolute minimum height (benching to slab soffit) of 900 mm.
7. The internal diameters quoted above are considered to be the minimum. Where two or more pipes enter the manhole, it can be necessary to increase the internal diameter to accommodate the minimum width of benching. Pipes of different diameters entering manholes should be installed with soffits at the same level.

8. The design of special manholes and other structures should be agreed with Northern Ireland Water.
9. Access covers and frames should be in accordance with Clause 3.2.31 of the Civil Engineering Specification.
10. Frames for manhole covers should be bedded upon bedding material which complies with NIRAUC Code of Practice - Specification for the Reinstatement of Openings in Roads (2nd Edition) Date published: 07 August 2006 and has the following properties:
 - a) the material should be non-shrink. Use of other materials may be considered in consultation with the Northern Ireland Water;
 - b) the material should have a minimum workable life of 15 minutes;
 - c) the compressive strength of the material should exceed 30N/mm² in 3 hours;
 - d) the tensile strength of the material should exceed 5 N/mm² in 3 hours;
 - e) notwithstanding the above requirements, the use of proprietary bedding components to different specifications may be permitted subject to appropriate certification and approval from the Overseeing Organisation.
11. This specification is for a rapid-hardening material which could, for example, be achieved by a suitable resin based material. The use of alternative bedding compounds to different specifications is not necessarily precluded where they form part of an alternative proprietary support system.
12. Bedding materials should be laid strictly in accordance with manufacturers' recommendations. Materials manufactured for use in different temperature conditions shall be selected as appropriate to suit site conditions at the time of mixing and application. Thickness of materials shall be within the range stipulated by the manufacturer.
13. The first manhole upstream from the connection to the existing public sewer should, at the discretion of Northern Ireland Water, be fitted with a 50mm screen in order to prevent debris entering the public sewer. The screen should not be removed until immediately prior to the occupation of premises to be served by the sewer.
14. Rocker pipes should be provided at entry to, and exits from, manholes. Their length should be as shown in Figure 2.12 (see Clause 3.6.6).
15. Steeper gradients are preferred to the use of backdrops. Backdrops should be constructed as shown in Figure 2.13.
16. Where step rungs and ladders are to be used, the distance from the top rung to the surface should be no more than 675 mm (see Clause 3.6.7).
17. The cover frame should be seated on between 1 and 3 courses of precast concrete frame seating rings.
18. The internal face of the manhole cover slab should be plumb with the front edge of the ladder steps.
19. Concrete surrounds to prevent infiltration are not required where the thickness of the manhole rings is at least 125 mm provided the manhole is watertight.

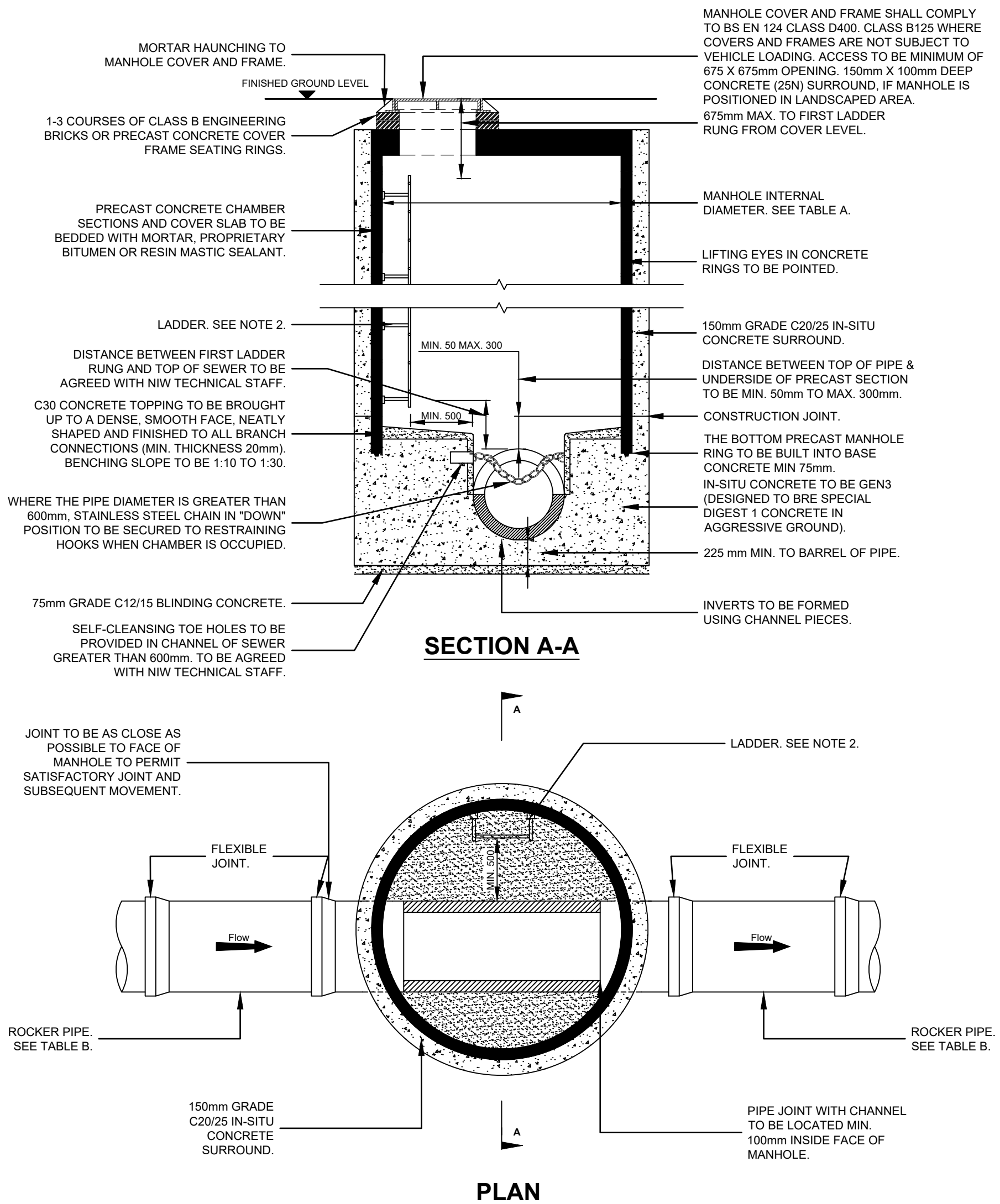
Figure 2.9 Typical manhole detail – NIW WWMH-01



Not to scale. Dimensions are in millimetres. All dimensions are minimums.

Notes:

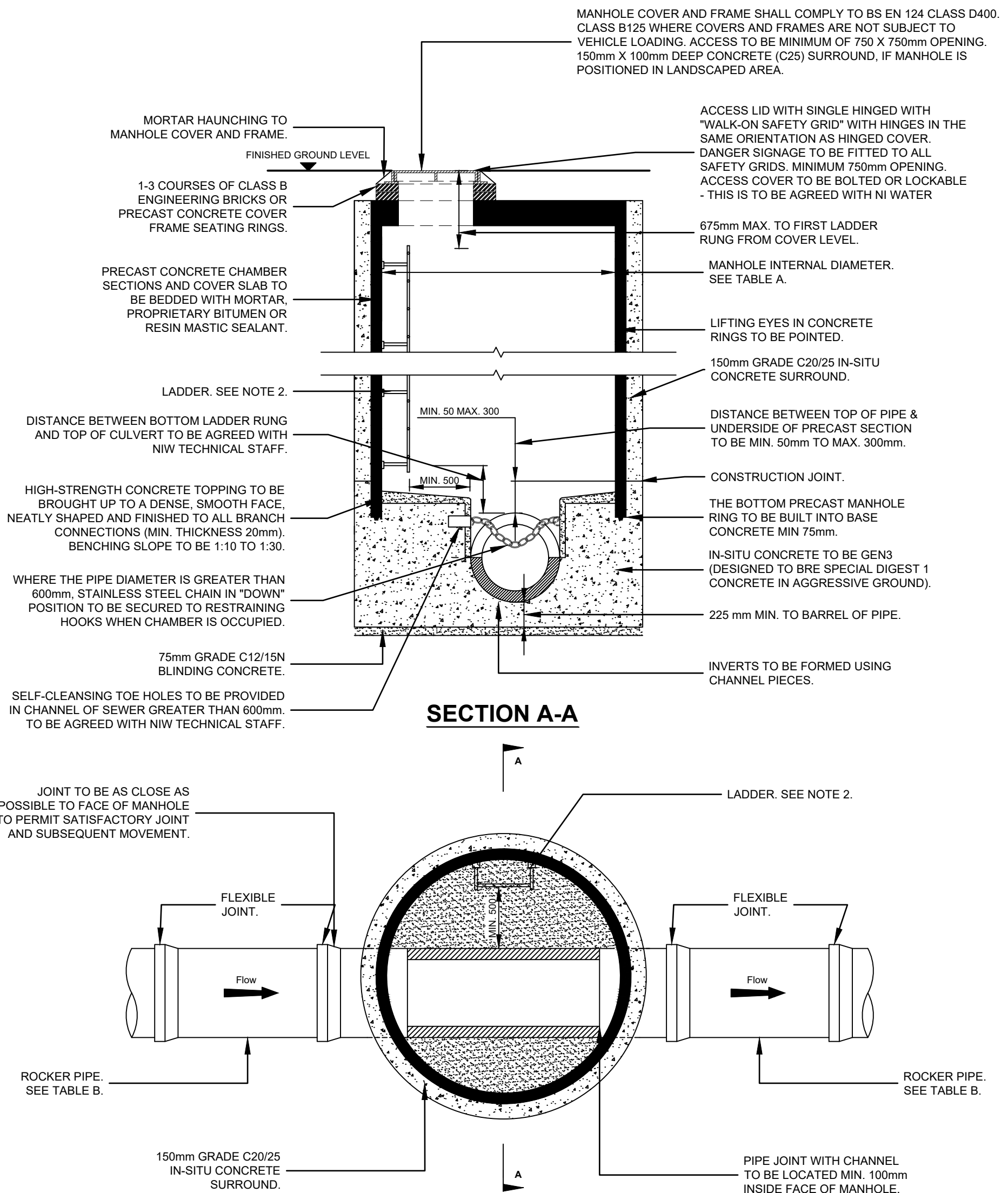
1. Thickness of concrete base and surrounds to be confirmed with NIW following on site ground investigations. Thickness to be confirmed to prevent differential displacement caused by ground conditions.
2. Manhole step irons to comply with BS EN 13101, type D, class 1, galvanised mild steel and plastic encapsulated.
3. Steps are required in manholes with a depth to pipe soffit of 3.0 m or less. manhole ladders are required for manholes with a depth in excess of 3.0m to pipe soffit.
4. All benching to be formed using sulphate resistant C35N concrete.

Figure 2.10 Typical manhole detail – NIW-WWMH-02**Depth from cover level to soffit of pipe 3 m to 6 m**

Not to scale. Dimensions are in millimetres. All dimensions are minimums.

Notes:

1. Thickness of concrete base and surrounds to be confirmed with NIW following on site ground investigations. Thickness to be confirmed to prevent differential displacement caused by ground conditions.
2. Manhole steps irons to comply with BS EN 13101 Type D Class 1 Galvanised mild steel and plastic encapsulated Step are required in manholes with a depth to pipe soffit of 3.0 m or less.
3. Manhole ladders are required for manholes with a depth in excess of 3.0m to pipe soffit. Ladders are to comply with BS EN 14396. For manholes over 4.5m deep, use a fabricated galvanised mild steel ladder.
4. All benching to be formed using sulphate resistant C35N concrete.

Figure 2.11 Typical manhole detail – NIW WWMH 03**Depth from cover level to soffit of pipe > 6m**

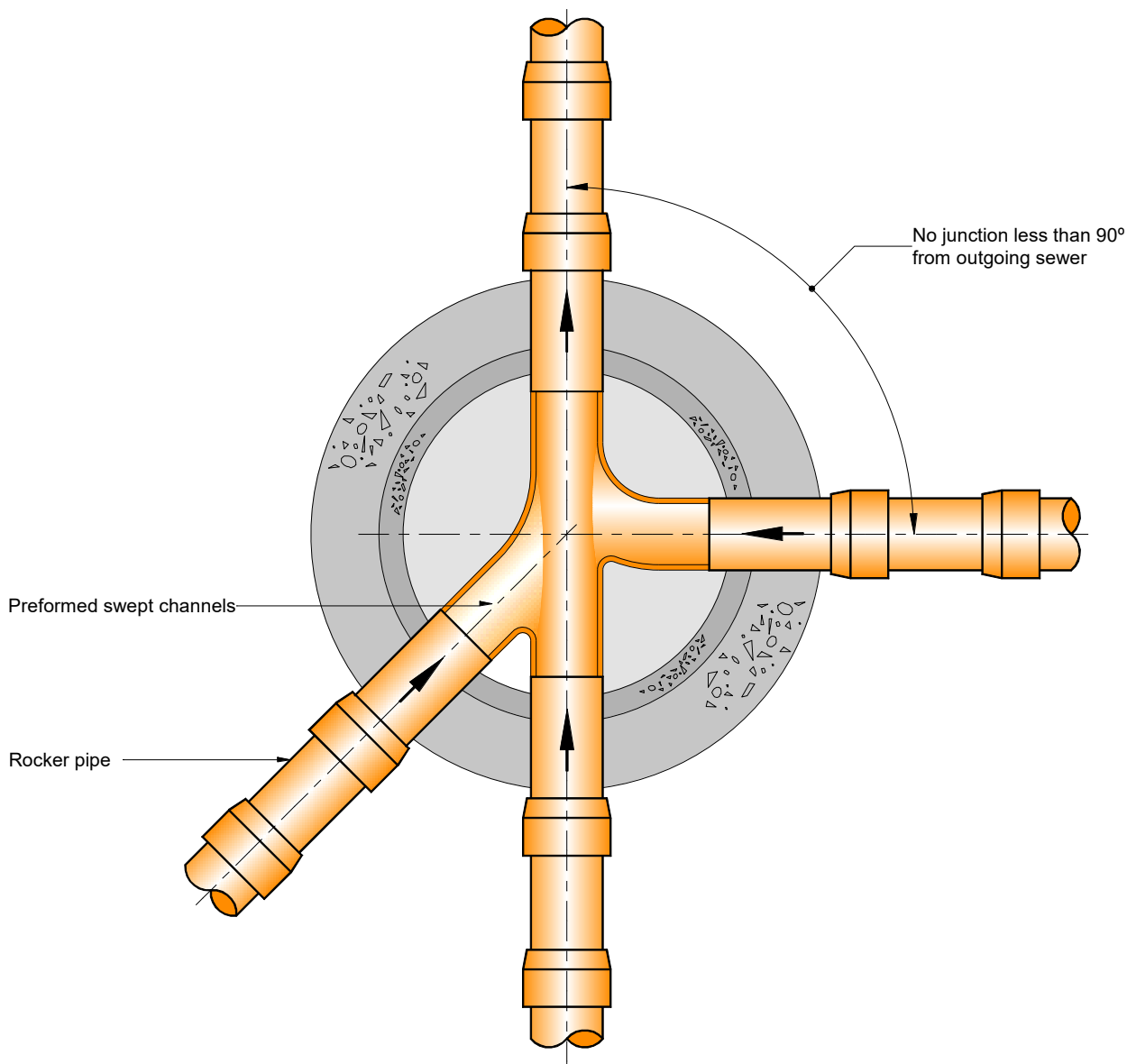
Not to scale. Dimensions are in millimetres. All dimensions are minimums.

Notes:

1. Thickness of concrete base and surrounds to be confirmed with NIW following on site ground investigations. Thickness to be confirmed to prevent differential displacement caused by ground conditions.
2. Manhole steps irons to comply with BS EN 13101 Type D Class 1 Galvanised mild steel and plastic encapsulated Step are required in manholes with a depth to pipe soffit of 3.0 m or less.
3. Manhole ladders are required for manholes with a depth in excess of 3.0m to pipe soffit. Ladders are to comply with BS EN 14396. For manholes over 4.5m deep, use a fabricated galvanised mild steel ladder.
4. All benching to be formed using sulphate resistant C35N concrete.

Figure 2.12 Typical connections to manholes

All pipes entering the chamber to have soffits level.



Not to scale. Dimensions are in millimetres. All dimensions are minimums.

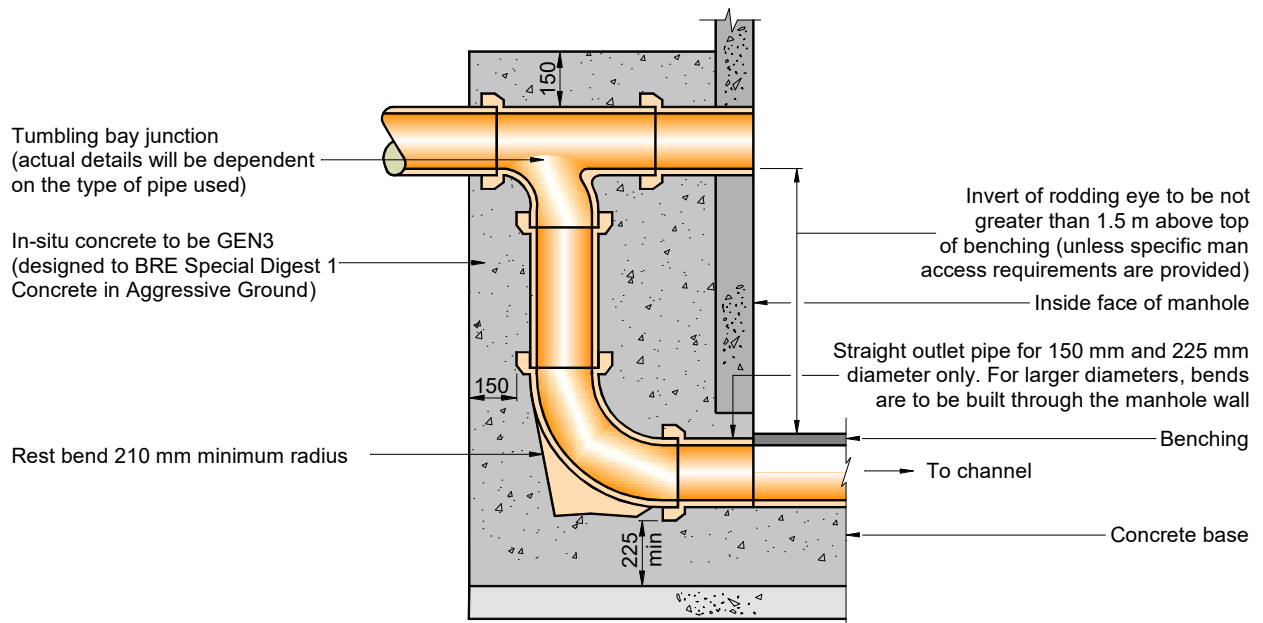
Table A	
Minimum Manhole diameters	
Diameter of largest pipe in manhole (mm)	Internal diameter of manhole
150 – 300	1200
375 – 450	1350
525 – 600	1500
675 – 900	1800
>900	Pipe diameter + 900

Table B	
Rocker pipe length	
Pipe diameter (mm)	Effective length (m)
150 - 600	0.6
601 - 750	1.00
over 750	1.25

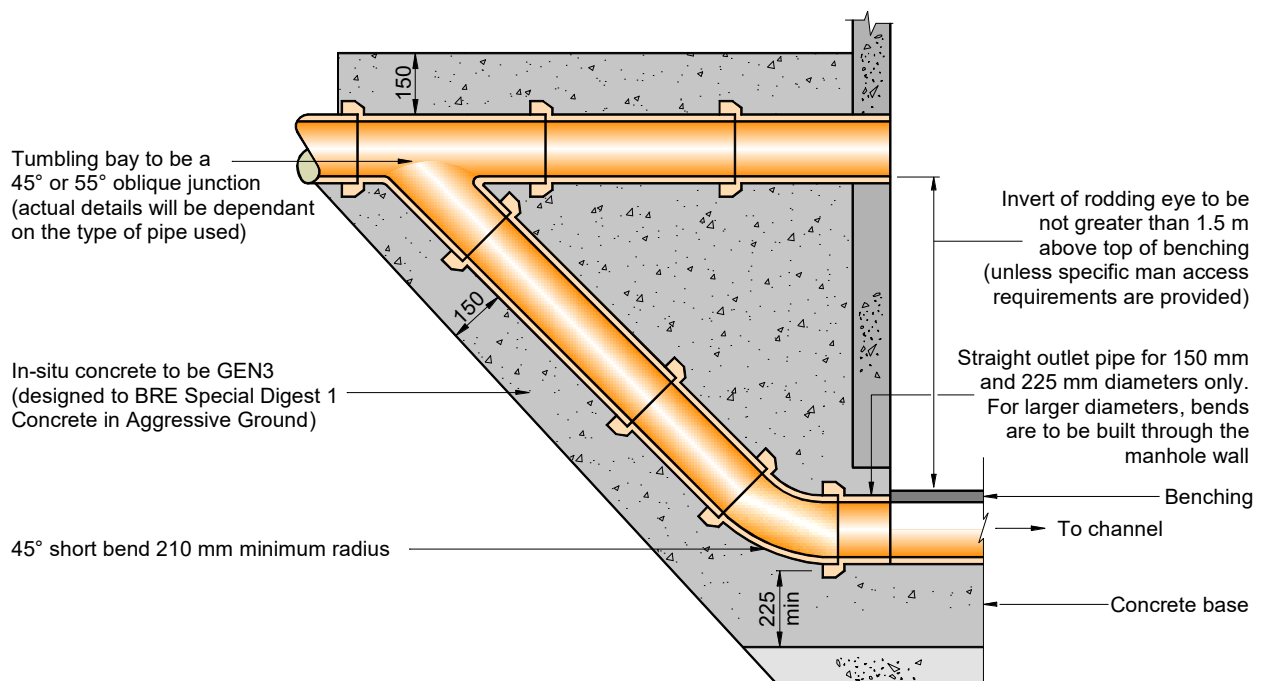
Rocker connections may be required for all pipe sizes up to 750mm due to variable ground conditions.

Figure 2.13 Typical vertical and ramped backdrop details

Note: Steeper gradients are preferred to the use of backdrops.
Type of backdrop to be used to be agreed with Northern Ireland Water.



External Vertical Backdrop



External Ramped Backdrop

Not to scale. Dimensions are in millimetres. All dimensions are minimums.

2.13 Marking of rising mains

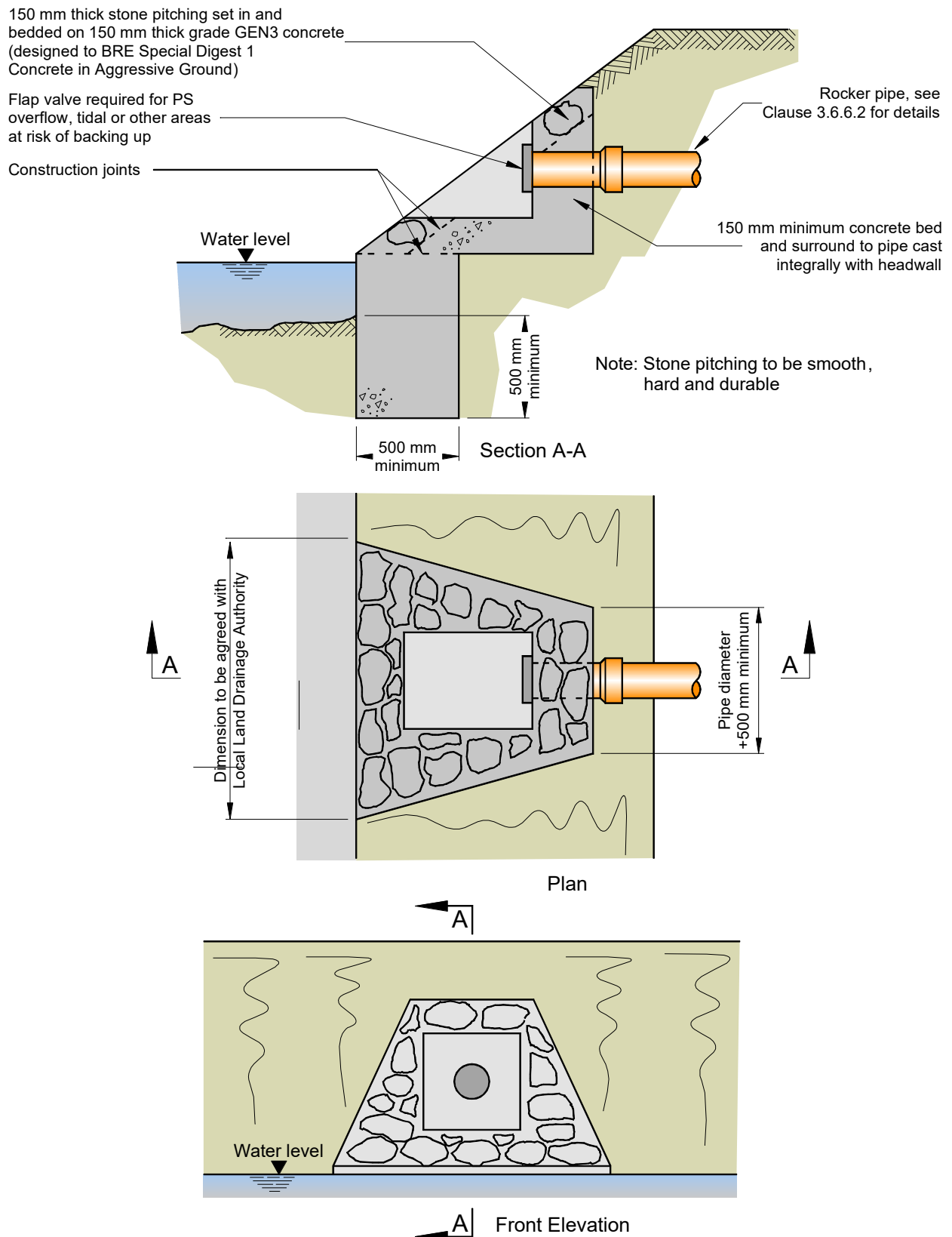
1. The route of a cross-country rising main should be marked at every field boundary and, where practicable, at every change of direction by approved concrete marker posts. The words 'PUMPED SEWER' and the depth to the crown of the pipe in metres should be marked.
2. Non-degradable marker tape should be laid 300 mm above the top of the rising main for its entire length. For a non-metal main, the marker tape should incorporate a trace wire brought to the surface at a marker post approximately every 1000 m and connected to terminals on the marker post. At the pumping station, the tape should enter through a sealed duct, 300 mm below the finished paved area, and should be terminated with 1 m of wire coiled inside the valve chamber. At the discharge end of the rising main, the tape should be terminated as directed by Northern Ireland Water.

2.14 Surface water outfalls

1. Surface water outfalls discharging to watercourses should be fitted with non-return valves to prevent backflow in the event of high water levels in the watercourse. A duckbill valve can be required at the discretion of Northern Ireland Water and the Department for Infrastructure Rivers Agency where:
 - a) properties are at risk of flooding from backflow during 1 in 100 year high water levels; or
 - b) outfalls greater than 350 mm diameter are installed in areas at risk of high water levels.
2. A hinged, lockable cage/safety grille should be fitted to surface water outfalls that are 350 mm diameter or larger. A typical detail of an outfall to a watercourse is shown in Figure 2.14 and a typical detail of a grille is shown in Figure 2.15.
3. Where a health and safety risk due to the height of the head wall exists, suitable railings/ fencing shall be installed.

Figure 2.14 Typical detail of outfall to watercourse

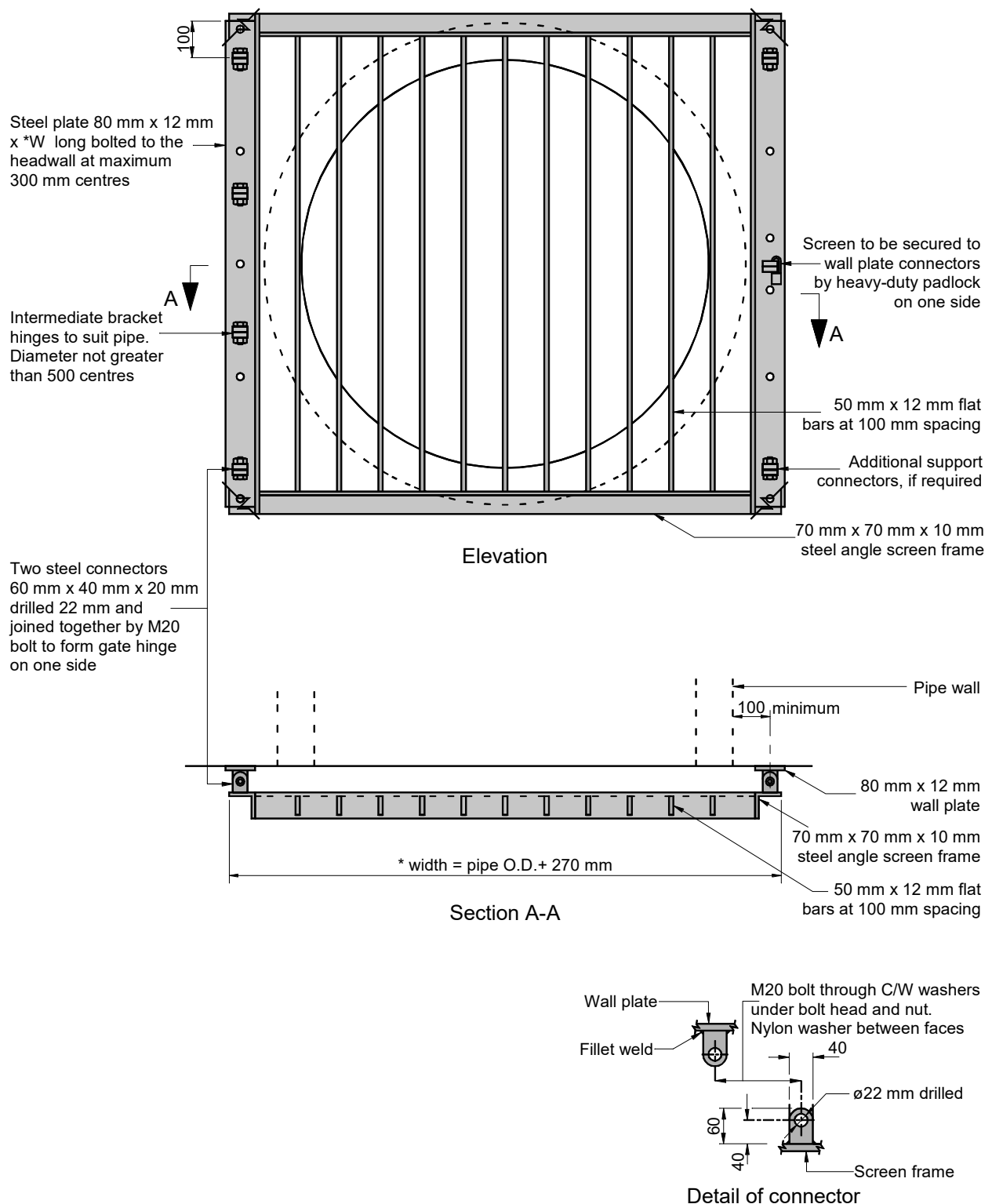
Suitable for outfall pipes of less than 350 mm
Pre-cast concrete outfall structures are acceptable



Not to scale. Dimensions are in millimetres. All dimensions are minimums.

Figure 2.15 Typical outfall safety grille

For outfalls of 350 mm diameter or greater



Not to scale. Dimensions are in millimetres. All dimensions are minimums.

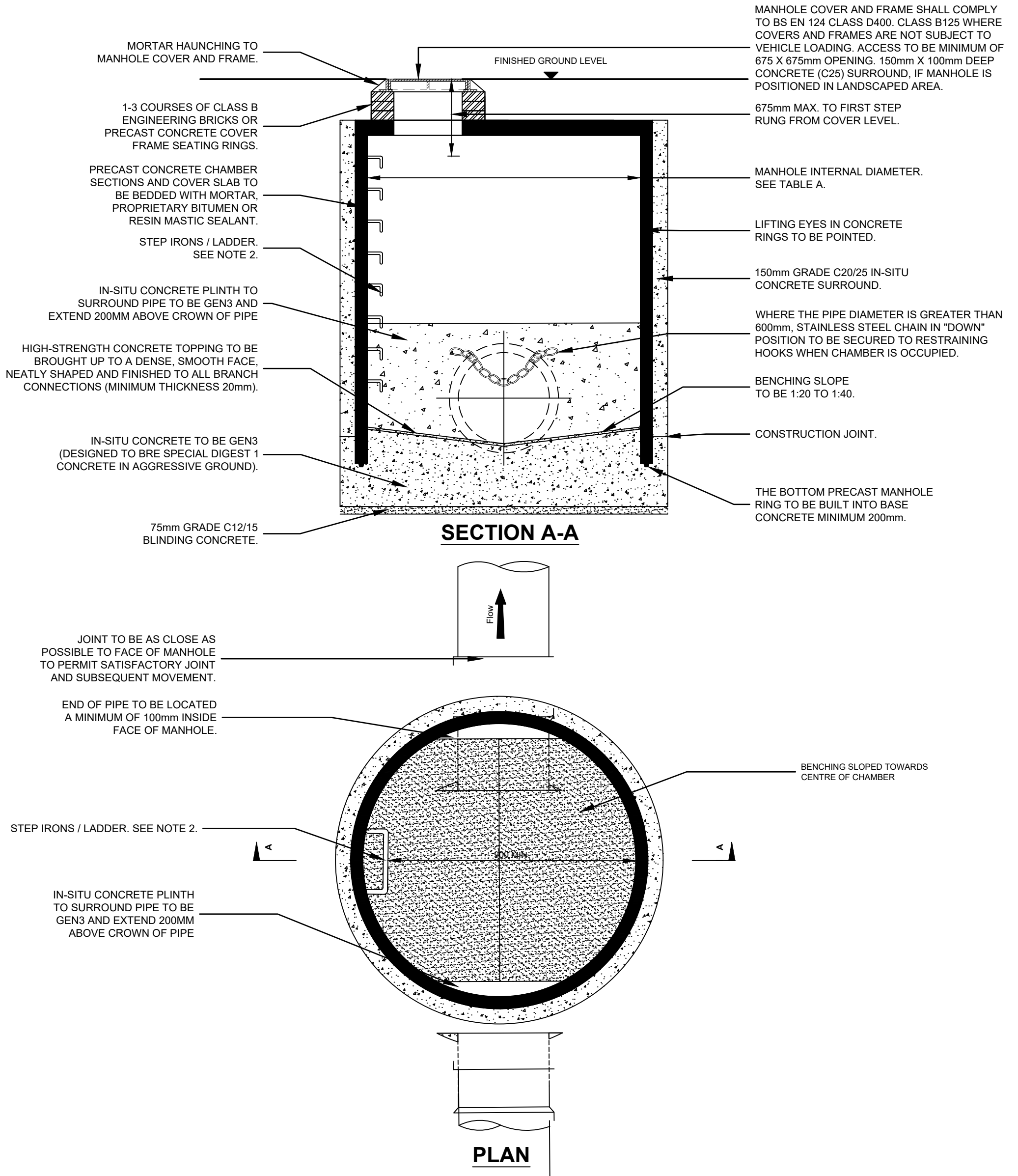
Notes:

1. * width (W) to suit pipe outside diameter.
2. Mild Steel fabrication to be hot dipped galvanised to BS EN 1461

2.15 Surface water flow attenuation

1. Flow attenuation systems should be designed as either large pipes or box culverts, in a linear configuration. In certain situations consideration will be given to the use of geo-cellular structures being used to provide flow attenuation.
2. Flow attenuation systems should be designed to avoid sedimentation and to permit access for regular maintenance.
3. Attenuation storage systems that utilise a flow control device should provide an overflow that:
 - a) has adequate flow capacity to prevent flooding of the site in a 1 in 30 year rainfall event if the main channel of the flow control device blocks completely;
 - b) does not require manual intervention; and
 - c) is located so as to provide at least 300 mm freeboard.
4. Flow control devices should incorporate a drain-down bypass with a surface-operated penstock or valve.
5. Orifice plates and vortex valves should have an orifice with diameter of no less than 100 mm.
6. Flow control devices should be designed using a flow rate to pressure head curve appropriate to the site.
7. Flow control devices should be installed in accordance with manufacturer instructions, with particular attention to orientation, level, depth of sump, and correct installation of bypass system.
8. Sustainable Drainage Systems infiltration systems and upstream drainage are not adopted by Northern Ireland Water.
9. Infiltration systems upstream of a public sewer should be situated at least 5 m above the p100 maximum water table level.
10. Specified sustainable drainage structures are adoptable in accordance with Northern Ireland Water Developer Services Guidance note [*Article 161 Agreement*](#)

Figure 2.16 Typical large diameter attenuation manhole detail

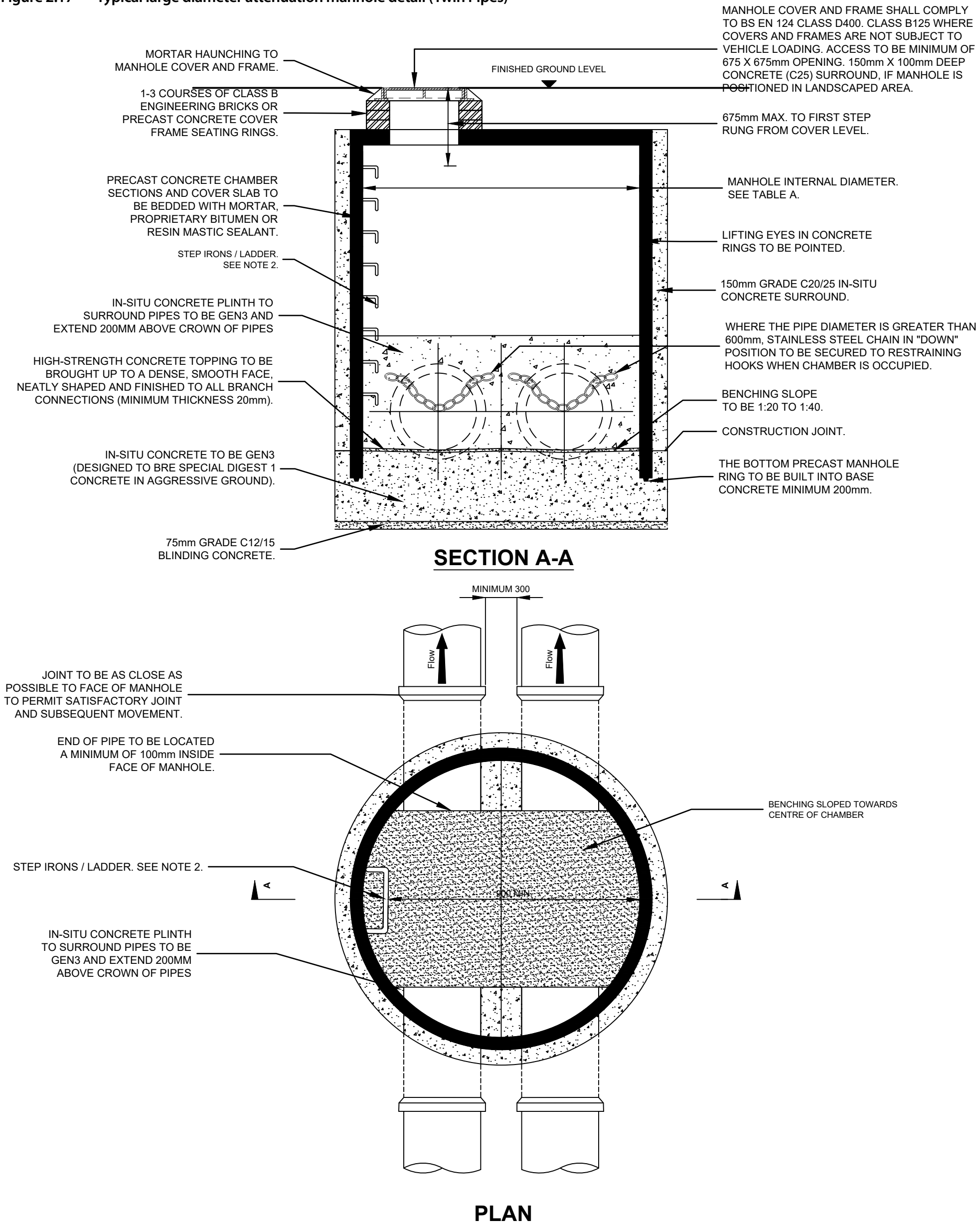


Not to scale, Dimensions in millimetres

Notes:

1. Thickness of concrete base and surrounds to be confirmed with NIW following on site ground investigations. Thickness to be confirmed to prevent differential displacement caused by ground conditions.
2. Manhole step irons to comply with BS EN 13101, Type D, Class 1, galvanised mild steel and plastic encapsulated. steps are required in manholes with a depth to pipe soffit of 3.0 m or less. Ladders are to comply with BS EN 14396. For manholes over 4.5m deep, use a fabricated galvanised mild steel ladder.
3. Steps are required in manholes with a depth to pipe soffit of 3.0 m or less. manhole ladders are required for manholes with a depth in excess of 3.0m to pipe soffit.
4. All benching to be formed using sulphate resistant C35N concrete.

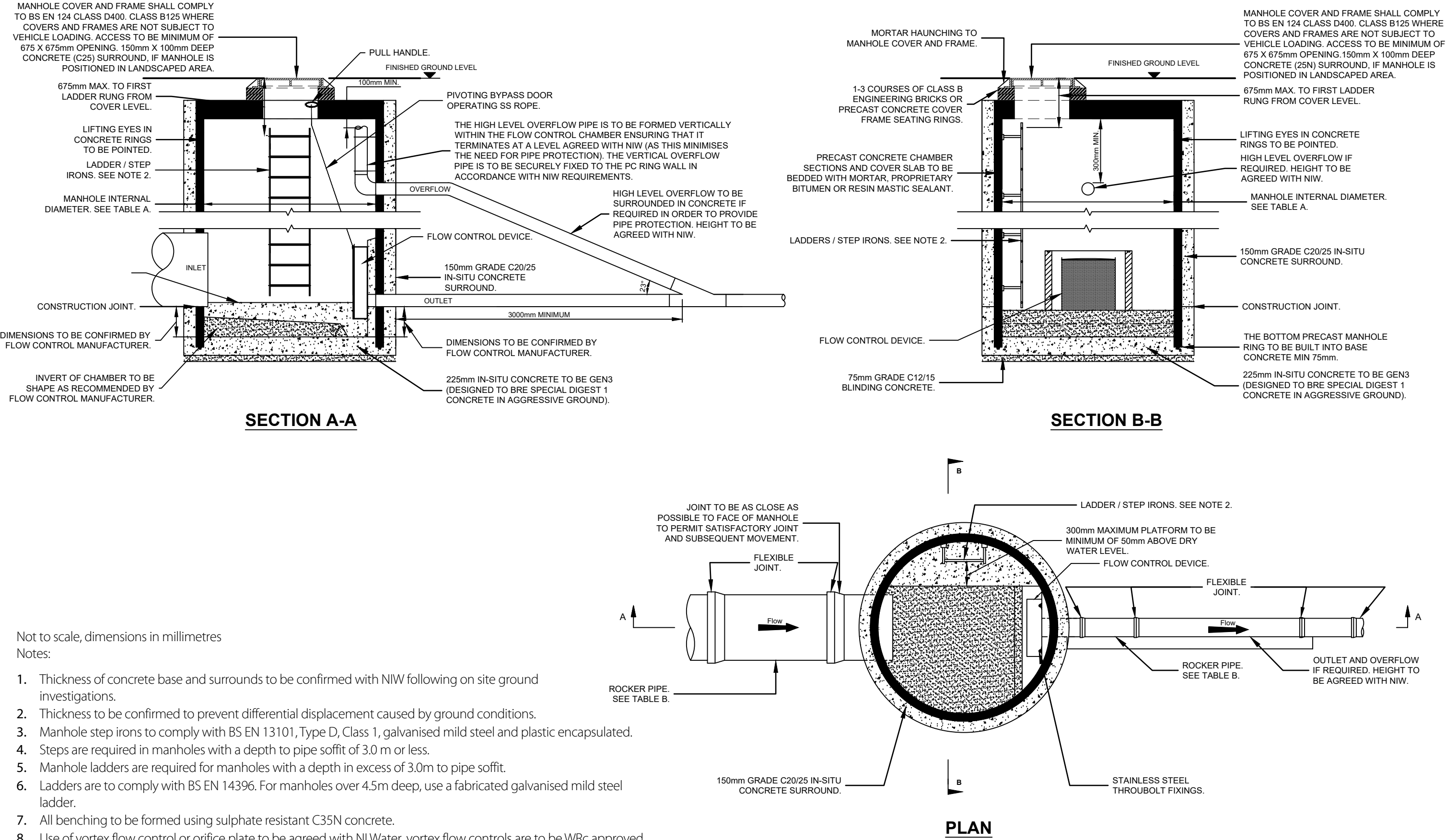
Figure 2.17 Typical large diameter attenuation manhole detail (Twin Pipes)



Notes:

1. Thickness of concrete base and surrounds to be confirmed with NIW following on site ground investigations. Thickness to be confirmed to prevent differential displacement caused by ground conditions.
2. Manhole step irons to comply with BS EN 13101, Type D, Class 1, galvanised mild steel and plastic encapsulated. steps are required in manholes with a depth to pipe soffit of 3.0 m or less. Ladders are to comply with BS EN 14396. For manholes over 4.5m deep, use a fabricated galvanised mild steel ladder.
3. Steps are required in manholes with a depth to pipe soffit of 3.0 m or less. manhole ladders are required for manholes with a depth in excess of 3.0m to pipe soffit.
4. All benching to be formed using sulphate resistant C35N concrete.

Figure 2.18 Typical large diameter flow control manhole detail



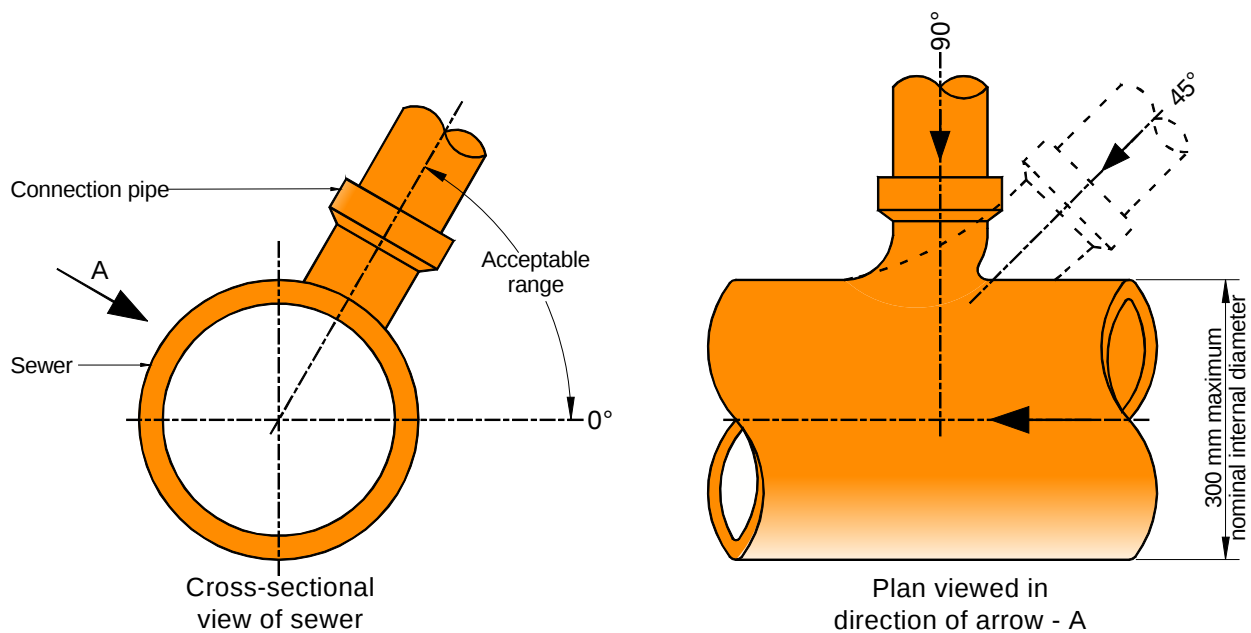
Not to scale, dimensions in millimetres
Notes:

1. Thickness of concrete base and surrounds to be confirmed with NIW following on site ground investigations.
2. Thickness to be confirmed to prevent differential displacement caused by ground conditions.
3. Manhole step irons to comply with BS EN 13101, Type D, Class 1, galvanised mild steel and plastic encapsulated.
4. Steps are required in manholes with a depth to pipe soffit of 3.0 m or less.
5. Manhole ladders are required for manholes with a depth in excess of 3.0m to pipe soffit.
6. Ladders are to comply with BS EN 14396. For manholes over 4.5m deep, use a fabricated galvanised mild steel ladder.
7. All benching to be formed using sulphate resistant C35N concrete.
8. Use of vortex flow control or orifice plate to be agreed with NI Water, vortex flow controls are to be WRc approved.
9. Minimum orifice opening to be 100mm and plate to be 3mm minimum thickness.

2.16 Post-construction connections to sewers

1. As far as practicable, junctions should be built in for anticipated future connections when sewers are constructed to avoid damage by installing connections at a later date. Where it is necessary to make a post-construction connection to a sewer, Clauses 2.17.2 to 2.17.6 apply.
2. Connections should not be made to the crown of the pipe. The vertical angle between the connecting pipe and the horizontal should be greater than 0 (zero) degrees and not more than 60 degrees above the horizontal (see Figure 2.19).

Figure 2.19 Typical post-construction connection to sewer



Not to scale

3. Where the connection is to a sewer that is 300 mm diameter or less, connections should be made using 45 degree angle or 90 degree angle curved square junction fittings (swept-tees).
4. Connections made with junction fittings should be made by cutting the existing pipe, then inserting the junction fitting and jointing with a flexible repair coupling.
5. Where the connection is being made to a sewer greater than 300 mm in diameter:
 - a) Where the diameter of the connecting pipe is greater than half the diameter of the sewer, an access point should be constructed
 - b) Where the diameter of the connecting pipe is less than or equal to half the diameter of the sewer, then the connection should be made using a preformed saddle fitting.
6. Connections made with saddle fittings should be made by cutting a core out of the pipe and jointing the saddle fitting to the pipe, in accordance with the manufacturer's instructions, to ensure a watertight joint. Neither the saddle fitting nor the connecting pipe should protrude into the sewer.

Part 2B – Provision of Pumping Stations

2.17 General

1. Foul pumping stations serving two or more properties can be adopted by Northern Ireland Water.
2. Foul sewage pumping stations should only be used where drainage by gravity is not feasible.
3. Surface water pumping stations can be considered for adoption by Northern Ireland Water, where there is no other practicable method of dealing with surface water drainage, and an adequate exceedance flood route is provided in the event of failure of the pumping station (see Section 2.8).
4. Pumping stations should be constructed in accordance with the Specification for the Construction of Wastewater Pumping Stations for Adoption by Northern Ireland Water (available at Article 161 Agreement). The Specifications cover the civil and M&E requirements for pumping stations serving from 2 up to, and including, 500 properties. If outside of this scale please contact Northern Ireland Water at an early stage to discuss. (Contact CustomerEngagementTeam@niwater.com)
5. Where the discharge from the rising mains is at or close to the receiving sewage treatment works and the discharge rate is more than 50% of the flow to the works, storage should be provided (either upstream of the works or inside the works) to ensure that the peak flow to the works is not more than 3 times the average flow.
6. Where the pump units feature an innovative design which does not allow compliance with Table 2.2 substantiating information shall be provided for approval to Northern Ireland Water prior to purchase of the pump units, to demonstrate that the solids handling performance of the pump units will satisfy the relevant requirements (i.e., the pump units will be capable of prolonged, reliable and trouble-free operation).

Table 2.2 Solids Handling Performance

Nominal bore of outlet (mm)	Diameter of solid sphere able to be passed (mm)
80	60
> 80 but ≤ 100	75
> 100 but ≤ 125	90
> 125 but ≤ 175	120
> 175	150

Part 2C – Provision of Treatment Works

2.18 General

1. WwTW serving two or more properties can be adopted by Northern Ireland Water.
2. WwTW will only be used when determined by the outcome of a Wastewater Impact Assessment
3. WwTW should be constructed in accordance with the Specifications for the Construction of Wastewater Treatment Works for Adoption by Northern Ireland Water (available on request from Northern Ireland Water (email CustomerEngagementTeam@niwater.com)). The Specification covers the civil and M&E requirements for WwTW serving up to 249 Population Equivalent (PE). WwTW for developments for 250PE and above shall require separate consultation between Developers and Northern Ireland Water (applicable to 2 or more properties).

Part 3

Civil Engineering Specification

Any Clauses in this Specification which relate to work or materials not required by the Works shall be deemed not to apply.

The Clause headings and marginal 'Notes for Guidance' are not part of the Specification, and are not to affect the interpretation of either the Specification or the other documents comprising the Agreement.

Where additional Clauses are required, these could be available in the UKWIR 'Civil Engineering Specification for the Water Industry (CESWI 8th Edition at the time of publication).

BRITISH AND EUROPEAN STANDARDS

1. A relevant European Standard (EN) is any European Standard covering the subject which is in force in the European Union. In the UK, ENs are published as BS ENs. A Water Industry Specification (WIS) may be used when there is no relevant European Standard (EN), British Standard (BS) or equivalent available.
2. A European Standard, British Standard or equivalent is not normally available in the case of newly developed products, but this is not to be seen as inhibiting the use of such products. Water Industry Specifications deal with products such as these and are identified in the Civil Engineering Specification (Part 3) of this Guide. However, in the case of any newly developed product for which no European Standard, British Standard or Water Industry Specification (or the equivalent of either) exists; care should be taken to ensure that the product is fit for purpose. This might be achieved by using products which have been assessed by an independent body. The British Board of Agrément (BBA) is authorised to issue European Technical Approvals under the provisions of the Construction Products Regulation (CPR) (EU) No 305/2011.
3. Developers are advised to discuss the use of newly developed products with Northern Ireland Water at the earliest opportunity.
4. Additional quality assurance requirements, including Third Party Certification, can be sought by Northern Ireland Water as a cost-effective means of ensuring compliance with Standards. BSI Kitemarking is an example of Third Party Certification.
5. Northern Ireland Water have a formalised process for the approval of products that are not covered by (as opposed to not complying with) European Standards, British Standards or Water Industry Specifications. If the Developer wishes any such product to be considered for use on their Site, this should be referred to the relevant Developer's Services Manager who will outline the necessary arrangements for its approval.

CESWI

Part 3 of this Guide (Civil Engineering Specification) is drawn from CESWI 8th Edition but is not a full reproduction of the same and is supplemented by additional information.

3.1 General

3.1.1 Drawings

1. One copy of the Drawings shall be kept on the Site and shall be available for use by Northern Ireland Water.
2. All levels on the Drawings shall be related to Belfast Ordnance Datum.

3.1.2 Setting out

1. The Developer shall be responsible for setting out the Works, and for the correctness of the position and dimensions of all parts of the Works.

3.1.3 Quality of materials, workmanship and tests

1. All materials and workmanship shall be subjected, from time to time, to such tests as Northern Ireland Water directs.
2. If required by Northern Ireland Water, a list of the Developer's proposed suppliers and sources of materials required for the execution of the Works shall be submitted to Northern Ireland Water. Samples shall be taken in accordance with the appropriate British Standard, where applicable.

3.1.4 Examination of work

1. Northern Ireland Water shall be afforded the opportunity to examine any work which is about to be covered up or put out of view, and to examine foundations before permanent work is to be placed thereon.
2. At least one clear working days' notice shall be given to Northern Ireland Water before any formation is covered with permanent work and before testing any pipeline.

3.1.5 Existing public sewers

1. All necessary precautions shall be taken to avoid causing any damage to, or interference with flow in, existing public Sewers and shall ensure that debris, silt and mud, etc., do not enter the Sewer. All necessary precautions shall be taken to avoid misconnection to existing public Sewers.
2. No existing sewers or drains shall be connected to the Works or vice versa without the sanction of Northern Ireland Water.

3.1.6 Safety in sewers

1. Where work is required to be carried out within or adjacent to any Sewer, there shall be regard of the relevant provisions of 'The Classification and Management of Confined Spaces' published by Water UK.

(i) Northern Ireland Water might also have its own health and safety provisions in respect of work carried out within or adjacent to any public Sewer.

3.1.7 British and European Standards and other documents

1. Undated references to British Standards and other documents in the Contract shall be deemed to be those current 28 days prior to the date for return of Tenders.
2. Any reference to a Standard published by the British Standards Institution, or to the specification of another body, shall be construed equally as reference to an equivalent one.

(i) Special storage requirements should be described in the Contract.

3.1.8 Storage of materials

1. Materials and components shall be positioned, stored and stacked in such a manner as to preserve their quality and condition to the standards required by the Specification.

3.2 Materials

3.2.1 Compliance with manufacturers' recommendations

(i) An understanding of manufacturer's recommendations are necessary before their applicability can be assessed.

(ii) Where appropriate, use should be made of any technical and advisory services offered by manufacturers.

1. The storage, use, installation application or fixing of materials and components shall be in accordance with manufacturer's recommendations.

3.2.2 Water

1. Water for use with cementitious materials shall be of potable quality.

3.2.3 Non-man-access chambers

1. Non-man-access chambers shall conform to relevant provisions of BS EN 752.

3.2.4 Manhole covers and frames

(i) The minimum clear opening should comply with Northern Ireland Water's standard for new construction. This would normally be 675 mm x 675 mm.

(ii) BS EN 124 is a minimum performance Standard only.

(iii) The Agreement should indicate any requirement for locking devices.

1. Manhole covers and frames shall conform to the relevant provisions of BS EN 124, BS 7903 and Highways England's 'Chamber Tops and Gully Tops for Road Drainage and Services CD 534. Aluminium covers shall not be used.
2. All manhole covers shall be of the non-ventilating type and shall have closed keyways.
3. All manhole covers and frames shall be provided with a prising slot to facilitate the removal of the cover.
4. Chamber access covers with a clear opening exceeding 1 m shall conform to BS 9124.
5. Access covers for pumping stations shall be lockable, galvanised, fabricated, mild steel or ductile iron.
6. Manhole covers on foul only sewers shall be of low leakage types in order to prevent excessive surface water ingress.
7. As a minimum, Class D 400 covers shall be used in carriageways of roads (including pedestrian streets), hard shoulders agricultural or recreational land and parking areas used by all types of road or pneumatic tyred agricultural vehicles.
8. Minimum frame depths for NRSWA road category Types 0 to 4 shall be as shown in the table below. Manhole covers in shared driveways that could be subject to occasional loads from heavy vehicles (e.g. refuse vehicles) should meet the requirements for Type 4 roads.

NRSA Road Category	Traffic Capacity	Description	Minimum frame depth (mm)
Type 0	30-125 msa	Trunk roads and dual carriageways	150
Type 1	10-30 msa	All other A roads	150
Type 2	2.5-10 msa	Bus services	150
Type 3	0.5-2.5 msa	All other roads except residential cul-de-sacs	150
Type 4	Up to 0.5 msa	Residential cul-de-sacs	100

9. Safety grids, where supplied, shall conform to the requirements of BS 9124. When lifted they shall be secure in the upright position. Aluminium safety grids shall not be used.
10. Class B 125 shall be used in footways, pedestrian areas and comparable locations.

3.2.5 Demarcation chamber covers and frames

1. The minimum strength class of cover shall be as shown in the table below.

Surface	Class (loading in kN)	Loading
Road	D400	Vehicle impact
Footway and driveway	B125	Occasional vehicle loading
Gardens	A15	Pedestrian and cyclist (no vehicle traffic)

3.2.6 Aggregates for concrete

(i) For the limitation of total chloride ion content see clause 3.2.17. British Standards no longer contain specific chloride limits for aggregates.

(ii) Marine aggregates may be used, providing Northern Ireland Water is satisfied that the total chloride content of the concrete mix complies with the Specification.

1. Aggregates for concrete shall conform to the relevant provisions of BS EN 12620 and PD 6682-1 (for normal and heavy-weight aggregates) and BS EN 13055-1 (for lightweight aggregates) and to the requirements of BS 8500-2:2015 + A2:2019 Clause 4.3.
2. The water absorption of aggregates for concrete designed to retain an aqueous liquid shall not exceed 3% when measured in accordance with BS EN 1097-6.
3. The proportion of coarse, recycled aggregate and coarse, recycled concrete aggregate shall not exceed 20% by mass of the total coarse aggregate in concrete. Fine, recycled aggregate or fine, recycled concrete aggregate shall not be used in concrete.
4. Recycled aggregates and recycled concrete aggregates shall only be used in contact with raw or potable water where it has been demonstrated that they are suitable for this application.

3.2.7 Aggregates for high strength concrete toppings

1. Aggregates for high strength concrete topping (granolithic finish) shall conform to BS EN 12620 and PD 6682-1, and be 10 mm nominal size, graded in accordance with Table E.1 in PD 6682-1:2009+A1:2013 and shall have a Los Angeles Coefficient no greater than 30.

3.2.8 Aggregates for mortar

1. Aggregates for mortar shall conform to with BS EN 13139 and/or BS EN 998-1 and BS EN 998-2, as applicable.

3.2.9 Sands

1. Sands for mortar and grout shall conform to BS EN 13139 and PD 6682-3.
2. All sands required to conform to BS EN 12620 and PD 6682-1, or BS EN 13139 and PD 6682-3, and shall be washed sands.

3.2.10 Pipe surround materials

1. Processed granular and 'as-dug' bedding, sidefill and surround materials for buried pipelines shall conform to WIS 4-08-02 as amended by 4-08-02A (as amended) and BS EN 1610.
2. Processed recycled granular bed and surround materials shall conform to BS EN 13242.

3.2.11 Plastic sheeting

1. Plastic sheeting for waterproof underlay shall have a composition in accordance with BS 6076.
2. The minimum nominal film thickness shall be 250 µm.

3.2.12 Concrete – Ready Mixed

1. Where concrete is to be obtained from a ready-mix supplier, the supplying plant shall be approved by a Third-Party Certification body accredited by the United Kingdom Accreditation Service (UKAS) for product conformity.
2. The delivery ticket required for each load of ready-mixed concrete shall, in addition to the information prescribed under BS EN 206:2013 + A2:2019 Clause 7.3, detail:
 - (a) the type of aggregate;
 - (b) the actual cementitious content and the percentage of any Pulverised Fuel Ash (PFA) or Ground granulated blast furnace slag (GGBS) included; and
 - (c) the position of the concrete in the Works (details to be inserted at the point of discharge).
3. All delivery tickets shall be kept at the Site and shall be made available for inspection.

(i) PD 6682-3 gives guidance on the application of BS EN 13139.

(i) The requirement for sands to be washed is additional to the Standards but is in line with the main conclusion of CIRIA Report R59 'Building Sands: Availability, Usage and Compliance with Specification Requirements.'

(i) Any limitations on the size and type of materials should be described in the Contract.

(ii) IGN 4-08-01 and 4-08-01A give guidance on pipe surround materials.

(i) Any restrictions on the use of ready-mixed concrete in the Works should be described in the Contract.

(ii) A coded description for the concrete, to obviate unnecessary repetition of items upon delivery tickets, may be acceptable.

(iii) Any requirements for information concerning the taking of test cubes or slump or other consistency determinations, should be described in the Contract.

(iv) Any restrictions on the use of admixtures in the Works should be described in the Contract.

(i) The permitted type(s) of cement should be described in the Contract.
(ii) PFA (pulverised fly ash) in Portland-fly ash cement and Pozzolanic cement and in combinations, should be siliceous only. Pozzolana used in Portland-pozzolana cement should be metakaolin only.

3.2.13 Cement

1. Cement shall either:
 - (a) be factory-produced by the cement manufacturer and conforming to the provisions of the appropriate Standard, as set out in the table below; or
 - (b) be combinations, complying with BS 8500-1:2015 + A2:2021 Annex A, of CEM 1 cement conforming to BS EN 197-1 and fly ash conforming to BS EN 450-1 or blast furnace slag conforming to BS EN 15167-1.

Cement Type	Standard
Portland cement (CEM I)	BS EN 197-1
Portland-silica fume cement (CEM II/A-D)	BS EN 197-1
Portland-limestone cement (CEM II/A-L; CEM II/A-LL)	BS EN 197-1
Portland-pozzolana cement (CEM II/A-Q; CEM II/A-Q)	BS EN 197-1
Portland-slag cement (CEM II/A-S; CEM II/B-S)	BS EN 197-1
Portland-fly ash cement (CEM II/A-V; CEM II/B-V)	BS EN 197-1
Blastfurnace cement (CEM III/A; CEM III/B)	BS EN 197-1 or -4
Pozzolanic cement (CEM IV/B)	BS EN 197-1
Sulphate-resisting Portland cement (CEM I-SR)	BS EN 197-1
Masonry cement	BS EN 413-1

2. Except for concretes having an equivalent compressive strength less than 20 N/mm², cement shall be sulphate-resisting Portland cement or a special combination of:
 - (i) cement complying with the relevant provisions of BS EN 197-1; and
 - (ii) GGBS or PFA, unless Northern Ireland Water can be satisfied that any attack from soils or groundwater will adequately be resisted by the use of cement to BS EN 197-1.

3.2.14 Ground granulated blast furnace slag

1. Ground granulated blast furnace slag (GGBS) for use with Portland cement shall conform to BS EN 197-1.
2. Ground granulated blast furnace slag for use with cementitious materials shall have an alumina (Al₂O₃) content not exceeding 14% by mass.

3.2.15 Cement grouts

1. Cement grout for filling drains which are to be abandoned shall be mixed in the relevant proportions indicated in the table below, using the minimum quantity of water to ensure the necessary fluidity and to render it capable of penetrating the work.

Class	Nominal mix by mass		
	Cement	Sand	Pfa
G3	1	10	-
G4	1	-	10

2. Cement grout shall be used within one hour of mixing, except where containing a retardant admixture.
3. Cement grout for fixing inserts and below plant bases shall include an approved expanding or non-shrink additive.

(i) Normal combinations of cement can be used in suitable concrete to provide resistance to sulphate attack under Design Chemical Classes DC-1 and DC-2. Special combinations can be used in suitable concrete to provide resistance to Design Chemical Classes 3 and 4 using additional protective measures, as appropriate. See Table A.6 and A.11 of BS 8500-1:2015. For further guidance see BRE Special Digest No.1 'Concrete in Aggressive Ground'.

(ii) Where high replacement levels are used, special care will be required in striking formwork and with curing.

(iii) The use of concrete mixes with high replacement levels may not be appropriate in areas subject to abrasion.

3.2.16 Concrete containing PFA or GGBS

1. For concrete mixes containing PFA or GGBS, the proportion of replacement shall be set out as in the table below:

Cementitious Component Other than Cement	Use of Concrete	Percentage by Mass of Cementitious Content	
		Normal	Special
PFA	Any	15 – 35	25 – 40
GGBS	Any	15 – 35	25 – 40
GGBS	Concrete designed to retain an aqueous liquid	0 – 50	70 – 90*
	Other	0 – 65*	70 – 90*

* Subject to Clause 2.8.7.3

2. For concrete designed to retain an aqueous liquid, the maximum cementitious content for mixes containing PFA shall be 450 kg/m³ and the maximum free water: cementitious ratio shall be 0.50.

3.2.17 Chloride content

1. Chloride content of fresh concrete shall be determined in accordance with BS EN 206:2013+A2:2021 Clause 5.2.8
2. Methods for determining the chloride content of constituent materials shall be in accordance with BS 8500-2.

3.2.18 Foamed Concrete

1. Reinstatement of openings in highways and roads using foamed concrete shall conform to the relevant Highway Reinstatement Specification.

3.2.19 Lime for mortar

1. Lime for mortar shall be in the form of lime putty, complying with the relevant provisions of BS EN 459-1.

3.2.20 Mortar

1. Mortar shall be mixed only as and when required, in the relevant proportions indicated in Table NA.2 of the UK National Annex to BS EN 1996-1-1:2005 + A1:2012, until its colour and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of fine aggregate.
2. Ready-mixed and ready-to-use rendering and masonry mortar shall conform to BS EN 998-1 and BS EN 998-2, respectively.
3. All mortar shall be conveyed fresh as required for use. Mortar which has begun to set, or which has been site-mixed for a period of more than one hour in the case of Classes M12 and M6, and two hours in the case of Classes M4 and M2, shall not be used. Plasticising and set-retarding mortar admixtures shall conform to BS EN 934-3 and shall be used in accordance with the manufacturer's instructions.
4. Rapid-hardening cementitious, epoxy resin or polyester resin mortar for setting manhole covers and frames shall have a minimum working time of 15 minutes. The mortar shall reach a minimum compressive strength of 30 N/mm² and minimum tensile strength of 5 N/mm² within 3 hours of mixing.

3.2.21 Pulverised fuel ash

1. Pulverised fuel ash (PFA) and fly ash for use as a Type I (essentially inert) addition to concrete or grout shall conform to the general requirements of BS EN 450-1 with limits on the following specific properties only.

Property	Maximum Value
Moisture content	0.5%
Fineness	60%
Sulphuric anhydride (SO ₃) content	3%
Loss on ignition	12%

2. PFA for use as a Type II (pozzolanic) addition to concrete, grouts or mortar shall conform to BS EN 450-1 fineness category S and loss on ignition category A or B. PFA for annulus grouts shall be pre-blended and bagged before delivery to the Site.

3.2.22 Cover blocks and spacers for reinforcement

1. Cover blocks and spacers shall be designed in accordance with BS 7973-1. To maintain the correct clear cover of concrete over steel reinforcement, shall be as small as possible, consistent with their purpose.
2. Concrete cover blocks shall be manufactured with a 10 mm maximum aggregate size and otherwise produced to the same specification as the surrounding concrete. Wire cast in the cover block for the purpose of tying it to the reinforcement shall conform to Clause 3.2.26.
3. Spacers shall be of rust-proof material and shall not produce staining, or otherwise be detrimental to the concrete or steel.

3.2.23 Joint sealing compounds and sealants

1. Joint sealing compounds shall be impermeable ductile materials of a type suitable for the conditions of exposure in which they are to be placed, and capable of providing a durable, flexible and watertight seal by adhesion to the concrete throughout the range of joint movement.
2. Hot poured joint sealants shall conform to BS EN 14188-1, Type N1 sealant.
3. Cold poured polymer-based joint sealants shall conform to BS EN 14188-2, Class A sealant.
4. Primers for use with joint sealants shall be compatible with, and obtained from the same manufacturer as, the adjacent sealant. Primers shall have no harmful effects on the surfaces to which the joint sealant is to be applied.
5. Sealants and primers which will be in contact with sewage shall be resistant to biodegradation.
6. Two-part, polyurethane joint sealants shall conform to the requirements of BS EN ISO 11600.

(i) Fuel-resistant types of sealants to BS EN 14188-1 or BS EN 14188 2 could be required where concrete surfaces are subject to fuel spillage.

(ii) There are no current British Standards for the cold-applied, non-curing and heat-softened, hand-applied types of sealant, though various such materials are available in proprietary form.

(iii) BS 6213 gives guidance on the selection of constructional sealants.

(iv) In certain circumstances, polyurethane-based sealants (for which there are no current British Standards) may be more resistant to biodegradation than poly-sulphide-based ones.

(v) CIRIA Technical Notes TN128 and TN144 deal with sealants in wet conditions.

(i) BS EN 681-1 does not contain a microbiological test requirement for elastomeric seals.

3.2.24 Joint seals and lubricants

- 1. Elastomeric joint seals shall be Type WC or WG, complying with the relevant provisions of BS EN 681-1, and shall be obtained from the pipe manufacturer. For water mains, the seals shall be Type WA and for drainage purposes they shall be either Type WC or WG.
- 2. Seals shall be tested in accordance with BS 7874 and shall conform to the following:
 - (a) the average loss in mass (Z) of the test pieces shall not exceed 3.5%; and
 - (b) there shall be no greater release of carbon black or other fillers from the test set than from the control set when the surface of the specimens is lightly rubbed.
- 3. In the case of composite seals, the requirements apply only to those components exposed to the contents of the pipeline or pipework.
- 4. Joint lubricants for sliding joints shall have no deleterious effect on either the joint rings or pipes and shall be unaffected by the liquid to be conveyed. Lubricants to be used for jointing water mains shall not impart to water, taste, colour or any effect known to be injurious to health, and shall be resistant to bacterial growth.

3.2.25 Steel Reinforcement

- 1. Steel reinforcement shall conform to the relevant provisions of the appropriate British Standard, as set out below:

Type	Standard
Carbon steel bars	BS EN 10080 and BS 4449
Cold reduced steel wire	BS EN 10080 and BS 4482
Steel fabric	BS EN 10080 and BS 4483
Stainless steel	BS 6744
Epoxy-coated steel	BS EN ISO 14654

- 2. Steel fabric reinforcement shall be welded at the intersections and shall be delivered to the Site in flat sheets, except where pre-bent reinforcement is specified.
- 3. Steel reinforcement shall be obtained from firms holding a valid Certificate of Approval for the manufacture and/or fabrication of steel reinforcement issued by the UK Certification Authority for Reinforcing Steels or equivalent Authority. The CARES, or equivalent, Certificate of Approval Number shall be stated on all appropriate purchase documentation.

3.2.26 Tying wire

- 1. Tying wire for steel reinforcement shall be 1.6 mm diameter annealed mild soft steel wire, complying with BS 1052.

3.2.27 Precast concrete products - General

- 1. Unless otherwise specified in Clauses 3.2.28 to 3.2.31 precast concrete components shall be formed from units manufactured to BS EN 13369.

(i) Where necessary, the surface finish should be shown on the Drawings.

(i) Particular requirements from the options listed in BS EN 1916 and BS 5911, should be described in the Contract.

(ii) The Design Chemical Class should be specified in the Contract in accordance with BRE Special Digest No.1, having regard to the aggressive nature of both the ground and the contents of the pipe.

(iii) Additional protective measures required by BRE Special Digest No.1 to provide resistance to the actual ACEC (Aggressive Chemical Environment for Concrete Class) should be described in the Contract.

(i) Particular requirements from the options listed in BS EN 1917 and BS 5911-3 should be described in the contract.

(ii) The Design Chemical Class should be specified in the Contract in accordance with BRE Special Digest No.1, having regard to the aggressive nature of both the ground and the contents of the pipe.

(iii) Additional protective measures required by BRE Special Digest No. 1 to provide resistance to the actual ACEC (Aggressive Chemical Environment for Concrete) Class should be described in the Contract.

(iv) Precast concrete manhole units of rectangular cross-section may be specified as an alternative to brickwork construction.

(i) Additional protective measures required by BRE Special Digest No.1 to provide resistance to the actual ACEC (Aggressive Chemical Environment for Concrete) Class should be described in the Contract.

3.2.28 Precast concrete pipes and fittings

1. Unreinforced and reinforced concrete pipes and fittings with flexible joints shall conform to the relevant provisions of BS EN 1916 and BS 5911-1. The Design Chemical Class of the concrete in accordance with BRE Special Digest No.1 shall be Class DC-4 unless otherwise specified in the Contract.
2. All pipes and fittings shall have gasket-type joints of spigot and socket or rebated form, unless otherwise stated in the Agreement.
3. Unreinforced and reinforced concrete jacking pipes shall conform to the relevant provisions of BS EN 1916 and BS 5911-1. Pipes shall withstand the jacking loads to which they will be subjected during installation, without cracking or spalling. A certificate shall be supplied, confirming that the pipes are suitable for jacking and stating the distributed jacking loads for which they were designed.

3.2.29 Precast concrete manholes

1. Precast concrete manhole units shall conform to the relevant provisions of BS EN 1917 and BS 5911-3. The Design Chemical Class of the concrete in accordance with BRE Special Digest No.1 shall be Class DC-4 unless otherwise specified in the Contract.
2. Units which bed into bases shall be manufactured so that imposed vertical loads are transmitted directly via the full wall thickness of the unit.
3. For joints between units and the underside of slabs, joint profiles shall be capable of withstanding applied loadings from such slabs, and spigot-ended sections shall only be used where the soffit of the slab is recessed to receive them.
4. Precast concrete chamber sections for valves and meters shall be interlocking and comply with BS EN 1917 and BS 5911-3.
5. Precast concrete corbel slabs shall conform to BS 5911-3 Table 5 and Figure 8.

3.2.30 Precast concrete slabs and cover frame seating rings

1. Precast concrete slabs and cover frame seating rings shall conform to the relevant provisions of BS EN 1917 and BS 5911-3.

3.2.31 Precast concrete setting blocks for pipes

1. Precast concrete setting blocks for pipes shall have rectangular faces, with sufficient plan area to prevent punching of the blinding concrete or formation, and to provide an adequate seating for the pipes.
2. Precast concrete setting blocks for pipes shall be manufactured from compressive strength Grade C16/20 concrete using the same type of cement as in the adjacent concrete bed.
3. Blocks shall not be used until they have achieved a cube strength of 13.5 N/mm².

3.2.32 General fill material

1. Hardcore shall consist of clean, hard, durable material, uniformly graded from 200 mm to 20 mm, and be free from extraneous matter.
2. Selected fill, whether selected from locally excavated material or imported, shall consist of uniform, readily-compactible material. Fill shall be free from vegetable matter, building rubbish and frozen material or materials susceptible to spontaneous combustion, and shall exclude clay of liquid limit greater than 80 and/or plastic limit greater than 55 and materials of excessively high moisture content. Clay lumps and stones retained on 75 mm and 37.5 mm sieves, respectively, shall be excluded from the fill material.

3.2.33 Clay puddle

1. Clay puddle shall be impervious to water and be free from sand, grit, stones and other deleterious matter.
2. The clay, on being dug, shall be exposed to the air for at least 24 hours and, thereafter, shall be worked with water into a consistency suitable for punning. A roll of clay 300 mm long and 40 mm in diameter shall support its own weight when suspended from one end.

3.2.34 Geotextiles

1. Geotextiles for use in drainage systems shall conform to BS EN 13252.
2. Geotextiles for use in erosion control shall conform to BS EN 13253.
3. Geotextiles shall:
 - (a) in both machine and cross-machine directions, sustain a tensile load of not less than 8.0 kN/m at break and have a minimum failure strain of 40% when determined in accordance with BS EN ISO 10319;
 - (b) have a minimum puncture resistance of 1500 N when determined in accordance with BS EN ISO 12236;
 - (c) have a size distribution of pore openings such that it shall have a minimum apparent opening size O90 when determined in accordance with BS EN ISO 12956 of 75µm; and
 - (d) allow water to flow through it, in either direction, normal to its principal plane at a rate of not less than that stated in the design under a constant head of water of 100 mm and a maximum breakthrough head of 50 mm when determined in accordance with BS EN ISO 11058.

(i) Any additional characteristics of geotextiles should be specified in the Contract.

3.2.35 Geosynthetic barriers

1. Geosynthetic barriers for lining ponds and wetlands shall conform to BS EN 13361.
2. Geosynthetic barriers for lining swales and other channels shall conform to BS EN 13362.
3. Geosynthetic barriers shall:
 - (a) sustain a tensile load of not less than 10.0 kN/m at break; and
 - (b) have a minimum tear resistance of 100 N when determined in accordance with ASTM D-1004.
4. When tested in accordance with BS EN ISO 12236, geosynthetic barriers shall have a minimum static puncture resistance of:
 - (a) 275 3N where no additional protection against puncture is provided.

(i) Any additional characteristics of geosynthetic barriers should be specified in the Contract.

- (i) Sizes and types of fixings should be described in the Contract, together with minimum requirements for edge distances, centres of fixings and embedments.
- (ii) For guidance on the selection and use of fixings in concrete and masonry, see CIRIA Technical Note TN137.
- (iii) BS 6180 gives recommendations for fixing protective barriers.
- (iv) CIRIA Technical Note TN75 deals with loading tests on fixings in concrete.
- (v) The safe working load should be shown on the Drawings.
- (vi) Stainless steel 1.4401 is also known as 4401-316-00-I (ISO Name) and X5CrNiMo17-12-2 (ISO Designation).

- (i) Any protective coatings required should be described in the Contract.
- (ii) The type of nuts, screws, washers and bolts required should be described in the Contract.
- (iii) The specific environmental conditions on Site would determine the grade of the material required.

3.2.36 Fixings for metalwork

- Mild steel bolts and nuts shall be hot dip galvanised in accordance with BS EN ISO 1461 Mild and high tensile steel proprietary fixings shall be protected in accordance with the relevant provisions of the appropriate Standard, as set out below:

Type of protection	Type of fixing		
	Cast-in having no machined thread	Cast-in/expanding, basic major diameter machined thread	
		Not exceeding 19 mm	Exceeding 19 mm
Hot dip galvanised	BS EN ISO 1461	-	-
Electroplated zinc	BS EN ISO 2081 Zn 10	BS 7371-12	BS EN ISO 2081 Zn 10

- Stainless steel proprietary fixings, bolts and nuts shall be manufactured from Grade 1.4401 steel conforming to BS EN 10088.
- Where fixings are metallurgically incompatible with the material being fixed, suitable isolating washers and sleeves shall be used.
- Anchor bolts for fixing safety chains shall be of the stainless steel safety type, which shall provide a progressive mode of failure.
- Axial and shear loading tests on structural fixings in concrete or masonry shall be carried out in accordance with the provisions of BS 5080-1 and 2, respectively.

3.2.37 Nuts, screws, washers and bolts

- Nuts, screws, washers and bolts shall conform to the relevant provisions of the appropriate Standard, as set out overleaf.

Type	Standard
Metal washers for general purposes	BS EN ISO 898, BS EN ISO 7091, BS EN ISO 7092, BS EN ISO 7093, BS EN ISO 7094
ISO black bolts, screws and nuts	BS 4190
High-strength friction grip bolts, nuts and washers	Relevant parts of BS EN 14399
Stainless steel bolts, screws, studs	BS EN ISO 3506-1
Stainless steel nuts	BS EN ISO 3506-2

- Bolting for pipes and fittings shall conform to the relevant provisions of BS EN 1092-2 and BS EN 1515-1, except that spheroidal graphite iron bolts for use with ductile iron pipes and fittings shall be manufactured from metal conforming to the provisions of BS EN 1563 and BS EN 1564 for Grade 500/7.
- Bolt lengths and tightening torque shall be in accordance with manufacturer's recommendations and shall be sufficient to ensure that nuts are full-threaded when tightened in their final position with two threads showing.
- Where bolting is metallurgically incompatible with the material being fixed, the contact areas shall be isolated either by painting with an approved silicon sealant (and allowed to dry before tightening together) or with suitable isolating washers and sleeves.
- Washers shall be provided under the head of the bolt and under the nut.

6. Unless manufactured from stainless steel, all fasteners shall be protected against corrosion in accordance with WIS 4-52-03.
7. Bolts, nuts and washers for flanged joints shall conform to the requirements of BS EN 1092.

3.2.38 Ductile iron pipes and fittings

(i) IGN 4-21-01 deals with ductile iron pipes and fittings.

(ii) The type and class of pipes, joints, fittings, gaskets, nuts, bolts and washers should be detailed in the Contract.

(iii) Dimensions are specified in BS EN 545 for integral flanges on ductile iron pipe. Flange facings can either be flat or raised face. Flanges in accordance with BS EN 545 and BS EN 598 are dimensionally compatible with BS EN 1092-1 and BS EN 1092-2.

(iv) The nominal bar pressure rating for the pipes and flanges should be selected to meet the duty requirements and should be described in the Contract.

(v) The type of anti-corrosion external (barrier) coatings for ductile iron pipes and fittings should be detailed in the Contract. BS EN 598 specifies external corrosion protection comprising zinc spray with synthetic resin (typically epoxy) finishing layer. BS EN 598:2007 +A1:2009 Annex B gives information on external protection systems available.

(vi) Any additional external protection for pipes laid in contaminated land should be described in the Contract.

(vii) The thickness of polymeric anti-corrosion (barrier) coatings should be such that the chemical resistance test in BS EN 598:2007+A1:2009 Clause 5.8 is met.

(ix) Polyurethane and thermoplastic acid modified polyolefin (TMPO) linings provide additional protection against more extreme acidic or alkaline conditions than cement mortar linings.

1. Ductile iron pipes, fittings and joints for sewerage pipelines shall conform to BS EN 598.
2. Flanges for pipes and pipeline fittings shall conform to BS EN 1092-2.
3. Tubular polyethylene film for use as a loose protective sleeving for buried iron pipes and fittings shall conform to the relevant provisions of BS 6076, except that the nominal lay flat width shall be 280 mm for use with 80 mm and 100 mm nominal internal diameter pipelines incorporating push-in flexible joints, and 400 mm for 150 mm nominal internal diameter pipelines. Sleeving for pipes for below-ground use for potable water shall be coloured blue and all other sleeving black. Joints in sleeving shall be taped so as to form a continuous barrier and any damage to the sleeving shall be repaired prior to backfilling.
4. Internal polyurethane linings for potable water, sewerage or gas pipes and fittings shall conform to the relevant provisions of BS EN 15655-1 or BS EN 14901-1, respectively.
5. Internal thermoplastic acid modified polyolefin (TMPO) linings for potable water, sewerage or gas pipes and fittings shall conform to the relevant provisions of BS EN 15655-2 or BS EN 14901-2, respectively.

3.2.39 Ladders

1. Ladders in manholes and similar structures shall conform to the requirements of BS EN 14396 with width of rung of 380 mm and two stringers but shall not be made from aluminium.

(i) For all manholes, the size and spacings and type of manhole steps should be described in the Contract.
 (ii) Unprotected aluminium steps should not be used.

(i) Where stainless steel tubes are to be bent to very small radii, it may be necessary to describe their condition as GKM(S) instead of KM
 (ii) BS 6180 deals with permanent protective barriers designed to resist vehicular impacts.
 (iii) BS EN ISO 14122-1 to 3 gives guidance on the construction of guardrails.
 (iv) Aluminium handrails and balusters should not be used in sewers, sewer manholes, sewage pumping stations or confined spaces in sewage treatment works.
 (v) Stainless steel 1.4401 is also known as 4401-316-00-1 (ISO Name) and X5CrNiMo17-12-2 (ISO Designation).
 (vi) Any requirements for toe boards and infill panels should be described in the Agreement.

(i) Lifting Regulations do not apply to safety chains in Sewers.
 (ii) Stainless steel 1.4401 is also known as 4401-316-00-1 (ISO Name) and X5CrNiMo17-12-2 (ISO Designation).

(i) The type, class and grade of all new and recycled bricks and blocks should be described in the Contract.
 (ii) Bricks used in bedding to manhole covers should be bonded using high-strength mortar (such as polyester resin).

3.2.40 Manhole steps

- Steps for manholes and other chambers shall be Type D Class 1, complying with the requirements of BS EN 13101.

3.2.41 Handrails and balusters

- Protective barriers shall conform to BS 6180 with loading determined with loading determined from Table NA.8 from the UK National Annex to specified in BS EN 1991-1-1:2002.
- Metal handrails and balusters shall be manufactured from materials conforming to the appropriate. Standard as set out below:

	Handrails			
	Solid		Tubular	
	Standard	Grade	Standard	Grade
Stainless steel	BS EN 10088-3	1.4401	BS EN 10296-2	LW17KM

	Balusters			
	Solid		Tubular	
	Standard	Grade	Standard	Grade
Mild steel	BS EN 10025	S275	BS EN 10255	HFW 2
Stainless steel	BS EN 10088-3	1.4401	BS EN 10296-2	LW17KM

- GRP handrails and balusters shall be manufactured from pultruded sections conforming to BS EN 13706-2 and BS EN 13706-3. The surface shall be smooth with fibres embedded and sealed against penetration from dirt and water. The Barcol hardness of the sections shall be at least 35 when tested in accordance with BS EN 59.
- After manufacture, mild steel balusters shall be hot dip galvanised in accordance with BS EN ISO 1461.

3.2.42 Safety chains

- Safety chains shall be medium tolerance chain conforming to BS EN 818-3 Grade 4 nominal size 8 x 24.
- Stainless steel safety chains shall be manufactured from Grade 1.4401 steel, conforming to BS EN 10088-3.
- Anchor bolts for fixing safety chains shall be of the stainless steel safety type which provide a progressive mode of failure.

3.2.43 Bricks and blocks

- Clay bricks, calcium silicate bricks and precast concrete masonry units shall conform to the relevant provisions of BS EN 771-1, BS EN 771-2 and BS EN 771-3 respectively.
- Clay bricks to be used for manholes and chambers shall be solid Class B engineering bricks to BS EN 771-1.
- The shapes and dimensions of special bricks shall conform to the relevant provisions of BS 4729.

4. Precast concrete masonry units to be used in manholes or chambers shall contain a minimum of 350 kg per m³ of sulphate-resisting cement having a maximum water:cement ratio of 0.45, a minimum compressive strength of 40 N per mm² and a maximum water absorption of 7%.
5. All bricks shall have freeze/thaw designation F2.
6. All bricks shall have active soluble salts content designation S2

3.2.44 Flexible couplings

1. Flexible couplings for gravity sewerage and drainage pipes shall conform to the provisions of BS EN 295-4.

3.2.45 Compressible filler and packing for pipelines

1. Compressible filler for interrupting concrete protection to pipes shall consist of bitumen-impregnated insulating board to BS EN 622-1 and BS EN 622-4, or other equally compressible material. The thickness of compressible filler shall be as set out in the table overleaf.

Nominal diameter of pipe (mm)	Thickness of compressible filler (mm)
Less than 450	18
450 – 1200	36
Exceeding 1200	54

2. Compressible packing for use between pipes and precast concrete setting blocks shall consist of bitumen damp-proof sheeting conforming to BS EN 14967.
3. Bituminous materials shall not be put into contact with plastics pipes.

3.2.46 Polyethylene pipes and fittings

1. Polyethylene pressure pipes for Rising Mains in nominal sizes greater than 63 mm shall conform to BS EN 12201-1 and BS EN 12201-2 and be coloured black. Co-extruded polyethylene pipes may be used for these purposes but shall have a black outer layer.
2. Polyethylene fittings, including fusion joints and electrofusion fittings, shall conform to the relevant provisions of BS EN 12201-3.
3. Electrofusion fittings shall not be used on pipes in excess of 355 mm external diameter or on systems subject to a pressure in excess of 10 bar. Type testing shall include the tolerance to contamination test described in WIS 4-32-14.
4. All electrofusion fittings shall be of integral wire construction. All fittings shall be of an automatic type and fitted with recognition resistors, identifiable by an automatic electrofusion control box, complete with an electronic data acquisition facility for joint data analysis and quality assurance.
5. Polyethylene (PE) and polypropylene (PP) solid wall pipes, joints and fittings for gravity sewers and drains shall conform to BS EN 12666-1 (PE), BS EN 1852-1 (PP) or BS EN 14758-1 (PP-MD), as appropriate. Ancillary drainage fittings shall conform to BS EN 13598-1 or BS 4660 as appropriate.
6. Polyethylene (PE) and polypropylene (PP) structured wall pipes and fittings for drainage and sewerage shall conform to BS EN 13476-1 and BS EN 13476-2 or BS EN 13476-3 and WIS 4-35-01.

(i) The Design Pressure (DP), the maximum operating pressure of the system fixed by the Designer, should be described in the Contract.

(ii) Further guidance on the choice of pressure rating for PE piping systems can be found in IGN 4-32-18.

(iii) The procedure for pressure testing of installed PE pipelines can be found in IGN 4-01-03. The System Test Pressure (STP) is calculated from the Design Pressure (DP) and should be stated in the Contract.

(i) BS EN 1295-1 gives guidance on the structural design of underground non-pressure PVC-U pipes.

3.2.47 Unplasticised PVC pipes and fittings

1. Unplasticised PVC pipes, joints and fittings for gravity sewers shall conform to BS EN 1401-1. Ancillary drainage fittings shall conform to BS EN 13598-1 or BS 4660, as appropriate.
2. PVC structured wall sewer pipe for gravity sewerage and drainage shall conform to the relevant provisions of BS EN 13476-1 and WIS 4-35-01 and BS EN 13476-2 or BS EN 13476-3.

3.2.48 Thermoplastics chambers and rings

1. Thermoplastics chambers and rings, including demarcation chambers, shall conform to BS EN 13598-1 or BS EN 13598-2.

3.2.49 Thermoplastics modular geocellular drainage systems

1. Thermoplastics boxes, including integral components, to be used as elements in a modular geocellular drainage system shall conform to the requirements of BS EN 17152-1. Product performance data used in the structural design of these attenuation and infiltration systems shall be determined through testing carried out in accordance with BS EN 17150 and BS EN 17151.

3.2.50 Vitrified clay pipes and fittings

1. Vitrified clay pipes and fittings, including extra chemically-resistant pipes and fittings shall conform to the relevant requirements of BS EN 295-1 and BS 65.
2. Vitrified clay jacking pipes shall conform to BS EN 295-7.
3. Extra chemically-resistant pipes and fittings shall conform to the additional requirements of BS 65.

(i) IGN 4-11-01 deals with vitrified clay pipes and fittings.

(ii) The type of joint and jointing materials for extra-chemically-resistant pipes should be described in the Contract.

3.3 Excavation and backfilling

3.3.1 Excavation

1. Operations shall be carried out in such a manner as to avoid damage to, or deterioration of, the formations of excavations.
2. Excavation in roads and streets shall be carried out in accordance with the relevant Highway Authority requirements. Supplementary guidance is given in the Northern Ireland Road Authorities and Utilities Committee (NIRAUC) 'Code of Practice - Specification for Reinstatement of Openings in Highway'.
3. Excavations in locations where services can be encountered shall be carried out in accordance with 'HSG47 Avoiding Danger from Underground Services'.
4. Trenches shall be excavated so that the effective width is maintained within any limit imposed by the design of the pipeline. The sides of excavations shall be adequately supported at all times and, except where described in or permitted under the Contract, shall not be battered.
5. Unsuitable ground or damaged surfaces below formation shall be excavated and then be refilled to formation level with the same material as the permanent work which is to rest on that formation. Any void which results from over-excavation below formation level shall be refilled in the same manner.
6. Excavated granular material which can be re-used shall be kept separate from excavated cohesive materials.
7. Trenches in rock for Rising Mains up to 100 mm nominal diameter shall be excavated to provide a minimum clearance of 100 mm around the outside of pipe barrels and joints. For pipes with nominal diameters exceeding 100 mm, the minimum clearance shall be increased to 150 mm for flexible and 200 mm for rigid pipelines.

(i) The following publications give recommendations as to standards of good practice for excavation:

BS 6031;

BS 6164;

Report R97, 'Trenching Practice', published by CIRIA; and Technical Note TN95 'Proprietary Trench Support Systems', published by CIRIA.

(ii) A definition of rock should be included in the Contract.

(iii) The relevant Highway Reinstatement Specification Roles should be defined in the Contract.

(iv) Any special requirements for Site clearance or for the disposal of excavated materials should be described in the Contract.

(v) The Contract should describe the extent of any excavations where battered sides will be permitted. Detail of the allowable cross-section should be given.

(vi) Excavation in carriageways should, wherever possible, be located such that the edge of the opening is at least 1 m from the edge of the carriageway.

(vii) Care should be taken when siting spoil heaps to avoid damaging trees by impinging on their root spread.

(viii) Excavated material for disposal off Site would normally be classified as controlled waste and the Client, under the Article 5(9) of the Waste and Contaminated Land (Northern Ireland) Order 1997 has a duty of care to ensure that the Works are carried out in compliance with the legislation relating to the treatment, keeping or disposal of such material.

(ix) Stored excavated granular material can require draining to achieve acceptable water content.

(i) Any requirements for prevention of the deposition of silt and/or protection from erosion should be set out in the Contract.

(ii) Discharge of water arising from, or draining into the Works can require an Environmental Permit or permission from the relevant Sewerage Undertaker.

(iii) Guidance for Pollution Prevention GPP 5 and 6 published by the Northern Ireland Environment Agency should be applied.

(i) Any particular requirements for the materials to be used for backfilling should be described in the Contract.

(ii) The Highway Authority can impose requirements for backfilling under existing highways. Supplementary guidance is given in the Highway Authorities and the Utilities Committee (NIRAUC 'Specification for Reinstatement of Openings in Highways')

3.3.2 Dealing with water

1. Water shall not be allowed to lie anywhere within excavations, unless so required by the Contract. Any drainage sumps required shall, where practicable, be sited outside the area excavated for the permanent Works, and shall be refilled with either Type 1 granular sub-base material or lean concrete Grade GEN1 (C10) to the level of the underside of the adjacent permanent Works.
2. All necessary precautions shall be given to prevent any adjacent ground from being adversely affected by loss of fines through any dewatering process.
3. The Contractor shall provide method statements and details of pollution prevention measures relating to the control and disposal of groundwater from de-watering operations. Discharging shall be subject to the Contractor obtaining prior written approval from the appropriate consenting body.

3.3.3 Temporary drains

1. Where temporary drains (trench sub-drains) are required, they shall be laid in a narrow trench or grip formed below the bottom of the excavation in an approved position. The pipes shall be open-jointed and shall be surrounded with free-draining granular material
2. When no longer required, temporary drains shall be removed or sealed.
3. When sealing temporary drains, grouting pipes shall be inserted in the line of the temporary drains at intervals not exceeding 25 m and the drains shall be solidly filled with grout (Class G3 or G4), the grouting pipes being cut off on completion, care being taken to avoid impregnation of any granular bedding material around the main pipeline.

3.3.4 Backfilling

1. Backfilling shall, wherever practicable, be undertaken immediately the specified operations preceding it have been completed. Backfilling shall not, however, be commenced until the Works to be covered have achieved a strength sufficient to withstand all loading imposed thereon.
2. Backfilling shall be undertaken in such a manner as to avoid uneven loading or damage.
3. Filling material to excavations not situated in highways or prospective highways shall conform to Clause 3.2.32 placed and compacted to form a stable backfill.
4. Backfilling and reinstatement in roads and streets shall be carried out in accordance with the relevant Roads Authority's Reinstatement Specification.

5. Where the excavations have been supported and the supports are to be removed, these (where practicable) shall be withdrawn progressively as backfilling proceeds, in such a manner as to minimise the danger of collapse, and all voids formed behind the supports shall be carefully filled and compacted.
6. Filling material shall be deposited in layers not exceeding 225 mm unconsolidated thicknesses, and then fully compacted to form a stable backfill. Where the excavation is within 1 m of the outside of the edge of the carriageway (or proposed carriageway) the fill material shall be such as to permit adequate drainage.

3.3.5 Using foamed concrete

1. The pipe surround material shall be protected from the foamed concrete by an impermeable layer.
2. Foamed concrete may be used for filling of abandoned sewers and sewer connections, subject to the approval of Northern Ireland Water.

3.4 Formwork and concrete

3.4.1 Concrete mixes and workability

1. Standard concrete mixes shall be in accordance with BS EN 206-1 and BS 8500, and shall be used with a 20 mm nominal maximum size of aggregate and a slump class S2 for a target 70 mm.

Suitable applications for the concrete mixes are shown in the table below.

Standard mix	Strength class of concrete	Applications
GEN1	C8/C10	Fillings, blindings, soft spots and drainage sumps
GEN3	C16/C20	All other applications

2. Compressive-strength testing shall not be used to judge the compliance of a concrete but, where required by Northern Ireland Water, evidence shall be provided of the batch masses used to produce any concrete.
3. Admixtures (including calcium chloride and pigments) shall not be used in the production of concrete.

3.4.2 Transporting, placing and compacting

1. Concrete shall be transported from the mixer in accordance with BS 8500-2 and placed in the Works as rapidly as practicable by methods which will prevent the segregation or loss of any of the ingredients and will maintain the required workability. It shall be deposited, as nearly as practicable, in its final position and all equipment for transporting concrete shall be kept clean.
2. Adequate notice shall be given to the Client of the intention to commence concreting.
3. Concrete shall be delivered to Site within the times specified in Clause 14.2 of BS 8500-2:2006.
4. Concrete shall be thoroughly compacted in its final position within 30 minutes of discharge from the mixer, unless carried in purpose-made agitators operating continuously, when the time shall be within 2 hours of the introduction of the cement to the mix and within 30 minutes of the discharge from the agitator. The concrete shall be adequately compacted to form a dense concrete that completely fills the formwork. The plant used for concrete compaction shall be

(i) For a comprehensive specification for reinforced concrete, see CESWI 8th Edition.

(ii) The mixes are consistent with the relevant standard mixes in BS 8500.

(iii) See Section 3.2.13 for the use of sulphate-resisting Portland cement.

(i) Any requirements for placing concrete in special sequence, e.g., by alternate bay construction, should be described in the Contract.

(ii) "Adequate" in the context of notice to the Client should be sufficient time to allow the Client to fulfil their quality management obligations. The minimum time period should be agreed at the commencement of the Contract.

(iii) Any variations to the times in Clause 3.4.2.3 should be specified in the Contract.

operated continuously during the placing of each batch of concrete until the expulsion of air has virtually ceased, and in a manner which does not promote segregation of the ingredients.

5. Whenever vibration has to be applied externally, the design of formwork and disposition of vibrators shall be such as to ensure efficient compaction and to avoid surface blemishes.

3.4.3 Concreting in cold weather

1. Concreting at ambient temperatures below 20°C may be carried out only if all of the following conditions are met:
 - (a) the aggregates and water used in the mix shall be free from snow, ice and frost;
 - (b) before placing concrete, the formwork, reinforcement and any surface with which the fresh concrete will be in contact shall be free from snow, ice and frost and be at a temperature above 0°C;
 - (c) the initial temperature of the concrete at the time of placing shall be at least 5°C as defined in BS EN 206-1:2000 Section 5.2, Lower Limit;
 - (d) the temperature at the surface of the concrete shall be maintained at not less than 5°C at any point until the concrete reaches a strength of 5 N/mm², as confirmed by tests on cubes matured under similar conditions; and
 - (e) temperatures at the surface of the concrete shall be measured where the lowest temperature is expected.
2. Precautions shall be taken to prevent the temperature of any concrete falling to 0°C during the first five days after placing.

3.4.4 Curing

1. Curing of concrete shall be carried out in accordance with BS EN 13670 Curing Class 2.
2. In cold weather, when the temperature of freshly-placed concrete can approach 0°C, water curing shall not be employed.

3.4.5 Construction of formwork

1. Formwork shall be sufficiently rigid and tight to prevent loss of mortar matrix from the concrete, and to maintain the correct position, shape and dimensions of the finished work. Formwork shall be so constructed as to be removable from the cast concrete without shock or damage.

3.4.6 Cleaning and treatment of forms

1. The interiors of all forms shall be thoroughly cleaned out before any concrete is placed. The faces of the forms in contact with the concrete shall be clean and treated with a suitable release agent, where applicable.

3.4.7 Striking of formwork

1. Formwork shall be removed without shock to, or disturbance of, the concrete.
2. Formwork to vertical surfaces or sloping formwork not supporting concrete in flexure shall not be removed until the concrete strength shall be sufficient to meet any wind loading upon the concrete likely to arise at the time when the formwork is removed, and:
 - (a) the concrete strength (as confirmed by tests in cubes cured under representative conditions) has reached 5 N/mm²; or
 - (b) for concrete containing cement to BS EN 197-1:2000 CEM I 42.5, 52.5 only, in the absence of cube test results, a minimum period shall have elapsed since the concrete was poured equivalent to 11 hours at 15°C for unsealed

(i) For further information see 'Winter Concreting', published by Concrete Information Ltd.

(i) BS 5975 gives recommendations as to standards of good practice in formwork construction.

(i) As the removal of formwork is dependent upon the method of working, the Contract can state a formal procedure for determining striking times, based on CIRIA Report R136.

(ii) Interpretation of CIRIA Report R136 should be in accordance with the following:
(a) for members with "Rough finish", the requirements applicable to F1 and F2 finish apply.

((b) for members with “Fair finish” or “Fair worked finish”, the requirements applicable to F3 and F4 finish apply.

iii) “Rough finish”, “Fair finish” and Fair worked finish” are described in Clause 3.4.14 (i).

(iv) It should be noted that 11 hours at 15°C is equivalent to:

8 hours at 20°C

15 hours at 10°C

24 hours at 5°

8 hours at 15°C is equivalent to:

6 hours at 20°C

12 hours at 10°C

(i) The Contract should detail any particular requirements for dealing with health and safety issues in connection with starter bars and the fixing of reinforcement, as a result of any Designer’s risk assessment.

(i) Where the use of proprietary reinforcement continuity systems, rolled mats, mesh or couplers is proposed as an alternative to the reinforcement detailed on the Contract Drawings, this could require a variation from the Contract.

- plywood forms or 8 hours at 15°C for impermeable forms.
- Formwork supporting concrete in flexure shall not be removed until:
 - the concrete strength (as confirmed by tests on cubes cured under representative conditions) has reached 10 N/mm2, or twice the stress to which the concrete will then be subjected, whichever is the greater; or
 - for concretes containing cement to BS EN 197-1:2000 CEM I 42.5, 52.5, in the absence of cube test results or any formal procedure agreed in writing, the periods before striking calculated from the relevant formula given in the following table shall be used:

Type of Formwork	Period Calculated for Mean Ambient Temperature (t) Between 0°C and 25°C Using Formulae Below
Soffit forms to slabs and beams	100 / (t + 10) days
Props to slabs and beams	250 / (t+10) days

- For concrete containing cement not conforming to BS EN 197, the times for striking of formwork shall be derived from CIRIA Report R136.
- Sufficient records to identify the time from pouring of any section to the striking of the formwork on the same shall be maintained on Site for inspection.

3.4.8 Cutting and bending of reinforcement

- Cutting and bending of reinforcement shall be in accordance with BS 8666.
- Except for the use of proprietary starter bar systems, reinforcement shall not be straightened or re-bent. When using proprietary systems and bending projecting reinforcement, care shall be taken not to damage the concrete and to ensure that the radius is not less than the minimum specified in BS 8666.

3.4.9 Fixing of reinforcement

- Reinforcement shall be firmly supported in position and secured against displacement, in accordance with BS 7973-2.
- Non-structural connections for the positioning of reinforcement shall be made with tying wire or other fixing devices. Precautions shall be taken to ensure that projecting ends of ties or clips do not encroach into the concrete cover.
- The concrete cover shall be not less than the nominal minus 10mm or greater than the nominal cover plus 15mm (Δc in BS 8500-1:2006 A3). Unless shown otherwise on the Drawings, nominal cover shall be:
 - 45 mm for tops of walls;
 - 50 mm for concrete cast against blinding;
 - 75 mm for concrete cast against soil; and
 - 40 mm for all other locations.

3.4.10 Surface condition of reinforcement

- Concrete shall not be placed until reinforcement is free from any substance which might adversely affect the steel or concrete chemically, or reduce the bond.

3.4.11 Laps and joints

- Laps and joints in reinforcement shall be made only at the positions described on the Drawings.

(i) Some coatings do not provide good adherence to concrete and, therefore, can require additional sealing systems and/or features to ensure a sound mechanical key to the concrete structure.

(ii) The fittings should be designed to avoid formation of air pockets or voids during the placing/compaction of concrete.

(i) Position and details of construction joints in concrete should be described in the Contract.

(ii) Guidelines on the control of cracking can be found in CIRIA C766 'Control of Cracking Caused by Restrained Deformation in Concrete'

(iii) Proprietary systems are available for this application.

(i) The three finishes are intended to be applied as follows:

(a) Screeded - surfaces to receive further treatment or of no visual merit, or expressly suitable to their function with the workmanship as specified;

(b) Wood float - surfaces where a reasonably regular finish is required but appearance is not of prime importance;

(c) Steel trowel - surfaces where appearance is important; and

(ii) Any other required finish should be described in the Contract.

(i) The two types of surface finish are intended to be applied as follows:

(a) Rough - surfaces next to earth, or to receive further treatment, or of no visual merit, or expressly suitable to their function with workmanship, as specified;

3.4.12 Built-in items

- Where pipes, sleeves, water bars or other items are designed to be cast into concrete, they shall be constructed and installed in order to ensure that they are:
 - securely and rigidly retained in position;
 - watertight for the design life of the fittings and structure;
 - resistant to corrosion for the design life;
 - adequately bonded to the concrete; and
 - free from external coatings which might adversely affect the bond.
- Precautions shall be taken to prevent the formation of air pockets, voids or other defects whilst the concrete is being placed.

3.4.13 Construction joints

- Joint lines shall be arranged to coincide, wherever possible, with features of the finished work.
- Unless these are to be located in the positions shown on the typical detail Drawings (Figures 2.11-2.18), the positions and details of any construction joints shall be agreed with Northern Ireland Water before work is commenced.
- Concreting shall be carried out continuously up to construction joints.
- Concrete shall not be allowed to taper off to a thickness of less than 50 mm. Vertical joints shall be formed against a stop board, suitably notched to accommodate the reinforcement. The top surface of each lift of concrete shall be straight and level.
- Where a kicker is used, it shall be at least 70 mm high and shall be cast integrally with the slab.
- The surface of any concrete against which new concrete is to be cast shall be free from laitance and shall be roughened to the extent that the large aggregate is exposed but not disturbed. The joint surface shall be cleaned immediately before the fresh concrete is placed against it.
- Where practicable, such preparation of joints shall be carried out when the concrete has set but not hardened.

3.4.14 Surface finishes produced without formwork

- Screeded finish: The concrete shall be levelled and screeded to produce a uniform plain or ridged surface, as required. No further work shall be applied to the surface unless it is a first stage for a steel trowel finish.
- Wood float finish: The screeded finish shall be wood floated under light pressure to eliminate surface irregularities.
- Steel float finish: When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface. The concrete shall then be steel trowelled under firm pressure to produce a dense, smooth, uniform surface free from trowel marks.
- Where the type of finish is not given, it shall be wood float finish.

3.4.15 Surface finishes produced with formwork

- Rough finish shall be obtained by the use of moulds or properly-designed forms. The surface shall be free from substantial voids, honeycombing or other large blemishes.
- Fair finish shall be obtained using forms designed to produce a hard, smooth surface with true, clean arises. Only very minor surface blemishes will be

(b) Fair - surfaces required for serviceability and structural soundness and which are not visually important.

permitted and there shall be no staining or discolouration. Any projections shall be removed and the surface made good.

3. Liquid-retaining surfaces and other surfaces exposed in the completed Works shall receive a fair worked finish. All other structural concrete surfaces shall receive a fair finish.

3.4.16 Wearing screeds

1. Wearing screeds (granolithic finish) shall be provided, laid and finished in accordance with the relevant provisions of BS 8204-2.
2. Wearing screeds shall provide abrasion resistance to class AR4/WS of Table 4 of BS 8204-2:2003. Where high-abrasion conditions are expected, wearing screeds shall provide abrasion resistance to class AR1/WS of Table 4 of BS 8204-2:2003.
3. Where concrete benching is required to have a granolithic finish with abrasion resistance to class AR4/WS of Table 4 of BS 8204-2:2003, this shall be formed with four parts 8 mm to dust to one part sulphate resisting cement placed with a steel trowel finish.

3.4.17 Tie bolts for formwork

1. Tie bolts shall be of the high tensile variety, fixed perpendicular to the formwork.
2. Tie bolts shall not embed metal parts within 50 mm of the concrete surface.
3. Voids remaining after the removal of all, or part, of each tie bolt shall be sealed using a polymer modified cementitious compound, or other suitable product, unless specified in the contract. Metal-based expansive admixtures shall not be used. All such voids shall be prepared by removing surface laitance, prior to filling, to ensure bond is achieved.
4. Tie bolts which form a continuous hole through a structure designed to retain an aqueous liquid shall not be used.
5. In the case of structures designed to retain an aqueous liquid, any other measures securing formwork shall not impair the watertightness of the structure.
6. Tie bolts or other devices to be built into concrete shall be approved by Northern Ireland Water.

3.5 Construction of gravity sewers and rising mains

3.5.1 Pipelaying generally

1. Where socketed pipes are required to be laid on a granular or sand bed or directly on a trench bottom, joint holes shall be formed in the bedding material or excavated formation to ensure that each pipe is uniformly supported throughout the length of its barrel and to enable the joint to be made.
2. Pipes shall be laid on setting blocks only where a concrete bed or cradle is used.
3. Where pipes are required to be bedded directly on the trench bottom, the formation shall be trimmed and levelled to provide even bedding of the pipeline and shall be free from all extraneous matter that can damage the pipe, pipe coating or sleeving.
4. Pipes and fittings, including any lining or sheathing, shall be examined for damage and the joint surfaces and components shall be cleaned immediately before laying. Where repairs are required, these shall be agreed with the Client.
5. Suitable measures shall be taken to prevent extraneous material from entering the pipe, and to anchor each pipe to prevent flotation or other movement before the Works are complete.

(i) The following publications give recommendations on standards of good practice for the installation of pipelines on land:
BS EN 752 'Drain and Sewer Systems Outside Buildings.'
BS EN 1610 'Construction and Testing of Drains and Sewers.'

6. Where pipeline marker tapes are specified, they shall be laid between 100 mm and 300 mm above the pipe. Where a tracer system is specified, it shall be continuous and adequately secured to valves and fittings.
7. Where the gradient of the “as-laid” pipeline exceeds 5%, installation shall be uphill with sockets leading.

3.5.2 Pipe bedding

1. Bedding for pipes shall be constructed by spreading and compacting granular bedding material over the full width of the pipe trench. After the pipes have been laid, additional granular material shall, if required, be placed and compacted equally on each side of the pipes and, where practicable, this shall be done in sequence with the removal of the trench supports.
2. In bad ground conditions where the migration of the pipe granular surround into the ground can occur, the surround shall be wrapped in geotextile membrane.
3. Where the flow of groundwater is likely to transport fine soil particles, water stops of puddle clay extending up through the bedding and sidefill shall be placed across the trench and immediately downstream of any Temporary Works.

3.5.3 Concrete protection to pipes

1. Pipes to be bedded on, or cradled with, concrete shall be supported on precast concrete setting blocks, the top face of each setting block being covered with 2 layers of compressible packing in accordance with clause 3.2.45.
2. Concrete provided as a protection to pipes shall be Grade GEN3 (C16/C20), placed to the required depth in one operation.
3. Where pipes with flexible joints are used, concrete protection shall be interrupted over its full cross-section at each pipe joint by a shaped compressible filler in accordance with clause 3.2.45.
4. Where pipes are protected by a concrete cover slab placed above the pipe, this shall span the pipe trench and extend a minimum of 300 mm both sides, widening the trench above the pipe surround. There shall be a minimum of 150 mm of surround between the crown of the pipe and underside of the slab incorporating a layer of compressible material isolating the slab from the surround material.

3.5.4 Pipe surround

1. Pipe surround material shall, where required, be placed and compacted over the full width of the trench in layers not exceeding 150 mm before compaction, to a finished thickness of between 100mm and 300 mm above the crown of the pipes.
2. Subsequent backfilling shall then be carried out as specified in clause 3.3.4.

3.5.5 Thrust block

1. Except where welded steel pipelines, welded polyethylene pipelines or self-anchoring joints are used, thrusts from bends and branches in pressure pipelines shall be resisted by GEN3 concrete thrust blocks, cast in contact with undisturbed ground.
2. Any additional excavation required to accommodate thrust blocks shall be carried out after the bend or branch is in position, and the thrust face shall be trimmed back to remove all loose or weathered material immediately prior to concreting.
3. Thrust blocks shall be allowed to develop adequate strength before any internal pressure is applied to the pipeline.

(i) When puddled clay stanks are required, these should be described in the Contract.

(ii) Details of pipe bedding, surround and sidefill should be described in the Contract.

(iii) Refer to BS EN 1295-1 and BS 9295 for pipe bedding design details.

(iv) Guidance on wrapping bedding material in geotextiles can be found in BS 9295:2020 Clause A.13, Figures A.5 and A.6.

(i) Rapid hardening cement should not be used in concrete for the protection of plastics pipes.

(ii) Plastics pipes should be wrapped with a layer of plastic sheeting conforming to Clause 3.2.11 before being surrounded by concrete.

(i) Further guidance is available in BS EN 1295-1.

(ii) The minimum side gaps for narrow trenching techniques are stated for compaction purposes.

(i) Thrust blocks should be described in the Contract.

(ii) Refer to CIRIA Report TN128 for the construction and design of thrust blocks.

4. Rapid hardening cement shall not be used in concrete for the protection of plastics pipes.
5. Plastic pipes shall be wrapped with 3 layers of plastic sheeting complying with Clause 3.2.11 before being surrounded by concrete.
6. Where connections to existing mains incorporate the casting of thrust or other support blocks, the temporary support shall be provided to pipework until such time as the concrete has cured sufficiently to resist the effects of foreseeable pressure in the affected mains.
7. The depth of cover to concrete blocks shall not be less than 600 mm, unless otherwise stated in the Contract.
8. Where a concrete surround to the pipe barrel is to be provided as anchorage, a means shall be provided to transmit the load to the concrete, e.g., via an integral stub flange or similar fitting to form a flange.
9. Where a polyethylene pressure pipe is connected to a non-end-load bearing pipe system, restraint shall be provided to the polyethylene pipe to contain the longitudinal stresses that result from pressurisation and thermal effects.

3.5.6 Pipe jointing generally

1. Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled. Care shall be taken to ensure that there is no ingress of grout or other extraneous material into the joint annulus after the joint has been made.
2. Where pipes with flexible joints are required to be laid to curves, the deflection at any pipe joint “as laid” shall not exceed three-quarters of the maximum deflection recommended by the manufacturer.
3. The number of joints shall be minimised.
4. Where, as part of the work, the protective coating or lining to the existing pipe or the new pipe is damaged, it shall be made good, as appropriate for the protective coating or lining.

3.5.7 Welding joints in polyethylene pipes

1. Butt fusion welding shall be used for jointing polyethylene pipes unless otherwise specified in the Contract.
2. Electrofusion and butt fusion jointing shall be made in accordance with WIS 4-32-08.
3. A pipe section containing a completed weld shall achieve the same strength characteristics as the parent pipe.

3.5.8 Cutting pipes

1. Pipes shall be cut in accordance with the manufacturer’s recommendations to provide a clean square profile without splitting or fracturing the pipe wall and causing minimal damage to any protective coating. Where necessary, the cut ends of pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used, and any protective coatings shall be made good and the ends sealed in accordance with Clause 3.5.6.4.
2. Where ductile iron pipes are to be cut to form non-standard lengths, the Contractor shall comply with the manufacturer’s recommendations in respect of ovality correction and tolerances to the cut spigot end.
3. Where concrete pipes are cut, any exposed reinforcement shall be sealed with an epoxy resin mortar.
4. Pre-stressed concrete pipes shall not be cut on-site.

(i) Any special requirements for filling the joint annulus should be described in the Contract.

(ii) The remaining flexibility is required for any subsequent settlement or ground movement.

(i) Any specific requirements for weld tests should be described in the Contract, else test requirements in WIS 4-32-08 should be followed.

(i) ‘The Control of Asbestos Regulations’ 2012 the ‘Control of Asbestos Regulations (Northern Ireland)’ 2012, the ‘Approved Code of Practices’ L127 and L143 have been introduced to enable a more risk-based approach to be taken for the control of asbestos.

(ii) Guidance Notes are available from the HSE which detail the precautions to be taken when dealing with asbestos cement.

(iii) A regulatory position statement ‘Leaving Decommissioned Pipes in

the Ground' and guidance notes are available from the Environment Agency.

(i) The type of jointing material should be described in the Contract.

(i) The benching material and surface finish should be described in the Contract.

(ii) The surface finishes referred to are specified in Clauses 3.4.14 and 3.4.15.

(i) Where a pipeline is to be constructed in ground which is variable or unstable, it can be appropriate for multiple rocker pipes to be provided to accommodate the anticipated differential settlement.
(ii) If flexible pipes are being used, rocker pipes are not needed.

(i) If bedding of frames on resin mortar or haunching in concrete (instead of mortar) is required, this should be described in the Contract.

- 5. Appropriate safety precautions shall be taken to avoid inhalation of dust when cutting asbestos-cement pipes.

3.5.9 Precast concrete manholes, chambers and wet well

- 1. Where steps, ladders and slabs are used in precast concrete chamber and shaft sections, aligned correctly.
- 2. Joints shall be made so that the required jointing material fills the joint cavity. Any surplus jointing material which is extruded inside the manhole, chamber, or wet well shall be trimmed off and joints shall be pointed on completion.
- 3. Where manholes are to have a concrete surround, the concrete shall not be less than Grade GEN3 and the height of each concrete pour shall not exceed 2 m. Each construction joint shall break joint with the precast sections by at least 150 mm.
- 4. Holes required in precast concrete chamber units to allow pipework to pass through shall be made in-situ, and oversized by the minimum amount required to ensure a watertight seal around the pipe by pre-drilling around their perimeters. Any overbreak of holes shall be made good using a mortar suitable for the pipe material.

3.5.10 Inverts and benchings

- 1. Where a wearing screed is required, it shall have a smooth, high-strength concrete topping applied with a steel trowel before the concrete has set.
- 2. Inverts and benchings in manholes, chambers and the wet well shall have a screeded, ridged finish.

3.5.11 Pipes and joints adjacent to structures

- 1. Except where the construction is by tunnelling, heading or pipe jacking, a flexible joint shall be provided as close as is feasible to the outside face of any structure into which a pipe is built, compatible with the subsequent movement of the joint.
- 2. The recommended length of the next pipe (rocker pipe) away from the structure shall be as set out in the table below.

Nominal diameter (mm)	Effective length (m)
150 to 600	0.6
over 600 to 750	1.0
over 750	1.25

- 3. A pipeline may, where practicable, be laid through a manhole and the crown cut out to the half diameter, provided flexible joints are situated on each side, no further than 600 mm from the inner face of the manhole wall, and that adjacent pipes shall conform to Clause 3.5.11.2.
- 4. Stub pipes into structures shall be of rigid material.

3.5.12 Setting manhole covers and frames

- 1. Manhole frames shall be set to level, bedded and haunched externally over the base and sides of the frame in mortar, in accordance with the manufacturer's instructions. The frame shall be seated on 1 to 4 courses of Class B Engineering bricks or on precast concrete cover frame seating rings to regulate the distance between the top of the cover and the top rung to no greater than 675 mm. A mortar fillet shall be provided where the corners to an opening in a slab are chamfered and the brickwork is not flush with the edges of the opening.

2. Frames for manhole covers should be bedded in a polyester resin bedding mortar in all situations where covers are sited in NRSWA Road Categories I, II or III. (i.e., all except residential cul-de-sacs). In all other situations, M12 mortar shall be used.

3.5.13 Connections to existing sewers

1. Connections shall be made using standard pre-formed junctions, where possible. Saddle connections to existing sewers shall only be allowed when the internal diameter of the major pipe is at least 150 mm greater than the internal diameter of the branch pipe.
2. Pipe saddles for concrete or clay sewers shall be bedded in Class M12 mortar and a mortar fillet formed to give a cover of at least 50 mm to the base of the saddle.
3. The ends of connections and pipes not required for immediate use shall be closed with purpose-made stoppers, disks or joiners. The position of all junctions shall be recorded by measurement from the manhole immediately downstream and recorded with the “as-laid” information and submitted to the Client for retention in their asset records.
4. Where junction pipes for future connections are required, they shall be inserted, as necessary, during construction of the sewers, and the ends of connections and pipes not needed for immediate use shall be effectively sealed with a plug. The position of all junctions shall be recorded by measurement from the centre of the manhole cover immediately downstream, and notified to Northern Ireland Water before backfilling is carried out.

3.5.14 Tolerances in gravity sewers, lateral drains and rising mains

1. The line and level of any pipeline shall not deviate from the line and level described in the Agreement, or agreed variation, by more than 20 mm and any combination of such deviations shall not create a reverse gradient.
2. The joint displacement, being the difference in level or alignment between the adjacent ends of two adjoining pipes at a joint, shall not exceed the least of 5% of the nominal diameter of the pipe or 20 mm. No joint displacement will be permitted on foul sewers.
3. The angular displacement at a joint, being the difference in the alignment of two adjacent pipes shall not exceed 2°, except where the joint has been specifically designed and manufactured to accommodate a larger displacement and agreed in advance of installation with NIW.

3.5.15 Brickwork and seating rings

1. Brickwork and blockwork shall be in accordance with the relevant provisions BS EN 1996-2.
2. The moisture content of the bricks shall be adjusted so that excessive suction is not exerted on the mortar.
3. Bricks and blocks in each course shall break joint correctly with the bricks / blocks underneath. The courses shall be laid parallel, with joints of uniform thickness, and shall be kept straight or regularly curved, as required. Brickwork shall be gauged to rise 300 mm in 4 courses. Vertical joints shall be in alignment, as required by the bond, and shall have an average thickness of 10 mm. Bricks forming reveals and internal and external angles, shall be selected for squareness and built plumb.
4. Brickwork and blockwork shall rise uniformly; corners and other advanced work shall be racked back and not raised above the general level more than 1 m.

(i) Any requirements for more stringent tolerances should be described in the Contract.

(ii) Where a pipeline is to be constructed in ground which is variable or unstable, it can be appropriate for a larger tolerance for line and level to be described in the Contract.

(i) Any requirement for rendering of manholes and chambers should be described in the Contract.

(ii) The bond should be described in the Contract.

(iii) The required class of mortar and type of cement should be described in the Contract (see Clause 3.2.20).

(iv) For guidance on the design of joints and jointing in building construction, see BS 6093.

- No brickwork shall be carried up higher than 1.5 m in 1 day. No bats or broken bricks shall be incorporated in the work unless essential for bond. Where cuts to bricks are required, all cutting shall be carried out with a mechanical cutting disc.
5. Completed brickwork shall be protected at all times from scaffold splash, mortar droppings, grout leakage from suspended slabs and the harmful effects of weather. Brickwork shall be allowed to set thoroughly hard before cutting or chasing is carried out.
 6. Brickwork shall be built in English bond. Bricks shall be set in mortar with all bed and vertical joints filled solid. Exposed work shall be flush pointed as the work proceeds. The moisture content of the bricks shall be adjusted so that excessive suction is not exerted on the mortar.

3.5.16 Corbelling

1. Oversail corbelling shall not exceed 30 mm on each course.

3.5.17 Bricklaying in cold weather

1. Materials used in bricklaying shall be frost-free, and no bricks shall be laid when the ambient temperature is below 3°C, unless special precautions are taken. Completed work shall be protected adequately during cold weather.
2. General working practices shall be in accordance with the Brick Development Association publication 'Bricklaying in Winter Conditions'.

3.6 Cleansing and testing

3.6.1 Cleansing of gravity sewers and manholes

1. On completion of construction, internal surfaces of Sewers and manholes and other access points shall be thoroughly cleansed to remove all deleterious matter, without such matter being passed forward into existing public sewers or watercourses.
2. The Sewers and manholes shall be maintained in a clean and serviceable condition until they are vested as public Sewers.

3.6.2 Precautions prior to testing rising mains

1. Before testing any pressure pipeline, it shall be anchored adequately and thrusts from bends, branch outlets or from the pipeline ends, are transmitted to solid ground or to a suitable temporary anchorage.
2. Open ends shall be stopped with plugs, caps or blank flanges properly jointed.
3. Testing against closed valves shall not be permitted.

3.6.3 Testing of gravity sewers

1. Non-pressure pipelines laid in open cut shall be tested after they are jointed and before any concreting or backfilling is commenced, other than such as is necessary for structural stability whilst under test.
2. Pipelines shall be tested by means of an air or water test or by a visual or closed-circuit television (CCTV) examination, in lengths determined by the course of construction, in accordance with the programme.
3. A further test shall be carried out after the backfilling is complete.

3.6.4 Water test for gravity sewers

1. The test pressure for Sewers shall not be less than 1.2 m head of water above the pipe soffit or groundwater level, whichever is the higher, at the highest point, and not greater than 6 m head at the lowest point of the section. Steeply-graded sewers shall be tested in stages in cases where the maximum head, as stated above, would be exceeded if the whole section were tested in one length.

(i) See also Clauses 3.5.1 and 3.5.5.

(i) Visual examination can include the use of CCTV and/or light-line inspections.

(ii) The type of test (air, water, visual or CCTV) should be described in the Contract.

(i) The allowable quantity of water added is stipulated in Clause 13.3 of BS EN 1610:2015.

- The pipeline shall be filled with water and a minimum period of 2 hours shall be allowed for absorption, after which water shall be added from a measuring vessel at intervals of 5 minutes and the quantity required to maintain the original water level noted, following which the original water level shall be restored. Unless otherwise specified, the length of Sewer shall be accepted if the quantity of water added over a 30-minute period is less than 0.5 litres per linear metre per metre of nominal diameter.
- Following a water test, pipelines and structures shall be emptied, as far as is practicable.
- Notwithstanding the satisfactory completion of the above test, if there is any discernible leakage of water from any pipe or joint, the pipe shall be replaced and/or the joint remade, as appropriate, and the test repeated until leakage is stopped.

3.6.5 Air test for gravity sewers

- Non-pressure pipelines to be air tested shall have air pumped in by a suitable means until a pressure of 100 mm head of water is indicated in a U-tube connected to the system. The pipeline shall be accepted if the air pressure remains above 75 mm head of water after a period of “t” given in the following table without further pumping, following a period for stabilisation.

Nominal Diameter	Testing Time (Minutes)
DN 100	5
DN 200	5
DN 300	7
DN 400	10
DN 600	14
DN 800	19
DN 1000	24

- Failure to pass the test shall not preclude acceptance of the pipeline if a successful water test can subsequently be carried out in accordance with clause 3.6.4.

3.6.6 Visual inspection of gravity sewers

- CCTV inspection shall be carried out in accordance with the Sewer Condition Inspection Specification and Guidance, 1st edition 2023, published by WRc Ltd.
- The pipelines shall be tested by means of a visual or closed-circuit television (CCTV) examination, in lengths determined by the course of construction, in accordance with the programme. For flexible pipes, the CCTV examination shall use light rings to measure deformations.

3.6.7 Infiltration

- Non-pressure pipelines and manholes shall be inspected and tested for infiltration after backfilling. All inlets to the system shall be effectively closed and any residual flow shall be deemed to be infiltration.
- The pipeline and manholes shall be accepted as satisfactory if the infiltration, including infiltration into manholes, in 30 minutes does not exceed 0.5 litres per linear metre per metre of nominal bore.
- Notwithstanding the satisfactory completion of the above inspection or test, if there is any discernible flow of water entering the Sewers or manholes which can be seen either by visual or CCTV inspection, such measures as are necessary to stop such infiltration shall be taken.

(i) BS EN 1610 ‘Construction and Testing of Drains and Sewers’ gives advice on testing requirements.

(i) A visual survey can include the use of CCTV and/or internal survey, or walk-through inspection.

(i) The permissible infiltration is the same as the permissible loss in the water test in 3.6.4.

- (i) BS EN 805 gives the permissible losses during the test.
- (ii) The Contract should specify either a "water loss" or "pressure loss" method of testing in accordance with BS EN 805.
- (iii) Details for Site pressure testing in accordance with BS EN 805 are provided in IGN 4-01-03 'Guide to Field Pressure Testing of Pressure Pipes and Fittings for use by Public Water Suppliers.'
- (iv) Where a pipeline is to be tested in sections, the Contract should identify any constraints in length.
- (v) The System Test Pressure (STP) should be described in the Contract. The STP should be calculated using the expressions in BS EN 805.
- (vi) Testing should be carried out with the pipework isolated from the existing adjacent pipework to prevent the transmission of thrust.

- (i) Where a pipeline is to be tested in sections, the Contract should identify any constraints in length.
- (ii) The test pressures should be described in the Contract.
- (iii) Testing should normally be carried out with the pipework isolated from the existing adjacent pipework to prevent the transmission of thrust. However, this might not be appropriate where the test is designed to test the tension capability of welds and the transfer of thrust through the pipeline.

3.6.8 Testing of ductile iron, PVC, GRP and steel pressure pipelines

1. The entire pipeline shall be pressure tested in accordance with BS EN 805 or WIS 4-01-03.
2. Gauges used for testing Rising Mains shall either be of the conventional circular type, not less than 200 mm diameter, calibrated in metres of head of water, or shall have a digital indicator capable of reading increments of 0.1 m head. Before any gauge is used, it shall be checked independently and a dated certificate of its accuracy shall be provided.
3. Before testing, valves shall be checked and sealed, the sections of main filled with water and the air released. After having been filled, pipelines shall be left under normal operating pressure for 24 hours, so as to achieve conditions as stable as possible for testing.
4. The pressure in the Rising Main shall then be raised steadily until the specified test pressure is reached in the lowest part of the section. The pressure shall be maintained at this level, by pumping if necessary, for a period of at least 1 hour. The pump shall then be disconnected and no further water shall be permitted to enter the Rising Main for a further period of 1 hour. At the end of this period, the original pressure shall be restored by pumping and the loss measured by drawing off water from the main until the pressure as at the end of the test, is again reached.
5. Where a new pipeline is to connect to an operational pipeline, the final connection shall be inspected visually under normal operating pressure and there shall be no visible leakage.
6. Rising Mains shall be tested after they are jointed and before any concreting or backfilling is commenced, other than such as is necessary for structural stability whilst under test.

3.6.9 Testing of polyethylene pressure pipelines

1. The testing of polyethylene pressure pipelines shall be carried out in accordance with the procedures in WIS 4-01-03 'Guide to Pressure Testing of Pressure Pipes and Fittings for use by Public Water Suppliers'.
2. Clauses 3.6.8.2 and 3.6.8.5 shall apply.

Appendix I – Publications relevant to the design of sewers, manholes, rising mains and pumping stations

(Note: The documents in this list are those relevant to design and are not necessarily referenced in the main text).

Number	Title	Published by/Date
WSA/FWR-01	A Guide to Sewerage Operational Practices	WSA/FWR, September 1991
FWR-03R	An Inspector's Guide to Sewerage Law, 3 rd Edition	FWR, April 2013
	Civil Engineering Specification for the Water Industry (CESWI 8 th Edition)	UKWIR Ltd, April 2023
	Design of Low-lift Pumping Stations - with Particular Application to Pumping Wastewater	CIRIA, 1992
WSA/FWR-04	Materials Selection Manual for Sewers, Pumping Mains and Manholes	WSA/FWR, January 1993
	The QSRMC Quality and Product Conformity Regulations 2024, Issue 2	QSRMC, May 2025

Appendix II – British Standards including European Standards and Codes of Practice

List of Standards to which Reference is made in this Guide

Standard types:

BS	British Standard
BS EN	European Standard adopted as a British Standard
BS EN ISO	International Standard adopted as a British and European Standard
PD	Published Documents

Type	Number	Title	References
BS	65:1991	Specification for vitrified clay pipes, fittings and ducts, also flexible mechanical joints for use solely with surface water pipes and fittings	3.2.50
BS EN	124:2015	Gully tops and manhole tops for vehicular and pedestrian areas.	
	Part 1	Design requirements, type testing, marking, quality control	3.2.4
	Part 2	Gully tops and manhole tops made of cast iron	3.2.4
BS EN	197	Cement	
	Part 1	Composition, specifications and conformity criteria for low heat common cements	3.2.13, 3.4.7
BS EN	206:2013+A2:2021	Concrete	
	Part 1	Specification, performance, production and conformity	3.2.12, 3.2.17, 3.4.1, 3.4.3
BS EN	295:2013	Vitrified clay pipes, fittings and pipe joints for drains and sewers	3.2.50
	Part 4	Requirements for special fittings, adaptors and compatible accessories	3.2.44
	Part 7	Requirements for vitrified clay pipes and joints for pipejacking	3.2.50
BS EN	450	Fly ash for concrete	
	Part 1	Definition, specifications and conformity criteria	3.2.13, 3.2.21
BS EN	459	Building lime	
	Part 1	Definitions, specifications and conformity criteria	3.2.19
BS EN	598	Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods	3.2.38
BS EN	622:2003	Fibreboards. Specifications	
	Part 1	General requirements	3.2.45
BS EN	681	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications	
	Part 1	Vulcanized rubber	3.2.24
BS EN	752:2017	Drain and sewer systems outside buildings	2.5, 3.2.3, 3.5.1
BS EN	771:2011+A1:2015	Specification for masonry units	
	Part 1	Clay masonry units	3.2.43
BS EN	805:2000	Water supply. Requirements for systems and components outside buildings	3.6.8

Type	Number	Title	References
BS EN	818:1996+A1:2008	Short link chain for lifting purposes. Safety	3.2.42
	Part 1	General conditions of acceptance	
BS EN	934:2009+A1:2012	Admixtures for concrete, mortar and grout	
	Part 3	Admixtures for masonry mortar. Definitions, requirements, conformity, marking and labelling	3.2.20
BS EN	998	Specification for mortar for masonry	
	Part 1	Rendering and plastering mortar	3.2.8, 3.2.20
	Part 2	Masonry mortar	3.2.8, 3.2.20
BS	1052	Specification for mild steel wire for general engineering purposes	3.2.26
BS EN	1092:2023	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated	
	Part 1	Steel flanges	3.2.37
	Part 2	Cast Iron flanges	3.2.36, 3.2.38
BS EN	1097:2008	Tests for mechanical and physical properties of aggregates	
	Part 6	Determination of the water content by drying in a ventilated oven	3.2.6
BS EN	1295:2019	Structural design of buried pipelines under various conditions of loading	
	Part 1	General requirements	2.1, 3.2.47, 3.5.2, 3.5.4
BS EN	1401:2019	Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticised poly(vinylchloride) (PVC-U)	
	Part 1	Specifications for pipes, fittings and the system	3.2.47
BS EN ISO	1460:2020	Metallic coatings. Hot dip galvanised coatings on ferrous materials. Gravimetric determination of the mass per unit area	3.2.36
BS EN ISO	1461:2022	Hot dip galvanised coatings on fabricated iron and steel articles. Specifications and test methods	3.2.41
BS EN	1515 2000	Flanges and their joints. Bolting	
	Part 1	Selection of bolting	3.2.37
BS EN	1563:2018	Founding. Spheroidal graphite cast iron	3.2.37
BS EN	1564:2011	Founding. Ausferritic spheroidal graphite cast irons	3.2.37
BS EN	1610:2015	Construction and testing of drains and sewers	3.2.10, 3.5.1, 3.6.4, 3.6.5, 3.6.7
BS EN	1916:2002	Concrete pipes and fittings, unreinforced, steel fibre and reinforced	3.2.28
BS EN	1917:2002	Concrete manholes and inspection chambers, unreinforced, steel fibre and reinforced	3.2.29, 3.2.30
BS EN	1991-1:2002	Eurocode 1. Actions on structures. General actions	3.2.41
	Part 1	Densities, self-weight, imposed loads for buildings	3.2.41
	Part 7	Accidental actions	3.2.41
BS EN	1996-1-2:2005	Eurocode 6. Design of masonry structures. Design considerations, selection of materials and execution of masonry	3.2.20, 3.5.15

Type	Number	Title	References
BS EN ISO	2081:2018	Metallic and other inorganic coatings. Electroplated coatings of zinc with supplementary treatments on iron or steel	3.2.36
BS EN ISO	3506	Mechanical properties of corrosion-resistant stainless-steel fasteners	
	Part 1	Bolts, screws and studs with specified grades and property classes	3.2.37
	Part 2	Nuts with specified grades and property classes	3.2.37
BS	4190:2014	ISO metric black hexagon bolts, screws and nuts. Specification	3.2.37
BS	4449:2005+A3:2016	Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification	3.2.25
BS	4482:2005	Steel wire for the reinforcement of concrete products. Specification	3.2.25
BS	4483:2005	Steel fabric for the reinforcement of concrete. Specification	3.2.25
BS	4729:2005+A1:2016	Clay bricks of special shapes and sizes. Recommendations	3.2.43
BS	5080	Methods of testing for structural fixings in concrete and masonry	
	Part 1	Method of test for tensile loading	3.2.36
	Part 2	Method for determination of resistance to loading in shear	3.2.36
BS	5911	Concrete pipes and ancillary concrete products	
	Part 1	Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints (complementary to BS EN 1916)	3.2.28
	Part 3	Specification for unreinforced and reinforced concrete manholes and soakaways (complementary to BS EN 1917)	3.2.29, 3.2.30
BS	6076:1996	Specification for polymeric film for use as a protective sleeving for buried iron pipes and fittings (for site and factory application)	3.2.11, 3.2.38
BS	6180:2011	Barriers in and about buildings. Code of Practice	3.2.36, 3.2.41
BS	6213:2000+A1:2010	Selection of construction sealants. Guide	3.2.23
PD	6682	Aggregates	
	Part 1	Aggregates for concrete. Guidance on the use of BS EN 12620	3.2.6, 3.2.7, 3.2.9
	Part 3	Aggregates for mortar. Guidance on the use of BS EN 13139	3.2.8, 3.2.9
BS	7371	Coatings on metal fasteners	
	Part 12	Requirements for imperial fasteners	3.2.36
BS	7874:1998	Method of test for microbiological deterioration of elastomeric seals for joints in pipework and pipelines	3.2.24
BS	7903:2020	Guide to selection and use of gully tops and manhole covers for installation within the highway	3.2.4
BS	7973:2001	Spacers and chairs for steel reinforcement and their specification	
	Part 1	Product performance requirements	3.2.22
	Part 2	Fixing and application of spacers and chairs and tying of reinforcement	3.2.22, 3.4.9
BS	8204	Screeds, bases and in situ floorings	
	Part 2	Concrete wearing surfaces. Code of Practice	3.4.16
BS	8500:2023	Concrete. Complementary British Standard to BS EN 206-1	3.4.1
	Part 1	Method of specifying and guidance for the specifier	3.2.13, 3.2.16, 3.4.9
	Part 2	Specification for constituent materials and concrete	3.2.6, 3.2.17, 3.4.2

Type	Number	Title	References
BS	8666:2020	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification	3.4.8
BS	9295:2010	Guide to the structural design of buried pipelines	2.1, 3.5.2
BS EN	10025:2004	Hot rolled products of structural steels	3.2.41
BS EN	10088	Stainless steels	
	Part 1	List of stainless steels	3.2.36
	Part 3	Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resistant steels for general purposes	3.2.41, 3.2.42
BS EN	10255	Non-alloy steel tubes suitable for welding or threading. Technical delivery conditions	3.2.41
BS EN	10296:2003	Welded circular steel tubes for mechanical and general engineering purposes. Technical delivery conditions	
	Part 2	Stainless steel	3.2.41
BS EN	12056:2000	Gravity drainage systems inside buildings	
	Part 2	Sanitary pipework, layout and calculation	2.5
BS EN	12620:2013	Aggregates for concrete	3.2.5, 3.2.7, 3.2.9
BS EN	13055:2016	Lightweight aggregates	3.2.6
BS EN	13101:2002	Steps for underground man entry chambers. Requirements, marking, testing and evaluation of conformity	Figures 2.9, 2.10, 2.11, 2.16, 2.17, 2.18 3.2.40
BS EN	13139:2002	Aggregates for mortar	3.2.8, 3.2.9
BS EN	12201:2024	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE)	3.2.46
	Part 2	Pipes	3.2.46
	Part 3	Fittings	3.2.46
BS EN	13598:2020	Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE).	
	Part 1	Specifications for ancillary fittings including shallow chambers	3.2.46, 3.2.47, 3.2.48
	Part 2	Specifications for manholes and inspection chambers	3.2.48
BS EN ISO	14122:2016	Safety of machinery. Permanent means of access to machinery	
	Part 1	Choice of a fixed means of access between two levels	3.2.41
	Part 2	Working platforms and walkways	3.2.41
	Part 3	Stairways, stepladders and guard-rails	3.2.41
BS EN	14188	Joint fillers and sealants	
	Part 1	Specifications for hot applied sealants	3.2.23
	Part 2	Specifications for cold applied sealants	3.2.23

Type	Number	Title	References
BS EN	14396:2004	Fixed ladders for manholes	Figures 2.10, 2.11, 2.16, 2.17, 2.18 3.2.39
BS ISO	14654	Epoxy-coated steel for the reinforcement of concrete	3.2.25
BS EN	14967:2006	Flexible sheets for waterproofing. Bitumen damp proof courses. Definitions and characteristics	3.2.45
BS EN	15167:2006	Ground granulated blast furnace slag for use in concrete, mortar and grout	
	Part 1	Definitions, specifications and conformity criteria	3.2.13

Appendix III – Water Industry Specifications/ Information and Guidance Notes (to which reference is made in this Guide)

Note: Water Industry Specifications (WISs) have replaced specifications previously published as Information and Guidance Notes (IGNs) and adopt the same numbering system.

Number	Title	Issue/Date	References
WIS 4-01-03	Specification for hydrostatic pressure testing of polyethylene and polyethylene barrier water supply pipelines and sewer rising mains	Issue 1/March 2024	3.6.8, 3.6.9
IGN 4-01-03	Pressure testing of pressure pipes and fittings for use by public water suppliers	Issue 2/Oct 2015	3.2.46, 3.6.8
IGN 4-08-01	Bedding and sidefill materials for buried pipelines	Issue 4/Feb 94	3.2.10
IGN 4-08-01A	Amendment to Bedding and sidefill materials for buried pipelines	Nov 2008	3.2.10
IGN 4-11-01	Vitrified clay pipes and fittings	Issue 2/Feb 84	3.2.50
IGN 4-21-01	Ductile iron pipes and fittings	Issue 3/Jul 94	3.2.38
IGN 4-32-18	The choice of pressure ratings for polyethylene pipe systems for water supply and sewerage duties	Issue 1/Mar 03	3.2.46
WIS 4-08-02	Specification for bedding and sidefill materials for buried pipelines	Issue 1/Feb 94	3.2.10
WIS 4-32-08	Specification for site fusion jointing of polyethylene pressure pipeline systems using PE80 and PE100 materials	Issue 4/Jun 16 Amended 2023	3.5.7
WIS 4-35-01	Specification for thermoplastics structured wall pipes – supplementary test requirements	Issue 2/Oct 2008	2.10.5, 3.2.46.6, 3.2.47.2
WIS 4-52-03	Specification for anti-corrosion coatings on threaded fasteners	Issue 1/Dec 94	3.2.37

Copies of these documents can be obtained from Water UK: <https://www.water.org.uk/>

Appendix IV – Parliament Acts and Regulations (to which reference is

made in this Guide)

Title	References
The Building Regulations (Northern Ireland) 2012	2.12.1
Construction (Design and Management) Regulations (Northern Ireland) 2016	1.5
Construction Products Regulation (CPR) (EU) No 305/2011	Part 3
Waste and Contaminated Land (Northern Ireland) Order 1997	3.3.1
Water and Sewerage Services (Northern Ireland) Order 2006, as amended Water and Sewerage Services Act (Northern Ireland) 2016	1.1, 1.2, 1.5, 1.10, 1.20

Appendix V – Miscellaneous Publications (to which reference is made in this Guide)

Number	Title	Reference
	The Classification and Management of Confined Spaces, Edition 3.0, Water UK, Dec 2019	3.1.6
Report R59	Building Sands: Availability, Usage and Compliance with Specification Requirements. CIRIA, 1976	3.2.9
Technical Note TN137	Selection and Use of Fixings in Concrete and Masonry. CIRIA, 1991	3.2.36
Technical Note TN128	Civil Engineering Sealants in Wet Conditions: Review of Performance and Interim Guidance on Use. CIRIA, 1987	3.2.23, 3.5.5
Technical Note TN144	Performance of Sealant-concrete Joints in Wet Conditions. Results of Laboratory Testing Programme. Volume 1: Main Results and Discussion. CIRIA, 1992	3.2.23
	Code of Practice - Specification for the Reinstatement of Openings in Highways, Second Edition. Northern Ireland Road Authorities & Utilities Committee (NIRAUC), 2006	2.12.10, 3.3.1.2, 3.3.4
	Sewer Condition Inspection Specification and Guidance, 1st edition, WRc 2023	3.6.6
GPP 5	Works and Maintenance in or near Water. version 1.2 NIEA, SEPA, NRW 2018	3.3.2
GPP 6	Working at Construction and Demolition Sites. version 1 NIEA, SEPA, NRW 2023	3.3.2
	Manual of Drain and Sewer Cleaning, 1st Edition. WRc, 2020	1.8.1
HA 104/02	Design Manual for Roads and Bridges. Volume 4, Geotechnics and Drainage. Section 2, Drainage. Part 5, 'Chamber Tops and Gully Tops for Road Drainage and Services CD 534	3.2.4
	Tables for the Hydraulic Design of Pipes, Sewers and Channels, 8th Edition: Volume II. HR Wallingford, 2006	2.9.2
	Civil Engineering Specification for the Water Industry, 8 th Edition. UKWIR Ltd/WRc plc	3.4.1
	UK Red List	1.2.13
BRE Special Digest 1	Concrete in Aggressive Ground, BRE, 2005	3.2.16, 3.2.28, 3.2.29, 3.2.30
PPS 15	Planning and Flood Risk. DfI, 2014	1.16.8, 2.7.5

Appendix VI – Standards Symbols for use on the drawings

SEWERS

	Foul
	Surface
	Combined
	Final Effluent
	Unknown
	Pumped
	Trunk (Foul)
	Abandoned (Foul)
	Retention (Foul)
	Not in Service
	Emergency Overflow
	Overflow
	Rivers Agency
	Private or Unadopted (Foul)
	Sludge

TERMINATING NODES AND FITTINGS

	Outfall
	Inlet
	End Cap
	Cascade
	Unknown
	Rodding Eye
	Soakaway
	Ejector
	Lamphole
	Oil Interceptor/Hydrobrake/Unknown
	Hatchbox
	Air Valve
	Valve

MANHOLES

	Foul
	Surface
	Combined
	Unadopted
	Final Effluent
	Unknown
	Suspect

OTHER FEATURES

	Kiosk
	Marker Post
	Gully
	General Point
	Update Point
	Sewer Sample Point

SEWER ASSETS

	Wastewater Pumping Station
	Wastewater Pumping Station (Disused)
	Wastewater Treatment Works
	Septic Tank
	Septic Tank (Private)
	Sludge Treatment
	Sludge Treatment (Disused)
	Combined Storm Overflow
	Combined Storm Overflow (Disused)

Asset Information Development
SEWER LEGEND Key Features: Updated 9 Sept 2009