Site sewer construction guide
Introduction

Sewers are expensive to construct and if not built correctly, remedial works can be disruptive, time consuming, costly and in some circumstances, have adverse effects on a company’s reputation. In many instances, a lot of mistakes can be avoided by considering the specification and requirements before and during construction.

This document has been produced as an on-site guide for contractors and operatives constructing sewers, with advice notes provided to avoid some of the common on site errors.

Agreed agreement drawings and manufacturer’s recommendations should be adhered to. Should this not be practicable, design changes or amendments must be agreed with United Utilities before construction.

It is a contractor’s responsibility to ensure that all operatives are competent and experienced to complete works to the required standards.

SAFETY IN SEWERS

The Health and Safety of workers on the Public Sewer Network is our number one priority. All work on public sewerage apparatus must be agreed in writing by United Utilities (see page 26 for further details). As a minimum requirement, workers carrying out sewer construction on the public sewer must hold a current City and Guilds or SQA standard or CABWI Level 2 Award Certificate for Working in Medium or High Risk Confined Spaces in the Water Industry. In addition, those carrying out the work must be suitably experienced.

Agreed agreement drawings and manufacturer’s recommendations should be adhered to. Should this not be practicable, design changes or amendments must be agreed with United Utilities before construction.

It is a contractor’s responsibility to ensure that all operatives are competent and experienced to complete works to the required standards.

Keep this booklet with you on site as a quick reference guide

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Only Intrinsically Safe CCTV equipment can be used in public sewers
Safety in sewers and excavations

Trenches and excavations

Trenches must be adequately supported, free from boulders and tree roots must be taken out. Muddy ground, water and soft areas in the trench base must be removed. Materials, spoil and equipment must be stored safely and plant should be operated within a safe working distance. The trench must be adequately protected from slips, trips, falls, site traffic and have a safe means of access and egress.

Trenches should be adequately dewatered to provide a firm base but not dug wider than necessary as excessive loading may be placed on the pipe. Should ground conditions be unsuitable for pipe laying and manhole construction, please consult with your engineer to design a solution.

Control of site and trench groundwater

The discharge of site ground water and excavation dewatering to the public sewer is only permitted by approval from United Utilities in writing. In addition, care must be taken to prevent site debris, sludge or silt from entering the sewer network which could ultimately cause flow restrictions, blockages, flooding, pollution and also affect the receiving wastewater treatment works. Costs associated with such incidents may be recovered from those responsible. In addition, should an inappropriate discharge of site groundwater or construction material cause a pollution incident, this may lead to prosecution.

Agreed drawings

For sewer adoption and diversion works, construction must comply with the drawings agreed by United Utilities. Similarly for public sewer connections, works must comply with the details which have been agreed by the Local Authority, the relevant Building Control Authority and the approval given by United Utilities for the works to proceed.

It is recommended that a site copy of the agreed drawings are available to those carrying out construction to avoid any mistakes or deviation from specification.

Any deviation from the agreed drawings must be agreed with United Utilities before construction.

Construction materials

All materials including pipes must comply with the United Utilities agreed drawings to Water Industry Standards (WIS) and be Kitemarked or have a similar EU certification mark. Should it be necessary to change to an alternative product or material, this must be agreed in advance with United Utilities, before construction commences.

Please note when ordering, suppliers should be made aware that the products selected must comply with United Utilities Standard Details and the current edition of Sewers for Adoption specification.

Storage of materials

All materials should be handled with care and stored safely in accordance with manufacture’s recommendations.
Manhole chambers

Typical manhole chambers up to 3m deep

Manholes should be constructed where there is a change of direction and/or a change of gradient, or where access is required for maintenance purposes. Such changes in direction or gradient must be made within the channel and not outside of the manhole or concealed by benching.

Manholes should also be positioned 0.5m away from curb lines, preferably with the manhole cover positioned away from the wheel line of traffic.

Sizing of manhole chamber

Manhole bases should be sized to accommodate the main channel, lateral connection channels and provide a minimum 600 x 600mm square landing area beneath the step rungs or ladder for main channels up to 375mm. However, should there be several channels, the size of the chamber may need increased. Please note, road cambers should be considered when positioning manholes with double covers across the centre of a carriageway.

Manhole base and channel construction

The manhole base should be a minimum of 225mm deep to the barrel of the channel. To prevent the ingress of ground water and associated calcified deposits bleeding through the benching, the concrete should not be a dry mix and sufficiently compacted or pokered to remove voids and entrained air.

Channels

The pipe joint adjacent to the channel should be a minimum of 100mm from the internal face of the manhole.

Lateral connections into the manhole must also enter the chamber as channels, again at 100mm from the internal face of the channel and connect to the main channel at soffit to soffit level, swept with the direction of main flow.

Preformed plastic bases constructed within manhole rings are also not permitted. Preformed concrete and plastic coated concrete bases are permitted.

Channel types

Channel inverts must be constructed using channel fittings for pipe diameters up to 300mm. Clay and suitably fixed plastic channels are acceptable. Granolithic channels formed for smaller diameter channels often are either not sufficiently finished or the profile of the channel is not maintained, causing the accumulation of solids and associated odour complaints and as such are not acceptable. Granolithic channels above 300mm diameter must be finished with a steel float.

Preformed plastic inspection chamber bases must not be installed within manhole rings or brickwork chambers.
Lateral connection manhole channels

Lateral connections within manholes must meet the main channel at ‘soffit to soffit’ level with the channel commencing 100mm from the chamber wall.

All lateral channels must meet the main channel, swept in the direction of the main flow.

Manhole benching

Benching should be self-cleansing and formed with high strength concrete at a gradient of between 1:10 – 1:30.

To maintain a smooth flow within the main channel, the benching must be formed vertically from the edge of the channel to at least the crown of the pipe.

Stub and rocker pipes

The manhole stub pipe must terminate within 150mm from the external face of the manhole. The length of the rocker pipe used must correspond to the sewer diameter. For sewers up to 600mm diameter, the rocker length must be 500 – 750mm long.

Please note, no rocker pipes are required on concrete pipes in excess of 1050mm diameter.

Setting out position of 1st ring and cover slab

The underside of the manhole ring must be situated between 50 – 300mm above the crown of the pipe.

The distance from finished ground level to the top step rung beneath the cover slab must not exceed 675mm. A minimum distance of 150mm between the underside of the cover slab to the top step iron must also be provided.

It is recommended that your site engineer sets out the cover slab, concrete base and manhole ring levels to ensure that the above distances are provided.
Manhole rings and step iron

Manhole rings must be seated on a mortar bed and adequately pointed to prevent the ingress of ground water. Alternatively, proprietary bitumen or mastic bedding materials can be used. Manhole ring lifting eyes must be pointed flush with the chamber walls.

The step rungs must be plumb, in vertical alignment and equally spaced, leading to a landing area of a minimum area of 600 x 600mm square from the edge of the main channel to the chamber wall.

Ladders

Stainless steel ladder

To maintain a 600 x 600mm square clear opening, the step rungs or ladders must be plumb and in alignment with the cover slab opening.

Where the distance from ground level to the benching landing area is in excess of 3m, step irons are not permitted and a ladder must be installed. Stainless steel or in certain circumstances GRP ladders are acceptable, but please consult with United Utilities who will confirm the relevant specification.

Cover slabs and access openings

For 600 x 600mm square openings on 1050mm diameter chamber rings and above, United Utilities Standard Detail Specification is that a 600 x 750mm cover slab is fitted, reduced to a 600 x 600mm square opening by the use of an eccentric raising piece to suit the manhole cover and frame used.

Generally, where manhole chambers are between 1.5 – 3.0m deep from finished ground level to benching landing area, a 600 x 600mm clear unobstructed opening is normally suitable.

Where chambers are less than 1.5m deep from finished ground level to benching landing area, consideration should be given to accessing and carrying out maintenance activities within the chamber.

For 1050mm and 1200mm diameter rings less than 1.5m deep to benching, 750 x 750mm covers shall be fitted.

For 1500mm diameter rings less than 1.5m deep to benching, 1200 x 675mm covers shall be fitted.

Please note, cover slabs must not be cut to increase opening dimensions as this will significantly weaken the cover slab.

<table>
<thead>
<tr>
<th>DEPTH TO SOFFIT FROM COVER LEVEL &lt; 1.5M</th>
<th>DEPTH TO SOFFIT FROM COVER LEVEL ≥ 1.5M</th>
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<tbody>
<tr>
<td>MINIMUM CLEAR OPENING SIZES</td>
<td>MINIMUM CLEAR OPENING SIZES</td>
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<tr>
<td>750 x 750 ON 1050 AND 1200 CHAMBER</td>
<td>600 x 600 FOR DOUBLE STEP ACCESS</td>
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<td>/ SHAFT</td>
<td>600 x 600 FOR LADDER ACCESS</td>
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<tr>
<td>1200 x 675 ON 1500 AND ABOVE CHAMBERS</td>
<td>750 x 600 FOR FEATURE LADDER ACCESS</td>
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<td>/ SHAFT</td>
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</tbody>
</table>
Positioning of cover slabs

Cover slabs must be positioned in square alignment with step irons or ladders and provide a minimum 600 x 600mm square unobstructed opening. The internal face of the cover slab must be plumb with the outer edge of the step irons.

Remember, the distance from ground level to the 1st step should be no more than 675mm.

Remember, the top step must be a minimum of 150mm from the underside of the cover slab.

Defective or damaged cover slabs must be replaced.

Step rungs must not be constructed in adjusting brickwork openings.

Adjusting brickwork, raising pieces and manhole cover and frames

1-3 courses of solid Class B engineering bricks should be used, free from thin masonry splits constructed using 3:1 cement sand mortar in English Bond. Please note, normal house building mortar is unsuitable for constructing adjusting brickwork. Furthermore, masonry splits should only be used to achieve road cambers and gradients.

Alternatively, pre-cast raising pieces can be used, bedded on 3:1 sand / cement mortar or stronger. Proprietary shimming pieces should be used to achieve road cambers and gradients etc.

Please note when calculating the number of masonry courses, the mortar bed beneath the manhole frame must not exceed 12mm.

Both adjusting brickwork and raising pieces must be of sound construction, plumb, in alignment with the cover slab, free from holes, mortar snouts with the mortar joints suitably pointed or flush with the brickwork. Please note, the rendering of adjusting brickwork or concrete seating rings is not permitted.

English bond adjusting brickwork

English bond must be constructed as per the diagrams below taking particular care to ensure that the bond is maintained throughout the courses with no vertical straight joints, using 1/2 brick Queen Closures at the corners.
Manhole cover and frames

Sewers for Adoption specifies that all manhole frames located in adopted highways must be a minimum of 150mm deep and only 100mm frames are permitted in residential cul-de-sacs. Covers must be Kitemarked and comply with BS EN124 with Class D400 covers used in all areas used by road vehicles. It is however recommended that all cover and frames subject to traffic loading have 150mm deep cover and frames fitted. Should you have any queries with regards to the suitability of manhole covers and frames, please clarify the requirements with United Utilities.

Inappropriate bedding of manhole frames often leads to movement of both the manhole cover within the frame and the disintegration of the surrounding ground, especially in trafficked areas.

Before final surfacing, it is recommended that all frames are checked for alignment and sound bedding. Resetting frames and associated reinstatement can be costly, time consuming and spoil the appearance of a newly surfaced area.

Manhole covers must be correctly selected in accordance with the given location and must be correctly seated in alignment with the adjusting brick work or raising pieces below.

Generally covers must be bolted together with manhole key holes free from debris and ready for inspection.

Block paved or masonry inset covers must not be installed on United Utilities public sewerage apparatus.

Pipes and bedding

Sewer pipes and bedding specification

Pipes used on main adoptable sewer lengths must comply with Sewers for Adoption specification. Should there be any queries as to the suitability of materials, these should be clarified before construction. Vitrified clay pipes should comply with requirements BS EN 295 for foul pipes and BS 65 for surface water pipes.

Thermoplastic structural walled pipes must comply with Water Industry Standard 4-35-01 and achieve Class 8k/Nm² nominal short term ring stiffness. Please note, not all structural walled pipes meet this specification and pipes which do not meet these requirements are unacceptable. Pipes must be Kitemarked or have a similar E.U. certification mark.

Handling and storage of pipes

Pipes are expensive and should be handled with care and stored safely in flat areas, away from excavations, stacked no greater than manufactures recommendations. In particular, PVC pipes should be stored on surfaces that prevent distortion of both the pipe circumference and linear profile.

Protection of sewers

Sewers located within highway or areas of traffic should have 1.2m of cover. In other areas, 0.9m of cover is required. Where this is not possible, a full protective concrete bed and surround must be provided, inclusive of flexible joints.

Pipe bedding

Pipes must be evenly bedded along the length of the pipe. Under normal circumstances, United Utilities’ specification for the bedding of pipes is Class S, full bed and surround for rigid, semi rigid and flexible pipe materials. Please consult with the pipe manufacturer’s recommendations and agreed drawings.

Recycled pipe bedding materials

Recycled materials must comply with BS 8500-2.
Laying and jointing of pipes

Pipes should be laid in 3m maximum lengths with the joints ‘pushed home’ into sockets. Furthermore, care must be taken to ensure the pipe jointing seals are free from grit, silt etc. which will likely cause the pipe length to fail later air testing. It is recommended that sewers are air tested at regular intervals as pipes are laid.

Pipes should be cleanly cut, be free from defects and laid without back fall and dips. It is recommended that sewers are laid using pipe lasers to achieve a single consistent gradient. Where there is little fall such as gradients up to 1:150 extra care should be taken to prevent dips.

Back laying of pipes should be avoided where possible as level errors and the positioning of unforeseen existing services may require corrective measures which can be either expensive or impossible to rectify.

Backfilling

Pipes should be backfilled and compacted in 150mm layers to 300mm above the pipe crown. Care should be taken during compaction so that the sewer remains in good line and level, in particular adjacent to manhole chambers to prevent rocker pipes being pushed down from stub pipes.

Testing of sewers

Sewers up to 750mm diameter must be available for testing either by air or water.

Air testing

For air testing, the sewer must hold a head from 100mm to a minimum of 75mm for 5 minutes once the pressure is initially stabilised.

Water testing

The sewer should be filled with water to provide 1.2 – 6.0m head of water above the soffit of the pipes at the highest point. To allow for absorption, after 2 hours water should be added at 5 minute intervals and the volume of water required to keep the water at the initial level recorded. The rate of water loss must not exceed 0.5 litres / per 30 minutes / metre diameter / linear metre.

CCTV surveys

All sewers proposed for adoption must be inspected by CCTV survey. For sewers subject to a S104 Agreement, United Utilities will survey the sewers. In advance of the CCTV survey, it is the developer’s responsibility to ensure that sewers are suitably cleansed otherwise the survey work will be abandoned.

Thermoplastic pipes are also subject to profile laser light-line surveying which measures any deformation within the pipeline. Pipes with deformation in excess of 5% must be replaced.

For sewers subject to S185 Sewer Diversion Agreements, it is the developer’s responsibility to provide CCTV footage of cleansed sewers before flows are diverted. However, CCTV surveys recorded during the jetting works or surveys of dry pipelines are not suitable as an indication of the level of the pipe can not be achieved.

Please note, pipe defects, dips, back fall and poor jointing highlighted by these surveys will need to be repaired.
Connections

Connections to existing public sewers
Depending on the number of properties that are served by the drain or sewer and the diameter of the main public sewer, connections can be made to:

- an existing public sewer manhole
- a new manhole constructed on the public sewer
- by the installation of a pre-formed oblique junction, matching the main sewer material, using proprietary couplings
- by core-drilling the barrel of the pipe at 2 or 10 o’clock and installing a proprietary saddle fitting

Connections to existing public sewer manholes
The dimensions and configuration of the existing public sewer manhole must be able to accommodate the new connection. Where this is not possible, a new manhole will need to be constructed.

Connections must be made via a core drill so that the chamber remains in good order.

Connecting pipe work should meet the main channel at ‘soffit to soffit’ level. High level external back drop pipes must also be core drilled.

Internal backdrop connections are generally not permitted.

Channels should be used to turn the discharge to the direction with the main flow. Channels and high level pipes must not conflict with existing openings, step irons and must maintain a clear 600 x 600mm clear landing area.

New manholes on existing public sewers
The diameter or size of a manhole chamber should provide sufficient access for maintenance such as jetting, CCTV surveys and man entry to the channels where required. A minimum 600 x 600mm clear opening should be provided for manholes 1.5 - 3m deep from benching to finished ground level.

New connection channels must not be constructed in the existing landing area. Connecting channels must be swept with the direction of main flow.

The new connecting pipe work must meet the main channel at pipe ‘soffit to soffit’ level.

Channels must be from half barrel and not intrude into the main sewer flow.

Where existing chambers do not provide sufficient space to make a new connection, chambers may have to be re-constructed with a larger chamber.

Please note, ‘T’ Junctions should not be used.
Pre-formed junction connections
Oblique preformed junctions only must be installed using proprietary couplings. ‘T’ junctions must not be used.

Openings in the existing sewer must be squarely and accurately cut, free from rough edges. The installed fitting should be in good alignment with the existing sewer.

Core-drilled saddle connections
All saddle connections must be core-drilled.

Please note, forming openings using circular cutting wheels weakens the pipe and causes structural defects.

Back drop connections
Generally, internal backdrop connections are not permitted. Should an external backdrop have a high risk of blockages, a rodding point extending to ground level should be provided.

Remember, once connections have been made, please leave the area exposed for inspection by United Utilities.

Bespoke or manhole chambers for storage systems
Chamber ring diameters should be selected on size of manhole inlets and outlets and should also be able to accommodate the number of connections, associated channels and provide a minimum 600mm x 600mm landing area.

For 600mm diameter pipes and above, where benching and a landing area is constructed 50% diameter above invert, a 500mm x 150mm recess must be cast within the manhole base, for step irons to be installed to lead down to the main channel invert.

Handrails must also be installed to United Utilities Standard Detail Specification.
Alternative access arrangements for larger diameter surface water sewer manholes

For 600mm diameter surface water sewers and above with headroom limited to 2m or less, suitable access into the channel can be achieved by forming a recess within the manhole base, with step rungs installed leading down to a landing area formed and finishing at a point 150mm above channel invert. Step rungs must be plumb and vertical alignment as shown below.

- **'Boxed out' benching positioned flush with manhole ring above.**
- **Step rungs in plumb and vertical alignment equally distanced apart.**
- **Minimum 600 x 600mm square landing area must remain dry during normal dry weather conditions.**
- **High level overflow not always required - see agreed drawings**
- **Integral bypass wire and handle fitted in position accessible from ground level, below cover.**
- **Ensure there is cross fall from manhole inlet to outlet.**
- **Channel formed.**
- **Sump (adhere to flow control manufacturer’s recommendations).**
- **Bypass sewer constructed for the event of flow control blockages, in addition to unit integral bypass.**
- **Fully operational penstock fitted to rising type spindle.**
Fixings and rails

Metal fixings and chains
The specification for United Utilities metal work fixings and chains is stainless steel, grade X5 Cr Ni Mo 17-12-2 to BS EN 10088: Part 1.

Safety chains
Safety chains are required on sewer outlets greater than 525mm internal diameter. The chain must be 8mm diameter and made from stainless steel.

Hand rail and balustrades
Stainless steel and in some circumstances GRP handrails and balustrades are permitted. Please contact United Utilities with regards to the relevant application and associated specification.

Other information

Typical 1:20 manhole details

Typical foul water manhole

Typical SW storage manhole (≥3m deep to soffit)

Minimum length of channel

<table>
<thead>
<tr>
<th>Chamber diameter</th>
<th>“X” min</th>
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<tbody>
<tr>
<td>1200</td>
<td>950</td>
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<td>1500</td>
<td>1050</td>
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<td>1800</td>
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<td>1450</td>
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<tr>
<td>2700</td>
<td>1550</td>
</tr>
<tr>
<td>3000</td>
<td>1700</td>
</tr>
</tbody>
</table>
Other contact information and advice

United Utilities Wastewater Developer Services
Tel. 03456 723 723

Permission to work on public sewers will either require the completion and acceptance of the S106 Sewer Connection Part 2 form (see Sewer Connection below) or by the issuing of a United Utilities Access Certificate.

Logging On /Off United Utilities Public Sewer Network  Tel. 07826 539459. Please note, to ‘Log On’ you will be required to provide either a valid Sewer Connection or Access Certificate Number.

United Utilities website
unitedutilities.com

Building over public sewers
unitedutilities.com/build-over-sewer.aspx

Closing or removing sewers
unitedutilities.com/sewer-close.aspx

Connecting to public sewers
unitedutilities.com/connecting-public-sewer.aspx

Laying sewers in third party land
unitedutilities.com/wastewater-requisitions.aspx

Offering sewers for adoption
unitedutilities.com/sewer-adoption.aspx

Sewer diversions
unitedutilities.com/sewer-diversion.aspx

Sewers for adoption copies
WRc Plc, Frankland Road, Blagrove, Swindon, Wiltshire, SN5 8YF