Site Handbook

aquaspira

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Contents

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27/06/24	Updated flotation table in line with BS 9295:2020 (page 24)	1.1

1. Introduction

Aquaspira gravity pipes, pipeline access and tank systems are fabricated from a unique composite steel reinforced HDPE structure. They are fabricated with push-fit joints and are robust and lightweight.

This handbook will provide step-by-step installation guidance, ensuring pipes and tank systems are correctly installed, protected during further construction phases and achieve full quality assurance and continued performance for the client. It will assist construction teams through all stages of the planning and installation process whilst assuming the pipe installer has good general knowledge in construction practices and experience of installing large diameter pipes. Further reference should be made to the HSE Guidance documents.

- Managing H&S In Construction
- HSE - Health & Safety in Construction HSG150

For design and installation, reference must be made to the project engineer's drawings, appropriate text and relevant standards.

Wherever there is a variance between information contained in this document and any project related sources, the project related sources should take precedence over information contained in this document.

All reasonable efforts have been made to ensure the accuracy of information contained in this document. However, Aquaspira makes no warranty as to the accuracy of this information and disclaims all liability relating to its use.

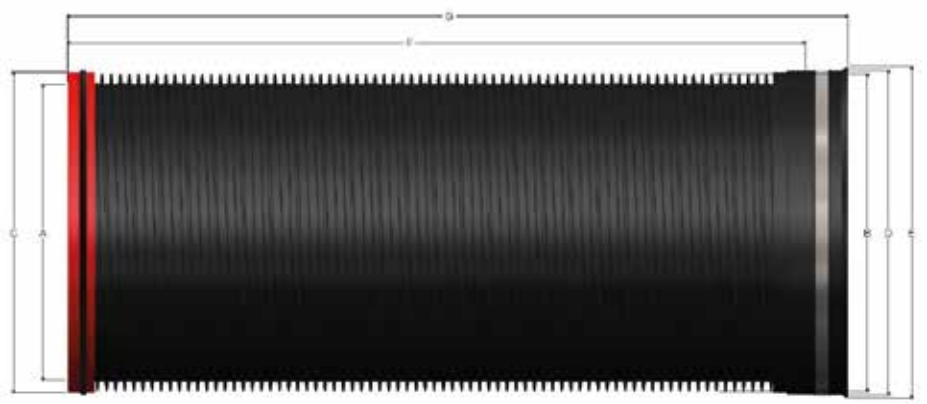
If further information is required at any stage, please contact Aquaspira on 01282 608510 or via the website: www.aquaspira.com.

2. Acronyms

CSR	Composite Steel Reinforced
HDPE	High Density Polythene
ITP	Inspection Test Plan
ITS	Inspection Test Sheets
LTC	Lateral Connectors
OD	Outside Diameter
RAMS	Risk Assessment Method Statement
SfS	Sewers for Scotland
SSG	Sewerage Sector Guidance

3. Pipe Dimensions

Normal pipe lengths are 2.6m and 3m; up to 6.5m pipes can be supplied upon request. All standard Aquaspira CSR pipes are manufactured with socket and spigot ends. Figure 1 below, shows an Aquaspira CSR pipe complete with red spigot on the left and socket on the right of the pipe.



A	Pipe inner diameter (nominal diameter)
B	Pipe outer diameter
C	Spigot outer diameter
D	Socket outer diameter
E	Socket outer diameter including flare
F	Effective length
G	Overall length
Weight	For single standard-length pipe

Figure 1: Digital image of CSR pipe showing locations of dimensions provided in Table 1.

Table 1, in conjunction with Figure 1, provides key dimensions and number of pipes that can be delivered on a full standard artic lorry trailer of 13.5m.

A	B	C	D	E	F	G	Nominal Weight (kg)	No. Pipes per Full Load	Metres per Full Load
600	662	674	688	700	3000	3180	69	64	192
675	737	749	763	775	3000	3180	77	56	168
750	812	824	838	850	3000	3180	94	36	108
825	887	899	913	925	3000	3180	103	36	108
900	962	974	988	1000	3000	3180	113	20	60
1050	1112	1124	1138	1150	3000	3180	140	16	48
1200	1282	1294	1308	1320	3000	3180	185	16	48
1350	1432	1444	1458	1470	3000	3180	214	16	48
1500	1582	1594	1608	1620	2600	2780	216	8	20.8
1650	1732	1744	1758	1770	2600	2780	248	7	18.2
1800	1882	1894	1908	1920	2600	2780	271	7	18.2
1950	2032	2044	2058	2070	2600	2780	302	6	15.6
2100	2182	2194	2208	2220	2600	2780	325	6	15.6
2250	2332	2344	2358	2370	2600	2780	349	6	15.6

- Full standard artic lorry trailer of 13.5m
- Tolerances of external diameters +/- 6mm
- Tolerances of finished pipe lengths at 23°C +/- 50mm

4. Pre-installation Planning

Prior to any works commencing on site the following documents should be in place:

- "For Construction" drawings, appropriate text, and relevant standards provided by the Designer.
- "For Information" drawings provided by Aquaspira will be labelled "Approved by Client for Fabrication" (Please note that these must not be used for construction).
- Temporary Works designs for trench support and the understanding of expected ground conditions.
- Expected groundwater, removal, and disposal of water during installation.
- Risk Assessment and Method Statements (RAMS) for:
    - Off-loading and storage,
    - Groundwater removal and disposal,
    - Excavation and pipe installation,
    - Backfill and removal of trench support,
    - Connection to structures,
    - Testing, inspection and commissioning.
- Inspection Test Plan (ITP) and associated Inspection Test Sheets (ITS)
- Assessment of how the pipe construction programme integrates with the construction programme for the site. In particular:
    - Will heavy vehicles be working near the pipeline?
    - Will access be needed over the pipeline before construction is finished?
- All inspection requirements by external authorities (if required), and whether inspection must be done in sections or for the completed pipeline only.

5. Inspection Test Plan And Sheets

Prior to the commencement of any works an ITP should be prepared. This will ensure that each element of the construction process is considered, and installation is in accordance with agreed standards. A suite of ITS has been created for all works directly associated with the installation of the Aquaspira CSR pipe. Alternatively, they can be incorporated into the existing Quality Assurance procedures adopted by the contractor.

The following ITS are available:

- Pipe delivery
- Pipelaying
- Backfilling

6. Unloading Handling & Storage

6.1 Unloading

If pipes are to be stored on site, select appropriately sized, flat areas with safe vehicle access, at locations that will not interfere with other construction work that may be going on at the same time as the pipe installation.

Ensure it is possible to safely unload the pipes at the locations you have chosen without disrupting traffic, other construction work, or blocking the access of residents. Check for overhead powerlines and the locations of other overground services.

Aquaspira pipes are robust, relatively light, and easy to handle, however, care must be taken to prevent damage during handling and unloading. Pipes should not be dropped, thrown, or dragged. Pipes should be inspected upon arrival and any damage immediately recorded and reported. Aquaspira cannot accept responsibility for any reported damage to pipes once the delivery vehicle has been offloaded. Where possible pipes should be offloaded using a machine with extended forks, (Figure 2) or a machine with a pole attachment (Figure 3).

Figure 2: Pipes being unloaded utilising extended forks.

Figure 3: Unloading utilising a pole attachment.

Alternatively, pipes can be safely offloaded with an appropriate pair of lifting straps without the need for operatives to mount the trailer. The straps can be thrown over the pack of pipes and drawn underneath. Note: Lifting straps used that come into contact with the ribs of the pipe need to cover minimum of three ribs to distribute the load.For packs of pipes lifting chains can be used in conjunction with the straps, for single pipes the straps should be looped back on themselves (choked). The external pipe ribs will prevent pipes from slipping. Note: Lifting chains should not be used to sling single pipes as this may cause damage to the polyethylene coating on the ribs (Figure 4).

Figure 4: Unloading CSR pipes in packs utilising lifting straps.

6.2 Safe Movement Around Site

Pipes can be safely moved around site whilst retained in their packs, significantly reducing the number of movements from storage area to the installation location. (Figure 5)

Figure 5: Moving CSR pipes around site.

6.3 Storage

Pipes should be placed or stacked on a flat surface that is free from protrusions and debris. They should be positioned on timber supports with integral timber wedges placed at 2m centres. Stacked pipes should not exceed a height of 3m.

Whilst Aquaspira pipes are relatively lightweight care must be taken to ensure they cannot roll and cause potential injury to operatives or the public. Refer to Figure 6.

Figure 6: CSR pipe storage on highway ensuring pipes are chocked.

7. Excavations & Trench Support

Reference should be made to: HSE Excavations

The following flowchart (Figure 7) provides a summary of the steps required during all stages of the excavation process. All personnel with direct responsibility for excavation activities should obtain a clear understanding of all excavation procedures and control measures including:

- Collapse of excavations
- Falling or dislodging material
- Falling into excavations
- Undermining nearby structures
- Underground and overhead services
- Inflow of ground and surface water
- Damage to trees
- Other aspects of excavation safety
- Inspection

These include:

- Operatives
- Foremen
- Engineers
- Project / Site Managers / Agents
- Designers (e.g. Temporary Works Design)

Please refer to the For Construction drawings for full details of the minimum trench widths required.

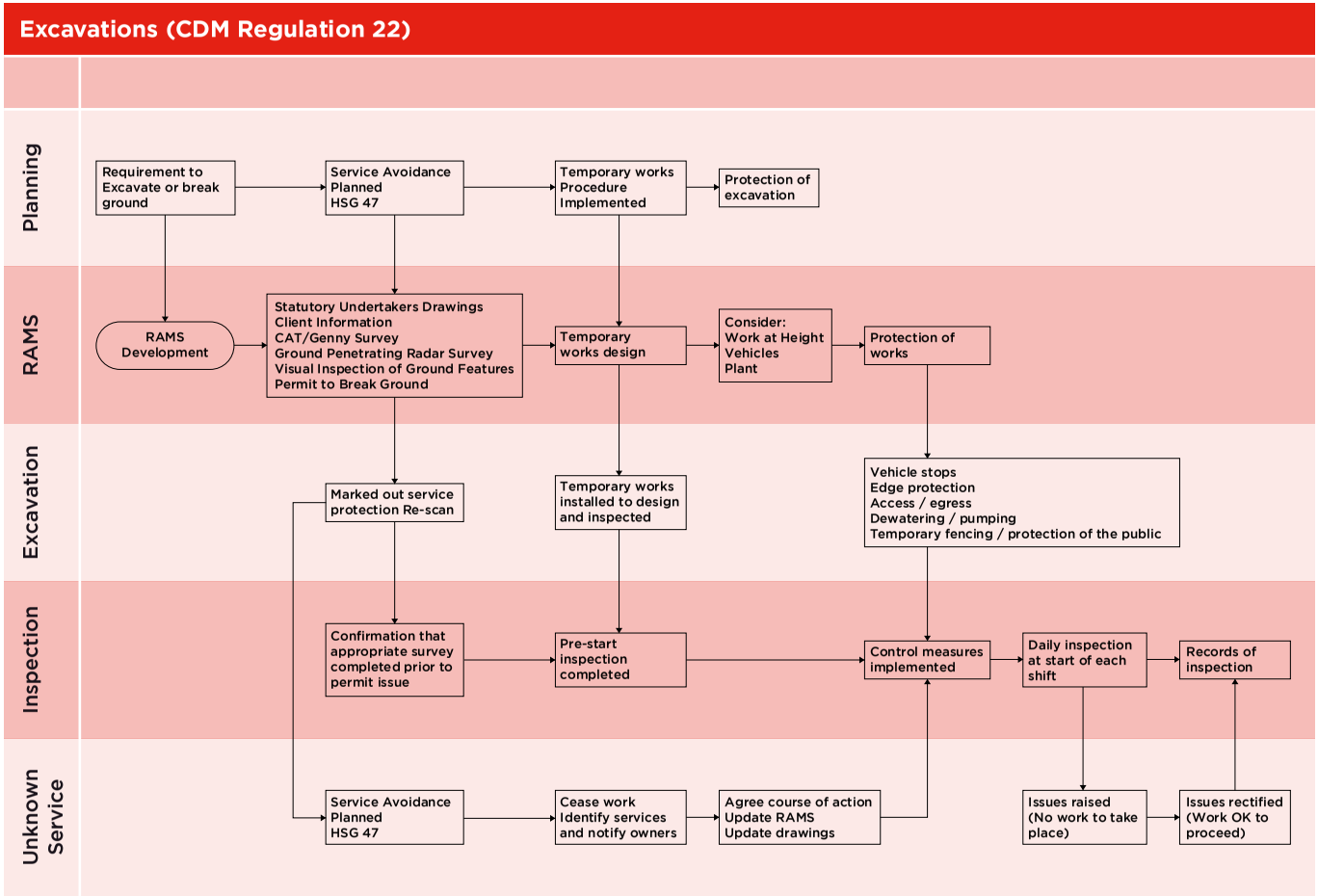


Figure 7: Excavation process flow chart, reproduced from CDM Regulation 22.

8. Bedding & Pipelaying

Reference must be made to the Designer's drawings. All design assessments carried out by Aquaspira must be confirmed prior to pipe installation by the Designer. Below is a general guidance.

Aquaspira CSR pipe is classified as "flexible" as defined in BS 9295:2020 and relies on deformation from imposed loads to mobilise the support of embedment material on both sides of the pipe. Therefore, correct pipe bedding and surround are fundamental to ensuring the pipe's inherent integrity (Figure 8).

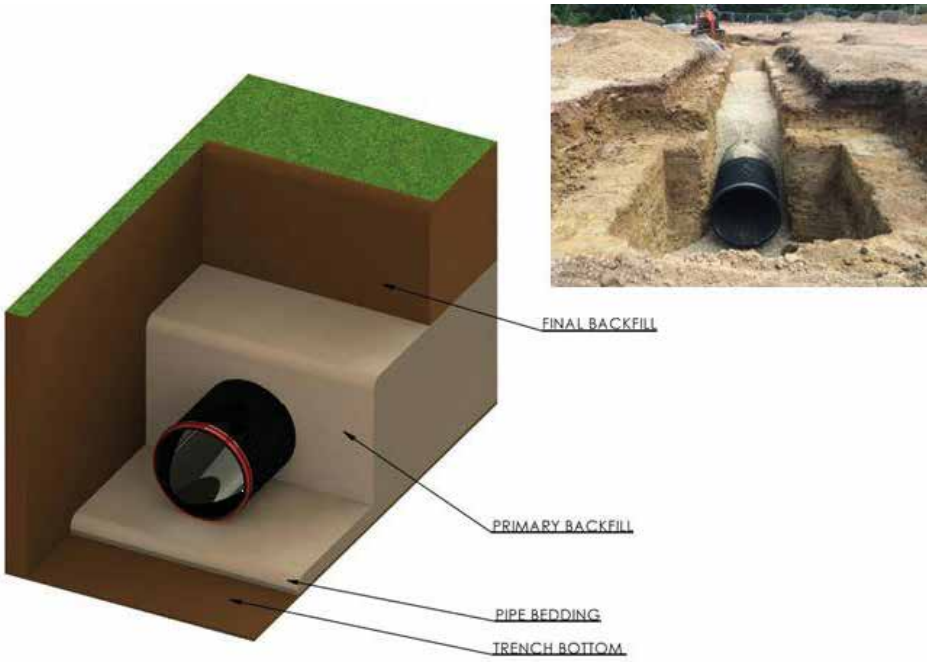


Figure 8: Pipe trench labels.

The trench should be free of ground water. Bedding material should be single sized granular material ranging from 10 – 20mm. The bedding soil (trench bottom) must be free from stones across the breadth of the pipe trench. On the trench bottom, a minimum 150mm thick bedding layer should be prepared and well compacted. Minimum trench widths will be determined by the Designer in line with BS EN 9295:2020. Refer to Figure 9. Unsuitable ground below formation must be removed and replaced as detailed by the Designer. Refer to the Designer limits on minimum bearing capacity below the pipe and if required carry out on site testing.

A geotextile may need to be placed under the bedding (Refer to the Designer specification). Geotextiles are used in the following situations:

- When laying through unstable ground including wet clay and sandy soil with poor bearing strength
- When soil settlement can be expected when a pipe passes through a soil transition.
- In difficult groundwater conditions and soft soils to prevent fine particle migration, reduction of uneven soil settlement, ground-beam support in trenches and the prevention of flotation.

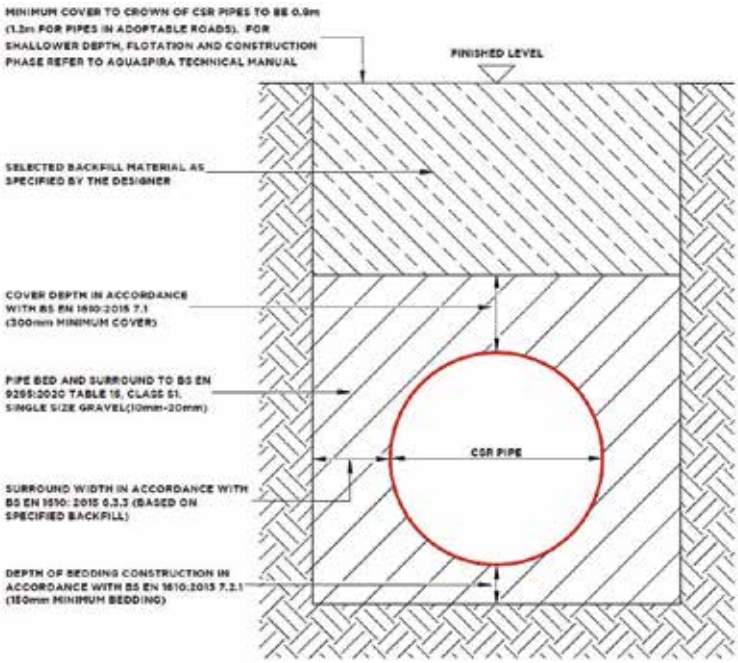


Figure 9: CSR pipe bed and surround detail.

Pipes are supplied in standard lengths of 2.6m or 3m so that they "fit" within proprietary shoring equipment. Other lengths can be supplied to special order.

Handling/slinging of the pipes should use a suitably rated flat webbed sling with an eye at each end. The pipe should be choked to prevent the sling slipping, and positioned to balance the pipe before lifting. The pipe should be inspected to ensure there is no damage prior to installation. Lifting chains should not be used as these may damage the HDPE exposing the steel in the ribs. Refer to Figure 10.

Figure 10: Handling CSR pipe during installation.

9. Jointing

9.1 Push Fit Socket/Spigot Joint (900 - 2250mmø)

a. The receiving pipe should be anchored with 75% of backfill in place.

b. The socket and spigot ends of the pipe should be clean and free from any bed and surround material.

c. The rubber ring seal around the spigot is factory fitted but should be checked immediately prior to installation to ensure that it has not been damaged.

d. Slacken the stainless-steel creep band, such that it is relatively loose making sure that the tightening bolts are at, or towards the top of the pipe.

e. Apply lubricant around the inner bore of the socket end of the adjoining (receiving) pipe.

f. Lay the pipe up to the adjoining (receiving) pipe and locate the spigot inside the socket.

g. Using the Aquaspira Jointing Frame, refer to Figure 11 image A, position the frame inside the socket of the pipe to be jointed, and with the arm of the machine, apply sufficient pressure to push the pipe home. Refer to Figure 11 image B. The pipe is fully inserted when the bright red section on the spigot is fully inside the socket and is no longer visible (when viewed perpendicular to the socket). Refer to Figure 12. Note: internally there will be a gap up to 20mm – this does not affect the water-tightness of the joint. Any attempt to close this gap is detrimental to the joint.

h. Check alignment of the pipe

i. Tighten up the creep bands until they are hand tight, approximately 8Nm torque, but no more than 12Nm. This will require either an 8mm hex bit or a M10 with 8mm socket head cap. Please check with Aquaspira prior to delivery. If an impact wrench is used ensure the correct torque setting to avoid overtightening. Refer to Figure 14.

Figure 11: Image A - Aquaspira jointing frame. Image B - CSR pipe jointing utilising excavator arm.

Figure 12 CSR correctly jointed socket/spigot.

Figure 13: Tightening creep band using a cordless drill and either 8mm 100mm long hex attachment (left) or an M10 with 8mm socket head cap for worm drive (right).

9.2 External Mechanical Couplings

There are two different manufacturers producing large diameter external mechanical couplers for Aquaspira CSR and stainless-steel pipes: Refer to Figure 14.

- **Mission Rubber:** https://www.missionrubber.co.uk/en/civils/couplings-adaptors
- **Teekay:** www.teekaycouplings.com

Figure 14 Teekay (left) and Mission Coupling (right)

The mechanical joint works by creating a seal around the external face of the Aquaspira CSR pipe. To do this the Aquaspira CSR pipe needs to be manufactured with a red spigot so that the rubber gasket on the mechanical joint has a flat surface to seal to. Full details and installation instructions are provided by the individual manufacturers. Refer to Figure 15

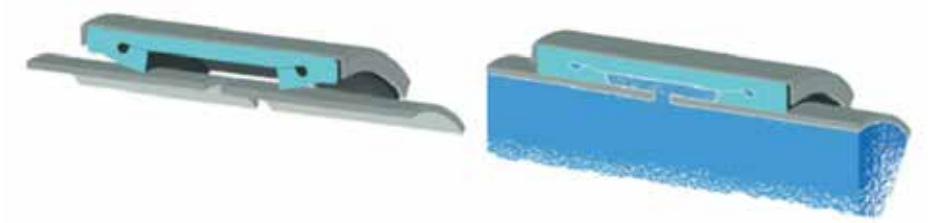


Figure 15: Mechanical joint seal.

9.3 Internal Mechanical Couplings

Internal mechanical couplers are fitted to the internal wall of the pipes to create a watertight seal. These are only suitable for pipes that allow man entry. They can be used where the external water pressure is less than 1 bar. Aquaspira suggest that these are used where Aquaspira CSR pipe meets a non-HDPE material and where extrusion welding cannot be implemented. Refer to Figure 16.

Specialists offering this service include:

- **K-Prema:** https://www.s1e.co.uk/k-prema-internal-seal
- **PMP Utilities:** https://www.pmp-utilities.co.uk/capabilities/pipeline-solutions

Figure 16: Internal repair mechanical coupling.

9.4 Extrusion Welding

Extrusion welds provide strong joints that are completely watertight. Extrusion joints can be made manually with portable welding equipment that has been specially developed for this process. Welding can take place internally or externally depending on situation or pipe diameter. Refer to Figure 17. Aquaspira offer an on-site service for extrusion welding used primarily following damage to an existing pipe (Refer to Section 21).

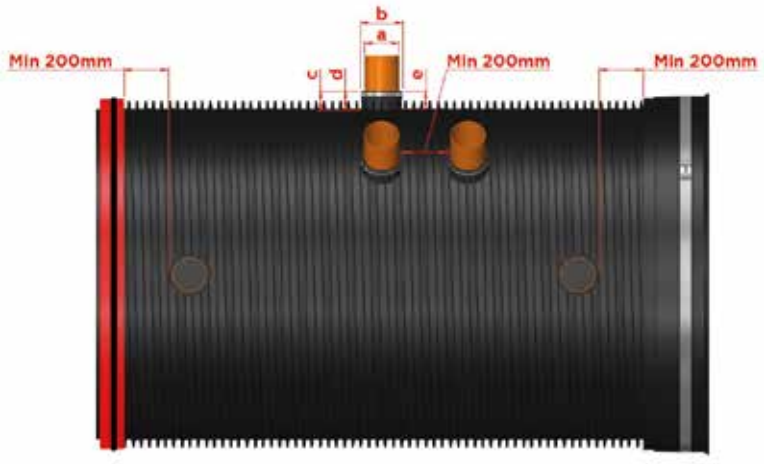
Figure 17: Extrusion Welding.

10. Lateral Connections

Lateral connections can be created quickly and easily into Aquaspira pipes with our LTC's. The LTC is placed inside a pre-drilled hole and the lateral pipe is then inserted and clamped into position, providing a neat, sealed connection in a matter of minutes.

The LTC's are manufactured from 9mm thick, high quality EPDM rubber in accordance with BS EN 681: Part 1-1996 'Specifications for elastomeric joint rings for pipework and pipelines – drainage' and are fitted with a stainless-steel clamping band.

Complete product, dimensional and installation details are set out in Figure 18.



Product Description	LTC 110 Lateral Connector for 110mm pipe	LTC 160 Lateral Connector for 160mm pipe
Product Code	A0000542	A0000540
OD of incoming lateral pipe (a)	110mm	160mm
OD of LTC sleeve and Ø of hole required (b)	127mm	177mm
Overall height of LTC sleeve (c)	90mm	90mm
Insertion depth of incoming pipe (d)	80mm	80mm
Height of LTC sleeve from outer pipe wall (e)	74mm	74mm

Figure 18: Lateral gully connector fitting restrictions.

10.1 Installation Process

a. Hole saw blades and LTC's to the correct specification should be obtained from Aquaspira (saw blades for LTC 110 – A0000562, for LTC 160 – A0000560).

b. Drill hole 90° to the pipe axis using a clutched drill. Where possible it is better to drill holes from the inside the pipe. Where this is not possible holes can also be drilled from the outside, but care must be taken to prevent the drill "snagging". Figure 19.

Figure 19: Drilling CSR pipe internally for gully connections.

c. Ensure hole is clean and exposed steel ribs are sealed (Refer to Section 20)

d. Fit the LTC into the hole such that the steel band remains above the level of the ribs, whilst ensuring that the bottom of the LTC protrudes into the pipe by 2-3mm (in line with small non-return flange (see Figure 20)).

Figure 20: Installation of the LTC.

e. Mark the pipe/bend to be connected, with a line 80mm from the end of the pipe/bend to indicate correct depth insertion.

f. Lubricate the inside of the LTC and the pipe/bend.

g. Insert the pipe/bend into the LTC until the depth insertion marker is level with the top of the LTC.

h. Tighten the clamp on the steel band to approx. 6Nm. For further information please see manufacturers information. A picture of a completed gully connection can be seen in Figure 21.

Figure 21: Picture of a completed gully connection.

11. Backfill

Correct pipe bedding and surround are fundamental in ensuring the inherent integrity of the pipe. The primary backfill material used should cover the whole width of the trench. Care should be taken to backfill the pipe in equal layers on either side working the granular material into the ribs with localized vibration. When working within trench boxes these should be raised as the pipe bedding surround is placed ensuring that it is worked / vibrated into the trench sides filling any voids in accordance with section A1 of BS 9295:2020.

NOTE : Correct pipe bedding and surround are fundamental in ensuring the inherent integrity of the pipe.

No compaction, using mechanical equipment, is to be undertaken until the backfill has reached 300mm. Layers above 300mm can then be compacted by the equipment indicated in Figure 22. It is suggested that this level is marked on the trench sides with spray paint to ensure sufficient cover prior to the use of any compaction equipment.

The final backfill is carried out with regard to the native soil, and external loads (e.g., traffic). Details of the backfill specification should be determined by the Designer considering both the temporary and permanent loads that the pipe may be exposed to.

Backfill material should not be placed above the crown of the pipe until the trench support and backfill material has been raised to the crown of the pipe. The backfill material should be placed and compacted in layers to meet the specification.

NOTE: Saturated as dug material should not be used during the final backfill process as it cannot be compacted.

Figure 22 assumes that all the layers have been correctly compacted in ascending order before the indicated equipment is used. The diagram is intended to provide an indication given the variability of wheel loads of site equipment.

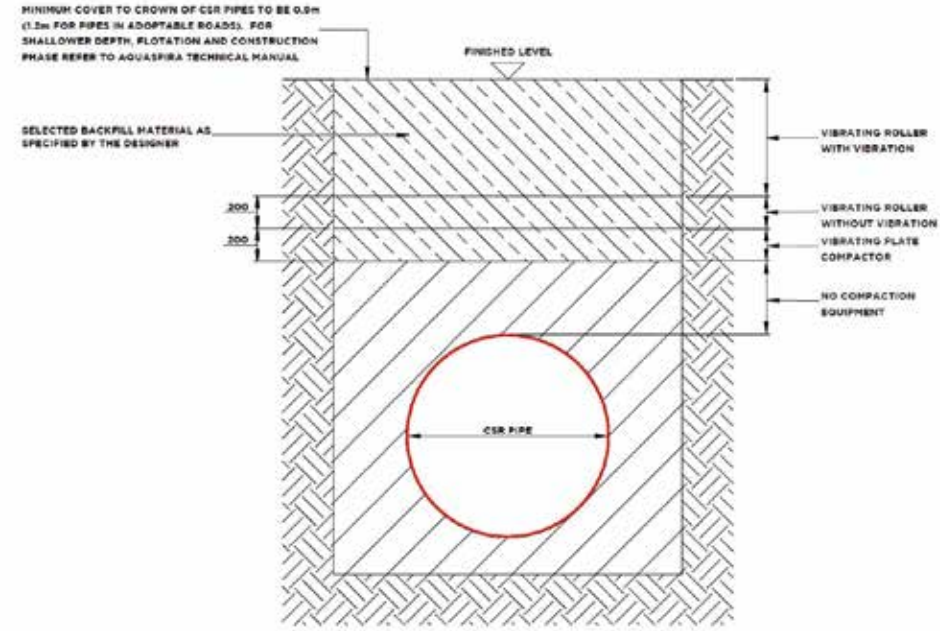


Figure 22: An illustration of the compaction equipment which can indiactively be used when different cover levels are achieved over the crown of the pipe.

12. Preventing Flotation & Post Installation Damage/Minimum Cover

12.1 Preventing Flotation

Pipes of any size or material that are empty can float if the trench becomes flooded before backfilling has commenced.

In accordance with BS 9295:2020, Aquaspira pipes require the following minimum depth of compacted fill over the crown of the pipe to ensure that flotation cannot occur. Figures are based upon groundwater at surface level see Table 2:

Table 2 provides the minimum cover required over each pipe diameter when the water table is at ground level.

Pipe diameter (mm)	Depth (m)
900	0.63
1050	0.74
1200	0.85
1350	0.96
1500	1.08
1650	1.18
1800	1.29
1950	1.4
2100	1.5
2250	1.62

If required, the Aquaspira Technical Support Team can produce a project specific flotation calculation/assessment.

12.2 Preventing Post Installation Damage/Minimum Cover

All types of pipes can be damaged by being trafficked with heavy construction equipment without sufficient cover and protection. Rigid pipes, such as reinforced concrete can be cracked, while semi-rigid or flexible pipes, such as Aquaspira CSR pipes, can become deformed. It is therefore very important that heavy loads are kept away from the pipes unless sufficient compacted fill has been placed over them.

Ensure any stockpiled spoil is not in close proximity to installed pipes or multi-leg installations to prevent shear forces being transferred into the trench causing the pipes to deform. For pipes in greenfield or landscaped areas we recommend that suitable markers are placed above the pipe to indicate its presence.

On construction sites where heavy machinery is operating, such as highway construction sites, it may be necessary to temporarily ramp fill above the pipe or use timber bog mats to span the trench at designated crossing points.

On installations in trafficked areas where the finished cover level is less than 900mm above the crown of the pipe (1200mm for adoptable estate roads and highways), it may be necessary to construct a reinforced concrete slab over the pipe. To ensure that any movement or deflection of the slab does not load the pipeline, a layer of compressible material, such as polystyrene, should be placed immediately below the slab. Refer to Figure 23.

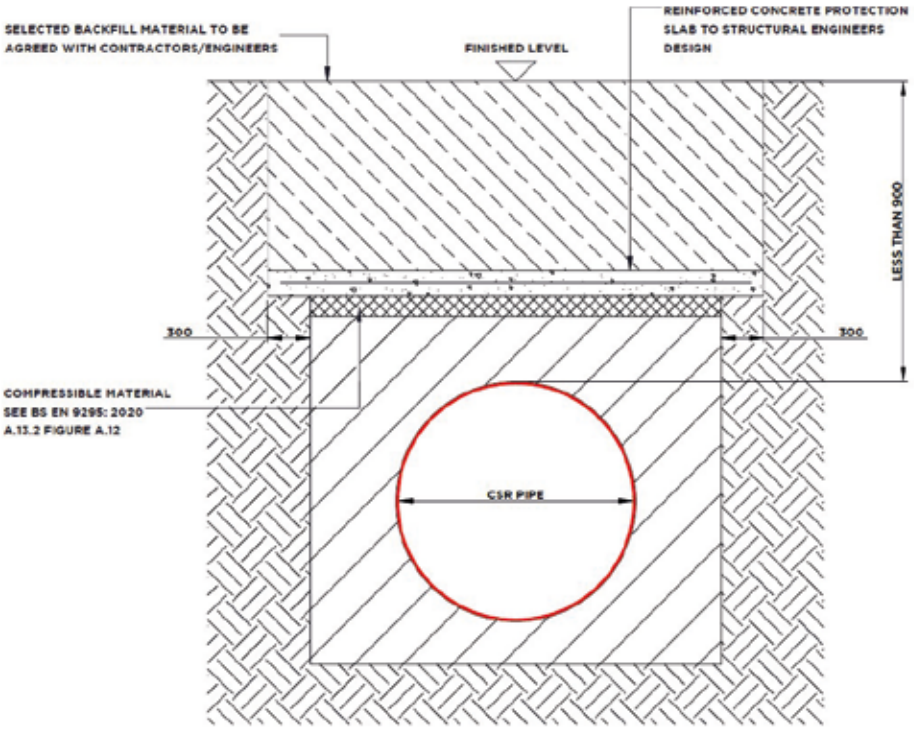


Figure 23: Illustration of installation requirements for trafficked areas where the finished cover level is less than 900mm (1200mm for adoptable estate roads and highways) above the crown of the CSR pipe.

13. Handling, Laying and Jointing Fabricated Units

The general rules and good practice associated with laying the CSR pipes equally apply to all fabrications, manifolds and bends. Additional considerations should include:

- Manifolds – use of a spreader beam to ensure an even lift. Use guide ropes to manoeuvre the manifold during the lift (Figure 24)

Figure 24: Installation of a manifold utilising a lifting beam.

- Jointing of bends/inspection points. Where possible a “straight” push should be considered taking care not to damage the CSR pipe (see Figure 25).

Figure 25: Jointing a fabricated stainless-steel bend.

14. Connection to Structures

When connecting pipes to a rigid structure such as an access chamber, the pipe should be cast in-situ into the concrete wall. The steel reinforced ribs of the pipe act as flanges to provide restraint and prevent longitudinal movement. This can be achieved either by casting a pipe through one / both faces of the structure as shown in Figure 26 or by the use of fabricated wall couplings as shown in Figure 27.

The following points should be noted:

- Cut end of the pipe is sealed (Aquaspira can manufacture to required lengths)
- Pipe is restrained internally to prevent any deflection during concrete placement.
- Use fine sized aggregate (15 – 20mm)
- Vibrate the concrete to ensure that all voids are filled, and a watertight joint is achieved.

Note: Care must be taken during concreting to prevent the pipe deforming. For pipes passing through the wall care must be taken to prevent stresses in the pipe when backfilling.

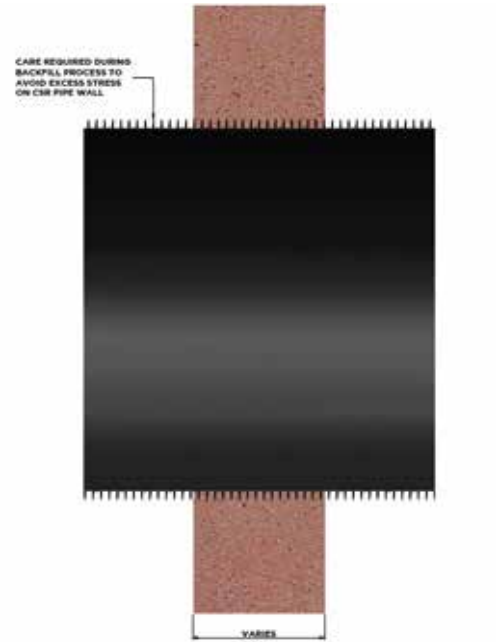


Figure 26: A CSR pipe formed into a concrete wall structure.

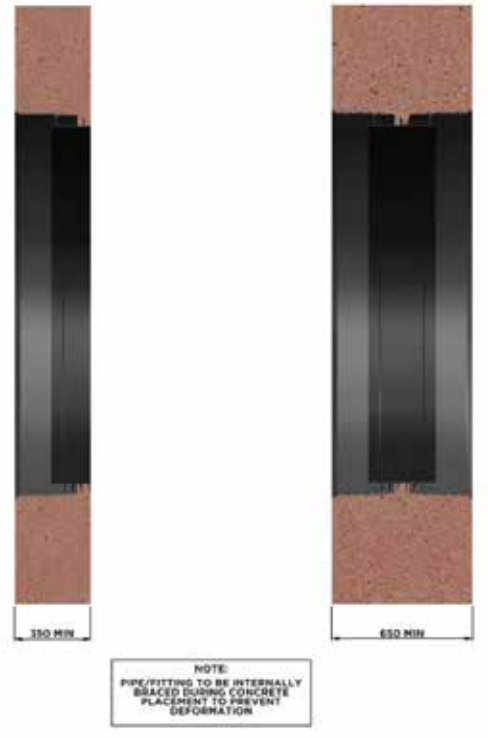


Figure 27: Single socket wall fitting (left), double socket wall fitting (right).

15. Manhole Installation (using Precast Contrete Rings)

Traditional manhole construction utilises precast concrete rings with short socket / spigot pipes cast into the manhole base (see Figure 28). This guide assumes that the user is familiar with this type of construction so the following points should be noted to avoid any issues arising:

- Care must be taken to ensure that the pipe does not undergo any deformation whilst concrete is placed (refer to Section 14) or this could potentially lead to problems with the socket / spigot joint when laying away.
- Manhole construction should be in accordance with the Sewerage Sector Guidance / Sewers for Scotland.
- BS 9295:2020 – Section A.10.3 states: *"Pipe materials with a high degree of longitudinal continuity and flexibility, such as welded polyethylene and welded steel, do not typically require rocker pipes at structures but other engineering solutions might be required where settlements are large"*. Rocker and Short Pipes are therefore not ordinarily required.
- Whilst there is no individual need for cut / rocker pipes it can often be more practical to build away from manholes with shorter pipes. The detail below shows how this can be simply achieved using 1.3m (Pipes > 1350mmØ) / 1.5m (Pipes ≤ 1350mmØ) long Spigot/ Plain End and Socket/Plain End pipes. These pipes are available to order or can be formed on site by simply cutting a standard pipe in half. For further information please refer Section 20 - 'Cutting Pipes' of this guide.

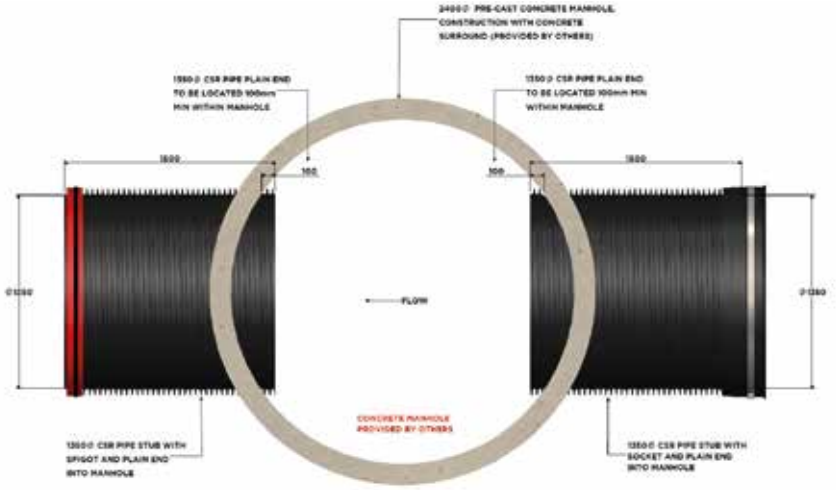


Figure 28: Shows a 2400mm diameter pre-cast concrete manhole with two 1350mm 1.5m long pipes cast into it. The pipe on the left being a Spigot/Plain End and the pipe on the right a Socket/Plain End pipe.

16. Installation of Prefabricated Manholes, Inspection Chambers and Turrets

Manholes are designed to allow personnel access whilst 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.

Aquaspira can provide prefabricated manholes and inspection chambers ensuring the highest standards of quality control, avoiding issues with benching / potential leaks in areas of high water table, these are lightweight so can be placed with the same construction plant as the pipes. There is no requirement for concrete surround for water tightness. However, a concrete surround may be required for highway loading and should be specified by the designer. CSR manholes are constructed from the same material as CSR pipe or stainless-steel sheet material. The manhole turrets are normally extended up to 550mm below ground level. Where the turret height needs to be adjusted, they can be cut on site referring to Section 20 of this guidance.

As seen within Figure 29 below an in-situ concrete collar should be cast to support the reinforced concrete cover slab. This collar must be independent of the CSR turret so that loads are transferred through the backfill and not through the CSR pipe. In order to achieve this the following steps must be carried out:

- CSR turret trimmed to 50mm below the underside of the precast concrete cover slab.
- All exposed steel should be sealed (see Section 20).
- CSR turret should be wrapped in 4mm corrugated plastic sheet (or similar). This should extend 50mm below the base of the concrete collar and 50mm above the turret to ensure there is a 50mm movement gap.

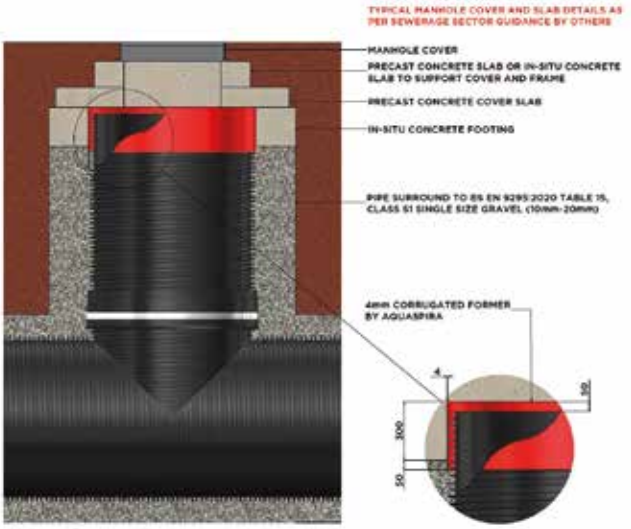


Figure 29: Close up illustration of the corrugated plastic beam former separating the concrete from the ribs of the CSR pipe.

Where concrete surround is specified by the designer for specific loading criteria, this will include the entire turret and at least to the spring line of the carrier pipe to which it connects.

In situations where the manhole and turret are surrounded in concrete there is no necessity for the 50mm movement gap as shown on Figure 30 below.

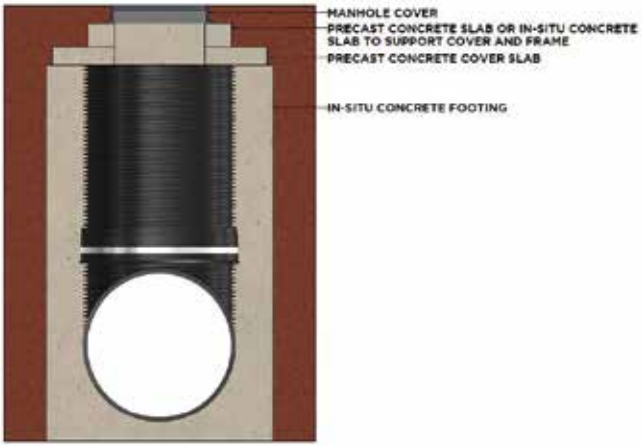


Figure 30: Illustration of access turret completely encased in concrete.

17. Multi-leg Installations/Tank Storage

When parallel pipes are installed in a single trench care must be taken when bedding and backfilling the pipes to ensure an even load. The manifolds should be installed first and then the parallel piping (see Figure 31). Working away from the manifolds avoids problems with alignment and stress at the intersections. As the pipes are jointed, they should be secured in place as the pipe laying progresses away from the manifold. The backfill operation should always commence starting at the manifolds and then progress along the piping trench evenly backfilling across all the parallel pipes at the same time (Figure 32).

The installation, bed and surround, and backfill process is identical to the laying of single CSR pipes as detailed in earlier sections of this guidance, noting that particular care must be taken during the backfilling process to ensure there is sufficient cover above the crown of the pipe to support any construction plant (see Figure 33). A long reach excavator is recommended to place backfill onto the multi-leg installations. If this is not possible bog mats or ramps should be used as a minimum if backfill is being transported on to the installation by dumper to prevent weight transfer to the pipes in the installation being deformed. Figure 34 provides an information regarding the cover over the pipes different compaction equipment requires over the crown of the pipe.

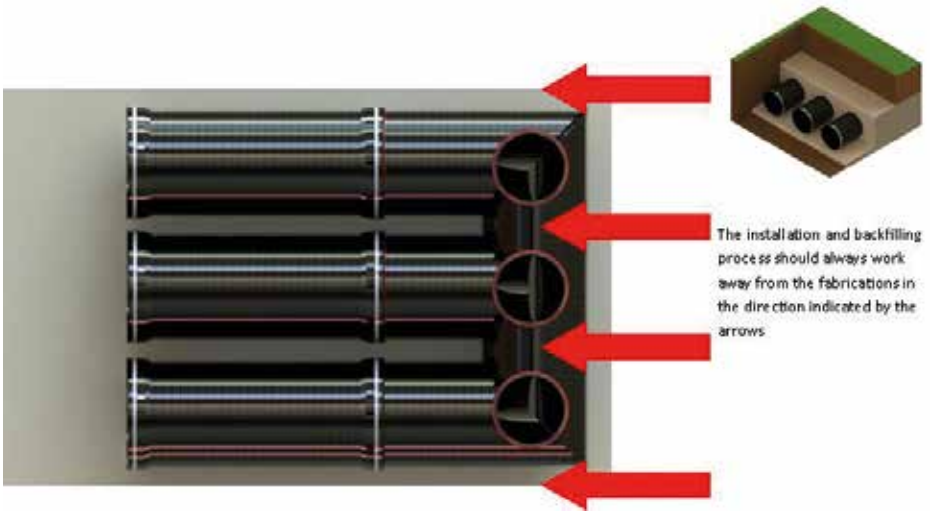


Figure 31: Shows the backfill direction after the manifold has been installed.

Figure 32: Picture of a multi-leg tank being backfilled evenly starting from the manifold.

NOTE: In some instances parallel pipes of different diameters may need to be laid near to existing flexible pipes. Where this occurs the contractor must seek guidance from the designers of the flexible pipes to make sure a safe excavation can be executed that prevents movement in any existing flexible pipes.

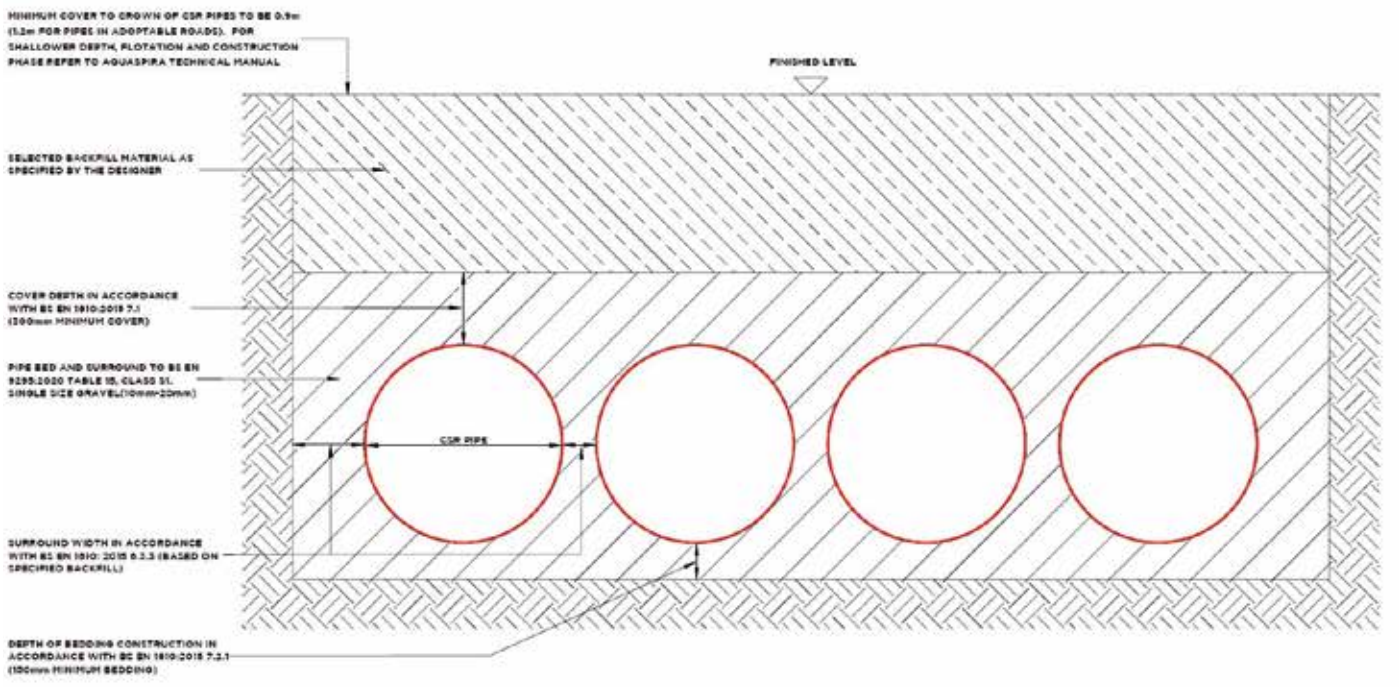


Figure 33: Typical bedding and backfill information for multi-leg installation with specific standards for important aspects of installation.

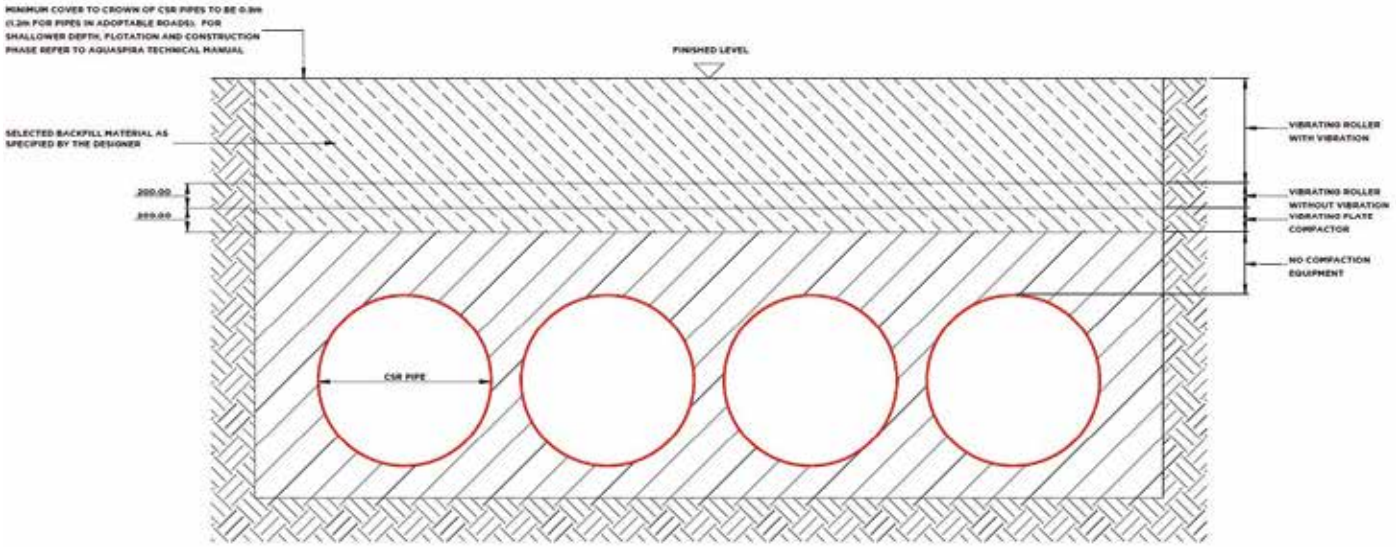


Figure 34: Illustration of the compaction equipment that can be used when different covers are achieved over the crown of the pipe and manifold.

18. Testing & Commissioning

It is essential that pipes are checked thoroughly for leaks. It is obvious that sewerage, for example, is not permitted to contaminate the adjacent soil. What is not so apparent is that in the vicinity of trees, openings, however small, can be penetrated by the roots which in time could further damage the pipe and increase the severity of the leak.

When a CSR pipeline is sealed for a tightness test, there is always a reduction in pressure known as pressure decay, even in a leak free system, due to the visco-elastic (creep) response of the material. This pressure decay is non-linear in an unconstrained pipe. CSR pipelines may require testing in sections.

Reference should be made to SSG D&C Guidance E7.2 to E7.8, or Sewers for Scotland 4.7.2 to 4.7.8:

- E7.2 / 4.7.2 Precautions Prior to Testing Rising Mains
- E7.3 / 4.7.3 Testing of Gravity Sewers
- E7.4 / 4.7.4 Air Test for Gravity Sewers
- E7.5 / 4.7.5 Water Test for Gravity Sewers
- E7.6 / 4.7.6 Visual Inspection of Gravity Sewers
- E7.7 / 4.7.7 Infiltration
- E7.8 / 4.7.8 Watertightness of Manholes, Inspection Chambers and Wet Wells

19. Cleaning

CSR pipe has been independently tested by Water Research Council in accordance with WIS 4-35-01 and will withstand a jetting pressure of up to and including 180 bar (2600 psi).

Reference should be made to SSG D&C Guidance E7.1, or Sewers for Scotland 4.7.1: Cleansing of Gravity Sewers and Manholes:

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

20. Cutting Pipes

Pipes can be cut quite easily using a manual or powered saw/cutter (see Figure 35). Prior to cutting, the pipe should be clearly marked with a cutting line that is square to the pipe. Whenever a pipe is cut there will always be 3 or more sections of exposed steel ribs that have been cut. Aquaspira recommend that they should be sealed off with a small bead of CT1 sealant.

Figure 35: Cutting a CSR pipe using 125mm angle grinder.

21. Pipe & Joint Issues - Remedial Action

From time-to-time on-site damage can occur to pipes, e.g. catastrophic damage, waterway wall split or puncture, external pipe rib damage, or leaking joint. 19.1 provides an outline of the replacement process by the site team. In any other circumstances damage can be reported to Aquaspira site service team who will assist with a plan to address the situation promptly.

Repairs may be carried out above ground or after installation on site, noting that internal repairs can only occur in CSR pipes that are ≥900mm diameter. The correct confined space procedures will need to be implemented so that this work can be carried out.

21.1 Pipe Replacement Process

The damaged section of pipe will be replaced using 2no. spigot/spigot pipes specially fabricated by Aquaspira plus 2no. couplings.

1. Excavate and expose the full length of the damaged pipe, plus a minimum of 500mm of the adjacent pipes, taking care to ensure that the adjacent pipes are not damaged during this process.
2. Untighten and slacken off the stainless-steel bands on the socket of the pipe to be removed, and on the socket of the pipe to be retained.
3. Using a disk cutter, or similar cutting tool, cut out a section of the damaged pipe approximately 500mm in length. Remove this section from the trench.
4. Place a sling/chain around the remaining cut lengths of pipe, pulling the sling/chain tight so that it locates within the pipe ribs and carefully withdraw the cut sections of pipe from the adjacent pipes. Carry out a check on the buried joints on the pipes either side of the damaged pipe noting that there is a gap between the socket and spigot of up to 20m.
5. Clean the exposed Spigot and Socket of the pipes retained in the ground.
6. Lubricate the internal surface of the socket on the existing pipe in the trench.
7. Place a sling around the centre of the first new spigot/spigot pipe. Lower the pipe into the trench and joint into the end of the existing socket. Tighten up the steel band on the existing socket.
8. Place the two Flexible Couplings (Refer to Section 9.2) around the second new spigot/spigot pipe, ensuring that the full width of the couplings are over the ends of the pipe, such that the pipe can be lowered between the two spigots of the pipes in the ground.
9. Lower the pipe (with couplings around) and carefully position it between the spigots of the pipes in the ground.
10. Align the spigots on both sides of the central pipe and slide the flexible couplings so that they are an equal distance over the spigots on the adjoining pipes. Tighten the flexible couplings to the manufacturers recommended torque.
11. The replacement pipes can now be backfilled in accordance with Aquaspira's standard construction detail.

21.2 Joint Leak Repair

During the installation process pipe joints can fail if backfill material penetrates between the rubber gasket and inner face of the socket. If this happens there are two options to create a watertight joint:

Aquaspira site services team can carry out a repair by welding the joint using extrusion welding methods as discussed in Section 9.4 or; an internal mechanical joint can be fitted by a specialist contractor as detailed in Section 9.3.

22. H&S Considerations

Health and Safety considerations have been highlighted throughout the Site Handbook but for ease of use these have been listed below to provide an aide-memoir when compiling site risk assessments. It should be noted that this is not an exhaustive list, and it is the responsibility of the site team to carry out their own assessment of all potential risks.

Unloading, handling and storage:

- Sufficient / suitable area for unloading & storage.
- Other construction plant / movement of vehicles and personnel.
- General public.
- Overhead power lines and other services.
- Mechanical lifting equipment.
- Lifting straps and chains.
- Pipe retaining straps.
- Timber supports and wedges.
- Height of pipe stacks.
- Prevention vandalism / intruders.

Excavation and trench support

- Service avoidance / Statutory undertakers' information.
- Unknown services.
- Damage to trees.
- Collapse of excavations.
- Falling or dislodging material.
- Falling into excavations.
- Undermining nearby structures.
- Client information – suitability and sufficiency.
- CAT & Genny survey / Ground penetrating radar survey.
- Temporary works procedure.
- Temporary works design.
- Working at height.
- Vehicle and plant movements.
- Vehicle stops.
- Edge protection.
- Spoil removal / off-site.
- Access / egress.
- Dewatering / pumping & groundwater disposal.
- Temporary fencing.
- Protection of the public.
- Spoil / mud on road.

Pipelaying

- Mechanical lifting equipment.
- Lifting straps and chains.
- Pipe bedding storage, transport and placement.
- Pipe storage, transport and placement.
- Jointing frame – manual handling.
- Lubricant – COSHH / application.
- Falls from height (personnel standing on new pipe to unhook sling / tighten creep band / localised working of bedding around pipes).

- **Internal mechanical couplings / Extrusion welding**
- Confined spaces.

Lateral connections

- Mechanical coring equipment.
- Power source / generator / 110V.
- Suitable pipe cores.
- Restraint of coring equipment to prevent snagging (Clutched drill).
- Exposed steel / sharp edges.

Cutting Pipes

- Additional PPE.
- Exposed sharp edges.
- Exclusion area whilst cutting.

Backfill

- Working at height.
- Vehicle and plant movements.
- Vehicle stops.
- Edge protection.
- Backfill material storage, transport and placement.

Testing and Commissioning

- End restraint stop ends.
- Confined spaces.

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