WSA 02:2014: Gravity Sewerage Code of Australia (Version 3.2)

Amendment No 2

Revision

Version 3.2 of the 2014 edition of WSA 02 is amended as follows:

SUMMARY This amendment applies to the following elements: Clauses 1.2.7, 3.2, 3.3.4, 4.1.1, 4.4, 4.6, 4.7.1, 4.9, 4.13, 5.2.5, 5.2.9, 5.3.8, Table 5.3, Clauses 7.6, 9.3, 9.6.8, 13.3.4, 13.3.4, 13.3.6, 14.12, 16.1.7, Table 16.1, Clause 16.17, Tables 16.2 and Table 16.3, 17.2.2, 21.4, 21.4.4, 21.6, Appendix D, Appendix I and Appendix K.

Published on XX XXX 2024

Approved for publication on behalf of the Water Services Association of Australia on **X XXX** 2023.

Disclaimer

This Amendment No.2 is issued by the Water Services Association of Australia Ltd and individual contributors are not responsible for the results of any action taken on the basis of information in this report, nor any errors or omissions. While every effort has been made to ensure the accuracy of that information, the Water Services Association of Australia (WSAA) does not make any claim, express or implied, regarding it.

Copyright

For more information please contact info@wsaa.asn.au

PART 0: GLOSSARY, ABBREVIATIONS AND REFERENCES

I GLOSSARY OF TERMS

Revise and update the Reference documents as follows:

Term	Definition
design flow	The estimated maximum flow into a sewer comprising the sum of peak dry weather flow (PDWF), ground water infiltration (GWI) and peak rainfall dependent inflow and infiltration (RDI) from the gravity drainage portion plus the sum of the maximum capacities of all upstream pumped discharges ($\Sigma_{\text{Pumped Flows}}$). See also peak dry weather flow, groundwater, infiltration, inflow, stormwater

II ABBREVIATIONS

Add new abbreviation as follows

ABBREVIATION	INTERPRETATION

III REFERENCED DOCUMENTS

Replace the first paragraph In III with the following:

Revise and update the Reference documents as follows:

AS

AS/NZS

ASTM

PIPA

POP001	Electrofusion jointing of PE pipe and fittings for pressure applications	16.1.2.3, 16.1.7, 16.17.3

POP003	Butt fusion jointing of PE pipes and fittings – Recommended parameters	16.1.2.3, 16.1.7, 16.17.2
POP014	Assessment of Polyethylene Welds	16.17.4.1, 16.17.5.2.1, 16.17.5.3.1
POP202	PVC, PP and PE Pressure Pipe Installation on Curved Alignments	Table 5.3

ISO/IEC

13953	Polyethylene (PE) pipes and fittings Determination of the tensile strength and failure mode of test pieces from a butt-fused joint	16.17.4, 16.17.4.1
13954	Plastics pipes and fittings -- Peel decohesion test for polyethylene (PE) electrofusion assemblies of nominal outside diameter greater than or equal to 90 mm (note the size restriction)	16.17.3, 16.17.4
21307	Plastics pipes and fittings -- Butt fusion jointing procedures for polyethylene (PE) pipes and fittings used in the construction of gas and water distribution systems	16.17.2, 16.17.4.1
12176	Plastics pipes and fittings Equipment for fusion jointing polyethylene systems	
	Part 1: Butt fusion	16.17.2
	Part 2: Electrofusion	16.17.3

WSAA

WSA 402	Product and Material Information and Guidance – Gravity Sewerage	4.1, 4.1.1, 4.4

WSA TN 08	Product Conformity Assessment Requirements	4.1
WSA TN 12	Self cleansing flows and Sewer Pipe Sizing Calculator - Information Guidance Note	
WSA TN 11	Minimum Air Space - Explanatory Note	
WSA TN 14	Sewage Flows from Fixture Units - Information Guidance Note	

1.2.7.1 Designer needs and responsibilities

Insert new Note under 1st paragraph.

> Laws around registration of engineers are different in each state. In Australia, each state and territory is responsible for registration of engineers. Some jurisdictions don't require an engineer to be registered to practise and others have statutory regulations that require it.
>
> To ascertain the current state and territory registration requirements refer to Engineers Australia website https://www.engineersaustralia.org.au

3.2 DESIGN FLOW ESTIMATION

Replaced the second paragraph with the following:

Flow in the gravity drainage portion (in L/s) is composed of the three components, illustrated in the pipe cross section in Figure 3.1, where the overall design flow is represented by the equation:

3.3.4 Design flow estimation—Partially pumped systems

In the 3rd paragraph replace the formula with the following

Design flow = design flow$_{Gravity}$ + $\sum_{Pumped\ Flows}$

where:

design flow$_{Gravity}$ = design flow for the gravity drainage portion

$\sum_{Pumped\ Flows}$ = sum of the maximum capacities of all upstream pumped discharges

4.1 GENERAL

Replaced the last two paragraphs with the following:

Product Specifications are listed on the WSAA website and have been published in an eBook format. Individual links to Product Specifications are provided within this Code to enhance user experience.

> *Note: For links to Product Specifications within this Code to work correctly, Users will need to have checked out the Product Specifications eBook from the WSAA Shop.*

Each Product Specification nominates default quality assurance requirements for the product. Refer to WSA TN 08 Product Conformity Assessment Requirements and WSA 402 Part 2

> *Note: This Technical Note (WSA TN-08) sets out product conformity assessment requirements to supplement the conformity testing and assessment requirements of the product Standard(s) called up in a duly nominated (e.g. WSAA) Product Specification. WSA TN 08 is available from the WSAA Shop.*

Additional specifications may at times be added and existing specifications may at times be changed. Water Agencies may have additional, fewer or modified specifications listed on their websites that take precedence.

Where product specifications are not available, arrangements should be made to develop and publish such documents to address essential product attributes.

When in doubt, specialist advice should be obtained, including from the pipe manufacturer.

4.1.1 Selection Guide for Pipeline Systems

Insert a new heading 4.1.1. after the last paragraph 4.1.1 Selection Guide for Pipeline Systems

The WSAA Product and Material Information and Guidance materials (WSA -402) Part 1 contains information on the principal pipeline system attributes and some details of ancillary products used in the construction of sewerage infrastructure and referenced in Gravity Sewerage Code of Australia WSA 02. It outlines aspects such as product specifications, product descriptions and classifications, joint types, water industry experience and recommendations on use.

WSA 402 Part 2 provides information on the applicability and limitations of the various quality assurance options.

It does not provide instructions on life expectancy for pipeline systems as this is dependent upon design, manufacture, transport, handling, installation, operation, protection from third party damage and other external factors.

WSAA Product and Material Information and Guidance materials (WSA 402) has been published in an eBook format. A PDF copy of the WSA 402 can be downloaded directly from this eBook. Individual links to WSA 402 are provided within this Code to enhance user experience.

Please note that in order for the link to Product and Material Information and Guidance materials (WSA 402) to function properly within this Code, Users must have purchased and checked out the WSA 402 eBook from the WSAA Shop.

4.4 PROTECTION AGAINST DEGRADATION

Insert new reference to WSA 402 and insert an external link to this document.

Replace 2nd paragraph with

Protection strategies may include, but are not limited to:

4.6.1 Product Specifications

Insert New WSA PS 243 and WSA PS – 236

WSA PS – 243 POLYVINYLCHLORIDE, UNPLASTICISED (PVC-U) FITTINGS (BS EN 1401-1) FOR NON-PRESSURE APPLICATIONS – SEWERAGE

WSA PS – 236 VARIABLE BEND, POST-FORMED PVC-U FITTINGS FOR NON-PRESSURE APPLICATIONS - SEWERAGE

4.6.2 Sizes and Configurations

Add a new second paragraph to 4.6.2 Sizes and Configurations

EN 1401-1 dimensional requirements for PVC injection moulded fittings comply with the dimensional requirements of AS/NZS 1260.

4.7.2 Sizes and configurations

Replace the first paragraph with the following:

The nominal diameter, pipe pressure classification, material class~~,~~ length and form of pipes (straight lengths or coils), joint types~~,~~ construction type (plain wall or structured wall), materials and classes of fittings shall be detailed in Product Specifications, which should be referenced in the Design Drawings and/or Specification.

Delete Notes (1) and (2) below

1. PIPA Industry Guideline POP001 Electrofusion Jointing of PE Pipe and Fittings for Pressure Applications may be used for guidance for non-pressure applications.
2. PIPA Industry Guideline POP003 Butt Fusion Jointing of PE Pipes and Fittings – Recommended Parameters may be used for guidance for non-pressure applications.

4.9 GRP Gravity Sewers

4.9.1 Product Specifications

Insert new Product Specification

WSA PS – 219 GLASS REINFORCED PLASTICS (GRP) PIPES AND FITTINGS FOR PRESSURE AND NON-PRESSURE APPLICATIONS - DRINKING WATER, NON-DRINKING WATER SUPPLY AND SEWERAGE

4.13 MAINTENANCE STRUCTURES

4.13.1. Product Specifications

Insert New WSA PS – 345

WSA PS – 345 POLYMERIC MAKE-UP RINGS FOR SEWERAGE ACCESS CHAMBERS

4.13.2. Classification and application

Replace the 6th paragraph, first two sentences with the following:

The maintenance structure base should incorporate a moulded inlet or moulded fitting of compatible material to the sewer material to provide fit-for-purpose watertight joints between pipes and maintenance structures e.g. In a fully welded PE sewer system, all components—including pipes, fittings, and maintenance structures—should be manufactured from compatible PE materials and resins to ensure welding compatibility and, if concrete maintenance structures are used, incorporate a suitable PE fitting (as described above) cast into the concrete maintenance structure so as to prevent groundwater infiltration.

5.2.5 Trenchless techniques for pipe installation

Add an an additional reference to 9.6.8 Trenchless technology at the end of the 2nd paragraph.

Replace (a) passing through with (a) traversing:

5.2.9 Disused sewers

Replace 1st and 2nd paragraph with the following:

Where a design results in the disuse of an existing sewer, the Design Drawings and Specification shall detail proposed treatment.

The Water Agency shall be consulted for instructions regarding disused sewerage infrastructure.

> *Leaving any asbestos waste underground, including sectioned, broken or fragmented AC pipe as a result of AC pipe replacement, removal or rehabilitation may be a contravention of environmental protection law and occupational health and safety laws.*

All works on disused sewerage infrastructure in road reserves shall comply with the road authority's requirements.

All works on disused sewerage infrastructure in railway reserves shall comply with the railway authority's requirements.

Removal of AC sewers shall be done in accordance with all relevant legislation and regulations.

In private land, disused sewers and sewer maintenance structures shall be completely removed.

In public open space, disused sewers and sewer maintenance structures shall be left in place and the sewer maintenance structures demolished to a depth of 600 mm below finished surface level.

In road reserve, disused sewers and sewer maintenance structures shall be completely removed. Where the road authority does not allow removal, or removal is impractical due to the

depth of the sewer or the presence of other services, the Water Agency may agree to the disused sewer being left in place and the sewer maintenance structures being demolished to a depth of 1200 mm below finished surface level.

In railway reserve, disused sewers and sewer maintenance structures shall be left in place and the sewer maintenance structures shall be demolished to a depth agreed with the railway authority, typically between 0 mm and 300 mm below finished surface level. Where the railway authority does not allow sewerage infrastructure to be left in place, the disused sewerage infrastructure shall be removed.

Where disused sewerage infrastructure is left in place unless otherwise directed by the Water Agency

(a) Sewers shall be flushed, drained and grout filled with 5 MPa cement grout and then plugged at maintenance structures and at all open ends

(b) The residual maintenance structures remaining after demolition shall be filled with 5 MPa cement grout

Following removal or demolition of sewerage infrastructure, excavations shall be backfilled and compacted in accordance with 20.1 TRENCH FILL and restoration shall be carried out in accordance with 24 RESTORATION.

The works undertaken on disused sewers and MHs shall be recorded as part of the Work As Constructed details.

5.3.8 Horizontal curves in sewers

Replace Table 5.3 and Notes with the following

Table 5.3 Methods of achieving curved sewers

Curve type	**Material and joint**	**Deflection at joint**	**Pipe size DN**	**Pipe length m**	**Minimum horizontal and vertical curve radius m**
Manual cold bending	PVC solvent cement jointed	No	100 – 225	Not dependent	0.3 X DN Refer to POP202 and Note 2
	PE welded joints	Yes –Butt fusion	110 – 355	Not dependent	Dependent on the SDR of the pipe (Refer to POP202) Note 2 and 6
		No – Electro-fusion	110 – 355		
Manufactured bends	Profiled wall PP	No	Up to 900	Not dependent	Note 3
	PVC variable bend	No	1505	Not dependent	3.0m (up to 45 degrees)

	PE sweep bend	No	110 – 250	Not dependent	Note 3, 6 and 7
	RC	No	≥900	Not dependent	Note 3

1. The minimum radius for solvent cement welded PVC pipes is based upon:
   (a) the deflection that may be achieved without overstressing the pipe or pipe joint; and
   (b) ensuring that the necessary restraint of the pipe and joints around the curve is readily achievable based on manually cold bending the pipe in the field.
2. Installations at much lower temperatures, for example at or below 0°C may require significant increases in the minimum bend radius of the order of 50% and hence under these circumstances the installer is advised to seek the recommendations of the pipe manufacturer
3. Refer to Water Agency for minimum acceptable radii for manufactured bends.
4. Refer to pipe manufacturer's allowable joint deflection to determine the minimum curve radii for elastomeric seal joint pipes.
5. Presently there are no manufacturers or suppliers of post-formed long radius bends for DWV PVC-U pipes ≤DN 150.
6. Refer to POP202 for minimum acceptable radii for manufactured bends and manual cold bends.
7. Short Radius bends for PE are available for DN110, DN160 and DN250, up to 45 degree. Larger sizes of PE or greater deflections require long radius bends.

9.3 STRUCTURAL CONSIDERATIONS

9.3.1 Pipes

Replace paragraph two with the following

The pipe design for a particular pipe material shall be in accordance with the relevant Australian/New Zealand, international or industry standard, such as:

After point (B) insert the following new clause

Other methods for assessing the predicted long-term defection of buried flexible pipes include the graphical design method developed by The European Plastic Pipes and Fittings Association (TEPPFA).

Water Agency approval is required for the use of the TEPPFA graphical design method.

9.6.8 Trenchless technology

Insert new Clause 9.6.8 Trenchless technology

9.6.8 Trenchless technology

Where trenchless technology is adopted for pipelaying or installation, the Designer shall prepare a construction specification in consultation with the installer, the pipe manufacturer and the asset Owner.

Before selecting the most appropriate trenchless technique and pipe design, the Designer shall undertake a comprehensive geotechnical study to identify soil formations at the potential bore sites.

The purpose of the investigation is not only to determine if trenchless installation is feasible, but to establish the most efficient method to accomplish it. With this information the best route can

be determined, equipment and procedures selected, and the pipe designed. The extent of the geotechnical investigation often depends on the pipe diameter, installation length and the nature of the crossing. Refer to ASTM F1962 and ASCE MREP 108 for additional information.

During the survey, the geotechnical consultant should identify a number of relevant items including the following:

(a) Soil identification to locate rock, rock inclusions, gravelly soils, loose deposits, discontinuities and hardpan.

(b) Soil strength and stability characteristics

(c) Groundwater.

Supplemental geotechnical data may be obtained from existing records, e.g. recent nearby bridge constructions, other pipeline/cable crossings in the area.

For some applications e.g. horizontal directional drilling, in addition to the hydraulic requirements, the pipe must be able to withstand:

(i) pullback loads which include tensile pull forces, external hydrostatic pressure and tensile bending stresses; and

(ii) external service loads (post-installation soil, groundwater and surcharge loads occurring over the life of the pipeline).

Often the load the pipe sees during installation such as the combined pulling force and external pressure will be the largest load experienced by the pipe during its life.

Since pipes installed using trenchless techniques may not develop the same soil support as pipe installed in a trench, the purveyor of the trenchless technology should be consulted for piping design information.

The Designer in specifying the pipe class (SDR), pipe diameter, bore diameter, minimum and maximum pipe annulus, need for annulus grouting etc. shall detail and make available all design references, assumptions and calculations.

All process details including location of access pits and exit points shall be documented and shall address:

(A) Achievement of clearances from services and obstructions.

(B) Depth at which the water main is to be laid to ensure minimum cover is maintained.

(C) Pipe support and ground compaction.

(D) Required alignment tolerances.

Refer to 5.2.6 NEAR-HORIZONTAL AND TUNNELS

The Australasian Society Trenchless Technology has developed the following Trenchless Guidelines, Standards and Specifications to assist industry users in Australia and New Zealand in utilising these technologies. For further information refer to:

ASTT Guidelines on

HDD, Pipe Bursting and Microtunnelling;

Microtunnelling Design Guidelines Sewer (MDG-S)

ASTT Standards for

Horizontal Directional Drilling;

Pipe Bursting;

Microtunnelling and Pipe Jacking

ASTT Sample Specification for

Horizontal Directional Drilling;

Pipe Bursting;

Microtunnelling and Pipe Jacking;

Design of Structural Pipe Lining

ASTM Standards

ASTM F1962.

13.3.4 On-site storage

Replace with the following:

Except for checking against the purchase order, keep pipe, fittings, solvent cement, seals and other components delivered within protective crating or packaging, until immediately prior to use.

Stack all pipes in a manner that minimises pipe ovalisation.

Keep the ends of plastics pipe and fittings or couplings on GRP pipe free of loading.

Where necessary, pipes shall be supported clear of the ground on sandbags, soil mounds, timber bolsters or similar, at sufficient support spacing to prevent excessive longitudinal bending of pipe lengths.

While in storage all coated pipes and fittings shall be supported on timber or rubber contacts. Avoid contact with sharp or hard surfaces that may damage the coating and/or lining.

Stacking of pipes during storage shall be in accordance with the manufacturer's recommendations.

Do not store plastic pipe and fittings near generators or other heat emitting equipment.

Do not store PVC, GRP and non-black PE and PP pipes, fittings and other components uncovered in direct sunlight for more than twelve (12) months. If storage periods are likely to exceed twelve (12) months, cover and store products in a manner that allows ventilation and prevents heat entrapment. Do not store products under dark coloured (e.g. black) plastics sheeting or in any situation where the temperature may exceed 60°C.

Use PVC, GRP and non-black PE pipe and fittings within two (2) years from the date of pipe manufacture as marked on the pipe.

Limit outside storage of black PE pipe with coloured stripes to a maximum of two (2) years from the date of pipe manufacture as marked on the pipe.

Store elastomeric ring seals, lip seals and gaskets away from sunlight and in an unstrained condition.

Electrofusion fittings shall be stored in their original unopened packaging.

Joint lubricants shall be stored in sealed containers until ready for use.

Store large diameter pipes and fabrications, including MHs, MCs and MSs, to preserve dimensional properties.

13.3.6 Coiled plastic pipe

Amend Clause 13.3.6 Heading to Storage, transport and handling of coiled plastics pipe

13.3.6 Storage, transport and handling of coiled plastics pipe

Insert new 1st paragraph.

Coils of pipe may be heavy and under tension. The amount of energy stored in the coil will depend on the size of pipe, the class of the pipe, and the size of the coil. The amount of energy can be substantial and cause significant injury, death or damage if released in an uncontrolled manner.

Insert new 3rd paragraph..

Although both ovality and curvature may reduce naturally with time, special equipment is available to facilitate handling and jointing. Coiled pipe is usually limited to a maximum of DN 125.

Insert new warning Note after last paragraph.

Additional information on storage, transport and handling of coiled PE pipes may be found in PIPA Guideline POP 005. In particular, attention is drawn to the dangers associated with stored energy in coiled pipes or those rolled on drums.

14.12 EXCAVATION AND PIPELAYING USING TRENCHLESS TECHNIQUES

1st Paragraph insert proposed before route

Add a new last paragraph

Refer to APPENDIX F TRENCHLESS TECHNOLOGIES

16.1 INSTALLATION OF PIPES

Change heading of clause 16.1 as follows:

16.1 INSTALLATION OF PIPES IN TRENCHES

16.1.1 General

Insert the a new 3rd and 4th paragraph as follows:

At the end of each day's laying, seal the end of the pipe to prevent ingress of trench material and/or water and other foreign matter.

(3) Undertake welding of pipes in accordance with 16.16 WELDING OF STEEL PIPELINES or 16.17 WELDING OF PE PIPELINES .

Clean and examine all pipeline system items before installation. Inspect each joint seal for fit and flaws before making the joint in accordance with the manufacturer's instructions

16.1.2 Cleaning, inspection and joint preparation

Move the 2nd paragraph in Clause 16.1.2 to the 1st paragraph in Clause 16.1.2

Inspect all items just prior to use in accordance with 13.2 DELIVERY INSPECTION OF PRODUCTS AND MATERIALS. Remove damaged items from the Works site and replace.

Move the 1st sentence of the 1st paragraph in Clause 16.1.2 to the 2nd paragraph in Clause 16.1.2

Clean and examine all pipeline system items before installation. Inspect each joint for fit and flaws before making the joint in accordance with the manufacturer's instructions.

Delete the 2nd and 3rd sentence in the 1st paragraph.

Do not use electrofusion fittings that have been removed from their packaging or have damaged packaging. Do not use damaged, dirty or incorrect seals. Ensure that the correct joint lubricant is used for rubber seals.

Delete 3rd and 4th paragraphs

Chamfer spigot, if required, and provide witness marks on the unmarked length of any cut pipes. Do not score pipes when providing the witness mark.

Treat cut pipe ends in accordance with pipe manufacturer's recommendations.

16.1.2.1 Socket and spigot with elastomeric seals joints

Insert New Clause 16.1.2.1 Socket and spigot with elastomeric seals joints

Insert the following text in new Clause 16.1.2.1

Inspect each joint seal for fit and flaws before making the joint in accordance with the manufacturer's instructions.

Do not use damaged, dirty or incorrect seals.

Treat cut pipe ends in accordance with pipe manufacturer's recommendations.

Chamfer spigot, if required, and provide witness marks on the unmarked length of any cut pipes. Do not score pipes when providing the witness mark.

Ensure that the correct joint lubricant is used for elastomeric seals.

The above steps apply to pipes formed with sockets or in the form of double socket couplings used to joint plain end pipes. For GRP pipes, a double-socket coupling is usually supplied mounted on one end of the pipe.

16.1.2.2 Solvent welded joint

Insert new clause 16.1.2.2 Solvent welded joint

Insert the following text in new Clause 16.1.2.2

Inspect each pipe and spigot or fittings for fit and flaws before making the joint in accordance with the manufacturer's instructions.

Treat cut pipe ends in accordance with pipe manufacturer's recommendations.

Chamfer, if required, and provide witness marks on the unmarked length of any cut pipes. Do not score pipes when providing the witness mark.

Select the correct solvent cement for the application and for tapered or parallel sockets, as specified by the pipe and pipe fitting manufacturer.

Ensure the correct priming fluid is used and ensure both the priming fluid and solvent cement are applied in accordance manufacturer's instructions.

PIPA Industry Guideline POP102 Solvent Cement Jointing of PVC Pipe may be used for guidance

16.1.2.3 Butt Fusion and Electrofusion Welding

Insert New Clause 16.1.2.3 Butt Fusion and Electrofusion Welding

For fusion jointing of polyethylene pipes and fittings prepare the jointing surfaces and the geometry of the assembly in accordance with Clauses 16.17 WELDING OF PE PIPELINES .

Iso-propanol impregnated pipe-wipe shall be used to clean fittings and pipe ends to be joined by welding. Refer to the fitting supplier for recommended iso-propanol impregnated pipe-wipe.

Do not use electrofusion fittings that have been removed from their packaging or have damaged packaging.

PIPA Industry Guideline POP001 Electrofusion Jointing of PE Pipe and Fittings for Pressure Applications may be used for guidance for non-pressure applications.

PIPA Industry Guideline POP003 Butt Fusion Jointing of PE Pipes and Fittings – Recommended Parameters may be used for guidance for non-pressure applications.

16.1.3 Coiled plastics pipes

Insert new warning Note after last paragraph

Additional information on storage, transport and handling of coiled PE pipes may be found in PIPA Guideline POP 005. In particular, attention is drawn to the dangers associated with stored energy in coiled pipes or those rolled on drums.

16.1.4 Laying

Rename heading to Clause 16.1.4 Positioning of the pipeline

16.1.4. Positioning of the pipeline

Replace the existing text with the following

Position pipes in the trench such that the embedment material can be placed and compacted, as required.

Excavate pockets for sockets, couplings, flanges or other projections so as to ensure the pipeline is fully supported along the full length of pipe barrels. Ensure such pockets are the minimum necessary to keep the projection clear of the bedding material, except where access for joint treatment requires additional excavation.

Adjust the pipe to the correct alignment by re-lifting the pipe without disturbing the integrity of the joint.

Firmly and evenly embed the barrels on the graded and compacted bedding material.

To prevent movement, restrain pipes already laid before the next joint is made.

Prevent flotation of pipes during laying in accordance with 16.4 FLOTATION CONTROL.

Lay all pipes with their identification markings facing upwards.

Lay the sewer on line and grade from maintenance structure to maintenance structure.

Lay pipes by starting from the downstream end with the coupling or socket end facing in the upstream direction.

16.1.5 Pipe laying and joining pipes and fittings with elastomeric seals

Insert a new Clause 16.1.5 Pipe laying and joining pipes and fittings with elastomeric seals

16.1.5.1. Laying and joining pipes and fittings with elastomeric seal incorporated into Socket

Insert a new Clause 16.1.5.1 Laying and joining pipes and fittings with elastomeric seal incorporated into Socket and insert the following text:

Complete cleaning, inspection and joint preparation in accordance with 16.1.2.1 SOCKET AND SPIGOT WITH ELASTOMERIC SEALS JOINTS

When joining pipes and fittings with elastomeric seal joints:

(a) Ensure that the inside of the socket is clean.

(b) Where elastomeric seals are required to be fitted, clean and fit the seal if not already fitted. Check that the elastomeric seal sits evenly in the socket.

(c) Apply the manufacturer's specified lubricant to the end of the spigot and chamfer of the pipe spigot.

(d) Align the pipes so that there is no deflection at the joints before inserting the spigot in the socket and pushing it home to the witness mark.

(e) Hold the socket end firmly during jointing to prevent previously assembled joints from moving.

(f) Do not insert a metal spigot (e.g. of a fitting) into the socket of a plastics pipe.

(g) Where pipes are required to be cut in the field:

  (i) Check the pipe spigot diameter to ensure it is within tolerance.

  (ii) Cut the spigot end square and remove all burrs.

  (iii) Chamfer the cut end of the pipe with a taper of approximately 15◦ to approximately half the wall thickness, or as otherwise specified by the pipe manufacturer.

  (iv) Witness mark the pipe at the distance specified by the manufacturer and make the joint as specified in (a) to (f).

  (v) If the same manufacturer does not make spigots and sockets, refer to the socket manufacturer for the correct witness marking depth.

(h) Push the spigot end of the pipe into the socket of the other pipe, not the other way.

(i) Small dia pipes can be pushed with a log bar. For larger diameter pipes, use of other equipment like a rack, lever puller or backhoe as necessary.

(j) Insert the spigot end into the socket till the socket is positioned at the witness mark.

(k) Jointing of push on fittings is recommended to be done using rack and lever equipment. Jointing of fittings with the pipe can also be done using a suitable tackle e.g. winch method.

(l) After the joint has been made, check the joint to determine if the seal has been correctly inserted.

(m) To inspect the joint insert a metal rule into the socket gap and measure insertion depth (provided by the manufacturer and indicated on the pipe) has been met and this depth uniform around the whole circumference. If a difference is found, dismantle and re-join.

NOTES:

1. If the joint is to be made using a cut pipe length the pipe spigot diameter must first be checked to ensure it is within tolerance.
2. For some pipeline systems it's important to select an adjustment pipe (suitably marked according to the applicable standard) for cutting as it will meet the required spigot tolerance for the jointing proposed, without any machining required

16.1.5.2 Laying and joining pipes and fittings with elastomeric seal mounted on spigot end of corrugated pipe.

Insert a new Clause 16.1.5.2 Elastomeric seal mounted onto spigot end of profile wall pipe and insert the following text:

Complete cleaning, inspection and joint preparation in accordance with 16.1.2.1 SOCKET AND SPIGOT WITH ELASTOMERIC SEALS JOINTS

When joining pipes and fittings where the elastomeric seal is mounted on the spigot end of a corrugated pipe:

(a) Ensure that the inside of the pipe socket and spigot grooves are clean.

(c) Where elastomeric seals are required to be fitted, clean and fit the seal by stretching it over the spigot so that it seats in the trough between corrugations as nominated by the manufacturer.

(d) Ensure the elastomeric seals sits evenly inside the trough around its full circumference.

(e) For pipes exhibiting out-of-roundness it is recommended to orientate the larger pipe diameter in the vertical plane to ease the jointing process and helps offset any deflection after backfilling.

(f) Apply the manufacturers jointing lubricant to the inside of the socket and lead-in flare. Keep the elastomeric seal and the pipe spigot end free of lubricant, unless otherwise recommended by the manufacturer.

(g) Align the pipes so that there is no deflection at the joints before inserting the spigot in the socket and pushing it home to the witness mark.

(h) Hold the socket end firmly during jointing to prevent previously assembled joints from moving.

(i) Where pipes are required to be cut in the field:

(i) Check the pipe spigot diameter to ensure it is within tolerance.

(ii) Cut the spigot end square in the valley between corrugations and remove any burrs.

(iii) Witness mark the pipe at the distance specified by the manufacturer and make the joint as specified in (a) to (g).

(j) Push the spigot end of the pipe into the socket of the other pipe, not the other way.

(k) Small dia pipes can be pushed with a log bar. For larger diameter pipes, use of other equipment like a rack, lever puller or backhoe as necessary.

(l) Insert the spigot end into the socket till the socket is positioned at the witness mark.

(m) Jointing of push on fittings is recommended to be done using rack and lever equipment. Jointing of fittings with the pipe can also be done using a suitable tackle e.g. winch method.

(n) After the joint has been made, check the joint to determine if the seal has been correctly inserted.

(o) Inspect the joint to ensure the manufacturers specified insertion depth has been achieved. Inspect the joint by inserting a metal rule into the socket gap and measure insertion depth . Ensure the manufacturers specification has been met and this depth is uniform around the whole circumference. If a difference outside the specified tolerance is found, dismantle and re-join..

A witness mark is normally positioned on the spigot by the manufacturer to show the optimum insertion depth.

Where corrugated pipes have a reduced spigot, jointing of pipes cut in the field may require special couplings.

Some manufacturers specify that the jointing force be applied to an intermediate stub of pipe inserted in the opposite socket to prevent damage to the socket end.

16.1.6 Laying and joining pipes and fittings with solvent cement joints

Insert a new Clause 16.1.6 Laying and joining pipes and fittings with solvent cement joints and insert the following text:

Complete cleaning, inspection and joint preparation in accordance with 16.1.2.3 SOLVENT WELDED JOINT.

When joining pipes and fittings with solvent cement joints:

(a) Ensure that the inside of the socket is clean.

(b) Check the pipe and spigot or fittings for proper alignment.

(c) Dry the area between the witness mark and spigot end, then clean and degrease with a clean cloth moistened with the pipe or fitting manufacturer’s specified priming fluid.

(d) Dry, clean and degrease the interior of the socket in a similar way. Repeat until the surface appears matt to observe;

(e) Use clean, suitably sized brushes or applicators, which shall not contaminate the solvent cement, to evenly coat the joints with solvent cement. Apply a coating of solvent cement evenly to the internal surface of the socket for the full engagement length, and then to the external section of the spigot up to the witness mark. Use only the amount of solvent cement necessary to fully coat the joint socket, to minimize excess solvent accumulation and solvent extrusion into the pipeline bore when jointed;

(f) Insert the spigot to the witness mark. Do not use excessive force. Firmly restrain the joint for the minimum period recommended by the pipe manufacturer;

(g) Where accessible, excess solvent cement should be removed from both internal and external joint surfaces; and

(h) Allow welded joints to cure for 24 hrs.

NOTES:

1. Burrs and protruding edges on the spigot can cause the solvent cement to be wiped from the surface of the socket and affect dimensional compatibility. This will result in a weaker joint, which might leak.
2. Reference should be made to suppliers of special or rapid-curing solvent cements to determine pipe material compatibility and minimum curing time requirements.
3. For sound jointing of pipes of 100 mm diameter and above, mechanical assistance may be required. Under most conditions, a lever placed against the protected end of the pipe will be sufficient.
4. PIPA Industry Guideline POP102 Solvent Cement Jointing of PVC Pipe may be used for guidance

16.1.7 Laying and jointing of polyethylene pipes and fittings

Insert a new Clause 16.1.7 Laying and jointing of polyethylene pipes and fittings and insert the following text:

Jointing of PE pipe and fittings shall be in accordance with Table 16.1

TABLE 16.1 JOINTING TECHNIQUES FOR PE PIPE

Pipe Diameter	Allowable Jointing technique	Preferred Jointing Technique
>DN 160 ≤ DN 450	EFJ, BFJ	BFJ
> DN 450	EFJ, BFJ	BFJ

Complete cleaning, inspection and joint preparation in accordance with 16.1.2.3 BUTT FUSION AND ELECTROFUSION WELDING

When fusion jointing of polyethylene pipes and fittings refer Clauses 16.17 WELDING OF PE PIPELINES and PIPA POP001 and POP003.

Pipes may be jointed at ground level and then lowered into position.

PIPA Industry Guideline POP001 Electrofusion Jointing of PE Pipe and Fittings for Pressure Applications may be used for guidance for non-pressure applications.

PIPA Industry Guideline POP003 Butt Fusion Jointing of PE Pipes and Fittings – Recommended Parameters may be used for guidance for non-pressure applications.

Pipes may be jointed at ground level and then lowered into position

Removal of the internal weld bead in butt welded gravity sewers is not considered necessary from hydraulic considerations, except where dry weather flow velocities do not exceed 0.3 m/s.

Installation shall allow for thermal contraction and expansion of the sewer pipe in accordance with AS/NZS 2033. The allowance shall be sufficient for a temperature change of at least 35°C.

PE pipes shall be laid in the trench to line and level with full embedment and partial trench backfill without restricting the ends until the pipe has had time to stabilise to ground temperature.

Where manual cold bending of the sewer pipe has been employed, the combined effect of pipe bending and thermal contraction shall be considered to ensure that strain in the pipe wall remains acceptable.

For trenchless installation of pipes, install in accordance with the Specification and relevant Design Drawings.

16.1.8 Laying and welding of steel pipes and fitting

Insert a new Clause 16.1.8 Laying and welding of steel pipes and fitting and insert the following text:

Undertake welding of steel pipes and fittings in accordance with 16.16 WELDING OF STEEL PIPELINES.

16.17 WELDING OF PE PIPELINES

Insert new Heading 16.17 WELDING OF PE PIPELINES

16.17.1 General

Insert a new Clause 16.17.1 General and the following text

Use electrofusion and/or butt fusion welding for joining pipe-to-pipe or fitting-to-pipe.

Undertake all welding in accordance with the Specification relevant Design Drawings and approved jointing procedures as specified in 16.17.2 Weld Testing Butt fusion and Electrofusion

Butt fusion and Electrofusion shall be performed by competent persons having current certification and experience as defined in Clause 16.17.6.

16.17.2 PE Butt Fusion Welding

Butt-fusion jointing procedures shall be in accordance with ISO 21307.

Other fusion procedures may be used subject to approval by the Water Agency.

PIPA Industry Guideline POP003, should be used for guidance on the butt fusion jointing of PE pipe and fittings.

All equipment for butt fusion jointing shall comply with the requirements of ISO 12176-1.

Butt fusion parameters shall be validated by test before welding commences on site.

16.17.3 PE Electrofusion Welding

Electrofusion jointing procedures shall be carried out in accordance with the manufacturer’s instructions for each specific size and type of fitting.

Electrofusion control boxes shall comply with ISO 12176-2.

PIPA Industry Guideline POP001, should be used for guidance on the electrofusion jointing of PE pipe and fittings for pressure applications.

Electrofusion joints shall be validated by test before welding commences on site – see clause 16.17.4.2 Electrofusion – Pre-Construction test welds

16.17.4 Weld Testing Butt Fusion and Electrofusion Joints

Joining pipes and fittings by electrofusion or butt fusion shall be to an approved jointing procedure that has been qualified by destructive testing in accordance with ISO 13953 and ISO 13954.

Fusion joining procedures shall be qualified prior to the commencement of welding on site

16.17.4.1 Butt fusion – Pre-Construction test welds

Before production jointing commences qualification of the butt fusion procedure shall be carried out unless a suitable pre-qualified procedure has been approved by the Water Agency. Qualification establishes the optimum weld procedure for the project within the scope of the ranges for each individual parameter nominated in ISO 21307.

Qualification welds shall optimise the weld parameters and be tested in accordance with ISO 13953 *Polyethylene (PE) pipes and fittings – Determination of the tensile strength and failure mode of test pieces from a butt-fused joint*

Qualified Procedures may be grouped by diameter to reduce the amount of qualification testing. The recommended groupings are shown in Table 16.2 below

Table 16.2: Butt Fusion testing qualification requirements

Procedure Qualification Test Pipe Diameter and for each SDR	Qualifies for sizes
Any ≤DN225	≤DN225
Any >DN225 – DN450	DN225 -DN450
>DN450	Each pipe diameter shall be tested

A pilot weld shall be undertaken for each welder, welding machine, pipe diameter and wall thickness using the qualified procedure.

A record of the parameter values for each weld shall be made.

Each pilot weld shall be performed on the actual pipe used in the project and under site conditions.

Pilot welds shall be tested in accordance with ISO 13953.

Options to assist in the interpretation and assessment of butt fusion tensile tests can be found in PIPA document POP014.

Only when these pre-construction joints pass the acceptance criteria shall the project proceed.

Test samples shall be identified by

(a) pipe size,

(b) SDR,

(c) PE material composition grade,

(d) date,

(e) actual weld parameters used

(f) welder number, machine and welding conditions at the time of welding.

Butt fusion joint samples shall be submitted for destructive testing to an approved NATA registered testing laboratory.

A field welding QA plan shall be submitted, and approved, before welding commences. REFER TO CLAUSE 16.17.5 QUALITY PLAN

16.17.4.2 Electrofusion – Pre-Construction test welds

Before production jointing commences qualification of the electrofusion procedure shall be carried out.

Qualified electrofusion joints may be grouped by diameter to reduce the amount of qualification testing. The recommended groupings are shown in table Table 16.3 below

Table 16.3 Electrofusion socket and saddle joint testing qualification requirements

Procedure Qualification Test Pipe Diameter and each fitting brand	Qualifies for sizes
Any ≤DN225	≤DN225
>DN225	Each pipe diameter shall be tested

Test joints shall be cut such that there is a minimum of 300 mm of pipe protruding either side of the joint.

Test samples shall be identified by

(a) pipe size,

(b) SDR,

(c) PE material composition grade,

(d) date,

(e) type and brand of fitting

(f) welder number, machine and welding conditions at the time of welding.

Electrofusion joint samples shall be submitted to an approved NATA registered testing laboratory.

Electrofusion joints shall be tested using the peel decohesion test in accordance with the requirements of ISO 13954.

When tested, electrofusion joints shall meet the requirements of AS/NZS 4129 Clause 3.5 Mechanical characteristics.

Only when these pre-construction joints pass the acceptance criteria shall the project proceed.

A field welding QA plan shall be submitted, and approved, before welding commences. REFER 16.17.5 QUALITY PLAN

16.17.5 Quality plans

16.17.5.1 General

A field welding quality plan shall be submitted, and approved, before welding commences.

A quality plan shall be prepared to demonstrate

(a) Safe Work Method statements and Job Safety Analysis

(b) Thermoplastic Welder Personnel Training and Qualifications

(c) Equipment details, brand, model, maintenance, servicing, and calibration of equipment

(d) Welding and joining procedures / including a record of all weld parameters.

(e) Test Sampling Plan for the number of test welds to be undertaken during the construction phase.

(f) Pre-construction test welds using inputs from items (b), (c) and (d)

(g) inspection and test records.

It is also recommended that quality records for each weld, numbered and located on a plan of works, be retained for at least 6 years from the date of installation.

16.17.5.2 Butt fusion – Test Sampling Plan during construction

Before construction commences qualification and pilot welds shall meet the test criteria - refer to Clause 16.17.2.1.

Once construction commences two types of testing shall be applied:

(a) Visual inspection of each joint

(b) Destructive testing of a selected joint. The Water Agency shall nominate the specific joint that will be destructively tested.

16.17.5.2.1 Visual inspection

All butt fusion joints shall be visually inspected around the full circumference.

All butt fusion joints shall be assessed in accordance with Table 1 and Table 2 of PIPA document POP 014. Joints that fail the acceptance criteria shall be reported, the parameters and welding process shall be investigated and corrective action taken. The Water Agency may require the joint be cut out.

All butt fusion joint external weld beads shall be removed using a suitable bead removal tool and then tested in accordance with POP014. If the bead separates, the parameters and welding process shall be investigated, reported and corrective action taken. The Water Agency may require the joint be cut out.

16.17.5.2.2 Destructive testing

Samples for destructive testing of butt fusion joints shall be provided for each individual pipe size and standard dimension ratio (SDR) as follows:

(a) 1 joint in the first 10 joints

(b) 1 joint in every 20 joints (or part thereof) for the remainder of the pipeline after the testing of the first joint as prescribed above meets the testing requirements.

Note: Following a series of successful joint tests the test frequency maybe further reduced with the approval of the Water Agency based on consistent successful welder performance. For example the test frequency could be reduced to 1 joint in every 50 joints (or part thereof) for the remainder of the pipeline.

Where testing reveals nonconformance to the test requirements the joint shall be reported, investigated and any corrective action recommended. In addition the previous weld to the failed test weld shall be cut out and tested. If the second weld also fails to meet the test criteria the project shall be stopped. Testing shall continue until the Contractor can demonstrate the welds meet the testing requirements.

16.17.5.3 Electrofusion – Test Sampling Plan during construction

Production Electrofusion jointing shall only commence following successful testing of the qualification weld.

Once construction commences two types of testing shall be applied:

(a) Visual inspection of each joint

(b) Destructive testing of a selected joint. The Water Agency shall nominate the specific joint that will be destructively tested.

16.17.5.3.1 Visual inspection

All electrofusion joints shall be visually inspected in accordance with the acceptance criteria of table 4 of POP 014. Joints that fail the acceptance criteria shall be reported, investigated and any corrective action recommended and if required by the Water Agency shall be cut out and replaced with new fittings.

Electrofusion couplings and saddles that indicate error readings, short circuiting, exposed wires, failure of coupling melt indicators and or melt outside the weld zone shall be cut out and replaced with new fittings.

16.17.5.3.2 Destructive testing

Samples for destructive testing of electrofusion joints shall be provided for each individual pipe size as follows:

(a) 1 joint in the first 10 joints

(b) 1 joint in every 20 electrofusion joints (or part thereof) for the remainder of the pipeline after the testing of the first joint as prescribed above meets the testing requirements.

Note: Following a series of successful joint tests the test frequency maybe further reduced with the approval of the Water Agency based on consistent successful welder performance. For example the test frequency could be reduced to 1 joint in every 50 joints (or part thereof) for the remainder of the pipeline.

Where testing reveals nonconformance to the test requirements the joint shall be reported, investigated and any corrective action recommended. In addition the previous weld to the failed test weld shall be cut out and tested. If the second weld also fails to meet the test criteria the project shall be stopped. Testing shall continue until the Contractor can demonstrate the welds meet the testing requirements.

16.17.6 Welder qualifications

All welders shall have successfully undertaken the following Units of Competence of the Plastics, Rubber and/or Cablemaking Training Package PMB07 appropriate to the welding processes used:

(a) PMBWELD301E - Butt weld polyethylene plastic pipelines

(b) PMBWELD302E - Join polyethylene plastic pipelines using electrofusion welding

Training shall be provided by Registered Training Organisations (RTO's) that are accredited by State/Territory Training Authorities under the Australian National Training Authority (ANTA) guidelines and conforming to PMB 07 Competency Standards prepared by Manufacturing Learning Australia, Qualification Framework for the plastics, rubber and cable making industry.

RTOs listed on the PIPA website (https://pipa.com.au/welder-training/) are preferred as they also commit to deliver a detailed course curriculum.

The RTO's providing training in all forms of welding plastics pipeline systems shall have staff qualified in presenting courses that meet competency standards covered by PMBWELD301E and PMBWELD302E.

“Successfully undertaken” shall mean “Statement of Attainment” for all those appropriate Units of Competence.

Only personnel who have successfully completed the above training programs shall be permitted to butt fuse or electrofusion PE systems .

Certification shall be valid for 2 years. At the end of this period, renewal of the certification shall be required.

Certified welders shall demonstrate continuous welding activity and any break of more than six months shall require renewal of certification.

Certification details shall be carried by field personnel on-site, and be made available as required.

In addition to having current certification welders shall be initially restricted to welding pipes and fittings in sizes <DN 225 until they can demonstrate either a successful track record of welding within this size range or that they have undertaken specific training on larger size pipe.

Welders demonstrating a successful track record of welding in sizes up to DN 225 shall be permitted to weld pipelines up to DN 450. Similarly, welders shall demonstrate a successful track record of welding up to DN 450 before being permitted to weld pipes and fittings >DN 450.

16.17.7 Connections to pipes of other materials

Make connections to PVC/ABS/DI/steel pipelines using PE flange adaptors and backing rings with AS/NZS 4087 Figure B2 mating dimensions

Make connections to non pressure VC/GRP/RC pipelines using a spigot end adaptor welded to the PE pipe spigot and utilising the socket and sealing ring of the VC/GRP/RC pipe.

21.4.2 Air testing methods for sewers

21.4.2.1 Vacuum testing

Some of the figures in Table 21.3 have been amended. Carl to check

21.6.2 Ovality proving tools

Amend Item (e) to (d) and replace with the following text

(d) of a diameter and shape approved by the testing organisation or the Water Agency for each combination of pipe material, stiffness, type (solid monolayer, solid-core sandwich, foam-core sandwich, ribbed or profile wall); and

Replace last paragraph with the following text.

Some product standards do not accurately specify internal diameters. APPENDIX K — OVALITY TESTING OF GRAVITY SEWERS DEFAULT PROVING TOOL DIAMETERS lists default proving tool diameters for common sewer pipe materials such as DWV PVC_U solid monolayer, solid-core sandwich or foam-core sandwich pipes.

21.14.4 Testing of non-pressure PE sewers

Amend paragraph 3 as following:

Where specified, deflection test non-pressure PE sewers in accordance with 21.6 DEFLECTION (OVALITY) TESTING OF FLEXIBLE SEWERS. The deflection testing will detect poorly installed pipe, but cannot be used as a quantitative measure of leakage under service conditions for infiltration or exfiltration.

Delete the paragraphs 4,5, and 6

~~Where specified, inspect all PE sewers by CCTV, optical pipeline scanner or other approved method in accordance with 21.8 INTERNAL INSPECTION after all backfill operations have been satisfactorily completed and all junctions are installed.~~

~~Where a free standing water table exists at a level of ≥1.5 m above a sewer or ≥150 mm above any side connections along the sewer, conduct an infiltration test in accordance with Appendix N of AS/NZS 2566.2:2002, to determine the extent of any infiltration.~~

~~Accept the test length if there is no infiltration. Rectify points of infiltration prior to conducting any further testing~~.

21.6.4.3 Flexible sewers ≥DN 750

Add the following after text after the last paragraph.

Measured deflection should be based on the following calculation.

$$\text{Deflection (\%)} = \left(\frac{Actual\ ID - installed\ vertical\ ID}{Actual\ ID}\right) x\ 100$$

This equation is adapted from Appendix O of AS/NZS 2566.2:2002

To determine the actual ID or mean internal diameter measure pipes of the same class and stiffness, immediately after the pipe embedment has been placed and compacted.

That is

$$\text{Actual ID} = \left(\frac{Vertical\ ID + Horizontal\ ID}{2}\right)$$

Measure the installed vertical ID of each section of pipe at the joints and mid-points between joints, not less than 14 days after placement and compaction of the trench fill.

Accept sewers when the pipeline short term vertical deflection calculated from the above equation is less than that specified in Table 21.6.

Repair all sections of pipes that exhibit unacceptable deflection. Retest each repaired sections in accordance with Clause 21.6 DEFLECTION (OVALITY) TESTING OF FLEXIBLE SEWERS

APPENDIX D PROTECTION AGAINST DEGRADATION

D4 PROTECTION AGAINST EXTERNAL CONTAMINATED GROUND

Amend list font (a) to (d) as follows

Protection measures may include:

(i) fully sealed conduits for plastics pipes and fittings in contaminated ground; or

(ii) fully sealed conduits for all pipes and fittings with exposed elastomeric sealed joints in contaminated ground; or

(iii) additional corrosion protection for metallic components such as petrolatum tape wrapping; or

(iv) coating of cementitious materials.

Item D4 (3)

Replace item (3) with the following

(3) Assess the OH&S risks during construction, operation and maintenance of the proposed sewers in relation to the identified contamination (Refer to Clause 1.2.6.3 ALL hazards – Infrastructure protection); and

Add the following sentence and items (A) to (D) at the end of the last paragraph.

Guidance notes for laying drinking water pipelines in contaminated ground are outlined in the following publications:

1. Plastics Industry Pipe Association of Australia Polyolefins and PVC Guidelines POP207 Installation of Potable Watermains in Contaminated Ground available at https://pipa.com.au/technical/pop-guidelines/
2. Water Regulation Advisory Service (WRAS) Information and Guidance Note No 9-04-03: “The Selection of Materials for Water Supply Pipes to be laid in Contaminated Land”. This is a freely available document from their website www.wras.co.uk.
3. Foundation for Water Research Report No. FR 0448 November 1994 available at www.fwr.org.
4. UKWIR report “Guidance for the Selection of Water Pipes to be used in Brownfield sites” Report Ref No. 10/WM/03/21 August 2010 available at https://ukwir.org.

I6 MAXIMUM DEPTH TO INVERT FOR STANDARD SUPPORT TYPE

Amend Clause I6 title and replace all text and tables in this section with the following.

I6 MAXIMUM DEPTH TO TOP OF PIPES FOR STANDARD SUPPORT TYPE

Tables I1 to I8 specify default maximum depths to the top of pipe for trenches complying with Figure 9.1 and with pipe support types nominated in Figure 9.2, Figure 9.3, Figure 9.4, and Figure 9.5. The designs are conservative. Project-specific designs may be undertaken by an appropriately qualified Designer where the stated assumptions for Tables I1 to I8 are varied e.g. alternative pipe stiffness or for actual geotechnical data from the site.

Applicable design standard is AS/NZS 2566.1 for non-pressure PVC–U, PP, PE and GRP and other non-pressure flexible pipes.

The following notes apply to Tables I1 to I8 inclusive:

1 The embedment soil deformation modulus(E_e) and native soil deformation modulus (E_n) are derived from Table 3.2 of AS/NZS 2566.1:1998 with reference to WSA 02 Table 21.1
2 Based on typical pipe material characteristics in Table 2.1 of AS/NZS 2566.1:1998
3 Minimum trench widths are derived from Figure 3.1 of AS/NZS 2566.1:1998 or Table 4.2 of AS/NZS 2566.2:2002.
4 Trench width to be measured at the spring line.
5 A Support Type 3 or 4 as shown in 9.4 LOADINGS and 9.5 FOUNDATION DESIGN AND GROUNDWATER CONTROL
6 The allowable long- term vertical pipe deflection is based on pipeline materials listed in Table 2.1 of AS/NZS 2566.1:1998.
7 Buckling factor of safety of 2.5.
8 Assuming SM1600 wheel loading from AS 5100 including distribution method in AS 5100
9 The values in Table I.1 to I.6 may be considered conservative. It is recommended the Designer confirm the pipe material characteristics with the pipe manufacturer.
10 Excluding water charged ground
11 For Table I.5 and Table I.6 DN is based on Australian sized outside diameter, not ISO sized outside diameter.

Table I.1 MAXIMUM DEPTH TO TOP OF PVC-U SEWERS (Excluding Traffic Loads)

DN	Pipe SN	Min Trench Width (mm)	Embedment Modulus E'e (MPa)	Native Soil Modulus E'n (MPa)									
				1	2	3	4	5	6	7	8	9	10
				Maximum Depth to top of Pipe (cover) (m)									
100	SN10	310	7	5.8	8.2	9.7	10.7	11.5	12.1	12.5	12.9	13.3	13.5
150	SN8	460	7	5.4	7.6	9	9.9	10.6	11.2	11.6	12	12.2	12.5
225	SN8	550	7	4.4	6.6	8.1	9.3	10.2	10.9	11.6	12.1	12.5	12.9
300	SN8	715	7	4.5	6.7	8.2	9.3	10.2	10.9	11.5	12	12.5	12.8
375	SN8	800	7	4.1	6.3	7.8	9	10	10.8	11.5	12.1	12.6	13
150	SN16	460	7	6.9	9.6	11.4	12.6	13.4	14.1	14.7	15.1	15.5	15.8
225	SN16	550	7	5.6	8.4	10.3	11.8	12.9	13.8	14.6	15.3	15.8	16.3
300	SN16	715	7	5.7	8.5	10.4	11.8	12.9	13.8	14.6	15.2	15.7	16.2
375	SN16	800	7	5.2	8	9.9	11.4	12.6	13.7	14.5	15.3	15.9	16.5

Table I.2 MAXIMUM DEPTH TO TOP OF PVC-U SEWERS including SM1600 Wheel Loads (AS 5100 distribution method)

DN	Pipe SN	Min Trench Width (mm)	Embedment Modulus E'e (MPa)	Native Soil Modulus E'n (MPa)									
				1	2	3	4	5	6	7	8	9	10
				Maximum Depth top of Pipe (cover) (m)									
100	SN10	310	7	5.2	7.7	9.3	10.3	11.2	11.8	12.2	12.7	13	13.3
150	SN8	460	7	4.8	7.2	8.6	9.6	10.3	10.9	11.3	11.7	11.9	12.2
225	SN8	550	7	3.6	6.1	7.7	8.9	9.8	10.6	11.3	11.8	12.2	12.7
300	SN8	715	7	3.7	6.1	7.7	8.9	9.9	10.6	11.2	11.7	12.2	12.6
375	SN8	800	7	3.3	5.7	7.4	8.6	9.6	10.4	11.2	11.8	12.3	12.8
150	SN16	460	7	6.3	9.3	11.1	12.3	13.2	13.9	14.4	14.9	15.3	15.6
225	SN16	550	7	5	7.9	10	11.5	12.6	13.6	14.4	15.1	15.6	16.1
300	SN16	715	7	5.1	8.1	10	11.5	12.7	13.6	14.3	15	15.5	16
375	SN16	800	7	4.5	7.5	9.6	11.1	12.4	13.4	14.3	15.1	15.7	16.3

Table I.3 MAXIMUM DEPTH TO TOP OF PP SEWERS (Excluding Traffic Loads)

DN	Pipe SN	Min Trench Width (mm)	Embedment Modulus E'e (MPa)	Native Soil Modulus E'n (MPa)									
				1	2	3	4	5	6	7	8	9	10
				Maximum Depth to top of Pipe (cover) (m)									
225	SN10	560	7	2.6	4.7	6	7	7.8	8.5	9	9.5	9.8	10.2
300	SN10	745	7	2.5	4.6	6	7	7.8	8.4	8.9	9.4	9.8	10.1
375	SN10	830	7	2.2	4.3	5.6	6.7	7.6	8.3	8.9	9.4	9.9	10.3
450	SN10	1115	7	2.4	4.5	5.9	6.9	7.7	8.3	8.8	9.3	9.7	10

525	SN10	1200	7	2.1	4.2	5.6	6.7	7.5	8.2	8.8	9.3	9.7	10.1
600	SN10	1285	7	1.9	4	5.4	6.5	7.4	8.2	8.8	9.3	9.8	10.2
225	SN20	560	7	3.7	6.2	7.9	9.2	10.1	10.9	11.6	12.1	12.7	13.1
300	SN20	745	7	3.7	6.2	7.8	9.1	10.1	10.9	11.5	12.1	12.6	13
375	SN20	830	7	3.3	5.8	7.5	8.8	9.8	10.8	11.5	12.1	12.7	13.2
450	SN20	1115	7	3.6	6.1	7.7	9	10	10.8	11.4	12	12.5	12.9
525	SN20	1200	7	3.3	5.8	7.5	8.8	9.8	10.7	11.4	12	12.6	13

Table I.4 MAXIMUM DEPTH TO TOP OF PP SEWERS including SM1600 Wheel Loads (AS 5100 distribution method)

DN	Pipe SN	Min Trench Width (mm)	Embedment Modulus E'e (MPa)	Native Soil Modulus E'n (MPa)									
				1	2	3	4	5	6	7	8	9	10
				Maximum Depth to top of Pipe (cover) (m)									
225	SN10	560	7	2.6	4.7	6	7	7.8	8.5	9	9.5	9.8	10.2
300	SN10	745	7	2.5	4.6	6	7	7.8	8.4	8.9	9.4	9.8	10.1
375	SN10	830	7	2.2	4.3	5.6	6.7	7.6	8.3	8.9	9.4	9.9	10.3
450	SN10	1115	7	2.4	4.5	5.9	6.9	7.7	8.3	8.8	9.3	9.7	10
525	SN10	1200	7	2.1	4.2	5.6	6.7	7.5	8.2	8.8	9.3	9.7	10.1
600	SN10	1285	7	1.9	4	5.4	6.5	7.4	8.2	8.8	9.3	9.8	10.2
225	SN20	560	7	3.7	6.2	7.9	9.2	10.1	10.9	11.6	12.1	12.7	13.1
300	SN20	745	7	3.7	6.2	7.8	9.1	10.1	10.9	11.5	12.1	12.6	13
375	SN20	830	7	3.3	5.8	7.5	8.8	9.8	10.8	11.5	12.1	12.7	13.2
450	SN20	1115	7	3.6	6.1	7.7	9	10	10.8	11.4	12	12.5	12.9
525	SN20	1200	7	3.3	5.8	7.5	8.8	9.8	10.7	11.4	12	12.6	13

Table I.5 MAXIMUM DEPTH TO TOP OF FW-GRP (PN1) SEWERS (Excluding Traffic Loads)

DN	Pipe Stiffness N/m.m	Min Trench Width (mm)	Embedment Modulus E'e (MPa)	Native Soil Modulus E'n (MPa)									
				1	2	3	4	5	6	7	8	9	10
				Maximum Depth to top of Pipe (cover) (m)									
300	10,000	745	7	4.7	7.1	9.1	10.8	11.9	12.8	13.5	14.1	14.7	15.2
375	10,000	826	7	4.4	6.7	8.7	10.4	11.7	12.6	13.5	14.2	14.8	15.4
450	10,000	1107	7	4.7	7.2	9.2	10.8	11.8	12.7	13.4	14	14.6	15
525	10,000	1187	7	4.5	6.9	8.9	10.5	11.7	12.6	13.4	14.1	14.7	15.2
600	10,000	1267	7	4.3	6.7	8.7	10.3	11.5	12.5	13.3	14.1	14.7	15.3
675	10,000	1347	7	4.2	6.5	8.5	10.2	11.4	12.4	13.3	14.1	14.8	15.4
750	10,000	1426	7	4.1	6.4	8.4	10	11.3	12.3	13.3	14.1	14.8	15.4
900	10,000	1623	7	4.2	6.4	8.4	10	11.2	12.3	13.2	14	14.7	15.3
1000	10,000	1725	7	4.1	6.3	8.3	9.9	11.1	12.2	13.1	14	14.7	15.4
1200	10,000	1827	7	3.8	6.1	8.1	9.6	10.9	12	13	13.9	14.7	15.4

Table I.6 MAXIMUM DEPTH TO TOP OF FW-GRP (PN1) SEWERS including SM1600 Wheel Loads (AS 5100 distribution method)

DN	Pipe Stiffness N/m.m	Min Trench Width (mm)	Embedment Modulus E'e (MPa)	Native Soil Modulus E'n (MPa)									
				1	2	3	4	5	6	8	9	0	10
				Maximum Depth to top of Pipe (cover) (m)									
300	10,000	745	7	3.9	6.6	8.7	10.4	11.6	12.5	13.3	13.9	14.4	15
375	10,000	826	7	3.6	6.2	8.3	10.1	11.4	12.4	13.2	13.9	14.6	15.2
450	10,000	1107	7	3.9	6.7	8.8	10.4	11.5	12.5	13.2	13.8	14.3	14.8
525	10,000	1187	7	3.7	6.3	8.5	10.2	11.4	12.3	13.1	13.8	14.4	15
600	10,000	1267	7	3.5	6.1	8.3	10	11.2	12.2	13.1	13.8	14.5	15.1
675	10,000	1347	7	3.4	6	8.1	9.8	11.1	12.1	13	13.8	14.5	15.2
750	10,000	1426	7	3.3	5.8	7.9	9.7	11	12	13	13.8	14.5	15.2
900	10,000	1623	7	3.3	5.9	8	9.7	10.9	12	12.9	13.7	14.4	15.1
1000	10,000	1725	7	3.2	5.8	7.8	9.5	10.8	11.9	12.9	13.7	14.5	15.2
1200	10,000	1827	7	2.9	5.5	7.6	9.2	10.6	11.7	12.8	13.7	14.5	15.2

Table I.7 MAXIMUM DEPTH TO TOP OF PE100 (Excluding Traffic Loads)

DN	Pipe SDR	Min Trench Width (mm)	Embedment Modulus E'e (MPa)	Native Soil Modulus E'n (MPa)									
				1	2	3	4	5	6	7	8	9	10
				Maximum Depth to top of Pipe (cover) (m)									
110	21	310	7	5.1	7.2	8.5	9.4	10.1	10.6	11.1	11.4	11.7	11.9
125	21	325	7	4.8	6.9	8.3	9.2	10	10.6	11	11.4	11.8	12.1
140	21	340	7	4.6	6.7	8.1	9.1	9.9	10.5	11.1	11.5	11.9	12.2
160	21	460	7	5.2	7.3	8.6	9.5	10.2	10.7	11.1	11.4	11.7	12
180	21	480	7	4.9	7	8.3	9.3	10	10.6	11	11.4	11.7	12
200	21	500	7	4.6	6.7	8.1	9.2	9.9	10.6	11.1	11.5	11.8	12.1
225	21	525	7	4.4	6.5	7.9	9	9.8	10.5	11	11.5	11.9	12.2
250	21	550	7	4.2	6.3	7.7	8.8	9.6	10.3	10.9	11.4	11.9	12.2
280	21	580	7	4.1	6.1	7.6	8.7	9.6	10.4	11	11.5	12	12.4
315	21	715	7	4.3	6.3	7.7	8.8	9.7	10.3	10.9	11.4	11.8	12.1
355	21	755	7	4.1	6.1	7.6	8.7	9.5	10.3	10.9	11.4	11.8	12.2
400	21	800	7	3.9	5.9	7.4	8.5	9.5	10.2	10.9	11.4	11.9	12.4
450	21	850	7	3.7	5.8	7.2	8.4	9.4	10.2	10.9	11.5	12	12.5
500	21	1100	7	4.1	6.2	7.6	8.7	9.6	10.3	10.8	11.3	11.8	12.1

Table I.8 MAXIMUM DEPTH TO TOP OF PE100 SEWERS including SM1600 Wheel Loads (AS 5100 distribution method)

DN	Pipe SDR	Min Trench Width (mm)	Embedment Modulus E'e (MPa)	Native Soil Modulus E'n (MPa)									
				1	2	3	4	5	6	7	8	9	10
				Maximum Depth to top of Pipe (cover) (m)									
110	21	310	7	4.4	6.7	8.1	9	9.8	10.3	10.8	11.1	11.4	11.6
125	21	325	7	4	6.3	7.8	8.8	9.6	10.2	10.7	11.1	11.5	11.8
140	21	340	7	3.8	6.1	7.6	8.7	9.6	10.2	10.8	11.2	11.6	11.9
160	21	460	7	4.5	6.8	8.2	9.2	9.8	10.4	10.8	11.1	11.4	11.7
180	21	480	7	4.1	6.5	7.9	8.9	9.6	10.2	10.7	11.1	11.4	11.7
200	21	500	7	3.9	6.2	7.7	8.8	9.6	10.2	10.8	11.2	11.5	11.8
225	21	525	7	3.6	6	7.5	8.6	9.5	10.1	10.7	11.2	11.6	11.9
250	21	550	7	3.3	5.7	7.2	8.4	9.3	10	10.6	11.1	11.6	11.9
280	21	580	7	3.2	5.5	7.1	8.3	9.3	10	10.7	11.2	11.7	12.1
315	21	715	7	3.5	5.8	7.3	8.4	9.3	10	10.6	11.1	11.5	11.8
355	21	755	7	3.2	5.5	7.1	8.3	9.2	9.9	10.6	11.1	11.5	11.9
400	21	800	7	3	5.3	6.9	8.1	9.1	9.9	10.6	11.1	11.6	12.1
450	21	850	7	2.8	5.2	6.7	8	9	9.8	10.6	11.2	11.7	12.2
500	21	1100	7	3.2	5.6	7.1	8.3	9.2	9.9	10.5	11	11.5	11.8

K1 GENERAL

Replace the second paragraph with the following:

Australian Standards for PVC (AS/NZS 1260—Solid wall structured pipes or solid-core or foam-core sandwich wall structured pipes) and GRP (AS 3571.1—external diameter series) sewer pipes do not specify internal diameters of pipes.

K2 REQUIREMENTS

Table K.1 PROVER OUTSIDE DIAMETER FOR DWV PVC -U PIPES

Pipe Size DN	Minimum Outside Diameter of Prover[1,2,3,4] mm	
	PVC-U - SN8	
	Solid Wall structured pipe	Solid-core or Foam-core Sandwich wall structured pipe
150	140	139
225	220	218
300	278	276
375	354	351

The tolerance on outside diameter of provers is ±0.5mm.

Applies only to SN8 DWV PVC-U solid wall structured pipes, solid-core or foam-core sandwich wall structured pipes conforming to AS/NZS 1260.

Where the inside diameter of fittings (e.g. junctions, bends) is less than the pipe internal diameter, the pull-through prover method of testing may not be valid/possible.