

COFFS HARBOUR CITY COUNCIL



**DEVELOPMENT SPECIFICATION
DESIGN**

1352 Pipe drainage

Version 1 01 January 2009

1352 PIPE DRAINAGE

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection covers the supply and installation of pipe culverts and pipe arches for stormwater drainage and should be read in conjunction with 1351 *Stormwater drainage (Construction)*.

The work to be executed under this worksection consists of supply of pipes and pipe arches, bedding, installation and backfilling.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 *Quality (Construction)*

0310 *Minor concrete works*

1112 *Earthworks (Roadways)*

1171 *Subsurface drainage*

1351 *Stormwater drainage (Construction)*

1354 *Drainage structures*

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Particle size distribution by sieving
AS 1141.51	Unconfined compressive strength of compacted materials
AS 1289	Methods of testing soils for engineering purposes
AS 1289.3.3.1	Soil classification tests—Calculation of the plasticity index of a soil
AS 1289.4.3.1	Soil chemical tests—Determination of the pH value of a soil—Electrometric method.
AS 1289.4.4.1	Determination of the electrical resistivity of a soil—Method for sands and granular materials
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1289.5.6.1	Compaction control test—Density index method for a cohesionless material
AS 1289.5.7.1	Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (rapid method)
AS 1397	Steel sheet and strip—Hot dipped zinc coated or aluminium/zinc coated.
AS 1646 series	Elastomeric seals for waterworks purposes
AS 1761	Helical lock-seam corrugated steel pipes
AS 1762	Helical lock-seam corrugated steel pipes—Design and installation
AS 2032	Code of practice for installation of UPVC pipe systems
AS 2041	Buried corrugated metal structures
AS 3725	Loads on buried concrete pipes
AS 3887	Paints for steel structures—Coal tar epoxy
AS 4058	Precast concrete pipes (pressure and non-pressure)

AS 4139	Fibre reinforced concrete pipes and fittings.
AS/NZS 1254	PVC pipes and fittings for storm or surface water applications.
AS/NZS 2566	Buried flexible pipelines
AS/NZS 2566.1	Structural design
AS/NZS 2566.2	Installation
AS/NZS 3750	Paints for steel structures
AS/NZS 3750.9	Organic zinc-rich primer
AS/NZS 3750.15	Inorganic zinc silicate paint
AS/NZS 4680	Hot-dip galvanised (zinc) coatings on fabricated ferrous articles
AS/NZS ISO 9001	Quality management systems – Requirements
ASHTOM 190	Bituminous coated corrugated metal culvert pipe and pipe arches

2 COMMON REQUIREMENTS

2.1 COMPLIANCE WITH QUALITY PLAN

Pipes and/or pipe arches shall not be placed in position until documentary evidence has been produced to the Superintendent that the manufacture of the products to be used in the works has complied with the Manufacturer's Quality Plan in accordance with AS/NZS ISO 9001.

2.2 CERTIFICATION

Documentation shall comprise a conformance certificate to AS 4058 or AS 4139, as appropriate, for each batch of pipes or pipe arches to be included in the works. Conformance certificates are to be supplied at least 24 hours in advance of dispatch to site.

2.3 MARKING

Each unit shall be marked at time of manufacture with:

- Class and size.
- Manufacturer's name.
- Date of casting.

2.4 EXCAVATION DRAINAGE

The Contractor shall take all necessary steps to drain the excavation to allow the foundation, the bedding and any backfilling to be compacted to the specified relative compaction.

2.5 TOLERANCES

Culverts shall be installed within 10 mm of the grade line and within 10 mm of the horizontal alignment specified on the Drawings.

The Contractor shall relay any culvert which is not within these tolerances.

2.6 SUBSURFACE DRAIN

At the discharge end of culverts terminating at pits and headwalls a 3 m length of 100 mm diameter subsurface drain shall be laid in the trench 100 mm above the invert level of the culvert and discharging through the wall of the pit or headwall at 100 mm above the invert level of the culvert or headwall.

The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with 1171 *Subsurface drainage*.

2.7 EXCAVATION AND BACKFILLING FOR CULVERTS

Excavation and backfilling for culverts shall be undertaken in a safe manner and in accordance with all statutory requirements.

2.8 CONSTRUCTION PLANT MOVEMENT

Where the Contractor proposes to travel construction plant in excess of 5 tonnes gross mass over culverts, the Contractor shall design and provide adequate protective measures for the crossings and shall submit the proposals to the Superintendent for prior approval.

3 PRECAST REINFORCED CONCRETE AND FIBRE REINFORCED CONCRETE PIPES

3.1 PIPES

Precast reinforced concrete pipes

Precast reinforced concrete pipes shall comply with AS 4058 and shall be of the class and size as shown on the Drawings.

Fibre reinforced concrete pipes

Fibre reinforced concrete drainage pipes shall comply with AS 4139 and shall be of the class and size as shown on the Drawings.

Joints

Unless specified otherwise, joints shall be of the flexible type and the pipes shall have special sockets incorporating rubber ring joints complying with AS 1646 series and as recommended by the manufacturer.

3.2 EXCAVATION

Formation to subgrade level

Unless otherwise indicated on the Drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

Normal trench conditions

For normal trench conditions, the pipe shall be laid in an excavated trench with bedding as specified in Bedding.

The trench shall be excavated to a width 1.4 times the external diameter of the pipe, or to the external diameter of the pipe plus 300 mm on each side, whichever is the greater.

Wide trench conditions

Care is necessary to avoid laying pipe drainage in trenches excavated to excessive width.

Pipes laid in wide trench conditions will be deemed to be in embankment conditions (positive projection).

Wide trench conditions apply when, for a single pipe, the width of trench $W \geq D + 0.6$ metres where D is the pipe diameter.

For multi-cell pipes wide trench conditions apply when the width of trench $W \geq \sum D + \sum S + 0.6$ metres where S is the square spacing between the pipelines.

NOTE This definition of wide trench conditions as equivalent to embankment conditions relates to the size and geometry of the excavation utilised at construction.

Pipes shown on the Drawings to require trench conditions shall not be placed under embankment conditions without a design check for compliance of the pipe strength in accordance with AS 3725.

3.3 BEDDING

Pipe support type

Bedding shall be in accordance with this worksection, AS 3725 and AS 3725 Supplement 1 for the pipe support types as shown on the Drawings.

Where the pipe support type is not shown on the Drawings, the support type shall be HS3 within road reserves and H2 elsewhere.

Bedding dimensions

Figure 3.1 and Table 3.1 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions for all AS 3725 pipe support types.

Material requirements

Bedding material for the bed and haunch zones shall consist of a granular material having a grading, determined by AS 1141.11, complying with Table 3.2, and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6.

Select fill material in the side zones, for pipe support type HS, shall also comply with Table 3.2.

Source

The Contractor shall advise the Superintendent of the source of bedding material.

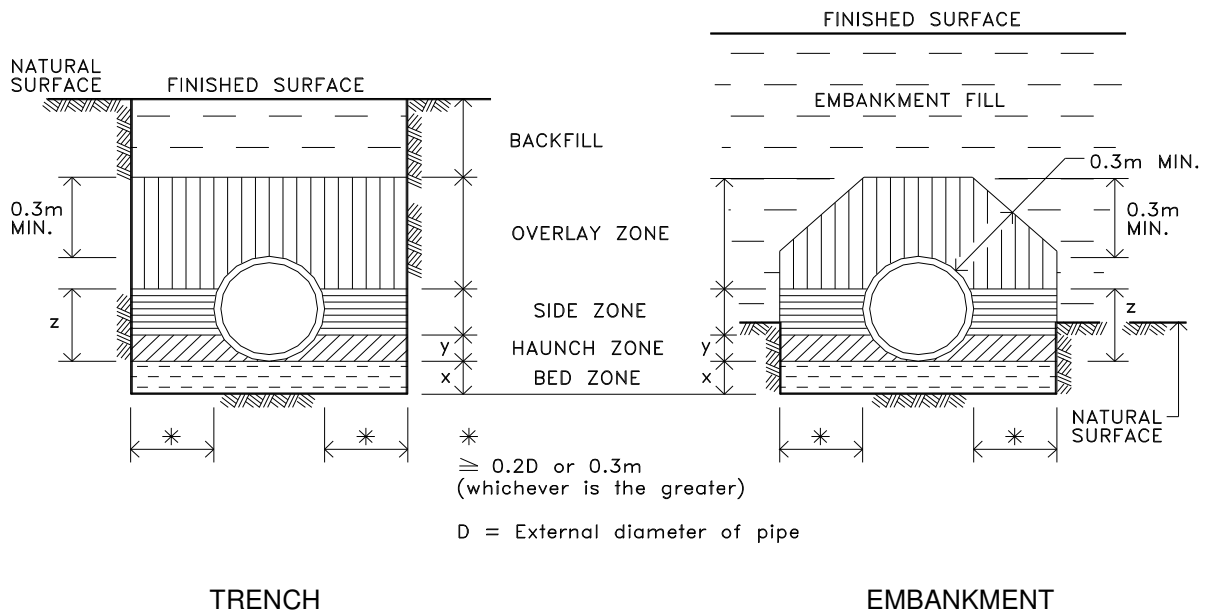


Figure 3.1 Pipe installation conditions

Table 3.1 Pipe installation dimensions

		Pipe Support Type						
		U	H1	H2	H3	HS1	HS2	HS3
Dimension (minimum)	x	75 on rock and Nil on soil	100 for $D \leq 1500$ 150 for $D > 1500$		0.25 D but >100	100 for $D \leq 1500$ 150 for $D > 1500$		
	y	—	0.1D	0.3D	0.3D	0.1D	0.3D	0.3D
	z	—	—	—	—	$\geq 0.7D$		

D = External diameter of pipe

Table 3.2 Bedding material grading limits

Sieve size mm	Weight passing %	
	Bed and haunch zones	Side zones
75.0	—	100
19.0	100	—
9.5	—	50–100
2.36	50–100	30–100
0.60	20–90	15–50
0.30	10–60	—
0.15	0–25	—
0.075	0–10	0–25

Layers

All material shall be compacted in layers not exceeding 150 mm compacted thickness except where explicitly approved by the Superintendent, for the first placed layer above the pipe crown in the overlay zone, in order to protect the pipe from construction damage.

Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

Moisture content

At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Compaction requirements

Compaction of select fill material in the bed and haunch zones shall be to the appropriate pipe support requirements shown in Table 3.3 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

H3 Pipe Support includes concrete bedding. Concrete shall be grade N20 to AS 3600. Pipe shall be suitably reinforced in accordance with AS 3725 as standard elliptically reinforced pipe may not be adequate for H3 Pipe Support.

Unless specifically selected pipes are nominated for use with H3 bedding.

Table 3.3 Bedding material compaction requirements

Bedding material		Pipe support type							
Criteria	Location	U	H1	H2	H3	HS1	HS2	HS3	
Minimum Relative Compaction %	Bed and haunch zones	—	50	60	Concrete	50	60	70	
AS1289.5.4.1 (Standard Compaction)	Side and overlay zones:	Cohesionless	—	—	—	—	50	60	70
		Cohesive	—	—	—	—	85	90	95

Material directly under the pipe

The top 0.1D mm of the bedding and haunch material directly under the pipe shall be placed and shaped accurately to house the pipe after compaction is achieved in the bedding and haunch zone external to the area of direct pipe support.

Cementitious stabilisation

Where the impermeability of the natural ground and the slope of the drainage line is such that erosion of bedding material is considered by the Superintendent to be a likely problem, the Superintendent may specify cementitious stabilisation of the bedding material used in the bedding and haunch zones.

Design check

A design check shall be undertaken to confirm the suitability of the proposed pipes.

3.4 LAYING

Positioning of pipes

Pipes shall be laid with the socket end placed upstream.

Pipes which have marks indicating the crown or invert of the pipes shall be laid strictly in accordance with the markings.

Unless specified, no individual length of pipe shall be shorter than 1.2 m.

Stiffening of culverts

In the case of pipes 1,200 mm or more in diameter, laid in situations where embankments are to be more than 3 m high, measured above the invert of the pipe, pipes shall be stiffened temporarily by the Contractor by interior timber struts, erected before filling is placed.

Struts shall be of hardwood measuring at least 100 mm by 100 mm or 125 mm diameter.

One strut shall be placed in a vertical position at each pipe joint, thence at a spacing not greater than 1,200 mm.

Struts shall bear against a sill laid along the invert of the pipe and a cap bearing against the crown of the pipe.

Both the sill and the cap shall be continuous throughout the length of the pipe and they shall be of sawn hardwood, of cross section not less than 100 mm by 100 mm.

Struts shall be made to bear tightly by the use of wedges between the top of the struts and the cap.

Struts, sills and caps shall be removed on completion of the embankment, unless removal is ordered earlier.

Seal lifting holes

Lifting holes in all pipes shall be sealed with plastic preformed plugs approved by the Superintendent, or a 3:1 sand:cement mortar, before the commencement of backfilling.

Bulkheads

Bulkheads shall be constructed in accordance with the Specification for 1354 *Drainage structures* on all lines where the pipe gradient exceeds 5%.

Inspection by Superintendent

The Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling.

Rubber ringed joints in reinforced concrete pipes

Clean and dry material: Before making the joint, the spigot and socket and the rubber ring shall be clean and dry.

Procedure for Rolling Rubber Rings: The rubber ring shall be stretched on to the spigot end of the pipe, square with the axis and as near as possible to the end, care being taken that it is not twisted.

The spigot end of the pipe shall then be pushed up to contact the socket of the pipe with which it is to join, and be concentric with it.

The spigot end shall then be entered into the socket of the already laid pipe and forced home by means of a bar, lever and chain, or other method approved by the Superintendent.

Joint test: The joint shall be tested to ensure that the rubber ring has rolled evenly into place.

'Skid' rings

Where wedge shaped 'skid' rubber rings are prescribed the Manufacturer's instructions, which include the use of lubricants, shall be followed.

Flush or butt joints in concrete pipes

Jointing: Flush or butt joints shall be used only where required to extend existing culverts. If pipes with flush or butt joints are required, the ends of the pipes shall be butted together.

Sealing: The joints shall be sealed with proprietary rubber sleeves, supplied and installed in accordance with the manufacturer's recommendations.

Joints in fibre-reinforced cement pipes: Joints shall be of a flexible type. Rubber rings shall be used to seal joints in both rebated and spigot and socket jointed pipes in the manner specified in Laying.

Alternatively, a jointing compound comprising plasticised butyl rubber and inert fillers may be used to seal such pipes in accordance with the manufacturer's instructions.

Direct side connections to other pipes shall be as detailed on the Drawings.

3.5 BACKFILL**Type HS pipe support**

Select fill material to the side zones for pipe support type HS shall be compacted to the requirements shown in Table 3.3 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

Other pipe support types

Ordinary fill to the side zones, for all pipe support types except type HS, and overlay zones, for all pipe support types, shall consist of Selected Backfill as defined in 1112 *Earthworks (Roadways)*. It shall be placed around the pipe to the dimensions shown in Figure 3.1.

Layers

All material shall be compacted in layers not exceeding 150 mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

Moisture content

At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Trench backfill

The remainder of the trench to the underside of the subgrade, or selected material zone as specified in 1112 *Earthworks (Roadways)*, shall be backfilled with material satisfying the requirements for embankment material as defined in 1112 *Earthworks (Roadways)*. Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in 1112 *Earthworks (Roadways)*.

Damage or misalignment to any culvert or drainage structure

When compacted adjacent to culverts or drainage structures, the Contractor shall adopt compaction methods which will not cause damage or misalignment to any culvert or drainage structure.

Any damage caused shall be rectified, and all costs of such rectification shall be borne by the Contractor.

Backfilling and compaction shall commence at the pipe or wall so as to confine remaining uncompacted material at commencement.

4 STEEL PIPES AND PIPE ARCHES**4.1 NESTABLE STEEL PIPE AND DRAINAGE UNITS****Specification**

Nestable steel pipes and drainage units shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the Drawings.

Galvanised steel sheets

The galvanised steel sheets used in manufacture shall comply with AS 1397 for steel base grade G250 and a minimum coating Class of Z600.

Protective treatment

Where specified, the pipes and drainage units shall be given a protective coating over the steel, after assembly of a coal tar epoxy paint or equivalent as approved by the Superintendent, to a thickness of 400 microns.

Field cuts

Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of zinc-rich organic primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15.

4.2 HELICAL LOCK-SEAM CORRUGATED STEEL PIPE**Specification**

Helical lock-seam corrugated steel pipe shall be supplied in accordance with AS 1761 and AS 1762 and shall be of the class and size as shown on the Drawings.

Galvanised steel sheets

The galvanised steel sheet used in manufacture shall comply with AS 1397 for steel based grade G250 and a minimum coating Class of Z600.

Protective treatment

Unless otherwise approved by the Superintendent, no part of the pipe shall incorporate steel strips which have been joined by welding.

Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of organic zinc-rich primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15.

Pipes and coupling bands shall be given a protective hot-dip coating of bitumen on both sides to AASHTO standard M190 or equivalent as part of the process of manufacturing.

4.3 BOLTED STEEL PIPES, PIPE ARCHES AND SPECIAL SHAPES**Specification**

Bolted steel pipes, pipe arches and special shapes shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the Drawings.

The corrugated pipe or plate shall be hot-dip galvanised on both sides after fabrication in accordance with the requirements for coating thickness and mass for articles in AS/NZS 4680.

Protective treatment

After assembly, all bolted steel pipes, pipe arches and special shapes shall be given a protective coating on the outside of the steel plate, of a coal tar epoxy paint complying with AS 3887 or equivalent paint approved by the Superintendent.

Invert plates shall be coated on the outside before they are placed on the pipe bed.

The plate surface shall be cleaned and degreased with a cleaning solution recommended by the protective coating manufacturer.

The protective coating shall be applied to give a uniform minimum dry thickness of 400 microns.

Any coating damaged shall be recoated by first cleaning any grease, mud or other foreign matter from the affected area. The area shall then be recoated so that the minimum dry thickness of the coating is 400 microns.

4.4 MATERIALS AND SURFACE TREATMENT

All steel pipes and pipe arches will require an Engineer's certification that the pipe materials and surface treatments are adequate to provide for installation and in-service loading as well as corrosion protection for a satisfactory design life of 100 years unless indicated otherwise on the Drawings.

Such certification shall address the chemistry of the soil, groundwater, stream and backfill material as specified in Material Against Steel Structures.

4.5 MATERIAL AGAINST STEEL STRUCTURES

Resistivity and pH

The severity of corrosive attack on steel structures will depend on the pH value and electrical resistivity of the soil surrounding the structure and the pH value of the water in the stream.

Besides meeting the normal requirements of the bedding, selected backfill materials and the materials used for embankment construction above the steel structures and within a horizontal distance from the structure equal to the height of the filling over the structure, the pH and resistivity limits as shown in Figure 4.1 will determine the level of corrosion protection required.

Notwithstanding the height of fill, embankment material within 6 m of the structure shall conform to the above requirements.

The pH and electrical resistivity of the material shall be determined in accordance with AS 1289.4.3.1 and AS 1289.4.4.1.

NATA Testing

The Contractor shall nominate the sources of the various materials and submit documentary evidence from a NATA registered laboratory that the representative samples conform to the requirements of this Clause and the protective treatment provided.

The samples shall be pretreated if necessary so as to represent the condition and grading when compacted and in service.

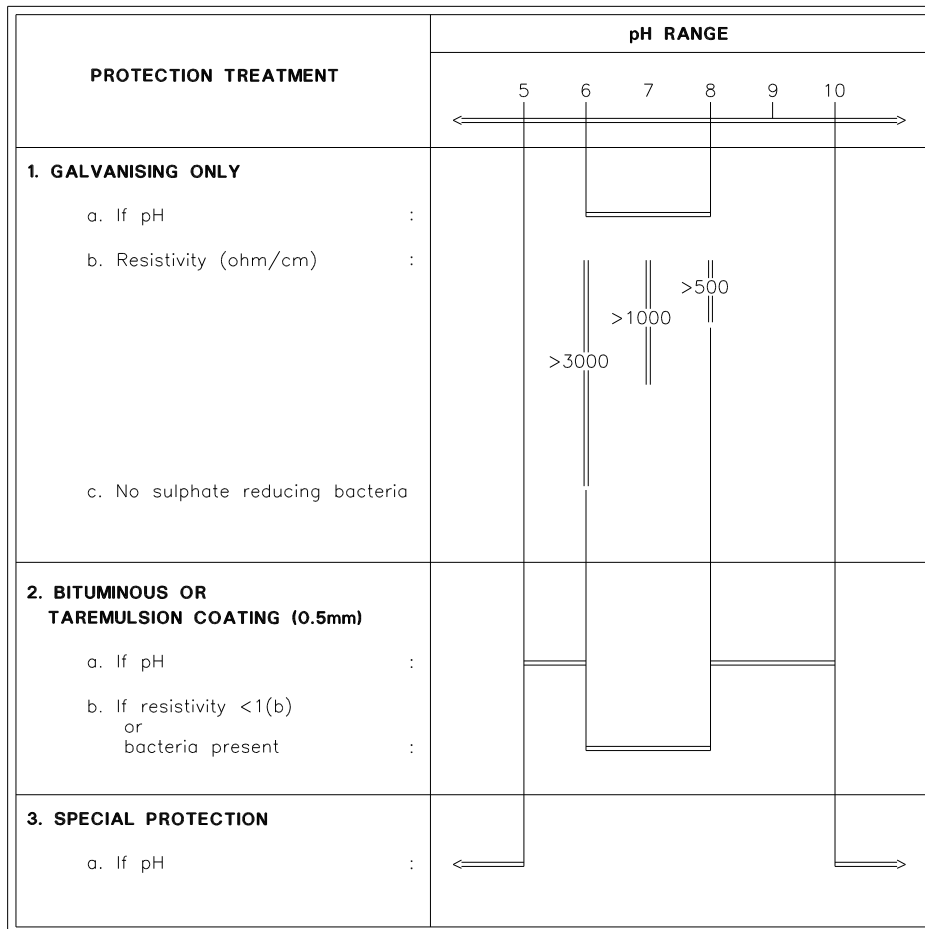


Figure 4.1 Corrosion protection requirements for steel structures

4.6 EXCAVATION AND FOUNDATION PREPARATION

Formation to subgrade level

Unless otherwise indicated on the Drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

Trench width select fill

The trench shall be excavated to a level 75 mm below the design invert and for a minimum width of 600 mm on each side of the structure.

Unsuitable material

Where unsuitable material, as determined by the Superintendent, is encountered at the foundation level, it shall be removed to a depth approved by the Superintendent.

The additional excavation shall be backfilled with material complying with, and compacted to, the requirements for HS3 pipe support as specified in Bedding.

Rock foundation

Where rock is encountered at the foundation level, the foundation shall be excavated for an additional depth of 250 mm, or 0.25 times the structure width, whichever is the lesser and for a width equal to the width of the structure.

The additional excavation shall be backfilled with material complying with, and compacted to, the requirements for HS3 pipe support as specified in Bedding.

4.7 BEDDING

Depth

Bedding shall meet the requirements of Bedding.

The thickness of uncompacted bedding material between the foundation and the outer surface of corrugation shall not be less than 75 mm.

The uniform blanket of loose material which provides the minimum 75 mm thick bedding, shall be placed on the shaped, compacted selected material foundation to allow the corrugations of the structure invert to bed in and become filled with the material.

4.8 LAYING

Assembly

The assembly of all corrugated steel pipes and pipe arches as well as helical lock-seam corrugated steel pipes shall be carried out in accordance with the manufacturer's recommendations.

These recommendations shall be submitted to the Superintendent before assembly or laying of the culverts is commenced.

Temporary bracing

If deemed necessary after consultation with the manufacturer, temporary bracing of corrugated steel pipes or pipe arches shall be carried out in accordance with the manufacturer's recommendations.

Joints

Method: Corrugated steel pipes or pipe arches shall be joined in accordance with the manufacturer's recommendations and AS 2041.

Ends to be rerolled: Where helical-lock seam corrugated steel pipes are to be joined, both ends of the join shall be rerolled with four annular corrugations of pitch 68 mm.

Coupling of the re-rolled ends shall be made in accordance with AS 1761 by using semi-corrugated bands.

Rubber ring joint seals shall be used in conjunction with the coupling bands except where specifically indicated otherwise in the Drawings.

Geotextile cover material: All joints or lap joints in pipes or pipe arches (excluding rubber ring joint coupling bands) shall be covered with strips of non-woven geotextile material, of minimum 250 mm width and of minimum mass 270 grams/m² in accordance with the requirements for geotextile in 1171 *Subsurface drainage*, to prevent loss of sand backfill or bedding into the pipe.

4.9 BACKFILL

Selected material

Compaction of the material in the side support and overlay zones shall comply with the requirements of Bedding except that the required relative compaction in the side support and overlay zones shall be 95% (AS 1289.5.4.1 standard compaction).

Backfill shall be placed around the steel pipe or structure, to a minimum dimension equal to the pipe width, on both sides.

Layers

All material shall be compacted in layers not exceeding 150 mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

Moisture content

At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Trench backfill

The remainder of the trench to the underside of the subgrade, or selected material zone as specified in 1112 *Earthworks (Roadways)*, shall be backfilled with material satisfying the requirements for embankment material as defined in 1112 *Earthworks (Roadways)*.

Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined 1112 *Earthworks (Roadways)*.

Distortion of structure shape

The Contractor shall check the shape of the culvert during backfilling to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure shall not vary from the manufacturer's specified dimensions by more than plus or minus 2% for pipes and pipe arches.

4.10 INVERT PROTECTION

Material

Where shown on the Drawings, the invert of corrugated steel pipes and pipe arches shall be protected using sprayed concrete.

Depth and width

The sprayed concrete shall be placed to a thickness of not less than 100 mm over the crest of the corrugations and to a width such that the bottom third of the pipe circumference is covered symmetrically about the invert of the pipe.

Scale removal

All foreign material shall be removed from the surface to be protected. Where corrosion has occurred all loose scale shall be removed.

Production, application and curing

The production, application and curing of sprayed concrete shall be in accordance with 0310 *Minor concrete work*.

Sprayed concrete reinforcement

The sprayed concrete shall be reinforced with a fabric of hard drawn steel wire 4 mm diameter with 200 mm square mesh.

The fabric shall be securely supported at a central location within the sprayed concrete by non-metallic supports.

Laps in fabric

Laps in fabric shall be 300 mm and a cover of 50 mm of sprayed concrete shall be provided to the fabric at all edges.

Cement slurry application

Immediately after placement of the sprayed concrete, all free water shall be removed and the surface coated with cement slurry.

Water flow

No water shall be allowed to flow over the surface of the sprayed concrete for twenty-four hours after the placement of sprayed concrete.

5 FLEXIBLE PIPES

5.1 MATERIALS

General

Flexible pipes shall be those covered by Australian Standard AS/NZS 2566.1 'Buried Flexible Pipelines Part 1: Structural Design.' This Standard is applicable to buried flexible pipes manufactured from homogeneous or composite material; of plain or structured wall construction; and plastic (UPVC, OPVC, ABS, GRP, Polyethylene) or metallic (Aluminium, Steel, Ductile Iron) materials of manufacture.

The size/type/class of the flexible pipeline shall be as shown on the Drawings.

Section 4 applies to corrugated metal pipes.

Embedment material

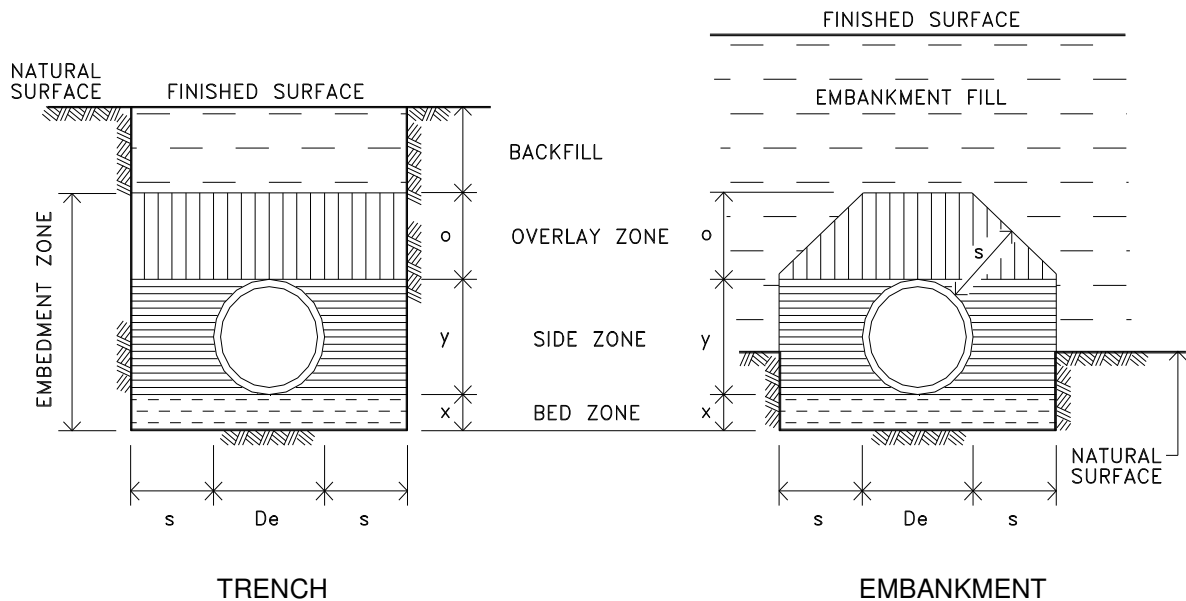
Embedment material in the bedding, side support and overlay zones shall be in accordance with this worksection, AS 2566.1 and AS 2566.2.

Unless otherwise specified, embedment material in the bedding, side support and overlay zones, as shown in Figure 5.1, shall be a cohesionless granular material having a grading, determined by AS 1141.11, no finer than Table 5.1 and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6.

Other aggregates, gravels and sands suitable for embedment material are those complying with Tables G2 and G3 of AS 2566.2.

Backfill material

Trench backfill material shall satisfy the requirements for embankment material as defined in 1112 *Earthworks (Roadways)*.



(Figure taken from AS 2566.2)

Figure 5.1 Pipe installation conditions

Table 5.1 Embedment material grading

Sieve size (mm)	Weight passing (%)
19.0	100
2.36	50–100
0.6	20–90
0.3	10–60
0.15	0–25
0.075	0–10

(Table taken from AS 2566.2, Table 5.5)

5.2 EXCAVATION AND BEDDING

Formation to subgrade level

Unless otherwise indicated on the Drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

Bedding dimensions

Figure 5.1 and Table 5.2 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions, unless otherwise indicated on the Drawings.

Compaction

Bedding zone material shall be placed and compacted in accordance with the requirements in Bedding except that the required relative compaction in the bedding zone shall be 95% (AS 1289.5.4.1 Standard compaction).

Table 5.2 Trench and embedment dimensions

Extreme external Dia (De)mm	Minimum dimensions (mm)			
	x	s	o	y
≥75 ≤150	75	100	100	Pipe dia.
>150 ≤300	100	150	150	Pipe dia.
>300 ≤450	100	200	150	Pipe dia.
>450 ≤900	150	300	150	Pipe dia.

Extreme external	Minimum dimensions (mm)			
	>900 ≤1500	150	350	200
>1500 ≤4000	150	0.25 De	300	Pipe dia.

Where multiple pipes are laid side by side, the minimum distance between the pipes shall be dimension 's' for the larger of adjacent pipes.

Table 5.3 Minimum relative compaction

Embedment material	Test method	Compaction	
		Traffic loading	No traffic loading
Cohesionless	Density index (AS 1289)	70%	60%

(Taken from AS 2566.2 Table 5.5)

5.3 EMBEDMENT AND LAYING

Embedment

Embedment of the flexible pipes shall be in accordance with the requirements of the Drawings, Section 5 of AS/NZS 2566.2 and to the dimensions shown in Figure 5.1.

Laying and Jointing

Pipes shall be laid and joined in accordance with the manufacturer's Specifications, and to any Australian Standards relevant to installation of the type of pipe.

Pipes with markings indicating the crown or invert of the pipe, or the required direction of flow in the pipe shall be laid strictly in accordance with the markings.

All pipes shall be lowered into the trench without being dropped

Bulkheads

Bulkheads or trenchstops shall be constructed where required in accordance with Table 5.7 of AS 2566.2. Bulkheads shall be constructed in accordance with 1354 *Drainage structures*.

Approval of bedding zone material and pipeline placement

The Superintendent's approval of the bedding zone material compaction and positioning and jointing of the pipeline is required.

5.4 BACKFILL

Embedment compaction

Compaction of the material in the side support and overlay zones shall comply with the requirements of Bedding except that the required relative compaction in the side support and overlay zones shall be in accordance with Table 5.3.

Layers

All material shall be compacted in layers not exceeding 150 mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

Moisture content

At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60% nor more than 95% of the apparent optimum moisture content, as determined by AS 1289.5.7.1 (standard compaction).

Trench backfill

The remainder of the trench to the underside of the subgrade, or selected material zone as specified in 1112 *Earthworks (Roadways)*, shall be backfilled with material satisfying the requirements for embankment material as defined in 1112 *Earthworks (Roadways)*.

Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in 1112 *Earthworks (Roadways)*.

6 LIMITS AND TOLERANCES

The limits and tolerances for materials and product performance related to the various Clauses in this worksection are summarised in Table 6.1.

Table 6.1 Summary of limits and tolerances

Activity	Limits/Tolerances	Worksection clause Reference
Culverts		
- Grade line	± 10 mm	Tolerances
- Horizontal alignment	± 10 mm	Tolerances
Concrete pipes		
Bedding		
- Bed and haunch zone compaction	Table 3.3	Bedding
- Backfill		-
- Side and overlay zone compaction	Table 3.3	Backfill
Steel pipes		
Backfill		
- Side and overlay zone compaction	Table 3.3, HS3	Backfill
- (Pipe/Structure distortion		-
. Horizontal and vertical variation	< 2% of specified dimensions	Backfill
Invert protection sprayed concrete		
- Over crest of corrugations over bottom third of pipe circumference	> 100 mm	Invert Protection
Flexible pipes		
Bedding Zone Compaction	≥95%	Excavation and Bedding
Backfill—PVC Pipes		
- Side and overlay zone compaction	Table 5.3	Flexible pipes (Backfill)

7 MEASUREMENT AND PAYMENT

7.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this worksection on a Schedule of Rates basis in accordance with Pay Item 1352.1.

A lump sum price for this item shall not be accepted.

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

Subsoil drains at pits and headwalls are measured and paid in accordance with this worksection and not 1171 *Subsurface drainage*.

Selected material around pipes, trench backfill in embankment material to the underside of the selected material zone and selected material backfill within the selected material zone where approved, is measured and paid in accordance with this worksection and not 1112 *Earthworks (Roadways)*.

Sprayed concrete invert protection is measured and paid in accordance with this worksection and not 0310 *Minor concrete works*.

Miscellaneous minor concrete work not included in the pay items in this worksection shall be in accordance with pay items described in 0310 *Minor concrete works*.

Bulkheads are measured and paid in accordance with 1354 *Drainage structures*.

7.2 PAY ITEM

1352.1 Pipe culverts

The unit of measurement shall be the linear metre measured along the centreline of each particular type, class and size of stormwater drainage pipe culvert and shall be the plan length between centres of gully pits or faces of headwalls.

The schedule rate shall include:

- Supply
- Survey and setting out
- Bedding
- Jointing (including connections)
- Subsoil drains at pits and headwalls
- Temporary bracing and strutting
- Bituminous painting
- Sprayed concrete lining and other protective measures
- Selected material backfilling
- Embankment material trench backfilling