

PART R04**INSTALLATION OF STORMWATER DRAINAGE****CONTENTS**

1. GENERAL
2. MATERIALS
3. EXCAVATION
4. INSTALLATION OF PIPES AND BOX CULVERTS
5. BACKFILL OF TRENCHES AND REINSTATEMENT OF EXISTING PAVEMENTS
6. EXCAVATION AT INLETS AND OUTLETS
7. CAST-IN-PLACE AND PRECAST CONCRETE DRAINAGE STRUCTURES
8. MINOR ACCESSES AND JUNCTIONS
9. SUBSOIL DRAINAGE
10. EXISTING DRAINAGE CONNECTIONS
11. SEDIMENTATION
12. TREATMENT OF REDUNDANT STORMWATER INFRASTRUCTURE
13. TEST PROCEDURES
14. HOLD POINTS
15. MEASUREMENT
16. VERIFICATION REQUIREMENTS AND RECORDS

ATTACHMENT R04A: CULVERT INSTALLATION IN FILL

1. GENERAL

- .1 This Part specifies the requirements for the installation of stormwater drainage infrastructure, including concrete pipes, box culverts, concrete drainage structures, subsoil drainage and miscellaneous stormwater drainage works. It also includes the installation of pipes and box culverts installed for purposes other than drainage. The works must be carried out in accordance with the requirements specified in the **Contract Specific Requirements** or on the drawings.
- .2 "**Unsuitable Material**" has the meaning defined in Part R10 "Construction of Earthworks".
- .3 Concrete, reinforcing and formwork used in drainage works must comply with Division CC "Concrete". Drainage work under new pavement must be completed prior to the construction of new pavement.
- .4 Documents referenced in this Part are listed below:

AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1428.4.1	Design for access and mobility Part 4.1: Means to assist the orientation of people with vision impairment -Tactile ground surface indicators
AS 1554.1	Welding of Steel Structures
AS 1597.1	Precast reinforced concrete box culverts - Small Culverts (not exceeding 1200 mm span and 1200 mm height)
AS 1646	Rubber Joint Rings for Water Supply, Sewerage and Drainage Purposes
AS 2758.1	Concrete Aggregates
AS 3610	Formwork for Concrete
AS 3972	Portland and blended cements
AS 3996	Metal Access Covers, Road Grates and Frames
AS 4058	Precast Concrete Pipes
AS 4139	Fibre Reinforced Concrete Pipes and Fittings
AS 4198	Precast Concrete Access Chambers for Sewerage Applications
AS 4671	Steel Reinforcing Materials
AS 4680	Hot-dip Galvanised (Zinc) Coatings on Fabricated Ferrous Articles
AS 9001	Quality management systems - Requirements

- .5 The work must be undertaken in accordance with the following drawings:

Drawing		Amendment No.
<u>Drawing No. S-4002, Headwalls:</u>		
sheet 17	Driveable, Type 1 RC Pipe and Box Culverts up to 600 mm high	0
sheet 18	Driveable, Type 2 RC Pipe and Box Culverts up to 600 mm high	0
sheet 19	for Box Culverts skew angle 0 - 20°	0
sheet 20	for Box Culverts skew angle 21 - 45°	0
sheet 21	for Pipe Culverts 450 - 900 mm diameter, skew angle 0 – 20°	0
sheet 22	for Pipe Culverts 1050 - 1800 mm diameter, skew angle 0 - 20°	0
sheet 23	for Pipe Culverts 450 - 900 mm diameter, skew angle 21 - 45°	0
sheet 24	for Pipe Culverts 1050 - 1800 mm diameter, skew angle 21 - 45°	0
<u>Drawing No. S-4080, Junction Boxes and Gullies:</u>		
sheet 1	Single Pipe Junction Boxes, Types A, B, C	5
sheet 2	Side Entry Gullies	9
sheet 3	Combined Junction Boxes and Side Entry Gullies	9
Sheet 6	Grated Field Pit	1
Sheet 7	Grated Inlet Pit for Concrete Side Drain	0
Sheet 13	Special Combined Junction Boxes with Side Entry Gullies or Grated Inlet.	0
<u>Drawing No. S-4065:</u>		
sheet 1	Concrete Channels and Grate	6

- .6 DPTI standard drawings are available from the following web site: <http://www.dpti.sa.gov.au/standards>.

2. **MATERIALS**

- .1 Concrete pipes, box culverts and precast drainage structures must comply with Part R03 "Supply of Pipes, Box Culverts and Drainage Structures".
- .2 Motar must comprise of one part cement (complying with AS3972) and three parts sand (complying with the requirements for fine aggregate in AS 2758.1).

3. **EXCAVATION**

General

- .1 Excavation must comply with R07 "Trench Excavation and Backfill". Any clearing and grubbing in the line of the drain, including cutting back of any tree branches, must conform to the requirements of Part CH50 "Environmental Protection Issues".
- .2 Over-excavation, taken below the levels specified, must be filled with the specified bedding material placed in accordance with Clause 4.4 "Bedding" except that for large box culverts, over-excavation must be filled with Grade 10 concrete.

Support of Utility Services in Excavations

- .3 Where Utility Services are encountered in an excavation, the Contractor must comply with the requirements of Part CH40 "Utility Services" (available from https://www.dpti.sa.gov.au/contractor_documents/specifications_-_division_CH), which includes liaising with the appropriate Service Authority to obtain any requirements for support of the Utility Services and comply with those requirements.

Redundant Culverts and Drainage Structures

- .4 Where pipe / box culverts or drainage structures become redundant, the Contractor must ensure that the Works cannot be damaged in the future by water leaking from the redundant culverts / structure and entering the earthworks. Unless specified otherwise, the following treatments must be applied at a minimum:
- (a) removal of any redundant culverts / structure which are encountered during excavation and backfill in accordance with Part R07 "Trench Excavation and Backfill"; and / or

- (b) any pipe / box culvert which is cut or broken during excavation is plugged with Grade 20 concrete to achieve a minimum penetration into the culvert of 500 mm and completely sealing the end of the culvert.
- .5 Where specified, the Contractor must remove any other existing pipes, culverts and drainage structures (outside of the area of excavation) and backfill the resultant voids in accordance with Clause 5 "Backfill and Reinstatement of Existing Pavements".

Excavated Material

- .6 Material excavated for drainage construction must be treated in accordance with the requirements of Part R10 "Construction of Earthworks".

Inspection after Excavation

- .7 Following completion of excavation, a **HOLD POINT** shall apply.
- .8 If foundation preparation concrete is not used, the Contractor must undertake proof rolling to verify the strength of the subgrade and identify any unsuitable material. For pipes, small box culverts and drainage structures, 2 passes of a vibrating plate compactor (Wacker Model BPU 3345 or similar) must be used. For large box culverts, a roller with a minimum weight of 1 tonne must be used. Where foundation preparation concrete is to be placed proof rolling will not be required.
- .9 The Contractor must remove and replace any unsuitable material which has been identified.

4. INSTALLATION OF PIPES AND BOX CULVERTS

Damage During Installation

- .1 The Contractor must:
 - (a) verify that the load capacity of the pipes / box culverts (and associated structures) will not be exceeded during installation;
 - (b) ensure that pipes / box culverts are not damaged during transportation, handling, placement, backfilling and subsequent construction activities; and
 - (c) if necessary, place sufficient protective material (in accordance with the Manufacturer's Instructions and design requirements) over the pipes / box culverts to prevent damage during construction activities.
- .2 Any damage to reinforced concrete pipes must be classified in accordance with AS 4058 Clause 3.4 "Workmanship and Finish" and subject to assessment in accordance with Table 4.2.

TABLE 4.2 ACCEPTABILITY OF DEFECTS		
Defect Type	Pipe Wall	Joint Surface
1	Acceptable	Not Applicable
2	Acceptable after completion of approved repair	Not Applicable
3	Reject	Not Applicable
4	Acceptable after completion of approved repair	Acceptable after completion of approved repair
5	Acceptable after completion of approved repair	Acceptable after completion of approved repair
6	Reject	Reject
7	Reject	Reject

- .3 Fibre reinforced pipes must be rejected if fractures and cracks wider than 0.1 mm and deeper than 0.3 mm are present.

Dimensions

- .4 The length shown on the drawings is:
 - (a) where pipes / box culverts terminate at headwalls, the length measured along the centreline of the pipes / box culverts units;
 - (b) at other locations, the plan length measured from centre to centre of the drainage structure (unless otherwise shown).

- .5 Nominal design gradients are calculated using the above lengths. Gradients are quoted in drainage schedules on the drawings are for guidance only and gradients necessary to achieve quoted invert levels may vary from the quoted gradients, depending on the overall dimensions of drainage structures.

Bedding

- .6 Bedding must be Sa-C Type C Sand, spread to a minimum compacted depth in accordance with the following:
- (a) 150 mm for pipes diameter 1500 mm or greater.
 - (b) 125 mm where verification testing is to be undertaken.
 - (c) 100 mm otherwise.
- .7 The Contractor must arrange for trials to be conducted to verify a method of achieving the specified compaction.
- .8 Prior to use of the method, a **HOLD POINT** shall apply.
- .9 For pipes the bedding sand must be rammed under both sides of the haunches of the pipe to a height of one third the diameter of the pipe. For large box culverts, the foundation area must be prepared in accordance with the requirements shown on the drawings.

Placement of Concrete Pipes

- .10 Concrete pipes must be placed and jointed in accordance with the Manufacturer's Instructions. Pipes must be placed with the female end upstream and with lifting holes (if any) uppermost. Lifting holes in pipes must be filled with plugs supplied by the pipe manufacturer for that purpose.

Placement of Small Box Culverts

- .11 Small box culverts must be placed so that the joints between base slabs are located half way between the joints on the crowns. Mortar or pipe sealant must be used to seal the joint between the crown units and bases.
- .12 A bituminised tape (Densopol 60HT or equivalent) must be used in accordance with the Manufacturer's Instructions to seal the joints of abutting crown units. Taping must be done immediately prior to backfilling to minimise the risk of separation of the tape from the concrete surfaces.
- .13 Lifting hooks must be cut off with a cutting disc, with both steel and concrete being ground away at least 5 mm below the surrounding concrete surface. The surface must then be finished flush with an epoxy putty (Bauer Gemcrete 205 or equivalent) to give a minimum cover of 5 mm over the remnant lifting hook.

Placement of Large Box Culverts

- .14 Unless specified otherwise, crown units must not be placed on the cast-in-place slab for a period of 48 hours after placement of the base slab concrete.
- .15 No superimposed loads other than the culvert crown units must be permitted on the base slab. If the Contractor intends loading the base slab with vehicular or other traffic, full calculations demonstrating that the concrete has sufficient capacity to support such loads must be provided to the Principal.
- .16 Immediately prior to positioning crown units onto the base slab, a 15 mm layer of cement mortar (1 part cement : 3 parts sand) must be placed into the recesses in the top of the base slab onto which the crown units are to be placed. Excess mortar must be removed to a minimum of 20 mm below the level of the base slab.
- .17 Following completion of the installation of the crown units and prior to commencement of backfilling, a stiff cement mortar (1 part cement: 3 parts sand) must be placed into the remaining spaces of the recess as shown on the drawings.
- .18 Lifting hooks must be cut off with a cutting disc, with both steel and concrete being ground away at least 5 mm below the surrounding concrete surface. The surface must then be finished flush with epoxy putty (Bauer Gemcrete 205 or approved equivalent) to give a minimum cover of 5 mm over the remnant lifting hook.

Junctions

- .19 Where a junction is shown on the drawings it must be constructed as a bandaged joint in accordance with Clause 4.8 "Extension of Existing Pipes / Box Culverts". Backfill must not be placed against junctions until the following day.

- .20 The construction of the joint must provide an unobstructed waterway of the specified dimensions in each of the Culverts after completion of the joint.

Cutting Pipes / Box Culverts

- .21 Cutting of pipes / box culverts to provide appropriate lengths at joints and drainage structures must be done in such a manner that it does not affect the structural capacity of the pipes / box culverts. Reinforcement exposed during cutting of pipes / box culverts must be painted with a thick highbuild epoxy (Megapoxy P1 or approved equivalent) applied in accordance with the Manufacturer's Instructions.

Extension of Existing Pipes / Box Culverts

- .22 Where existing pipes are to be extended, any existing headwalls or drainage structures must be demolished and disposed of by the Contractor.
- .23 Cutting of existing pipes must be carried out as specified in Clause 5.7 above. Bandaged joints must be constructed and the joint strengthened with a concrete fillet (bandage) around the pipes forming the joint and extending at least 300 mm from the junction along the surface of each pipe. The fillet must be a minimum of 100 mm thick and must be reinforced with SL62 mesh to AS 4671 completely encircling both pipes forming the joint, lapped 300 mm and extending the full length of the fillet.
- .24 Backfill must not be placed against fillet joints until the following day.
- .25 The construction of the joint must provide an unobstructed waterway of the specified diameter in each of the pipes after completion of the joint.

5. BACKFILL OF TRENCHES AND REINSTATEMENT OF EXISTING PAVEMENTS

- .1 Backfill of trenches must comply with Part R07 "Trench Excavation and Backfill". Pipes / box culverts placed in fill must be protected from damage by construction machinery.
- .2 Reinstatement of any existing pavements which are to be retained must comply with Part R08 "Reinstatement of Existing Pavements".

6. EXCAVATION AT INLETS AND OUTLETS

- .1 The Contractor must excavate as necessary to match the pipe / box culvert invert to the adjoining drainage channels or natural surface.
- .2 Unless shown otherwise on the drawings, the excavation must be uniformly graded at a maximum grade of 2% or to the boundary of the road reserve, whichever extends the least. The excavation must be the full width of the pipe / box culvert apron, with batters not steeper than 6 horizontal to 1 vertical.

7. CAST-IN-PLACE AND PRECAST CONCRETE DRAINAGE STRUCTURES

Scope

- .1 If the Principal has provided a design for the drainage structures, it will be based on cast-in-place structures and the use of precast drainage structures must be at the Contractor's risk. The information regarding location of existing culverts and services may not be sufficiently accurate for the use of precast structures. Where normal class concrete is specified on the drawings, the concrete must comply with Part CC26 "Normal Class Concrete".
- .2 Junction boxes must have inspection pit covers as detailed on the drawings. Notwithstanding any note on the drawings to the contrary, junction boxes must be provided with inspection pit covers complying with AS 3996, Class D or AS 4198, Class H as appropriate.
- .3 Inspection pit covers must be installed flush with the final surface.
- .4 Grated junction boxes and field gullies must include covers and frames. Grates and frames must be fabricated to the dimensions shown on Drawing No. 4065, sheet 1. Welds must be GP in accordance with AS 1554.1.
- .5 Side entry pit covers for single or multiple 900 mm x 450 mm openings must be either:
- (a) Gatic heavy duty cast iron cover, GSEC945C;
 - (b) Everlevel ductile iron (spherical graphite) cover, SEC945SG; or
 - (c) PCP ductile iron cover, SEC945CIHD.
- .6 Exposed steel work other than cast iron must be hot-dip galvanised in accordance with AS 4680.

Foundation Preparation for Drainage Structures

- .7 Where detailed on the drawings, foundation preparation concrete must be placed below cast-in-place structures.
- .8 Bedding must be in accordance with Clause 4.4 "Bedding".
- .9 Excavation below the specified levels must be filled with either Sa-C Type C Sand and compacted to the same standard as the bedding or with Grade 10 concrete where foundation preparation concrete is to be placed under the structure.

Formwork

- .10 Both internal and external surfaces of walls must be formed. If the Contractor can demonstrate that the ground is stable and will stand vertically without any distress or contamination of the concrete, the concrete may be cast against the ground, provided that:
 - (a) the wall thickness is increased by at least 50 mm over that detailed; and
 - (b) the cover to reinforcement adjacent to the ground is increased by at least 50 mm.
- .11 External formwork must be used for the top portion of junction boxes and gullies contained within the road pavement in all cases. Formwork must be used for all exposed faces of headwalls and drainage structures.

Precast Drainage Structures

- .12 Where a precast drainage structure is used, the external joint with the pipes / box culverts must be strengthened with a concrete fillet encircling the culvert at the joint. The fillet must be a minimum of 100 mm thick 10 MPa concrete (or rapid mix equivalent). The inside joint must be rendered flush with the inside wall of the structure with mortar (1 part cement and 3 parts sand) or equivalent.

8. MINOR ACCESSES AND JUNCTIONS

- .1 Pipes / box culverts used under any minor accesses and junctions for side drains must be placed in the centre of the side drain with the same grade as the side drain. The pipes / box culverts must allow unimpeded flow of water in the side drain.

9. SUBSOIL DRAINAGE

- .1 This Clause only applies where the construction of subsoil drainage is specified on the drawings or in the **Contract Specific Requirements**.
- .2 Subsoil drainage must be installed and the trench backfilled in accordance with the Manufacturer's Instructions. Following placement of the subsoil drain and prior to backfilling, a **HOLD POINT** shall apply.
- .3 Flushout points must be provided where shown on the drawings. Flushout points must consist of 100 mm diameter UPVC pipe connected to the subsoil drain and rising vertically to approximately 100 mm below the finished surface level and fitted with a threaded cap. A removable concrete cover (Everlevel IP100CF or equivalent) must be provided.

10. EXISTING DRAINAGE CONNECTIONS

- .1 Existing stormwater connections from private properties and local government systems must be maintained at all times.

11. SEDIMENTATION

- .1 Soil and any other material entering the pipes / box culverts or drainage structures must be removed so that the pipe / box culvert provides an unobstructed waterway of the specified dimensions at all times up to the completion of all of the work on the Site.
- .2 Any sedimentation prevention measures (such as sediment traps, silt fences and straw bales) must be fully functional at the completion of all of the work on the Site.

12. TREATMENT OF REDUNDANT STORMWATER INFRASTRUCTURE

- .1 Where pipe / box culverts or drainage structures become redundant, the Contractor must ensure that the Works cannot be damaged in the future by water leaking from the redundant culverts / structure

and entering the earthworks. Unless specified otherwise, the following treatments must be applied at a minimum:

- (a) removal of the redundant culverts / structure and backfill in accordance with Part R07 "Trench Excavation and Backfill"; or
- (b) a pipe / box culvert is plugged with Grade 20 concrete to achieve a minimum penetration into the culvert of 500 mm and completely sealing the end of the culvert.

13. **TEST PROCEDURES**

- .1 The Contractor must use the following test procedures (refer http://www.dpti.sa.gov.au/contractor_documents) to verify conformance with the Specification:

TEST		PROCEDURE NO.
Sampling of Soil, Aggregates and Rocks		TP 226
Preparation of Samples		AS 1289.1
Site Selection by Stratified Random Technique		AS 1289.1.4.2
Field Density:	Nuclear Method	AS 1289.5.8.1
Moisture Content:	Oven Drying Method	AS 1289.2.1.1
	Microwave Method	AS 1289.2.1.4
Maximum Dry Density:	Modified Compaction	AS 1289.5.2.1
	Rapid Method	TP 165 ⁽¹⁾
Dry Density Ratio		TP 320

⁽¹⁾ This test may only be used for control testing, not for verification testing.

14. **HOLD POINTS**

- .1 The following is a summary of Hold Points referenced in this Part:

CLAUSE REF.	HOLD POINT	RESPONSE TIME
3.7	Inspection after excavation	1 working day
4.8	Prior to use of compaction method for bedding	1 working day
9.	After placing subsoil drain and prior to backfilling	1 working day

15. **MEASUREMENT**

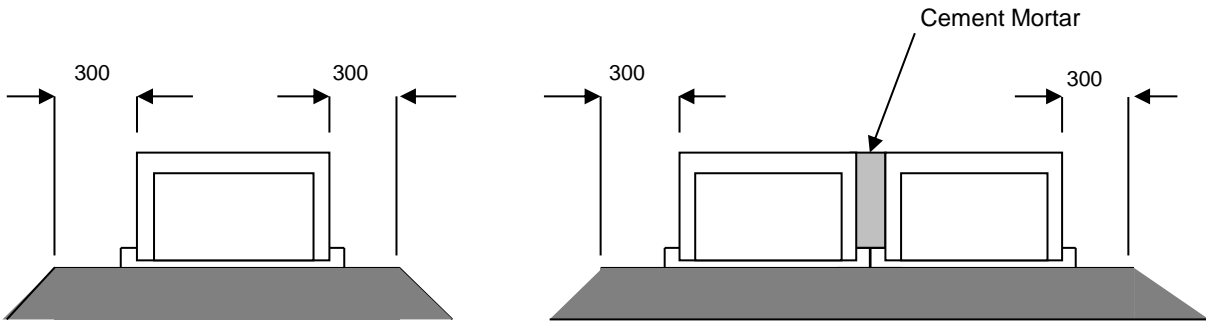
- .1 If measurement is required for the purpose of payment, the measurement of pipes / box culverts must be based on the length of installed Culvert and the measurement of kerb and gutter must include the gutter across the openings of gullies (which may include deflector vanes).

16. VERIFICATION REQUIREMENTS AND RECORDS

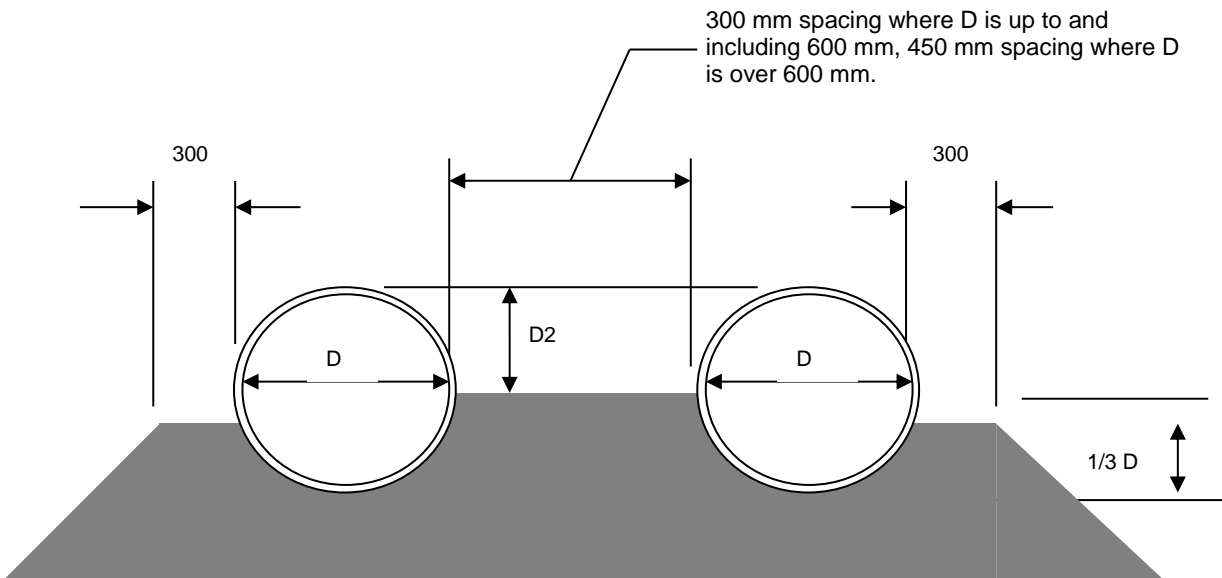
.1 The Contractor must supply written verification that the following requirements have been complied with and supply the verification with the lot package.

CLAUSE REF.	SUBJECT	PROPERTY	TEST PROCEDURE	TEST FREQUENCY	ACCEPTANCE LIMITS
4.5.3	Placement of Large Culverts: dimensions, level and position	Placement tolerances	As specified in Part CH30	As specified in Part CH30	As specified in Clause 310.5 "Tolerances".
4.4	Culvert Bedding	Compaction	TP 320	The Contractor must develop a method specification in accordance with Clause 5.3	Not less than 90%
5.	Backfill	Compaction	TP 320	Refer Part R06	Refer Part R06
7.	Drainage Structures: Concrete Requirements	Concrete Requirements, vide Division 3 "Concrete"	As specified in Division CC "Concrete"	As specified in Division CC "Concrete"	As specified in Division CC "Concrete"
7.	Placement of Drainage Structures: dimensions, level and position	Variation in cross-sectional dimensions:	As specified in Part CH30	As specified in Part R10	Within \pm 6 mm of specified dimension
		Misplacement from specified position:	As specified in Part CH30	As specified in Part CH30	Within \pm 20 mm of specified position
		Permissible surface irregularities:	As specified in Part CH30	As specified in Part CH30	Less than 10 mm
		Variation of reduced levels of invert from specified level:	As specified in Part CH30	As specified in Part CH30	Within \pm 10 mm of specified position, with the proviso that, notwithstanding tolerances, the invert of the structure must not impede the gravity flow of water into or from the structure.
9	Subsoil Drainage: level and position	Misplacement from horizontal position	Tape Measure	Every 10 m	Within \pm 100 mm of specified position
		Variation from specified level	Surveyors Level	Every 10 m	Within \pm 30 mm of specified level; with the proviso that, notwithstanding tolerances, gravity flow of water to the drainage outlet must be provided

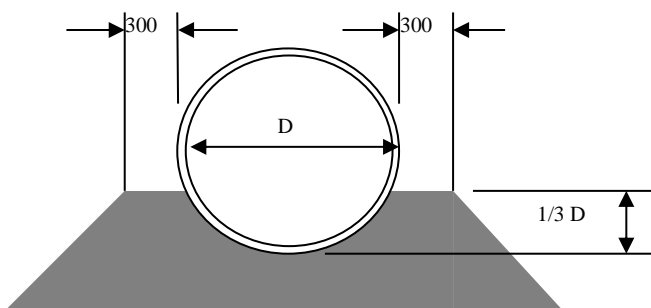
ATTACHMENT R04A
CULVERT INSTALLATION IN FILL



SINGLE AND MULTIPLE BOX CULVERTS



MULTIPLE PIPES



SINGLE PIPES

NOTE:

1. Not to scale.
2. All dimensions in millimetres.
3. D = Internal pipe diameter.
4. Refer to specification for bedding and backfill requirements