

# Engineering Construction Specification C24 Open Drains

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This document is a modified version of AUS-SPEC 1121 Open Drains October 2018 version

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# 1 General

## 1.1 Responsibilities

### 1.1.1 General

Requirement: Provide open drains, including unlined and lined open drains, as documented.

## 1.2 Cross references

### 1.2.1 General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- *C01 General requirements (Construction)*
- *C02 Quality management (Construction)*
- *C03 Control of traffic*
- *C04 Control of erosion and sedimentation (Construction)*
- *C05 Clearing and grubbing*
- *C06 Earthworks (Road reserve)*
- *C23 Stormwater drainage (Construction)*
- *C25 Pipe drainage*
- *C26 Precast box culverts*
- *C27 Drainage structures*
- *C28 Auxiliary concrete works*
- *C29 Landscape - road reserve and street trees*
- *Council's Standard Drawings*

## 1.3 Interpretation

### 1.3.1 Definitions

General: For the purposes of this worksection the following definitions apply:

- Open drains: All drains other than pipe and box culverts and include catch drains, channels (gutters) and kerbs and channels (gutters).

## 1.4 Submissions

### 1.4.1 Authority approvals

Road opening permit: Submit an application to Council for approval for any works in the road reserve (Section 138 Application), including the following:

- Location of services.
- Opening and compaction specifications: To the *C13 Road openings and restoration* worksection.

### 1.4.2 Execution details

Survey: Submit set-out survey of drainage system.

Set-out of open drains: Submit details of any proposed changes to the location, length and design levels to suit construction procedures.

Temporary drainage: Submit details of procedures/devices to maintain effective drainage of the works area during construction.

Trees and rock outcrops: Submit a diversion proposal, if trees marked for preservation or rock outcrops occur in the line of the open drain.

### **1.4.3 Products and materials**

Proprietary products: Submit the manufacturer's technical data.

### **1.4.4 Samples**

Joint fillers and sealants: Submit a sample of the proposed preformed joint filler.

Wire mattresses: Submit a sample of the proposed type of mattress and a schedule of locations.

Geotextile: Submit a sample of the proposed geotextile material and the manufacturer's recommendations for installation.

Proprietary products: submit details of proposed proprietary product such as turf or seed blends

### **1.4.5 Tests**

Results: Submit results of testing to **ANNEXURE – MAXIMUM LOT SIZE AND MINIMUM TEST FREQUENCIES.**

## **1.5 Inspections**

### **1.5.1 Notice**

General: Give notice so that inspection may be made of the following:

- Set-out of open drains: Set-out.
- Salinity prevention: Location of open drains after set-out.
- Excavation:
  - Grade to open drains.
  - Backfill of excavation below the level of the natural channel.
  - Surplus material disposal.
- Catch drains: Location of drains.
- Table drains: Location of drains, swales and depressed medians after completing earthworks.
- Concrete lining: Location of weepholes.
- Stone pitching: Bedding material.
- Wire mattresses: Completed installation.
- Turfing: completed seeding

## **2 Materials**

### **2.1 Concrete**

#### **2.1.1 General**

Concrete properties and delivery, placing, compaction, finishing, curing and protection: To the *C28 Auxiliary concrete works* worksection.

### **2.2 Proprietary products**

#### **2.2.1 General**

Requirement: Conform to the manufacturer's recommendations.

## 2.3 Wire mattresses

### 2.3.1 General

Requirement: Provide wire mattresses, refer to Council's Standard Drawings.

Diaphragms: Divide mattress into cells not exceeding 600mm centres.

## 2.4 Batter drains

### 2.4.1 General

Material: Half round steel pipes or precast nestable concrete units, as documented.

## 2.5 Geotextile

### 2.5.1 General

Type: Non-woven geotextile conforming to Austroads AGPT04G.

### 2.5.2 Geotextile strength and filtration requirements table

Application	Geotextile strength class <sup>(1)</sup>	EOS and flow rate requirements for $D_{15} \leq 75 \mu\text{m}$ <sup>(3)</sup> (predominantly low permeability soils including clays and silts)	EOS and flow rate requirements for $D_{15} > 75 \mu\text{m}$ <sup>(3)</sup> (predominantly pervious granular soils)	Filtration class
Drainage and separation behind retaining structures, including rock filled mattresses and joints of pipes and arches.	C	$\text{EOS} \leq 120 \mu\text{m}$ <sup>(2)</sup> $Q_{100} \geq 30 \text{ L/s/m}^2$ <sup>(3)</sup> $\psi \geq 0.3 \text{ s}^{-1}$	$\text{EOS} \leq 250 \mu\text{m}$ <sup>(2)</sup> $Q_{100} \geq 50 \text{ L/s/m}^2$ <sup>(3)</sup> $\psi \geq 0.5 \text{ s}^{-1}$	2

Source: RMS R63.

(1) Geotextile strength class for survivability for the given application. Geotextile survivability refers to the ability of the geotextile to withstand the installation stresses during construction. It is related to the construction method, subgrade condition, backfill material including stone size, and other factors.

(2) Equivalent opening size (EOS), defined as  $O_{95}$ , taken to be the mean value of the test results in conformance with AS 3706.1 and AS 3706.7. It is recognised that wet sieving generally results in lower EOS values than dry sieving.

(3)  $Q_{100}$ , the flow rate under 100 mm constant head and permittivity ( $\psi$ ) determined in conformance with AS 3706.9.

### 2.5.3 Delivery and storage

Delivery: Deliver to site in the manufacturer's original packing, at least 14 days prior to before commencement of installation and legibly marked to show type and batch number.

Storage: Store above ground, under protective cover or wrapped in waterproof, opaque UV protective sheeting to the manufacturer's recommendations.

## 2.6 Testing

### 2.6.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

Quality verification: If material/product quality verification can be obtained from the supplier, documented tests need not be repeated.

## 3 Execution

### 3.1 Establishment

#### 3.1.1 General

Survey control: Provide for the following:

- Mapping and pegging the drainage system.
- Locating components.

Survey data: Provide data for the set-out of gradients, open drains and construction to tolerances.

#### 3.1.2 Set-out of open drains

Requirement: Identify and set out the location and levels of the open drains.

#### 3.1.3 Temporary drainage during construction

Dams and diversions: Do not, temporarily or permanently, dam or divert existing watercourses.

Material and equipment: Locate material and equipment clear of watercourses or secure to prevent danger or damage due to large runoff flows.

Swales and buffer strips: Protect during construction or make use of the swale as a temporary measure. Provide geotextile with 50 mm topsoil and instant turf laid perpendicular to the flow path.

Stabilisation of topsoil areas: If required, stabilise the topsoil with hydroseed immediately after earthworks to the *C29 Landscape - road reserve and street trees* worksection.

#### 3.1.4 Trees and rock outcrops

General: If trees marked for preservation or rock outcrops occur in the line of the drain, give notice.

### 3.2 Open drains

#### 3.2.1 General

Clearing: To the *C05 Clearing and grubbing* worksection.

Trees and rock outcrops: Gain approval to divert the drain where trees marked for preservation, where trees exceeding 1m girth at 500mm from ground level or rock outcrops occur. This is a HOLD POINT.

Removal of topsoil and unsuitable material: To the *C06 Earthworks (Road reserve)* worksection.

Salinity prevention: Locate open drains to minimise ingress of surface water into the groundwater table and to prevent salinity degradation of adjacent land.

Discharge: Extend open drains to natural drainage depressions, culverts, or pits connected to underground drainage systems. Follow existing watercourses and depressions in the natural surface.

Waterways outside the site: Do not disturb.

### **3.2.2 Excavation**

Profile: V-shaped or trapezoidal with a minimum depth of 300 mm and minimum waterway area 0.2 m<sup>2</sup> or as documented.

Grade: Minimum 0.5% or as documented.

Trimming: To a uniform surface free of irregularities.

Compaction of foundation material: Not less than 95% for standard compactive effort to AS 1289.5.4.1.

Excavation below the level of the natural channel: Backfill with suitable material and compact to a density equal to and compatible with that existing naturally.

Surplus material: Place excavated material to form embankments to lower side of drains or remove to spoil stockpiles as documented.

### **3.2.3 Construction**

Embankments: Form in layers maximum 200 mm in depth and compact in layers of maximum depth of 150 mm.

Batter slope: Not steeper than 2H:1V.

Compaction of excavated material: Not less than 95% for standard compactive effort to AS 1289.5.4.1.

Revegetation: Vegetate the embankment after its completion to the *C29 Landscape - road reserve and street trees* worksection.

Open drains: Grade to ensure free flow of water and minimum grade of 1.0%. This is a WITNESS POINT

## **3.3 Unlined open drain Types**

### **3.3.1 Catch drains**

General: Provide catch drains before construction of the adjacent roadway above the tops of cuttings and along the toes of embankments, as documented.

Position: Locate as follows:

- Minimum: More than 2 m above the tops of cuttings or below the toes of embankments.
- Maximum: To maintain the fall of the drain.

### **3.3.2 Minor diversion and contour drains**

General: Provide minor diversion and catch drains as documented and with the same capacity as the nearest pipe culvert on the line of the drain.

### **3.3.3 Table drains**

General: Provide table drains, swales and depressed medians, as part of earthworks to the line and level, as documented.

### **3.3.4 Channels**

Requirement: Excavate inlet, outlet and diversion channels to the full width of the open drain, as documented and, extend to join the existing stream bed, avoiding disturbance in stream flow.

Existing stream bed: Preserve outside the limits of the excavation.

## **3.4 Lined open drain types**

### **3.4.1 General**

Timing: Line within 5 days of shaping and compacting the foundation.

### 3.4.2 Organic fibre mat and vegetation lining

Requirement: Provide to lined open drains with a longitudinal grade between 1% and 5% for the completed drain.

Compaction of Foundations: Before placing any lining material, the foundation material shall be shaped and compacted to form a firm base for the lining. the relative compaction, as determined by AS 1289.5.7.1 or AS 1289.5.4.1 shall not be less than 95 per cent for standard compactive effort

Installation: To **OPEN DRAINS, Surface protection** in the *C29 Landscape - road reserve and street trees* worksection.

### 3.4.3 Concrete lining

Requirement: Provide to lined open drains with a longitudinal grade of less than 1% or greater than 5% for the completed drain.

Minimum compacted thickness: 100 mm, measured at right angles to the surface of the concrete lining.

Colour: To match that of the surrounding materials or as documented.

Installation: Cast in situ or sprayed concrete to the *C28 Auxiliary concrete works* worksection.

Weepholes: Provide weepholes at 2 m spacing in non-horizontal elements or as documented.

Top of finished lining: True to line and of uniform width, free from humps, sags or other irregularities.

Tolerances: Conform to the following limits:

- Finished levels of lining surface:  $\pm 10$  mm of design levels.
- Surface deviation: Not more than 5 mm from a 3 m straightedge parallel to the direction of flow.

Contraction joints: Construct as follows or as documented:

- Width: 5 mm minimum.
- Depth: Minimum 50% of cross sectional area. Tool joint to minimum 20 mm depth to form groove.
- Intervals: Every 5 m of lining.

Expansion joints: Construct as follows or as documented:

- Width: 15 mm.
- Depth: Full thickness of the concrete lining.
- Intervals: 15 m maximum.
- Material: Preformed jointing material of bituminous fibreboard or as documented.

### 3.4.4 Stone pitching

Material: Sound durable rock n loam or sand and mortared to present a uniform surface. Rock to be sized to suit flow, in accordance with the "blue book" Managing Urban Stormwater: Soils and Construction, (NSW Government).

Exposed surface of each stone or block: Approximately flat and not less than 0.05 m<sup>2</sup> in area.

Spaces between adjacent stones or blocks: 20 mm maximum width.

### 3.4.5 Wire mattresses

Installation: Refer to Council's Standard Drawings.

### 3.4.6 Batter drains

Installation: Install drains as follows:

- Backfill over-excavation and undulations in the batter line.



- Compact both sides of the drain to form a firm shoulder against the top edge of the batter drain.
- Lay the units in a template controlled excavated trench to form an even top edge to the batter drain.
- Tolerance from the batter line at the underside of topsoil: +0 mm, - 50 mm.

Topsoil: Taper over a width of 1 m to zero thickness at the top edge of the drain.

Turfing: To the *C29 Landscape - road reserve and street trees* worksection.

- Extent: To both sides of the drain for a minimum width of 600 mm.

## **3.5 Testing**

### **3.5.1 Quality**

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES.**

## 4 Annexure

### 4.1 Annexure - Summary of hold and witness points

Reference No:	Clause description and	Type*	Submission/Inspection details	Submission/Notice times	Process held
C24-HP01	SUBMISSIONS Authority approvals  Road opening permit or road occupancy permit from Road Authority	H	Approval of application	10 days before site commencement	Site commencement
C24-HP02	SUBMISSIONS Execution details  Set-out of open drains	H	Details of any proposed changes to designed system	10 days before proceeding	Site set-out of drainage
C24-HP03	SUBMISSIONS Execution details  Temporary drainage	H	Details of procedures/devices	10 days before site commencement	Temporary drainage
C24-HP04	SUBMISSIONS Execution details  Tree and rock outcrops	H	Proposal for diversion	1 day before set-out	Site set-out of drainage
C24-WP05	INSPECTION Notice  Set-out of open drains	W	Set-out	3 days	-
C24-WP06	INSPECTION Notice  Salinity prevention	W	Location of open drains for salinity prevention	1 day before set-out	-
C24-WP07	INSPECTION Notice  Excavation	W	Grade of open drains	Progressive	-
C24-WP08	INSPECTION Notice  Excavation	W	Backfill of excavation below the level of the natural channel	Progressive	-
C24-WP09	INSPECTION Notice  Excavation	W	Surplus material disposal	Progressive	-
C24-WP10	INSPECTION	W	Location of catch drains	Progressive	-

Reference No:	Clause description and	Type*	Submission/Inspection details	Submission/Notice times	Process held
	Notice Catch drains				
C24-WP11	INSPECTION Notice Table drains	W	Location of table drains, swales and depressed medians	Progressive	-
C24-HP12	INSPECTION Notice Compacted Bedding	H	Bedding material and formwork for lining	1 day before placing	-
C24-WP13	INSPECTION Notice Concrete lining	W	Location of weepholes	1 day before concreting	-
C24-WP14	INSPECTION Notice Wire mattresses	W	Completed installation	3 days	-
C24-HP15	SUBMISSIONS Work as Executed Drawings and Drainage Asset Attribute information	H	Submit certified drawings and schedules	2 weeks after placement of last channel/pipe/conduit/pit/structure	Payment
	*H = Hold point W = Witness point				

## 4.2 Annexure - Maximum lot sizes and minimum test frequencies

Activity	Key quality verification requirements	Test method
Siting and excavation	Geometry	Survey
Foundation	Compaction	AS 1289.5.4.1
Bedding	Material quality: Particle size distribution	AS C08.11.1
	Material quality: Compaction/moisture content	AS 1289.5.4.1 AS 1289.5.7.1
Concrete lining	Geometry	Survey and 3 m straightedge
Selected backfill	Material quality: <ul style="list-style-type: none"> <li>Maximum particle size</li> <li>Plasticity index</li> </ul>	AS 1289.3.3.1 AS 1289.5.4.1 AS 1289.5.7.1

Activity	Key quality verification requirements	Test method
	<ul style="list-style-type: none"> <li>• Compaction/moisture content</li> </ul>	

### 4.3 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS C08		Methods for sampling and testing aggregates
AS C08.11.1	2009	Particle size distribution - Sieving method
AS 1289		Methods of testing soils for engineering purposes
AS 1289.3.3.1	2009	Soil classification tests - Calculation of the plasticity index of a soil
AS 1289.5.4.1	2007	Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio
AS 1289.5.7.1	2006	Soil compaction and density tests- Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method)
AS 3706		Geotextiles - Methods of test
AS 3706.1	2012	General requirements, sampling, conditioning, basic physical properties and statistical analysis
AS 3706.7	2014	Determination of pore-size distribution - Dry sieving method
AS 3706.9	2012	Determination of permittivity, permeability and flow rate
Austrroads AGPT		Guide to pavement technology
Austrroads AGPT04G	2009	Geotextiles and geogrids
RMS R63	2017	Geotextiles (separation and filtration)

#### Other publications

Council's Standard Drawings