*COFFS HARBOUR CITY COUNCIL*

# DEVELOPMENT SPECIFICATION
# DESIGN

## *1121 Open drains including kerb and channel gutter*

***Version 1*** ***01 January 2009***

# 1121 OPEN DRAINS INCLUDING KERB AND CHANNEL GUTTER

## 1 SCOPE AND GENERAL

### 1.1 SCOPE

The work to be executed under this worksection consists of the construction, lining and protection of all types of open drains, including the construction of kerb and/or channel and the construction of rock filled wire mattresses and gabions.

This worksection should be read in conjunction with *1351 Stormwater drainage (Construction)*, *1352 Pipe drainage*, *1353 Precast box culverts* and *1354 Drainage structures* as applicable.

### 1.2 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)*

*0250 Open space – landscaping*

*0310 Minor concrete work*

*1102 Control of erosion and sedimentation*

*1351 Stormwater drainage (Construction)*

*1352 Pipe drainage*

*1353 Precast box culverts*

*1354 Drainage structures*

**Standards**

| | |
|---|---|
| AS 1141 | Methods for sampling and testing aggregates |
| AS 1141.22 | Wet/dry strength variation |
| AS 1289 | Methods of testing soils for engineering purposes |
| AS 1289.5.4.1 | Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio |
| AS 1289.5.7.1 | Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (rapid method) |
| AS 2758 | Aggregates and rock for engineering purposes |
| AS 2758.4 | Aggregate for gabion baskets and wire mattresses |
| AS 2876 | Concrete kerbs and channels (gutters)—Manually or machine placed |
| AS/NZS 4534 | Zinc and zinc/aluminium-alloy coatings on steel wire |

**Other publications**

AUSTROADS

AP-3/90 Guide to Geotextiles

### 1.3 DEFINITION

Open drains are all drains other than pipe and box culverts and include catch drains, contour drains, diversion drains, table drains, batter drains, swales, channels, grated drains, channels (gutters) and kerbs and channels (gutters).

### 1.4 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 016 *Quality (Construction)*.

## 2 UNLINED OPEN DRAINS

### 2.1 GENERAL

**Shape**

Unless shown otherwise on the Drawings, drains shall be vee shaped or of trapezoidal cross section and shall not be less than 300 mm deep and have a minimum waterway area of 0.2 square metres.

**Grade**

Open drains shall be graded to ensure free flow of water and, unless shown on the Drawings or directed otherwise by the Superintendent, shall not have a grade of less than 1 %.

Trees and rock outcrops

Where trees marked for preservation or rock outcrops occur in the line of a drain, the drain may be neatly diverted if approved by the Superintendent.

**Open drains**

Open drains shall be extended as necessary to lead the water clear of the work to natural drainage depressions, culverts, or pits connected to underground drainage systems.

The drains shall follow existing watercourses and depressions in the natural surface, unless other locations are shown on the Drawings or directed by the Superintendent.

**Salinity prevention**

Open drains shall be located and constructed so as to avoid recharging groundwater encouraging a shallow water table and creating or worsening salinity degradation of adjacent land.

**Control of erosion**

All work shall be undertaken in accordance with 1102 *Control of erosion and sedimentation*.

### 2.2 TYPES

**Catch drains**

Catch drains shall be provided above the tops of cuttings or along the toes of embankments where shown on the Drawings or as directed by the Superintendent before construction of the adjacent roadway.

The edges of catch drains shall be positioned not less than 2 m from the tops of cuttings or the toes of embankments nor more than is necessary to maintain the fall of the drains unless otherwise approved by the Superintendent.

**Diversion and contour drains**

Minor diversion and contour drains shall be constructed where shown on the Drawings or directed by the Superintendent. Minor diversion drains shall have the same capacity as the nearest pipe culvert on the line of the drain.

**Table drains**

Table drains, swales and depressed medians shall be constructed to the line and level shown or calculated from the Drawings. Their construction is deemed to be part of earthworks.

**Channels**

Inlet, outlet and diversion channels shall be excavated as shown on the Drawings and, unless indicated otherwise, shall extend to join the existing stream bed in a regular manner, avoiding disturbance in stream flow. The channel shall be excavated to the full width of the structure but the existing stream bed shall be preserved as far as possible outside the limits of the excavation.

### 2.3 CONSTRUCTION

**Excavated material**

Material excavated from drains shall be placed on the lower sides of the drains and formed as banks with side slopes not steeper than 4H:1V on the cross section of the bank to increase the capacity of the drains.

This material shall be compacted in accordance with AS 1289.5.4.1 and shall be not less than 95 % for standard compactive effort.

**No disturbance to waterway outside the site**

The Contractor shall ensure that none of the activities associated with the work disturbs any watercourse outside the site.

Any excavation below the level of the natural channel shall be backfilled with suitable material compacted to a density equal to and compatible with that existing naturally.

**Excess material**

Any excess material shall be disposed of by the Contractor at locations and in a manner approved by the Superintendent.

**Revegetation**

Unlined drains and areas adjacent to open drains shall be revegetated immediately after the drains are complete, in accordance with 0250 *Open space – landscaping*.

## 3 LINED OPEN DRAINS

### 3.1 GENERAL

**Shape**

Lined open drains shall be formed as for unlined open drains with the inclusion of a lined invert in accordance with the Drawings, or as directed by the Superintendent.

**Profile**

Lining shall conform to the profile of the drain and shall be provided as soon as possible after forming the 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 % for standard compactive effort.

### 3.2 CONCRETE LINING

**Method**

Concrete lining for open drains shall be cast-in-situ or sprayed concrete supplied and placed in accordance with 0310 *Minor concrete work*.

Weepholes shall be provided in the concrete at intervals of 2 m or as determined by the Superintendent.

**Finish**

The top of the finished lining shall be true to line and of uniform width, free from humps, sags or other irregularities.

**Tolerances**

The level at any point on the surface of the lining shall be within ±20 mm of design levels.

When a straight edge 3 m long is laid on top of the lining parallel to the direction of flow, the surface shall not vary more than 10 mm from the edge of the straight edge.

**Contraction joints**

Unless shown otherwise on the Drawings, contraction joints shall be formed every 3 m of lining length for a minimum of 50 % of cross sectional area.

The joint shall be tooled a minimum of 20 mm in depth to form a neat groove of 5 mm minimum width.

**Expansion joints**

Unless shown otherwise on the Drawings, expansion joints, 15 mm in width for the full depth of the concrete lining, shall be constructed at intervals not exceeding 15 m.

Expansion joints shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent.

### 3.3 STONE PITCHING

Stone pitching shall consist of sound durable rock not less than 100 mm thick, properly bedded on approved loam or sand and mortared to present a uniform surface.

The exposed surface of each stone or block shall be approximately flat and not less than 0.05 square metres in area.

Spaces between adjacent stones or blocks shall not exceed 20 mm in width.

### 3.4 BATTER DRAINS

**Type**
Batter drains shall be constructed using either half round steel pipes or precast nestable concrete units as shown and detailed on the Drawings.

**Installation**
The units shall be installed in carefully excavated and template controlled trench to produce an even top edge of batter drain of +0 mm to –50 mm from the batter line at the underside of topsoil.

**Compaction**
Any over excavation and undulations in the batter line shall be backfilled and both sides of the drain compacted over the full length to form a firm shoulder against the top edge of the batter drain.

**Topsoil and turfing**
When topsoil is placed it shall be tapered over a width of 1 m to zero thickness at the rim of the drain.

Both sides of the drain shall then be turfed for minimum width of 600 mm and pinned down as provided in 0250 *Open space – landscaping*.

### 3.5 PROPRIETARY PRODUCTS

Unless shown on the Drawings, proprietary products may only be used with the approval of the Superintendent.

Where specified, they must be used strictly in accordance with the manufacturer's instructions.

## 4 KERB AND CHANNEL (GUTTER)

### 4.1 GENERAL

**Description**
Kerb and channel (gutter) includes all forms of concrete channels (gutters), dish drains, grated drains, and mountable median and barrier kerbing.

**Compaction of foundations**
Before placing any kerb and/or channel, the foundation material shall be shaped and compacted to form a firm base.

Other than for kerb and channel (gutter) constructed on pavement courses, the relative compaction, shall be in accordance with the requirements of AS 2876.

Where placed on pavement courses, the foundation shall be compacted to the requirements of the respective pavement course.

The foundation material in all cases will be subject to the Superintendent's approval.

This action constitutes a HOLD POINT.

The Superintendent's approval of the foundation materials and its condition is required prior to release of the hold point.

### 4.2 CONSTRUCTION

**Method**
Kerb and/or channels may be constructed in fixed forms, by extrusion or by slip forming in accordance with AS 2876.

**Construction Details**
The foundation, concrete quality, curing and testing details shall be in accordance with AS 2876.

**Finish**
The top and face of the finished kerb and/or channel shall be true to line and the top surface shall be of uniform width, free from humps, sags or other irregularities. Kerb and channel shall have a steel float finish.

**Tolerances**
The level at any point on the surface of the channels shall be within ±10 mm of design levels.

When a straight edge 3 m long is laid on top of or along the face of the kerb or on the surface of channels, the surface shall not vary more than 5 mm from the edge of the straight edge, except at kerb laybacks, grade changes or curves or at gully pits requiring channel depression.

**Contraction joints**

Unless shown otherwise on the Drawings, contraction joints shall be formed every 3 m of channel length for a minimum of 50 % of cross sectional area. The joint shall be tooled 20 mm in depth to form a neat groove of 5 mm minimum width.

**Expansion joints**

Unless shown otherwise on the Drawings, expansion joints, 15 mm in width for the full depth of the kerb and channel shall be constructed at intervals not exceeding 15 m and where the channel abuts against pits, retaining walls, overbridges, and at both sides of kerb laybacks for vehicular or pedestrian access.

Expansion joints shall consist of preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent.

**Adjacent concrete pavement**

Where kerbs and/or channels are cast adjacent with a concrete pavement the same type of contraction, construction and expansion joints specified in the concrete base shall be continued across the kerb and/or channel.

**Stormwater outlets**

All house stormwater outlets shall be provided and/or extended, to match the existing type and size of pipe, through the kerb as shown on the Drawings. Pipework shall be in accordance with the requirements for PVC pipes in 1352 *Pipe drainage*, or as directed by the Superintendent for other types of pipe.

**Vehicular or pedestrian access**

Opposite all driveways, where shown on the Drawings or where directed by the Superintendent, barrier kerb shall be discontinued to provide for vehicular or pedestrian access.

At such locations, kerb laybacks shall be constructed in accordance with the Drawings.

Footpath crossovers shall be constructed to meet the laybacks as shown on the Drawings, or reinstated to match existing materials where not otherwise shown.

**Backfill timing**

After the new kerb and channel has been constructed and not earlier than three days after placing, the spaces on both sides of the kerb and/or channels shall be backfilled and reinstated in accordance with the Drawings, or as instructed by the Superintendent.

**Backfill material**

Backfill material behind the kerb shall consist of granular material, free of organic material, clay and rock in excess of 50 mm diameter, or material as approved by the Superintendent.

**Behind kerb**

Backfill material behind the kerb shall be compacted in layers not greater than 150 mm thick, to a relative compaction of 95 % when tested in accordance with AS 1289.5.4.1, for standard compactive effort.

The whole of the work shall be finished in a neat and workmanlike manner, free draining and free from surface undulations and trip hazards.

**Pavement**

Pavement material adjacent to new channel shall be backfilled in accordance with the Drawings or as directed by the Superintendent.

## 5 ROCK FILLED WIRE MATTRESSES AND GABIONS

### 5.1 GENERAL

**Location and geotextile**

Rock-filled wire mattresses and gabions shall be placed at the locations shown on the Drawings. Installation shall be in accordance with the manufacturer's instructions.

A geotextile, as shown on the Drawings, shall be placed between the wire cage and the material being protected.

**Foundation material**

Before installation of rock-filled wire mattresses, the foundation material shall be excavated such that the mattresses finish flush with the surrounding ground.

Where mattresses are used to line open drains, the foundation material shall be shaped and compacted, in accordance with AS 1289.5.4.1 and shall not be less than 95 % for standard compactive effort, to form a uniform channel cross-section prior to installation of mattresses.

## 5.2 MATERIALS

**Galvanising**

For Wire mattresses and Gabions, the galvanising requirements for wire of circular cross section cited in this clause as 'heavily galvanised' shall comply with the coating mass requirements for round wire, Class W10, in AS/NZS 4534.

**Wire mattresses**

Mattress dimension: Unless otherwise specified or shown on the Drawings, the wire mattresses shall be supplied in units having dimensions of 6 m × 2 m × 230 mm, and shall be cut to suit areas as shown on the Drawings. The mattresses shall be divided by diaphragms into cells of length not exceeding 600 mm. Unless otherwise specified, they shall be fabricated of woven heavily galvanised wire and PVC coated where specified on the Drawings.

Wire dimensions: Mattresses shall have a mesh size of 60 mm x 80 mm and body wire shall be a minimum diameter of 2.0 mm heavily galvanised with an additional minimum thickness of 0.4 mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 2.7 mm and 2.2 mm respectively.

**Gabions**

Gabion dimensions: The gabions shall be of the sizes shown on the Drawings and fabricated of woven heavily galvanised wire mesh and PVC coated where specified on the drawings.

Each gabion shall be divided by diaphragms into cells whose length shall not be greater than the width of the gabions plus 100 mm.

Wire dimensions: Gabions shall have a nominal mesh size of 80 mm × 100 mm and body wire shall be a minimum diameter of 2.7 mm heavily galvanised with an additional thickness of 0.4 mm PVC coating where specified on the drawings.

The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 3.4 mm and 2.2 mm respectively.

**Geotextile**

Type: A chemically and biologically stable geotextile with a minimum strength rating (G) of 1350 and minimum mass of 180 grams per square metre, in accordance with AUSTROADS Guide to Geotextiles, shall be used.

Sample: Samples, manufacturer's worksection and instructions on installation shall be submitted to the Superintendent seven days before the intended use of geotextile.

This action shall constitute a HOLD POINT.

The Superintendent's approval to the quality test documentation and procedure is required prior to the release of the hold point.

**Rock fill material**

Rock Quality: The rock fill shall consist of clean hard rock complying with the requirements of AS 2758.4.

For wire mattresses: Rock fill for wire mattresses shall have particle sizes between 75 mm and two-thirds of the mattress thickness, or 250 mm, whichever is the lesser. When the mattress is on a slope, rock fill material shall be placed into the units starting from the low end. Units shall be filled slightly overfull by 25 mm to 50 mm to allow for settlement and to provide an even tight and smooth surface of the required contour.

For gabions: Rock fill for gabions shall have particle sizes between 100 mm and 250 mm and preferably not greater than 200 mm.

Rock fill material may be placed by hand or suitable mechanical device to ensure fill is tightly packed with a minimum of voids.

Fill material shall be levelled off 25 mm to 50 mm above the top of the mesh to allow for settlement.

## 5.3 ASSEMBLY AND ERECTION

Before laying out the wire mattresses or gabions, geotextile shall be placed on the founding material.

The edges of wire mattresses shall be firmly tied to galvanised star pickets driven a minimum of 900 mm into the surrounding ground at 1 m maximum intervals and the star pickets cut off level with the top of the mattress.

The upstream edge of wire mattresses shall be folded down into a trench of minimum depth 300 mm and filled with rock fill. This edge shall be tied to star pickets.

## 6 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in Table 6.1.

**Table 6.1 Summary of limits and tolerances**

| **Activity** | **Limits/Tolerances** | **Worksection Clause Reference** |
|---|---|---|
| **Unlined open drains** | | |
| - Grading | Grade >1% | **Unlined open drains** |
| - Depth | >300 mm | **Unlined open drains** |
| - Waterway Area | >0.2 sq m | **Unlined open drains** |
| - Catch Drain Location | >2 m from top of cuttings or toes of embankments | **Types (Unlined catch drains)** |
| - Compaction | > 95% (standard compaction) | **Construction (Excavated material)** |
| **Lined open drains** | | |
| - Compaction of Foundation | >95% (standard compaction) | **Lined open drains** |
| - Level of lining surface | Level ±20 mm of design level | **Concrete lining** |
| - Surface uniformity | Deviation lining surface from 3 m straight edge ≤10 mm | **Concrete lining** |
| **Kerb and channel** | | |
| - Compaction of foundation | to AS 2876 | **Kerb and channel (gutter)** |
| - Level of channel surface | Level ≤±10 mm of design level | **Kerb and channel (gutter) Construction** |
| - Surface uniformity | Deviation kerb and channel surface from 3 m straight edge ≤5 mm | **Kerb (gutter)** |
| - Contraction joints | | |
| . Area | ≥50% of CS area | **Kerb.(gutter)** |
| . Groove width | ≥5 mm | **Kerb (gutter)** |
| - Expansion joint interval | ≤ 15 m | **Kerb(gutter**) |
| - Backfill behind kerb | | |
| . Layer thickness | ≤ 150 mm | **Kerb (gutter)** |
| . Compaction | >95% (standard compaction) | **Kerb (gutter)** |
| **Rock fill for gabions and wire mattresses** | | |
| - Compaction of foundation | >95% (standard compaction) | **Rock filled wire mattresses and gabions** |
| - Wet strength | >100kN | **Materials** |

| Activity | Limits/Tolerances | Worksection Clause Reference |
|---|---|---|
| - Wet/Dry strength variation | <45% | **Materials** |
| - Particle size for wire mattresses | >75 mm <150 mm | **Materials** |
| - Particle size for gabions | >100 mm <250 mm | **Materials** |
| - Gabion fill level | >25 mm <50 mm above top of mesh | **Materials** |
| **Erection of wire mattresses** | | |
| - Star pickets for ties | Depth in ground >900 mm<br>Spacing <1 m | **Assembly and erection** |
| - Trench depth for upstream edge | >300 mm | **Assembly and erection** |

## 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 Items 1121.1 to 1121.8 inclusive.

A lump sum price for any of these items 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 as not been priced.

Erosion and sedimentation control measures are measured and paid in accordance with *1102 Control of erosion and sedimentation*.

Sprayed concrete lining of open drains is measured and paid in accordance with *0310 Minor concrete work*.

Cast-in-situ concrete or other lining of open drains is measured and paid in accordance with this worksection and not *0310 Minor concrete work*.

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 work*.

Topsoiling and turfing to sides of batter drains are measured and paid in accordance with *0250 Open space – landscaping*.

### 7.2 PAY ITEMS

**1121.1 Excavation—catch, contour and minor diversion drains**

The unit of measurement shall be the linear metre measured along the invert of the drain.

The placement and compaction of material excavated from the drains on the lower sides of the drains to form banks shall be included in the excavation rates.

The schedule rate for excavation shall allow for excavation of all types of material. Separate rates shall not be included for earth and rock.

Any temporary measures for the control of stormwater runoff shall be included in the rate for excavation.

**1121.2 Excavation—inlet, outlet and diversion channels**

The unit of measurement shall be the cubic metre measured from cross sections on the drawings using the end area method, or as ‘each’ where minor work is involved.

The disposal of surplus material shall be included in the excavation rates.

The schedule rate for excavation shall allow for excavation of all types of material. Separate rates shall not be included for earth and rock.

Any temporary measures for the control of stormwater runoff shall be included in the rate for excavation.

**1121.3 Concrete lining of open drains**

The unit of measurement shall be the square metre of concrete in place.

The schedule rate under this Pay Item shall include all the operations involved in the surface preparation, supply and placing of concrete, jointing and curing.

**1121.4 Stone pitching of open drains**

The unit of measurement shall be the square metre of stone pitching in place.

The schedule rate under this Pay Item shall include all the operations in the surface preparation, supply of stone, placing, final trimming and mortar jointing.

**1121.5 Batter drains**

The unit of measurement shall be linear metre along the length of the drain formed by batter drain units.

The schedule rate shall include supply of the units, excavation, installation, backfilling and compaction.

**1121.6 Rock filled gabions**

The unit of measurement shall be the cubic metre of rock filling.

The volume shall be taken from the Drawings with appropriate adjustments being made for any authorised changes.

The schedule rate shall include the supply and placement of geotextile material behind the gabions, the supply and assembly of the gabions, the supply and placing of the rock fill in the gabions.

**1121.7 Rock filled wire mattresses**

The unit of measurement shall be the square metre of rock filled mattress complete.

The area shall be determined from the actual completed work and shall include the area folded into the trench.

The schedule rate shall include the supply and placement of geotextile material, star pickets and ties as specified, together with the supply and assembly of the wire mattresses and the supply and placing of the rock fill.

**1121.8 Kerb and/or channel (gutter)**

The unit of measurement shall be the linear metre measured along the length of the kerb and/or channel including kerb laybacks and perambulator ramps.

The schedule rate shall include all operations involved in the forming, compaction of foundations, concreting, expansion and contraction joints, backfilling and compaction adjacent to the completed kerb.

Separate pay items shall be included for each type of kerb and/or channel specified.