1354 DRAINAGE STRUCTURES

1 GENERAL

1.1 RESPONSIBILITIES

Objectives

General: Provide drainage structures as documented including the following: headwalls, wingwalls, pits, gully pits, inspection pits, junction boxes/pits, drop structures, inlet and outlet structures, energy dissipators, batter drains and other supplementary structures as shown on the drawings.

Performance

~~Requirements: [complete/delete]~~

Design

~~Designer: [complete/delete]~~

~~Authority requirements: [complete/delete]~~

1.2 CROSS REFERENCES

General

Requirement: Conform to the following worksection(s):

- *0136 General requirements (Construction).*
- *0152* Schedule of rates – supply projects.
- *0161 Quality (Construction).*
- *0167 Integrated management.*
- *0319 Minor concrete works.*
- *1101 Control of traffic.*
- *1102 Control of erosion and sedimentation.*
- *1112 Earthworks (Roadways).*
- *1121 Open drains, including kerb and channel (gutter).*
- *1351 Stormwater drainage (Construction).*
- *1352 Pipe drainage.*
- *1353 Precast box culverts.*

~~[complete/delete]~~

1.3 REFERENCED DOCUMENTS

Standards

General: The following documents are incorporated into this worksection by reference:

AS 1012-Various	Methods of testing concrete
AS 1379-2007	Specification and supply of concrete
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 1478.1-2000	Admixtures for concrete
AS/NZS 1554	Structural steel welding
AS/NZS 1554.3:2008	Welding of reinforcing steel
AS 1657-1992	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS 1726-1993	Geotechnical site investigations
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1-1998	Concrete aggregates
AS 3600-2009	Concrete structures
AS 3610	Formwork for concrete
AS 3610.1-2010	Documentation and surface finish
AS 3735-2001	Concrete structures retaining liquids
AS 3972-2010	General purpose and blended cements

AS 3996-2006	Access covers and grates
AS/NZS 4671:2001	Steel reinforcing materials
AS 5100-Various	Bridge design
NP:PCH-2009	Precast concrete handbook

Other publications

Austroads

AGPT04G:2009	Guide to geotextiles – Geotextiles and geogrids

1.4 INTERPRETATION

Definitions

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

- Drainage structures: Devices to control stormwater flowing into and through a stormwater drainage system including culverts, inlet and outlet structures, junction boxes, gully pits, drop structures, headwalls, wingwalls, energy dissipaters and ancillary hardware such as grates, frames and step irons as well as subsurface drainage pipes at pits, headwalls and wingwalls.
- Selected backfill: The material obtained from excavation of the pipe trench or elsewhere with a particle size not greater than 75 mm, and which conforms with the soil classes defined in AS 1726.

1.5 SUBMISSIONS

Approval

Submissions: To the Superintendent's approval.

~~Calculations: [complete/delete]~~

~~Components: [complete/delete]~~

~~Design: [complete/delete]~~

~~Drawings: [complete/delete]~~

~~Execution details: [complete/delete]~~

~~Manuals: [complete/delete]~~

~~Materials: [complete/delete]~~

~~Prototypes: [complete/delete]~~

~~Samples: [complete/delete]~~

~~Technical data: [complete/delete]~~

~~Type tests: [complete/delete]~~

~~Warranties: [complete/delete]~~

1.6 HOLD POINTS AND WITNESS POINTS

Notice

General: Give notice so that the documented inspection and submissions may be made to the **HOLD POINT table** and the **WITNESS POINT table**.

HOLD POINTS table

Clause title/Item	Requirement	Notice for inspection	Release by
EXECUTION			
Precast units			
General – Product drawings	Submit details of precast or proprietary items for approval	1 working day	*Principal Certifying Authority*
General – Quality	Submit quality test results.	3 working days before delivery	*Principal Certifying Authority*
Installation			
Excavation	Excavation and compaction of foundation as documented	1 working day	*Principal Certifying Authority*

Clause title/Item	Requirement	Notice for inspection	Release by
Headwalls and wingwalls			
General – Rock foundations	Submit details of cut-off walls in rock	1 working day	*Principal Certifying Authority*
Backfill			
General - Commencement	Obtain approval for commencement	1 workday day	*Principal Certifying Authority*

WITNESS POINTS table

Clause title/Item	Requirement	Notice for inspection
EXECUTION		
Pits and junction boxes		
Precast units	Give notice of installation of precast pits and junction boxes	1 week
Construction	Submit for approval part omission of concrete lining	3 working days

2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Program of works

General: Program the works as follows:

- Materials: Arrange the program for compliance and usage of component and materials.
- Authorities: Arrange approvals and confirm environmental requirements from local authorities.
- Constraints: Incorporate **HOLD POINTS** and **WITNESS POINTS**.

3 MATERIALS

3.1 CONSTITUENT MATERIALS

Cement

Standard: To AS 3972.

Type: Do not use high alumina cement.

Aggregates

Standard: To AS 2758.1.

Aggregate properties: Conform to the **Aggregate property schedule**.

Aggregate property schedule

Aggregate property	Tests	Limits
Particle density		
Water absorption		
Particle size		
Durability		

Water

Standard: To AS 1379.

Quality: Provide clean water, free from oil, acid, alkali, organic or vegetable matter with not more than 500 mg/l of chloride ions.

Other

Chemical admixtures: To AS 1478.1.

Reinforcement

Standard: To AS/NZS 4671.

General: Clean and free from harmful matter e.g. loose mill scale, loose rust, oil, grease and retarders. Ensure there is no pitting.
Corrosion protection: To AS 3600 clause 17.2.
Structural welding: To AS/NZS 1554.3.

Cast-in items

Cast in inserts: Provide structural steel cast in lifting items in conformance with the drawings.
~~Protective coating: [complete/delete]~~

3.2 FORMWORK

Formed concrete surface

Requirement: Conform to the following:
- Smooth, dense and dust free concrete finish.
- Unobtrusive form joint marks.
- No blowholes deeper than 5 mm.
- Class 3 formwork to AS 3610.1.
- Surface irregularities: Maximum 3 mm over the width of the surface.

Unformed surface

Requirement: Conform to the following:
- Wood float to a uniform surface without pitting or cavities.
- Surface irregularities: Maximum 5 mm over the width of the surface.

3.3 IN SITU CONCRETE

General

In situ concrete: Conform with *0319 Minor concrete works* for the concrete and reinforcement for cast-in situ structures.

3.4 PRECAST CONCRETE

General

Concrete: To AS 3600 and AS 1379.
Testing: To AS 1012.
Casting: Do not remove precast units from casting mould until the concrete compressive strength > 15 MPa.

Durability

~~Exposure classification: [complete/delete]~~

Concrete cover: To AS 3600.

Strength

~~Minimum compressive strength: [complete/delete]~~

3.5 ACCESS COVERS AND FRAMES

Specification

Access covers and frames: To AS 3996 and the **Access covers and frames schedule**.
Ductile iron cover size:
- Width: Parallel to the lifting ends and undercut.
- Length: Parallel to the direction of cover removal.

Infill material: Bond tile or paver to the concrete bed with an epoxy mortar.
Proprietary products: To the manufacturer's recommendations.

Access covers and frames schedule

Requirements	A1	A2	A3	A4
Cover number				
Load class				
Size				
Aesthetics				
Decorative edging				
Cover type				
Security				
Seals				
Cover orientation				
Handling				

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General

Control of traffic: To *1101 Control of traffic*.

4.2 PRECAST UNITS

General

Product drawings: For any precast item, including proprietary items, not detailed in the drawings, submit the following:

- Product drawings.
- Method of manufacture, testing and installation including clearance to pit shaft ends, pipe to pipe jointing and step iron positioning

This is a **HOLD POINT**.

Substituting precast units for cast in situ units: Submit detailed drawings and complete details of installation procedures for approval.

Quality: Submit test results for all units prior to delivery to the works. This is a **HOLD POINT**.

Handling, delivery and storage

Handling and installation: Handle and install precast units, including kerb inlet lintels, to conform with the manufacturer's instructions.

Marking

Identification marking: At the time of manufacture, clearly mark each precast unit with the following information:

- Date of manufacture.
- Manufacturer's name or registered mark and the location of manufacture.
- Maximum mass of unit in kg.
- Batch number.
- Inspection status.

Height of letters: 75 mm.

Location of marking: Easily visible but hidden once the unit is installed.

4.3 INSTALLATION

General

Members subject to traffic and earth loads: To AS 5100.

Water retaining structures with a capacity > 25000 L: To AS 3735.

Water retaining structures with a capacity ≤ 25000 L: To AS 3600.
Other concrete components: Conform to AS 3600.
Program: Install drainage structures as soon as possible and not later than 14 days after the installation of associated pipes, box culverts or open drains.
Location: As shown on the drawings.
Horizontal tolerance: ± 25 mm.
Inlet and outlet invert levels: As shown on the drawings ± 10 mm.

Excavation

Bedding: Excavate and compact the foundation to conform with *1351 Stormwater drainage (construction)*. This is a **HOLD POINT**.

Foundation

Preparation: Dewater and wash clean of contaminants in preparation for concreting.
Mass concrete bedding: Dampen the surface of the foundation and place a layer of concrete > 50 mm thick over the excavated surface and finish to a smooth, even surface.

Joints and seals

Location: Provide an isolation joint where a drainage structure abuts a structure or concrete pavement.
Isolation joint: 10 mm wide approved preformed jointing filler.
Sealing: Effectively seal joints and connection points against the ingress of water and other kinds of material with cement mortar 1: 3 general purpose cement: sand ratio.

Locating drainage structures

Arrangement: Unless otherwise shown on the drawings, construct headwalls and pits parallel to the road centreline and wingwalls at 135° to the headwall.
Skewness: If the culvert is laid skew to the road, splay the wingwalls and headwalls so that the front edge of the wing bisects the angle between the centreline of the culvert and the headwall.
Dissipaters: Construct as shown on the drawings.
Trash racks: If shown on the drawings, construct trash racks with access for machine removal of accumulated debris.

Rung ladders and step irons

Drop structures > 600 mm deep: Install an individual rung ladder or step iron on one internal wall for the full depth of the structure to conform to AS 1657.
Tolerance: Conform to the following:

- The top of the uppermost rung: ≤ 600 mm below the top of the pit.
- The top of the bottom rung: ≥ 300 mm and ≤ 500 mm above the invert of the pit.
- Rung spacings: 300 mm ± 50 mm.

Fixing: Conform to the following:

- Fix step irons firmly within the formwork before placing the concrete for the pit walls.
- Provide blockout formers to make recesses in the concrete to receive the arms of the step irons.
- Install at a later date by drilling the pit wall.
- Drill holes using a rotary masonry bit or similar. Do not use percussion tools to form the hole for the step iron.
- Use epoxy resin in conformance with the step iron and epoxy resin manufacturer's recommendations.
- Ensure that no movement of the step irons occurs until the epoxy resin has reached the specified strength.

4.4 HEADWALLS AND WINGWALLS

General

In situ concrete: To *0319 Minor concrete works* and the drawings.

Batter retention: Construct the wingwalls to retain the batters as shown on the drawings.
Rock foundations: If rock is encountered at the bottom of excavations for wingwalls and headwalls, submit for approval, a proposal to reduce the depth of cut-off walls in uniform rock over the full width of the foundations. This is a **HOLD POINT**.
- Depth: > 150 mm into sound rock.

Precast headwalls: Cannot be used for pipes exceeding 525 mm diameter.

Weepholes

Detail: Provide weepholes as shown on the drawings.
Requirement: Place broken stone or river gravel to *1351 Stormwater drainage (construction)* as follows:
- Height: > 450 mm above the bottom of the weephole.
- Plan area: > 600 mm along the wall and 300 mm out from the wall located centrally about the weephole.

Geotextile: Enclose the broken stone or river gravel with geotextile filter fabric in conformance with AGPT04G.
Alternative to geotextile: Cover the facial area of the structure with an equivalent area of geocomposite.
~~Type: [complete/delete]~~

4.5 PITS AND JUNCTION BOXES

Precast units

General: Should not be used in pits and junction boxes unless approved by Council. Council will consider their use when the design of the pipe inlets is sufficiently straightforward to guarantee successful construction. Precast units may be used for access covers, gully grates and frames

~~Knockouts: Do not provide standard precast pit base units with thinned wall sections on all 4 sides. Provide base units and other riser units to suit the design configuration of the particular pit with preformed knockouts only where required.~~

Notice: Give notice before installation of precast pits and junction boxes. This is a **WITNESS POINT**.

Construction

Details: Construct all new pits to accept access covers, gully grates and frames to AS 3996 and to the details shown on the drawings.
Concrete: Unless otherwise shown on the drawings, conform to the following:
- Strength: > 32 MPa.
- Aggregate size: > 12 mm.

Access cover and pit: Locate so that removal of the cover is not obstructed by a wall, kerb or other fixed item.
Existing pits: Modify existing pits only if shown on the drawings.
Finished level: Flush with the finished level of the surrounding area ± 3 mm.
Full depth rock excavation: If the full depth of the excavation is in sound rock, submit for approval to omit part of the concrete lining of gully pits and sumps and to construct a neatly formed pit of the required dimensions. Construct in concrete the wall of the pit adjacent to and parallel to the road. This is a **WITNESS POINT**.
Inlet and outlet pipes: Cast ends of inlet and outlet pipes into the pit walls.
Subsoil drain: Provide subsoil drains for the pits or headwalls to *1172 Subsoil and foundation drains*.

Access covers and frames

Fit and seals may be compromised: Covers and frames are matched items. Do not switch.
Tight fit: Make sure there is no excavated or other material between cover and frame to compromise seals and service life.

Proprietary access covers: Conform with the manufacturer's recommendations, including any infill requirements for the covers.

Bulkheads

Location: If the pipe gradient of the line > 5%, construct concrete bulkheads on stormwater drainage pipe lines. Spacings and details as shown on the drawings.

Kerb Deflectors

General: Should not be used at the entrance to a pit except where the grade exceeds 5%. Seek the advice of Council prior to design.

4.6 BACKFILL

General

Commencement: Do not backfill against cast in situ concrete drainage structures within 14 days of placing the concrete or until compressive strength > 15 MPa unless otherwise approved. This is a **HOLD POINT**.

Selected backfill: Place selected backfill against the full height of the vertical faces of structures for a horizontal distance equal to one-third the height of the structure, or as shown on the drawings.

Loading: Prevent excessive surcharge loading against vertical surfaces during the backfilling.

Horizontal terraces: If the sides of the excavation are steeper than 4H:1V, cut benches in the form of successive horizontal terraces at least 600 mm in width, before the backfill is placed.

Balance: Backfill on both sides of the structure alternately in layers to avoid unbalanced forces on the structure.

Compaction: To *1351 Stormwater drainage (Construction)*. Commence backfilling and compaction at the wall.

4.7 COMPLETION

General

Requirement: Remove and replace any drainage structure if required for any of the following reasons:

- Not true to line or level.
- Shows settlement after laying.
- Damaged during backfilling, compaction or subsequent operations.

5 LIMITS AND TOLERANCES

Summary of limits and tolerances

Activity	Limits/tolerances	Clause Worksection reference
Formed concrete surface:		**Formwork**
- No blowholes	< 5 mm	
- Surface irregularities	< 3 mm over the width of the surface	
Unformed surface:		
- Surface irregularities	< 5 mm over the width of the surface	
Precast units compressive strength of concrete	> 15 MPa	**Precast concrete**
Identification marking lettering	75 mm high	
Horizontal tolerance	± 25 mm	**Installation**

Activity	Limits/tolerances	Clause Worksection reference
Inlet and outlet invert levels	± 10 mm	
Foundation:		
- Mass concrete bedding depth	> 50 mm	
Joints and seals:		
- Thickness	10 mm	
- Cement mortar	1:3 general purpose cement:sand	
Wingwalls location	135° to the headwall	
Step irons:		
- Distance from top of the uppermost rung to top of pit	< 600 mm	
- Distance of top of the bottom rung above the invert of the pit	≥ 300 mm and ≤ 500 mm	
- Rung spacings	300 mm ± 50 mm	
Headwalls and wingwalls – cut off walls depth into sound rock	> 150 mm	**Headwalls and wingwalls**
Weepholes:		
- Height of gravel above the bottom of the weephole	> 450 mm	
- Plan area of gravel centrally about the weephole	> 600 mm along the wall and 300 mm out from the wall located	
Concrete construction:		**Pits and junction boxes**
- Strength	> 32 Mpa	
- Aggregate size	> 12 mm.	
-Finished level	± 3 mm. level of the surrounding area	
-Compressive strength	> 15 MPa	**Backfill**
Headwalls and wingwalls – cut off walls		
– Depth into sound rock	> 150 mm	**Headwalls and wingwalls**
Foundation for concrete bases		
– Mass concrete bedding depth	> 50 mm	**Foundation for concrete basis**

6 MEASUREMENT AND PAYMENT

6.1 MEASUREMENT

General

Payments made to the Schedule of Rates: To *0152 Schedule of rates – supply projects*, this worksection, as shown on the Drawings and **Pay Items 1354.1** to **1354.3** inclusive.
Lump sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology

The following methodology will be applied for measurement and payment: The cost of all work, materials and equipment is included in the Schedule rate for each Pay Item.

- Excavation: To *1351 Stormwater drainage (Construction)*.

6.2 PAY ITEMS

Pay items	Unit of measurement	Schedule rate scope
1354.1 Supply and place headwalls and wingwalls	m^3 of concrete in place. Volume calculated from the dimensions on Drawings, specified or directed by Superintendent.	All costs associated with supply and placing of in situ concrete including reinforcement in place including joints or backfilling.
1354.2 Supply and place pits, dissipators, channel basins and other supplementary structures	'Each' completed structure as shown on the Drawings, specified or directed by Superintendent.	All costs associated with the structures including cast in metal work, precast items frames, grates, lintels, lids, backfilling.
1354.3 Supply and place bulkhead structures	'Each' completed bulkhead as shown on the Drawings, specified or directed by Superintendent.	All costs associated with bulkhead structures including reinforcement and backfilling.

Alternatively use a single pay item.

Pay items	Unit of measurement	Schedule rate scope
1354.1 Supply and place drainage structures other than pipes and box culverts.	'Each' completed structure as shown on the drawings, specified or directed by superintendent.	All costs associated with supply and placing of in situ concrete including reinforcement in place including joints or backfilling. All costs associated with the structures including cast in metal work, precast items frames, grates, lintels, lids, backfilling.