

Engineering Construction Specification C23 Stormwater Drainage (Construction)

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This document is a modified version of AUS-SPEC 1351 Stormwater Drainage (Construction) and 1859 CCTV inspection of drainage conduits October 2018 version

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1 General

1.1 Responsibilities

1.1.1 General

Requirement: Provide drainage works as a complete system for collecting and carrying stormwater from roadways, open spaces and built-up areas, as documented.

General: Provide CCTV inspection and reporting of stormwater drainage and sewerage conduits and related maintenance structures, as documented and in conformance with **ANNEXURE - SCOPE OF CCTV INSPECTION**.

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)*
- *C06 Earthworks (Road reserve)*
- *C13 Road openings and restoration*
- *C24 Open drains*
- *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 STANDARD

1.3.1 General

Code: To WSA 05.

1.4 Interpretation

1.4.1 Abbreviations

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

- ADAC: Asset Design As Constructed.
- CCTV: Closed circuit television.
- FMP: Flow Management Plan.
- NATA: National Association of Testing Authority.
- WHS: Work Health and Safety.
- WSUD: Water Sensitive Urban Design.

1.4.2 Definitions

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

- Inadequate foundation material: Material beneath or adjacent to the proposed drainage structures with insufficient strength to support the structure and loads on the structure, or material with characteristics that would adversely affect the performance or construction of the drainage structure.
- Select fill: Backfill material with known properties and grading placed and compacted in layers.

1.5 Submissions

1.5.1 Authority approvals

Road opening permit: Submit a **Section 138** application to Council for approval for any works within the road reserve including the following:

- Location of services. Contact Dial Before You Dig.
- Opening and compaction specifications to *C13 Road openings and restoration* worksection.

1.5.2 Certification

Construction traffic: If proposing to move heavy construction plant or vehicles over pipe or box culverts structures, submit certification by a professional engineer of the protection measures.

Traffic Management Plan: Submit the traffic management plan for approval to the appropriate Road Authority. Traffic Management Plan must be completed by a person holding a current qualification Prepare Work Zone Traffic Management Plan

Details of proposed shoring systems (if required)

1.5.3 Execution details

Survey: Submit set-out survey for drainage system.

Set-out of stormwater drainage system: Submit details of any proposed changes to the location, length, design levels, strength, conditions of installation or cover to suit construction procedures.

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

Soil type: Give notice if the soil type on site is not consistent with the soil type used for design. Check for contaminants in the soil.

Subgrade before bedding: Check suitability of support material below culverts and compaction of subgrade.

Depth of bedding: Check level of base of trench to meet minimum bedding requirements before placing bedding material.

Depth of trenching and shoring

1.5.4 Products and materials

General: Submit product information for components of the stormwater system.

Product conformity: Submit current assessment of conformity as follows:

- Certificates for all pipes, culverts, precast concrete units, access covers, road grates or frames and all materials and components. Identify the item and record the inspection and test records that verify conformance to the specification.

1.5.5 Records

Work-as-executed drawings: Submit drawings including stormwater system information sheets and works, and photos of any structures near works. .

1.5.6 CCTV Reports

CCTV inspection results: Submit inspection results within 5 working days of field CCTV inspection completion.

1.5.7 Flow management plan

Requirement: Submit the FMP, in conformance with **FLOW MANAGEMENT**.

Submission time: A minimum of 5 working days before starting a CCTV inspection at any location.

1.5.8 Qualifications

Requirement: Submit evidence of operator's qualifications, in conformance with **OPERATOR TRAINING**.

Submission time: A minimum of 5 working days before starting CCTV inspection at any location.

1.5.9 Report

Inspection results: Submit inspection reports, in conformance with **Inspection report**.

Submission time: A maximum of 5 working days from completion of the first CCTV inspection and a maximum of 10 working days for subsequent inspections.

Urgent issues: Immediately after completion of the field investigation submit details of any defects nominated as requiring immediate notification, in conformance with **Immediate notification**. Provide the Principal with the option of a site visit whilst the camera is still on site.

1.5.10 Work health and safety plan

Requirement: Submit the WHS plan, in conformance with **WHS plan**.

Submission time: A minimum of 2 working days before starting a CCTV inspection at any location.

1.5.11 Samples

General: Submit the following:

- Components: Pipes and fittings.
- Samples: For conformity testing to relevant standards.
- Recycled materials.

1.5.12 Tests

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

2 Materials

2.1 General

2.1.1 Materials and components

Pipe and culvert material: To Austroads AGRD05 Table B1, unless otherwise approved by Council.

Pipes: To the *C25 Pipe drainage* worksection.

Precast: To the *C26 Precast box culverts* worksection.

Structures: To the *C27 Drainage structures* worksection.

2.2 Bedding and support material

2.2.1 General

Recycled material: To IPWEA NSW Greenspec.

2.2.2 Concrete pipes

Fill material for bed and haunch zones: Select fill conforming to the following:

- Particle size distribution: To AS/NZS 3725 Table 6.
- Plasticity index: To AS 1289.3.3.1: Maximum 6.

Fill material for side and overlay zones of pipes, box culverts and adjacent to other drainage structures: Select fill conforming to the following:

- Maximum dimension: 75 mm.
- Plasticity index to AS 1289.3.3.1: 2 to 12.

2.3 Testing

2.3.1 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, culverts and drains and construction to tolerances.

3.1.2 Set-out of stormwater drainage systems

Requirement: Identify and set out the location and levels of the following:

- Outlets and inlets of pipes and box culvert structures. Include the lengths in the set out.
- Gully pits, junction boxes, energy dissipators and inlet and outlet structures.
- Ends of wingwalls and headwalls.
- Open drains.

Site conditions: If required by site conditions, amend the inlet and outlet locations, designed levels or the culvert length.

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 Construction traffic

Requirement: If proposing to move heavy construction plant or vehicles over pipe or box culverts structures provide protection measures.

3.1.5 Existing structures

Existing redundant drainage structures: Demolish and remove existing redundant pipe culverts, head walls and pits as documented.

3.1.6 Excavation near underground services

Public utilities within or near the excavation for drainage systems: Obtain approval of the relevant authority for the method of excavation before commencing excavation. This is a HOLD POINT.

Contact: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, collecting enquiries and passing them on to affiliated utilities to assist in locating underground pipe and cables (initial response possible within two working days with responses from utilities some time later). See www.1100.com.au. This is a HOLD POINT.

Locations: Obtain locations of water, sewer, stormwater, gas, electricity and telephone services.

If excavation is taking place within or near known contamination, provide clear methodology for operation.

Marking: Before commencing earthworks, locate and mark existing underground services in the areas which will be affected by the earthworks operations including clearing, excavating and trenching. This is a HOLD POINT.

3.2 Open drains

3.2.1 General

Requirement: Provide open drains, associated embankments and protective linings in conformance with the *C24 Open drains* worksection.

3.3 Excavation for drainage systems

3.3.1 General

Topsoil removal: To the *C06 Earthworks (Road reserve)* worksection and before excavation.

Trench support stabilisation: Provide shoring, sheet piling or other stabilisation to the sides of trench excavations in accordance with the requirements of Safe Work Australia and the relevant Australian Standards.

Excavation level: Excavate to the design level for bedding or foundation. Remove all loose material.

Swales, batter slopes and bioretention trenches: Level beds as documented.

Blasting operations: Excavation by blasting, if permitted by Council, shall be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed culvert or drainage structure does not exceed 25 millimetres per second. The Developer shall comply with other requirements concerning blasting operations in Specification C06 Earthworks (Roadways).

3.3.2 Soil type

Requirement: Confirm surrounding soil type conforms to the soil type used for the stormwater drainage system design.

3.3.3 Trenches and embankments

Concrete and flexible pipes: Minimum trench width as follows:

- Concrete pipes: To AS/NZS 3725 clause 9.

- Flexible pipes: To AS/NZS 2566.2 clause 4.4.

Embankment installation condition: Before placing bedding and laying pipes, place and compact embankment fill to the *C06 Earthworks (Road reserve)* worksection and to the following:

- Height above the top of the bed zone: At least 0.7 times the external diameter of the pipe.
- Minimum lateral distance outside each trench wall: 2.5 times the external diameter of the pipe.

Trench installation condition: Complete the embankment to the underside of the selected material zone before trenching.

Installation condition: 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 installation condition: Complete the embankment to the underside of the selected material zone prior to the commencement of the excavation. For normal trench conditions, the pipe shall be laid in an excavated trench with bedding as specified in this work section. The trench shall not be excavated wider than 1.4 times the external diameter of the pipe plus 300mm.

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

Benching: All trenching shall be benched or supported in accordance with the requirements of Safe Work Australia and the relevant Australian Standards

3.3.4 Drainage structures other than pipes

Excavation: Provide a clear width between the structure wall and the face of the excavation of one third of the excavation face height or a minimum of 300 mm.

3.3.5 Inadequate foundation material

Requirement: Remove and dispose of inadequate foundation material to the *C06 Earthworks (Road reserve)* worksection and replace with material to **BEDDING AND SUPPORT MATERIAL**.

3.3.6 Rock foundation

Requirement: If rock is encountered at the foundation level, excavate to a depth required by the pipe type and backfill with compacted selected fill.

3.3.7 Excavation of Inlet and Outlet Channels

Extent: Excavation of inlet and outlet channels shall be carried out as shown on the Drawings and shall extend to join the existing stream bed in a regular manner as detailed in Specification C24 – Open drains including kerb and channel (gutter).

3.4 Bedding and backfilling

3.4.1 Pipe bedding

Concrete and flexible pipes: Bedding depth as follows:

- Concrete pipes: To AS/NZS 3725 Table 5.
- Flexible pipes: To AS/NZS 2566.2 Table 4.2.

3.4.2 Backfilling

Concrete pipes minimum cover: To AS/NZS 2566.2 Table 4.1.

Flexible pipes height of fill: To AS/NZS 3725 Table B1.

In situ concrete structures: Do not backfill against in situ concrete drainage structures less than 14 days after placing concrete.

Trench backfill material: Backfill the remainder of the trench to the underside of the subgrade, or selected material zone in conformance with the *C06 Earthworks (Road reserve)* worksection.

Sequence: Start backfilling and compaction at the pipe or structure to confine future backfill material.

3.5 Compaction

3.5.1 Compaction of foundations, bedding and backfilling

Foundations, bedding (other than for pipe drainage) and backfilling: To the **Compaction table**, tested in conformance with AS 1289.5.4.1 for standard compactive effort. Figures for modified compactive effort are also provided.

3.5.2 Compaction table

Zone	Relative compaction	
Foundations or trench base:	Standard	Modified
- To a depth of 150 mm below foundation levels	95%	92%
- Material replacing unsuitable material	95%	92%
Bedding material	95%	92%
Selected backfill and ordinary backfill material:		
- Below 1.5 m of finished surface	95%	92%
- Within 1.5 m of finished surface	100%	97%
Backfill material within the selected material zone	100%	98%

Compaction layers thickness: Compact all material in layers not exceeding 150 mm compacted thickness and to the documented relative compaction before the next layer is commenced.

Moisture content range: At the time of compaction, adjust the moisture content (within the range 60% to 95% of the optimum moisture content) of the material to achieve the documented compaction as determined by AS 1289.5.7.1 (standard compaction).

3.5.3 Compaction adjacent to culverts or drainage structures

Method: If compacting adjacent to culverts or drainage structures, adopt compaction methods which do not cause damage or misalignment. Rectify any damage.

3.5.4 Compaction of pipe drainage bedding

Protection of the pipe from construction damage: If required, adjust the layer thickness to avoid damaging the pipe.

Concrete pipes bed and haunch zones:

- Compaction: To AS/NZS 3725 clause 8 and Table 5.
- Place and shape the top 0.1 times the external diameter of the pipe of the bedding and haunch material directly under the pipe to house the pipe after compaction achieved in the bed and haunch zone external to area of direct support.

- If the impermeability of the natural ground and the slope of the drainage line may result in erosion of bedding material, provide cementitious stabilisation.

Flexible pipe embedment: To AS/NZS 2566.2 clause 5.6 and Table 5.5.

3.6 Concrete work

3.6.1 General

Requirement: Supply and place normal class concrete, sprayed concrete, steel reinforcement, formwork and provide tolerances, construction joints, curing and protection to the *C28 Auxiliary concrete works* worksection and as documented.

3.7 Water sensitive urban design

3.7.1 Protection to WSUD

Vegetated swales, buffer strips and bioretention systems: Do not allow construction traffic access to areas of WSUD or infiltration systems. Provide fences if required to the requirements of Council.

Permanent protection: Install bollards, signposting or other street furniture, to protect the constructed vegetated areas from damage. Access for maintenance vehicles must be ensured for to ensure the long term functionality of the WSUD.

3.7.2 Vegetated swales and buffer strips

Details: As documented and to the following requirements if appropriate.

Ponding prevention: Provide a perforated pipe beneath the swale drain.

Geometry: Trapezoidal or parabolic shapes, side slopes no steeper than 3H:1V.

Longitudinal slope: If longitudinal slope is not within 1% to 4%, conform to the following:

- Slopes greater than 4%: Install check dams.
- Slopes less than 1%: Install under drains.

Maximum swale width: 2.5 m.

Maintenance:

- Buffer strips: Remove deposited sediment. Inspect vegetation regularly for reasonable condition.
- Swales: Vegetation height should be maintained so that it is not submerged.

3.7.3 Bioretention systems/rainwater gardens

Base or drainage layer:

- Depth: 150 to 200 mm.
- Material: Coarse sand (1 mm) or fine gravel (2 to 5 mm).
- Impermeable liner: If the surrounding soil is free draining, use an impermeable liner on the base and sides.

Transition layer:

- Minimum 100 to 150 mm thick layer of sand. A geotextile fabric may be used.

Filtration layer:

- Depth of filter media: 300 and 700 mm, as documented.
- Saturated hydraulic conductivity: 200 to 500 mm/hr.
- Perforated pipe capacity: Make sure the perforated pipe capacity is more than the infiltration capacity of the filter media.

Maintenance:

- Inspection: Inspect bioretention systems every fortnight between October to March and once a month between April to September, for 2 years after construction is complete.
- Litter: Remove litter and dead plant material from gardens.
- Density: Maintain the planting density of the garden.
- Herbicide: Do not use herbicides in bioretention systems/rainwater gardens.
- After rainfall of over 10 mm, within 2 days:
 - Remove surplus silt build up.
 - Replace washed away soil.
 - Replace gravel or mulch.
 - Remove litter.

3.7.4 Gross pollution treatment (GPTs) as part of a treatment system

General: Provide GPTs as documented.

Treatment objectives: To capture gross pollutants litter and vegetation larger than 5 mm and sediment particles larger than 0.125 mm.

3.7.5 Landscape and vegetation

Plant species selection: To the *C29 Landscape - road reserve and street trees* and street trees worksection.

Minimum depths of topsoil: Conform to the following:

- Turf areas: 150 mm.
- Ground covers and small shrubs: 300 mm.
- Large shrubs: 450 mm.
- Trees: 600 mm.

3.7.6 Stormwater re-use

Requirement: Provide stormwater re-use collection, storage, treatment and distribution.

3.8 Testing

3.8.1 Quality

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

3.9 Completion

3.9.1 Inspection

Closed circuit television (CCTV) inspections:

- On completion of all drainage structures and before commencement of pavement construction above the drainage structure to verify the works are within the specified tolerances and without visual signs of structural failure.
- No more than 14 days before completion to verify tolerances and to make sure there is no obstruction to the flow of water.

3.9.2 Cleaning

Flushing: On completion of the system, flush all pipes clean from end to end and leave in working order.

4 CCTV Pre-INSPECTION Planning

4.1 Drainage network

4.1.1 Asset information

General: For conduits and maintenance structures to be inspected the following information is provided:

- A plan/map of the network, to scale, including node and conduit locations, node numbers, street names and property boundaries.
- Size, material, class and flow direction of conduits.
- Coordinates, depth, surface and invert levels of nodes.
- Dates of construction - Age.
- Asset names or descriptors.
- Critical flow patterns and any pumped discharges.
- Any isolation or flow control measures relating to the network.

4.1.2 Access

Location: Confirm location of access maintenance structures based on the asset information obtained.

Traffic impact: Do not use access maintenance structures which are located under road surfacing or at heavy traffic junctions, if possible. Complete CCTV inspection from adjacent maintenance structures.

Notification: Provide minimum notice of 1 full working day of any required access locations which are inaccessible on Council property and a written notice to the owner/occupier before accessing any maintenance structures on private property, with the format and timeframe for such notice to be in conformance with relevant State legislation and local laws.

Identification: Always carry the Council/Municipality/Utility identification provided.

4.2 Operator training

4.2.1 Qualifications

Requirement: Use operators trained and qualified with certified competence in conformance with WSA 05 clause 2.2.1 to conduct CCTV inspections, identify defects and report on condition of conduits and related maintenance structures. For stormwater assets the operators must also read the guidelines in *IPWEA Practice Note 5 – Stormwater drainage*.

4.3 Clearing and Cleaning

4.3.1 General

Requirement: If clearing or cleaning of the conduit and maintenance structures prior to inspection is requested, conform to the requirements of Council.

Initial inspection: Perform an initial inspection using zoom cameras to identify any potential obstructions or blockages which may impede the successful completion of the detailed CCTV inspection.

4.4 Work health and safety

4.4.1 WHS plan

Requirement: Prepare a WHS plan for the CCTV inspection works including safe work method statements for each inspection location, in conformance with State regulatory requirements.

4.4.2 Confined spaces

General: Make sure all staff entering any confined space have completed the necessary confined space training, and are provided with the necessary safety equipment, required by State WHS regulation.

4.5 Flow management

4.5.1 General

Timing: Where possible, plan to carry out CCTV inspections during dry weather for stormwater conduits and during periods of predicted low flow for sewerage conduits.

FMP: If it is anticipated that flows within the conduit will require management for a successful CCTV inspection, prepare a FMP detailing how normal dry weather and wet weather flows will be managed.

4.5.2 Flow storage

Upstream: Where storage of flows within the network can be safely achieved upstream of the inspection location, detail the following in the FMP:

- Management resources.
- Monitoring procedures of upstream storage/flow levels.
- Procedures to manage any sudden rises in storage/flow levels.
- Systems in place to make sure that, where plugs are used, they cannot be displaced in a situation where they deflate.

4.5.3 Flow diversion

By-pass pumping: If storage of flows within the network cannot be safely achieved, use by-pass pumping to divert flows past the area of inspection. Detail how the by-pass pumping will be installed, managed and operated in the FMP and include the following information:

- Proposed pumping access points.
- Identification of each point of inflow into the conduit to be inspected.
- Proposed equipment and provision of back-up equipment.
- Procedures for monitoring the equipment in operation.
- Control of noise and public safety.
- Anticipated duration of pumping activities.
- Procedures for dealing with any spillage/leakage which may occur.

5 Equipment for CCTV Inspection of Drainage Conduits

5.1 CCTV CAMERA

Standard: To WSA 05 clause 2.5.1.

Camera type: Use a camera to suit the specific conduit diameter and required picture quality.

5.1.1 Capability and quality

Requirement: Use cameras which conform to the following:

- Capability (Manoeuvrability): To WSA 05 clause 2.5.2.
- Picture quality: To WSA 05 clause 2.5.3.

6 Inspections

6.1 Notice

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

- Set-out of stormwater drainage system: Set-out of culverts and drainage system.
- Unsuitable foundation material: Area (including trench sides) containing material unsuitable to support drainage system.
- Rock foundation: Remove to spoil of any excavated rock, measure insitu to pay.
- Backfilling:
 - Dimensions of corrugated metal structures after backfilling.
 - Against in situ concrete structures.
- Compaction adjacent to culverts or drainage structures: Rectification of damage due to compaction.
- Compaction of pipe drainage bedding: Cementitious stabilisation in the concrete pipe bedding and haunch zones. Refer to Council's standard drawings for steps in pavement.
- Protection to WSUD: Vegetated swales, buffer strips, and bioretention systems from construction traffic (Environmental protection).

7 EXECUTION CCTV Inspection of Drainage Conduits

7.1 Provision for traffic

7.1.1 General

Requirement: Conform to *C03 Control of traffic*.

7.2 Required documentation

7.2.1 General

Requirement: The CCTV operator and inspection reporter/coder must have a copy of this specification and WSA 05 available at all times during inspection and coding.

7.3 Camera operation

7.3.1 Camera position

Requirement: Position camera centrally within the conduit or maintenance structure in conformance with the tolerance requirements of WSA 05 clause 2.6.1.

7.3.2 Camera travel speed

Maximum: Manoeuvre the camera at no greater than the maximum speed documented in WSA 05 clause 2.6.2.

7.3.3 Camera pan

Restriction: Do not pan the camera whilst the camera is moving. At a defect or feature, stop the forward camera movement and then pan or rotate the camera, to conform to WSA 05 clause 2.6.2.

7.4 Inspection procedure

7.4.1 General

Asset data: Confirm that the conduit material and size conforms to any asset data obtained before starting the inspection. Identify and record any asset data which contradicts previous asset data obtained.

7.4.2 Inspection

Maintenance structures: Inspect, observe and record any features or defects of the maintenance structures at the start and end of the inspection. Also include any intermediate maintenance structures, not previously documented in the obtained asset data.

Liase with Council regarding the correct identification of new assets to tie in with Council's existing asset data.

Start of conduit: Position camera at the face of the maintenance structure (conduit invert) and inspect the start of the conduit. Rotate the camera through 360°, paying particular attention to the 3, 6, 9 and 12 o'clock positions for the start of any longitudinal cracks or fractures. Record start node and water level codes to WSA 05.

End of conduit: Complete the same 360° inspection at the end of the conduit length. Record an inspection closing code to WSA 05.

Conduit joints: When defects are visible upon approach to a joint, complete the same 360° inspection at those joints.

7.4.3 Observation

Record: Record observed features or defects, which extend over a length greater than 1 m, as a continuous code. Define the continuous code by recording the start and finish linear measurement of the defect from the longitudinal reference point. Record defects or observations affecting less than 1 m of the conduit length as a non-continuous defect.

7.4.4 Camera vision

Clean lens: If the lens of the camera becomes obscured, preventing a clear view of the conduit and potential defects, pause the inspection and clean the lens. If the camera needs to be removed to clean the lens, the inspection can be resumed at the location where the inspection was paused. The video however must be a single video record.

7.4.5 Completion

Covers: Correctly reinstate all maintenance structure covers at the completion of the field CCTV inspection.

7.5 Linear Measurement

7.5.1 General

Standard: To WSA 05 clause 2.7.

Levels: Record all levels to Australian Height Datum (AHD). If a reference level is not available, record relative levels from the centre of the cover to the maintenance structure at which the inspection is to start.

7.5.2 Longitudinal reference point

Zero measurement: Set the longitudinal reference point as the centre of the maintenance structure at which the inspection is to start. The start linear measurement is the distance from the centre of the maintenance structure to the face of the maintenance structure.

Finish point: Finish the inspection at the corresponding reference point in the target maintenance structure, unless inspection has to be abandoned.

Alternative: If the centre of the maintenance structure cannot be accurately determined, set the longitudinal reference point in conformance with WSA 05 clause 3.5.4.5.

7.6 Maximum depth of flow

7.6.1 In-service assets

General: Pause or terminate any inspection if the maximum depth of flow values stated in WSA 05 Table 2.1 are exceeded. Conform to the requirements of WSA 05 clause 2.11.

7.7 Recording water level

7.7.1 General

Water level: Record the water level of stagnant (ponding) water or water flowing at a constant depth at the start of the inspection. Do not record water flowing at fluctuating depths as a water level. Record water level and changes in water level to WSA 05 clause 3.7.8.3, Quantification 1.

7.7.2 Sagging

Sag: Record the water level to WSA 05 clause 3.7.8.3, Quantification 1, where the water level is increasing due to a sagging conduit. Terminate the inspection if the camera becomes submerged, unless the camera will become unsubmerged in a short distance.

8 Reporting

8.1 General

8.1.1 Inspection report

Requirement: Prepare a report of the CCTV inspection in conformance with WSA 05 clause 2.12.1, WSA 05 Appendix A and as follows:

- Report file type: In a format that is compatible with Council's asset management systems. Liaise with Council. Preferred formats include MS Word and software outputs such as WinCan
- Report format: electronic submission of reports is preferred.
- Photographs of features/defects: as per the requirements of WSA 05 clause 2.12.4.
- Video clips of features/defects:

8.1.2 Video record

Data display: During video playback, display data, superimposed on the image, to satisfy the requirements of WSA 05 clause 2.8. For conduits also include the following data:

- Direction of view (a dial, mimic or graphical indicator showing the camera's position with respect to the angle/circumferential direction of view). If camera does not have capability to record the direction of view, record the angle of view in conformance with WSA 05 clause 3.7.9.4.
- Conduit asset reference number.

8.1.3 Drawings

Requirement: Provide electronic format drawings, included in the inspection report, conforming to Councils requirement.

8.2 Observation coding

8.2.1 Conduit inspection

Reporting: When describing and encoding all observations from the CCTV inspection, conform to the requirements and codes in WSA 05 Section 3.

Header information: Record the mandatory information required by WSA 05 clause 3.4.2.

8.2.2 Maintenance structure inspection

Reporting: When describing and encoding all observations from the CCTV inspection, conform to the requirements and codes in WSA 05 Section 4.

Header information: Record the mandatory information required by WSA 05 clause 4.4.2.

8.2.3 Immediate notification

Requirement: Upon completion of the field investigation, immediately notify the Principal of any observed defect that may warrant immediate investigation by the Principal, or if any of the following defect codes were observed:

8.2.4 Scoring of defects

General: Score each defect and grade the apparent condition of the asset, in conformance with the relevant WSA 05 Appendices, as follows:

- Appendix D – Stormwater.

9 Annexure

9.1 Annexure – Summary of hold and witness points

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
C23-WP01	SUBMISSIONS Authority approvals	W	Dial Before You Dig investigation. Gain Service Authority Approval where conflicts exist.	10 days before site commencement	Site commencement
C23-HP02	SUBMISSIONS Road occupancy permit from the Road Authority	H	Approval from Road Authority with appropriate approval certificate.	5 days before site commencement	Gain road opening permit with conditions
C23-HP03	SUBMISSIONS Certification Construction traffic	H	Certification of protection measures	10 days before protection measures installation.	Protection measures
C23-HP04	SUBMISSIONS Traffic Management	H	Traffic Management Plan submitted to Road Authority for Approval	10 days before site commencement	Site Commencement
C23-HP05	SUBMISSIONS Execution details Set-out of stormwater drainage system	H	Details of any proposed changes to designed system	10 days before site commencement	Construction setout
C23-HP06	SUBMISSIONS Execution details Temporary bypass drainage during construction	H	Details of procedures/devices	10 days before site commencement	Temporary drainage proposal
C23-WP07	SUBMISSIONS Execution details Soil type	W	Soil type confirmation	3 days before starting excavation	Excavation
C23-HP08	SUBMISSIONS Tests Durability	H	Soil test results	5 days before proceeding	Site commencement
C23-WP09	INSPECTIONS Excavation near underground services	W	Locate services visually by approved non-mechanical methods, mark locations and	1 week prior to proceeding	Excavation

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
			depths. Submit marking for approval		
C23-WP10	INSPECTIONS, Notice Set-out of stormwater drainage system	W	Set-out of location design levels and design cover	3 days	Set-out of stormwater drainage
C23-WP11	INSPECTIONS, Notice Drainage structures other than pipes	W	Clear width of excavations	3 days	Temporary drainage during construction
C23-WP12	INSPECTIONS Notice Unsuitable foundation material	W	Area containing material inadequate to support drainage system Identify unsuitable material and remove to spoil heap and pay loose heap measure.	Proceeding	Trench grade suitability
C23-WP13	INSPECTIONS Notice Rock foundation	W	Compaction to fill for excavated rock Removal of rock to spoil to measure loose in heap.	Proceeding	Bedding depth over rock
C23-WP14	INSPECTIONS Notice Culvert subgrade strength	W	Compaction and suitability of subgrade under culverts.	1 day before culvert foundation material	Subgrade before bedding material
C23-WP15	INSPECTIONS Notice Backfilling	W	Dimensions of corrugated metal structures after backfilling	1 day	Backfilling
C23-WP16	INSPECTIONS Notice Backfilling	W	To in situ concrete structures	2 days	Backfilling
C23-WP17	INSPECTIONS Notice Compaction adjacent to or culverts drainage	W	Observation of compaction around culverts to check compliance.	Proceeding	Compaction of backfilling

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
	structures				
C23-WP18	INSPECTIONS Notice Compaction of pipe drainage bedding	W	Cementitious stabilisation in the concrete pipe bedding and haunch zones as specified	Proceeding	Compaction and stabilisation of backfilling and bedding
C23-WP19	INSPECTIONS Notice Protection to WSUD	W	Vegetated swales, buffer strips, and bioretention systems from construction traffic	Proceeding	Restoration of any damaged WSUD
C23-HP20	INSPECTIONS Notice Pipework installation	H	Each section of the installed and jointed pipework before commencement of trench backfilling	Progressive	Execution and installation. For development inspections book through "MyInspect".
C23-HP21	SUBMISSION Work as Executed Drawings and Drainage Asset Attribute Schedules	H	Submit certified drawings and schedules	2 weeks after completion of works	Prior to Subdivision Certificate/Occupation Certificate
C23-HP22	SUBMISSION Submit CCTV video	H	Submission of CCTV video and accompanying inspection reports	5 days after completion of CCTV inspection	Prior to sealing of road. Inspection and reports as per WAS Code.
	*H = Hold Point, W = Witness Point				

9.2 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
Material surrounding steel structures	Material quality: <ul style="list-style-type: none"> pH/Electrical resistivity 	AS 1289.4.3.1 AS 1289.4.4.1
Bedding	Material quality: <ul style="list-style-type: none"> Particle size distribution Compaction/moisture content 	AS C08.11.1 AS 1289.5.4.1 AS 1289.5.7.1
Concrete bedding or lining	Geometry	Survey and 3 m straight edge
Selected backfill	Material quality: <ul style="list-style-type: none"> Maximum particle size Plasticity index Compaction/moisture content 	AS 1289.3.3.1 AS 1289.5.4.1 AS 1289.5.7.1

9.3 Annexure - Scope of CCTV inspection

Inspection location:

- Area: _____
- Start: _____
- End: _____

Reason for inspection
and scope of works: _____

Inspection exclusions

The following defects/features can be excluded from the CCTV inspection reporting:

Existing asset information

Data on existing assets has been made available to Contractors in conformance with WSA 05 clause 2.3, clause 3.4.4 and clause 4.4.4:

Yes

No (see below)

The following asset data is not available:

Pre-cleaning/Obstruction removal

Before starting the CCTV inspection the Principal requires the following:

9.4 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 1289.4.3.1	1997	Soil chemical tests - Determination of the pH value of a soil - Electrometric method
AS 1289.4.4.1	2017	Soil chemical tests - Determination of the electrical resistivity of a soil - Method for sands and granular materials
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/NZS 2041		Buried corrugated metal structures
AS/NZS 2041.2	2011	Installation
AS/NZS 2566		Buried flexible pipelines
AS/NZS 2566.1	1998	Structural design
AS/NZS 2566.2	2002	Installation
AS/NZS 3725	2007	Design for installation of buried concrete pipes
Austrroads AGRD		Guide to road design
Austrroads AGRD05	2013	Drainage – General and hydrology considerations
IPWEA NSW Greenspec	2010	Specification for the supply of recycled materials for pavements, earthworks (Roads and Transport Directorate)