



Engineering

Technical Standard

TS 0524 – CCTV Inspection of Gravity Sewer Infrastructure

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Only the current revision of this Standard should be used which is available for download from the SA Water website.

Significant/Major Changes Incorporated in This Edition

In February 2020 the WSAA Codes were gazetted in South Australia, as the minimum standard requirement for all new water and wastewater infrastructure.

This review of TS 0524 has been undertaken with consideration given to the requirements of the new WSA 05-2020 Conduit Inspection Reporting Code of Australia Version 4.1. The latest edition of the WSA 05 Code, focuses on internal asset condition assessment of conduits such as sewers, sanitary and stormwater drains, as well as maintenance structures. It replaces Version 3.1 of the 3rd edition, published in 2013.

The WSA 05-2020 Conduit Inspection Reporting Code of Australia Version 4.1 edition also focuses on improving the efficiency of reporting, through code changes and software requirements. This will assist in providing the necessary information needed, to make prudent asset management decisions. To complement these changes, the scoring and grading system has been revised to better reflect the severity and impact of defects. It also recognises that 3D optical scanners are now being used instead of CCTV cameras, and addresses the use of laser and sonar profiling of conduits.

Clause 1.2 Glossary

Removal of MS – Maintenance Structure acronym.

Clause 5.1 Timing

Clarification added, regarding when CCTV inspection needs to be undertaken.

Clause A8 Dropped Invert

Former Table 7 and the acceptance of dropped invert tolerances removed.

Document Controls

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Role	Signature and Date
Principal Engineer, Reticulation Networks Tom Galek	20/08/2021 X  ----- Signer's Name Signed by: GA112117
Manager Engineering Quality and Innovation Matthew Davis	25/08/2021 X  ----- Signer's Name Signed by: DA003681
Senior Manager Engineering Services Richard Gray	25/08/2021 X  ----- Signer's Name Signed by: GR001964

Reviewers

Role	Name	Revision	Review Date
Principal Engineer Reticulation Networks	Tom Galek	0.3	24/08/2017
Construction & Completions Manager	Tim Ingram	0.3	1/08/2017
Lead Planner Wastewater Assets	Adam Russo	2.1	08/12/2020
Snr Planner Wastewater Assets	David Van Bochove	2.1	08/12/2020
Snr Planner Wastewater Assets	Kate Malysheva	2.1	08/12/2020
Construction Technical Manager	Mark Marschall	2.1	02/12/2020
Construction Technical Officer	Vernon Groom	2.1	04/12/2020

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1 Introduction

SA Water is responsible for the operation and maintenance of an extensive amount of water and sewer infrastructure, throughout the state.

This Technical Standard has been developed to provide guidance to key stakeholders.

In July 2014, SA Water introduced the mandatory requirement for CCTV inspection of newly constructed sewer infrastructure (in line with WSA 02-2014), and subsequently prepared this Technical Standard to detail CCTV inspection acceptability criteria and provide clarity for all stakeholders.

1.1 Purpose

The purpose of this Technical Standard is to detail minimum requirements for CCTV inspection of sewer infrastructure, to ensure all key stakeholders (including but not limited to; Civil Constructors, CCTV Operators and SA Water Personnel) have a clear understanding of their responsibilities, the Technical Requirements and SA Water's acceptance criteria.

The aim is to detail SA Water's requirements for CCTV inspection of sewer infrastructure, to ensure that new and replacement sewerage assets covered by the scope of this standard, are constructed to consistent standards and achieve the required asset life.

1.2 Glossary

The following glossary items are used in this document:

Term	Description
CCTV	Closed-circuit colour television
DAFI	Development Agreement Formal Instrument
DN	Diamètre Nominal / Nominal Internal Bore
ID	Internal Diameter
Inspection	The internal inspection of sewer infrastructure comprising the CCTV examination and resultant production of videos, photographs and report.
Inspection Report	The Report incorporating videos, photographs and Reportable Items Summary List. Refer Clause 7.1. and Appendix C
JPEG	Joint Photographic Experts Group
MPEG	Moving Picture Experts Group
NATA	National Association of Testing Authorities
PAL	Phase Alternating Line, is a colour encoding system
PDF	Portable Document Format
PIPA	Plastic Industry Pipe Association of Australia
SA Water	South Australian Water Corporation
TS	SA Water - Technical Standard
WSAA	Water Services Association of Australia

1.3 References

This Technical Standard references other Standards and Codes, but shall take precedence over these documents.

1.3.1 Australian and International

The following table identifies Australian and International standards and other similar documents referenced in this document:

Number	Title
WSA 02-2014	Sewerage Code of Australia
WSA 05-2020	Conduit Inspection Reporting Code of Australia
AS 1260: 2017	PVC-U pipes and fittings for drain, waste and vent applications
PIPA POP 102	Solvent Cement Welding of PVC Pipe

1.3.2 SA Water Documents

The following table identifies the SA Water standards and other similar documents referenced in this document:

Number	Title
SCM	Sewer Construction Manual
	SA Water Supplementary Documentation, Sewerage Code – Part 3 (Construction)

1.4 Definitions

The following definitions are applicable to this document:

Term	Description
SA Water's Representative	The SA Water representative with delegated authority under a Contract or engagement, including (as applicable): <ul style="list-style-type: none"> • Superintendent's Representative (e.g. AS 4300 & AS 2124) • SA Water nominated contact person/s.
Constructor	The Civil Contractor as defined under a SA Water Contract or Specification or under the Development Agreement.
CCTV Operator	The qualified assessor responsible for analysing CCTV video footage and compiling the Inspection Report detailing defects in accordance with this Technical Standard and WSA 05-2020. Refer Clause 4.3, in this standard. The CCTV Operator engaged by either the Constructor or an SA Water Project Manager.
Developer	The Developer is responsible for completion of the Development Works in accordance with the Land Development Agreement, with SA Water
Project Manager	A Project Manager appointed by SA Water to oversee a SA Water project.
Specification	SA Water Project Specification requiring CCTV Inspection

2 Scope

This Technical Standard relates to CCTV Inspection of Gravity Sewer infrastructure, both new and existing.

CCTV Inspections shall be undertaken for the purpose of confirming:

- new sewer infrastructure has been constructed in accordance with the design drawings, and SA Water's construction requirements.
- existing sewer infrastructure has been successfully augmented (replaced or relined) for verification of the condition of an asset.

The contractual Agreements by which the CCTV Inspection is undertaken are:

1. The Development Agreement for new infrastructure. The Developer is responsible for the provision of new sewer (and water) infrastructure to service newly created allotments, including satisfactory CCTV inspection and testing of the assets installed.
2. A Contract Specification for new or replacement infrastructure. SA Water will typically detail specific project requirements, contractual matters and contractual responsibilities.

This Technical Standard shall be considered together with these Agreements or Contracts.

In all instances where CCTV Inspections and reports are undertaken they shall be:

- in accordance with this Technical Standard,
- executed by qualified Operators, refer Clause 4.3,
- reported in accordance with Clause 7,
- certified by a qualified Operator, refer Clause 4.3,
- countersigned by the Constructor

3 WSA Codes Relevance and Interpretation

WSA 05 - 2020, specifies CCTV requirements for new and existing gravity sewers, as well as stormwater systems.

3.1 New Infrastructure

For new infrastructure, WSA 05 - 2020 provides acceptance testing specifications for newly constructed gravity sewers and stormwater conduits (Appendix J).

Accordingly, SA Water has based its acceptability requirements for new infrastructure on these specifications. Herein, SA Water provides details of its acceptability requirements (Appendix A).

SA Water requires a CCTV Inspection Test Report in accordance with Appendix C.

If defective work is observed, in the CCTV footage/images, An Acceptance Test Report, must be completed by the CCTV Operator and forwarded to the Constructor and SA Water Representative.

3.2 Existing Infrastructure

For existing sewer infrastructure WSA 05-2020, provides a detailed scoring system for confirmation of any defects, faults or extent of deterioration.

SA Water requires a CCTV Acceptance Test Report, to be completed by the CCTV Operator and forwarded to the Constructor and SA Water Representative. Herein, SA Water provides details of its acceptability requirements (Appendix A).

3.3 Precedence

This Technical Standard shall have precedence over WSA 05 - 2020 .

4 Roles and Responsibilities

4.1 Third Party's undertaking the Works

The Third Party (e.g. Developer, Department for Infrastructure and Transport, Council etc.) shall be responsible for:

- compliance with the Obligations stated in the Development Agreement Formal Instrument or Contract,
- the Constructor's compliance with SA Water's Acceptance Testing requirements, for new infrastructure,
- the provision of all Acceptance Testing documentation, prior to Practical Completion.

4.2 The Constructor

The Constructor shall be responsible for compliance with this Technical Standard. Ensuring that the following steps are undertaken:

- **For new sewer infrastructure** - verifying that all sewer construction works have been completed. Including any service crossings and trench fill (min 1000 mm for DIT roads and min 800 mm on other roads), prior to the CCTV Inspection commencing.
- **For existing infrastructure** – Liaise and take direction from the SA Water project manager, regarding project specific requirements.
- Obtain approval from SA Water for the connection or augmentation of existing assets
- maintaining the integrity of the existing assets to which the new sewer infrastructure is being connected to
- providing advice to SA Water/ Field Services Operations confirming the timing of the inspection and compliance with the required Authorisations / Permits / Approvals.
- providing advice to the Road Authority (i.e. Department for Infrastructure and Transport or Local Government (Council)) in accordance with their notification requirements, where work may be undertaken on a public road.
- the engagement of appropriately qualified and certified CCTV operators (including subcontractors, refer Clause 4.3) for:
 - removal of debris and cleaning of the mains, prior to the CCTV Inspection and,
 - provision of clean water for testing,
 - the CCTV Inspection/s and Reports,
- ensuring the differing responsibilities for each subcontractor are understood and fulfilled,
- The timely provision of the CCTV footage and Inspection Report and notification of the CCTV Inspection/s, to be forwarded to SA Water Representatives and associated stakeholders (refer Clause 7),
- any additional testing (e.g. deflection) where the original CCTV Inspection identifies or highlights a possible defect or fault,
- the retesting of any assets following rectification work,
- providing advice to the SA Water Representative of all unacceptable results confirmed within the Report, together with:
 - confirmation of rectification actions undertaken,
 - confirmation that additional testing has been completed for all rectification.

4.3 The CCTV Operator

The CCTV Operator shall have:

- For all personnel undertaking the CCTV inspection and reporting, evidence for one of the following Nationally recognised qualifications, A copy of which shall be provided to SA Water, upon request:
- A Certificate III in Water Industry Operations including Unit NWPNET037 – Inspect sewer or stormwater assets from the National Water Training Package 2019 (previously NWPNET016) for Inspect sewer or stormwater line from the National Water Training Package 2015 (or Unit NWP331B – Inspect conduit and report on condition and features from NWP07) and
- A Statement of Attainment in Unit NWPNET017 – Inspect sewer or stormwater assets from the National Water Training Package 2019 (previously NWPNET016) - Inspect sewer or stormwater line from the National Water Training Package 2015 (or Unit NWP331B—Inspect conduit and report on condition and features from NWP07)
- An alternative recognised qualification that meet the requirements of this Technical Standard and WSA 05-2020 for Operators providing the Report as approved by SA Water.
- The required knowledge and experience of the equipment to facilitate a detailed Report in compliance with this Technical Standard.

The CCTV Operator shall be responsible for:

- ensuring video footage, photos and details of the sewer and potential defects, are of good quality and suitable for audit and quantification by the CCTV viewer,
- compliance with the contractual and standard obligations required by SA Water or the Constructor, (e.g. WHS, inductions, timing etc.) and any other requirements that may be needed by another Authority (e.g. Council, DIT, SAPN etc.).
- creating the Inspection Report as defined in Clause 7, including confirmation of all unacceptable or notifiable defects,
- Forwarding the CCTV footage and Report to the Constructor, advising the Constructor of all unacceptable or reportable defects

4.4 SA Water

SA Water will:

- provide oversight of the Constructor's Quality Assurance program, including testing and witness point verification,
- provide technical advice to the Constructor, where requested,
- use the CCTV Inspection Report in determining compliance with the Constructor's obligations.

5 Undertaking the CCTV Inspection

The CCTV Inspection shall be undertaken in accordance with this Technical Standard.

For new infrastructure, the CCTV Inspection Report shall be considered confirmation that all new sewer pipes and maintenance structures conform with the Design Drawings, SA Water's Construction requirements and are fit for purpose.

For existing infrastructure, SA Water may have a Specification detailing the scope of work and contractual requirements. The Specification may reference this Technical Standard for details of the specialist and aspects of the CCTV Inspection.

5.1 Timing

The CCTV Inspection shall be undertaken:

For new infrastructure.

In compliance with the requirements of clause 21.8 (Internal Inspection) of WSA 02 (2014), internal inspections are to be carried out on sewers and maintenance structures.

The timing of a CCTV inspection must ensure that the CCTV footage provides an accurate representation of the condition of the sewer, once it is subject to the stress loadings of backfill soil and maintenance structures.

This requires the presence of trench fill up to the road base, which shall not be less than 1000 mm for DIT roads or 800 mm on other roads. Prior to fitting of M/H covers, commissioning and placement of bitumen, or as agreed with the SA Water Representative.

For existing infrastructure.

As stated in the Specification or as agreed with the Project Manager.

5.2 Notice of Intending Works

SA Water shall have the opportunity to be present to witness the CCTV Inspection. The Constructor shall be responsible for notifications to the SA Water Representative of the CCTV Inspection/s.

Unless otherwise instructed by SA Water, the Constructor shall provide an approximate date for the initial CCTV Inspection and Test Plan to the SA Water Representative within the following notification periods:

- 15 working days for the actual CCTV Inspection
- 3 working days for any subsequent CCTV Inspection (that may be required).

The Contractor shall make all reasonable effort to undertake the CCTV Inspection during a time when the SA Water Representative is available.

When the time is not suitable for the SA Water Representative, an alternative appointment may be requested, in the case that the required notice is not provided. Any associated impact (program or financial) will be the responsibility of the Constructor.

Where the SA Water Representative cannot witness the test and the required notifications have been provided, the Constructor may proceed with the test.

Where CCTV Inspection of existing infrastructure is required, the above notification requirements apply and notification of the following key stakeholders shall also be provided to the following, for consideration of any operational requirements to be implemented, including Notifications, Authorisations and Associated Permits:

- SA Water Service Provider (Metropolitan areas),
- SA Water Operations (Country areas),
- Superintendent or Project Manager.

5.3 Pre-Inspection Activities

5.3.1 Mains Cleaning and Placement of Water in the Mains

This Clause is relevant for new infrastructure only.

Further information is provided in Appendix A, of this standard. Details of requirements for existing infrastructure, are provided in Appendix B.

All maintenance structures shall be visually inspected by the Constructor prior to the CCTV Inspection. The cover shall be temporarily removed to enable the base of the structure to be examined.

The Constructor shall ensure that all internal surfaces of the pipes and maintenance structures are cleaned no earlier than 24 hours before the commencement of CCTV Inspection.

Cleaning shall ensure that all pipes and maintenance structures are clear of debris to achieve a standard that will facilitate the CCTV Inspection and enable the reporting of any defects. Jet rodding (or an equivalent technique) shall be undertaken to ensure all debris, sand, stones, grit etc has been removed.

No debris, objects and material fragments shall be disposed of into the existing SA Water sewer system.

Fifteen minutes prior to the CCTV Inspection of a section of pipe, clean water shall be released into the upstream maintenance structure, while witnessed by the SA Water Representative. For DN 150 pipe, the quantity of water to be inserted shall be 20 litres per 100 metres of pipe. For pipes larger than DN 150, the quantity of water to be inserted shall be increased to 50 litres per 100 metres of pipe.

The purpose of the addition of water is the detection of any reverse grade (backfall) and/or pooling of water within the pipes and structures.

5.4 New Infrastructure - Mandatory CCTV Inspection

5.4.1 Items to be Inspected

The following assets shall be inspected:

- All sewer infrastructure, inclusive of branch laterals,
- All maintenance structures, inclusive of the inlet pipes and shaft.

In addition, SA Water reserves the right to request CCTV Inspection for any sewer connection/s, should it be considered that there may be a potential defect or problem.

5.5 Existing Infrastructure - Requiring CCTV Inspection

5.5.1 Items to be Inspected

SA Water shall confirm items to be inspected in a scope of works contained within the Specification.

Pre-cleaning and removal of debris, together with flow control requirements provides additional complexities, for undertaking CCTV inspection of existing sewer infrastructure.

Generally the (CCTV) Inspection Technical Requirements will be in accordance with Clauses 5 and 6 of this Technical Standard.

5.6 Additional CCTV Inspection

Additional CCTV Inspections and reports, shall be required where:

- the video footage or photographs are of unsatisfactory quality,
- the Report is not to SAW requirements specified in section 7 of this standard
- faults were identified and rectification work has been completed,

The Contractor will be responsible for additional Inspection/s.

All further CCTV inspections shall be:

- completed with the SA Water Representative on site,
- completed at the Constructor's cost unless otherwise agreed by SA Water
- given a different Report number.
- camera and technical requirements

6 Camera and Technical Requirements

6.1 Camera / Scanner

Unless otherwise specified, a CCTV camera or a 3D optical pipeline scanner shall be used. As a minimum:

- CCTV systems shall operate on the PAL standard with minimum optical resolution of 720 x 576 for all points of the CCTV inspection
- Pan and tilt cameras shall be used, capable of 360° rotation and tilt up to 135° from the horizontal
- Pan and tilt cameras should have zoom capability
- 3D optical scanners shall have a resolution of 1040 x 1040 pixels and provide 100% pipe and maintenance structure wall coverage, plus virtual 360° pan and tilt and HD resolution
- The camera and illumination system shall provide a clear, accurate, and in focus record of the internal condition of the pipe.

6.2 Capability

Cameras and scanners shall be capable of providing:

- a continuous video or digital record of the sewer pipes and structures,
- still images of defects and features of interest as detailed in WSA 05 - 2020,
- a record of all defects and features required to be reported,
- a clear view of the lateral at junctions and connections,
- measurements by means of a laser measurement tool.

The camera shall not move and pan simultaneously. If defects are observed, the camera shall be halted. The defect shall be recorded and included in the report.

Videos and Photographs shall be referenced. Refer Clause 7.2.

6.3 Camera Operation

The Camera / Scanner operation shall be undertaken to meet the specifications for camera position and speed outlined in WSA 05-2020, Clause 1.7.

The direction of the CCTV inspection shall be from upstream to downstream, except where this is not possible.

6.4 Measurement and Data Display

Recording of information shall be in accordance with WSA 05-2020, Clauses 1.8. and 1.9.

The camera video record of the CCTV inspection shall display in metres and tenths of metres from a nominated zero position nominally at the start of the pipe segment.

Screen text shall be coloured to contrast the background image for text clarity.

To achieve satisfactory laser profiling measurements, the camera or laser device shall be capable of producing measurements to the accuracy stated in WSA 05-2020, clause 1.10.

For validation of measurement accuracy, the Operator shall gauge scanned measurements against an accurately marked incremental Template (mm), e.g. 5, 10, 15 etc.

6.4.1 Start Screen

The start of each CCTV inspection shall record the following information:

Table 1 Information to be displayed

New Infrastructure	Existing Infrastructure
Road/Street and location/suburb/town	SA Water Specification Number
Pipe Line ID Number (refer Design Drawings)	Asset Number (pipe ID number, e.g. 123456)
Name of the Company undertaking the CCTV inspection	Name of the Company undertaking the CCTV inspection
Date and Time of CCTV inspection	Date and Time of CCTV inspection
Maintenance Structure, Start & Finish Chainage	Maintenance Structure Reference Number
Meterage (relative to Start Chainage)	Meterage (relative to Start Chainage)
Direction of CCTV inspection (U = upstream, D = downstream)	Direction of CCTV inspection (U = upstream, D = downstream)
Pipe Diameter & Material	Pipe Diameter & Material
	Cleaning ('yes' or 'no')

6.4.2 Video Header & Footer

A header and footer shall be electronically generated and recorded on each digital video.

For each pipe segment the header and footer shall be displayed at all times preferably in a single line at the extreme top and extreme bottom of the page or where it does not obscure the video.

The Header and Footer shall include:

Table 2 Header and Footer display

Header	Footer
Maintenance hole chainages or reference numbers (upstream & downstream)	Date and Time of CCTV inspection
Pipe Line Number or segment number	Meterage (relative to Start Chainage)

6.4.3 End Screen

Finish of an inspection - When a video recording is finished at the end of a survey, the text 'Finish survey', shall be electronically generated, displayed and recorded on the digital video for each pipe segment and shall be clearly visible for a minimum duration of 20 seconds.

Abandonment of inspection – When a video inspection has to be abandoned, the text 'Survey abandoned' (include the reason for abandoning the inspection), shall be electronically generated, displayed and recorded on the digital video for each pipe segment and shall be clearly visible for a minimum duration of 20 seconds.

6.4.4 Defect Measurement

In accordance with Clause 4.3, measurement/quantification of suspected or actual defects shall be confirmed by a CCTV Operator, e.g. ovality, pooling of water etc.

Where Appendices A or B state measurement / quantification is required, all defects shall be quantified to verify compliance or not with this Technical Standard.

6.5 Image Quality

All videos and photographs shall be colour, clear, in focus and satisfy the technical requirements stated in Clause 6.

Videos or photographs will be rejected where they are:

- of poor resolution,
- out of focus, or,
- displaying inadequate lighting
- camera moving too fast, not allowing sufficient assessment

In such circumstances, the Constructor will be required to provide another CCTV inspection.

Figure 1 Example of poor quality image

(Note: Information is to be displayed shall be in accordance with Clause 6.4.1).

7 The CCTV Inspection Report

7.1 CCTV Inspection Report

The CCTV inspection Report, shall be certified by the CCTV Operator. Refer Clause 4.3.

The data to be provided shall be a detailed CCTV inspection Report, containing:

1. video files stored in mpeg format (i.e. MPEG1, MPEG2 or MP4), or a format that is readily transcoded to MPEG1, MPEG2 or MP4. If a format other than mpeg is used, the engaging agency should be consulted before job commencement.
2. digital photographic records shall be in JPEG format. Resolution shall be PAL (720 x 576 pixels) as a minimum, and shall be sufficient to allow clear identification of the feature.
3. defect coding shall be WinCan V8 format as a minimum,
4. Reportable Items Summary List/s in pdf format. Refer Clause 7.4.

Where a subsequent CCTV inspection may be undertaken (for any reason), each Report shall have a separate revision number, to clearly distinguish between the CCTV inspections.

7.2 Data Transmission

A USB (or external hard drive for large projects) shall be provided to the SA Water Representative, containing the total CCTV footage and inspection Report as detailed in Clause 7.1.

Alternatively, for some SA Water managed projects there may also be the option of utilising the SA Water Secure File Transfer System. The Project Manager should be able to confirm the suitability of this option.

7.3 Referencing Images

Video images shall be allocated a specific reference number, related to the examined section of sewer. All observed defects or features shall be assigned a specific defects code (refer Table 7 of this standard). Together with the recorded chainage these details will assist location on the video. Should the defect involve a section of affected pipe (e.g. pooling of water), the start and finish chainages shall be recorded for confirmation of the length.

The CCTV inspection Report shall include a reference number for each photo of each defect or feature. Should the defect involve a section of pipe and multiple photographs are required, all shall be recorded against the defect.

The Operator shall check that all defects or features listed correspond with the video footage.

7.4 CCTV Acceptance Test Report

7.4.1 General

Identification of Reportable Items shall be in accordance with:

- Appendix A of this Standard (for new infrastructure).

The CCTV Acceptance Test Report shall be provided in accordance with Clauses 7.4.2.1 and 7.4.2.2.

7.4.2 List Content

7.4.2.1 New Infrastructure

Where a reportable defect is listed, the CCTV Operator shall analyse it to confirm its acceptability. Each fault shall be quantified (where required).

The following Reportable Items Summary Lists shall be produced:

1. Appendix C of this Standard confirming all defects specified in Appendix A.
2. A Summary WinCan Report. All defects identified in the standard WinCan report for each Pipe Line Number shall be extracted to generate one Summary Report (example below).

Table 3 Report Example

Operator to complete sections below (refer section 7 of TS 0524)									
Defect No.	Video Ref.	Photo Ref.	Line No.	Start MH	End MH	Chainage	Defect/ Feature	Defect Code	Extent of Defect
1	VO 1	P4-6	3-1	0.00	88.75	8.70	Crack	L1	1.5 metres
2	VO 2	P39-42	3-2	125.33	170.2	143.26	Pooling	P	3.0 metres
3	VO 3	P122-124	4-2	50.29	204.62	93.55	DJW	C2	Location Specific
4	VO 4	P148-149	4-3	0.00	36.57	3.72	OB	M2	Location Specific
5	VO 5	P188	4-5	84.23	145.66	102.65	D1	D1	2.0 metres

Where rectification has occurred it shall be noted against the original defect. A CCTV Acceptance Test Report is required for verification of the success of the remedial work.

7.4.2.2 Existing Infrastructure

A Summary WinCan Report is required as stated in Clause 7.4.2.1. A standard WinCan report shall be generated for each Pipe Line / Asset Number. Detected faults from the Standard Report shall be integrated into the Summary WinCan Report.

The report/s and result pages shall include the SA Water Contract / Specification number, Pipe Line / Asset Number, and Street Name & Suburb.

Information to be provided in the WinCan Summary Defect List shall be as shown in Table 4.

Table 4 Image Reference information

Defect Number	Chainage
Video reference Number	Defect/s code
Photo reference number	Defect Description
Asset Line Number	Acceptable / Not Acceptable
Maintenance Structure, Start & Finish Chainage	Comments

7.4.3 Report Accuracy

All defects found during the investigations shall be reported.

Failure to provide reports, as specified in section 7 of this standard or where the Report does not correspond with the video footage may result in the CCTV inspection being rejected. Should the CCTV inspection Report be inadequate or unsatisfactory the Constructor shall engage another qualified Operator to perform a new CCTV inspection at the Constructors cost.

7.5 Supply of the CCTV Inspection Report

The Constructor shall be responsible for the provision of the final CCTV inspection Report (including any additional Report for rectification works) to the SA Water Representative within 5 working days following the Report completion, for sign off of the Construction Hold Point.

Practical completion can not be obtained without release of this Construction Hold Point

8 Acceptance Criteria

The acceptance criteria for CCTV Inspection of new sewer infrastructure shall be in accordance with WSA 05 (Version 4.1), unless otherwise stated in this Technical Standard.

Refer Appendix A.

9 Rectification Work

Should the CCTV inspection reveal construction defects requiring rectification, the work shall be completed at no cost to SA Water.

9.1 Proposal for Rectification Work

Where rectification is required due to a defect or failure, the Constructor will be required to resolve all faults, in accordance with the submitted Quality Plan.

All products used for the rectification shall be approved by SA Water and shall be obtained from an approved manufacturer listed in the relevant Technical Standard.

Should the rectification require a product not currently listed in an SA Water Technical Standard, specific approval from SA Water will be required for use of that product.

The Constructor or Consultant shall provide the SA Water Representative with data sheets / manufacturer information to enable appropriate assessment by SA Water.

SA Water will review and advise of acceptability.

All repaired sections of pipe shall be reinspected in accordance with Clause 9.2.

9.2 Retesting of Any Assets Following Rectification Work

Where rectification has been undertaken, the Constructor shall arrange for a new CCTV inspection. The video, photographs and a follow-up CCTV Acceptance Test Report shall be provided to the SA Water Representative.

The CCTV inspection shall be in accordance with Clause 5.6.

The Constructor shall also arrange for the As Constructed drawings to be amended to show details of the rectification work.

10 Loss of Equipment or Materials in Sewer

The SA Water Representative shall be notified immediately, upon loss of any equipment or foreign materials in the sewer.

The Constructor shall confirm the equipment and materials that have been lost.

The Constructor shall advise the SA Water Representative of a plan for retrieving the items. No recovery shall be undertaken without receiving approval to do so, from the SA Water Representative.

Failure by the Constructor to report loss of equipment or materials which leads to asset damage may result in financial penalties being actioned against the Contractor.

Appendix A - Acceptance Criteria - New Infrastructure

In accordance with WSA 05-2020, Appendix J, Acceptance Testing of newly installed sewer infrastructure is mandatory. **CCTV inspection** is one component of the Acceptance Testing.

SA Water introduced mandatory CCTV inspections, for new gravity sewers in 2014. Prior to that time, issues caused by pipe movements during the compaction phase or debris left in the pipe generally went undetected.

For many years, levels were taken at the top of the pipe, as a means of confirming the pipe had been installed within acceptable tolerances (to the design grade) and subsequent backfilling could occur. However, placement of backfill and subsequent compaction would sometimes impact the pipe, e.g. either a drop of the pipe level or, a change of pipe shape (ovality). Ovality is generally caused by insufficient pipe bedding and side support.

A CCTV Inspection may reveal a number of different faults within the pipes or structures. This Appendix details SA Water's requirements and where a tolerance may be acceptable, following the granting of a dispensation to the Constructor (Refer A12).

WSA 05-2020 Appendix J, *guide for Internal Inspection of Newly Constructed Sewers or Stormwater Conduits and Criteria for Acceptance*, quantifies the requirements for acceptability of various types of defects. Generally, SA Water's requirements are similar to WSA 05.

A1 Reportable Items – CCTV Acceptance Test Report

The CCTV Acceptance Test Report, which is to be completed by the CCTV Operator. Is available on the SA Water Corporate website.

The CCTV Inspection shall result in the following Reportable Items Summary Lists being produced:

- Appendix C of this Standard
- A Summary WinCan Report

WinCan reports, videos and photographs shall all comply with Clause 6.4.

Where rectification work has occurred, a follow-up CCTV Inspection is required to be completed and a new CCTV Acceptance Test Report, shall be provided, for verification of the quality of the remedial work.

A2 Defects or Faulty Workmanship

All rectification work shall be undertaken in accordance with Clause 9.

A3 Infiltration / Exfiltration

Any infiltration or exfiltration observed during the CCTV inspection is not acceptable. Rectification shall be undertaken in accordance with Clause 9.

Constant running water in the new sewer pipe will be deemed to be infiltration. Collections of water which are not flowing or changing in size, will not be considered to be infiltration.

A4 Cracked or Fractured Pipe

SA Water will not accept any crack in a new or recently constructed pipe or structure.

Longitudinal or circumferential cracks will shorten the asset life of the pipe and will provide the opportunity for root, groundwater, or soil intrusion. Cracks may also result in external release of sewage which is in breach of environmental protection legislation.

Rectification work shall be undertaken in accordance with Clause 9.

Figure 2 Example of cracked pipe

A5 Deflection (Ovality) Testing

A5.1 Requirement for Deflection Testing

Although the survey of the laid pipe may confirm it is within the acceptable tolerance, the placement of embedment/backfill materials and the compaction processes may cause stress fractures in the pipe.

Should the CCTV video demonstrate a deflection issue a Deflection Test shall be undertaken in accordance with Clause A5.2.

A5.2 Performing the Deflection Test

WSA 05-2020, Appendix I1.5 – *Estimating Deformation (D)* and Appendix J9 – *Deformation of Flexible Conduits* provides three options for proving ovality:

- Physical measurement in large diameter conduits
- Laser measurement technology Type 1, where a laser source is attached in front of a CCTV camera producing a ring of laser light on the conduit wall
- Laser measurement technology Type 2, using direct measurement using a laser signal, usually from a rotating laser, that continuously generates a point cloud of digital data as the laser travels through the conduit. A direct measurement of the pipe size, shape, loss of fabric or other features are obtained.

Both laser measurement technology types are applicable to new reticulation sewers. However, SA Water's preference is Type 1.

A5.3 Ovality Proving Tool

The Ovality Proving Tool shall be:

- circular shaped plastic (to minimise any pipe damage),
- sized in accordance with Table 5 (below),
- in accordance with WSA 05-2020, Table J.1 – *Maximum Allowable Short-term Pipe Deformation for Flexible Pipe* for the OD tolerance, pulling rings and markings.

The Proving Tool shall be passed through the sewer. Should it become wedged the distance from the maintenance structure shall be recorded and it shall be removed and passed through the sewer from the other direction to confirm the affected length of pipe. The lengths from each maintenance structure shall be compared with the CCTV video and photographs.

The Operator shall record all occurrences as a defect. Further, the Operator shall inform the Inspector and the Constructor.

Note: WSA-05 recommends that this type of ovality proving tool is not advocated, as it may damage the conduit if not correctly sized.

A5.4 Acceptable Deflection Testing Results

WSA 05-2020, Table J.1, specifies Permissible Pipe Deflection for 6 time periods: 3 days, 7 days, 14 days, 30 days, 3 months and 1 year. The allowable deflection is listed as a differing percentage for each time period.

For simplification SA Water has adopted the 3 month value as its requirement and converted the percentage into millimetres.

All deflections exceeding the values listed in Table 5, are unacceptable to SA Water.

All defective sections of pipe shall be rectified. The rectification work shall be undertaken in accordance with Clause 9.

Table 5 Permissible Pipe Deflection (mm)

DN	Maximum allowable vertical deflection after 3 months = 5.5%	
	D min (mm)	D max (mm)
150	142	159
225	213	238
300	283	317

Figure 3 Example of pipe ovality

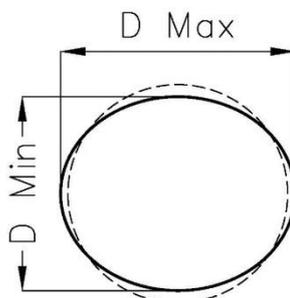
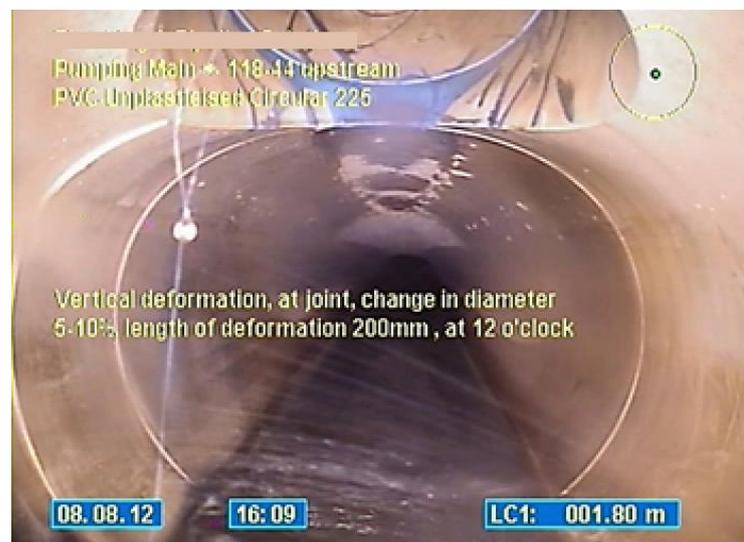


Figure 4 Example of excessive deflection**Figure 5 Pipe deformation and water infiltration**

A6 Backfall and Ponding (Pooling) of Water

Backfall and the resultant ponding of water, may be due to the conduit being laid at an irregular grade or it may be due to a localised loss of foundation, or side support characterised by a dropped invert.

WSA 02-2014, stipulates:

- reverse grades (backfall) are not permitted, (Clause 22.2.1),
- that backfall shall not be permitted at any point along the sewer and that inverts of new sewers and property connection sewers, must be maintained within the tolerances shown in Table 22.1 and Table 22.2 (Clause 22.2.3),

In compliance with the WSA Codes, SA Water does not accept any backfall, in newly constructed sewers.

SA Water requires all instances of water pooling which are observed to be:

- recorded by the Operator and reported to the Inspector
- measured by the Inspector to confirm
 - the width of the water (from wall to wall - refer Figure 6.)
 - the length for each pool of water,
- reported to the Constructor for rectification of the length of pipe, and/or the maintenance structure.

Figure 6 Ponding measurement

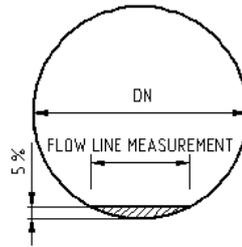


Figure 7 Example of pooling

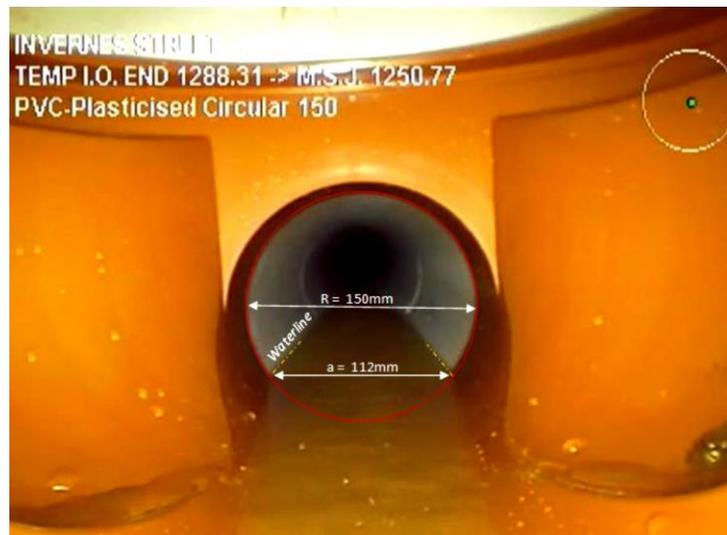


Figure 8 Example of pipe holding water



A7 Joint Displacement / Defective Joint Weld

SA Water is concerned about immediate and ongoing issues and defects, as a result of unsatisfactory pipe jointing. Typical problems may be:

- Joint displacement (longitudinal), JD (L), pipe / fitting not being adequately inserted into joint,
- Defective Joint Weld—DJW (P), a cured pool of excess solvent cement in the pipe invert

Table 6 Permissible Joint Displacement (mm)

DN	JD (L)	DW (P)
150	5	8
225	5	12
300	5	15

Solvent Welded Joints, shall be undertaken in compliance with PIPA POP 102 (Solvent Cement Welding of PVC Pipe).

JD (L) shall be in accordance with AS/NZS 1260, Clause 4.7 (witness mark)

Examples of unsatisfactory joints are presented in Figures 9 to 11.

Figure 9 Joint Displacement



Figure 10 Defective Joint Seal



Figure 11 Excessive Solvent Cement

A8 Dropped Invert

Where a Maintenance Structure, OB (Oblique Junction) or other fitting has been installed and the fitting has collapsed due to poor support, the dropped maintenance structure, or fitting shall be removed and replaced, in compliance with SA Water standards.

Rectification work shall be undertaken in accordance with Clause 9.

A9 Surface Damage

Materials should be inspected prior to installation for surface damage, if damage is excessive, the pipe should be rejected as not suitable.

Types of damage that may be observed during the CCTV Inspection include:

- B – blistered or flaking pipe
- C - cracking
- MD - mechanical damage (e.g. scoring or gouging etc.)

Should surface damage be observed, it shall be recorded by the Operator who shall also advise the Constructor.

The Constructor shall:

- provide details of the damage to the manufacturer for quantification,
- replace the defective pipe/or materials,
- report the issue:
 - as a Non Conformity within the Contractors Quality Management System
 - to the SA Water Representative

A10 Obstructions

All obstructions shall be removed from pipes and Maintenance Structures.

Objects and material fragments shall be extracted.

General debris may be cleared by undertaking mains cleaning. (Refer Clause 5.3.1).

Where the CCTV Inspection indicates debris has not been satisfactorily removed, the Operator shall advise the Constructor. The Constructor shall remove all obstructions. All unacceptable section/s shall be recleaned at the Constructor's cost.

Following recleaning a new CCTV Inspection shall be undertaken for confirmation that the sewer has been satisfactorily cleaned and is suitable for use.

Examples of unsatisfactory debris removal are presented in Figures 12 to 14.

Figure 12 Gravel

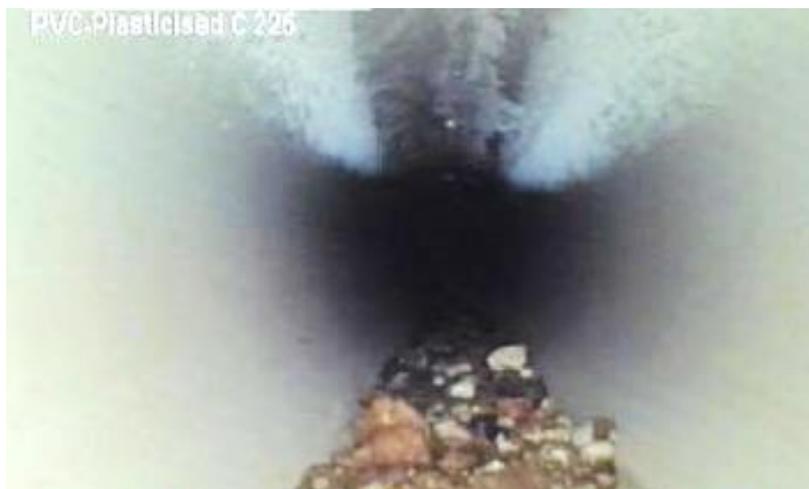


Figure 13 Off-cut in sewer



Figure 14 Presence of Litter



A11 SA Water Acceptance Criteria Summary List

Table 7 Acceptability Criteria Summary List (based on WSA 05 – 2020 Table J6)

SA WATER ACCEPTANCE CRITERIA SUMMARY LIST			
Defect/Feature	Defect Code ¹	Extent of Defect	Acceptance Determination Remarks
Infiltration S		Refer A3	Not acceptable.
Exfiltration EX		Refer A3	Not acceptable.
Cracked or Fractured Pipe C	L1, C1, S, or M1	Refer A4	Not acceptable.
Deflection Testing or Ovality D (Deformation)	D1	Refer Table 5	Not acceptable above values provide in Table.
Backfall and Ponding (Pooling) of Water B	P	Refer A6	Not acceptable.
Joint displacement/ Defective Joint Weld DJW	L2, A	Refer Table 6	Not acceptable above values provided in Table.
Dropped Invert DI		Refer A8	Not acceptable.
Surface damage SD	MD	Refer A9	A defect shall be recorded.
Obstruction OB	C2, J, M2 or Z	Refer A10	Not acceptable.
Inspection/Survey abandoned	D2, O, HW		

Note: 1) Definitions

Defect Code	Defintion
A	Angular displacement
C1	Circumferential
C2	Cured pool of excess solvent cement
D1	Deformation
D2	Debris
HW	High water level
J	Object wedged in joint
L1	Longitudinal crack
L2	Longitudinal displacement
M1	Multiple cracks
M2	Material laying in invert
MD	Mechanical damage
O	Obstruction
P	Ponding
S	Simple Crack
Z	Other

Appendix B - Inspection of Existing Sewer Infrastructure

For existing sewer infrastructure, SA Water utilises CCTV technology to undertake condition assessments.

SA Water requires sewer mains to be pre-cleaned and debris removed prior to the CCTV Inspection. SA Water maintains a register of services providers, as panel contractors. This includes a CCTV contractor panel agreement, with a list of contractors who undertake condition assessment on Corporation's wastewater networks.

A package of work is generally compiled into a Specification. Tenderers are requested to submit an offer based upon the content of the Specification.

This Technical Standard provides details of the technical requirements and deliverables to be supplied by the Constructor or CCTV Operator.

Older sewer pipes may be constructed of material which is now in an advanced state of deterioration or in poor condition. These may include reinforced concrete (RC), rectangular RC, Oviform RC, PVC, vitreous clay (VC), mild steel concrete lined (MSCL), some asbestos concrete (AC) and other materials. WSA 05 provides guidance on observable defects.

B1 Typical Scope

The Specification could have a typical Scope of Work comprising:

- Notifications to:
 - Commercial/industrial premises
 - Residential customers
 - Special Needs individuals
- Site establishment
- WHS / Quality requirements
- Traffic management
- Flow control
- Pre-cleaning pipes and structures prior to the CCTV Inspection
- Performing the CCTV Inspection
- Post Inspection Site Clean-up
- Provision of Reports.

B2 Provision of Reports

A CCTV report shall be provided, upon completion of the CCTV Inspection. Reporting shall be in accordance with Clause 6, of this document.

Any additional reporting requirement, will be stated in the Project Specification.

B3 Flow Control

Depending on the specific nature of the CCTV Investigation of the existing sewer network, the Contractor Constructor shall be responsible for flow control and diversion measures to facilitate the CCTV Inspection. This may involve assistance of SA Water or it's Service Operators.

In existing sewers, flow control measures may involve restricting or diverting sewer flows. In all cases of interrupting flows in the sewer network, SA Water must be notified to approve the flow control measures being considered.

For details of flow control requirements and responsibilities refer to the Project Specification.

B4 Approved Cleaning Methods And Debris Removal

Sewer cleaning shall be conducted, to provide an environment that enables the CCTV Inspection to be undertaken, as specified in 5.3.1

Cleaning may include but not limited to one or more of the following techniques; jet rodding, root cutting, root saw, dragging, vacuuming etc.

Cleaning shall remove all foreign matter, debris, slime, fat, tree roots, sand, stones, grit etc which may prevent the passage of the CCTV camera through the pipe, and / or prevent the surface of the pipe being examined.

Internal tree root masses shall be cleared using a mechanical root cutter (or similar).

It is the Contractor's responsibility to select the most appropriate cleaning techniques that will not adversely affect the serviceability or structural integrity of the sewer. Where the Constructor has concerns regarding the condition of the sewer and whether or not to proceed with cleaning and the CCTV Inspection, the Constructor shall consult the SA Water Representative.

SA Water has a preference for cleaning equipment to have water recycling capabilities.

B4.1 Debris Removal and Record Keeping

Where cleaning of sewer infrastructure is undertaken as specified in 5.3.1, the Contractor shall collect, record and submit to the SA Water Representative the following information:

- the site or location,
- the pipe/s size,
- the length cleaned,
- the type and quantity of all foreign material / debris removed (for each site)

The volume (in litres) of all debris removed shall be recorded and submitted in accordance with the Specification.

B4.2 Disposal

Debris shall be removed by utilisation of a vacuum tanker or traps / rakes and loaded directly into appropriate storage (e.g. sealed plastic root bags).

Where root cutting or chain flail work is undertaken, the Contractor shall use a removable wire basket or trap placed in the downstream maintenance structure to catch the debris. This requirement shall be rigorously followed.

Should a downstream overflow occur due to debris passing the trap, the Contractor will be liable for all associated costs of remediation.

It shall be noted that sewer debris is contaminated and shall be deemed a 'Regulated Waste' as defined by the Environmental Protection Authority, South Australia. Any transport and disposal of this material, shall be undertaken by an operator licensed for this purpose.

B5 Obstructions

Should an obstruction impact the progression of the CCTV unit, the unit shall be removed and inserted at the next maintenance structure, to survey back towards the obstruction from the opposite direction. The chainages from each video shall be used to confirm the length of the obstruction.

The CCTV Operator shall photograph the obstruction and confirm its length and approximate size.

The CCTV Operator shall immediately advise the Constructor and SA Water Representative:

- when significant debris or irregularities are found in the pipe, regardless of whether it prevents the CCTV camera passing through the full length of the line.
- of any pipe segment which cannot be cleared or cleaned due to major structural defects or immovable obstructions.

Where debris prevents CCTV inspection and recording of 100% of the sewer length, the Constructor shall arrange to have the debris removed and sewer re-cleaned. The Constructor shall then have the full length of main re-inspected. The costs of re-clean and re-inspection of the main shall be borne by the Constructor.

B6 Abandonment of the CCTV Inspection

A collapsed joint, a large hole in a pipe, or significant defect may necessitate abandonment of the CCTV Inspection. Should an occurrence of this magnitude be encountered, the SA Water Representative shall be immediately notified.

Vapour and fog (or similar event) shall not be a justifiable reason for abandonment of the Inspection. The Constructor shall consider ventilation or cleaning of the lens in such circumstances. In each case, the CCTV Inspection shall be restarted at the Constructor's expense.

Appendix C - SA Water Acceptance Test Report Template

For CCTV Inspection of both the new and existing sewer infrastructure, SA Water require Appendix C to be completed. Reporting shall be in accordance with defects and codes included in Appendix A.

APPENDIX C

(Example)

CCTV Acceptance Test Report



Report No : 123-4
 Project: Seaford (St 100A)
 Sewer Material: PVC - U
 SA Water Contract No: 100/19
 Construction Company: ABC Construction Services
 CCTV Company: XYZ Inspection Services
 CCTV Operator: Tom Cannon

Legend

Defect/Feature Refer TS 0524, Table 7
Defect Code Refer TS 0524, Table 7
Extent of Defect Refer TS 0524, Table 7
A / NA Acceptable/Not Acceptable

Reportable Items:

Operator to complete sections below (refer section 7 of TS 0524)										SA Water representative to complete	
Defect No.	Video Ref.	Photo Ref.	Line No.	Start MH	End MH	Chainage	Defect/Feature	Defect Code	Extent of Defect	A / NA	Comments
1	VO 1	P4-6	3-1	0.00	88.75	8.70	Crack	L1	1.5 metres		
2	VO 2	P39-42	3-2	125.33	170.2	143.26	Pooling	P	3.0 metres		
3	VO 3	P122-124	4-2	50.29	204.62	93.55	DJW	C2	Location Specific		
4	VO 4	P148-149	4-3	0.00	36.57	3.72	OB	M2	Location Specific		
5	VO 5	P188	4-5	84.23	145.66	102.65	D1	D1	2.0 metres		

APPENDIX C

(Example Only)

CCTV Inspection Test Report



Report No:	<i>123-4</i>		
Project:	<i>Seaford (St 100A)</i>		
SA Water Contract No:	<i>100/19</i>		
Construction Company:	<i>ABC Construction Services</i>		
Constructors Representative:	<i>Jack Thompson</i>		
CCTV Company:	<i>XYZ Inspection Services</i>		
CCTV Operator 1:	<i>Tom Cannon</i>	Qualification	: NWPNET016
CCTV Operator 2:	<i>Bob Ball</i>	Qualification	: NWPNET017
Date of Inspection:	<i>30/09/2020</i>		
Date of Examination:	<i>05/10/2020</i>		
Video No.s:	<i>XYZ-100-V01 to V08</i>	Photograph Nos	: XYZ-100-P01 to P207
Satisfactory Compliance with SA Water TS 0524, Appendix A	Y/N - <i>N</i>		
Operator advised Constructor of all reportable defects:	Y/N - <i>Y</i>		
Signed:	<i>Tom Cannon</i>	<i>Jack Thompson</i>	
	_____	_____	
	CCTV Operator	Constructor	
Date:	<i>05/10/2020</i>	<i>05/10/2020</i>	