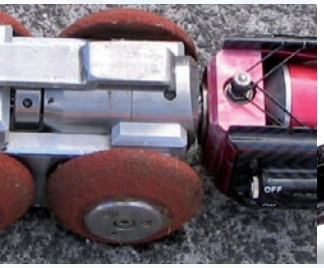
New Zealand

May 2006

Pipe Inspection Manual

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New Zealand Water & Wastes Association
Waiora Aotearoa

Third Edition

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3rd Edition

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CONTENTS

Contents

CASE STUDIES

SUPPLEMENTARY INFORMATION

GLOSSARY

ASSET

A physical component that has value, enables service to be provided and has an economic life greater than 12 months. For example, a section of sewer pipeline is an asset. Refer also to “INFRASTRUCTURE ASSETS”.

ASSET MANAGEMENT

The combination of management, financial, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost effective manner.

ASSET MANAGEMENT SYSTEM (AMS)

Software that contains an inventory of assets and links to asset history, condition and financial information. The software can generate reports about the assets including condition ratings.

ASSET MANAGER

The person responsible for managing assets.

ASSET NUMBER

A unique number allocated to an asset. It may be different from other identifiers used. For example, manhole and node numbers which identify a pipeline will not be the same as the asset number for that pipeline.

ASSET REGISTER

A record of asset information including inventory, historical, condition, construction, technical and financial.

ATTRIBUTES

Physical properties of an asset. For example, the diameter of sewer pipe.

BEADING

Protrusions in a polyethylene pipe created by the joint butt welding processes. They are normally not very prominent and will normally have been removed by the pipe installation contractor.

CLIENT

The “Client” refers to the organisation which has initiated the work and will pay for it. The Client will generally be a utility operator and the Principal in terms of the contract documents.

CONDITION CODES

Two character alphanumeric codes which represent pipeline features (such as lateral pipe connections) or defects (such as cracks in a pipe).

CONDITION DATA

The separate components of condition records. Data may include distance information, condition codes and severity ratings.

CONDITION RECORDS

The recorded information that identifies a pipeline defect or feature. The information may include such items as the distance from the upstream manhole, the condition code and a severity rating.

CONTRACTOR

The company appointed to carry out work by the Principal.

DATABASE

An electronic information file. The major component of a database is a table containing details of the items. The table consists of “FIELDS” and “RECORDS”. A database can also contain reporting systems and forms to facilitate data entry and editing.

DEFECT CODE

Refer to “CONDITION CODES”.

DEFECT DATA

Refer to “CONDITION DATA”.

ENGINEER’

The Engineer to a contract as defined in the contract.

FEATURE CODE

Refer to “CONDITION CODES”.

FEATURE DATA

Refer to “CONDITION DATA”.

FIELD (database)

A column in a database table of information. Fields are separated into the types of information to be stored against individual items. For example, a CCTV inspection database will include separate fields for the distance of a defect or feature from the downstream manhole, the condition code, the severity rating and comments.

GEOGRAPHIC INFORMATION SYSTEM (GIS)

A computer based map system which in the context of the Manual enables as-built plans of pipeline systems to be generated by the computer.

GLOBAL POSITIONING SYSTEM (GPS)

A method of accurately determining absolute locations and relative levels using multiple observations from geosynchronous satellites.

HEADER

A header in a CCTV inspection is the selection of information that is used to head up the condition records for a particular pipeline section. It identifies and describes the pipeline section and records inspection details.

HEADER CODES

Alphanumeric codes that represent header information, such as inspection status or pipe material.

HEADER DATA

The separate components of headers. Data may include inspection and attribute information.

INFRASTRUCTURE ASSETS

Stationery systems forming a network and serving whole communities where the system as a whole is intended to be maintained indefinitely, at a particular level of service, by the continuing replacement and refurbishment of its components. For example, a sewer reticulation system is an infrastructure asset. Refer also to “ASSET”.

INSPECTION DATA

The information recorded during a CCTV inspection. It may include inspection information, attribute data and pipeline defect and feature information.

INSPECTION INFORMATION

Information relating to a particular inspection. It may include the date and time of the inspection, the name of the contractor and the name of the operator.

INVERT

The bottom surface of the inner wall of a pipe.

MAINTENANCE CONTRACTOR

The person, company or department responsible for the day to day maintenance of sewer and stormwater reticulation systems.

MANHOLE COVER

The metal cover which is removed for access to a manhole.

MANHOLE LID

The slab of concrete covering the top of the manhole chamber.

NODE

Any point or feature other than a manhole which defines an end of a pipeline asset. A node may be a lamphole, junction, end of pipeline, stormwater inlet or outlet or other features.

OPERATOR

The person responsible for allocating condition codes and severity ratings to the various defects and features identified during a CCTV inspection. The operator need not be the camera operator or even be employed by the Contractor.

PAN and TILT CAMERA

A CCTV camera, which is generally tractor mounted, with a range of vision which pans for ± 90º to ± 135º in the horizontal plane (dependent of the make of camera) and tilts 0º + 90º in the vertical plan. It can be expected that these ranges will be progressively extended by improved technological developments. The

term “pan and tilt” in this Manual may refer to an external moving lens or an internal scanning wide angle lens camera.

PARALLEL LINE

Where there are two pipelines laid parallel between two consecutive manholes and both pipeline assets are identified by the same manhole numbers. A parallel line number is used to differentiate between them.

PRINCIPAL

See “Client”. The term Principal is generally used in contract documents.

RECORD (database)

A row in a database table. In the CCTV inspection example given for a “FIELD” there will be a separate record for each defect or feature code entered. In a CCTV inspection header table, each record will contain details of each inspection header such as the date and the name of the contractor.

SEVERITY RATING

The relative severity of a defect in a pipeline.

SOFFIT

The upper surface of the inner wall of a pipe.

SPRING LINE

The horizontal centreline of the pipe, i.e. the line between the 3 o’clock and 9 o’clock positions on the pipe.

THROAT

The section of a manhole between the top of the lid and ground level.

UTILITY OPERATOR

The organisation responsible for managing infrastructure assets.

ABOUT THE MANUAL

ABOUT THE MANUAL

The Purpose of the Manual

The New Zealand Pipe Inspection Manual 3rd Edition has been prepared in order to provide:

- An overview of the tasks that can be completed using Closed Circuit Television (CCTV) and how these activities can be used to manage wastewater and stormwater assets.
- A standardised set of codes for recording observations noted during CCTV inspections.
- An outline of good practice procedures for carrying out CCTV inspections and for processing and analysing the information collected.
- Standard Technical Specifications and Model Conditions of Contract for use when engaging CCTV contractors.

The Structure of the Manual

The Manual is divided into the following sections:

Section 1 - The Role of CCTV Inspections This section provides an overview of the tasks that can be completed using Closed Circuit Television (CCTV) and how these activities can be used to manage wastewater and stormwater assets
Section 2 – Good Practice This section outlines practices for cleaning pipes, carrying out CCTV inspections and logging inspections. Quality assurance and health and safety are also discussed.
Section 3 – The Tools This section provides an overview of CCTV equipment, recording media and CCTV software. New developments in CCTV equipment are also discussed.
Section 4 – CCTV & Asset Management This section discusses the role of CCTV in proactively managing sewer and stormwater system. The section covers issues that need to be considered when developing a CCTV programme and analysing the information produced.
Section 5 – Standard Documents This section provides a model specification for CCTV contracts.
Section 6 – Condition Codes This section provides details of the defect and feature codes that should be used to log CCTV inspections. Some interesting photographs collected during the preparation of this manual are also included. A description of the changes made to codes since the 2nd Edition of the Manual is provided.
Section 7 – Sample Forms This section contains sample forms for recording and auditing CCTV inspections. A sample form for manhole inspections is also included.

Developments in CCTV Practice Since the 2nd Edition

The major developments since the 2nd Edition of the New Zealand Pipe Inspection Manual (NZPIM) was published in March 1999, centre on the way that CCTV observations are now able to be integrated into an asset management programme and the ease at which the CCTV information can be retrieved and analysed.

When the 2nd Edition of the NZPIM was first published, many contractors were still producing handwritten logsheets. This made future retrieval and analysis of the information collected difficult and time consuming. Electronically generated logsheets were just starting to come into use. These are now common place.

Software is now available that links the observations and images captured during the CCTV inspections with Geographical Information Systems (GIS) and Asset Management Systems (AMS). The CCTV information can now be used easily to update records such as pipe size, connectivity, pipe material and condition and to carry out analysis as to the general condition of pipe networks and to help estimate future renewal and maintenance programmes.

Digital images from CCTV inspections and electronic sketches are now able to be linked to CCTV logsheets, providing asset managers with far more information than can be gained from a handwritten logsheet. CCTV inspections can now be recorded on DVD or direct to hard drive, reducing the space required for storage and improving retrieval.

In the future it is likely that there will be less reliance on operators to record observations, and processes that accurately measure pipe faults will become common place. Some of these products are already available and have been described in Section 3.

What has Changed in this Manual?

The front end sections have been rewritten so they are more user friendly. Case studies have been introduced to illustrate good practice.

The photographs that illustrate condition codes have been improved.

Condition codes and gradings have been adjusted where necessary, but the general intent of the condition codes and gradings has not been significantly altered. A full description of the changes made to the condition codes and gradings is given in Section 6.

What Process Was Used to Determine How the Manual Should be Changed?

In September 2005 a survey was conducted of all members of the Drainage Manager's Group and holders of the 2nd Edition of the Manual.

Feedback was also sought from a presentation at the New Zealand Water and Waste Association's Environs 2005 conference.

Draft sections for the new Manual were prepared and presented to focus groups consisting of operators, consultants and client organisations. The draft sections were amended following receipt of their comments.

The final draft of the manual was then made available on the internet for general comment.

THE ROLE OF CCTV INSPECTIONS

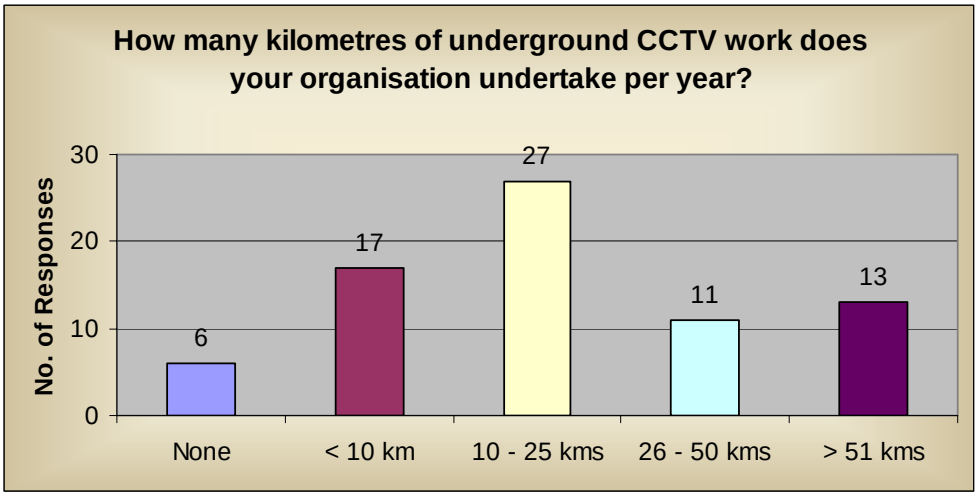
FIGURES

1 THE ROLE OF CCTV INSPECTIONS

What Do We Mean by CCTV Inspections?

The New Zealand Pipe Inspection Manual covers the inspection of pipelines by Closed Circuit Television (CCTV). The process involves a camera that travels through the pipeline and transfers images to a screen on the surface, where they can be viewed by an operator. The images can then be recorded on video, DVD or direct to hard drive. At the same time the operator can also record observations of the pipe and faults, capture still images and/or produce sketches showing, for example, the position of manholes.

Figure 1- 1 – How Much CCTV Work is Carried Out?

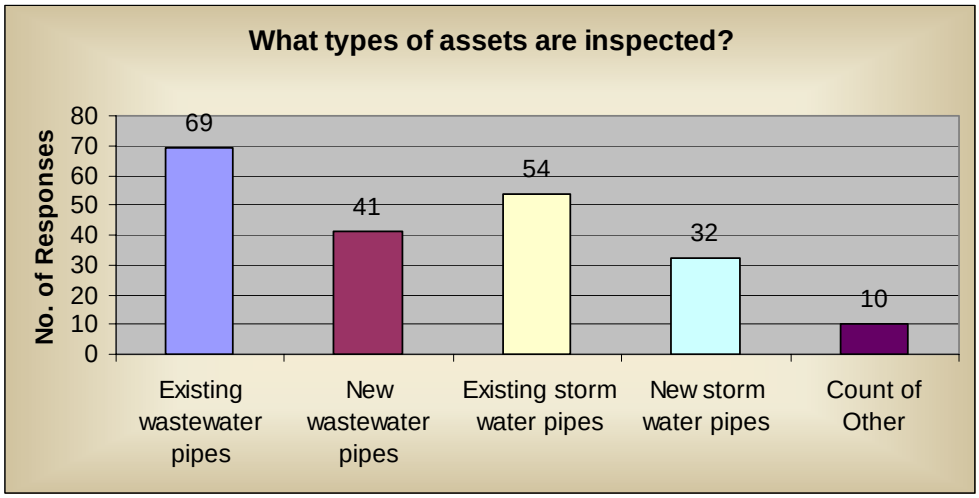


Why Are CCTV Inspections Undertaken?

The majority of CCTV inspections undertaken in New Zealand are completed on wastewater and stormwater pipes, but CCTV inspections can be undertaken on any pipelines. Some of the other types of assets that CCTV inspections are completed on include:

- Watermains
- Conduits
- Landfill leachate lines
- Inspections of ground water bores
- Industrial process systems

Figure 1- 2 – What Types of Assets are Inspected?

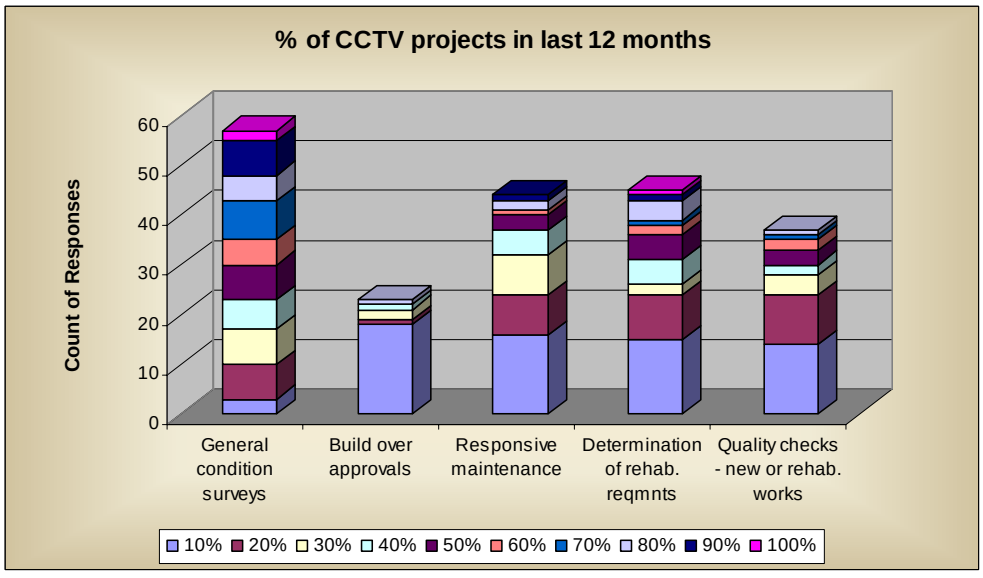


Some of the reasons that CCTV inspections are undertaken include:

- General condition surveys to determine the areas in pipe networks that require attention and to develop long-term programmes for replacement and maintenance of the network.
- Responsive maintenance, e.g. to identify and repair faults in pipes that have caused overflows or flooding.
- Determination of rehabilitation requirements, e.g. to determine which pipes need to be lined to prevent too much water entering into the system. This can result in the pipes not having enough capacity to cope with the flow, thus causing overflows.
- Quality checks on new works or after the rehabilitation of pipes.
- Build over approvals, e.g. inspections of pipes to determine whether buildings can be constructed above them.

If CCTV inspections are carried out correctly in accordance with the requirements of this manual then a CCTV inspection completed for one purpose, e.g. a build over approval, should be able to be used for any other purpose.

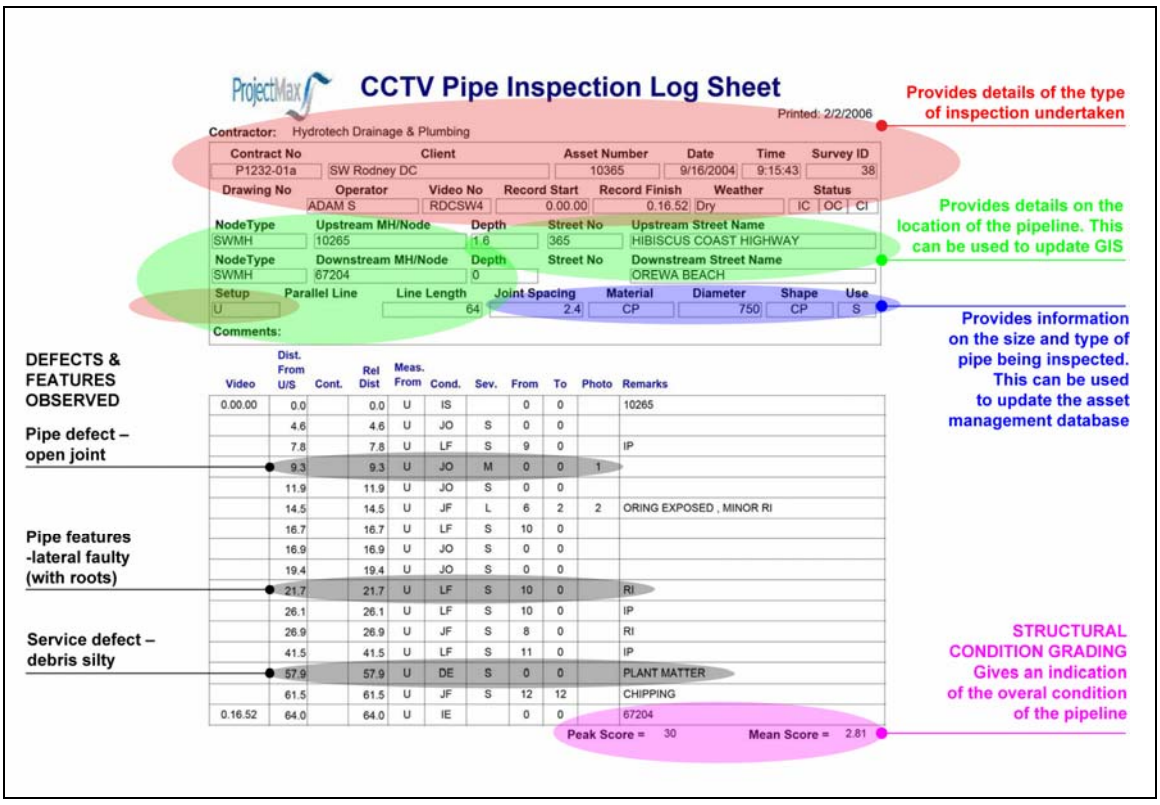
Figure 1- 3 – What Types of CCTV Inspections Are Being Carried Out?



What Information Can Be Determined From a CCTV Inspection?

Figure 1- 4 illustrates some of the information that can be determined from a CCTV inspection.

Figure 1- 4 – Examples of the Information That Can be Determined From a CCTV Inspection



A CCTV inspection provides information for asset management, maintenance and rehabilitation purposes. CCTV inspections view the condition of assets, and provide information on attributes. Condition data can be used to:

- Determine the structural condition of pipes to enable rehabilitation works to be prioritised.
- Maintain a check on the structural condition and rate of deterioration of pipes to enable forward budgeting for maintenance and rehabilitation.
- Provide an overall inventory of the asset and a global picture of system problems.
- Check service conditions to enable regular maintenance planning.
- Provide miscellaneous information for additional uses, such as locating unused lateral connections for new housing developments.
- Provide a status of sewer and stormwater systems for industry benchmarking.

CCTV inspections also provide valuable information on the position and type/size of the pipes being inspected, such as:

- Connectivity, i.e. which manholes are connected by the pipe.
- The location of pipes and manholes can be determined by the length of the pipe surveyed and the position of the manholes noted when the CCTV camera was put into or retrieved from the pipe.
- The diameter of the pipe being inspected.
- The material of the pipe being inspected.

What Cannot Be Determined From CCTV Inspection?

CCTV inspections cannot:

- Provide information beyond the inside surface of the pipe being inspected. CCTV inspections on their own cannot provide information on the condition or thickness of the pipe wall material, nor can they determine whether there are cavities behind the pipe wall.
- Confirm that a pipe is not leaking. CCTV inspections may show that water is leaking into a pipe, if the inspections were undertaken during wet conditions. They may also show that material is leaking out of a pipe, e.g. through pipe breaks. However CCTV inspections carried out in the dry cannot confirm that water is not leaking out of joints. The joints may look to be in good condition but may still be leaking. Even if the CCTV inspection is carried out during wet conditions there is no guarantee that the water table might not be below the pipe when the survey is carried out, but raise up above the pipe at a later date, causing water to leak into the pipe.

What is the Role of CCTV Inspections in Asset Management?

The aim of asset management is to manage assets, such as sewer systems, in a way that provides the required level of service in the most cost-effective manner through the creation, operation, maintenance, renewal and disposal of assets to provide for existing and future customers.

CCTV inspections can help organisations gain an understanding of the existing condition of their piped assets. This understanding can help organisations make decisions such as which pipelines are:

- Undersized and need to be upsized to meet future flows.
- In risk of collapse.
- In need of maintenance works such, as root cutting.

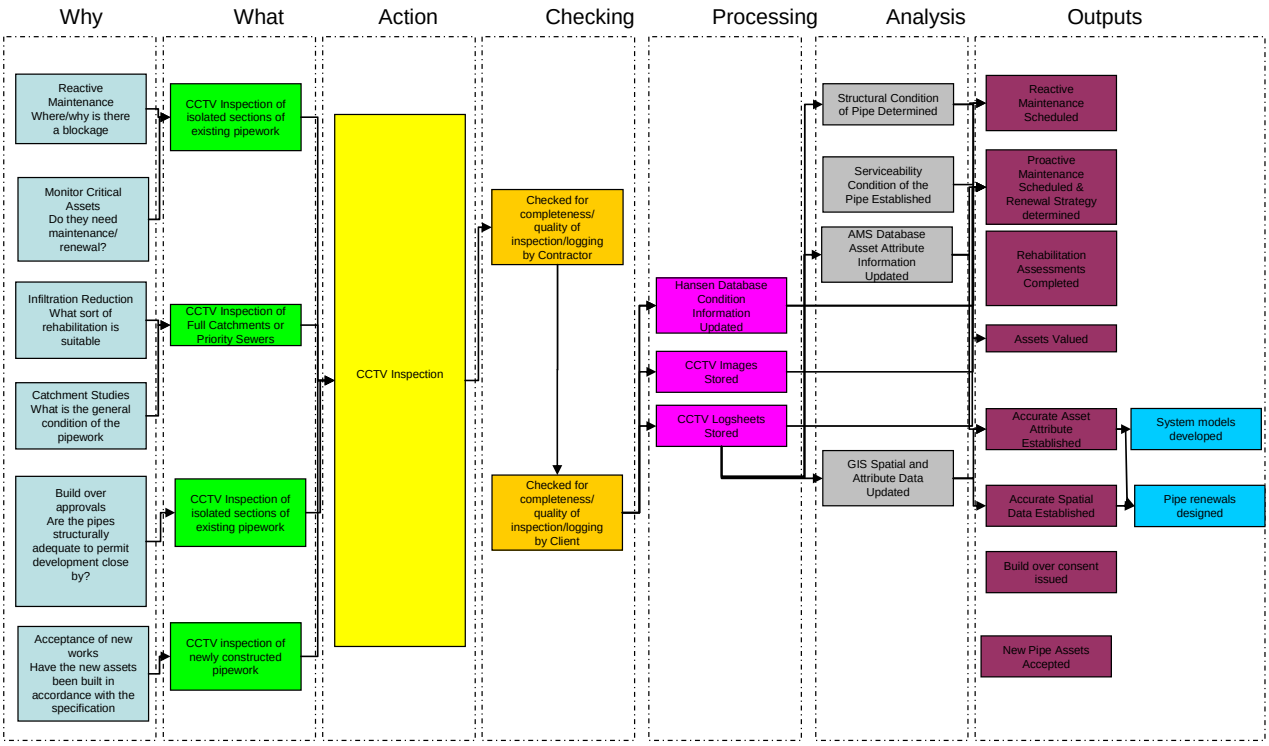
The client is then able to prioritise works and prepare a timetable and budget for any required rehabilitation works.

An Outline of the CCTV Process

On outline of the CCTV process is given Figure 1- 5. The process involves:

- Determining the purpose of the inspections.
- Determining which pipelines are to be inspected.
- Carrying out CCTV inspections.
- Checking that the information collected during the CCTV inspection is accurate and complete.
- Processing and storing the data obtained from the CCTV inspections.
- Analysing the CCTV inspections.
- Generating the required outputs.

Figure 1- 5 – The CCTV Process



What is Important For Making Sure CCTV Inspections Serve Their Intended Purposes?

- All pipes are fully inspected. If this is not possible the reason for stopping the survey needs to be clearly stated and it needs to be determined whether the survey has satisfied its intended purpose.
- The CCTV survey captures all pipe condition and faults.
- The survey is correctly logged. Two different operators should be able to log the survey and produce the same logsheet.
- CCTV inspections need to be recorded against the correct asset. If the wrong asset number is used it is very difficult to retrieve the information in the future.
- Discrepancies between what is recorded in GIS and what is actually found need to be identified and the GIS records corrected.

GOOD PRACTICE

FIGURES

TABLES

2 GOOD PRACTICE

2.1 Good Practice for Operation of CCTV Equipment

Cleaning

Should the pipe be cleaned before CCTV inspection?

Whether or not a pipe should be cleaned before CCTV inspection depends upon the purpose of the CCTV inspection.

Cleaning prior to CCTV inspection will ensure that there is a good view of the pipe wall, thus making it easier to identify defects and features in the pipe. Often it is necessary to clean the pipe and remove debris to enable the camera to travel the full length of the pipeline.

On the other hand cleaning adds to the cost of the CCTV inspection, it can sometimes damage the pipe and it will remove serviceability defects such as roots and debris.

The level of cleaning recommended for various purposes of inspection is outlined in Table 2- 1.

Table 2- 1 – Recommended Cleaning

Purpose of Inspection	Recommended Cleaning
To determine the serviceability of the pipe, e.g. is the pipe silting up.	Do not clean prior to CCTV inspection. Only clean if the camera cannot travel through the pipeline.
Inspection of structurally suspect pipelines.	Carry out an initial CCTV inspection without cleaning, as cleaning may damage the pipeline. If this CCTV inspection indicates that the pipeline is in reasonable condition, it is recommended that the pipeline be cleaned and a second CCTV inspection completed to identify any defects that may have been obscured during the initial CCTV inspection.
To identify the general structural condition of the pipeline. Identification of small severity faults is not a concern.	Light cleaning to remove slime and spider webs.
To identify all faults in the pipeline, including small severity faults, e.g. in order to determine whether the pipeline is suitable for grouting.	Full cleaning of the pipeline to remove all foreign material.

How is cleaning undertaken?

Cleaning is normally completed by hydro jetting. Equipment capable of delivering 140 bar pressure and a volume rating of 170 l/min is normally used for light cleaning. Jetting units that have been specifically set up for root cutting and removal of heavy debris may be required to fully clean the pipeline.

In some cases cleaning by rodding or dredging may be appropriate.

What needs to be considered when cleaning pipelines?

Consideration needs to be given to ensuring that:

- Adjacent properties are not damaged or flooded.
- Sewer overflows do not occur.
- The sewer being cleaned is not damaged.
- All debris from the cleaning is collected and removed from the sewer system.

What direction should the cleaning be done in?

Cleaning should generally be carried out from a downstream manhole, in a downstream direction. Upstream cleaning should be avoided wherever possible because it increases the possibility of water being blown up laterals and causing gully traps or toilets at adjacent buildings to overflow.

If upstream cleaning is absolutely necessary, then property owners should be advised to seal toilet seats by placing towels on the toilet seats to try and contain any backflow.

How long after the cleaning should the pipeline be inspected?

The pipeline should be inspected as soon as possible after it has been cleaned. In any case the inspection should be completed within seven days of cleaning. For pipes with high levels of debris or grease flowing through them seven days may be too long and re-cleaning may be required.

CCTV Inspection

What direction should the CCTV camera travel?

Wherever possible inspections should start at the upstream manhole and proceed downstream. Circumstances where this may not be practical and therefore it may be necessary to start the inspection at the downstream manhole include:

- Inspection of long pipelines where the CCTV camera does not have enough cable to complete the inspection from the upstream end.
- Where the upstream manhole cannot be accessed, e.g. it is buried.
- There is no manhole at the upstream end, e.g. there is a lamphole at the upstream end.
- There are obstructions that prevent the CCTV camera travelling downstream for the full length of the pipeline.

Where should the inspection start and finish?

All inspections should start at the centre of the manhole with a clear view of the entry into the pipeline and the manhole wall. Inspections should end at the centre of the finish manhole. If it is not possible to start or finish an inspection at these positions, comments should be included in the “Comments” field of the logsheet explaining why this was not possible. The video should still record the inspection as the camera is inserted into the pipe.

What speed should the CCTV camera travel along the pipeline?

The camera should travel along the pipeline as smoothly as possible. The speeds at which the CCTV camera should travel along the pipeline are defined in Table 2- 2. These speeds have been set to ensure that the CCTV camera travels at a speed slow enough to allow adequate time to view defects and features, but not so slow that it takes an excessive amount of time to view the inspection.

The speed of travel is not an issue for cameras that digitise images from the pipe inspection (refer Section 3 – The Tools).

Lack of traction, e.g. when travelling upstream on a pipe with a steep gradient, may cause the camera to consistently travel at speeds below the specified minimum. In these cases it may be necessary to fit a tow line to the camera and pull it through the pipeline.

Table 2- 2 – Camera Speed

Pipe Diameter	Camera Speed (m/sec)	Camera Speed (m/min)
Up to 200 mm	0.05 to 0.10	3.0 to 6.0
225mm to 300mm	0.05 to 0.15	3.0 to 9.0
Over 300mm	0.10 to 0.20	6.0 to 12.0

What should happen at a defect or feature?

To gain a clear view of a defect or a feature, such as a lateral connection, the camera should stop and pan over the defect ensuring that the defect is clearly in focus. The camera zoom should be set at a distance that enables the severity of the defect to be determined, i.e. not too close so that the severity of the defect is exaggerated, but not too far away that the defect cannot be clearly seen. The camera should show a clear view along the spring line of laterals. Generally the inspection of the defect or feature should not exceed 20 seconds.

If the inspection is being carried out with a CCTV camera that does not have pan and tilt capabilities, e.g. if a 100mm lateral is being inspected, then the camera should be stopped and should focus on the defect or feature for 5 to 10 seconds.

Stopping and panning over defects or features is not necessary when using cameras that digitise the images from the pipe inspection (refer Section 3 – The Tools).

What level of picture quality is required?

To enable CCTV inspections to be evaluated to determine the condition of the pipeline there must be a clear view of the pipeline. Examples of issues that may cause an unacceptable picture quality include:

- Camera out of focus.
- Insufficient lighting
- Fog or steam in the pipe.
- Condensation or grease on the lens.
- Temporary discharge of water down the pipe.
- Debris or spider webs over the lens due to insufficient cleaning.
- Camera not stationary during a still picture capture.
- Camera moving too fast through the pipe.

The camera iris and/or light intensity should be adjusted to get the best possible picture clarity. This is of particular importance when completing inspections of PE pipes, where there could be limited light, in the case of black PE pipe, or too much reflection in the case of white PE pipe. Care also needs to be taken to adjust light intensity when the picture quality may be influenced by light from outside of the pipe, e.g. when the camera is close to an outfall.

What should be shown on the screen header?

A screen header should be included at the start of the recording of each inspection to identify the inspection on the video or DVD. The screen header should display:

- Contract Number.
- Upstream and downstream manhole/node numbers.
- The set-up manhole (Upstream or downstream).
- The name of the Contractor.
- Location (town or suburb).
- Inspection date.

If a new manhole or node is identified during the inspection the asset numbers shown on the header may be incorrect. In this case a screen header should be displayed at the conclusion of the inspection, e.g. “Inspection completed at manhole 123456”.

This header should be displayed for between 3-5 seconds.

What displays should be shown on the screen during the inspection?

During the inspection the following should be displayed in the corners of the recorded image:

- The distance of the camera from the centre of the start manhole or node.
- The identification numbers of the upstream and downstream manholes nodes as identified at the start of the inspection. If during the inspection an intermediate manhole or node is identified, making the numbers shown on the display incorrect, the number shown does not need to be corrected.

What measurements should be taken during CCTV inspections?

Distance measurements need to be accurately recorded during CCTV inspections to enable the position of defects or features to be located.

To enable accurate measurements the camera cable should be kept taut in front of the distance measurement unit. Camera cable should not be coiled in front of the distance measurement unit except for the first metre or so at the start of the inspection, prior to setting the distance measure system. It the camera is reversed more that 300mm the camera cable should be pulled back through the distance measurement unit to ensure that the correct distance measurements are maintained.

How is the distance measurement counter set?

At the start of the survey, the camera is positioned in the centre of the manhole and the distance counter is set to 0.0m, (this is displayed on the screen in the continuous display). Once the camera has moved inside the manhole pipe starter, the cable slack is removed so that the cable is taut. Before continuing with the inspection the distance counter is then set to the 'true distance' travelled from the centre of the manhole.

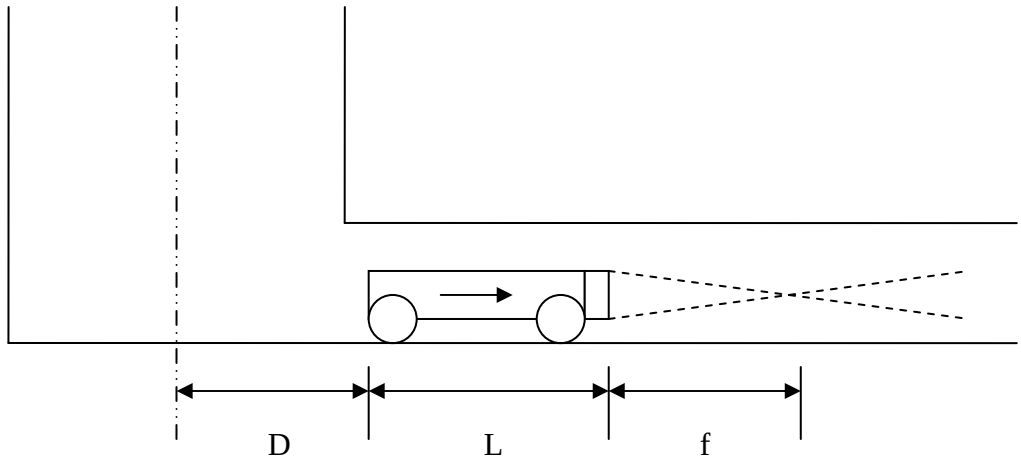
The 'True Distance' is measured as the distance from the centre of the manhole to the rear of the camera, plus the camera length, (refer to the Formula 2- 1 and Figure 2- 1 below). For inspection of pipelines less than 150mm in diameter, where a pan and tilt camera is not used, the focal length of the camera should be added to the length when calculating 'True Distance'.

Formula 2- 1 – Calculation of True Distance

True Distance (Pan & Tilt camera) = D + L

True Distance (Fixed Head camera) = D + L + f

Figure 2- 1 – Measuring the true distance



Where it is not possible to start the inspection at the centre of the manhole, the camera should be placed in the manhole pipe starter to commence the inspection. The cable should be taut and the distance counter should be pre-set with the 'True Distance' displayed on the screen display. The reason for not commencing the inspection from the centre of the manhole should be recorded in the "Comments" field on the logsheet header.

What to do when there is water in the pipe?

Dips in the pipeline or high flow rates may obscure the view of the pipeline. Generally flow depths less than 25% of the pipe diameter are acceptable. If the camera is travelling upstream then water may surge in front of the camera. The water level will therefore need to be reduced to about 12% before starting the inspection to ensure that the water surge does not exceed 25% of pipe diameter.

Where the depth of the water in the pipeline exceeds 25%, or the view of the pipe is obscured by the flow, then it will be necessary to reduce or remove the water in the pipeline. This may involve the following:

- Returning at an off-peak time when the flow rates have reduced. Off-peak times vary according to location and use of the pipeline, but in general this would be between 10am – 3pm and after 9pm.
- Controlling (limiting) the flow or by-pass pumping the water around the pipeline being inspected.
- Flushing the water from a dip in the pipe by pulling a jetting nozzle through the line immediately in front of the CCTV camera. When flushing water from the pipe, the jetting unit should be set up at the downstream node, flushing the water downstream towards it.

Sometimes it may be necessary for the pipeline to be dry, with no water in the invert. This may be required where there is particular interest in the invert of the pipe, e.g. on trade waste sewers where the pipe invert could be corroded, or in cases of newly rehabilitated pipes where the engineer may wish to check that the lining has not been laid over debris in the base of the pipeline. To ensure that the pipe is dry, the upstream manhole inlets should be blocked and the flows by-passed pumped around the pipeline being inspected. Any water in dips should be removed using the method describe above.

What to do if there is a risk of damage to the CCTV equipment?

If there appears to be a risk of the CCTV equipment being damaged or jammed in the line then the inspection should be abandoned and an attempt made to complete the inspection from the other end. If an inspection is not possible from the other end, or if the inspection from the other end is also incomplete, then the item causing the risk should be removed or repaired before the inspection is completed.

Issues that may put the CCTV equipment at risk may include:

- Reductions in diameter of the pipeline or protrusions into the pipeline such as protruding material that may cause the camera to become stuck in the pipeline.
- Sections of pipeline that have collapsed or are near to collapse.
- Dips in the pipeline where it is not possible to see the invert and where there may be large holes in the invert.

2.2 Collecting of Information on the Assets Being Inspected

Why is it Important to Record the Asset Number of the Pipeline?

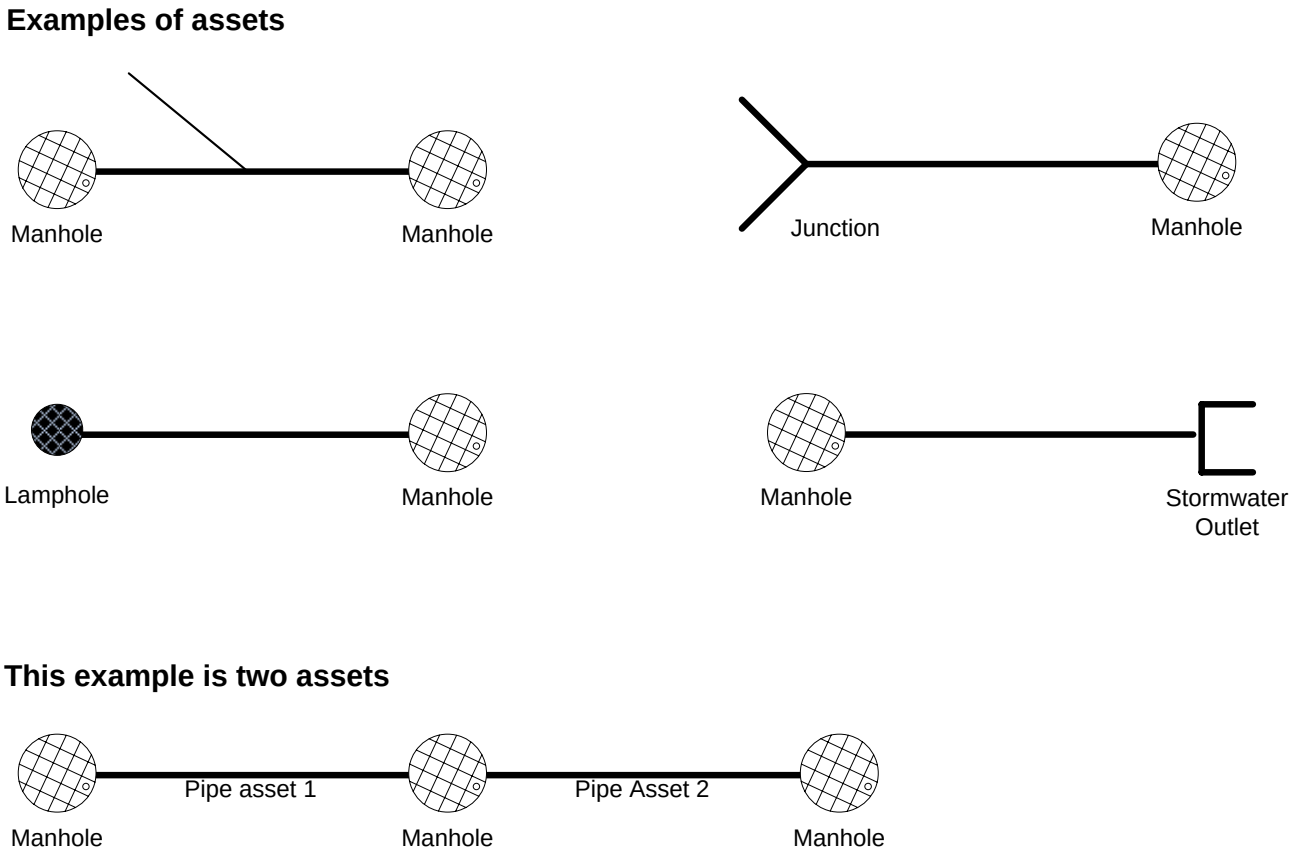
CCTV information is normally identified in a database through the asset number. If the correct asset number is not shown on the CCTV header then the information cannot be easily retrieved in the future.

What is an Asset?

An asset is a single length of pipe between manholes or a node. Examples of nodes include a lamphole, junction, stormwater inlet or outlet. (Refer Glossary for a full definition).

A pipe asset cannot contain an intermediate manhole or node. Examples of assets are shown in Figure 2- 2.

Figure 2- 2 – What is an Asset?



What to Do if a New Manhole or Node is Found During the Inspection?

When a previously un-recorded manhole or node is found during an inspection:

- The new manhole or node is allocated a unique asset number.
- The inspection is ended at the centre of the new manhole, and a screen header displays the manhole asset number.
- A new inspection is started for the new asset. The distance at the un-recorded manhole or node is re-set to zero.

Multiple Inspections

What are multiple inspections?

Sometimes it may take more than one inspection to complete the survey of a pipeline, e.g. due to blockages, roots or the length of the line. Multiple inspections consist of two or more inspections of one pipeline meeting at common points.

The most frequent multiple inspection scenario has two inspections. Typically this would be an abandoned inspection from one direction, and a second inspection from the other direction ending at the previous point of abandonment.

What are the general requirements for multiple inspections?

Although multiple inspections are separate surveys, the inspections are recorded on the same logsheet, even if they are surveyed on different days. The different inspection dates are recorded in the “Remarks” field at the start of the second and subsequent inspections.

For each inspection of a multiple inspection survey the start code (IS) and the relevant inspection end codes (IE or IA) are recorded. In addition to any different date remarks at the start of the inspections, the operator should note the node number of the setup node in the “Remarks” field. This ensures that the logsheet remains clear as to where individual inspections start and finish.

When recording multiple inspections for a pipeline close attention is required to ensure that:

- Defects or features are not overlooked.
- Defects or features are not logged twice.
- The full extent of defects, such as dips, is recorded.
- The position of defects or features is accurately recorded, i.e. all clock positions are relative to the upstream position.
- The locations of defects or features are accurately recorded, i.e. the "Relative Distance To" field is correctly calculated relative to the distance from the upstream node.

What happens if there is an obstruction and the survey cannot be completed from the other end?

In this case the inspection cannot be completed until the obstruction has been removed. Once the obstruction has been removed, the pipeline should be completely re-inspected on a new logsheet and header, superseding the previous abandoned survey. Commentary should be made in the "Comments" field on the inspection header, noting that the current inspection has been completed "post the removal of the obstruction".

What to do if a dip is encountered and the water has to be removed by jetting?

The inspection of the line should be "paused" at the start of the dip until the jetting unit is in place. Once the jetting unit commences with flushing the water from the dip, the inspection should be "re-started" from the same position and the inspection completed as a single inspection.

Commentary is included in the "Comments" field of the inspection header to note that water was removed with a jetter. The extent of the dip is recorded on logsheet using the Dipped Pipe "DP" code.

2.3 Completing the Logsheet Header

The header of the logsheet provides information that enables the CCTV inspection to be linked to the pipelines being inspected through the recording of the pipe asset number and the asset numbers of the upstream and downstream manholes. This is essential information which must be recorded otherwise it is not possible to know which inspections relate to which sections of pipeline.

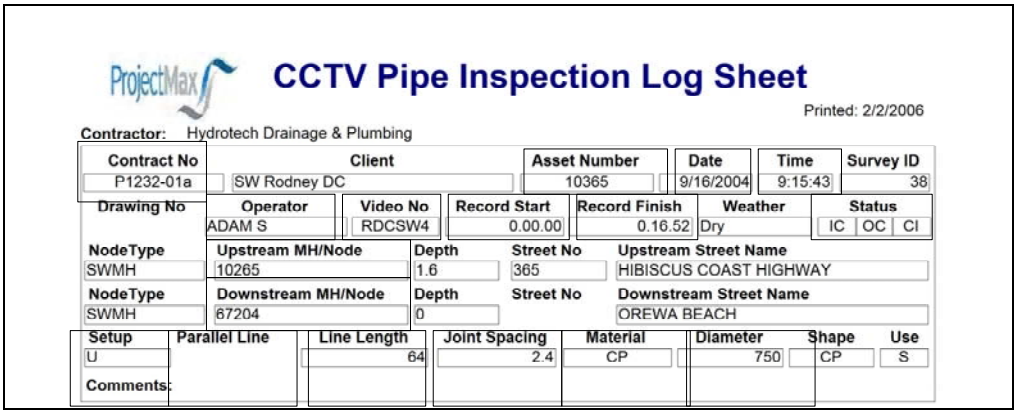
The logsheet header also provides details on:

- When the inspection was carried out and who completed it.
- The direction of the survey, e.g. did it start at the upstream or downstream manhole.
- Where the inspection is located on the videotape or DVD.
- The address at which the manholes are located and depth of pipelines.
- The pipe being inspected, e.g. its size, material, joint spacing, whether it has been rehabilitated.
- The status of the inspection, e.g. is it current or has been superseded.
- The inspection completion status, i.e. is it complete (IC) or uncompleted (UI) or not yet undertaken (IR).

The asset data recorded on the logsheet header provides valuable information that can be used by organisations to update their GIS systems.

Most of the input fields in the logsheet header are mandatory and must be completed. This information is described in Table 2-3 and shown in Figure 2- 3. The remaining fields are optional. These are described in Table 2 -4.

Figure 2- 3 – Mandatory Header Fields



ProjectMax

CCTV Pipe Inspection Log Sheet

Printed: 2/2/2006

Contractor: Hydrotech Drainage & Plumbing

Contract No	Client	Asset Number	Date	Time	Survey ID
P1232-01a	SW Rodney DC	10365	9/16/2004	9:15:43	38

Drawing No	Operator	Video No	Record Start	Record Finish	Weather	Status
	ADAM S	RDCSW4	0.00.00	0.16.52	Dry	IC OC CI

NodeType	Upstream MH/Node	Depth	Street No	Upstream Street Name
SWMH	10265	1.6	365	HIBISCUS COAST HIGHWAY

NodeType	Downstream MH/Node	Depth	Street No	Downstream Street Name
SWMH	67204	0		OREWA BEACH

Setup	Parallel Line	Line Length	Joint Spacing	Material	Diameter	Shape	Use
U		64	2.4	CP	750	CP	S

Comments:

Table 2- 3 – Mandatory Header Fields

Field Name	Description	Discussion	Format
Asset No.	The unique number for the pipe asset provided by the client.		Text
Contract No.	The number allocated for a contract by the client.	To enable importing and exporting of electronic inspection data for a project, it is essential that all parties use the same Contract No.	Text
Operator	The name of the person responsible for allocating the codes and severity ratings for defects.	If the people carry out the inspection and logging are different, it is the person who logged the inspection that should be entered as the operator.	Text
Camera Operator	The name of the person responsible for recording the video inspection of the pipeline.	If the operator and the camera operator are the same person, this field is left blank.	Text
Date Started	The date that the inspection started.	If multiple inspections are required, the date of the first inspection should be entered. The date of subsequent inspections should be entered under the “Remarks” field.	Day/month/year, i.e. dd/mm/yy
Time Started	The time that the inspection started.		Time
Upstream/Down stream Manhole/Node No.	Manhole or node reference as supplied by the Client.	If the finishing manhole or node is different from that supplied the correct node number is recorded in this field.	Text
Video Record No.	The number allocated to the video tape or DVD.	The video number must be a unique number. Two tapes or disks cannot be allocated the same number. If the inspection spans two tapes or discs then the number of the second tape or disc should be noted in the “Remarks” field.	Text

Field Name	Description	Discussion	Format
Video Recorder Run-time Start/Finish	The video record run time at the start/finish.	The video recorder run time at the start/finish of the inspection. This is only mandatory for inspections recorded on video. It is not required for inspections recorded to DVD or hard drive.	Hour minute second. There should be no separator (e.g. colons) within the field, e.g. hhmmss
Set-up	Whether the camera has been set up at the upstream or downstream manhole.	The set up refers to the position where the camera was put into the pipeline. An Upstream setup indicates that the camera has been set up at the upstream manhole and is facing downstream. In the case of the inspection starting at the downstream manhole and being reversed up the line, the Set Up would still be shown as Upstream as the camera is facing the same direction as an inspection that started at the upstream manhole. In the case of multiple inspections the set up of the first inspection should be recorded.	U (for upstream) D (for downstream)
Parallel Line	Whether there is a parallel line that has the same upstream and downstream manholes.	This item is only mandatory if there is a parallel line.	Text
Currency of Inspection	Records whether the inspection is the “current” inspection or has been replaced (Superseded) by a more recent inspection.	In software, this is an automated function. Where this is not the case, care needs to be taken by the client to ensure that preceding inspections are marked as superseded (SI) inspection so that there is no conflict as to which inspection is the most current.	Refer Table 2-11
Status of Pipe	Records whether the pipe being inspected is : • “Original condition”, i.e. the pipe has not recently been rehabilitated. • “Rehabilitated”, i.e. the pipe has recently been rehabilitated.	Grouting and root cutting of pipes is not normally considered to be “rehabilitation” for the purpose of this field because the original pipe material has not been replaced.	Refer Table 2-11

Field Name	Description	Discussion	Format
Inspection Completion	Records whether the inspection is: • "Complete", i.e. the inspection shows a clear picture of the entire pipeline. • "Incomplete", i.e. the inspection has not been completed, e.g. the inspection was stopped part way through due to roots. • "Inspection Required", i.e. the inspection has not yet been attempted.	When an incomplete inspection is completed, e.g. roots are removed or the inspection is completed from the other end then the status will be changed to "Complete".	Refer Table 2-11
Line Length	The length of the pipeline being inspected.	The length recorded is measured from the centre of the manhole covers/nodes. If the survey is incomplete, the length of the pipeline supplied by the client is entered in this field. The length is recorded in metres, measured to 0.1m accuracy.	Numeric
Surveyed Length	The length of the pipe surveyed.	This length may be different from the Line Length field for various reasons, e.g. the inspection is not complete or the actual length is different from the information supplied by the client.	Numeric
Pipeline Diameter	The measured pipe diameter or height (where the pipe is not circular).	Recorded in millimetres.	Numeric
Joint Spacing	Enter the typical joint spacing.	Recorded in metres, measured to 0.1m accuracy. Refer Table 2- 5 for typical joint spacings.	Numeric
Material	Enter a code to describe the pipeline material.	If the contractor is unable to determine what the pipe material is then they should note what details they can ascertain in the "Remarks" field.	Refer Table 2-11

Table 2- 4 – Optional Header Fields

Field Name	Description	Discussion	Format
Inspection No.	A unique number that identifies the inspection.	This number will normally be automatically generated by the CCTV software.	Numeric
Client	The name of the client organisation.		Text
Contractor	The name of the contractor's organisation.		Text
Drawing No.	The number of the drawing on which the pipeline is shown.		Text
Date of Data Entry	The date of the data entry.	This is as opposed to the date of the inspection which is mandatory field.	Day/month/year, i.e. dd/mm/yy
Upstream/Down stream Asset Type	The type of asset at each end of the pipeline being inspected.		Text
Upstream/Down stream Manhole Depth	Enter the depth from the centre of the manhole cover to the invert of the pipe being inspected.	Depths should be recorded to 0.1m accuracy. Drop structures are measured to the invert of the upper level pipe.	Numeric
Street and Street type	Enter the name of the street that best describes the general location of the pipeline being inspected.		Text
Upstream/Down stream Manhole Address	Enter the name of the street that best describes the general location of the manhole or nodes at either end of the pipeline being inspected.	If there is no readily identifiable property numbers nearby then this section should be left blank and the location described in the "Remarks" field.	Text
Shape	Enter a code to describe the shape of the pipeline.		Refer Table 2-11
Use	Enter a code to describe the use of the pipeline.		Refer Table 2-11
Date Completed	The date that the inspection was completed.	Useful when multiple inspections over several days were required.	Day/month/year, i.e. dd/mm/yy
Time Completed	The time of completion of the inspection.		Numeric
Video Recorder Run-time Finish	The video recorder run-time reading at the end of finish of the inspection.		Hour minute second. There should be no separator (e.g. colons) within the field, e.g. hhmmss
Record format	The format upon which the inspection was recorded.		VHS DVD Hard drive

Field Name	Description	Discussion	Format
Location	Enter a code to describe the general location of the pipeline.		Refer Table 2-11
Surface	Enter a code to describe typical surface cover over the pipeline.		Refer Table 2-11
Weather	Enter a code to indicate weather conditions.	Weather conditions may influence inflow and infiltration into the pipeline and affect flow conditions.	Refer Table 2-11
Flow Depth	The flow depth at the start manhole.	The depth should be recorded in millimetres, recorded to an accuracy of 20mm. The depth should be measured prior to any flow management such as bypass pumping or flushing in front of the CCTV camera.	Numeric
Comments	Enter comments regarding the inspection.	Any clarifying detail regarding the inspection. This may include the reason for the inspection (e.g. "post root cut survey), known restrictions, or special conditions. Comments relating to a defects or features are recorded in the "Remarks" field adjacent to that defect or feature.	Text

Table 2- 5 - Typical Joint Spacings

Material	Typical Joint Spacing
Asbestos Cement	4.0m
Cement lined steel	6.0 to 12.0m
Concrete, pre-cast	0.6 to 1.2m
Concrete, spun	1.8m or 2.4m
Earthenware	0.6 to 1.0m
Polyvinyl chloride	3.0 to 6.0m
Vitrified clay	1.2 to 1.8m

2.4 Recording the Condition of Pipes

All defects and features identified during the CCTV inspection should be recorded in the main body of the logsheets. This should include defects and features in the pipeline being inspected, as well as observations from any laterals connecting to the pipeline. Defects and features in manholes are not recorded on the pipeline inspection logsheets.

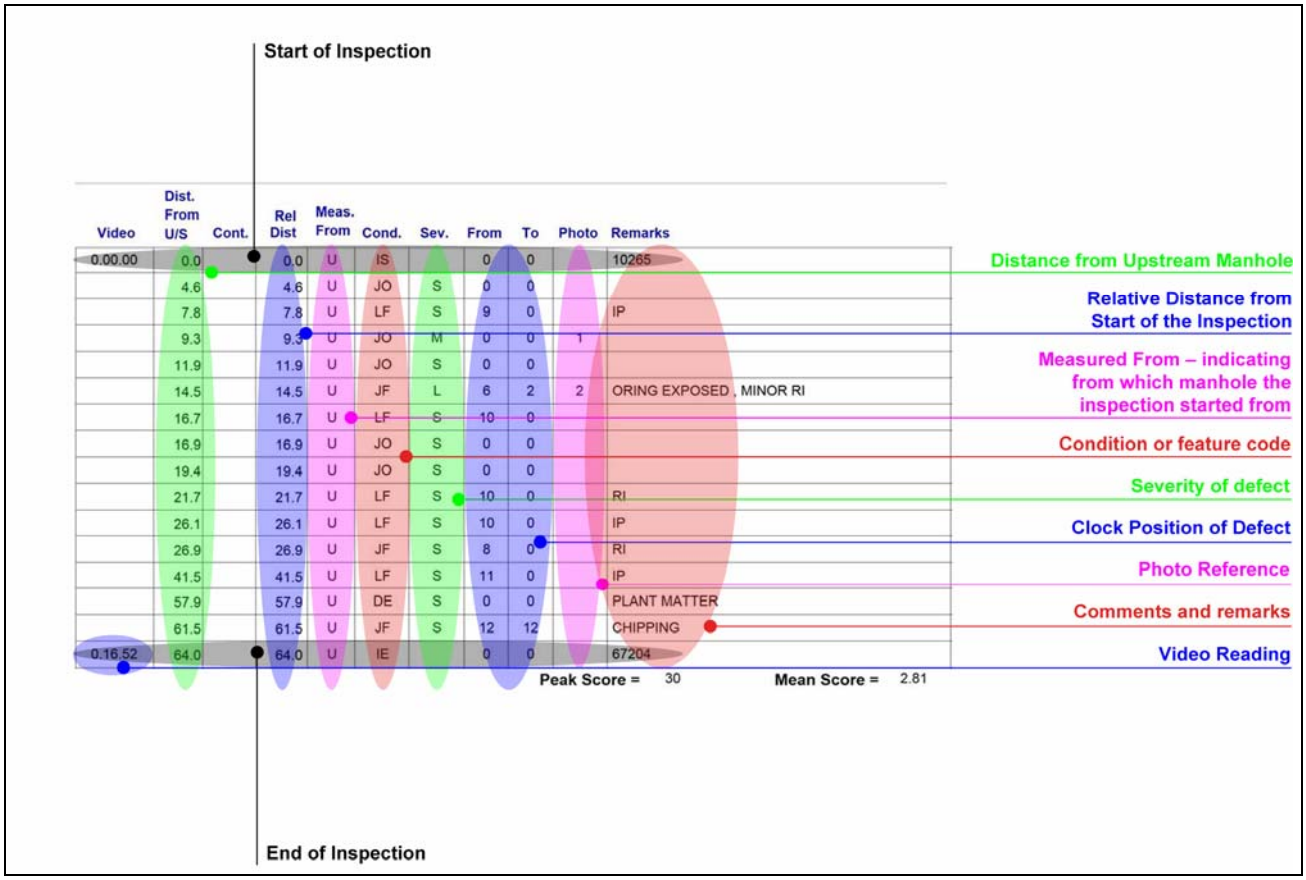
The defects and features are recorded in accordance with the descriptions outlined in Section 5. This is often referred as "coding". The coding descriptions outline for each type of defect or feature:

- The identifying features of each code.
- The information that is required to be entered or captured in the logsheet.
- Sample photographs, providing examples of each defect and varying severities.
- Any other issues that may help with identification or coding.

What Should be Entered to Record the Condition of Pipes?

The information that should be entered on logsheets to record defects and features noted during the CCTV inspection is shown in Figure 2- 4. This information is discussed in more detail in the following sections.

Figure 2- 4 – Recording of Defects and Features



Video Reading

Enter the video recorder run-time reading at the defect or feature. This is essential when the CCTV inspection is recorded to video tape to enable defects and features to be easily relocated on the video tape.

Recording of the video reading is not necessary when the inspection is being recorded to DVD or hard drive.

Record at the Start of the Inspection

All inspections should start with the code "IS" to indicate that this is the start of the inspection. If multiple inspections are required to complete the inspection of the pipeline, all subsequent inspections should start with the code "IS".

Distances

Two sets of distances are required to be recorded, i.e.:

- **Distance From**, meaning the distance to the defect of feature from the start manhole.
- **Relative Distance From**, meaning the distance to the defect or feature relative to the upstream manhole. This is calculated by subtracting the 'Distance from' away from the Line Length (or Surveyed Length, if the inspection is complete).

When the inspection is started at the upstream manhole the two sets of distances will be the same. When the inspection does not start at the upstream manhole the "Relative Distance" measured during the inspection needs to be converted.

Distance readings are measured from the centre of the manhole or node. Measurements should be recorded in metres to an accuracy of 0.1m.

Record at the End of the Inspection

All inspections, including second or subsequent inspections in cases where multiple inspections are required, should end with either:

- "IE" – meaning "Inspection Ends". This signifies that the camera has travelled the full length of the pipeline being inspected.
- "IA" – meaning "Inspection Abandoned". This signifies that the camera was not able to proceed past this point, e.g. due to a root blockage or a grout protrusion. The reason for the camera being stopped should be noted under the "Remarks" field.

The "IA" code is used in addition to any defects that may have prevented the camera from travelling along the pipeline.

What to do when multiple inspections are required?

When multiple inspections are required to complete a pipeline:

- "IA" is used when the camera is stopped from completing the inspection.
- "IE" is used when the camera has completed the section of pipe that is required to be inspected, e.g. the camera has reached the point where the previous inspection was abandoned from the other end of the pipeline.

Multiple Condition Record Codes

If there is more than one defect or feature at any one point in the pipeline then both defects or features are entered as separate condition records.

For example a lateral maybe protruding into the pipeline, and a root is extending into the pipe from inside the lateral. In this case the protruding lateral would be coded "LP", and the defective lateral would be coded "LX" due to the root, and the root intrusion would be coded "RI". All of these condition codes would be recorded at the same "Distance From" measurement.

What to do if there is no code to describe the defect or feature?

The defect or feature should be recorded under the condition code that describes it the best. Additional comments should be added under the "Remarks" field to further describe the defect or feature. An electronic image of the defect or feature should also be captured.

When Should the Code "GC" be used

The code "GC", meaning "General Comment", should be used when it is necessary to make a general comment on the condition of the pipeline, but is not making a particular reference to a structural or service pipe fault that has a condition code. As an example, a comment may be made on the depth of the flow in the pipe.

Measurement From

Enter the location of the manhole from which the inspection is being measured as follows:

- "U" for inspections where the camera entered the pipe at the upstream manhole and is facing downstream.
- "D" for inspections where the camera entered the pipe at the downstream manhole and is facing upstream.

Condition Code

Enter the condition code for the relevant defect or feature from Table 2- 6 or Table 2- 7. Full descriptions of these codes are given in Section 5, Condition Codes.

Table 2- 6 - Defect Codes

Code	Defect
CC	Crack, Circumferential
CL	Crack, Longitudinal
CM	Crack, Multiple
DE	Debris, Silty
DF	Deformed Pipe
DG	Debris, Greasy
DP	Dipped Pipe
ED	Encrustation Deposits
IP	Infiltration Present
JD	Joint, Displaced
JF	Joint, Faulty
JO	Joint, Open
LF	Lateral, Sealing Faulty
LP	Lateral, Protruding
LX	Lateral Problem
OP	Obstruction, Permanent
OT	Obstruction, Temporary
PB	Pipe, Broken
PF	Deformed Plastic Pipe
PH	Pipe, Holed
PL	Protective Lining Defective
PX	Pipe, Collapsed
RI	Root Intrusion
SD	Surface Damage
TM	Tomo

Table 2- 7 - Feature Codes

Code	Defect
CF	Construction Feature
DC	Dimension Change
GC	General Comment
IA	Inspection Abandoned
IE	Inspection Ends
IS	Inspection Start
LB	Lateral Blank
LC	Lining Change
LL	Line Deviates Left
LR	Line Deviates Right
LD	Line Deviates Down
LU	Line Deviates Up
LO	Lateral OK
MC	Material Change

Severity

This field provides an indication to the size of the defect. Enter the severity rating from the relevant conditions code, described in Section 5, Condition Codes. Some features do not require a severity rating in which case this field is left blank.

Position From/To

This field describes the position of the defect or feature relative to the circumference of the pipe. The positions are described in clock reference, with 12 o'clock being the soffit of the pipe. The "Position From/To" (or "clock order") records relate to what would be seen if the camera was travelling down the pipe from the upstream manhole.

If the inspection is being completed from the downstream manhole (i.e. the camera is facing upstream) the clock order positions need to be reversed from the observed positions.

For example, if the inspection started at the downstream manhole a defect might be observed on the centre left hand side of the pipe, but rather than record the defect as being at 9 o'clock it would be recorded as being at 3 o'clock, as this is the position that would have been observed had the inspection been completed from the upstream manhole. In some cases the software used for recording the CCTV observations will automatically translate the clock position.

For Condition Codes that require both the "Position From" and the "Position To" to be recorded, the start of the defect, (in clockwise order) is entered in the "Position From" field, and the end of the defect is recorded in the "Position To" field

Photo

Enter the reference number of the photo or electronic image if one is captured. It is recommended that images be captured of all medium and large severity defects.

Remarks

Any general comments that may help users understand the CCTV inspection are entered into the "Remarks" field.

For some codes supplementary information is required to be included in the Remarks column. Refer Section 6, Condition Codes for details.

Continuous Defects

What are continuous defects?

Where a defect extends over more than 1m it is described as being continuous.

The start and finish distances of the defect are recorded. Examples of how this can be done include:

- The continuous defect is recorded as one entry in the logsheet. The start and finish distances of the defect are recorded in the "Distance From" and the Distance To" fields.
- The continuous defect is recorded as two entries on the logsheet. One entry for the start of the defect and another for the end of the defect. "S1" is recorded in the "Continuity" field to indicate the start of the first continuous defect recorded on the section of pipeline being inspected. The end of the defect is signalled by recording "F1" in the "Continuity" field. Subsequent continuous defects are recorded using S2, F2, S3, F3 etc.

What effect do continuous defects have on the condition of the pipeline?

The effect that a continuous defect has on the condition evaluation of the pipeline depends on the particular type of defect.

Table 2- 8 describes the two different types of continuous defect. The data entry requirements for each condition code (refer Section 5, Condition Codes) identifies which codes have continuity and which type of continuous defect applies.

Table 2- 8 - Continuous Defects

Method Used to Describe Continuity	Description	Relevant Codes
Per Metre	A single condition record is used to describe the full extent of the defect, but the Condition Rating Score increases proportionally to the length of the defect. The start and finish locations of the defect are recorded on the logsheet.	CL, CM, DF, ED, PB, PF, SD
Per Defect	A single condition record is used to describe the full extent of the defect, and a single Condition Rating Score applies the defect regardless of length. The start and finish locations of the defect are recorded on the logsheet.	DE, DG, DP, PH, PL, TM

Why are there different approaches?

These different approaches reflect the impact that the different defects or features have on the condition of the pipe. In general structural faults, which are typically recorded on a "per metre" basis, have a more significant impact on the integrity of the pipeline than serviceability defects, which are typically recorded on a "per defect" basis.

What do you do when the severity of the defect changes?

In cases where the severity of the defect changes, the continuous defect shall be ended, (the "Distance To" length is entered at that point) and an additional defect is recorded. The fact that the defect continues is recorded in the "Remarks" field.

2.5 Ensuring That the Required Quality is Achieved

CCTV inspections are generally carried out to help clients make decisions on the asset management of their pipe networks. If the CCTV data provided is not accurate or reliable then the client may not be able to make decisions or the decisions that they do make may be wrong because they are based on incorrect information.

42% of the clients surveyed in the preparation of this manual were not satisfied with the general quality of the CCTV data being provided. Clearly there is room to improve the quality management of CCTV works.

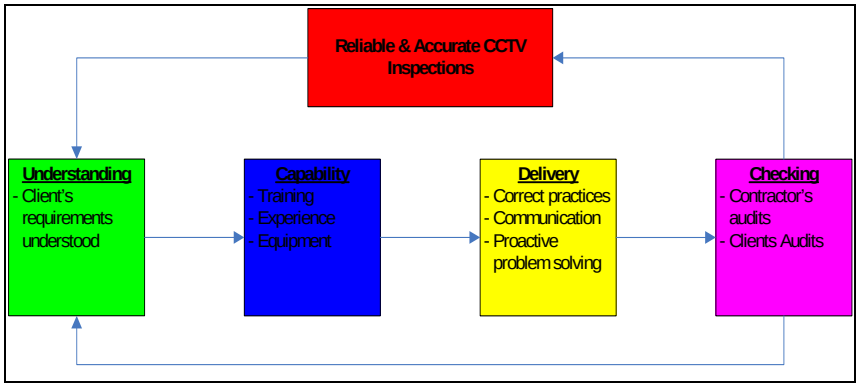
Table 2- 9 – The Impact of Incorrect CCTV Data

Item	Problem	Impact
Logsheet Header	Asset information is missing or not correctly recorded.	The wrong asset validation data may be recorded in the client's asset management database. The CCTV inspection may not be accepted into the asset management database or may not be able to be retrieved.
Inspection	Camera speed too fast, poor picture quality, pipe not cleaned to specification.	Defects in the pipe may be overlooked. Maintenance works that should be carried out on the pipe may not be completed resulting in pipe collapses, blockages or overflows.
Condition Codes	Faults not logged or incorrectly logged.	The engineer may overlook faults. Required maintenance works may not be carried out.
Completeness of Inspection	The full length of the sewer is not inspected.	Defects may be overlooked.

What Are The Key Elements of Quality Management?

The key elements for ensuring that a high quality job is produced are summarised in Figure 2- 5.

Figure 2- 5 - Key Elements of Quality Management



The completion of accurate and reliable CCTV is a shared responsibility of both the client and the contractor.

The client needs to ensure that:

- Their requirements are communicated to the contractor, e.g. in the form of the contract specifications.
- They need to be available to help solve any problems, e.g. difficulty in getting a property owner's permission to access a manhole.
- They must check some of the work that is being carried out to ensure that it is meeting their requirements and advise the contractor of any areas needing improvement.

The contractor needs to ensure that their staff:

- Understand the client's requirements.
- Have the experience, training and equipment to complete the work.
- Complete the CCTV work in the correct manner.

It is expected that the contractor complete internal audits of their work as it is being carried out, as well as checking the completed work.

What Checks Should The Client Undertake?

It is recommended that the client check:

- Prior to award – that the contractor has the experience and capability to carry out the work. The competence of the proposed operators should also be checked. It is often good practice to require that the contractor submit a sample of the work for checking.
- Auditing of initial works – the initial works completed by the contractor should be checked to ensure that they are to standard.
- Ongoing auditing – further samples of the work should be checked as the works are carried out to ensure that standards are maintained.

Initial Audit Procedures

As soon as possible after the start of the works the contractor should submit to the client for auditing a section of completed work. This should include:

- A minimum of at least one complete inspection supplied in the format set out in the contract documents (DVD or VHS). Wherever possible this should be the first inspection completed.
- Logsheets and photographs
- Electronic data.

The client should check this work as soon as possible and advise the contractor of any deficiencies. Items that should be checked include:

- Cleanliness of pipe.
- Picture quality.
- Camera speed.
- Video or DVD header.
- Logsheet header records.
- Accuracy of defect and feature recording.
- That the electronic data is able to be transferred into the client's system.

If any deficiencies are noted the contractor should immediately rectify the problems and if necessary re-inspect the pipelines.

Ongoing Auditing

As the works are carried out it is good practice for the client to:

- Carry out regular audits to ensure that standards are maintained. Typically at least 5% of the CCTV inspections should be audited.
- Where the asset data recorded or the logsheet header, e.g. pipe diameter or pipe material, is different to that currently recorded in the client's asset database system the records should be checked to ensure that they are accurate before the asset management database is updated.
- Check that all of the required pipelines have been fully inspected. Where the contractor had to abandon an inspection, determine what additional works need to be completed to enable the inspection to be completed.
- Complete random measurements in the field to confirm that the pipeline distances, and where relevant, the manhole depths that have been recorded are accurate.

Auditing of Data Audit Procedures

It is recommended that that the accuracy and completeness of the header and condition records be progressively audited as the works are completed. Typically 5% of the works should be selected for auditing.

The following auditing process is recommended:

- Check the accuracy of header and condition codes and identify any errors.
- Check whether the pipe cleaning and picture quality is acceptable.
- Check that tapes or DVDs have been labelled correctly and screen headers are accurate.

- Classify errors as either Grade 1 or Grade 2 as per Table 2- 10 (Grade 1 are considered to be more serious than Grade 2 errors).
- Calculate the overall accuracy level using Formula 2- 2.
- Determine whether the accuracy level achieved is acceptable or not.

Formula 2- 2 – Calculation of Accuracy Level

$$Accuracy\_Level = 100 * \frac{(RE - G1 - (0.5 * G2))}{RE}\%$$

Where:

RE is the required number of header and condition record entries.

G1 is the total number of Grade 1 errors.

G2 is the total number of Grade 2 errors.

The Accuracy Level is rounded to one decimal place.

Typically accuracy levels greater or equal to 95% are considered to be acceptable. If the accuracy level is less than 95% the contractor should be required to re-evaluate and correct all works completed prior to the audit report.

If the auditing results are consistently unsatisfactory, the client may require the contractor to review their internal checking processes and/or replace the CCTV operator.

Should the client have to carry out repeat audits due to unsatisfactory work by the contractor, then the contractor may be required to pay for this additional work.

Table 2- 10 – Grading of Errors Noted During Auditing

Grade	Error
Grade 1	• tape or DVD incorrectly labelled • screen header is incorrect • continuous information displayed incorrectly • missing or incorrect mandatory header information • distance counter not zeroed at manhole centre • there is not a clear view of the camera entering the pipe • camera not aligned in the centre of the pipeline • pipe cleaning not to standard (every 10m of pipe is considered as one entry) • water level in the pipeline is more than the specified amount • picture quality not acceptable or is not in focus or light intensity is not acceptable (every 10m of pipe is considered as one entry) • camera speed too fast or too slow (every 10m of pipe is considered as one entry) • camera does not stop at a defect • features not recorded • “M” and “L” defects not recorded • severity ratings, “S” instead of “L” or “L” instead of “S” • incorrect distance recorded to defects or features
Grade 2	• missing or incorrect additional header information • “S” defects not recorded • condition record information not recorded e.g. “IA” and “IE” • incorrect condition codes • position to & from (clock references) recorded incorrectly • still images do not clearly show the defect

The client should be flexible with regard to differences in condition coding where subjective interpretation is involved.

Checking of Field Measurements

It is recommended that random measurements be made in the field to check:

- Displayed Distances
  The distance between two manholes should be measured with a tape and compared against the distance recorded during the CCTV inspection. The two distances should be within 1%.
- Manhole Depths
  The depth from the manhole cover to the pipe invert should be measured with a tape and compared against the depth measurement recorded on the logsheet. The two depths should be within 200mm of each other.

2.6 Being Safe

The environment that we work in whilst undertaking inspections of pipes is potentially one of the most dangerous of all work places. There have been far too many cases where people working in and inspecting drains have been injured or lost their lives. Working safely in this environment is extremely important.

What risks are involved in the inspections of pipes?

There are a many risks associated in undertaking a pipe inspection. Some of these are:

- Working in confined spaces.
- Working on the road.
- Working with toxic waste.
- Working with electrical equipment.
- Risk of falls, trips or slips.
- Lifting heavy objects such as cameras and generators.

"Working in a confined space is 150 times more dangerous than doing the same job outside."
- Department of Labour, OSH.

There are significant risks associated with every inspection, regardless of whether the inspection is undertaken in the road, in a private property, in a busy shopping street or wide open park.

Who is responsible for making the work safe?

It is everyone's responsibility to ensure that the work they are undertaking does not endanger themselves or anyone else. It is the responsibility of the client, the contractor and the person working on the site to be aware of the site conditions, identify all hazards and to ensure that all significant hazards are eliminated, isolated or minimised. By law organisations and individuals are required to take all practicable steps to provide a safe place to work.

What can we do to make the work safe?

Training

Ensure that all people involved in the inspection of pipes are competent to work in the environment. This means providing training so that they are aware of the potential risks, safe work practices, and how to identify hazards and what is expected of them. It is recommended that all members of the camera crew have attended an NZQA approved training course on confined space entry.

Discuss Safety

Talk about safety frequently. Actively discussing safety ensures that safety remains a focus in everyone's minds. Open and frequent talk provides an environment where information can be shared, and where people can easily raise safety concerns or hazards. Discussion within and across organisations provides the opportunity for best safe practices to be adopted.

Take minutes of your safety meeting, even for toolbox meetings on the side of the road. These minutes can be circulated and referenced in the future, but they also document what safety processes you have in place.

Scope of work

Understand what work you are undertaking, and what the restrictions of the site area. If you are not sure, find out before the work commences. Do not work on a site/road, or enter a manhole without knowing what kind of environment you are working in. Some dangers may not be immediately apparent.

Carry out risk assessments

For every site a risk assessment should be undertaken to determine the specific risks or hazards particular to that site. This should be completed by all of the people working on that site prior to starting the work, and recorded on a site safety plan. Visitors to the site should be made aware of the risks or hazards present and the controls that have been put in place.

Control the environment

Maintaining control of the work environment reduces the risk of accidents happening.

Eliminate hazards where possible. If it is possible by taking some steps to avoid entering a manhole to complete the inspection do so. All unnecessary confined space entries should be avoided.

If you cannot eliminate the hazard, isolate it. Cone or barricade off all areas where possible to isolate those areas from the work zone, e.g. temporary traffic control, pedestrian barricades and work vehicles can provide a barrier to external hazards.

Minimise the risk. Use the personal protective equipment provided. Damage to hearing, eyesight, burns, cuts, knocks and infections may not necessarily be life threatening, but can be extremely serious, and devastating to you and your family or friends.

Keep the site tidy. Organise the equipment and tools so that they can be available quickly when needed, but do not restrict access around the site.

Resource the job appropriately. Make sure there is enough staff and equipment on site to safely carry out the work. This may vary depending on the site location, access, and whether manhole entry is required.

Equipment

Have the right gear for the job; don't make do with substandard equipment. Implement a regular maintenance program. Most of the equipment we use for pipe inspection requires regular certification. Check what equipment you have for its certification status, and set up a maintenance schedule to make sure they all remain certified and able to be safely used with confidence.

Safety Audit

Audit the work you are undertaking. A regular auditing process promotes the commitment to safety within your organisation, monitors the standard of safe practices on site, and identifies areas where safety can be improved. The results of the safety audits should be discussed at safety meetings.

Procedure for Conducting Walk Through Inspections

Equipment

A Situation; High Flow lines 100mm to 500mm depth.

- Boat/barge/pontoon.
- Camcorder mounted on a tripod setup in boat at mid point of pipe.
- Camcorder with sound recording and waterproof housing.
- Light source comprising individual halogen spot/flood lights, generally 70 watt each. Typical application of 3 x spot lights arranged in an array to project one down the conduit and the other two at approximately 30 degrees to the side for lighting the wall of the pipe. This arrangement may require doubling in order to achieve the required illumination in pipe diameters over 2m.
- 4 man crew comprising:
  - Camera operator stationed on the boat.
  - Boat controller stationed at the rear of the boat walking in the pipe.

- Measuring wheel operator in front of the boat.
- Pipe Inspector with the tools necessary to obtain the required samples.

B Situation; Low Flow lines up to 100mm depth.

- Wheel mounted trolley.
- Camcorder mounted on trolley setup at mid point of pipe.
- Camcorder with sound recording and waterproof housing.
- Light source comprising individual halogen spot/flood lights, generally 70 watt each. Typical application of 3 x spot lights arranged in an array to project one down the conduit and the other two at approximately 30 degrees to the side for lighting the wall of the pipe. This arrangement may require doubling in order to achieve the required illumination in pipe diameters over 2m.
- 3 man crew comprising:
  - Camera operator stationed behind the trolley.
  - Measuring wheel operator in front of the trolley.
  - Pipe Inspector with the tools necessary to obtain the required samples.

Procedure

In trunk and man entry sewer and stormwater conduits, it is highly recommended that the asset is shutdown by the client where possible. The process will vary depending on the client, but will generally consist of a formal procedure where the appropriate departments are notified of the intention for work to take place, lockout tags fitted, pumps shut down and penstocks, where fitted, are closed and isolated.

In addition to the above, where inspections are taking place in high flow pipelines a catch net may be utilised at the downstream manhole of an asset should the event arise where a member of the inspection team is swept away.

Man entry into confined spaces is carried out as per normal entry procedures.

The process of inspecting the pipe differs from remote CCTV inspections only in that the pipe is able to be more closely inspected using tools and sampling. The CCTV camera may differ in that it is able to record sound. The process of condition coding faults and service features does not change. Some asset owners however may use different coding protocol from that specified in the NZPIM in order to accommodate their requirements for more detailed analysis of faults, such as surface damage caused by H_2S attack.

Hazards

- Hygiene/Biological contamination.
- Dangerous atmosphere – unpredictable gas concentrations, particularly Hydrogen Sulphide (H_2S).
- Flooding.
- Drowning
- Falling during access/egress of manholes.
- Fast flows.
- Poor lighting during night work.

The following safety precautions are carried out for all confined entry personnel:

- Forced ventilation sufficient to reduce gas concentrations to safe levels.
- Approved and calibrated gas detection equipment to be used at all times.
- Gas levels to be continuously monitored while personnel are within a confined space.
- All personnel to evacuate confined space immediately any alarm is registered.
- All confined space entry personnel to carry oxy-box re-breather self rescue kits and air horn.
- All confined space entry personnel shall wear respiratory protection to the minimum standard, P2.
- Full BA sets will be available for use if required by rescue personnel at the entry manhole chamber.
- Harnesses attached to rescue tripod via a fall arrest system to be worn by all confined space entry personnel during manhole entry.
- Full dry suits to be worn by all confined space entry personnel.
- Torches are to be available for use as required.
- Stocked 1st aid kits are to be available on site.

Table 2- 11 - Header Codes

Field	Description	Default Code
Node Type	Sewer node	SND
	Sewer manhole	SMH
	Sewer pump station	SPS
	Sewer Miscellaneous	SMS
	Stormwater node	STND
	Stormwater Inlet	STI
	Stormwater manhole	STPS
	Stormwater Miscellaneous	STMS
Street Type Upstream/Downstream Manhole Street type	Avenue	AV
	Close	Cl
	Court	CRT
	Crescent	CR
	Drive	DV
	Highway	HW
	Lane	LN
	Parade	PDE
	Place	PL
	Road	RD
	Street	ST
	Terrace	TCE
	Way	WY
Material	Aluminium	AL
	Asbestos Cement	AC
	Brick	BK
	Cast Iron	CI
	Cement Lined Steel	CLS
	Concrete cast in situ	CIS
	Concrete pre cast	CP
	Concrete spun	CS

Field	Description	Default Code
	Earthenware	EW
	Polyethylene	PE
	Polyvinyl chloride	PVC
	Resin Impregnated Liner	RL
	Stainless Steel	SS
	Vitrified Clay	VC
	Other (state in comments)	XXX
Shape	Circular Pipe	CP
	Egg-Shaped	ES
	Oval-Shaped	OS
	Rectangular Box	RB
	Square Box	SB
	U-Shaped with a flat top	US
	Other (state in comments)	XX
Use	Abandoned	A
	Combined foul/stormwater	C
	Foul/sanitary sewer	F
	Overflow	O
	Stormwater	S
	Trade effluent/industrial	T
	Other	X
	Not Know	U
Inspection Status (Timing of Inspection)	Current Inspection	CI
	Superseded Inspection	SI
Inspection Status (Status of Pipe)	Original Condition	OC
	Rehabilitated Condition	RC
Inspection Status (Inspection Completion)	Inspection Complete	IC
	Uncompleted Inspection	UI

Field	Description	Default Code
Location	Council Park – Grassed	CP-G
	Council Park – Hardstand	CP-H
	Council Road – Berm	CR-B
	Council Road – Carriageway	CR-C
	Council Road – Footpath	CR-F
	Council Road – Hardstand	CR-H
	Private with easement	ESPR
	Other – Environmentally sensitive area	OT-E
	Other – Railway	OT-R
	Other – School Grounds	OT-S
	Other – Under Structure	OT-U
	Private Property – Driveway	PV-D
	Private Property – Hardstand	PV-H
	Private Property - Yard	PV-Y
Surface	Supported by bridge	BRIG
	Cobbles	COB
	Concrete	CONC
	Dense trees or shrubs	DNSE
	Exposed pipe i.e. no cover	EXPO
	Gardens	GARD
	Grass paddock	GRAS
	Hotmix	HMIX
	Mown Lawn	LAWN
	Metalled surface	MET
	Chip Seal	SEAL
	Tunnel	TUNN
	Other	XXXX

Field	Description	Default Code
Weather	Dry Weather	DRY
	Showery	SHOWER
	Light rain	LI-RAIN
	Heavy rain	HE-RAIN
	After rain	AF-RAIN

THE TOOLS

FIGURES

TABLES

3. THE TOOLS

3.1 What CCTV Camera Equipment Should Be Used

Overview of CCTV Cameras

One of the first recorded uses of a TV camera to survey a pipeline was in the 1950s when a very large camera was pushed through a sewer in a wheelbarrow to convince the drainage committee of a London Borough that the brick sewer needed urgent repairs. In 1958 a usable, though cumbersome, CCTV pipeline inspection system was developed in Germany.

Early cameras used cathode-ray tubes which were poorly suited to rough handling and aggressive environments. The equipment tended to be fragile and temperamental. This changed in the 1980s with advances in electronics and the introduction of solid-state CCD (charge-coupled device) camera modules. Today's cameras are much smaller, lighter and more reliable than their predecessors and high resolution colour has become a standard feature in all but the least expensive units. (Source ISTT-ASTT)

Cameras may have:

- Fixed, forward view heads.
- Heads which can pan and rotate to look directly at features within the pipe.
- Zoom lenses to give a close up view of features in large diameter pipelines.

Two types of cameras are standard. These are:

Pan and Tilt Camera for Inspecting Main Sewers

These cameras have heads that can pan and rotate to look directly at the pipe wall or up lateral connections. They may also have zoom lenses to give a close up view of the pipe wall. Lights are typically built into the head itself which point wherever the head is facing, although more powerful lights aligned along the axis of the pipe may also be used in addition to these lights for larger diameter pipes.

The camera is normally fitted to a self powered tractor or crawler which is controlled from the operator's console, in which case only single ended access is required. Cameras can also be mounted on skids and pulled through the pipeline by winch. This requires access from two points. This method can be appropriate for inspecting lines that are too steep for a tractor camera to traverse. Pan and tilt cameras can be supplied with tractor units to suit pipes from 100mm diameter upwards.

Figure 3- 1 - Pan & Tilt Camera

Push Rod Cameras

The camera is mounted at the front of a semi rigid cable that is rodded up the pipe from a single access point. The camera is normally fitted with a circular brush or skids to centralise it within the pipe. Lighting is typically provided by either a ring of halogen bulbs or LEDs (light emitting diode) mounted around the lens.

The quality of picture produced by push rod cameras can vary significantly depending on the make and model of camera used. There is often a trade off between the flexibility of the camera unit and picture quality. The better push rod cameras can provide picture quality that is as good as pan and tilt cameras.

Some push rod cameras will digitally orientate the image so that the top of the pipe is always shown at the top of the picture regardless of the orientation of the camera.

Push rod cameras can only record what is in front of the lens, i.e. they cannot pan or tilt. They are able to be installed in much smaller pipes than pan and tilt cameras, i.e. pipes down to 50mm diameter, and they are able to be pushed around some tight bends. They are usually able to traverse through earthenware gullies. Although installation through the newer PVC gullies with flat bases on the trap is not normally possible.

Figure 3- 2 - Pushrod Camera

3.2 Media Recording Technology

What media is used for recording CCTV inspections?

With the current rapid advances being made in electronic technology, the ability to capture and store information has become more efficient and effective. It is now commonplace for CCTV units to have a computer of some description on board to capture both data and visual images. The trend is also moving away from capturing moving footage on VHS and towards a digital format. The use of Digital Video Disk (DVD) recorders is increasing and some contractors are also capturing footage directly to the hard drive of their on board computer.

One Auckland Local Authority is now also transferring their DVD footage to their main computer server hard drives, so that this footage can be accessed from anywhere in the organisation via the network. Linking this footage to the GIS also produces efficiencies when it comes time to view the footage.

What is important when recording to any media?

The main point to consider is that the records need to be able to be retrieved in the future. Thus the following points need to be considered:

- Each video or DVD has to be marked with a unique reference number.
- The reference number of the video or DVD and the position on the video where the inspection starts needs to be shown on the logsheet.

What needs to be considered when recording onto DVDs?

With more clients specifying the delivery of footage on DVD, it is pertinent at this time to clarify some requirements when it comes to recording footage on this media.

- It is crucial that each asset inspection is recorded on a separate chapter. One of the defining differences between the VHS format and DVD is that an inspection is very easy to locate via the menu system on a DVD. If each inspection is itemised into a “chapter”, then this system is able to be used to its full potential.
- When formatting the menu page for each DVD, be sure to include relevant details to improve the information for the engineer. This should include information similar to that on the summary sheet of a VHS and usually consists of:
  - Asset Number.
  - Instruction/Order Number.
  - Upstream/Downstream manhole numbers.
  - Address.

What format should DVD information be supplied in?

It is recommended that DVD information be supplied in the following format:

- Encoded to WMV, MPEG1, or MPEG2 format (PAL standard, Capture Rate = 25 frames/sec and minimum Sample Rate = 1.2Mb/sec for WMV, minimum Sample Rate = 1.2 Mb/sec for MPEG1 or 3Mb/sec for MPEG2)

- Recorded on DVD dual layered discs.
- Readable on DVD-ROM drives using Windows Media Player software.
- Separate video file for each pipeline section inspection to the following naming convention:
  AAAAA BBBBBBB CCCCCC DDDD
  (underscore to separate each block of code).

Table 3- 1 - Naming Convention for Video Files Supplied on DVD

Code	Description	No. of Characters	Example
AAAAA	Principal's Contract Number	5	21055
BBBBBBB	Principal's Sewer Line Asset Number	7	2325348
CCCCC	Date of CCTV survey	6	150403 (ddmmyy)
DDDD	Stage and type of CCTV viewing	4	PR – pre PO – post CL – cleaning RT – root cleaning RH – rehabilitation EG. PORH = Post rehabilitation

3.3 Software to Collect CCTV Data and Images

Another area that has seen major improvements over recent years is the development of software to record CCTV inspections and to link the data collected with geographical information systems (GIS) and Asset Management Information Systems (AMIS).

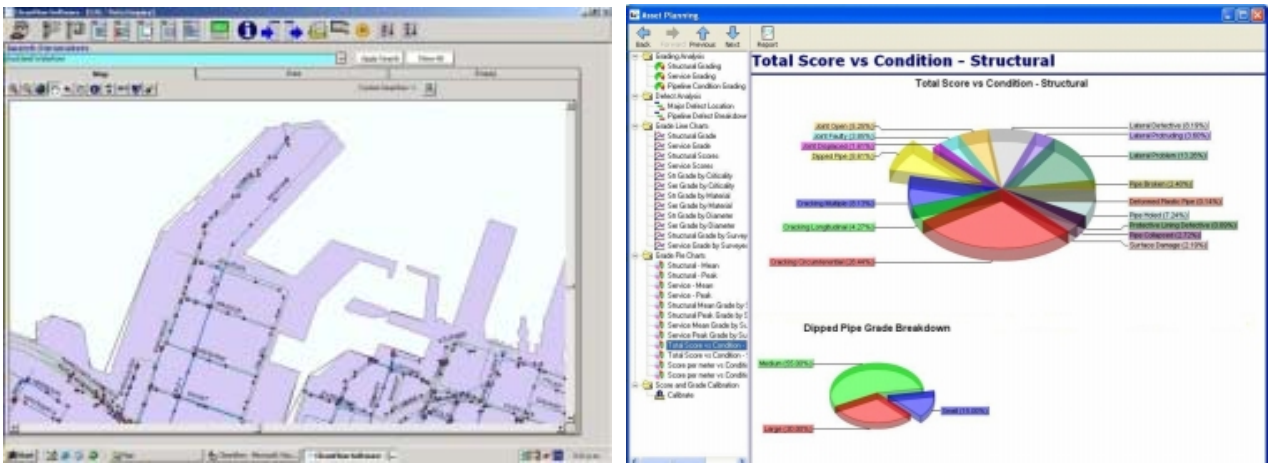
Some of the features that that are available include the ability:

- To populate logsheet header information directly from the Client's GIS system.
- To record details of defect and feature and prepare logsheets.
- To capture photographs.
- To link photographs and video records to entries in the logsheet.
- To identify discrepancies between the asset attribute information in the Client's GIS and the information collected during the CCTV inspection.
- They enable sorting and querying of records, e.g. all incomplete inspections or pipes with particular faults can be identified easily.

Some of the advantages of the use of this software include:

- Data retrieval is easier and quicker.
- Discrepancies between the existing data in GIS and AMS and the data captured during the CCTV inspection can be identified and the GIS and AMS can be updated.
- Management of the project is easier, e.g. it is easier to see which works have been completed and which works are outstanding.
- The ability to query data and show it graphically makes it easier to see trends.
- Data can be reported in different formats to suit different end users.

Figure 3- 3 – Displays From CCTV Software



Case Study – How Metrowater Uses Cleanflow to Manage Their CCTV Works

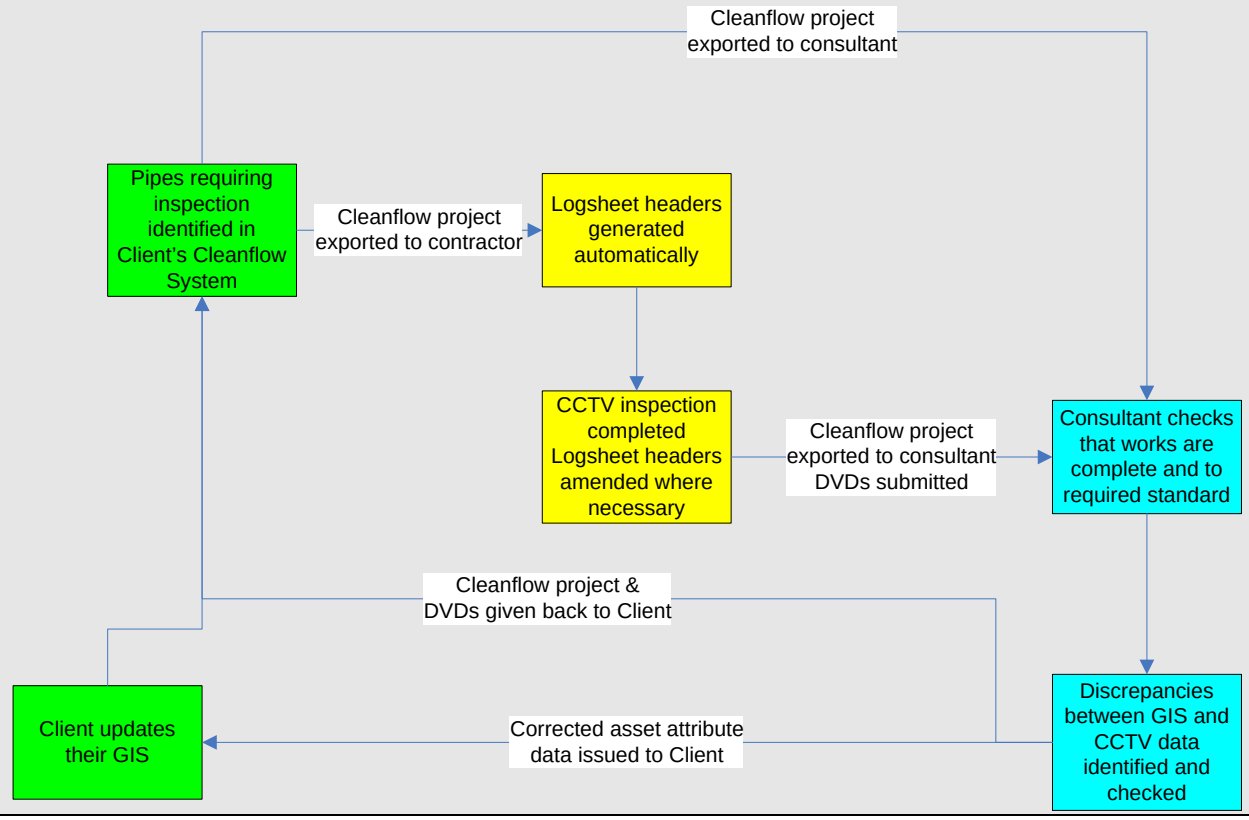
Metrowater use Cleanflow software to manage its CCTV works. The software contains a download from their GIS system showing the position and asset attribute information for all pipes and manholes. Metrowater identifies the pipes that need to be inspected and then issues a Cleanflow project to the contractor and consultant. The software automatically populates the logsheet headers with the existing information from the GIS system.

The contractor then completes the CCTV inspections and prepares logsheets, captures photographs and prepares sketches of any discrepancies noted in the field using the software. The software is also used by the consultant and contractor to track progress. On completion of the works the contractor exports the Cleanflow project to the consultant.

The consultant checks that the works are complete and to the required standard. The software is also used to identify any discrepancies between the existing GIS information and the information collected during the CCTV inspection. Examples of discrepancies may include different pipe sizes, pipe materials, pipe lengths being different, new manholes located or different connectivity. The consultant confirms which set of data is correct.

The consultant issues the Cleanflow project back to Metrowater, where the GIS system is updated and the Cleanflow file loaded back into the system. Users are then able to access the completed CCTV inspections and DVDs directly from their computers.

Figure 3- 4 – How Metrowater Use Cleanflow Software



3.4 What Other Tools Are Available?

Pipe Profiler

It often difficult with CCTV equipment to quantify the size of defects and it is not possible to make accurate measurements. The Clearline Profiler has been developed in New Zealand to overcome these problems.

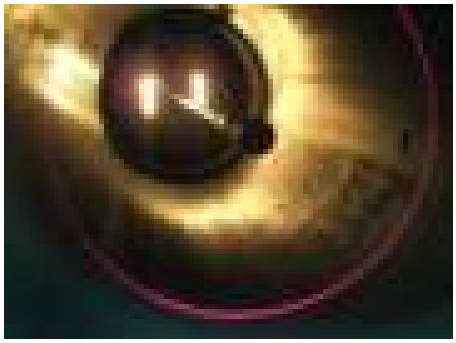
The profiler is mounted in front of a standard CCTV camera. It projects a ring of laser light onto the internal surface of the pipe as the camera travels down the pipe. Software is used to analyse the ring of light produced by the profiler and to produce a digital pipe profile. This enables measurements to be taken of

pipe size, laterals positions, water levels and pipe ovality. The profiler is able to operate in pipes from 150mm through to 1800mm.

Figure 3- 5 – Clearline Profiler

Profiler mounted on CCTV Camera

Laser Ring generated by profiler



Case Study – How Profiling Was Used to Identify Areas of Hydrogen Sulphide in Pipes at Tauranga City

Tauranga City Council were concerned that sections of the gravity sewer system downstream of discharges from rising mains were being subjected to corrosion from hydrogen sulphide. CCTV inspections had been carried out on parts of the pipe network. These inspections identified some areas of large severity surface damage, but these areas did not necessary coincide with areas adjacent to previous pipe failures.

Cores were taken from sections of pipe to identify the extent of corrosion and the CCTV information was then correlated against the core results. However it was only practical to take cores at isolated spots.

The Council then embarked on a programme of using the Clearline Profiler to measure cross-sectional area and diameter. They found that this approach more accurately determined the level of corrosion and removed the subjectivity of the previous CCTV surveys, particularly where core sample data was not available.

Cameras that Digitise Pipe Inspections

One of the latest developments that is starting to become available in New Zealand are cameras that take images of the pipe from multiple angles and produce a digital image of the pipe. One example is the Ibak Panoramo system.

With the digitised images produced by these cameras the user is able to control what they see. They are able, for example, to zoom in on defects or pan and tilt onto the features they wish to view. They are no longer reliant on the camera operator moving the camera head to show pipe features and defects. The digitised image can also be “unwrapped” and viewed in two dimensions. It is also possible to take accurate measurements of defects such as crack widths.

Figure 3- 6 - Panoramo Opto-Scanner

CCTV AND ASSET MANAGEMENT

TABLES

FIGURES

4. CCTV AND ASSET MANAGEMENT

4.1 Asset Management

The aim of asset management is to manage assets, such as sewer systems, in a way that provides the level of service required, in the most cost-effective manner, through the creation, operation, maintenance, renewal and disposal of assets to provide for existing and future customers.

CCTV inspections can help organisations gain an understanding of the existing condition of their piped assets. This understanding can then help assist organisations make decisions such as which pipelines are:

- Undersized and need to be upsized to meet future flows.
- In risk of collapse.
- In need of maintenance works such as root cutting.

The client is then able to prioritise works and a timetable and budget.

Condition Assessment and Performance Monitoring

CCTV inspections are a valuable tool for assessing the current condition and performance of pipe networks.

By conducting regular condition and performance monitoring, maintenance and/or rehabilitation strategies can be updated and/or refined and ultimately replacement programmes can be determined more accurately. If pipe failure is imminent the utility will at least have time to look at options other than replacement or in the event of failure be able to reduce some of the consequences.

Condition assessment also allows a utility to understand the remaining life of its pipe networks. This understanding can help the utility determine future expenditure patterns.

However, condition assessment needs to be justified economically by considering the costs of a programme and the benefits expected to be achieved. Any CCTV inspection programme needs to be developed with this in mind.

What condition assessment and performance monitoring can be undertaken with CCTV inspections?

CCTV inspections can be used to help with:

- Reactive maintenance e.g. locating the position and cause of pipe blockages.
- General condition surveys to determine the areas in pipe networks that require attention and to develop long-term programmes for replacement and maintenance of the network.
- Responsive maintenance, e.g. to identify and repair faults in pipes that have caused overflows or flooding.
- Determination of rehabilitation requirements, e.g. to determine which pipes need to be lined to prevent too much water entering into the system. This can result in the pipes not having enough capacity to cope with the flow, thus causing overflows.
- Quality checks on new works or after the rehabilitation of pipes.
- Build over approvals, e.g. inspections of pipes to determine whether buildings can be constructed above them.

If CCTV inspections are carried out correctly in accordance with the requirements of this manual then a CCTV inspection completed for one purpose, e.g. a build over approval, should be able to be used for any other purpose.

4.2 Developing a CCTV Programme

What can be determined from CCTV inspections?

CCTV can help determine the size, type and condition of pipe assets. What is more difficult is to determine which assets should be repaired. Obviously those pipes that have collapsed or are close to collapse should

be repaired, but it is likely that the CCTV inspection will identify a multitude of pipes that have defects, but are not in imminent danger of collapse.

Which of these pipes should be repaired? In many cases the defects may have been present since the pipe was laid.

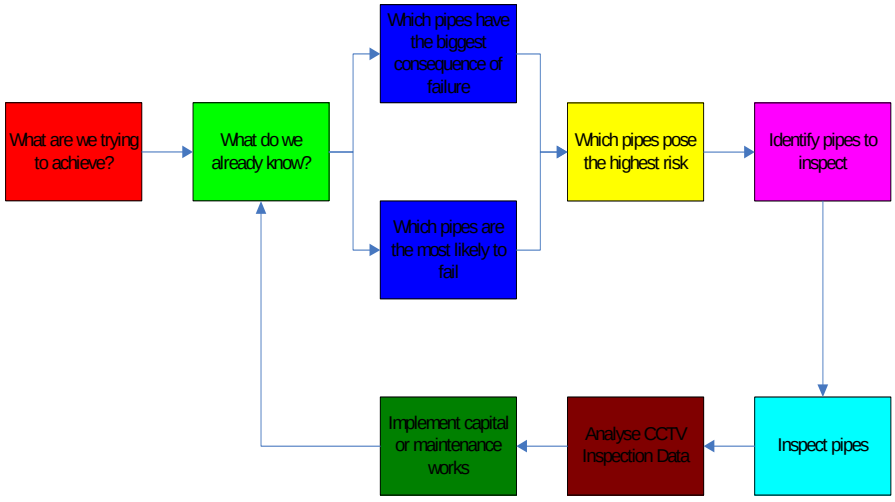
To determine which defects should be repaired and to prioritise this work the utility needs to have a clear understanding as to:

- What is it they are trying to achieve, e.g. are they trying to reduce the risk of blockages or are they more concerned about pipe collapses damaging structures above the pipes?
- What are the consequences of the pipe collapsing or blocking, e.g. will any overflow be localised or could it contaminate a waterway?
- What is the likelihood of the defect worsening?

How to Develop a CCTV Programme

The generic process for developing a CCTV Programme is outlined in Figure 4- 1.

Figure 4- 1 - Generic Process to Develop a CCTV Programme



The generic process involves:

- Determining the objectives of the programme. What is it that we are trying to achieve, e.g.
  - Obtain an understanding of the general condition of pipes.
  - Identify the condition of specific assets.
  - Specify rehabilitation works.
- What do we already know, e.g.
  - What CCTV inspections have already been carried out?
  - What is the maintenance history for the area, e.g. locations of blockages, silting and overflows?
- Which pipes have the biggest consequence of failure, e.g.
  - Which pipes are under buildings or busy roads?
  - Which pipes are deep and therefore difficult to repair?
  - Which pipes may overflow into watercourses if they were to block.
- Which pipes are the most likely to fail, e.g.
  - Pipes with previous history of failure.
  - Older pipes or pipes of particular materials that are more prone to failure.
  - Pipes in unstable ground.
  - Pipes that are subject to trade waste discharges.
- Identify the pipes with the greatest risk of failure, i.e. consequence of failure multiplied by the likelihood of failure.
- Identify the pipes to inspect. This would normally be as many as possible of the pipes with the highest risk of failure that could be inspected given budget and time constraints.

The pipes are then inspected, the inspection data analysed and capital works and maintenance works identified and implemented. The information collected and the work undertaken is then fed back into the development of future CCTV programmes.

Case Study – CCTV Inspection of Critical Sewers by Metrowater

Metrowater owns and operates the reticulated wastewater system in Auckland City (excluding the trunk wastewater system owned by Watercare Services), which covers an area of 153 square kilometres. As it is not practical or cost effective to inspect the entire network on a regular basis Metrowater has adopted a risk-based approach.

Each pipe in the network is allocated a criticality ranging from A (most critical) to E (not critical). Criticality is assigned depending on a range of factors including the effect of an overflow on the environment, the potential damage caused by failure to other structures in close proximity, the interruption to other activities (traffic and pedestrians) and the interruption to other services that an open-trench repair might cause.

The critical A, B & C sewers, representing approximately 20% of the network, are inspected on a cyclical basis. Each CCTV inspection is reviewed and a decision made on whether maintenance or rehabilitation is required. Typically, approximately 15% of pipes will be recommended for remedial action, ranging from complete replacement/relining, to spot repairs or maintenance.

What other factors need to be considered when designing a CCTV programme?

It needs to be remembered that the CCTV inspection will only provide a picture of the pipe wall as it is seen by the camera. Therefore consideration needs to be given to:

- Cleaning of the pipe prior to CCTV inspection. Cleaning will enable defects in the pipe to be seen, but cleaning can be costly and can cause collapse of the pipe if it is in very poor condition. Recommendations as to which pipes should be cleaned prior to CCTV inspection are given in Section 2, Good Practice.
- Removal of water. Water flowing in the pipe can obscure the view of the invert of the pipe. Typically flows up to 25% of the bore of the pipe are accepted, except if there is particular interest in the condition of the invert of the pipe, e.g. dry pipe inspections are often specified immediately prior to rehabilitation by lining to check that all debris has been removed.
- CCTV inspections do not provide information on the condition of the pipe wall or the material around the pipe. If this is of interest then other techniques, such as ultrasonic testing, may be required.
- It is difficult to accurately measure the size of the defects and features observed. If this is important, e.g. the ovality of a pipe needs to be accurately determined in order to design a liner that is to be installed within the pipe, other techniques such as profiling should be considered.

Case Study – Rodney District Council Wanted to Know the General Condition of Their Piped Assets

Rodney District Council wanted to know the general condition of the pipes in their wastewater and stormwater network. They also wanted to ascertain the general accuracy of the current information asset information in their GIS system.

5km of stormwater and 10km of wastewater pipes were selected at random for CCTV inspection. Adjacent manholes were also inspected. Stormwater pipes were not cleaned before inspection so that maintenance issues such as silting could be identified. Wastewater pipes were given a light clean prior to CCTV inspection to aid the identification of structural faults.

CCTV inspections were captured on DVD. Logsheets were prepared using Cleanflow software. Consulting engineers were engaged to administer the works. They audited 10% of the CCTV inspections and checked the accuracy of any other inspections that indicated that the existing asset information in the GIS system was incorrect.

The project identified some stormwater pipes that were in need of de-silting and a few wastewater pipes that need repair in the medium term. It also highlighted that pipes in one or two areas were in worse condition than others. These areas will be the subject of more detailed investigations.

4.3 Analysis of CCTV Information

The purpose of any CCTV programme is to evaluate the current condition of the pipes being inspected and to identify whether any capital improvements or maintenance works are required to be undertaken. To do this CCTV inspections must be carefully analysed by experienced engineers.

The level and type of analysis that should be completed will depend on the purpose of the CCTV programme. Some examples are given in Table 4- 1.

Table 4- 1 – Analysis of CCTV Information

Purpose of CCTV Programme	Recommended Analysis	Comments
To identify the general condition of the network for long-term planning.	• Carry out structural scoring analysis and determine general condition of pipe network. • Identify any pipes that may need immediate attention and review CCTV inspection in detail. • Estimate remaining life of pipe network. • Determine long-term asset management strategies and budgets.	Pipes that may need immediate attention and require the CCTV inspection to be reviewed in detail may include: • Peak Scores greater than 50. • Pipes with high mean scores greater than 3. • Pipes with Pipe Collapsed (PX) defects. • Pipes with Tomo (TM) defects.

Purpose of CCTV Programme	Recommended Analysis	Comments
To identify the condition of critical assets.	• All CCTV inspections should be viewed by an experienced engineer. • The need for maintenance or capital works should be identified and scheduled.	The criteria for repairing pipes will depend on the budget available and the amount of risk that the utility is prepared to accept. In assessing pipes for repair the engineer needs to consider: • The consequence of failure. • Whether the defects are likely to deteriorate further.
To identify the type of rehabilitation that needs be carried out to reduce infiltration and inflow into the pipe network.	• All CCTV inspections should be viewed by an experienced engineer. • The type of rehabilitation required should be determined and scheduled.	Areas that require rehabilitation to reduce infiltration should be identified through sewer gauging and modelling. Areas of infiltration can not normally be identified from CCTV inspections.

Case Study – CCTV Investigations by North Shore City Council to Determine Rehabilitation Requirements

North Shore City Council is in the process of implementing their ProjectCARE program to improve beach water quality. A strategic study involving gauging and computer modelling of wastewater flows has been completed. This study has recommended catchments to be rehabilitated to reduce inflow and infiltration into the wastewater network. Catchments are then broken up into mini-catchments of about 200 properties and the leakiest mini-catchments are selected for rehabilitation.

In order to determine what sort of rehabilitation should be undertaken the entire public wastewater network within the mini-catchment are inspected by CCTV inspection. The status of all laterals is identified by dye testing; manholes are inspected and hydrostatically tested and smoke testing is carried out. Private property drainage is also inspected.

The entire public network within a mini-catchment will be rehabilitated, unless the pipework is very unlikely to be leaking, e.g. if it is PVC or PE pipework shown to be in good condition. The rehabilitation specified will typically be lining, either by CIPP or spiral wound liners. Pipe bursting and replacement by opencut excavation is also specified, but to a lesser extent.

Notices to remedy defective drainage are sent to property owners who have sewers that can leak or permit direct inflow of water into the private wastewater pipes.

4.4 Scoring Analysis

The scoring analysis method has been used for some time throughout New Zealand to evaluate the general conditions of pipelines following the completion of CCTV inspections.

The process involves assigning weighted scores to various defects and severity ratings on the basis of their influence on the structural integrity and serviceability of the pipeline. Mean and peak scores for pipelines are then calculated and compared against grading thresholds to provide a general indication of the condition of the pipe.

The scoring analysis has been designed to provide;

- An assessment on the overall state of the asset for reporting and future budgeting requirements.
- A trigger to indicate possible problem areas for further intensive study.
- An indication of any changes in sewer management that may be required, such as the development of a rehabilitation programme.

The system is not designed however for determining which individual pipes need repair or maintenance. This can only be done by an experienced engineer reviewing the CCTV inspection.

Structural Condition Assessment

The defects included in the evaluation of the structural condition have been selected in accordance with the following criteria;

- Defects likely to reduce life expectancy.
- Defects likely to lead to catastrophic failure.
- Defects, such as protruding laterals and infiltration, which require structural rehabilitation to maintain performance standards requirements.

The condition rating is generated from the number and severity of defects for each pipeline. Severity scores have been allocated in accordance with the general principles outlined in Table 4- 2.

Table 4- 2 – Basis of Severity Scores

Severity Code	Severity Score
S	Defects which should cause no problem in the foreseeable future and/or could have the potential for deterioration in the long-term (10 years plus). Generally scoring fewer than 10 points.
M	Defects for which there is a minimal short-term failure risk, but potential for failure in the long term (10 years). They may need attention, but not urgently. They generally score between 10 and 25 points.
L	Defects for which there is immediate or short-term risk of pipe failure or severe loss of service. They generally score 30 points or more.

Roots in pipelines are a sign of structural deterioration, as well as causing service issues. However roots are not normally allocated a structural condition score. As a defect that has roots growing through it will be allocated a “large” severity, as the roots are evidence that the defect extends through to the outside wall of the pipe. As a result the defect with the roots will be assigned a relatively high structural condition score.

The weighted scores that have been allocated to the various structural defects and severities are given in Table 4-3.

Table 4- 3 – Structural Condition Scores

Code	Description	Condition Rating Score		
		S	M	L
CC	Crack circumferential	2	15	30
CL	Crack longitudinal	3	15	30
CM	Crack multiple	10	20	40
DF	Deformed pipe	Not Used	25	65
DP	Dipped pipe	10	15	35
IP	Infiltration at pipe wall	2	15	30
JD	Joint displaced	0	15	45
JF	Joint faulty	1	10	25
JO	Joint open	0	5	25
LF	Lateral sealing defective	5	10	25
LP	Lateral protruding	0	15	25
LX	Lateral problem	5	20	30
OP	Obstruction permanent	10	20	35
PB	Pipe broken	15	30	75
PF	Deformed plastic pipe	5	10	30
PH	Pipe holed	5	25	40
PL	Protective lining defective	5	25	60
PX	Pipe collapsed	N/A	N/A	100
SD	Surface damage	3	20	60
TM	Tomo	N/A	N/A	40

Service Condition

The maintenance status of a pipeline may be monitored with a service condition rating. It provides a guide to the future levels of maintenance required for the pipeline, but does not indicate the type of maintenance required. The service condition is calculated similarly to that for structural condition.

Only those defects that can be remedied by non-structural maintenance works are included in the service condition evaluation. They generally impair the capacity of the system to accept design flows and will require regular attention, unless rehabilitation works to mitigate them are carried out.

The weighted scores that have been allocated to the various service defects and severities are given in Table 4- 4.

Table 4- 4 – Service Condition Scores

Code	Description	Condition Rating Score		
		S	M	L
DE	Debris silty	8	20	40
DG	Debris greasy	8	20	40
ED	Encrustation deposit	0	5	20
OT	Obstruction Temporary	0	5	20
RI	Root intrusion	5	25	70

What Gradings Have Been Altered

The scores that have been changed in the 3rd Edition of the Manual are shown in the following table. The scores allocated in the 2nd Edition of the Manual are shown in brackets.

Structural Condition Codes

Code	Description	Condition Rating Score		
		S	M	L
CM	Crack multiple	10 (8)		40 (30)
DF	Deformed Pipe		25 (15)	
DP	Dipped pipe	10 (2)	15 (10)	35 (25)
JD	Joint displaced		15 (10)	45 (30)
LF	Lateral defective		10 (25)	25 (60)
LP	Lateral protruding	0 (2)		25 (70)
LX	Lateral problem			30 (40)
OP	Obstruction permanent	10 (2)	20 (15)	35 (70)
PB	Pipe broken	15 (10)	30 (25)	75 (40)
PH	Pipe holed			40 (50)
TM	Tomo (New Code)	N/A	N/A	40

Service Condition Codes

Code	Description	Condition Rating Score		
		S	M	L
DE	Debris silty		20 (25)	40 (70)
DG	Debris greasy		20 (25)	40 (70)
ED	Encrustation Deposit	0 (2)	5 (15)	20 (70)
OT	Obstruction Temporary		5 (0)	20 (0)

Condition Grading

Grading calculations: Peak Score

The Peak Score reflects the magnitude of the worst defects in each pipeline. The Peak Score is the maximum defect score for any one metre length of pipe within a pipeline. Where more than one defect occurs within a one metre length the scores are aggregated.

Gradings: Mean Score

The Mean Score reflects the overall condition of a pipeline, but does not identify the type of physical works required on it. The Mean Score is the average of the defect scores per metre of pipeline, in each individual pipeline.

$$\text{Mean Score} = \frac{\text{Sum of individual defect scores}}{\text{Pipeline length}}$$

Grading Report Generation

Grading distributions are calculated by expressing the total number of pipelines in each grading step as a percentage of the total number of pipelines being assessed. The shape of a grading distribution curve (i.e. a graph showing all available gradings plotted against the numbers of pipelines falling within those gradings) will indicate the general condition of the pipelines.

Grading Thresholds

Structural Condition Grading Thresholds are provided in Table 4- 5. Service Condition Grading Thresholds are given in Table 4- 6.

Table 4- 5 – Structural Condition Grading Thresholds

Grading		Peak Score		Mean Score	
		Initial	Intermediate	Initial	Intermediate
1.0	Excellent	0 to 2.0	0 to 2.0	0 to 0.50	0 to 0.50
2.0	Good	2.1 to 15.0	2.1 to 15.0	0.51 to 0.90	0.51 to 0.90
3.0	Moderate	15.1 to 30.0	15.1 to 20.0	0.91 to 1.70	0.91 to 1.18
3.4			20.1 to 25.0		1.19 to 1.44
3.8			25.1 to 30.0		1.45 to 1.70
4.0	Poor	30.1 to 50.0	30.1 to 34.0	1.71 to 3.00	1.71 to 1.97
4.2			34.1 to 38.0		1.98 to 2.23
4.4			38.1 to 42.0		2.24 to 2.49
4.6			42.1 to 46.0		2.50 to 2.74
4.8			46.1 to 50.0		2.76 to 3.00
5.0	Fail	> 50.0	50.1 t0 60.0	> 3.00	3.01 to 30.0
5.2			60.1 to 70.0		30.1 to 60.0
5.4			70.1 to 80.0		60.1 to 90.0
5.6			80.1 to 90.0		90.1 to 110.0
5.8			> 90.0		> 110.0

Table 4- 6 - Service Condition Grading Thresholds

Grading		Peak Score		Mean Score	
		Initial	Intermediate	Initial	Intermediate
1.0	Excellent	0 to 3.0	0 to 3.0	0 to 0.50	0 to 0.50
2.0	Good	3.1 to 7.0	3.1 to 7.0	0.51 to 1.0	0.51 to 1.0
3.0	Moderate	71. to 15.0	7.1 to 10.3	1.1 to 2.0	1.10 to 1.40
3.4			10.4 to 13.5		1.41 to 1.80
3.8			13.6 to 15.0		1.81 to 2.00
4.0	Poor	15.1 to 30.0	15.1 to 18.0	2.1 to 5.00	2.10 to 2.60
4.2			18.1 to 21.0		2.61 to 3.20
4.4			21.1 to 24.0		3.21 to 3.80
4.6			24.1 to 27.0		3.81 to 4.40
4.8			27.1 to 30.0		4.41 to 5.00
5.0	Fail	>30.0	30.1 to 40.0	>5.00	5.01 to 5.60
5.2			40.1 to 50.0		5.61 to 6.20
5.4			50.1 to 60.0		6.21 to 6.80
5.6			60.1 to 70.0		6.81 to7.40
5.8			>70.0		>7.40

Case Study – Can CCTV Inspections Be Used to Identify Leakage Into Wastewater Pipes?

CCTV inspections are not normally recommended for the identification of leakage into wastewater systems. A joint that looks good on a CCTV inspection may in fact be leaking. Conversely a joint that looks like it may leak may have been repaired on the outside of the pipe and not leak.

North Shore City Council was hydrostatically testing private wastewater pipes (typically 100mm diameter) to identify pipes that allowed leakage into the system. CCTV inspections were then undertaken on those that failed. However property owners found that the hydrostatic tests were hard to understand and they were not sure which sections of pipe required repair. The Council therefore decided to move away from hydrostatic tests and rely solely on CCTV inspections for determining whether pipes were acceptable or not. They developed a grading system as shown in the table below. Property owners are required to repair drains with peak scores above 15 or a mean scores above 0.5.

The Council trialled this system and found that it gave similar results to hydrostatic testing.

Code	Description	Condition Rating Score		
		S	M	L
CC	Crack circumferential	8	15	30
CL	Crack longitudinal	8	15	30
CM	Crack multiple	8	15	30
DF	Deformed pipe	10	15	40
DP	Dipped pipe	2	10	25
IP	Infiltration at pipe wall	15	20	40
JD	Joint displaced	10	15	30
JF	Joint faulty	10	15	30
JO	Joint open	10	15	30
LF	Lateral defective	10	25	50
LP	Lateral protruding	2	15	70
LX	Lateral problem	15	20	40
OP	Obstruction permanent	2	10	30
PB	Pipe broken	15	25	40
PF	Deformed plastic pipe	5	10	30
PH	Pipe holed	15	25	50
PL	Protective lining defective	5	25	60
PX	Pipe collapsed	N/A	N/A	100
SD	Surface damage	3	20	60
RI	Root intrusion	12	25	50

Differences between the standard Structural Condition Scores and those adopted by North Shore City Council are shown in red.

STANDARD DOCUMENTS

Standard Documents

1.0 INTRODUCTION

This section provides standard documentation for preparing CCTV inspection Contracts. The following sections are included:

Particular Specification – provides a schedule that specifiers should complete to outline the scope of works and other items that are specific to the particular contract being prepared.

General Specification – provides a standard specification for CCTV inspections.

Basis of Payment – this section provides details of items of work are covered by each item in the Schedule of Prices.

Schedule of Prices - provides a schedule that specifiers should complete to detail the quantity of each type to be completed. Tenderers should then fill out the Schedule of Prices showing their rates and the total amount for completing the Contract.

2.0 PARTICULAR SPECIFICATION

Purpose of Contract

The purpose of this contract is to:

(Complete outlining the purpose of the contract)

Scope of Works

The scope of this contract involves:

- CCTV inspection.
- Manhole inspections.
- Confirming whether laterals are live or dead, by dye testing.
- Confirming the source of all laterals.
- Locating the position of buried manholes.
- Locating major defects requiring immediate repair.
- Reporting the position of manholes that are incorrectly positioned on the Clients plans.

(Delete the items that do not apply)

The pipelines to be inspected are:

- Shown on the attached plans.
- Listed on the attached schedules.
- Other *(provide details).*

(Delete the items that do not apply)

The works to be carried out are located in:

- Public roads.
- Private land.
- Council reserves.
- Other *(provide details).*

(Delete the items that do not apply)

Issues that the CCTV contractor needs to be aware of include:
(Provide details on the location, flow conditions and the Client's requirements if any of the following may impact upon the works)

- Pump Stations.
- Heavy Flows.
- Pipes that are known to contain debris.
- Traffic.
- Access.
- Hot water discharges.
- Aggressive industrial discharges.

The following applies regarding the location and access to manholes:

- The Client has located and opened all manholes prior to the start of the CCTV contract starting.
- The contractor is required to confirm the location of all manholes.
- The Client has located and opened all manholes, with the following exceptions which the contractor is required to locate.

(Delete the items that do not apply)

When buried manholes are located the contractor is required to:

- Mark the position of the manhole on the ground surface. The manhole will be raised by Others.
- Mark the position of the manhole on the ground surface. The Engineer may then instruct the contractor to raise the manhole.

(Delete the items that do not apply)

Health & Safety Hazards

- Access and egress.
- Biological substances.
- Environmental conditions (hot, cold).
- Contact and contamination with sewage or other harmful substances.
- Dogs.
- Driving, parking, reversing and towing vehicles.
- Electrical and power tools.
- Exposure to sunshine, stings, bites and infectious environment.
- Eye strain from CCTV viewing.
- Flooding and overflow.
- Gas, fumes and foul air.
- Handling fuels and chemicals.
- High pressure water cleaning.
- Loading objects on to vehicles.
- Lifting heavy objects.
- Noise exposure.
- Public Safety – pedestrians.
- Public Safety – traffic controls.
- Restricted access.
- Safety around plant and machinery.
- Traffic hazards – working on the road.
- Uneven and slippery surfaces.
- Waste disposal/management
- Working at heights or above deep holes (e.g. manholes).
- Working at pipe inlets 450mm diameter and larger.
- Working downstream of a sewer discharge.
- Working in confined spaces.
- Working in the dark.

(Add or delete items from the above list to show all hazards known by the Client)

Cleaning and Root Removal

Prior to the CCTV inspections being undertaken pipes are to be:

- Fully cleaned to remove all foreign matter, including all roots. This may involve several passes or the use of several different techniques to ensure that all debris is removed.
- Fully cleaned to remove all foreign matter. This may involve several passes or the use of several different techniques to ensure that all debris is removed. Only those roots that impede the passage of the CCTV camera are required to be removed.
- Light cleaning. If after light cleaning deposits or roots still remain in the pipe that stop the CCTV camera, then the inspection is to be attempted from the other manhole. If the full length of the pipeline cannot be inspected then the contractor is to notify the Engineer. The Engineer may instruct further cleaning of the pipeline, root removal or abandonment of the inspection.
- No cleaning is required to be completed prior to the CCTV inspection. If there is debris or roots within the pipeline that stops the inspection, then the inspection is to be attempted from the other manhole. If the full length of the pipeline cannot be inspected then the contractor is to notify the Engineer. The Engineer may instruct cleaning of the pipeline, root removal or abandonment of the inspection.

(Delete the items that do not apply)

Slope Correction

Slope corrections are:

- Not required.
- Are to be made in the following manner *(specify method to be used).*

(Delete the items that do not apply)

Maximum Depth of Water Flow

The maximum depth of water flow permitted during the inspection is:

- No water is permitted to be in the pipe during the CCTV inspection, i.e. the pipe is to be dry.
- The depth of water is not to exceed 25% of the pipe diameter.
- Other *(Specify maximum water depth).*

(Delete the items that do not apply)

Still Images

Still images of the following are to be captured:

- All severity “L” defects.
- All severity “L” & “M” defects.
- Every 20m along the pipeline.

(Delete the items that do not apply)

Optional Codes

Joint Displaced, Small severity (JD,S) and Joint Open, Small severity (JO,S) defects are:

- Not required to be recorded.
- Are required to be recorded.

(Delete the items that do not apply)

Maj or Defects Requiring Immediate Attention

If the Contractor identifies any of the following defects they are to immediately notify the Client:

- Pipe Broken (L severity).
- Pipe Collapsed (L severity).
- Deformed Pipe (L severity).
- Tomo (L severity).
- Any defects where it is evident that tomos are forming outside the pipe.
- Other *(Provide details).*

(Delete the items that do not apply)

Q uality Assurance

The Client shall undertake ongoing auditing of the works at the following frequency:

- 5%.
- Other *(Define frequency).*

Deliverables

The contractor is required to provide the following deliverables:

Logsheets (*Include number of copies*) in the following format:

- Computer generated.
- Handwritten.

(Delete the items that do not apply)

CCTV inspections (*Include number of copies*) in the following medium:

- Video tapes.
- DVD.
- Hard drive.

(Delete the items that do not apply)

The CCTV inspection media that is supplied is to be labelled in accordance with the following numbering system:
(Specify numbering system)

Electronic Data in the following format:

- Cleanflow.
- PIRAT.
- Hansen.
- Other *(Specify).*

(Delete the items that do not apply)

Still images (*Include number of copies*) in the following format:

- Hard copies.
- Electronic snapshots.
- Are not required.

(Delete the items that do not apply)

CCTV Summary Sheets (*Include number of copies*) in the following format:

- Hard copies.
- Electronic snapshots.
- Are not required.

(Delete the items that do not apply)

Marked-Up Drawings of manholes and pipelines incorrectly shown on the Client's plans:

- Hard copies.
- Electronic snapshots.
- Are not required.

(Delete the items that do not apply)

Schematic diagrams showing the locations of features and defects along the pipeline:

- Hard copies.
- Electronic snapshots.
- Are not required.

(Delete the items that do not apply)

Header Information Required

The following header information is required to be provided in addition to the mandatory fields specified in the General Specification (descriptions of these items are included in Section 2 of the Manual):

- Inspection No.
- Client.
- Contractor.
- Drawing No.
- Date of Data Entry.
- Upstream/Downstream Asset Type.
- Upstream/Downstream Manhole Type.
- Street.
- Street Type.
- Upstream/Downstream Manhole Street No.
- Upstream/Downstream Manhole Street Name.
- Upstream/Downstream Manhole Street Type.

- Shape.
- Use.
- Date Completed.
- Time Completed.
- Video Recorder Run-time Finish.
- Video Record Format.
- Location.
- Surface.
- Weather.
- Flow Depth.
- Comments.
- Additional Information *(Client to specify).*

(Delete the items that do not apply)

3.0 GENERAL SPECIFICATION – CCTV INSPECTION

1 GENERAL

1.1 Basis for Specification

The contract shall be carried out in accordance with the provisions of the New Zealand Pipe Inspection Manual, 3rd Edition (hereafter referred to as the Manual) and the Particular Specification. The order of precedence shall be:

- Particular Specification
- General Specification
- The Manual

1.2 Scope of Works

The scope of works is defined in the Particular Specification.

Payment will be made on receipt of all required deliverables, only for pipeline sections for which there is a clear picture of the full length of the section, and for which an accurate assessment of pipeline has been recorded.

Where the Contractor is unable to complete an inspection on a pipeline section due to circumstances beyond the control of the Contractor, the Engineer may approve payment for any work completed on that pipeline section.

1.3 Manhole Access

The requirements for locating manholes are defined in the Particular Specification.

Where a manhole cannot be located by surface visual inspection, the Contractor shall either find the manhole or to prove that the manhole does not exist by carrying out a CCTV from the manholes upstream and/or downstream of the manhole in question.

Buried manholes located by the above means shall have their location marked on the ground, either with a peg, spike or paint. Where a node is in private property, the owner shall be consulted with regard to an acceptable way of marking the node location. In addition a sketch of the manhole location shall be provided.

If it is confirmed that the manhole does not exist a location sketch shall be provided, showing the new layout.

Where the actual position of a manhole or the pipe arrangement differs from that shown on the Client's asset plans then plans shall be prepared showing correct position of the manhole and/or pipe arrangement. Plans shall be prepared in the following cases:

- Where a manhole position has been recorded on the asset plans more than 2.0m from where its actual position should be recorded.
- Where a manhole position is closer than 2.0m to its actual position but is shown on the wrong side of a boundary.
- Where an inlet or outlet pipe has been recorded on the asset plans as connected to the wrong upstream or downstream manhole or node.

Sketch plan location measurements shall have an accuracy of ± 0.3m. Measurements shall be made from permanent features such as buildings, existing manholes, site boundaries or outside kerb face. Offset measurements are preferred, but intersecting arc measurements may also be made, with a minimum of two measurements in each case, being made as close as possible perpendicular to each other. A total of three measurements shall be made to the manhole cover.

The location sketch shall clearly indicate the address of the property in which the manhole is located, or the nearest adjacent property where the manhole is located in the road reserve or a park. At least one adjacent property should also be identified to facilitate later manhole location by other personnel.

1.4 Pump Stations

Details of pump stations that may impact upon the CCTV works are given in the Particular Specification.

Where there are pump stations upstream of the inspections, the Contractor shall make due allowances for bypass pumping, or coordinating the management of pump stations during the inspections with the pump station operator.

2 PIPELINE CLEANING

2.1 General

The requirements for cleaning prior to carrying out the CCTV inspection are given in the Particular Specification.

The Contractor, when using cleaning equipment or undertaking any of the associated cleaning activities, must take all necessary precautions to ensure that these activities do not:

- Damage or flood public property.
- Cause sewer overflows.
- Damage the sewer conduit being cleaned or any associated conduits or structures.

Cleaning shall generally be carried out from a downstream manhole, in a downstream direction. Upstream cleaning shall only be carried out with the prior written approval of the Engineer, in which case special requirements may include:

- On-site meetings with every property owner connected to the line and written confirmation that the property owners have been advised of the precautions required, such as sealing toilet seats down.
- Water removal upstream of the cleaning nozzle during cleaning.
- A visual check of all gully traps on completion of cleaning.

CCTV inspections shall be carried out within seven days of cleaning (when cleaning has been specified). Any build up of debris occurring between cleaning and inspection shall be attended to as necessary for a satisfactory picture quality but shall not be considered for additional payment.

On the day prior to cleaning, the Contractor shall notify all residents connected to the sewer lines to be cleaned, of the work being carried out. Householders shall be provided with appropriate instructions to minimise and contain blow-back of the water seal. Where such blow-back occurs, the Contractor shall be responsible for cleaning up, including disinfecting the property to the satisfaction of the owner/s.

2.2 Pipes That Require to be Fully Cleaned Prior to CCTV Inspection

Where the pipe is specified as requiring to be fully cleaned prior to the CCTV inspection this shall mean the removal of all foreign matter, including but not limited to silt, sludge, encrustation grease, debris and scale. The level of root removal required is specified in the Particular Specification.

The cleaning work shall include manholes, dead end pipes and any other structure encountered in the sewer system. Cleaning of manholes shall include benches, and walls to the soffit level of the highest pipe connection to the manhole.

The Contractor is responsible for selecting the most appropriate method for ensuring that pipes are fully cleaned. This may involve hydraulic jetting, rodding, dredging or any other suitable method.

2.3 Light Cleaning

Light cleaning is defined as that that will remove spider webs, slime, light debris in the invert and light deposits of fat. Typically this will be achieved with cleaning equipment that delivers a pressure of 140 bar (2000 psi) and volume rating of 170 l/min (40 gpm). Several passes may be required.

2.4 Cleaning Structurally Suspect Pipes

Where a pipeline is in poor condition and it is considered by the Contractor that cleaning will cause further damage, the Contractor is to notify the Engineer and seek further direction.

Similarly if the Contractor suspects that the pipe is being damaged during cleaning (e.g. pieces of earthenware pipe are observed in the debris trap), cleaning shall cease immediately and the Engineer notified.

In such cases payment adjustments shall be a matter for negotiation between the Engineer and the Contractor.

2.5 De-scaling

The Contractor, where necessary shall de-scale and remove scales from the pipeline so as to restore a minimum of 95% of the pipe cross-sectional area. Details of the equipment to be used for de-scaling shall be submitted to the Engineer for review prior to commencement of the works. The work shall be carried out with care so that pipelines are not damaged.

2.6 Removal and disposal of Materials

All sludge, silt, debris, grease, roots, scales and other materials resulting from cleaning operations shall be collected at the manhole immediately downstream of the section being cleaned. Passing material from manhole section to another manhole section shall not be permitted.

The Contractor shall be responsible for removal and disposal of the material dislodged from the operations such as cleaning, root removal, dredging, de-scaling etc. All disposable materials shall be removed from the site at the end of each work day and shall not be allowed to accumulate, except in totally enclosed containers.

3 CCTV INSPECTION

3.1 Inspection Equipment

Inspection equipment shall be capable of providing a picture quality suitable for the purpose of the pipeline inspection and shall meet acceptable industrial standards for this type of equipment.

The Contractor shall use pan and tilt colour CCTV equipment or other suitable equipment which is capable of looking up lateral connections, except that in pipelines less than 150mm diameter a fixed head colour camera may be used.

The inspection equipment shall be sufficient to enable a single pass inspection of a minimum 100m length of pipeline.

3.2 Direction of Camera Travel

Pipelines should wherever possible be inspected from the upstream manhole heading downstream. Examples of cases where this may not be possible or pipeline may need to be inspected from both ends are given in Section 2 of the Manual.

3.3 Start and finish of inspection

All inspections shall start with a clear view of the entry to the pipeline at the manhole wall, and end with the camera at the centre of the finish manhole.

3.4 Camera Speed

Camera speed shall be within the following travel speeds:

0.05 to 0.10 m/sec (3.0 to 6.0 m/min) for diameters up to 200mm;
0.05 to 0.15 m/sec (3.0 to 9.0 m/min) for diameters 225mm to 300mm
0.10 to 0.20 m/sec (6.0 to 12.0 m/min) for diameters over 300mm

Where the CCTV inspection is being carried out with equipment that digitises the pipe inspection, maximum and minimum speeds of travel are not applicable.

Camera travel shall be as smooth as is practicable. The camera shall move forward only when the line of sight is along the spring line of the sewer pipeline. Inspections carried out with the camera in pan or tilt mode while in motion, may be cause for rejection of that part of the inspection.

Where these speeds are exceeded, either instantaneously or as an average, to the extent where the Engineer considers the Operator's ability to identify defects is compromised, the Engineer may require the Contractor to repeat the inspection at no additional cost to the Principal.

Where the above minimum speeds are consistently unachievable due to lack of traction or for any other reason, the Contractor shall fit a tow line to the camera and pull it through the pipeline, or take other appropriate action.

When a defect or feature is detected the camera shall be stopped in a position where the defect or feature can be clearly seen for a period of 5 to 10 seconds. If a pan and tilt camera is used the video time the camera is halted at a defect or feature shall not exceed 20 seconds, plus an additional 5 seconds with the camera at rest and the defect or feature clearly in focus.

Inspections of junctions shall be carried out by panning and rotating the camera through 360° over a period of not less than 20 seconds. The traverse shall be smooth, and paused where appropriate to record obvious defects.

3.5 Picture Quality

Video and still pictures shall be sufficiently sharp that any defect can be clearly seen. Examples of inferior picture quality are given in Section 2 of the Manual.

If the picture quality is not acceptable to the Engineer, the Contractor shall rectify the inadequate picture quality and may be required to carry out a re-inspection at no additional cost.

Where the pipe material is not conducive to CCTV inspections, such as white reflective or black, light absorbing polyethylene pipe, the Contractor shall adjust light intensity to maintain picture quality as far as practicable.

4 LINEAR MEASUREMENT

4.1 Accuracy of Measuring Equipment

The CCTV monitor shall display, to tenths of a metre, the camera's position in the pipeline relative the centre of the start manhole. The displayed camera position shall be accurate to ± 2% or 0.3 m, whichever is the greater.

Camera cable shall be kept taut in front of the distance measurement unit to ensure the meterage shown on the screen reflects the true position of the camera. Camera cable shall not be coiled in front of the distance measurement unit, except for the first metre or so of the inspection, prior to setting the distance measurement system. If the camera is reversed, the camera cable shall also be pulled back through the distance measurement unit to ensure correct distance measurements are maintained.

Where a defect or feature occurs prior to the minimum monitor distance setting, the Contractor shall estimate the distance from the centre of the manhole.

Where an inspection proceeds through a manhole or node, whether marked or unmarked on the plan, the distance reading shall be re-set to zero at the centre of that point.

4.2 Slope Correction

The requirements for slope correction are specified in the Particular Specification.

5 VIDEO RECORDING AND INFORMATION DISPLAY

5.1 General

Video records shall be recorded and edited as necessary to ensure that:

- Headers appear on the screen for a maximum of 5 seconds at the start of each inspection.
- The pipe at the entrance to the manhole is visible at the start of the inspection.
- The camera is seen to move continuously through the pipelines, except at features or defects.
- Any stops at features or defects in excess of 10 seconds (or 25 seconds for a pan and tilt camera) are removed.
- Features or defects are clearly in focus for 5 seconds.

5.2 Header information

At the start of the inspection of each new asset section, the following header information shall be entered:

- Contract Number
- Upstream and downstream manhole/node numbers.
- The set-up manhole (Upstream or downstream)
- The name of the Contractor
- Location (town or suburb)
- Inspection date

Where a new manhole or node is identified during the inspection, a corrected header shall be displayed at the conclusion of the inspection of that newly identified section.

Promotional material shall not be entered onto the video record.

5.3 Continuous Display

The control unit shall continuously display in the corners of the monitor:

1. The distance of the camera from the centre of the start manhole or node.
2. The identification numbers of the upstream and downstream manholes or nodes, as recorded at the start of the inspection.

The continuous display may be temporarily deleted or moved if necessary to facilitate viewing of defects.

6 MULTIPLE INSPECTIONS

Where there are multiple inspections the Contractor shall record the following details in the “Remarks” field of the condition records for each additional inspection:

1. The circumstances of the continuation of the inspection. (For example “Roots removed”.)
2. The date of continuation of the inspection.
3. The camera travel direction.
4. The video record number.
5. The video recording start and finish times.
6. The start and finish distances from the upstream manhole.

Video records of multiple inspections may be on different tapes.

When the Contractor is initially unable to complete the inspection of a pipeline section, the inspection status shall be recorded as “UI” (Uncompleted Inspection). When all inspections on a pipeline section have been completed the Contractor shall check the inspection status to ensure that it is still relevant.

7 INSPECTIONS FROM BOTH ENDS OF A PIPELINE SECTION

Where inspections are carried out from both ends of a pipeline section, the Contractor shall endeavour to terminate each part of the inspection at a common, readily identifiable, feature or defect.

Should the Contractor consistently inspect from both ends of pipeline sections due to equipment or methodology inadequacies, the Engineer may require the Contractor to make appropriate changes to enable single pass inspections.

8 HIGH WATER FLOWS AND DIPS

8.1 Depth of Water Flow During Inspection

The maximum depth of water flow permitted during the inspection is specified in the Particular Specification.

If the maximum depth of water flow exceeds specified depths then the flow shall be lowered by plugging the line and/or bypass pumping or by rescheduling the CCTV inspection to time when there is less flow.

8.2 Inspection Through Dips

CCTV inspections shall generally continue throughout the full length of any dip that is encountered, and the extent of the dip noted on the log sheets in the normal manner. Alternatively if the Contractor has genuine concerns about the safety of the equipment in a dip, the length of the dip may be determined by inspecting from the other direction.

Where a dip continues through a manhole, it shall be recorded in accordance with the instructions for recording a “DP” defect code (refer Section 5 of the Manual).

If the depth of water in the dip exceeds the maximum depth specified in the Particular Specification, then the water shall be removed and the section of pipeline.

Where water is removed from a dip with a flusher unit, it shall be in a downstream direction, i.e. with the flusher unit set up at the downstream manhole.

Where a rise in water level in a pipeline is subsequently found to be caused by debris which should have been removed by the cleaning specified in the Particular Specification, no additional payments will be made for re-cleaning and re-inspection.

8.3 Flat Gradients

If the depth of water in a pipeline due to flat gradients exceeds the maximum depth specified in the Particular Specification, the Contractor shall proceed as for a dip. The depth of water in the pipeline at each end of that section prior to modifying flow levels shall recorded.

9 BLOCK AGES PREVENTING PASSAGE OF EQUIPMENT

Blockages, which prevent the passage of equipment, shall be photographed. The inspection shall then continue from the opposite direction, up to the same blockage if feasible.

10 RISK TO EQUIPMENT

The Principal will accept no responsibility for damage to or loss of the Contractor's equipment, unless specific instructions have been given by the Engineer directing that the works proceed through an area of risk. Any works required to recover Contractor's equipment shall be the full responsibility of the Contractor, and shall be carried out only with the prior approval of the Engineer.

In the event that the Contractor considers that to proceed further with cleaning or an inspection could involve risk of damage to the equipment, or risk of equipment becoming jammed in the pipeline, then that inspection may be abandoned at that point. The Contractor shall then inspect from the other direction to the point of abandonment, where practicable.

In such cases the contractor is to inform the Engineer. The Engineer may instruct the contractor to proceed with the inspection through the area at risk. In which case payment for recovery of equipment will be made if the equipment becomes stuck.

11 ABANDONMENT

Where an inspection is abandoned for whatever reason, payment will only be made for the length of pipeline for which there is a video picture of acceptable quality. Examples of reasons for abandonment are given in Section 2 of the Manual.

Where the full section of pipeline can be inspected by removing temporary obstructions, inspecting down to the point of abandonment from the other direction and the like, the inspection is not regarded as “abandoned”.

Abandoned inspections shall all be recorded and the reason/s for abandonment clearly identified in the “Remarks” column of the condition records, and the Inspection Status recorded as “UI” (Uncompleted Inspection) in the header.

When a pipeline inspection is abandoned, details of the reason/s for abandonment shall be recorded and handed to the Engineer within 5 working days.

Where the cause of the abandonment is rectified prior to completion of the inspection works with intervention by the Engineer, the Contractor shall complete the inspection.

12 DELIVERABLES

The type and quantity of deliverables to be provided are specified in the Special Condition of Contract.

12.1 Electronic data

Electronic data shall be provided in accordance with the Particular Specification. Computer disks must be free of all forms of computer virus, and labelled in accordance with the requirements of the Particular Specification.

12.2 Log sheets

Logsheet headers shall contain the following information, plus any other additional information specified in the Particular Technical Specification:

- Asset No.
- Contract No.
- Operator.
- Camera Operator.
- Date Started.
- Time Started.
- Upstream/Downstream Manhole/Node No.
- Video Record No.
- Video Recorder Run-time Start.
- Set Up.
- Parallel Line No.
- Currency of Inspection.
- Status of Pipe.
- Inspection Status.
- Line Length.
- Surveyed Length.
- Pipe Diameter.
- Joint Spacing.
- Material.

The Contractor shall ensure that logsheets include records of debris deposits, dips and/or roots where it is known these defects occurred, whether or not the defects are visible in the submitted video record. An estimate of the severity of any deposits, dips or root intrusions, shall be made when necessary.

12.3 Summary Sheets

Summary Sheets shall contain the following information:

- Date.
- Video counter reading in hhmmss format, e.g. 012350. (Only applicable to inspections recorded on video).
- Area (or town).
- Upstream manhole.
- Downstream manhole.
- Pipe Asset No.

The summary sheet header shall contain the following information:

- Contract Number.
- Name of the Contractor.
- Video record number.

12.4 Video Records

Where the supply of video tapes is specified in the Particular Specifications then they shall be provided in VHS format and labelled in the manner specified in Particular Specifications.

12.5 DVD Records

Where the supply of DVDs is specified in the Particular Specifications then they shall be supplied in the following format:

- Encoded to WMV, MPEG1, or MPEG2 format (PAL standard, Capture Rate = 25 frames/sec and minimum Sample Rate = 1.2Mb/sec for WMV, minimum Sample Rate = 1.2 Mb/sec for MPEG1 or 3Mb/sec for MPEG2)
- Recorded on DVD dual layered discs.
- Readable on DVD-ROM drives using Windows Media Player software.
- Separate video file for each pipeline section inspection to the following naming convention:
  AAAAA BBBBBBB CCCCCC DDDD
  (underscore to separate each block of code).

Table 5- 1 - Naming Convention for Video Files Supplied on DVD

Code	Description	No. of Characters	Example
AAAAA	Principal's Contract Number	5	21055
BBBBBBB	Principal's Sewer Line Asset Number	7	2325348
CCCCC	Date of CCTV survey	6	150403 (ddmmyy)
DDDD	Stage and type of CCTV viewing	4	PR – pre PO – post CL – cleaning RT – root cleaning RH – rehabilitation E.G. PORH = Post rehabilitation

12.6 Still Images

Where hard copy images are required, they shall be colour, and preferably printed directly onto durable photographic paper. They shall be 100mm x 75mm unless otherwise specified.

Images shall clearly show all on-screen text. Hard copy images shall in addition be annotated to show upstream and downstream manhole numbers, conduit dimensions, defect observed, direction of survey, image number as recorded on the log sheet and date when image was taken.

The Contractor shall number hard copy images in accordance with the requirements of Particular Specification. Images shall be supplied in a suitable holder bound into a file which is clearly marked with the video record numbers and project reference.

Still electronic and hard copy images shall be captured only when the camera is stationary.

Digital images shall be linked to the relevant electronic logsheet.

12.7 Marked up and Schematic Drawings

Marked up drawings and schematic drawings shall be provided in the format outlined in the Particular Specification.

13 ASSET ATTRIBUTE COLLECTION

13.1 Manhole depths

Manhole depths shall be measured from the invert of the pipeline being inspected, at the manhole wall, to the manhole cover (lid). Internal or external drop structures shall be measured from the invert of the upper pipe, at the manhole wall. Measurements shall be to the nearest 0.1m.

13.2 Pipeline diameters

Pipeline diameters shall be measured only where access into a manhole is otherwise required. Whether or not pipe diameters were measured and method by which they were measured is to be shown in the “Comments” field of the logsheet header.

13.3 Blank laterals

A pan and tilt camera shall be utilised where required to identify blank laterals. Blank laterals shall only be identified as such where there is a clearly visible cap totally blocking the lateral pipe.

13.4 Confirming the source and status of lateral connections

If required, the source and status of lateral connections is to be identified by dye testing. To confirm that a lateral is “dead” the Contractor is to dye test all surface drainage features, at all properties within a two property radius of the lateral connection in question.

14 QUALITY MANAGEMENT

14.1 Sample work

The Contractor shall submit for the Engineer’s approval, a sample video record and still image/s for all cameras, prior to their use. The sample video record shall be of a complete inspection, including the header. The samples will be used to verify compliance with assessed picture quality.

The Contractor shall also provide a sample electronically generated log sheet.

14.2 Operator training

It shall be the Contractor's responsibility to ensure that Operators are familiar with the requirements of the New Zealand Pipe Inspection Manual.

14.3 Change of Operator

In the event that the Contractor wishes to replace the Operator nominated in their tender, the prior approval of the Engineer shall be sought in writing.

14.4 Initial audit procedures

An initial audit of CCTV inspection information will be carried out by the Engineer. It will consist of a visual evaluation of the video record and recorded data.

The Contractor shall supply the first available video records and log sheets (or database) to the Engineer for auditing, within two working days of completion. The Engineer will report the results of the first audit back to the Contractor within two working days of receipt of the video. Examples of items that may be checked are given in Section 2 of the Manual.

The acceptance level for the accuracy of logsheet records is an Accuracy Level of 95%, as calculated in accordance with Section 2 of the Manual. If in the opinion of the Engineer the deliverables are unacceptable in any sense, a report will be provided with details of the auditor’s concerns.

If the results of the initial audit are deemed by the Engineer to be unacceptable the Contractor shall take immediate steps to rectify the Engineer’s concerns and if necessary re-inspect pipelines where the picture quality is deficient.

14.5 Ongoing Auditing

The Engineer shall audit the works at the frequency listed in the Particular Specification.

The acceptance level for the accuracy of logsheet records is an Accuracy Level of 95%, as calculated in accordance with Section 2 of the Manual. If in the opinion of the Engineer the deliverables are unacceptable in any sense, a report will be provided with details of the auditor's concerns.

If the results of the initial audit are deemed by the Engineer to be unacceptable the Contractor shall take immediate steps to rectify the Engineer's concerns and if necessary re-inspect pipelines where the picture quality is deficient.

4.0 BASIS OF PAYMENT

15 ESTABLISHMENT/DISESTABLISHMENT

Item 1.1 - Contract Establishment/disestablishment

Payment shall include all items which are general to the project as a whole. Such items shall include but are not limited to:

- Establishment and disestablishment of plant, equipment.
- Provision of insurances, etc.
- Provision of all the plant, equipment and personnel required to carry out the works.
- Provision of computer hardware and software which is required for the contract.
- Notification and liaison with private property owners and the public.
- Producing a Traffic Management Plan and adherence to it.
- Keeping the site clean and tidy throughout the Contract.
- Liaison with all other Service Authorities.
- Attendance of all Contractor's staff involved in site collection of data and data entry, at any training sessions conducted by the Client.
- Attending site and progress meetings.
- Providing written progress reports.
- Liaison with the Principal, Engineer and Engineer's Representative.
- Provision and maintenance of all equipment required for Health and Safety purposes, including confined space entry equipment.

Item 1.2 – Set Up (per site)

Payment shall include for all items relating to setting up and demobilising from each pipe section. This shall include:

- Locating Manholes (excludes buried manholes)
- Setting up for cleaning.
- Setting up for CCTV inspection.
- An allowance for repeat set-up where multiple inspections are required.
- Demobilising after the CCTV inspection has been completed.
- Preparation and provision of deliverables.

Only one set-up payment will be made for each pipeline section, no matter how many inspections are required to complete the CCTV inspection.

Set up costs shall not include for items which are separately provided for, such as root removal or water removal during inspections.

Item 1.3: Locate buried manholes

Payment will be made under this item for locating buried manholes.

The works shall include but not be limited to:

- Locating buried manholes by CCTV inspection.
- Marking and recording the location of buried manholes.

Item 1.4: Provide location sketches

Payment will be made for:

- Providing location sketches of manholes that are not shown on Client's GIS system or are incorrectly located. This item includes determining or confirming the connectivity of public sewers connected to these manholes.
- Providing location sketches for pipelines with incorrect connectivity details. This payment applies only to those pipelines which are connected to otherwise correctly located manholes.

This shall include:

- Determine the correct connectivity of pipelines.
- Provide location sketches of manholes in the specified format. The plans shall also show connectivity of all public sewers connected to those manholes.
- Provide location sketches in the specified format, showing amended connectivity of incorrectly connected public sewer pipelines.
- All other items required to produce location sketches.

16 CLEANING

Item 2.1 – Cleaning

Payment shall include for all items required to achieve the specified level of cleaning. This shall include:

- Cleaning to the specified standard.
- Disposal of debris.

Payment will be on a per metre basis. Payment will be made for based on the measured distance of each pipeline between manholes/nodes.

Where the amount of debris removed from any one pipeline section exceeds 500kg (weighed after excess water has been drained off) then an extra over payment will be made on a per tonne basis (measured in increments of 0.1 Tonne) for all material removed from the pipeline in excess of the initial 500kg. No additional payment is made for the removal of the first 500kg of material.

Item 2.2 – Root Removal

Payment shall be paid for metre of the pipeline requiring root cutting. It shall include:

- Locating manholes.
- Setting up equipment.
- Removal and disposal of roots.

Payment for this work will only be made on the basis of video record evidence of attempts to push the camera through the root infestation.

17 FLOW CONTROL

Item 3.1: Over-pumping (Set Up)

Payment will be made for each set-up. A single set-up may involve up to 150 m of pipeline measured between the centres of the manholes at the ends of the pipeline section to be over-pumped.

The works shall include but not be limited to:

- Traffic control.
- Mobilisation of over-pumping equipment.
- Temporary plugging of the sewer main to minimise flows, as required.
- Removal of over-pumping equipment.

Item 3.2: Bypass pumping (pumping rate)

Payment for this work will be at a per metre rate for the whole of the length of the line required to be isolated by over-pumping. Distances will be measured from centre of manhole (or node) to centre of manhole (or node).

Item 3.3: Extra over for flushing in front of camera

Payment for this work will be at a per metre rate for the whole of the length of the line requiring flushing in front of a camera to remove water from dips Distances will be measured from centre of manhole (or node) to centre of manhole (or node).

The works shall include but not be limited to:

- Set up of equipment.
- Temporary plugging of the sewer main to minimise flows, as required.
- Flushing ahead of the camera with a flusher unit.
- Removal of equipment.

18 CCTV INSPECTION

Item 4: CCTV Inspection of pipes

Payment will be made for the following items:

- The inspection of a full pipeline section inspection, carried out in accordance with the Technical Specifications. Payment for this work will be at a per metre rate for the whole of the length of the pipeline as measured from centre of manhole (or node) to centre of manhole (or node).
- Where cleaning was carried out to requirements of the Specification, the inspection had to be abandoned through no fault of the Contractor. Payment for this work will be at a per metre rate for the length of the pipeline surveyed as measured from centre of manhole (or node) to the end of the inspection. Payment will not be made where the inspection was abandoned because the contractor had not completed cleaning works to the specified standard.

The works shall include but not be limited to:

- CCTV inspection of wastewater pipe inspections.
- Assessment of CCTV.
- Provision of all deliverable's.
- All other items required to complete CCTV inspections in accordance with the Specification.

19 DETERMINE STATUS AND SOURCE OF LATERAL CONNECTIONS

Item 5: Determine the status and source of lateral connections

Payment will be made for the following items:

- Determining that a lateral is blank, i.e. end cap or other similar feature is visible from the CCTV inspection.
- Determining that a lateral is live and identifying the source of the lateral by dye testing.
- Determining that a lateral is dead by dye testing all surface drainage features at all properties within a 2 property radius of the lateral in question.

The works shall include but not be limited to:

- CCTV inspection of lateral connections.
- Dye testing.
- Provision of all deliverable's.

Payment is made on a per lateral connection basis.

20 DAYWORKS

Item 6.1: Personnel

The hourly rate shall include all personnel overheads including transport to and from site.

Item 6.2: Equipment

The hourly rate is to include all costs associated with running of equipment including operators.

21 UNSCHEDULED ITEMS (CONTRACTOR TO LIST

The Tenderer to price any other items they consider are necessary to complete the works.

22 CONTINGENCY SUM

The Contractor shall not make use of the contingency item unless written approval is issued by the Engineer.

5.0 SCHEDULE OF PRICES

Tenderers shall set out and enter against each item a price or rate as appropriate. Failure to price any item shall be taken to mean that the cost of that item is included in the prices and costs of other items.

This is a measure and value contract, and all quantities are provisional.

All prices shall be exclusive of Goods and Services Tax.

This Schedule of Prices is to be read in conjunction with the Specification and Basis of Payment.

Contract No.:
Contract Name:

Item	Description	Unit	Quantity	Rate	Amount
1	**Establishment**				
1.1	Contract Establishment/disestablishment	LS			
1.2	Set Up (per site)	Each			
1.3	Locate buried manholes	Each			
1.4	Provide location sketches	Each			
2	**Cleaning**				
2.1	Cleaning				
2.1.1	Light cleaning up to 150mm diameter	Lin.m			
2.1.2	Light cleaning up to 200mmm to 450mm diameter	Lin.m			
2.1.3	Light cleaning up to over 450mm diameter	Lin.m			
2.1.4	Full cleaning up to 150mm diameter	Lin.m			
2.1.5	Full cleaning up to 200mmm to 450mm diameter	Lin.m			
2.1.6	Full cleaning up to over 450mm diameter	Lin.m			
2.1.7	Extra Over Items 2.1.1 to 2.1.6 for removal of debris in excess of 500kg from any one pipeline section	Tonne			
2.2	Root Removal				
2.2.1	Root removal up to 150mm diameter	Lin.m			
2.2.2	Root removal up to 200mmm to 450mm diameter	Lin.m			
2.2.3	Root removal up to over 450mm diameter	Lin.m			
3	**Flow Control**				
3.1	Over-pumping (Set up)	Each			
3.2	By-pass Pumping (pumping rate)				
3.2.1	Over-pumping up to 10 l/s	Lin.m			

3.2.2	Over-pumping 10l/s to 25l/s	Lin.m			
3.2.3	Over-pumping 25l/s to 50l/s	Lin.m			
3.2.4	Over-pumping over 50l/s	Lin.m			
3.3	Extra over for flushing in front of camera	Lin.m			
4	**CCTV Inspection**				
4.1	CCTV inspection up to 150mm diameter	Lin.m			
4.2	CCTV inspection up to 200mmm to 450mm diameter	Lin.m			
4.3	CCCTV inspection up to over 450mm diameter	Lin.m			
5	**Determine the status and source of lateral connection**				
5.1	Determining that a lateral is blank.	Each			
5.2	Determining that a lateral is live and identifying the source of the lateral.	Each			
5.3	Determining that a lateral is dead.	Each			
6	**Dayworks**				
6.1	Personnel				
6.1.1	Foreman	Hr			
6.1.2	Camera Operator	Hr			
6.2	Equipment				
6.2.1	CCTV camera - pan & tilt	Hr			
6.2.2	CCTV camera - pushrod	Hr			
6.2.3	Flusher unit	Hr			
6.2.4	Root removal equipment	Hr			
7	**Unscheduled Items (Contractor to list)**				
8	**Contingency**				
				Total	

CONDITION CODES

Defect Codes

Feature Codes

CC: CRACK, CIRCUMFERENTIAL

Description

Covers cracks that are at right angles to the pipeline axis.

If the crack extends more than 100mm along the length of the pipe then it is allocated a Crack Longitudinal “CL” code.

If the crack does not extend more than 100mm from a joint it is allocated a Joint Faulty “JF” code.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes	No	Yes	Yes	Yes	Yes	If Specified	No

Small

CC, S Crack visible but not open.

Condition Scores

- Structural Score - 2

Comments on the photo

- The crack is visible but not open, and there is no evidence that it extends to the outside wall of the pipe
- In this example, the crack occurs within 100mm of a joint, and so this fault would be coded as Joint Faulty, Small (JF,S) and the CC,S would be denoted in the Remarks.

Medium

CC, M	Crack open but there is no evidence that the crack extends to the outside wall.

Condition Scores

- Structural Score - 15

Comments on the photo

- The crack is chipped and open, but there is no evidence that the crack extends through to the outside wall of the pipe.
- In this example, the crack occurs within 100mm of a joint, and so this fault would be coded as Joint Faulty, Medium (JF,M) with the CC,M denoted in the remarks

Large

CC, L	Crack is open and there is evidence that it extends through to the outside wall. Evidence that the crack extends through to the outside wall may include the width of the crack, displacement of the crack, the presence of roots, infiltration and/or encrustations. The presence of roots, infiltration or encrustations would be coded separately.

Condition Scores

- Structural Score - 30

Comments on the photo

- The displacement between the edges of the crack in this photo indicates that the crack is open through to the outside wall.
- In this example, the crack occurs within 100mm of a joint, and so this fault would be coded as Joint Faulty, Large (JF,L) with the CC,L denoted in the Remarks

CL: CRACK, LONGITUDINAL

Description

Refers to cracks that are parallel to the pipeline axis. The cracks can be located anywhere around the circumference of the pipe. If there are two or more unconnected longitudinal cracks, then each crack is separately recorded.

Where cracking does not extend more than 100mm from a joint it is allocated a joint faulty “JF” code.

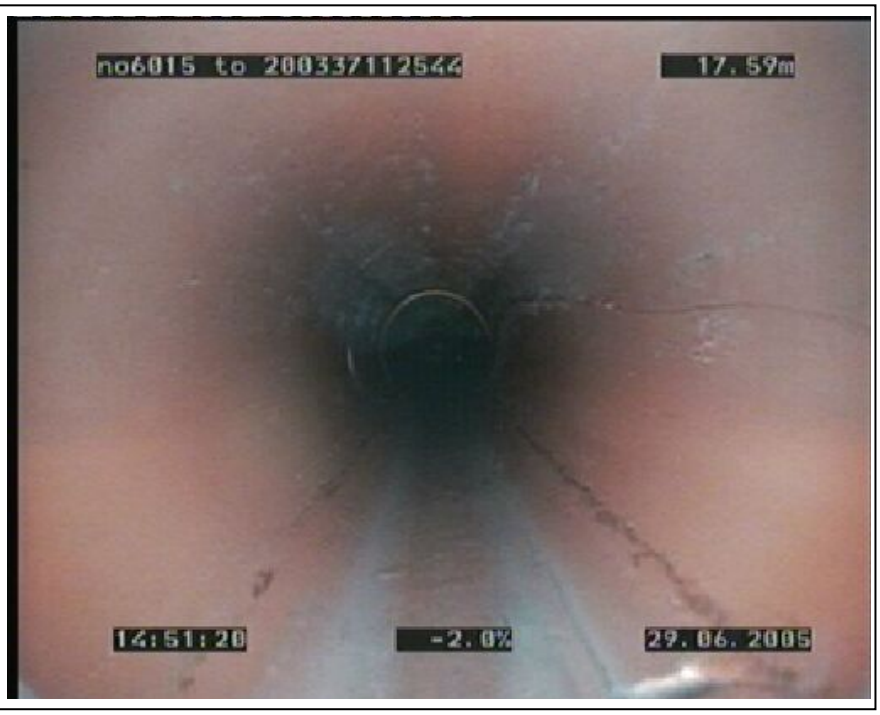
If longitudinal cracks are visisble at any three of the following points: 12 O’clock, 3 O’clock 6 O’clock or 9 O’clock, this may indicate that the pipe is being subjected to undue external pressure, in which case the defect is allocated the Deformed Pipe “DF” code.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes	Per metre	Yes	Yes	Yes	Yes/No	If Specified	No

Small

CL, S Crack visible but not open.



Condition Scores

- Structural Score - 3

Comments on the photo

- The crack extends through the bore of the pipe at 3 o’clock. It does not appear to be open and there is no evidence that it extends through to the outside of the pipe wall.

Medium

CL, M	Crack open but there is no evidence that the crack extends to the outside wall.

Condition Scores

- Structural Score - 15

Comments on the photo

- Crack is definitely open, in either EW or VC pipe. The amount that the crack is open would tend to suggest the crack may be through to the outside wall of the pipe in this material, however the lack of indicators such as infiltration or roots dictate that a medium score is defined.
- As the crack continues to the far joint, an additional code of JF, M would be added at that joint.

Large

CL, L	Crack is open and there is evidence that it extends through to the outside wall. Evidence that the crack extends through to the outside wall may include the width of the crack, displacement of the crack, the presence of roots, infiltration and/or encrustations. The presence of roots, infiltration or encrustations would be coded separately.

Condition Scores

- Structural Score - 30

Comments on the photo

- The crack extending from the joint is open through to the outside wall as evidenced by the separation of the two faces of the crack. Other types of evidence that could also indicate that a crack is open to the outside wall could be roots, staining, or displacement of the pipe wall at the crack.
- In this example, the crack is within the confines of the joint, and so would be coded as a Joint Faulty , Large (JF, L) with the CL,L denoted in the Remarks.

CM: CRACK, MULTIPLE

Description

Multiple cracks that running both in circumferential and longitudinal directions. The cracks join together to form a mosaic effect.

If pieces of the pipe have fallen out or are displaced to such an extent that they may fall out, the defect would be allocated the Pipe Broken, “PB” code.

Where cracking occurs does not extend more than 100mm from a joint it is allocated a Joint Faulty “JF” code.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes	Per metre	Yes	Yes	Yes	Yes	If Specified	No

Small

CM, S Crack visible but not open

Condition Scores

- Structural Score - 10

Comments on the photo

- Cracks running in both longitudinal and circumferential directions. None show evidence of being open to the outside wall.

Medium

CM, M	Crack open but there is no evidence that the crack extends to the outside wall.

Condition Scores

- Structural Score - 20

Comments on the photo

- Open & chipped cracks in the soffit of this pipe, but there is no evidence (e.g. staining, roots or displacement of the pipewall) to indicate that the cracks extend through to the outside wall.

Large

CM, L	Crack is open and there is evidence that it extends through to the outside wall. Evidence that the crack extends through to the outside wall may include the width of the crack, displacement of the crack, the presence of roots, infiltration and/or encrustations. The presence of roots, infiltration or encrustations would be coded separately.

Condition Scores

- Structural Score - 40

Comments on the photo

- There is some displacement which indicates that the cracking extends through to the outside wall. However the displacement is not servere enough to indicate that pieces of pipe may fall out.

DE: DEBRIS, SILTY

Description

Silt and gravel deposited in the pipeline. The nature of the debris and the extent of the pre-cleaning is noted in the “Remarks” field.

A separate code Debris Greasy “DG” relates to fat and grease deposits.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes	Per defect	Yes	Yes	No	No	If Specified	Yes

Small

DE, S The clear diameter is reduced by less than 10%

Condition Scores

- Service Score - 8

Comments on the photo

Medium

DE, M The clear diameter is reduced by 10% - 25%.

Condition Scores

- Service Score - 20

Comments on the photo

Large

DE, L The clear diameter is reduced by more than 25%.

Condition Scores

- Service Score - 40

Comments on the photo

- This pipe is blocked. As is often the case with DE, L. The inspection was abandoned in order to carry out further cleaning and inspection from the other end. This type of cleaning often requires specialist equipment such as high flow jetting equipment in conjunction with a trap or suction unit in order to prevent the debris being washed on down the line.

DF: DEFORMED PIPE

Description

This code refers to rigid pipe, such as earthenware, asbestos cement or concrete pipe, that has been deformed due by external pressure.

The code is alos used if longitudinal cracks are visible at any three of the following points: 12 O'clock, 3 O'clock 6 O'clock or 9 O'clock, as this may indicate that the pipe is being subjected to undue external pressure.

Continuous longitudinal cracking associated with the deformation is included in the "DF" code. Longitudinal cracking outside the area of the deformed pipe is separately coded using Crack Longitudinal, "CL".

Deformed plastic pipe is coded separately using Deformed Plastic Pipe "PF".

The pipe is not manufactured correctly and the dimensions do not meet specification. Instances of this have been seen in concrete spun pipe. It is recommended this pipe be profiled to confirm dimensions

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes	Per metre	Yes	Yes	Yes	Yes	If Specified	No

Small – Not Used

Medium

DF, M	i) ii)	Deformation 10% or less of the pipe diameter, and there is continuous longitudinal crackings. Longitudinal cracks are visible at any three of the following points: 12 O'clock, 3 O'clock 6 O'clock or 9 O'clock.

Condition Scores

- Structural Score - 15

Comments on the photo

- Pressure on the pipe has deformed and cracked the pipe at the 4 quadrants which is typical of EW pipe that has been subjected to undue external force.

Large

DF, L	Deformation greater than 10% of the pipe diameter and there is continuous longitudinal cracking.

Condition Scores

- Structural Score - 65

Comments on the photo

- As with most DF, L situations, the pipe has been subjected to external pressure to such an extent that collapse is imminent.

DG: DEBRIS, GREASY

Description

Refers to the presence of grease, fat, scale and any other material that is adhered to the pipe wall, with the exception encrustation deposits. The nature of the debris and the extent of pre-cleaning is noted in the “Remarks” field.

Encrustrations are allocated the Encrustration Deposit “ED” code.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes	Per defect	Yes	Yes	No	No	If Specified	Yes

Small

DG, S Clear diameter is reduced by less than 10%

Condition Scores

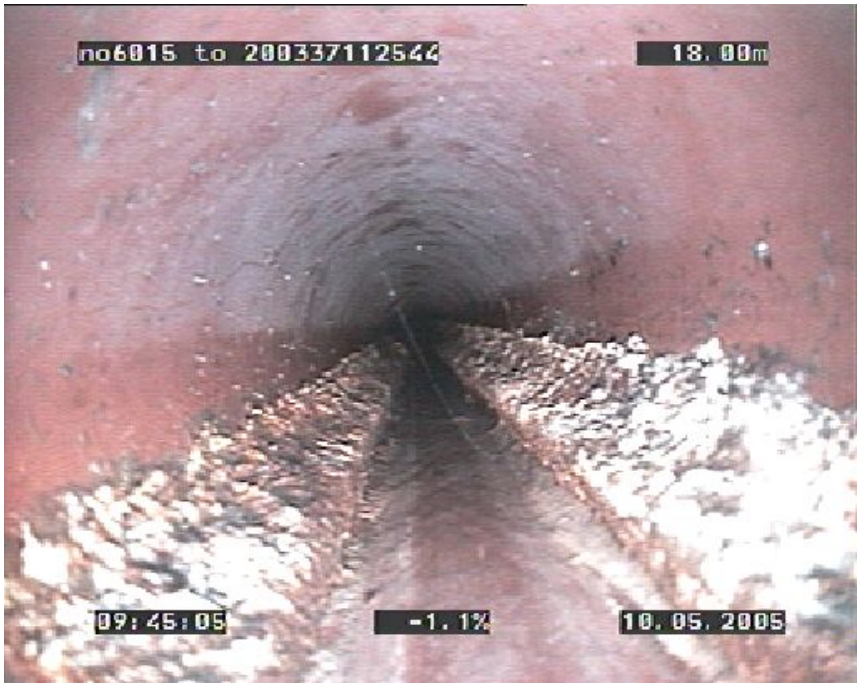
- Service Score - 8

Comments on the photo

- A light film of grease is present at the “high tide” mark of the pipe.

Medium

DG, M The clear diameter is reduced by 10% to 25%



Condition Scores

- Service Score - 20

Comments on the photo

- This build up has just reached the transition from Small to Medium. The conduit is still flowing fairly well, however, continued build up is likely.

Large

DG, L The clear diameter is reduced by more than 25%.

Condition Scores

- Service Score - 40

Comments on the photo

- There is probably only 20% of the clear diameter left in the bore of the pipe. As can be seen, the fat build up is starting to hold up normal flow and will soon totally block the pipe.

DP: DIPPED PIPE

Description

Dipped pipes are generally identified by changes in water level. Where a dip continues through a manhole and finishes on the far side of the manhole, it is recorded as two separate dips, the first finishing at the manhole and the second starting at the manhole.

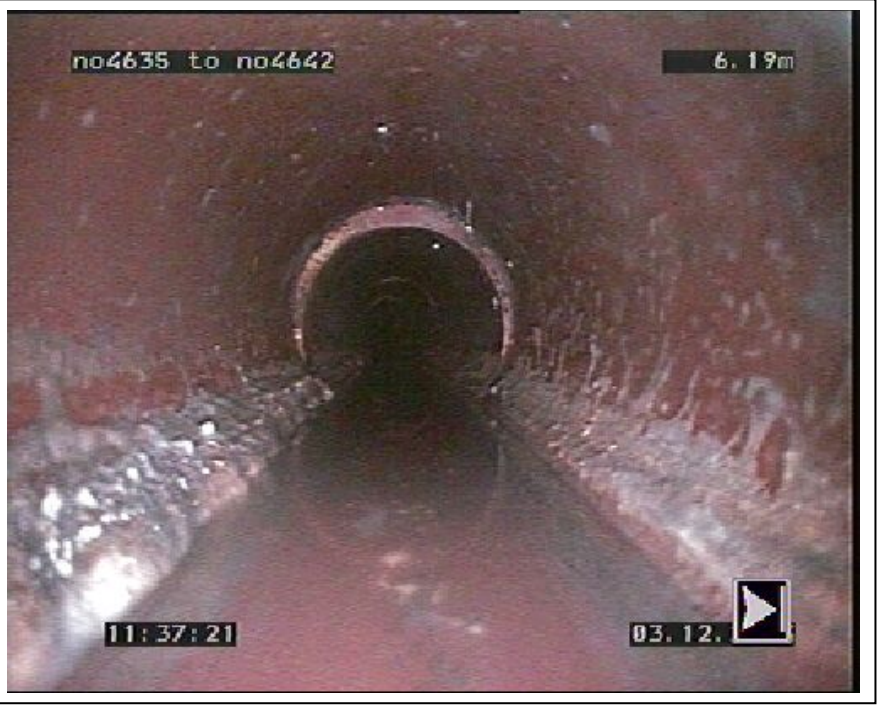
Where a dip appears to continue through a manhole but the pipeline on the far side of the manhole is not inspected, the rise in water level is not recorded as a dip. Similarly should an inspection on the far side of the manhole show that the rise in water level is caused by a downstream obstruction (for example debris, or a high flow of a branch pipeline), the rise in water level is not recorded as a dip. This may involve editing of previous records.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes	Per defect	Yes	Yes	No	No	If Specified	Yes/No

Small

DP, S Dip 25% or less of the pipe diameter



Condition Scores

- Structural Score - 10

Comments on the photo

- When traversing the pipe in a downstream direction, it is important to note the start point of the dip and to check that the rise in water level is not caused by other factors further downstream, such as a build up of debris. The fat build up would be recorded separately “DG, S”.

Medium

DP, M Dip 25% to 50% of the pipe diameter.

Condition Scores

- Structural Score - 15

Comments on the photo

- The flow through the dip is to such an extent that it is hitting the underside of the body of the camera tractor. This is causing the turbulence that is seen in the photo. Conversely, when travellng upstream, a bow-wave can make the dip appear deeper than it actually is.

Large

DP, L Dip greater than 50% of the pipe diameter

Condition Scores

- Structural Score - 35

Comments on the photo

- This dip is just at 50% of the pipe diameter. If a camera is set up correctly at the mid point of the pipe diameter it is difficult to obtain a picture of a large dip as the camera lens is often underwater.

ED: ENCRUSTATION DEPOSITS

Description

This code covers encrustation deposits on the pipe wall. These are generally the result of infiltration seepage bringing with it dissolved salts from the surrounding soil. The seepage moisture evaporates and leaves precipitated salts behind. Encrustation is often an orange colour (probably due to a high proportion of iron oxide in many soils), and is usually seen at joints. However it may occur anywhere there is a minor leak in the pipeline.

The “Distance To” is only recorded when an encrustation deposit extends for more than 200mm along the pipe wall.

Any pipe or joint faults associated with the encrustration deposits are coded separately.

If infiltration is visible it is also recorded separately using the Infiltration Present “IP” code.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No/Yes	Per metre	Yes	Yes	Yes	Yes	If Specified	No

Small

ED, S The clear diameter is reduced by less than 10%

Condition Scores

- Service Score - 0

Comments on the photo

- Light encrustation deposits from infiltration through a crack. The corresponding crack would be coded separately as “CL, L” as the presence of the encrustration indicates that there is infiltration through the crack, which is evidence that the crack is open to the outside wall.

Medium

ED, M The clear diameter is reduced by 10% to 25%.

Condition Scores

- Service Score - 5

Comments on the photo

- The fault causing the encrustation is not always able to be determined. The fault causing the encrustation is coded separately. The fault will be large severity as the presence of encrustration is evidence that it extends through to the outside wall.

Large

ED, L The clear diameter is reduced by more than 25%

Condition Scores

- Service Score - 20

Comments on the photo

- Encrustation caused by a leaking joint. The leaking joint is coded separately as JF, L.

IP: INFILTRATION PRESENT

Description

Visible infiltration through either the pipe wall or pipe joints.

Pipe or joint faults and/or encrustrations associated with the visible infiltration are coded separately.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	Yes	Yes	If Specified	No

Small

IP, S Infiltration seeping or dripping.

Condition Scores

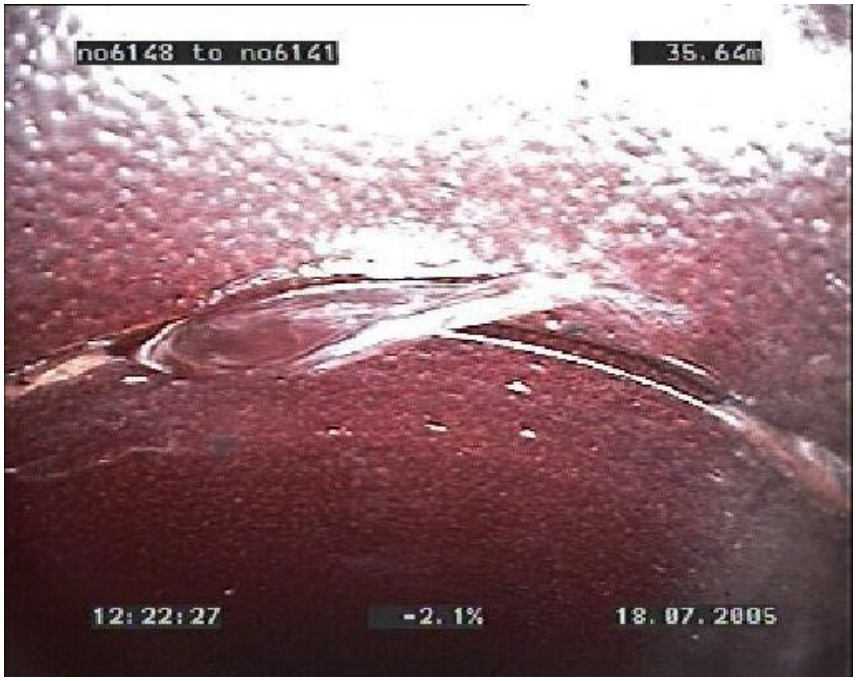
- Structural Score - 2

Comments on the photo

- Wet patch indicating water seeping through from the joint.
- Photo taken by a pan & tilt camera; the right most portion of the patch would be at approximately 11 o'clock with the seepage running down the wall to 6 o'clock

Medium

IP, M Running flow. Can also be squirting where the flow section area is small.



Condition Scores

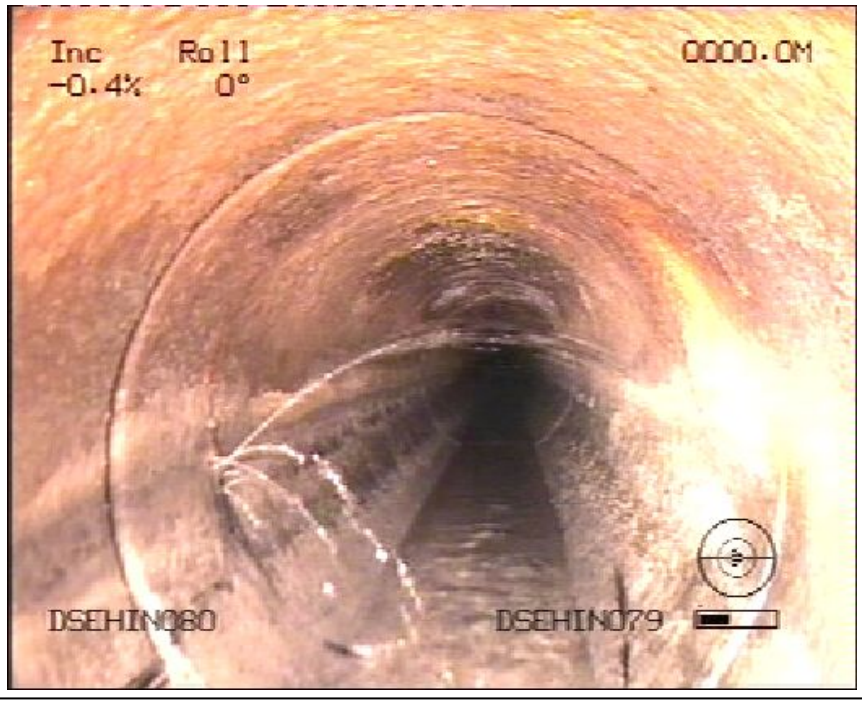
- Structural Score - 15

Comments on the photo

- The infiltration shown in this photo is at 3 o'clock. The Pan and Tilt camera used for this survey, has rotated the image 90°.
- This fault was coded by the contractor as large, but as the flow is not under pressure, it should have been coded as medium severity.

Large

IP, L Gushing (pressure flow).



Condition Scores

- Structural Score - 30

Comments on the photo

- Although the volume is not great compared to other examples (see Interesting photo section), the fact that the stream of water is jetting upwards indicates that it is under pressure.

JD: JOINT, DISPLACED

Description

This code records where there is a displacement or step at a pipe joint.Pipe. The wall thickness can often be used as a guide to the percent displacement. Comments regarding any obvious remaining effectiveness of the joint sealing system can be made in the “remarks” field.

Recording of “S” severity joint displacements is optional. It is only required if the Client has specified that it be recorded.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	No	No	If Specified	Yes/No

Small

JD, S Displacement less than 10% of the pipe diameter.

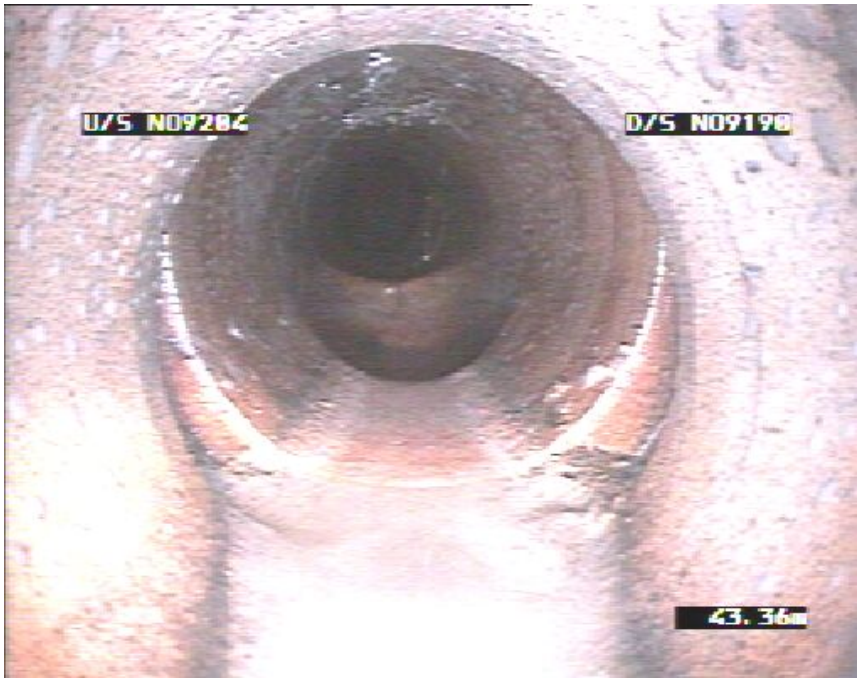
Condition Scores

- Structural Score - 0

Comments on the photo

Medium

JD, M Displacement 10% to 25% of the pipe diameter.



Condition Scores

- Structural Score - 15

Comments on the photo

- This joint is the last one before the external dropper to a manhole.

Large

JD, L Displacement greater than 25% of the diameter.

Condition Scores

- Structural Score - 45

Comments on the photo

JF: JOINT, FAULTY

Description

Joint sealing defects or physical damage to joints, excluding open and displaced joints. The nature of the defect is noted in the “Remarks” field.

If cracking or damage to the pipe does not extend more than 100mm from the joint it is recorded under this code.

If the cracking or damage extended more 100mm from the joint it is not considered to be a joint fault and should be recorded under the relevant condition code.

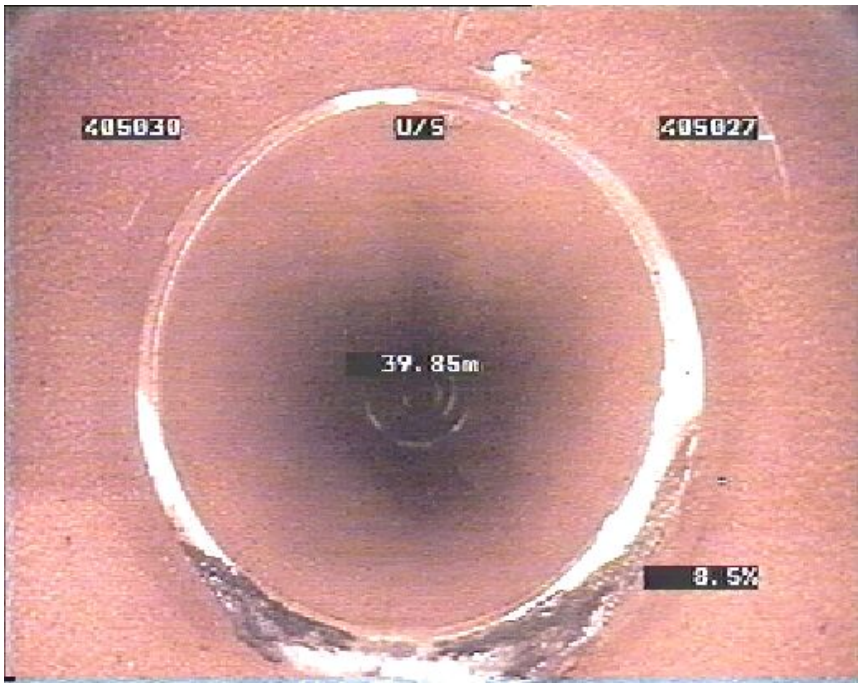
The presence of roots, visible infiltration or encrustrations are coded separately.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD - No	Yes	No	N/A	Yes	Yes	Yes	Yes/No	If Specified	If applicable

Small

JF, S Minor cracking or spalling.



Condition Scores

- Structural Score - 1

Comments on the photo

- There is a hairline Circumferential Crack within 100mm of the joint
- There is no indication that any of the faults extend beyond the outside wall of the pipe. The presence of the circumferencial crack would be noted in the “Remarks” field only as it is within the confines of the joint.

Medium

JF, M	Cracking or spalling which is open but there is no evidence to suggest that it extends through to the outside wall.

Condition Scores

- Structural Score - 10

Comments on the photo

Large

JF, L	i)	Cracking or spalling where there is evidence that it extends through to the outside wall. Evidence that the crack extends through to the outside wall may include the width of the crack, displacement of the crack or the presence of roots, infiltration, staining or encrustrations.
	ii)	There is evidence that the joint is leaking. Evidence may include the rubber ring is proud of the pipe wall or the presence of roots, staining, encrustration deposits and/or infiltration.

Condition Scores

- Structural Score - 25

Comments on the photo

- The ring has come free of the pipe joint and the presence of roots confirms the sealing is faulty.
- The roots are coded separately as RI, S.

JO: JOINT, OPEN

Description

Pipes are longitudinally displaced. Make due allowance for normal construction tolerances and do not code as “JO” if mortar or some other sealing is visible unless there is obviously a fault.
The pipe material, diameter and jointing method needs to be taken into consideration when assessing the severity.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	No	No	If Specified	No

Small

JO, S Displacement is less than 20mm.

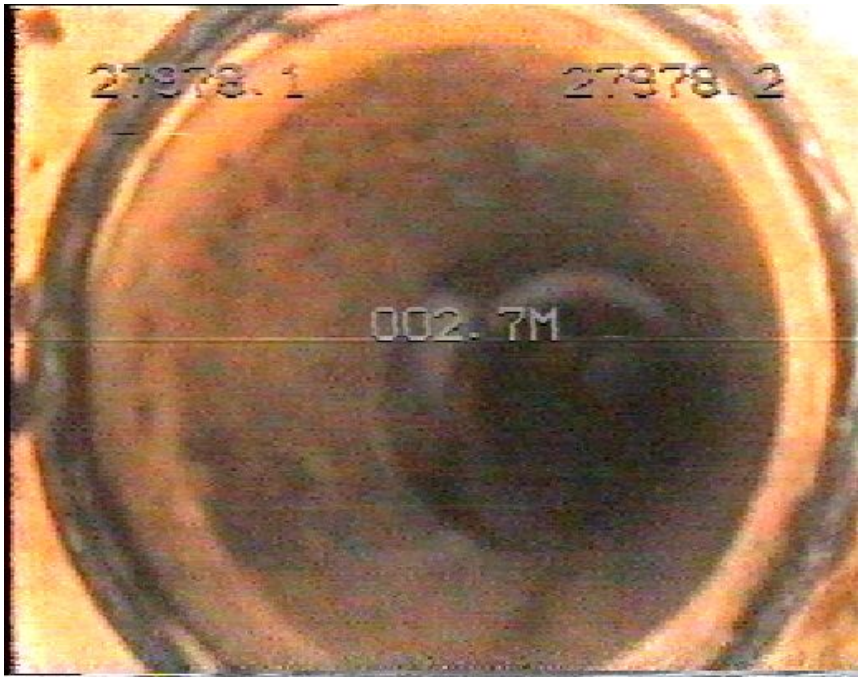
Condition Scores

- Structural Score - 0

Comments on the photo

Medium

JO, M Displacement is 20mm to 40mm.



Condition Scores

- Structural Score - 5

Comments on the photo

- Many still captures when taken with a pan and tilt camera are looking perpendicular to the axis of the pipe and directly at the joint making assessment of captures difficult.
- Many open joints occur at changes in direction or gradient in a pipe materials such as earthenware which are not designed for these changes.

Large

JO, L Displacement is greater than 40mm.

Condition Scores

- Structural Score - 25

Comments on the photo

- A 300mm concrete storrmwater pipe.

LF: LATERAL, SEALING FAULTY

Description

This code relates to the sealing between the lateral and the main pipe. The code usually applies to lateral connections made insitu.

If roots are present at the connection between the lateral and the main pipe this is evidence that the lateral sealing is faulty. The roots are coded separately as Root Intrusion “RI”.

Defects in the lateral itself are recorded under the Lateral, Problem, “LX” code.

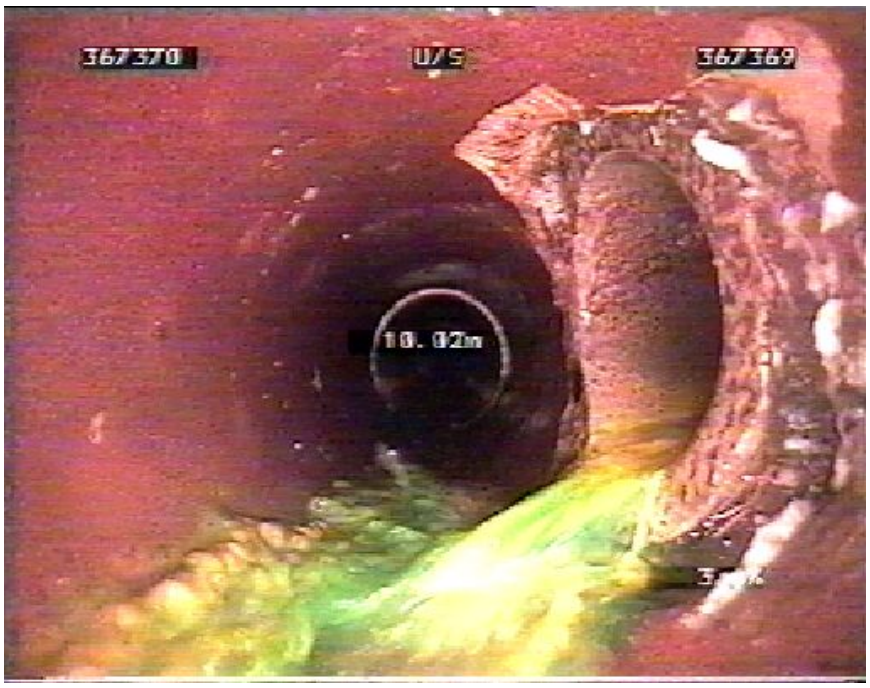
Defects in the main pipe that are not part of the lateral connection are coded separately.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	Yes	No	If Specified	No

Small

LF, S There are small gaps between the lateral and the main pipe which are not open.



Condition Scores

- Structural Score - 5

Comments on the photo

- Although there is no visual evidence of a sealing fault, the butt connection is poorly made and may deteriorate.
- The lateral is also protruding and is coded separately.

Medium

LF, M	There are gaps between the lateral pipe and the main pipe that appear open, but there is no evidence that the gap extends through to the outside wall of the main pipe.

Condition Scores

- Structural Score - 10

Comments on the photo

Large

LF, L	There is evidence that the connection between the lateral and the main pipe is leaking. Evidence may include the presence of roots, staining, encrustration deposits and/or infiltration.

Condition Scores

- Structural Score - 25

Comments on the photo

- Infiltration and encrustation below the lateral indicates a flow path through to the outside. The surrounding bedding and fill is also visible at the top of the lateral. The lateral is also protruding and this is separately recorded.

LP: LATERAL, PROTRUDING

Description

Part of the lateral pipe is protruding into the mainline. The estimated diameter of the lateral is recorded under the “Remarks” section.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	Yes	No	If Specified	Yes/No

Small

LP, S Lateral protrudes into the sewer main by 10% or less of the diameter of the sewer main.

Condition Scores

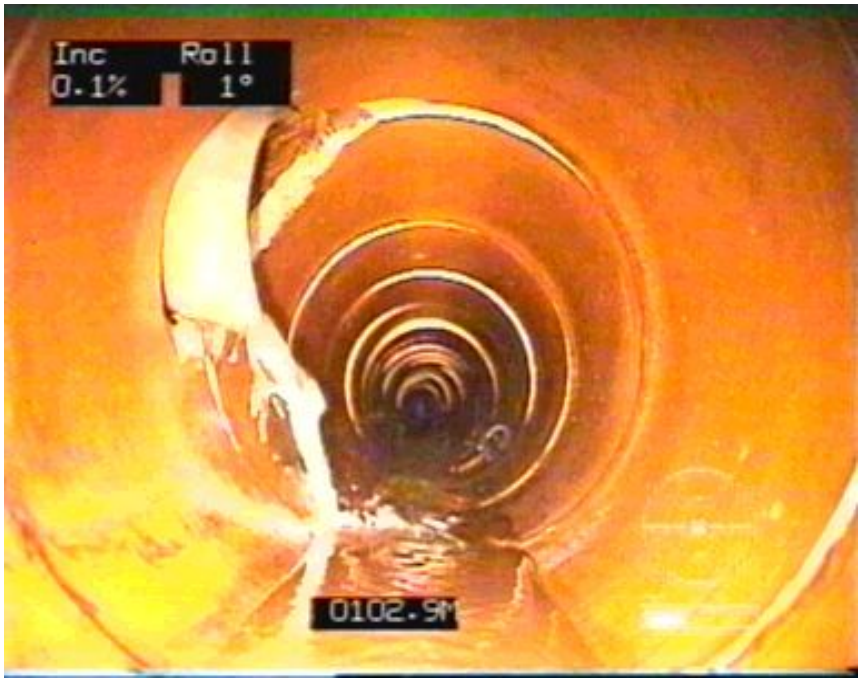
- Structural Score - 0

Comments on the photo

- This connection would also be coded as LF, S as there are small gaps between the lateral and the main pipe, but these gaps are not open.

Medium

LP, M	Lateral protrudes into the sewer main by 10% to 25% of the diameter of the sewer main.



Condition Scores

- Structural Score - 15

Comments on the photo

Large

LP, L	Lateral protrudes into the sewer main by more than 25% of the diameter of the sewer main.

Condition Scores

- Structural Score - 25

Comments on the photo

- Would also attract a LF, L defect code due to infiltration between lateral and the main.

LX: LATERAL, PROBLEM

Description

The “LX” code is used to record defects that were identified inside a lateral pipe. The nature of the defect is noted in the “Remarks” field, preferably with an offset measurement. The estimated diameter of the lateral is also recorded in the “Remarks” field.

Roots that originate from inside the lateral are recorded under this code. If the roots extend into the main pipe thay are coded additionally as Root Intrusion “RI”.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	Yes	No	If Specified	Yes

Small

LX, S As defined elsewhere for the type of defect noted in the “Remarks” column.

Condition Scores

- Structural Score - 5

Comments on the photo

- Small roots in lateral.
- This photo is taken up the lateral using a pan and tilt camera.

Medium

LX, M	As defined elsewhere for the type of defect noted in the “Remarks” column.

Condition Scores

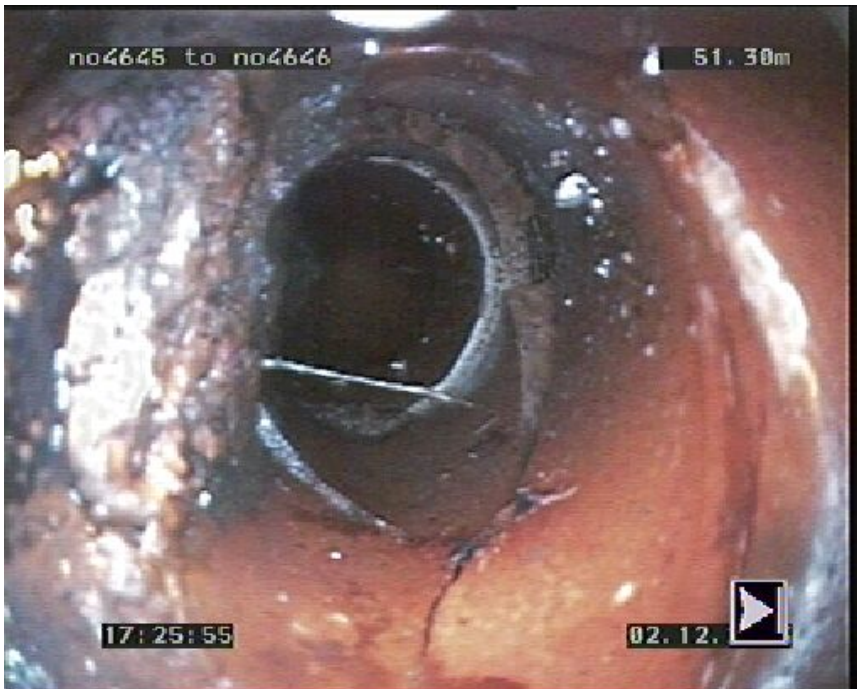
- Structural Score - 20

Comments on the photo

- The medium displacement of the joint inside the 100mm lateral pipe attracts the LX entry.

Large

LX, L	As defined elsewhere for the type of defect noted in the “Remarks” column.



Condition Scores

- Structural Score - 30

Comments on the photo

- Large multiple cracks within the 100mm lateral attracts a LX,L code.

OP: OBSTRUCTION, PERMANENT

Description

An obstruction in the pipeline caused by a fixed construction feature, an external object embedded in the pipe wall or an object or material that is not able to be removed using standard cleaning equipment. This code covers mortar in the pipeline and weld beads in PE. The nature of the obstruction is noted in the "Remarks" field.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	Yes	Yes/No	If Specified	Yes

Small

OP, S The clear diameter of the pipeline is reduced by less than 10%.

Condition Scores

- Structural Score - 10

Comments on the photo

- Grout has been inadvertently squeezed into the pipe at the time of installation. This would require specialist equipment to remove it.

Medium

OP, M The clear diameter of the pipeline is reduced by up 10% to 25%.

Condition Scores

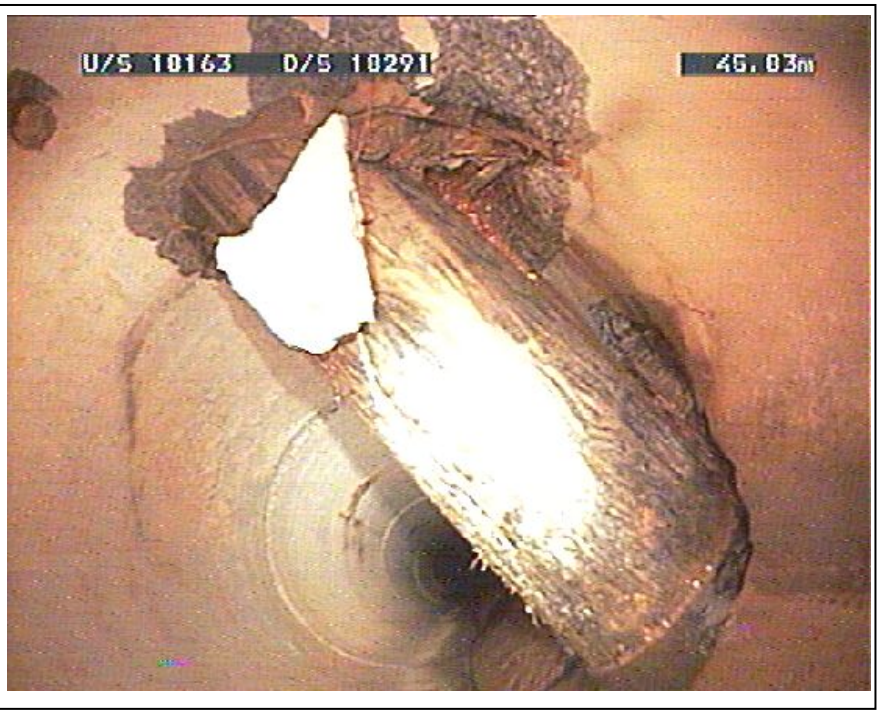
- Structural Score - 20

Comments on the photo

- A water main has been drilled through the soffit of the pipe. The camera has focused on the service making it appear that it takes more of the diameter than it actually does.
- The hole in the pipe and the roots would be recorded separately.

Large

OP, L The clear diameter is reduced by more than 25%.



Condition Scores

- Structural Score - 35

Comments on the photo

- This is a 900mm diameter stromwater pipe approximately 6m deep that had a foundation pile for a shopping mall driven through it. A good case for checking the service plans before carrying out work of this type.
- The Local Authority that owns this asset insisted the pipe be dug up and repaired at the pile driving contractor's cost.

OT: OBSTRUCTION TEMPORARY

Description

An obstruction in the pipeline, which is potentially removable and is not attached or embedded in the pipe wall and can be removed with standard pipe cleaning equipment. The nature of the obstruction is noted in the “Remarks” field.

This code does not apply to items such as paper build-up which will be washed away by normal sewer flows.

Silt and gravel deposited in the pipeline is recorded under the Debris, Silty “DE” code.

Fat and grease deposits are coded under Debris, Greasy “DG”>

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	Yes	Yes/No	If Specified	Yes

Small

OT, S The clear diameter of the pipeline is reduced by up to 10%.

Condition Scores

- Service Score - 8

Comments on the photo

- A piece of wood is lying in the invert and requires heavy cleaning to remove it.

Medium

OT, M The clear diameter of the pipeline is reduced by 10% to 25%.

Condition Scores

- Service Score - 20

Comments on the photo

- Rocks in 825mm line. As this rock is approx 250mm across, fairly heavy duty flushing equipment coupled with an experienced operator is required to remove it.

Large

OT, L The clear diameter of the pipeline is reduced by more than 25%.

Condition Scores

- Service Score - 40

Comments on the photo

- Piece of pipe in 150mm diameter line reducing the clear diameter by approximately 30%.

PB: PIPE, BROKEN

Description

The pipe still functions as a free-flowing conduit but pieces of it have broken out or are displaced to the extent that they may fall out.

This code is more severe than Crack Multiple “CM” but less severe than Pipe Collapsed “PX”.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes	Per metre	Yes	Yes	Yes	Yes	If Specified	No

Small

PB, S	i) ii)	Damage extends up to 10% of the circumference, or parts of the pipe are displaced by less than half the pipe wall thickness.

Condition Scores

- Structural Score - 15

Comments on the photo

- The break is displaced by just on ½ of the pipe wall thickness. This fault is bordering on attracting an “M” severity. The roots are recorded separately.

Medium

PB, M	i)	Damage extends between 10% and 25% of the circumference and parts of the pipe are displaced by less than half the pipe wall thickness, or
	ii)	Parts of the pipe are displaced between half the pipe wall thickness and the full pipe wall thickness

Condition Scores

- Structural Score - 30

Comments on the photo

- A piece of pipe is displaced however remains within the confines of the conduit.

Large

PB, L	i)	Damage extends over 25% of the circumference and parts of the pipe are displaced by less than half the pipe wall thickness, or
	ii)	parts of the pipe are displaced by more than the pipe wall thickness, or
	iii)	pieces of the pipe have totally dislodged.
	iv)	Alternatively in the opinion of the operator, the pipe is close to collapse, in which case alert the Engineer immediately

Condition Scores

- Structural Score - 75

Comments on the photo

- This defect was originally coded as a collapse, but this is not the case as the pipe is still acting as a free flowing conduit. However the pipe is under threat of collapsing in the future.

PF: DEFORMED PLASTIC PIPE

Description

This code refers to plastic pipe that has been deformed due to external pressure or loading.

It is recommended that deformed pipes be “profiled” in order to accurately determine the level of deformation. Profiling is a particularly useful tool when inspecting new pipes for acceptance of the asset.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	Per Metre	Yes	Yes	3, 9 or 12 only	No	If Specified	Yes/No

Small

PF, S Deformation 10% or less of the pipe diameter

Condition Scores

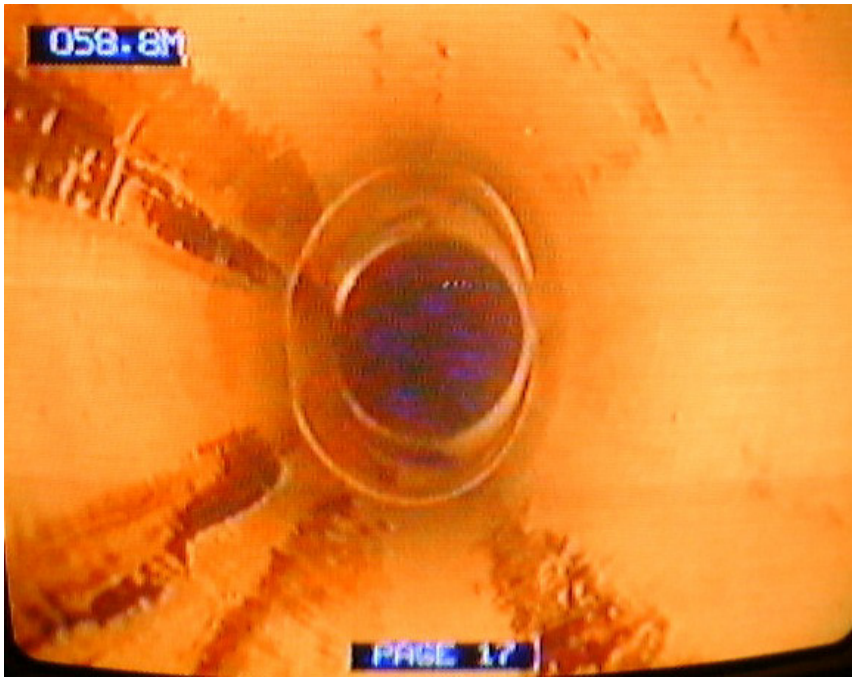
- Structural Score - 5

Comments on the photo

- The PVC section is slightly deformed between 10 and 1 o’clock.

Medium

PF, M	Deformation 10% to 25% of the pipe diameter, and there are no signs of imminent failure.



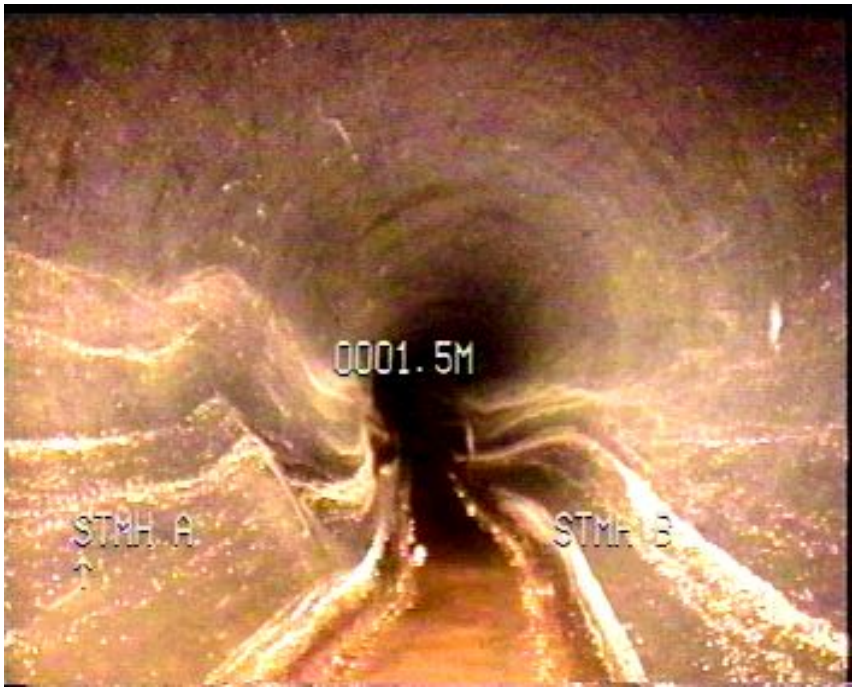
Condition Scores

- Structural Score - 10

Comments on the photo

Large

PF, L	i)	Deformation greater than 25% of the pipe diameter, or
	ii)	Deformation less than 25% of the pipe diameter and in the opinion of the operator, failure of the pipe is imminent.



Condition Scores

- Structural Score - 30

Comments on the photo

- This PE section of pipe has been subjected to external pressures sufficient to cause deformation on the left hand side. There is also an area of point pressure just to the right of the letter “A”

PH: PIPE, HOLED

Description

A hole has been cut or punched into the pipe either to gain access to the pipe or during the construction of another underground service.

If there is also an obstruction in the hole the feature is to be additionally coded as a permanent obstruction ("OP"). The surmised reason for the hole and evidence or otherwise of its repair is noted in the "Remarks" field.

If infiltration is visible through the pipe hole it is additionally coded as Infiltration Present "IP".

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes/No	Per defect	Yes	Yes	Yes	Yes/No	If Specified	Yes

Small

PH, S The hole has been repaired.

Condition Scores

- Structural Score - 5

Comments on the photo

- The photo shows a small puncture hole that appears to have been repaired.

Medium

PH, M The hole is up to 20% of the pipe circumference and has not been repaired

Condition Scores

- Structural Score - 25

Comments on the photo

- The hole is up to 20% of the pipe circumference and has not been repaired.
- An unusual one this, not sure what caused the holes. There is also a blank lateral on the left.

Large

PH, L The hole is greater than 20% of the pipe circumference and has not been repaired

Condition Scores

- Structural Score - 40

Comments on the photo

- A large hole with displaced pieces in the invert. It also looks as if a tomo may be developing, which should be code additionally as TM, L.

PL: PROTECTIVE LINING DEFECTIVE

Description

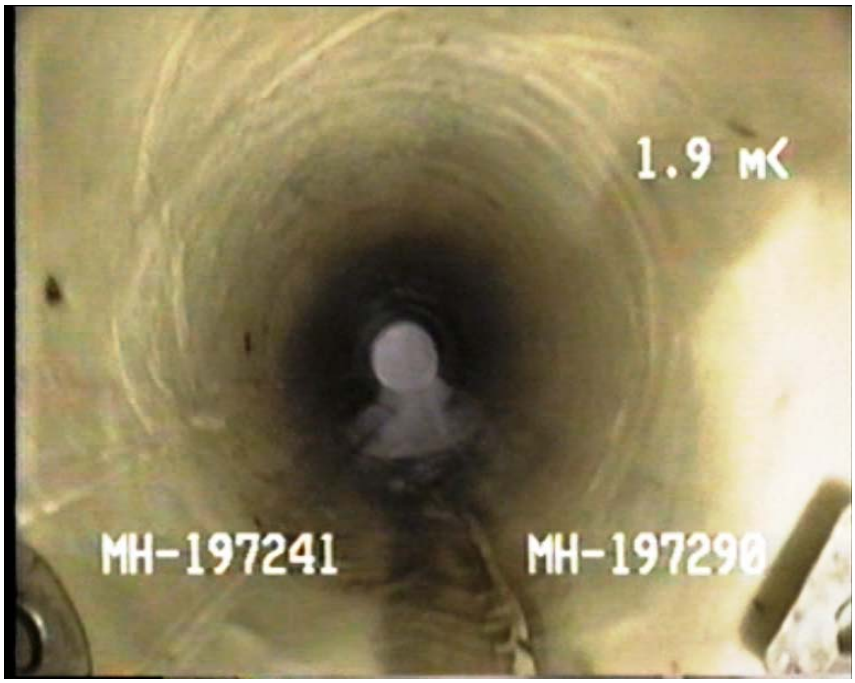
This code covers defects in pipe liners which have been installed during rehabilitation works. This may include bulges, weld failures, missing sections or separation from the pipe wall. The nature of the defects are to be noted in the “Remarks” field.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes/No	Per defect	Yes	Yes	Yes	Yes/No	If Specified	Yes

Small

PL, S Bulge 10% or less of the pipe diameter.



Condition Scores

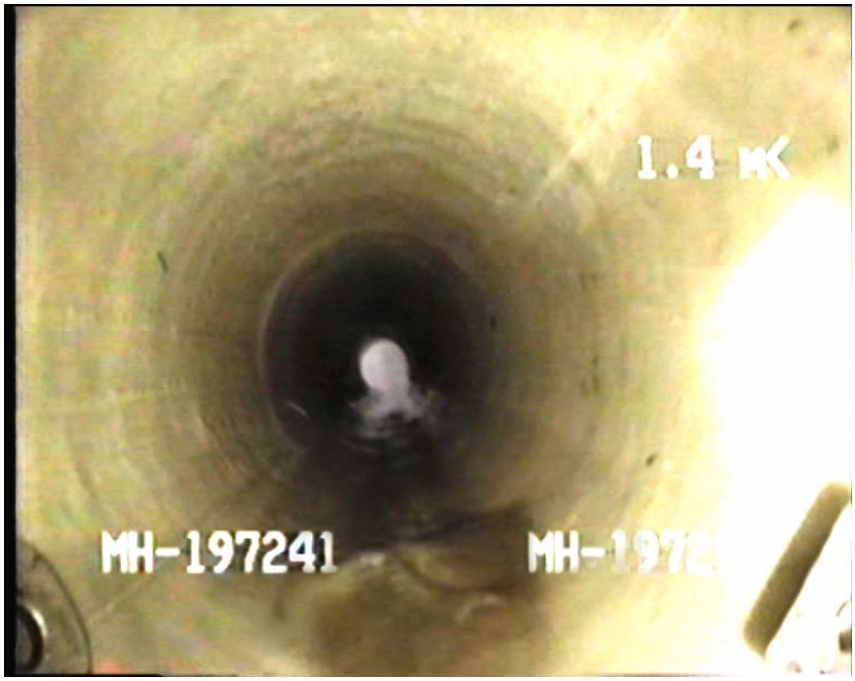
- Structural Score - 5

Comments on the photo

- A Cured In Place Pipe (CIPP) Liner has a wrinkle at 5 o’clock. This wrinkle is caused by variance in the diameter of the concrete host pipe. In this particular case, it is deemed that this defect does affect the structural integrity of the liner with this particular system, although it may impact on the serviceability of the asset..

Medium

PL, M	Bulge 10% to 25% of the pipe diameter, weld failure, small holes.



Condition Scores

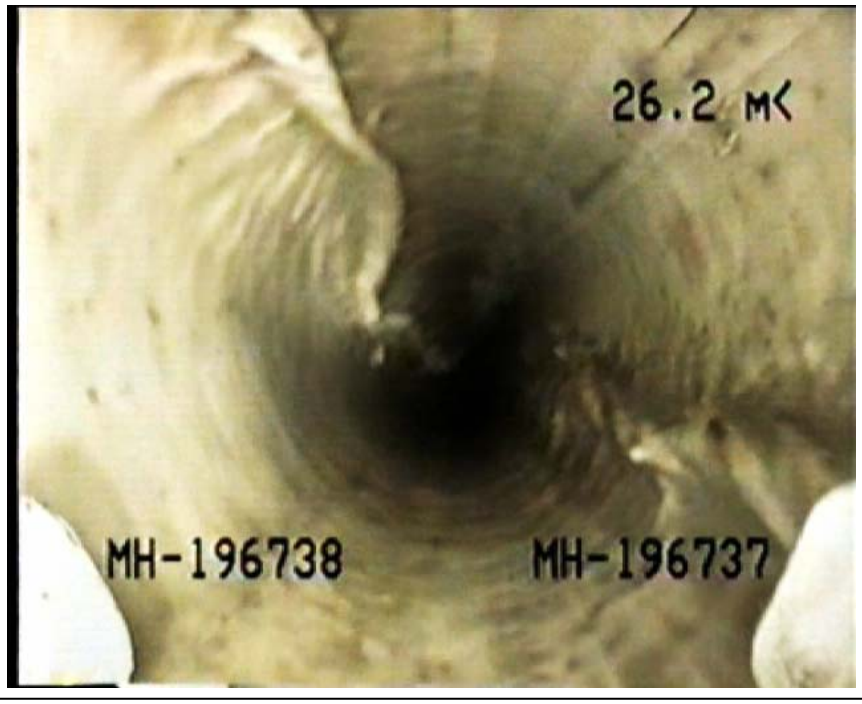
- Structural Score - 25

Comments on the photo

- A CIPP liner has been installed over a defect in the invert of the host pipe. In this particular case, it is deemed that this defect does affect the structural integrity of the liner with this particular system, although it may impact on the serviceability of the asset..

Large

PL, L	Bulge greater than 25% of the pipe diameter, missing or separated lining.



Condition Scores

- Structural Score - 60

Comments on the photo

- There is a bulge between 9 and 11 o'clock. This image has been computer enhanced.

PX: PIPE COLLAPSED

Description

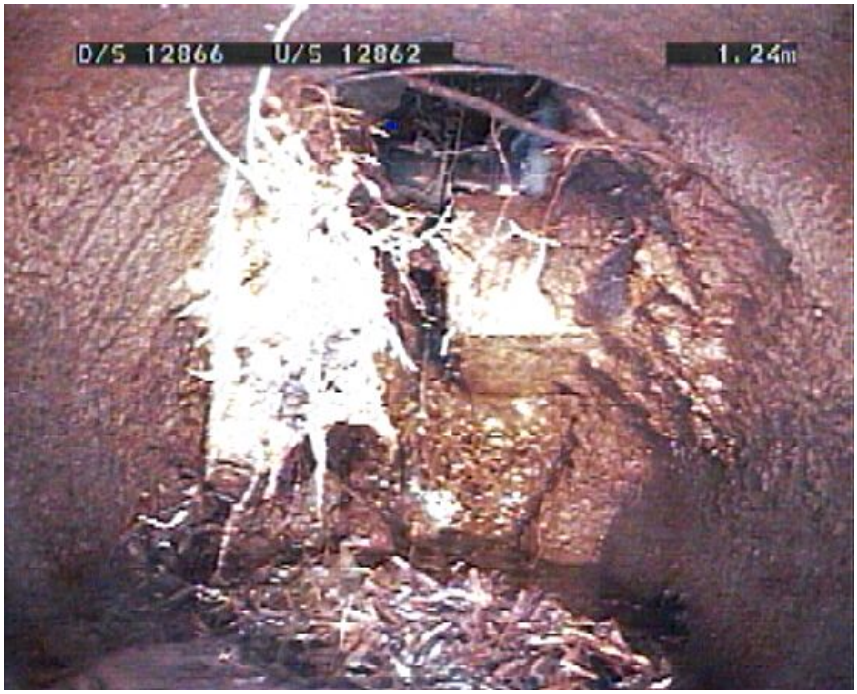
The pipe no longer functions as a free-flowing conduit, although water may still flow through the rubble of the collapsed pipe.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	No	No	If Specified	No

Large

L There is no “S” or “M” rating.



Condition Scores

- Structural Score - 100

Comments on the photo

- Debris from the collapsed pipe has fallen into the conduit and blocked it.

RI: ROOT INTRUSION

Description

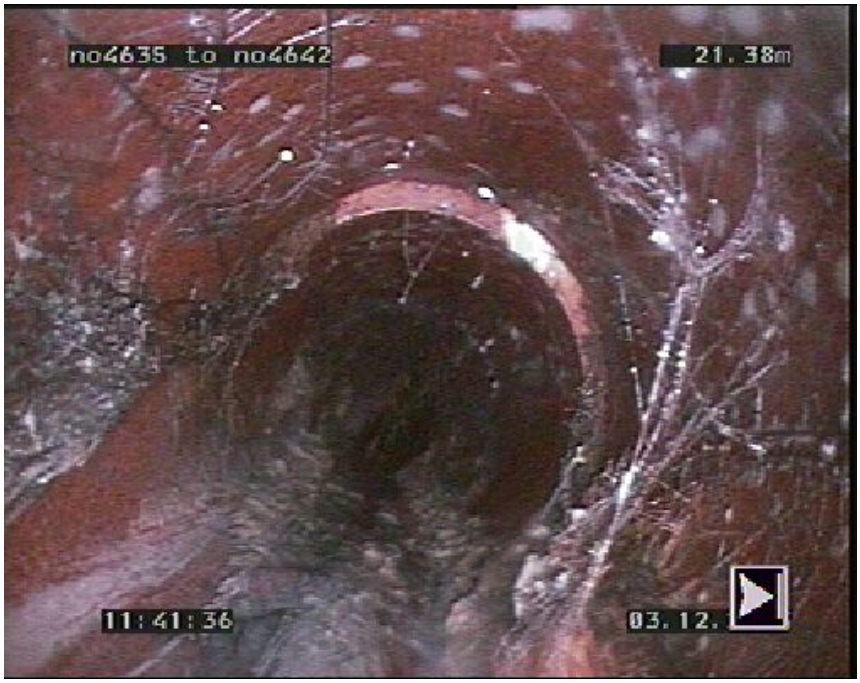
Refers to roots growing through the defects in the pipe wall or through joints. The severity of the defect depends on the amout of restriction caused by the roots. Thus a “curtain” of minor roots extending over the full pipe diameter may rate an “S” severity rating if the effect on a full pipe flow will be minor.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	Yes	Yes	Yes	If Specified	No

Small

RI, S Roots restrict flow by 10% or less of full flow.



Condition Scores

- Service Score - 5

Comments on the photo

- There are many roots, but the obstruction is less than 10%.

Medium

RI, M Roots restrict flow by 10% to 25% of full flow.

Condition Scores

- Service Score - 25

Comments on the photo

- A root mass appears to originate from the lateral which will also be coded as LF.

Large

RI, L Roots restrict flow by more than 25% of full flow.

Condition Scores

- Service Score - 70

Comments on the photo

- Total blockage

SD: SURFACE DAMAGE

Description

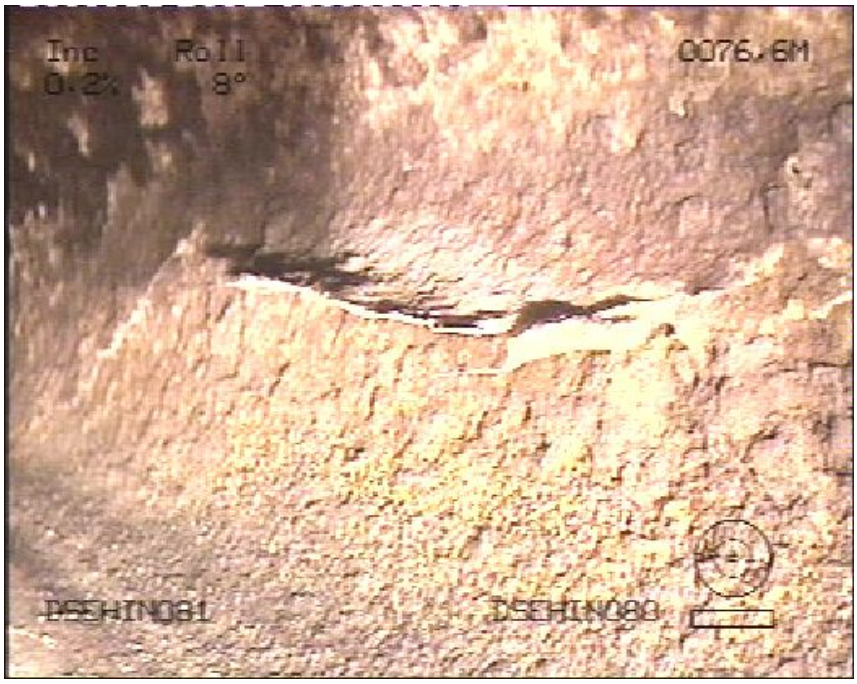
Includes chips in of the pipe, spalling, abrasive erosion or chemical corrosion. The nature of the damage is noted in the "Remarks" field. Where damage only occurs within 100mm of a joint, it is allocated a Joint Faulty "JF" code.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes	Per metre	Yes	Yes	Yes	Yes	If Specified	Yes

Small

SD, S Superficial only. Cement Lining spalled from steel pipe.



Condition Scores

- Structural Score - 3

Comments on the photo

- Minor flaking of the cement surface is evident.

Medium

SD, M	Aggregate exposed or pipe wall otherwise significantly affected. Cement lining spalled from steel pipe and evidence of corrosion in the steel.

Condition Scores

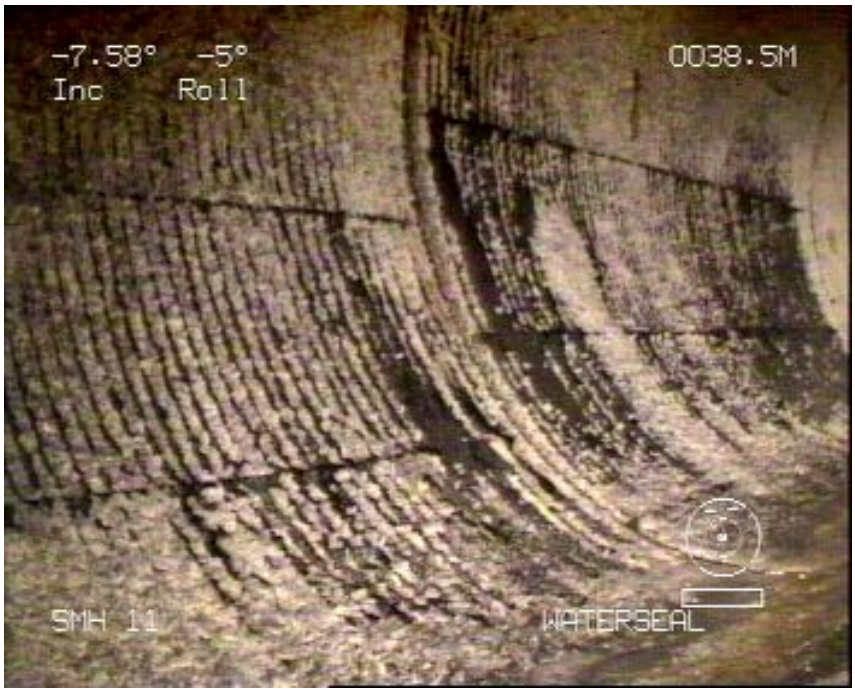
- Structural Score - 20

Comments on the photo

- Minor hydrogen sulphide attack which has removed enough concrete to expose some aggregate.

Large

SD, L	Reinforcing exposed or no longer present due to corrosion, severe corrosion or deep voids in pipe wall.



Condition Scores

- Structural Score - 60

Comments on the photo

- The uniform arrangement of the reinforcing is clearly evident.

TM: TOMO

Description

A cavity is evident outside the pipe wall. The bedding or fill material from the outside of the pipe is depleted. Generally caused by a pipe break, pipe hole or displaced joint that allows backfill material to be washed into the pipe.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes/No	Per defect	Yes	Yes	Yes	Yes/No	If Specified	Yes

Large

TM, L There is no S or M severity

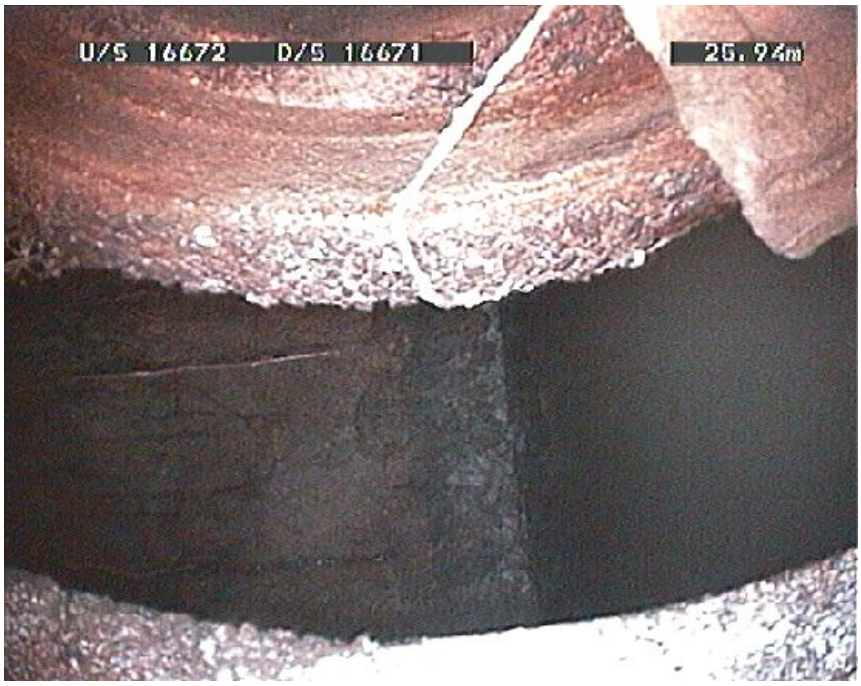
Condition Scores

- Structural Score - 40

Comments on the photo

- A large joint displacement and large joint open has resulted in the depletion of fill material.
- This fault had been coded prior to the introduction of this new code as “JD, L and JO, L”. There was nothing to alert the Engineer to the seriousness of the condition other than the operators comments and a phone call directly to the Engineer.

TM, L Supplementary photo



Comments on the photo

- This photo is of the same joint as shown on the previous page. The photo was taken during the inspection of a 375mm diameter stormwater pipe. It was situated under the corner of a house and approximately 2.5m deep. The owner of the property above the pipe reported that “occasionally” a hole appeared at the ground surface. When this occurred he would pour a “little bit more gravel” into it. Estimates place the size of this tomo at 3 cubic metres.

Feature Codes

Feature Codes identify construction Features and indicate the start and finish of an inspection. They do not attract a severity code.

CF	Construction Feature
DC	Dimension Change
GC	General Comment
IA	Inspection Abandoned
IE	Inspection Ends
IS	Inspection Start
LB	Lateral Blank
LC	Lining Change
LL	Line Deviates Left
LR	Line Deviates Right
LD	Line Deviates Down
LU	Line Deviates Up
LO	Lateral OK
MC	Material Change

CF: CONSTRUCTION FEATURE

Description

Construction features will generally be drainage fittings (other than manholes) such as inspection covers.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes/No	Per feature	Yes	No	Yes	Yes/No	If Specified	Yes

DC: DIMENSION CHANGE

Description

Record the previous and new dimensions in the “Remarks” field.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	No	No	No	If Specified	Yes

GC: GENERAL COMMENT

Description

This code is to be used for any relevant information that is not provided for elsewhere. It is not used for defects of any nature. Defects are to be coded under the specific defect code.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes/No	Per comment	Yes	No	Yes/No	Yes/No	If Specified	Yes

IA: INSPECTION ABANDONED

Description

The final code for inspections that are abandoned prior to reaching the finish node. The reason for the abandonement is noted under the “Remarks” field. If the abandonement is due to a defect, the defect is recorded separately.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes/No	Per feature	Yes	No	Yes	Yes/No	If Specified	Yes

IE: INSPECTION ENDS

Description

The final code for all inspections, unless an inspection is abandoned prior to reaching the finish node, in which case the final record is “IA”. The “Remarks” field is used to record the feature and, if relevant, the identifier of the node where the inspection ends, ie Manhole 123456.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	No	No	No	If Specified	Yes/No

IS: INSPECTION STARTS

Description

The first entry for all condition record data sheets. Any unusual features at the start of the inspection are recorded in the “Remarks” field.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	No	No	No	If Specified	Yes/No

LB: LATERAL, BLANK

Description

There is visible evidence that the lateral is blank, e.g. an end cap can be seen. The estimated diameter of the lateral is recorded in the “Remarks” field.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	No	Yes	No	If Specified	Yes/No

LC: LINING CHANGE

Description

Records the start and end of any inserted lining in the original pipe. Record the lining type in the “Remarks” frilled.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	No	No	No	If Specified	Yes

LL, LR, LD, LU: LINE DEVIATES LEFT, RIGHT, DOWN, UP

Description

Records significant changes in the grade or direction of the pipeline.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	No	N/A	Yes	No	No	No	If Specified	No

LO: LATERAL EXISTS, OK

Description

Satisfactory lateral connection that meets the specification of the pipe manufacturer and would not otherwise attract a condition code of LB, LF, LP or LX. Any connection that is not either a manufactured wye or saddle would need to be of particularly high quality to attract this code. The estimated diameter of the lateral is recorded in the “Remaks” field.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes/No	Per feature	Yes	No	Yes	Yes/No	If Specified	Yes

MC: MATERIAL CHANGE

Description

Record the previous and new pipe materials in the “Remarks” field. Also record the joint spacing for the new pipe material if it is longer than one pipe length.

Data Entry Requirements

Video Reading	Distance From	Distance To	Continuity	Condition Code	Severity Rating	Position From	Position To	Photo (s)	Remarks
VHS - Yes DVD, CD – No	Yes	Yes/No	Per feature	Yes	No	Yes	Yes/No	If Specified	Yes

INTERESTING PHOTOGRAPHS

PLUG IN A LATERAL

Comments on the photo

- A drainage plug has been installed into a lateral at some point to abandon the lateral. This is generally not standard procedure!
- Defect Code; OP, L

PIECE OF WOOD JAMMED IN THE LINE

Comments on the photo

- A piece of wood has floated down the line and is just the right length to jam across a slightly displaced joint.
- Defect Code; OP, L

TOMO

Comments on the photo

- Difficult to get into perspective, however a large tomo has developed due to a pipe fault.
- Defect Code; TM, L

TOMO, BRICK LINE

Comments on the photo

- A large oval/egg shape brick line. The catastrophic result of a few missing bricks.
- Defect Code; TM, L

MAJOR INFILTRATION

Comments on the photo

- This photo was taken during a walk through inspection of a Watercare trunk sewer in Auckland. Core samples had been taken of the concrete pipe to determine thickness and strength. The resulting ground water infiltration was interesting to say the least. The core sample holes were later repaired.
- Defect Code; IP, L

MAJOR INFILTRATION

Comments on the photo

- More infiltration
- Defect Code; IP, L

MAJOR INFILTRATION

Comments on the photo

- And again
- Defect Code; IP, L

MAJOR INFILTRATION

Comments on the photo

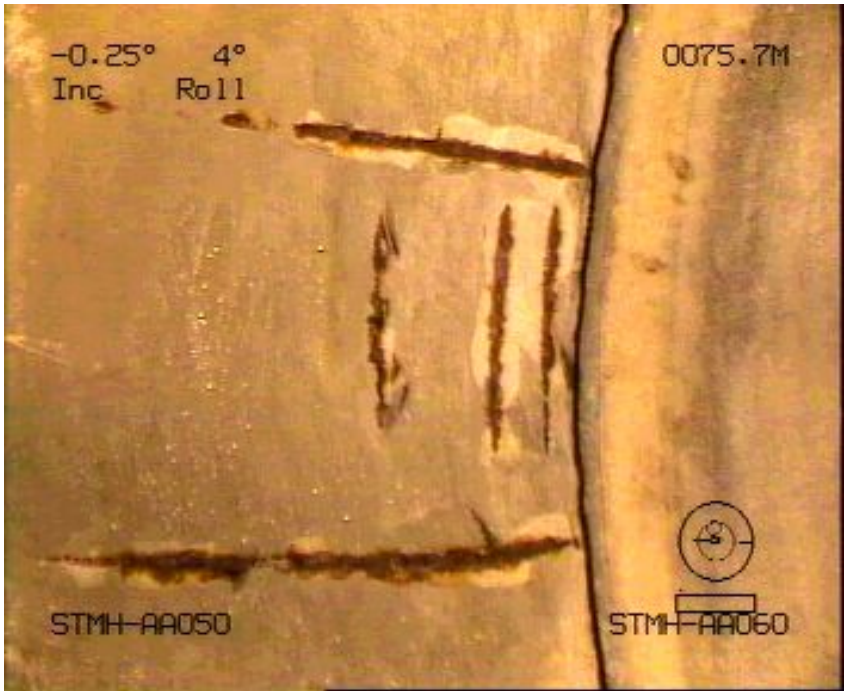
- More
- Defect Code; IP, L

MAJOR ENCRUSTATION

Comments on the photo

- Iron Oxide encrustation in a brick sewer.
- Defect Code; ED, L

SUBSTANDARD MANUFACTURE



Comments on the photo

- There is very little, if any indication of surface damage to the pipe wall in this instance, however the rebar is showing indicating that the quality of manufacture may have been substandard.
- Defect Code, SD, L with added remarks.

SURFACE DAMAGE

Comments on the photo

- Surface damage by way of Hydrogen Sulphide attack extends through the pipe wall thickness
- Defect Code, SD, L with added remarks.

SEWER INHABITANTS

Comments on the photo

- An example of vermin that may inhabit our sewers and stromwater pipes.
- Defect Code; GC with added remarks.

SEWER INHABITANTS

Comments on the photo

- A possum!
- Defect Code; GC with added remarks.

WHAT HAS CHANGED IN THE CODES?

- All photos of relevant defects have been updated.
- Clearer layout with severity ratings attached to the photos.
- A commentary with each photo.
- Description changes as below.

Table 6-1 – Changes to Condition Codes

Code	Defect	Change
CC	Crack, Circumferential	"Crack obviously through to the outside wall" changed to "there is evidence that the crack extends to the outside wall"
CL	Crack, Longitudinal	As per "CC". If there are cracks at 3 of the four quadrants the defect is to be coded as Deformed Pipe "DF".
CM	Crack, Multiple	As per "CC".
DE	Debris, Silty	Nil
DF	Deformed Pipe	Stated that this code relates to rigid pipe only. Small severity deleted. Reference to deformation without cracking deleted.
DG	Debris, Greasy	Nil
DP	Dipped Pipe	Nil
ED	Encrustation Deposits	Removed reference to "pipe wall"
IP	Infiltration Present	Removed statement that if there is an encrustration present then an "IP" code should also be allocated. "IP" code is only required if infiltration is visible.
JD	Joint, Displaced	Recording of small severity defects made optional. Client to specify if required.
JF	Joint, Faulty	Reference to passage of service equipment removed from defect description. Defects that affect the joint seal are coded as large serverity.
JO	Joint, Open	Recording of small severity defects made optional. Client to specify if required.
LF	Lateral, Sealing Faulty	Name change to focus more on the sealing of the lateral to the mainline. Lateral diameter to be recorded in "Remarks" field.
LP	Lateral, Protruding	Lateral diameter to be recorded in "Remarks" field.
LX	Lateral, Problem	Lateral diameter to be recorded in "Remarks" field.
OP	Obstruction, Permanent	Reference to specialist cleaning equipment added. Mortar and PE beading is now covered under this code.
OT	Obstruction, Temporary	Reference to specialist cleaning equipment added.
PB	Pipe, Broken	Nil
PF	Deformed Plastic Pipe	Reference to profiling added
PH	Pipe, Holed	Reference to infiltration at pipe hole as a definition of serverity has been deleted.
PL	Protective Lining Defective	Nil
PX	Pipe, Collapsed	Nil
RI	Root Intrusion	Nil

Code	Defect	Change
SD	Surface Damage	If reinforcement no longer exists the defect is now allocated an “L” serverity.
TM	Tomo	New code added

Table 6-2 - Changes to Feature Codes

Code	Feature	Change
CF	Construction Feature	Nil
DC	Dimension Change	Nil
GC	General Comment	Nil
IA	Inspection Abandoned	Removal of reference to deletion of IA code if the inspection is later completed
IE	Inspection Ends	Clarification of identifier.
IS	Inspection Start	Nil
LB	Lateral Blank	Lateral diameter to be recorded in “Remarks” field.
LC	Lining Change	Nil
LL	Line Deviates Left	Nil
LR	Line Deviates Right	Nil
LD	Line Deviates Down	Nil
LU	Line Deviates Up	Nil
LO	Lateral OK	Reference to manufactured wyes and saddles added. Lateral diameter to be recorded in “Remarks” field.
MC	Material Change	Nil

SAMPLE FORMS

Sample Forms

CCTV INSPECTION LOG SHEET

CONTRACT NO	CLIENT	ASSET NO	DATE STARTED	TIME STARTED	TIME COMPLETED	PAGE	OF
						01	

DRAWING NO	CONTRACTOR	OPERATOR	CAMERA OPERATOR	RECORD NO	RECORDING START	RECORDING FINISH

NODE TYPE	UPSTREAM MANHOLE/NODE NO	DEPTH (m)	STREET NO	STREET NAME

NODE TYPE	DOWNSTREAM MANHOLE/NODE NO	DEPTH (m)	STREET NO	STREET NAME

SET-UP MANHOLE		PARALLEL LINE NO	LINE LENGTH (m)	SURVEYED LENGTH (m)	DIAMETER (mm)	JOINT SPACING (m)	MATERIAL	SHAPE	USE
U	D								

LOCATION	SURFACE	WEATHER	FLOW DEPTH

CURRENCY OF INSPECTION		STATUS OF PIPE		INSPECTION COMPLETENESS		VIDEO RECORD FORMAT	DATE OF DATA ENTRY
CI CURRENT	SI Superseded	OC ORIGINAL	RC Rehab	IC Complete	UI Uncomplete		

COMMENTS

VIDEO READING	DISTANCE FROM (m)	DISTANCE FROM (m)	CONDITION CODE	SEVERITY	POSITION FROM	POSITION TO	PHOTO NO	REMARKS
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
	■	■						
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CCTV INSPECTION LOG SHEET: CONTINUATION PAGE

CONTRACT NO	CLIENT	DATE	PAGE	OF
			01	

UPSTREAM MANHOLE/NODE NO	DOWNSTREAM MANHOLE/NODE NO	ASSET NO

VIDEO READING	DISTANCE FROM (m)					DISTANCE FROM (m)					CONDITION CODE		SEVERITY	POSITION		PHOTO NO		REMARKS
														FROM	TO			
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VIDEO SUMMARY SHEET

CONTRACT NO	CLIENT	ASSET NO	RECORD NO	PAGE	OF
				01	

DATE	COUNTER	AREA (OR TOWN)	UPSTREAM MANHOLE	DOWNSTREAM MANHOLE

CCTV INSPECTION AUDIT REPORT

Quality Audit Ref #

Contractor	Contract No	Catchment	Operator	Asset No

U/S UFI	U/S UFI	Video Number	Log Sheet Printed	Survey Date	Survey Time

Grade 1 Errors

Tape or DVD correctly labelled	
Screen header is correct	
Continuous information displayed correctly	
Missing or incorrect mandatory header information	
Distance counter zeroed at manhole centre	
There is a clear view of the camera entering the pipe	
Camera not aligned in the centre of the pipeline	
Pipe cleaning not to standard (every 10m of pipe is considered as one entry)	
Water level in pipeline is not acceptable	
Picture quality not acceptable or not in focus or light intemsity is not acceptable (every 10m of pipe is considered as one entry)	
Camera speed too fast or too slow (every 10m of pipe is considered as one entry)	
Camera does not stop at defect	
Features not recorded	
"M" and "L" defects not recorded	
Severity ratings, "S" instead of "L" or "L" instead of "S"	
Incorrect distance recorded to defect or features	
Total No. Grade 1 Errors (G1)	

Grade 2 Errors

Missing or incorrect additional header information	
"S" defects not recorded	
Condition record information not recorded e.g. "IA" and "IE"	
Incorrect Condition codes	
Position to & from (clock references) recorded incorrectly	
Still imges do not clearly show the defect	
Total No. Grade 2 Errors(G2)	

Required number of entries (RE)

ACCURACY LEVEL (Acceptable Result >= 98%) *****

****= ((RE-G1-(0.5xG2))/RE%***

Audit Result

Comments and/ or follow up required

Action Required:

Audited By		Audit Date		Audit Status	

MANHOLE INSPECTION REPORT

CONTRACT NO	CLIENT	DATE STARTED	DATE COMPLETED	CONTRACTOR	OPERATOR

MANHOLE NUMBER			DEPTH TO INVERT(m)	THROAT DEPTH	THROAT DIAMETER
	LOCATED	BURIED			

CATCHMENT - ADDRESS	DEBRIS / SILT BUILT UP	WEATHER	INSPECTION STATUS
	DEPTH m		

MANHOLE CONSTRUCTION

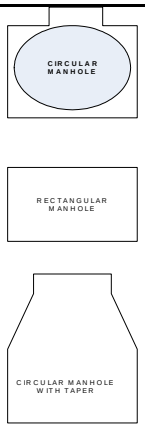
	PRECAST	CAST in SITU	MATERIAL	CONDITION
LID				
COVER				
WALL				

Wall diameter 1050, 1200, 1500, 1800, 2400, >2400…….others

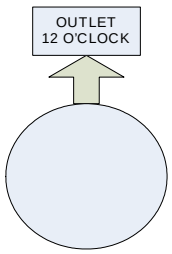
	Clock	Depth m	Diameter mm	Drop Int	Drop Ext	Drop No	Connect To	Features
Outlet # 1								
Outlet # 2								
Inlet # 1								
Inlet # 2								
Inlet # 3								
Inlet # 4								
Inlet # 5								

MANHOLE SKETCH

SELECT TYPE OF MANHOLE



DETAILS OF MANHOLE



Components:Check List	Defects Description	Present Y	Present N	Location Component	Location Depth	Location Clock	Severity
Base; Outlet Pipe; Inlet Pipe							
Riser; Riser Joint; Rung	Structural Cracks / Holes						Size hole/ crack…….mm
Throat; Cover	Structural Cracks / Holes						Size hole/ crack…….mm
	Structural Cracks / Holes						Size hole/ crack…….mm
	Structural Cracks / Holes						Size hole/ crack…….mm
	Root Intrusion						Max dia. roots…….mm
	Root Intrusion						Max dia. roots…….mm
	Root Intrusion						Max dia. roots…….mm
	Root Intrusion						Max dia. roots…….mm
	Displaced Component						Displacement…….mm
	Displaced Component						Displacement…….mm
	Displaced Component						Displacement…….mm
	Displaced Component						Displacement…….mm
	Loose / Defective Components						
	Loose / Defective Components						
	Loose / Defective Components						
	Loose / Defective Components						
	Active Infiltration						Seeping/ running / gushing
	Active Infiltration						Seeping/ running / gushing
	Active Infiltration						Seeping/ running / gushing
	Active Infiltration						Seeping/ running / gushing

NOTES:

General Comments:

Work recommended:

Review	
Record Reviewed	
Reviewed by	

Approval	Visual Inspection Approved	
Approved by		
Date approved		