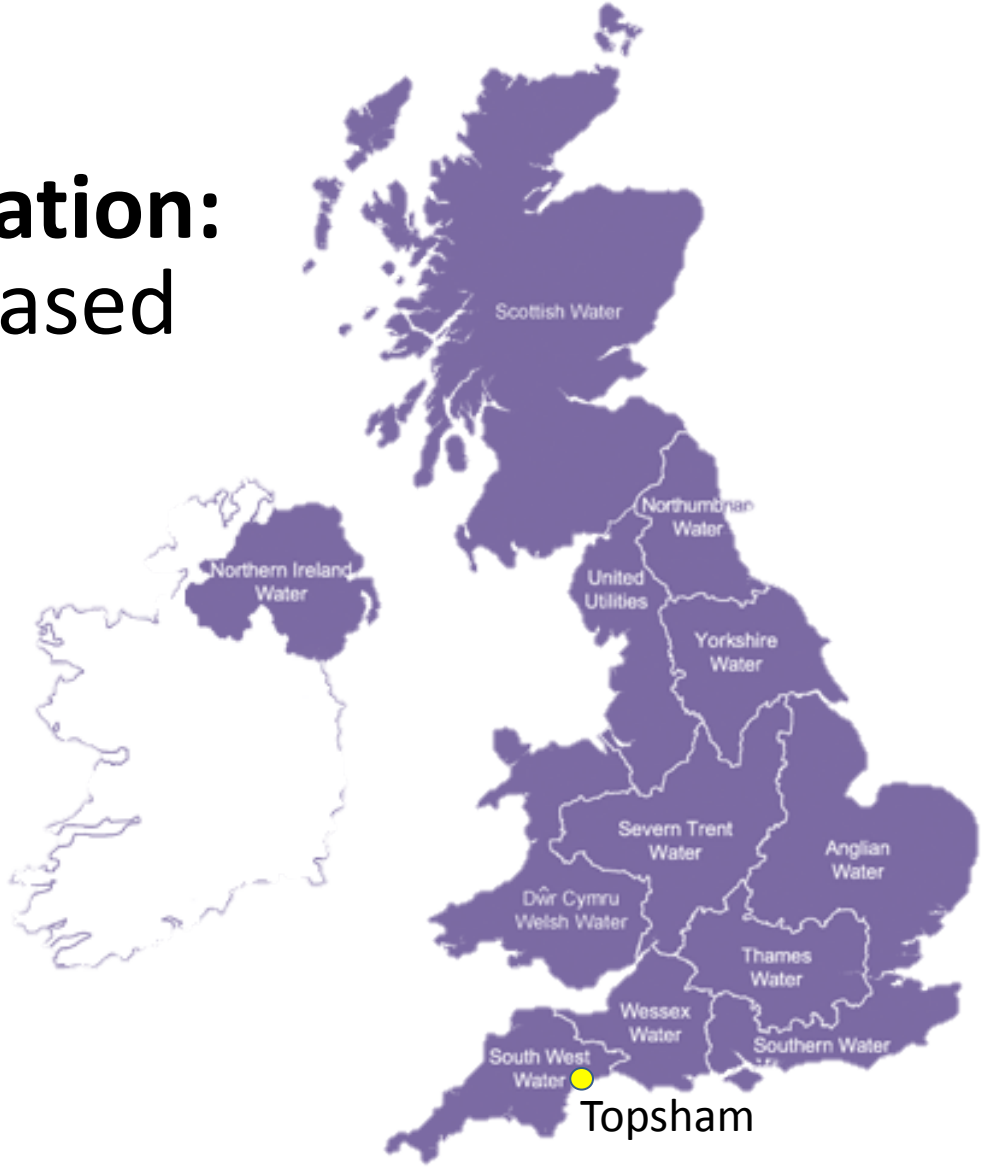
electro scan inc.

Benchmark Demonstration:
Comparison of WRc-based CCTV Inspections v. Electro Scanning

Topsham, England
8 November 2012



Presented in Cooperation with
South West Water
Pell Frischmann, and
Electro Scan Inc.

electro scan inc.

Pell Frischmann*

Consulting Engineers

Selected Attendees

SOUTH WEST WATER

Wessex Water

a YTL company

AECOM

Hyder Consulting

Upstream Pipeline Services

sdi-unistride

drainage solutions

exjet

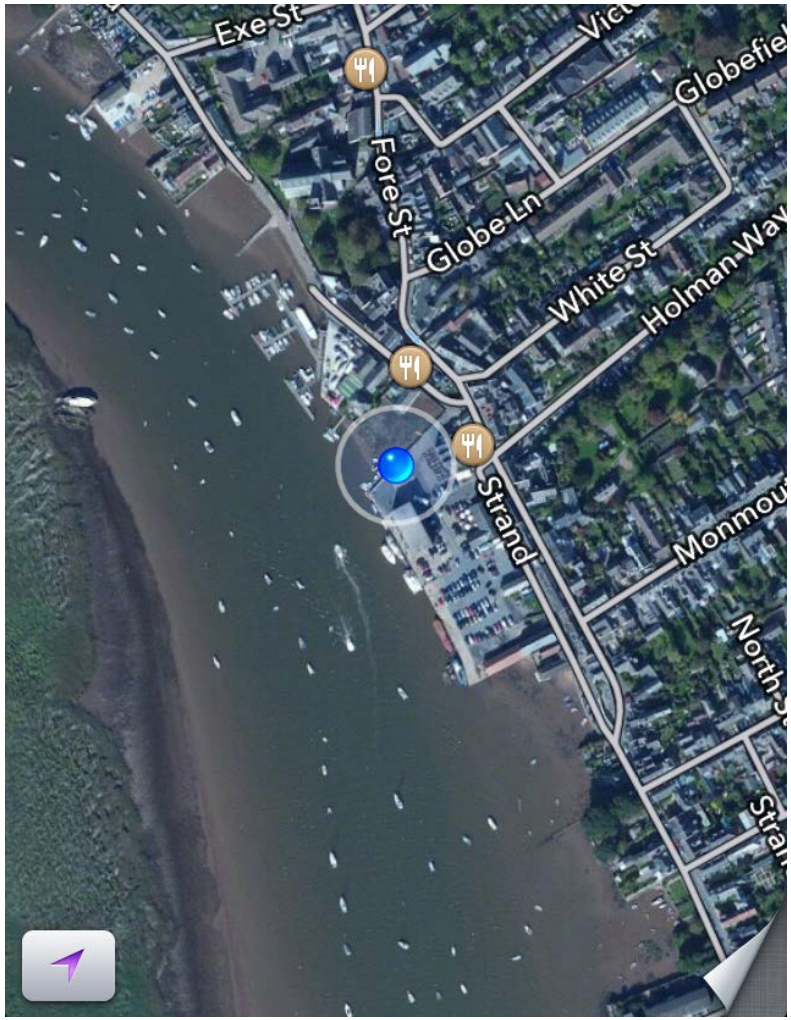
OnSite

Ant Hire Ltd

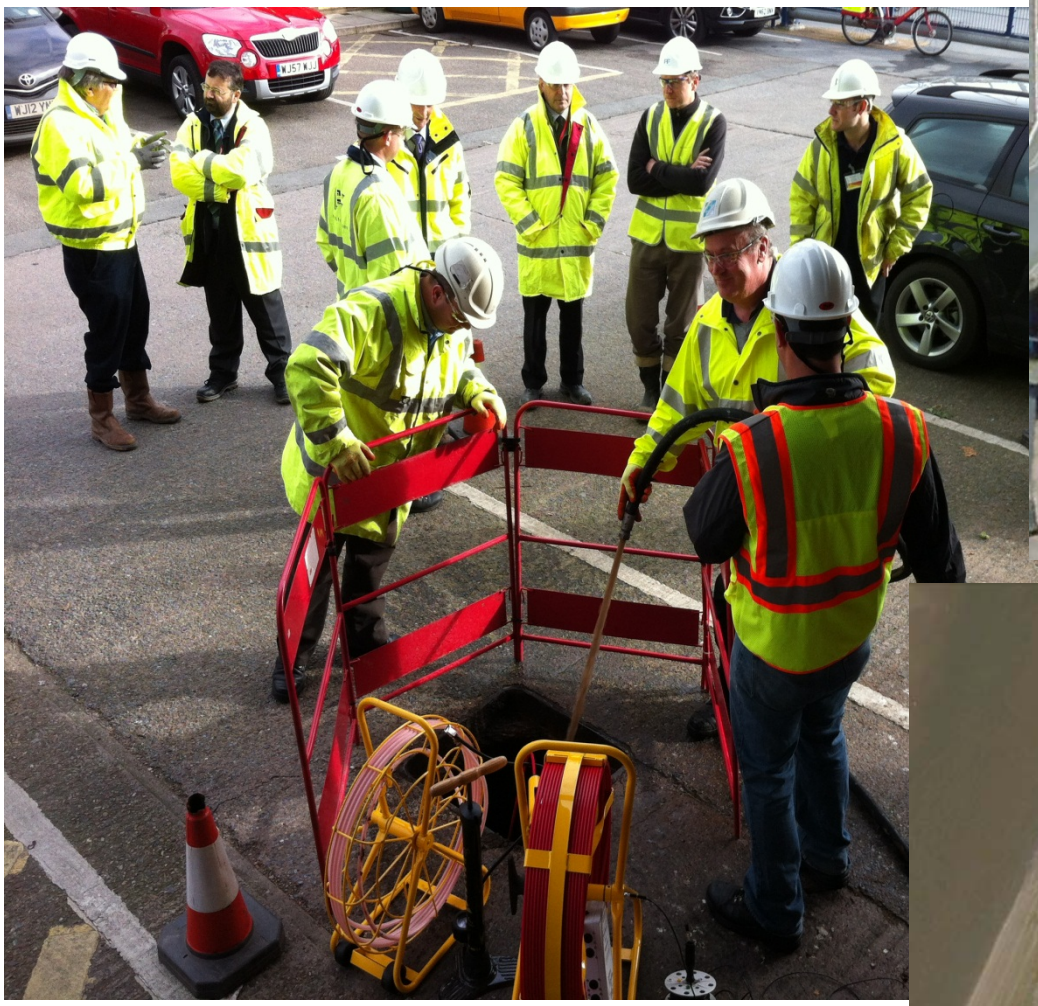
The Specialist Hire & Sales Company

* **A Special Thanks to Pell Frischmann Consulting Engineers for hosting Electro Scan's Inaugural Demonstration in the UK, Thursday 8 November in Topsham (near Exeter).**

Topsham Demonstration 8 Nov 2012

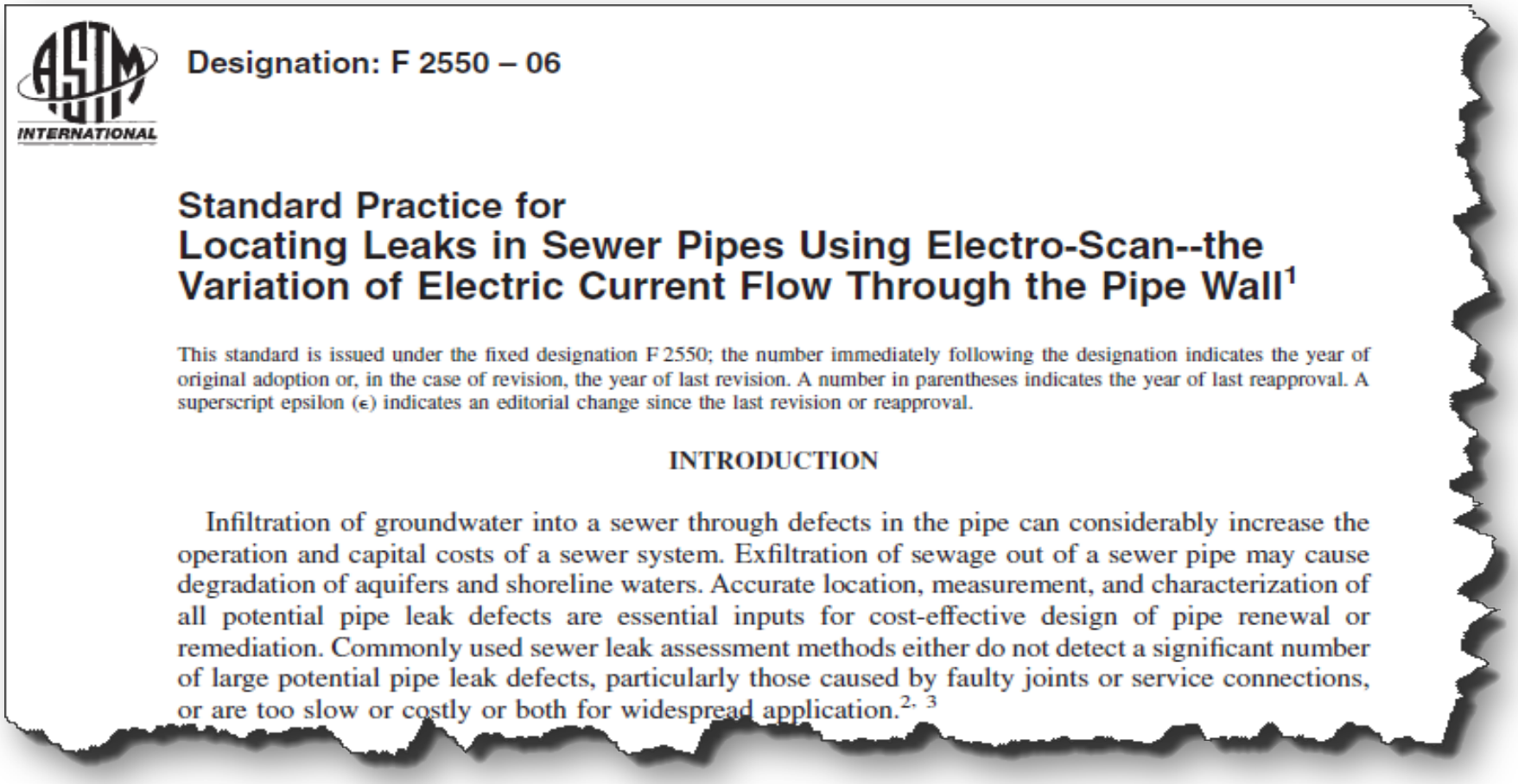


Topsham Demonstration 8 Nov 2012



Challenge

Use Electro Scan ,in accordance with ASTM F2550-06, to assess a UK sewer pipe that had been previously televised, in accordance with WRc UK CCTV standards, that found no evidence of infiltration or leaks.



Designation: F 2550 – 06

Standard Practice for Locating Leaks in Sewer Pipes Using Electro-Scan--the Variation of Electric Current Flow Through the Pipe Wall[1]

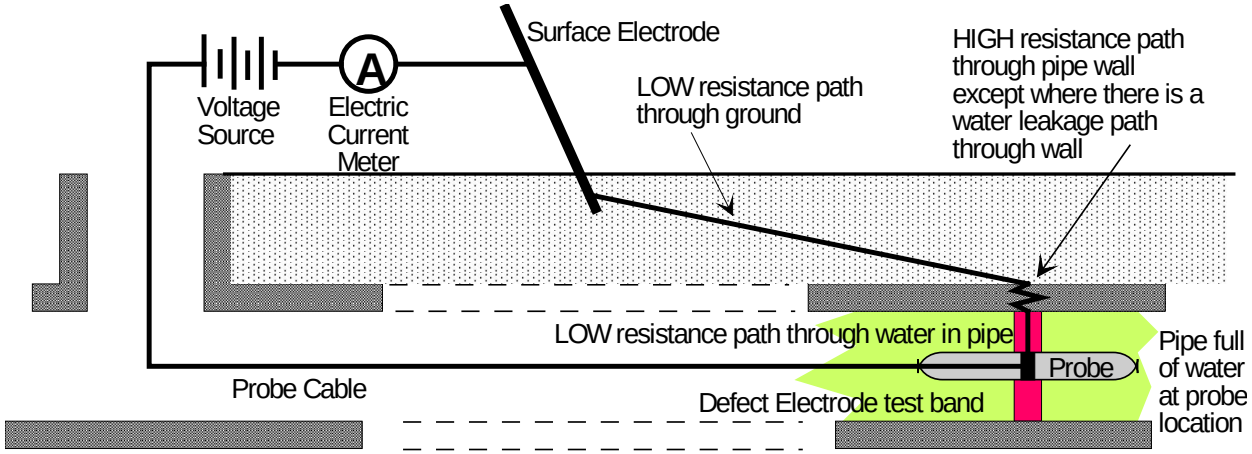
This standard is issued under the fixed designation F 2550; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

Infiltration of groundwater into a sewer through defects in the pipe can considerably increase the operation and capital costs of a sewer system. Exfiltration of sewage out of a sewer pipe may cause degradation of aquifers and shoreline waters. Accurate location, measurement, and characterization of all potential pipe leak defects are essential inputs for cost-effective design of pipe renewal or remediation. Commonly used sewer leak assessment methods either do not detect a significant number of large potential pipe leak defects, particularly those caused by faulty joints or service connections, or are too slow or costly or both for widespread application.[2, 3]

http://www.astm.org/Standards/F2550.htm

Principle of Operation



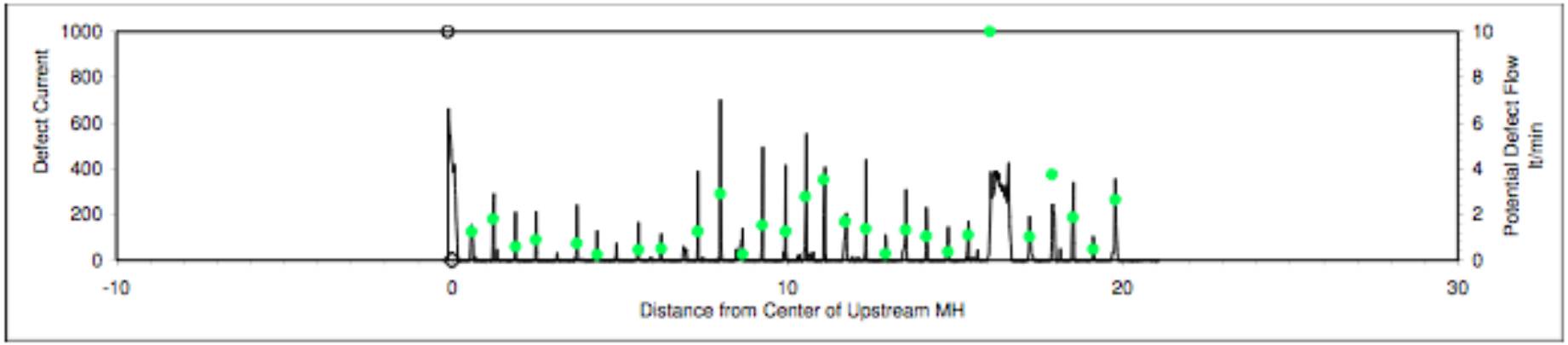
- Electro-scanning is carried out by pulling the probe through the pipe at a speed of 10 m/minute (30 ft/minute) and measuring the variation of electric current flowing between the probe and the fixed electrode on the surface. When the probe is close to a pipe defect the electric current increases because the defect decreases the electrical resistance of the pipe wall. The probe is designed to measure only that electric current which flows through a circular test band around the pipe wall. The test band is about 30 mm (1 inch) wide and located at the middle of the probe.

- As the probe is pulled through the pipe the electric current flow and the position of the probe in the pipe are recorded and displayed in real time as a “current trace” on a notebook computer (Figure 5). When the middle of the probe is within 20 to 30 mm of a defect in the pipe wall the electric current through the pipe wall increases, attaining a maximum value when the center of the probe is radially aligned with the defect.

Run 1 Analysis

ANOMALY ANALYSIS						
Anomaly Picking Threshold	100.00	Grade Current Levels	Number	Length	% Length of Pipe Tested	% of Total Anomaly Length
Grade	Large	>700	1	0.0	0%	1%
	Medium	700 to 400	6	0.7	3%	72%
	Small	<400	21	0.3	1%	27%
	Total		28	1.0	5%	100%

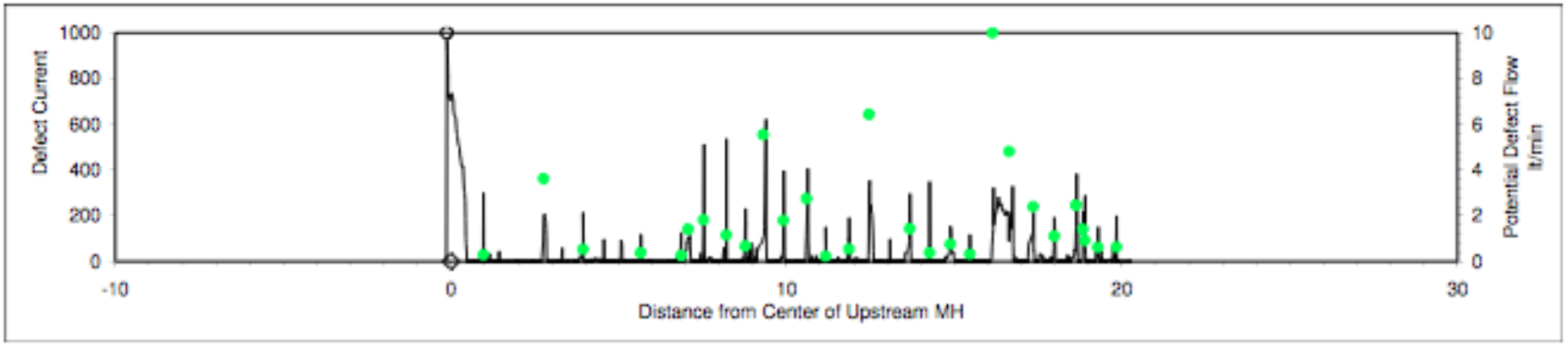
Grade Flow Levels	Number	Flow lt/min	Flow lt/sec
>15	1	40.7	0.6783
15 to 5	0	0.0	0.0
<5	27	36.8	0.6133
<1	28	77.5	1.2916



Run 2 Analysis

ANOMALY ANALYSIS						
Anomaly Picking Threshold	100.00	Grade Current Levels	Number	Length	% Length of Pipe Tested	% of Total Anomaly Length
Grade	Large	>700	0	0.0	0%	0%
	Medium	700 to 400	4	0.2	1%	13%
	Small	<400	24	1.0	5%	87%
	Total		28	1.2	6%	100%

Grade Flow Levels	Number	Flow lt/min	Flow lt/sec
>15	1	23.0	0.3833
15 to 5	2	12.0	0.2000
<5	25	32.6	0.5433
<1	28	67.6	1.126



Topsham Defect Analysis

Run 1

ANOMALY ANALYSIS						
Anomaly Picking Threshold	100.00	Grade Current Levels	Number	Length	% Length of Pipe Tested	% of Total Anomaly Length
Grade	Large	>700	1	0.0	0%	1%
	Medium	700 to 400	6	0.7	3%	72%
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	Total		28	1.0	5%	100%

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Run 2

ANOMALY ANALYSIS						
Anomaly Picking Threshold	100.00	Grade Current Levels	Number	Length	% Length of Pipe Tested	% of Total Anomaly Length
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	Medium	700 to 400	4	0.2	1%	13%
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	Total		28	1.2	6%	100%

Grade Flow Levels	Number	Flow lt/min	Flow lt/sec
>15	1	23.0	0.3833
15 to 5	2	12.0	0.2000
<5	25	32.6	0.5433
<1	28	67.6	1.126

Notes:

- A variance of defect quantification within the expected + or – 20% range is shown as expected. This generally occurs as a result of changes in the nature of the contact between the pipe wall and ground in the trench. As more water is forced out through a defect, it pushes the earth away from the pipe, slightly reducing the amplitude of electrical leakage.
- Due to the grading of defects occurring at a definite point (ie. 700) some defects may be graded differently as this + or – 20% variance occurs.

Topsham Defect Analysis

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
-0.117	0.205	322	554	M
2.79	2.88	90	249	S
3.951	3.951	0	161	S
4.563	4.563	0	116	S
5.072	5.072	0	112	S
5.664	5.664	0	132	S
7.542	7.564	22	581	M
8.221	8.221	0	113	S
8.778	8.778	0	238	S
9.388	9.676	288	695	M
9.93	9.947	17	422	M
10.637	10.689	52	423	M
11.869	11.869	0	191	S
12.398	12.424	26	128	S
12.48	12.649	169	479	M
13.079	13.079	0	132	S
13.676	13.707	31	317	S
14.901	14.901	0	116	S
15.462	15.462	0	117	S
16.68	16.68	0	130	S
16.743	16.76	17	242	S
17.355	17.369	14	138	S
17.981	17.992	11	202	S
18.642	18.667	25	385	S
18.851	18.883	32	168	S
18.901	18.912	11	284	S
19.296	19.32	24	188	S
19.836	19.836	0	200	S

Notes:

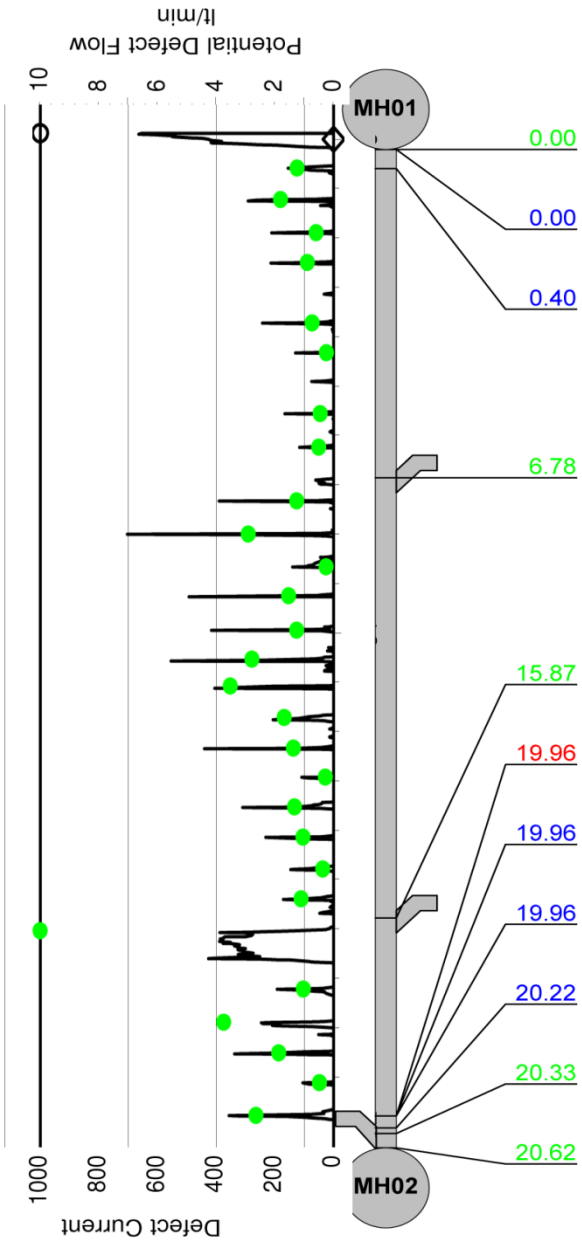
- Defect location appears to be offset from CCTV measurements by as much as 0.13 m (towards end of pipe) due to differences in zeroing of data cable, and potential slack in CCTV data cable.
- Defects with length reading of ‘0’ are considered radial pipe defects of < 10mm in size.
- Regular interval of defects indicated many leaking joints.

Electro Scan and CCTV Comparison

Electro Scan	
Size Grading of Defect	Number of Defects Identified
Small	24
Medium	4
Large	0
Total	28

CCTV		
Nature of Defect	Number of Defects Identified	Grade
Structural	1	1
Service	3	4

Electro Scan and CCTV Comparison



0.00		MH	Start node type, manhole, reference number : MH01	00:00:00	(Constr) 0
0.00	S01	DEG	Attached deposits, grease, from 6 to 5 o'clock, 5% cross-sectional area loss, Start	00:00:00	(Serv) 3
0.40		WL	Water level, 5% of the vertical dimension	00:00:12	(Serv) 0
6.78		JN	Junction, at 9 o'clock, diameter 100mm	00:01:58	(Constr) 0
15.87		JN	Junction, at 10 o'clock, diameter 100mm	00:04:22	(Constr) 0
19.96		OJM	Open joint, medium	00:05:33	(Struct) 1
19.96		DEE	Attached deposits, encrustation, from 7 to 11 o'clock, 5% cross-sectional area loss	00:05:33	(Serv) 3
19.96		DEE	Attached deposits, encrustation, from 3 to 5 o'clock, 5% cross-sectional area loss	00:05:33	(Serv) 3
20.22	F01	DEG	Attached deposits, grease, from 6 to 5 o'clock, 5% cross-sectional area loss, End	00:06:22	(Serv) 3
20.33		JN	Junction, at 3 o'clock, diameter 100mm	00:06:22	(Constr) 0
20.62		MHF	Finish node type, manhole reference number: MH02	00:06:47	(Constr) 0

CCTV Screenshot Comparisons

The following analysis shows a screenshot taken at the location of each defect identified with Electro Scan in this trial.

Notes:

- Visual comparisons will note distances slightly less than those recorded on Electro Scan report. This is due to the need to stop the camera short of defects in order to get a screenshot of them.

Defect Identified: Manhole Connection Defect

CCTV Call Out: None

No Photo Available on CCTV video. Inspection started at 0.4m

Notes: Most significant leak in pipe.

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
-0.117	0.205	322	554	M

Defect Identified: Joint Defect

CCTV Call Out: None

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
2.79	2.88	90	249	S

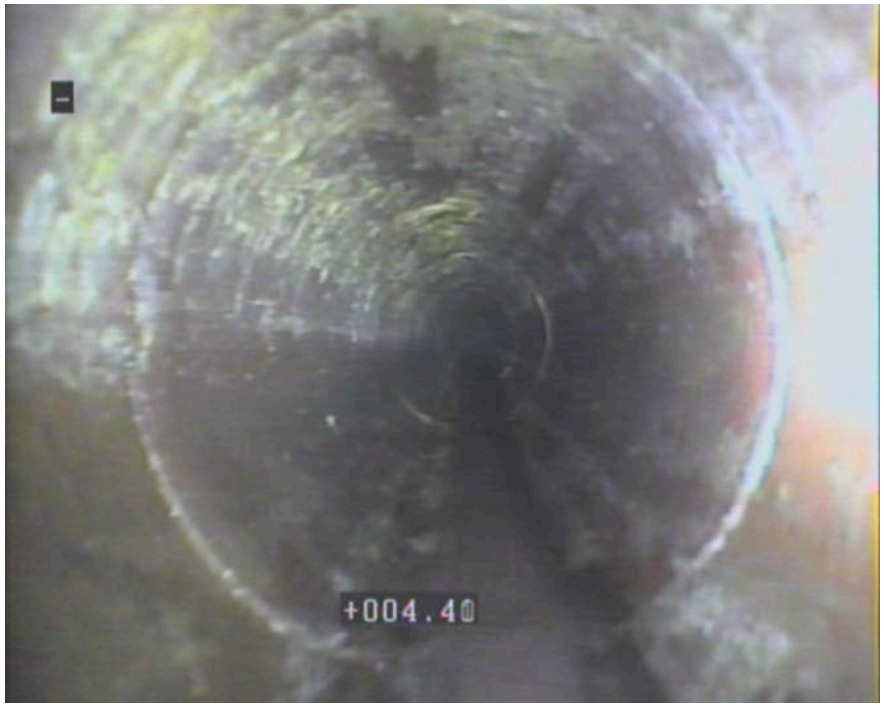
Defect Identified: Joint Defect

CCTV Call Out: None

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
3.951	3.951	0	161	S

Defect Identified: Joint Defect

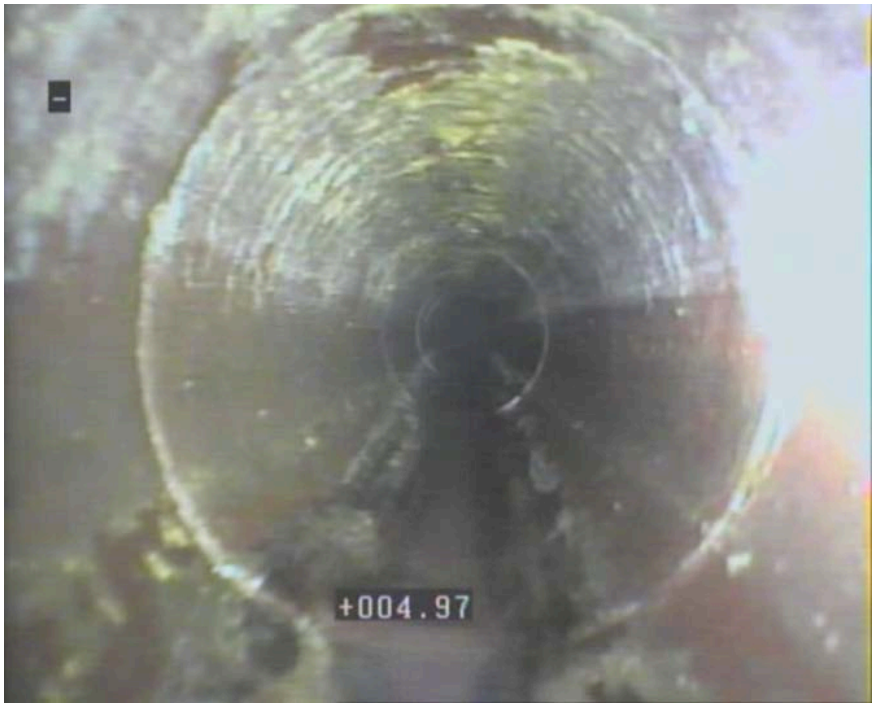
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
4.563	4.563	0	116	S

Defect Identified: Joint Defect

CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
5.072	5.072	0	112	S

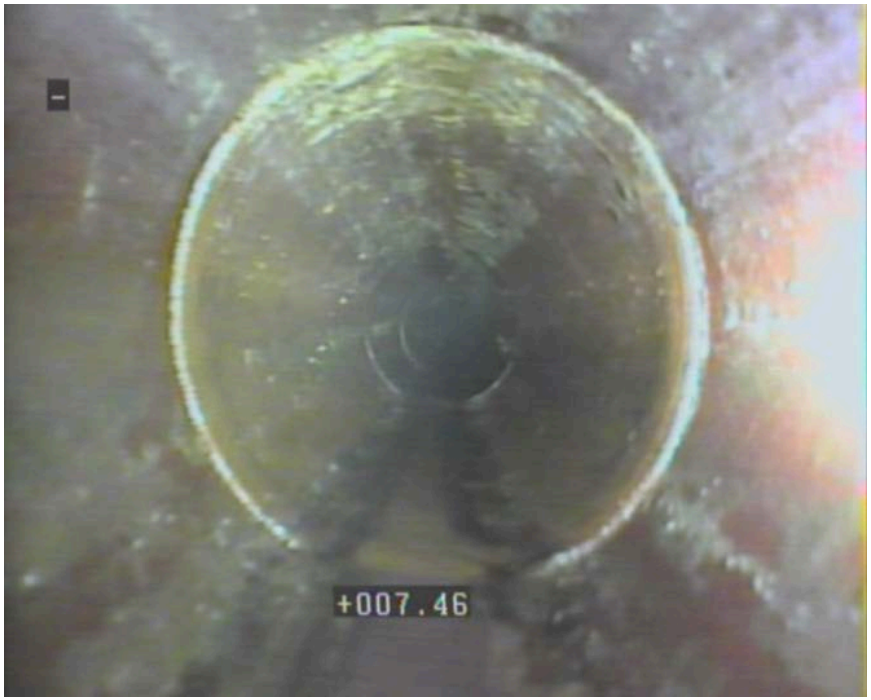
Defect Identified: Joint Defect

CCTV Call Out: None

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
5.664	5.664	0	132	S

Defect Identified: Joint Defect

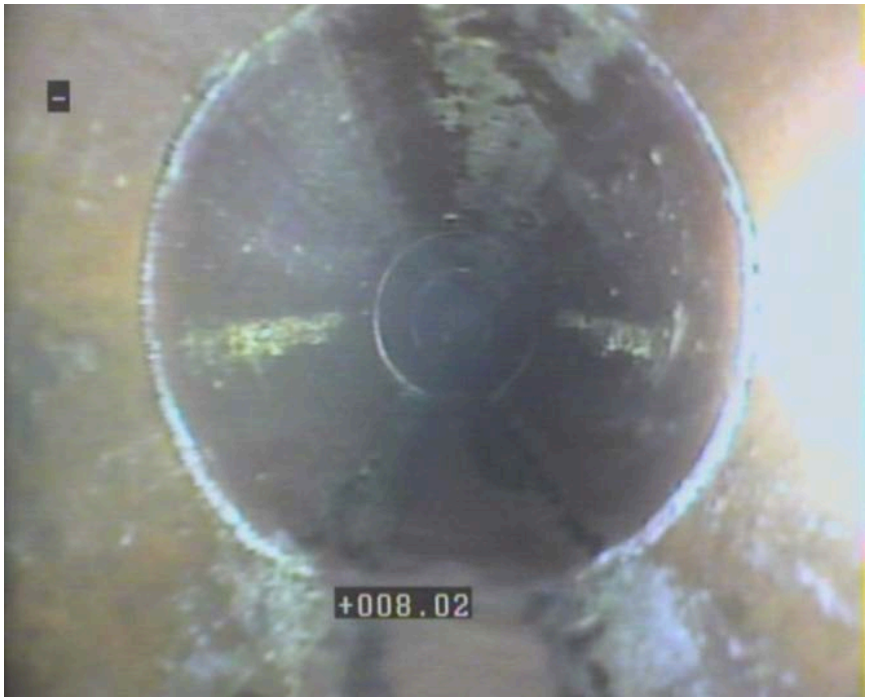
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
7.542	7.564	22	581	M

Defect Identified: Joint Defect

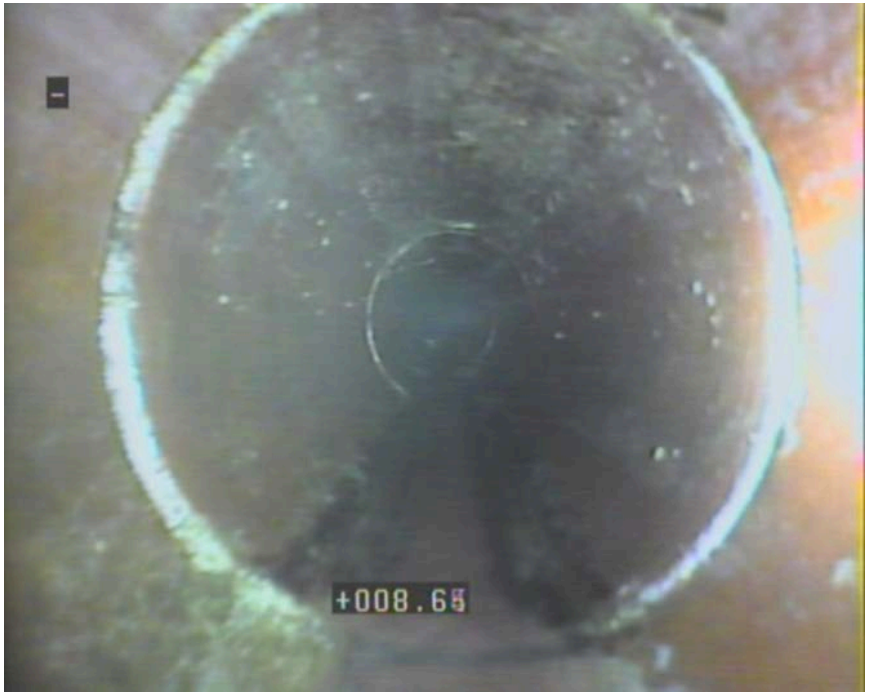
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
8.221	8.221	0	113	S

Defect Identified: Joint Defect

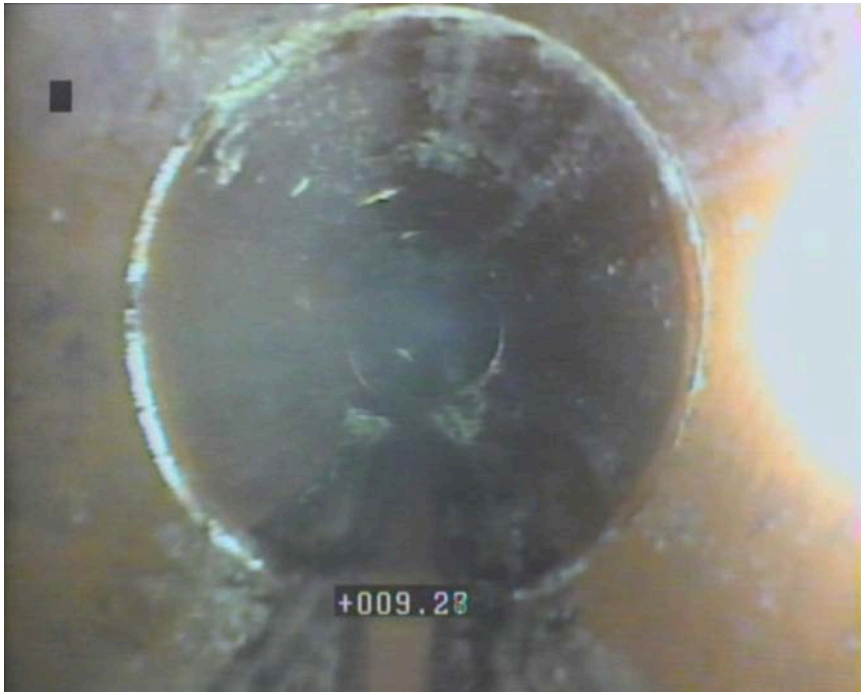
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
8.778	8.778	0	238	S

Defect Identified: Joint Defect

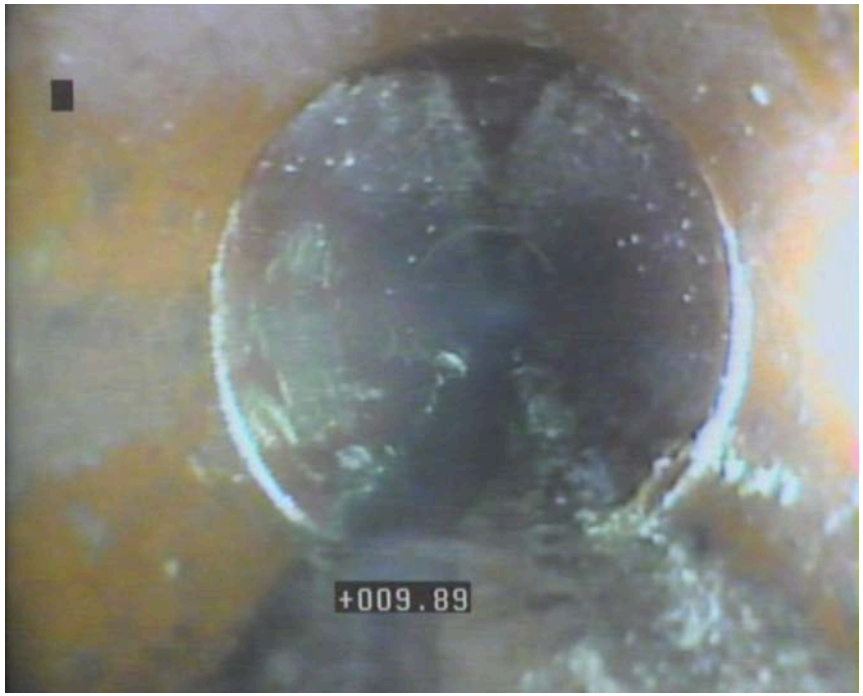
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
9.388	9.676	288	695	M

Defect Identified: Joint Defect

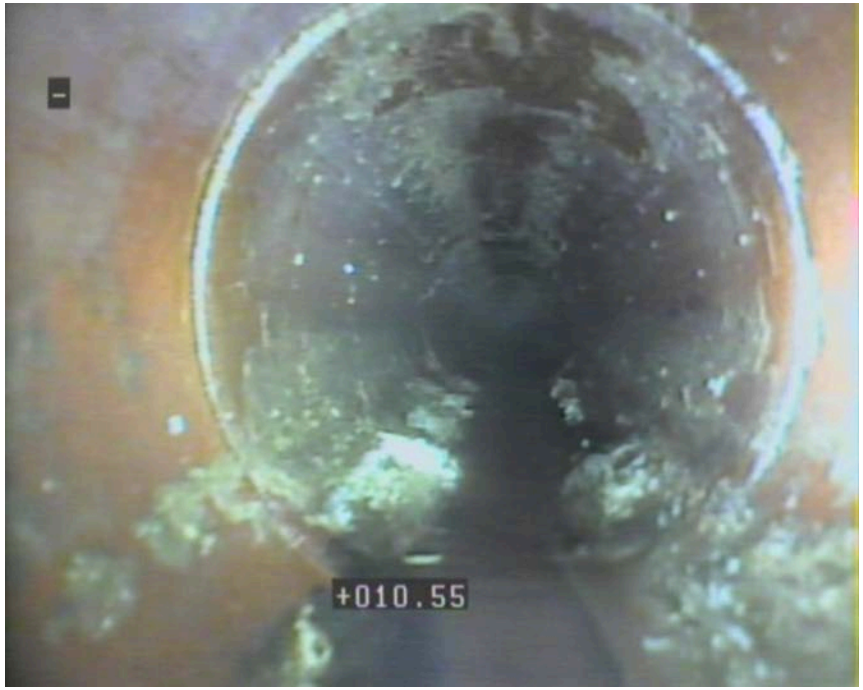
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
9.93	9.947	17	422	M

Defect Identified: Joint Defect

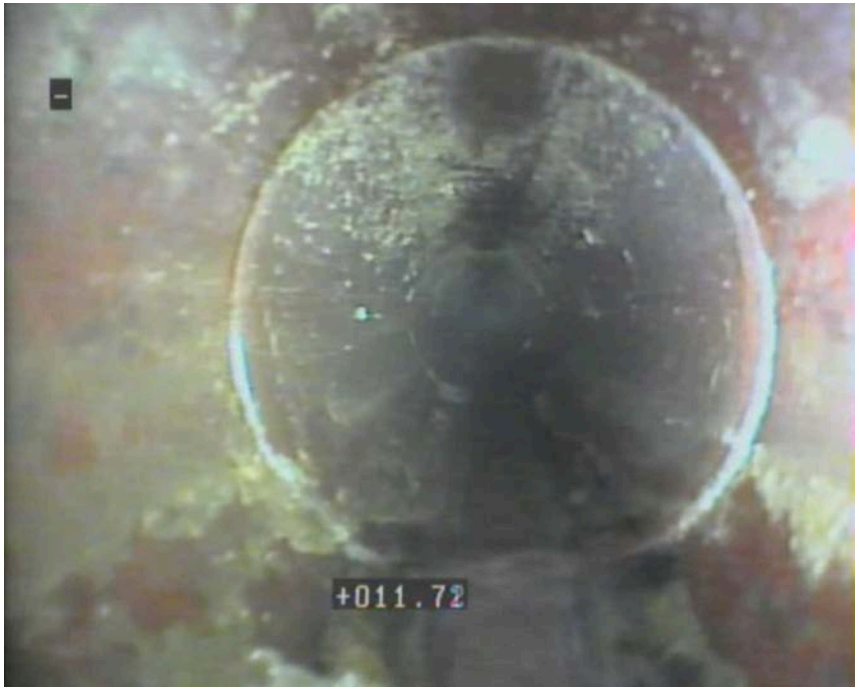
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
10.637	10.689	52	423	M

Defect Identified: Joint Defect

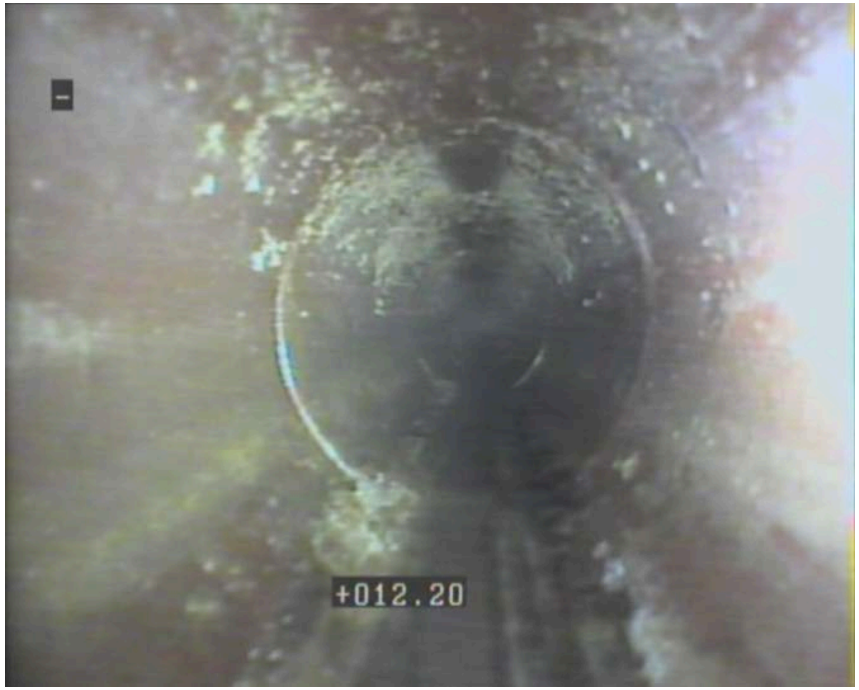
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
11.869	11.869	0	191	S

Defect Identified: Small Longitudinal Defect

CCTV Call Out: None

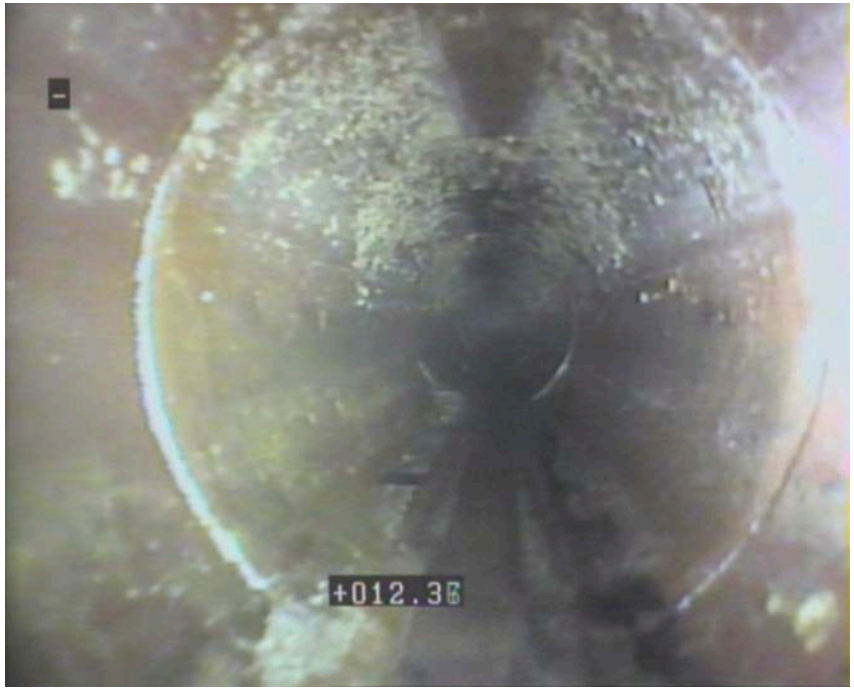


Notes: Evidence of minor cracking @ 5 o'clock

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
12.398	12.424	26	128	S

Defect Identified: Joint Defect

CCTV Call Out: None

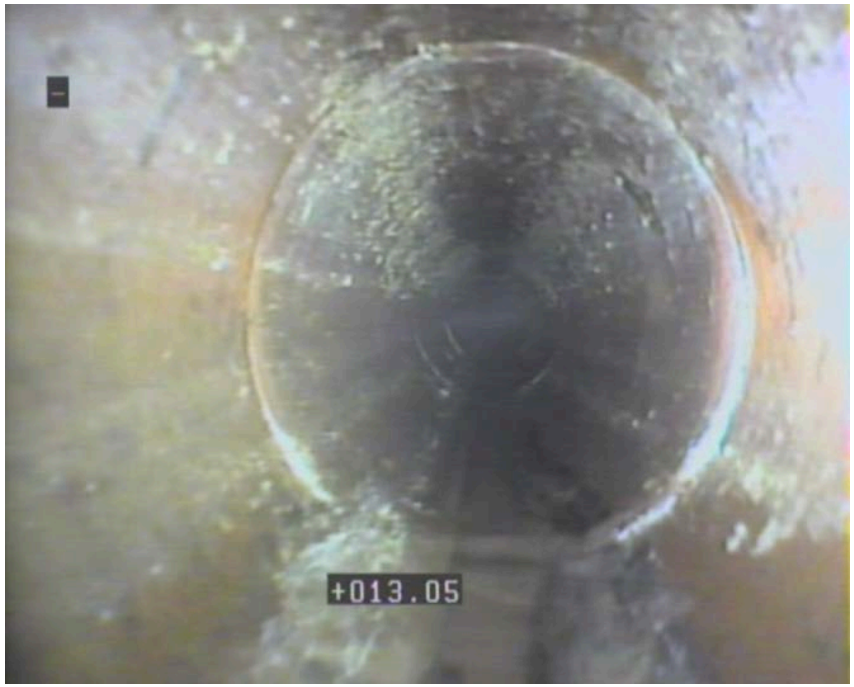


Notes: Evidence of minor cracking @ 5 o'clock continuing on from joint.

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
12.48	12.649	169	479	M

Defect Identified: Joint Defect

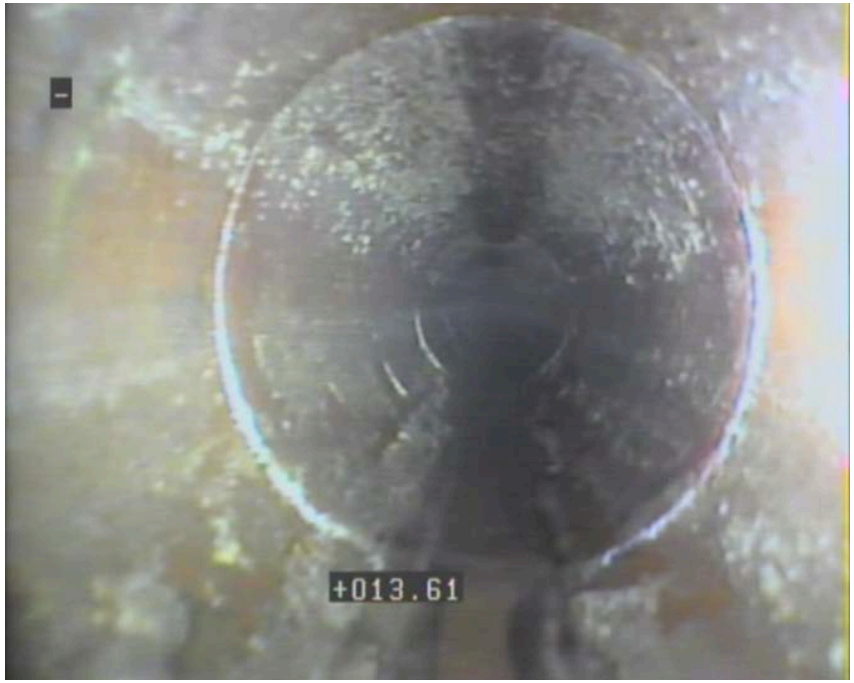
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
13.079	13.079	0	132	S

Defect Identified: Joint Defect

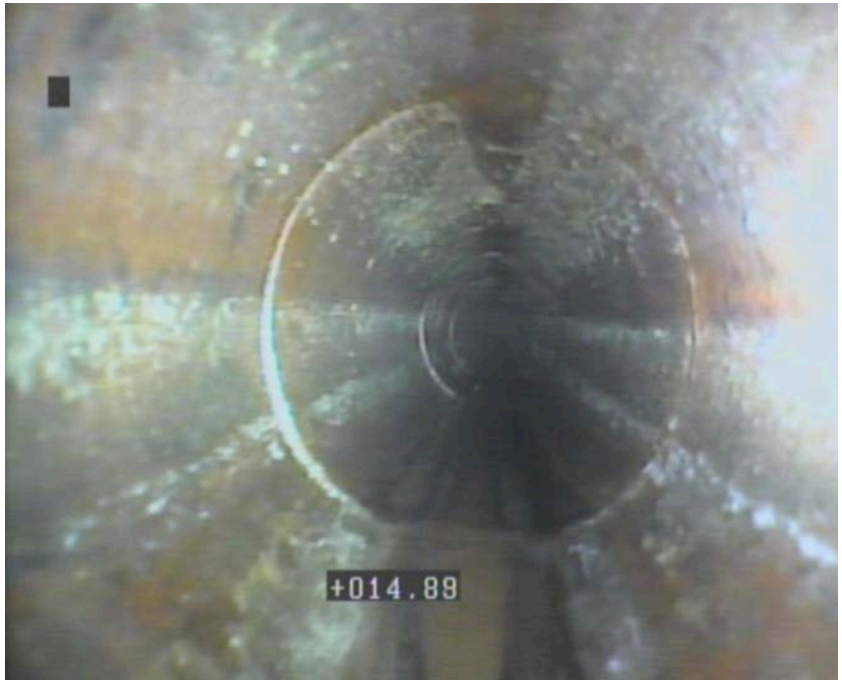
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
13.676	13.707	31	317	S

Defect Identified: Joint Defect

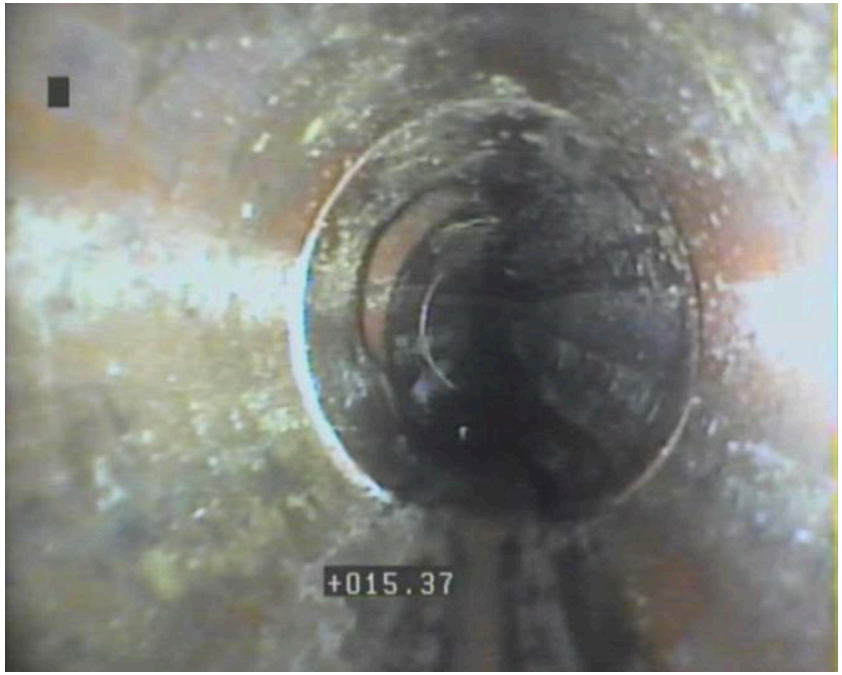
CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
14.901	14.901	0	116	S

Defect Identified: Joint Defect

CCTV Call Out: None



Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
15.462	15.462	0	117	S

Defect Identified: Small Longitudinal Defect

CCTV Call Out: None

Notes: Evidence of minor cracking @ 9 o'clock.

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
16.68	16.68	0	130	S

Defect Identified: Joint Defect

CCTV Call Out: None

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
16.743	16.76	17	242	S

Defect Identified: Joint Defect

CCTV Call Out: None

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
17.355	17.369	14	138	S

Defect Identified: Joint Defect

CCTV Call Out: None

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
17.981	17.992	11	202	S

Defect Identified: Joint Defect

CCTV Call Out: None

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
18.642	18.667	25	385	S

Defect Identified: Small Longitudinal Defect

CCTV Call Out: None

Notes: Evidence of minor cracking @ 9 o'clock.

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
18.851	18.883	32	168	S
18.901	18.912	11	284	S

Defect Identified: Small Longitudinal Defect

CCTV Call Out: None

Notes: Evidence of minor cracking @ 9 o'clock.

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
19.296	19.32	24	188	S

Defect Identified: Joint Defect

CCTV Call Out: OJM – Open Joint Medium

Defect Start (m)	Defect End (m)	Defect Length (mm)	Defect Max Current	Defect Severity
19.836	19.836	0	200	S

Findings & Conclusions

CCTV, alone, is unable and inadequate to identify, locate, and quantify defects in sanitary sewers that potentially cause infiltration.

In addition to becoming a recommended pre-rehabilitation assessment tool, added benefit exists as a post-rehabilitation assessment tool to certify sewer repairs, relining, and replacements, as “leak free.”

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