

*CCTV CONDUIT CONDITION  
INSPECTIONS –  
THE IMPORTANCE OF TRAINING  
OPERATORS AND THE CLIENT*

Steve Weatherstone  
Streamline Learning

# Introduction

- ▶ Why conduit condition assessment with CCTV
- ▶ Sewer Inspection Reporting Code of Australia
- ▶ CCTV operators behaving badly
- ▶ Training and qualifications
- ▶ Asset owners misbehaving
- ▶ Suggestions for asset owners
- ▶ Ideas for the future





# An all too common event!

- ▶ That massive hole appeared in Gosford street last week after torrential rain
- ▶ The reason – a DN1200 concrete sewer had been weakened, probably due to the corroding effects of  $H_2S$ , and the surcharged condition of the sewer during heavy rain caused the top of the pipe to disintegrate
- ▶ Then sewage saturated the surrounding ground
- ▶ As the surcharged condition subsided the ‘liquefied’ ground flowed into the pipe through the hole











# CCTV conduit inspections

- ▶ Knowing the condition of sewers and stormwater drains is critical
- ▶ Internal inspection by specialised remote control cameras can give the asset owner valuable information on their condition
- ▶ But not always!





What information can you get on the condition of the asset in the following CCTV inspection video?



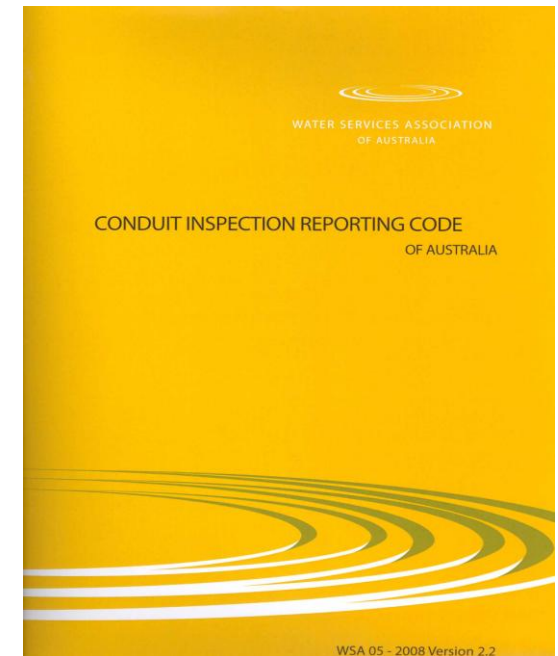
FROM M/H G9066 TO M/H 10A  
DOWN STREAM

700mm CO



# The Conduit Inspection Reporting Code of Australia

- ▶ Published by the Water Services Association of Australia the Code sets out a standard for the way inspections are to be carried out
  - Camera position
  - Speed
  - Distance measurement
  - Quality of images
- ▶ Provides a standard for reporting on
  - details of the asset
  - defects and features



# Reporting defects & features

- ▶ The Code uses a system of shorthand abbreviations to 'code' defects and features
- ▶ Each defect or feature is defined in terms of its characteristics
- ▶ Cracking has the main code 'C' and is defined as
  - *A crack is an apparent discontinuity in the fabric of the conduit where the pieces of conduit on either side of the crack still remain interlocked with negligible separation along the discontinuity*



# More on 'cracking'

- ▶ Orientation of the cracking
  - *Longitudinal* – code 'L'
  - *Circumferential* – code 'C'
  - *Simple* – code 'S'
  - *Multiple/Complex* – code 'M'
- ▶ The cracking is further characterised by its structural significance
  - *Surface 'S'* – shrinkage cracking or glazing cracking
  - *Wall 'W'* – cracking extends through the wall
- ▶ The location or extent of the cracking is identified by one or two clock references
- ▶ The distance at which the defect first occurs is recorded



020,90m

600mm VC

MELLO ST

M/H 010

TO

M/H 011

SMRS8AA

TAPE E207-94

PRINT E569 28/2/94

MEADOWBANK

CRACKS MULTIPLE

## CASE 1

Code	Ch1	Ch2	Q1	Q2	Circ Loc'n		Long'l	Cont	Joint	Remarks
C	L	W	1.0		9		20.9	S1		
C	L	W	1.0		12		20.9	S2		
C	L	W	1.0		3		20.9	S3		
C	L	W	1.0		6		20.9	S4		



# Reporting defects & features – ‘breaking’

- ▶ Breaking has the main code ‘B’ and is defined as
  - *The conduit has broken into a few or many separate pieces where there is significant movement of some or all of the pieces resulting in local or general distortion from the original conduit cross section*
  - *Pieces of conduit wall may be missing or the whole conduit may have been displaced through shear action such that soil or a void is visible*
  - *If deformation is observed also use deformation code ‘D’*

# More on 'breaking' – the extent

- ▶ Displaced – Code 'D'
  - *all pieces are present but some of them are visibly displaced from position*
- ▶ Missing – Code 'M'
  - *one or more pieces of the conduit are missing*
- ▶ Exceptional – Code 'E'
  - *a piece of conduit is missing as a result of some exceptional event that has not affected adjoining sections of sewer. The rest of the pipe is in good condition*



P.O.

## CASE 2

Code	Ch1	Ch2	Q1	Q2	Circ Loc'n		Long'l	Cont	Joint	Remarks
B	M		300		10		137.6			Whole pipe breaking

137.6 28 FEB 95 04:45 450MM VC



# Reporting defects & features – ‘collapsed’

- ▶ Collapsed conduit has the code ‘X’ and is defined as
  - *The conduit has collapsed in that the internal surface has deformed/deflected >25% in the plane of the deformation/deflection/displacement across the conduit*
- ▶ Collapsed requires very little further reporting

27.06.95 13:48

M, H No 2 Augusta St Up Str 225 Vc

CASE 3

Code	Ch1	Ch2	Q1	Q2	Circ Loc'n		Long'l	Cont	Joint	Remarks
X			500				6.9			
SA	D						6.9			Collapsed

SECTION LEN. : +6,93 m



# CASE 4

Code	Ch1	Ch2	Q1	Q2	Circ Loc'n		Long'l	Cont	Joint	Remarks
X			900				28.6			Shear displacement - whole pipe over 50%
SV							28.6			
SA	D						28.6			Shear displacement - whole pipe



# The system of scoring

- ▶ To provide a guide for asset management the Code assigns scores for each defect reflecting the seriousness of the defect in terms of
  - the structural integrity of the conduit
  - the service capability of the asset
- ▶ The defect scores are notionally applied to a 1 metre length of the conduit and may be additive if more than one defect occurs within that same metre
- ▶ The scores are used to grade the conduit based on the average score per metre or the peak metre score

# Purpose of grading

- ▶ Grading the condition of conduits allows asset or maintenance managers to screen reports for the assets requiring attention from those that are operating okay and or are structurally sound
- ▶ It makes little sense for managers to look at all inspection videos after the operator has inspected and produced a report – but that does happen



# Examples of scoring

- ▶ CASE 1: CLW @ 12 o'clock – 2
  - For the four reported longitudinal cracks these are added to give a total score of 8 in one metre
  - The cracks are also continuous so this score will be repeated every metre until those defects are no longer present
- ▶ CASE 2: BM – 60
  - Broken missing is the worst category for breaking
- ▶ CASES 3 & 4: X – 165
  - Collapse is catastrophic in terms of structure and service and the score reflects this situation





# Grading

- ▶ The grades range from 1 to 5 for both structural and service conditions
- ▶ Structural Grade 5 for example is described as – *failure of the sewer has occurred or is imminent*
- ▶ The Code suggests the following action for a conduit with a Grade 5 rating – *take immediate action as appropriate e.g. temporary support. Immediately undertake risk assessment and further investigation, and take appropriate action which may include immediate rehabilitation and/or renewal.*

# Structural grading example

## ▶ Case 1

- If the cracking continued for the full length the mean score would be 8 per metre and fall in the Grade 5 range for the conduit
- If there were only three longitudinal cracks the score per metre would be 6 and the conduit would be Grade 4

## ▶ Case 2

- The peak score of 60 puts the conduit in the Grade 5 range

## ▶ Cases 3 and 4

- These both have a peak score of 165 which is clearly in the Grade 5 range



# Reports

- ▶ Reporting on inspections usually utilises computer software such as WinCan, Pipex, Clearflow or Auscodes
- ▶ These produce reports in various formats to allow the asset owner to review the condition of the conduit
- ▶ Scores and Grading are automatically calculated by the software and usually appear in the report

RANGEDALE				Rangedale Drainage Services Factory 6, 414-440 Dynon Road West Melbourne 3003 Tel: (03) 9687 3299, Fax: (03) 93961799			
Inspection report							
Date: 08.11.2005	Asset owner's job ref.: 432351	Precipitation: Rain	Operator: Damian	section number: 2	Sewer Ref.: 133947		
	Method of inspection: TV	Camera:	Ant. Length: 48.23	Cleaning: not cleaned	Criticality:		
Town or suburb: Moorabbin		Sewername: South East Water		Start node ref.: FLE10-5			
Location: 2, Adj Kiama Street		Asset Owner:		End node ref.: FLE10-6			
Location type: Road		Tape No.: TK100		pipe length: 48.23 m			
Purpose of inspection: C			Shape: C	Dia/Height: 150	Width: Class:		
Use of sewer: S			Material: Vitrified clay	Pipe unit length: 1.2m			
Land ownership: Public land			Lining Material:	No measures			
Flow control:							
Type of sewer: Overlap achieved. Refer Section 1 for D/S survey.							
1:375	position	code	observation	counter	photo	grade	
	FLE10-5	0.00	STMH	Start node, maintenance hole, FLE10-5	00:27:38	56a	0
		0.00	GC	Comment: Material is VC, 150mm.	00:27:49		0
		0.00	S1 WLC	Water (Sewage) level, clear effluent (the invert is visible), 5	00:27:49		0
		1.20	CLW	Cracking, longitudinal, wall, width 2 mm, at 07 o'clock, at joint	00:28:27		2
		1.20	CLW	Cracking, longitudinal, wall, width 1 mm, at 04 o'clock, at joint	00:28:27		1
		2.30	FL	Fracturing, longitudinal, width 3 mm, at 06 o'clock, at joint	00:29:08	60a, b	3
		2.30	FL	Fracturing, longitudinal, width 3 mm, at 05 o'clock, at joint	00:29:08		3
		2.60	GC	Comment: Typical pipe length is 1.2m.	00:29:11		0
		4.90	FL	Fracturing, longitudinal, width 4 mm, at 09 o'clock, at joint	00:31:06	62a, b	3
		4.90	FL	Fracturing, longitudinal, width 3 mm, at 12 o'clock, at joint	00:31:06		3
		4.90	FL	Fracturing, longitudinal, width 3 mm, at 04 o'clock, at joint	00:31:06		3
		11.00	CLW	Cracking, longitudinal, wall, width 1 mm, at 09 o'clock, at joint	00:33:37		1
		14.60	JNO	Junction open, height 80 mm, at 10 o'clock	00:34:49	67a	0
		15.90	CLW	Cracking, longitudinal, wall, width 2 mm, at 08 o'clock, at joint	00:35:08		2
		15.90	RF	Fine roots, reduction in cross sectional area 1 %, at 03 o'clock, at joint	00:35:08		1
		18.40	GC	Comment: Severe fractures both sides of joint.	00:36:39		0
		18.40	FL	Fracturing, longitudinal, width 4 mm, at 08 o'clock, at joint	00:36:39	70a, b	4
		18.40	FL	Fracturing, longitudinal, width 4 mm, at 08 o'clock, at joint (toward breakage).	00:36:39		4
		18.40	FL	Fracturing, longitudinal, width 3 mm, at 04 o'clock, at joint	00:36:39		3
		18.40	FL	Fracturing, longitudinal, width 4 mm, at 04 o'clock, at joint (running to breakage).	00:36:39		4
		19.00	DEC	Hard or compacted material in the invert, reduction in cross sectional area 40 %, within 03 to 09 o'clock	00:39:21	76a	5
		19.00	GC	Comment: Overlap with D/S survey (at pipe breakage) achieved. Survey complete.	00:41:24		0
		19.00	E1 WLC	Water (Sewage) level, clear effluent (the invert is visible), 5	00:41:24		0
		19.00	SAD	Inspection (Survey) abandoned, Overlap with prior survey achieved.	00:42:24	79a	0
STR no def	STR peak	STR mean	SER no def	SER peak	SER mean		
13	15	2.95	2	5	0.12		

432351\_R1599 (Moorabbin).mdb // page: 7



# The importance of correct coding & camera operation

- ▶ Poor observation and incorrect coding of a defect can have a significant effect on the overall grading of the conduit
- ▶ Incorrect coding may suggest that the conduit is ready to collapse when it is actually okay or the converse
- ▶ Poor camera operation leads to
  - incorrect distances
  - missed defects
  - distorted images
  - inability to determine conduit condition



Operators behaving badly

BAILEY ST  
PIT 11 -> PIT 7  
FC, C 675  
0002.7M





Braeside Gate Drive

SBR13 -> SBR12

225, Vitrified clay Circular



19. 11. 10

LC1: 037.90 m

Mudgee Vitrified clay Circular 150

DU\_05 Lewis St <-

DV\_01 Mortimer St

1.4%



02.06.2010

17:20:50

25.45m

ASSET NO:LS143788  
U/S M/H:MH142251  
D/S M/H:MH92862

11.05.2010

0.24m



# Look out – operators behaving badly

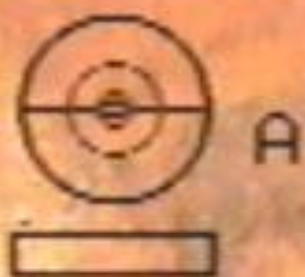
- ▶ Camera speeds exceeding Code standard
- ▶ Coding ‘defects’ that are not
- ▶ Incorrectly coding features
- ▶ Inadequate data on video and photos
- ▶ Incorrect screen display of defect or feature
- ▶ Codes missed
- ▶ Important information about the asset missing in the report header and observations
- ▶ Camera, lighting and transport system inadequate for the conduit

# Look out – operators behaving badly

- ▶ Poor quality images
- ▶ Distance errors of up to 3 metres
- ▶ Start distance location incorrect
- ▶ Lack of understanding of conduit types and systems
- ▶ Panning and investigating features too quickly
- ▶ Incorrect identification of conduit material
- ▶ Reports incomplete
- ▶ Panning while moving forward
- ▶ Camera not centred
- ▶ Inspection data lost \$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$

LOTUS GLENN  
5/L21A1 -> 6/L21A1  
0013.9M

General comment at 67:





# Training of operators and supervisors

- ▶ In 2004 Streamline Learning, in association with Auscodes, began training operators, supervisors & managers
- ▶ Locations – Darwin, Adelaide, Sydney, Melbourne, Coolangatta, Bundaberg, Moss Vale, Mackay and others



# Training programme

- ▶ The course is conducted over 4 days
- ▶ Supervisors/managers attend the first 3 days covering theory and practical exercises
- ▶ Operators spend an additional day on camera operation and maintenance
- ▶ Both groups complete a preliminary assessment during the course
- ▶ Final assessment is based on defined evidence from the workplace on actual work assignments
- ▶ Where evidence does not meet requirements feedback is given and additional evidence is requested

# Successful completion leads to –

Statement of  
Attainment in –

- ▶ *NWP331B – Inspect conduit and report on condition and features*
- ▶ *NWP440A – Supervise conduit inspection and reporting*





Asset owners misbehaving

# Asset owners – some observations

- ▶ A lack of understand of the Code requirements
- ▶ Compliance with Code and specification not being enforced
- ▶ Poor specifications missing key aspects of the work
- ▶ Reluctance to adopt WSA05 – 2002, 2006 or 2008
- ▶ No interest in the qualifications or competence of operators or in what Code was being used for reporting
- ▶ Acceptance and payment for inferior inspections and incorrect or incomplete reports
- ▶ Manipulation of defect codes that distort grading values

# Asset owners – some observations

- ▶ Report templates that miss key information in the header
- ▶ Insufficient information given to the operator on assets being inspected
- ▶ Specifications do not ask for a list of equipment to be used and the capabilities of those camera systems for the conduit types and sizes
- ▶ Specifications do not require the operator to have a copy of the Code and Specification available on the job
- ▶ Requirement for qualification ignored
- ▶ Construction practices on stormwater that create defects at the time of installation



# Suggestions for asset owners

- ▶ Critically review your specifications and report templates
- ▶ Make sure that operators get all the information available about the asset
- ▶ Review inspection videos and reports and provide feedback regularly and early during a contract
- ▶ Get your people trained so that they know what they are looking at
- ▶ Make sure there is a data security system
- ▶ Make sure that operators are qualified or are in the process of being qualified
- ▶ Make sure that new assets are inspected before acceptance



# Some ideas for the future

- ▶ Publication on the Web of operators who have achieved a qualification
- ▶ Creating a CCTV operator of the year award involving asset owners and industry players critically reviewing operator performance in terms of
  - camera operation
  - coding accuracy
  - site safety
  - presentation
- ▶ Biannual review of operator performance for 'accreditation' by an agency
- ▶ Remote control cobweb cleaning device

ERNEST ST  
326663 → 62592  
CO, 225

# Remote control cobweb remover





End

ST SWC310 300MM CO U E SWC286

5.2%  
77.38m