CLEARLINE PROFILER REPORT

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Location: Chullora, Sydney Australia
Pipe Size: 1225
Age of Pipe: 1890's
Pipe Type: CICL (Cast-iron)
Pipe Length: 2.5km (various sections from 3 cut ins – 1.825km profiled)
Date: June 2004
Customer: Sydney Water
Contractor: Tyco Water

Overview

The works covered in this project consists of the Closed Circuit Television Inspection (CCTV) and Laser conduit profiling inspection of approximately 2.5kms of disused watermain 1225mm in diameter in the Sydney Water Corporation area of operations. The scope is to record and report real- time images of the pipe on all salient features affecting the structural and service condition of the disused watermain.

The works associated with CCTV inspection include:

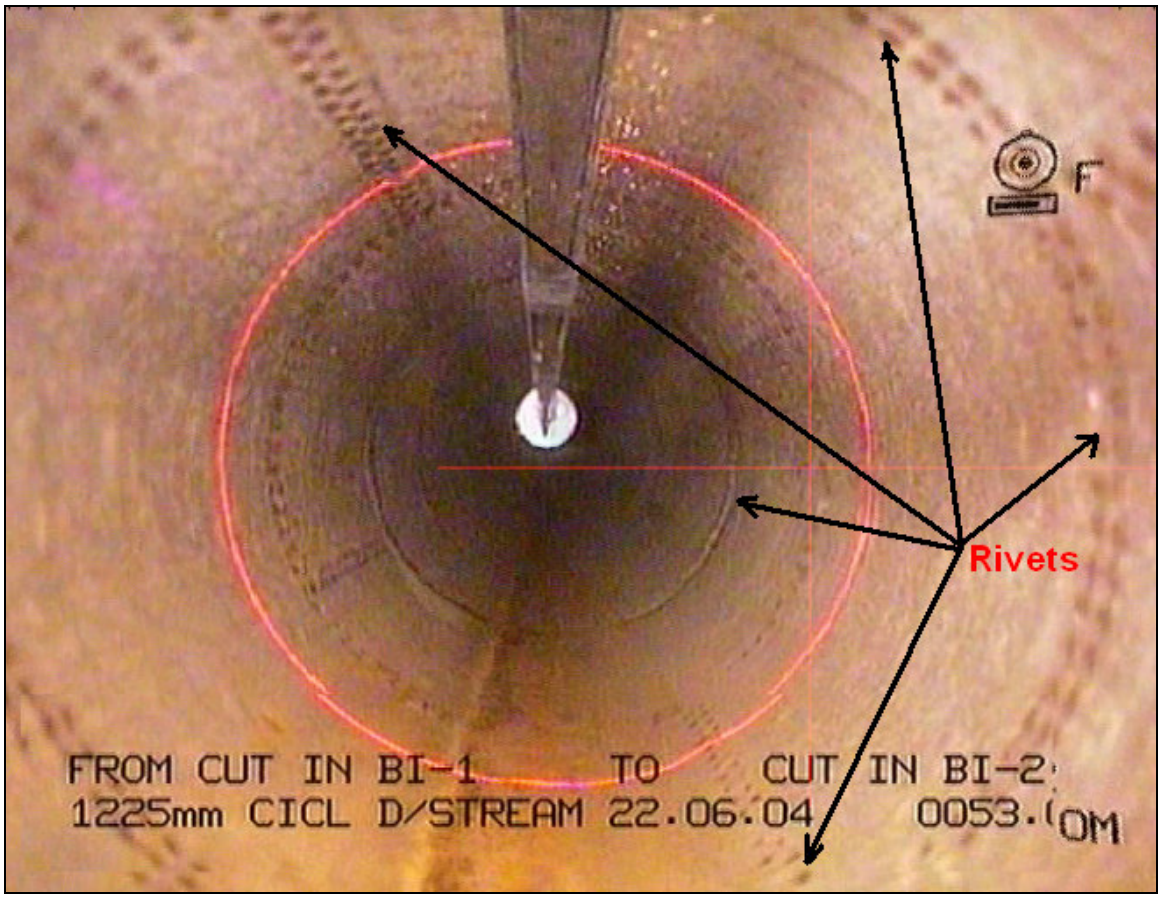
- CCTV inspection of the disused conduit
- Laser profile Inspection of the disused watermain conduit
- Access opening cut outs inspection every 500metres per entry point

This report focuses on the results of the laser profiling only.

Aerial View of 1225mm pipe

It is the intention of this project to determine whether a 1060mm external diameter pipe can be ‘slip-lined’ into the existing 1225mm pipe.

Pipe structure - The existing pipe, believed to be from the 1890’s has had the circumferential and longitudinal joints riveted together. Small circumferential deviations around these joints are visible during both standard CCTV and the laser profiling.



For profiling and inspection purposes, three entry points were cut into the pipe. BI-1, BI-2, BI-3

Method

Camera Type: PearPoint P494
Profiler Type: 10 laserhead configuration
Format: mpg2 (digital) and VHS
Digital Recording: 180 circumferential points per frame, 1 frame per 8mm (218,525 frames for 1825m)
Duration: 1 week
Lens distortion software correction: Applied
Profiling Method:
Camera lights on (recorded for visual analysis) – forward
Camera lights off (recorded for automated laser analysis) - reverse
Ovality formula:
The automated ovality calculations used by the ClearLine software are based on the American Society for Testing and Materials F1216 standards where it states;

q = percentage of ovality of original pipe =

$$100 \times \frac{\text{(Maximum Inside Diameter - Mean Inside Diameter)}}{\text{Mean Inside Diameter}}$$

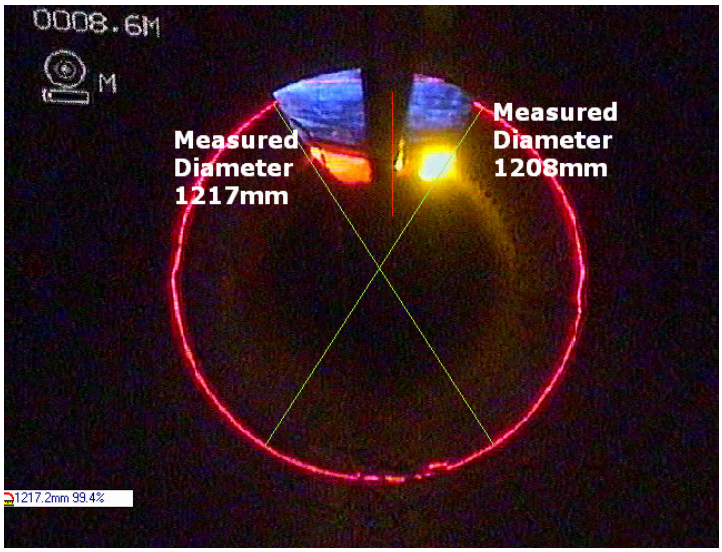
Distance Counter
The distance counter displayed onscreen (video) is that of the camera. The laser profile is 2.256m infront of the lens.

Therefore at counter reading of 0.00, the true distance of laser from centre of entry manhole is estimated at 2.25m. This should be taken into account when considering rehabilitation.

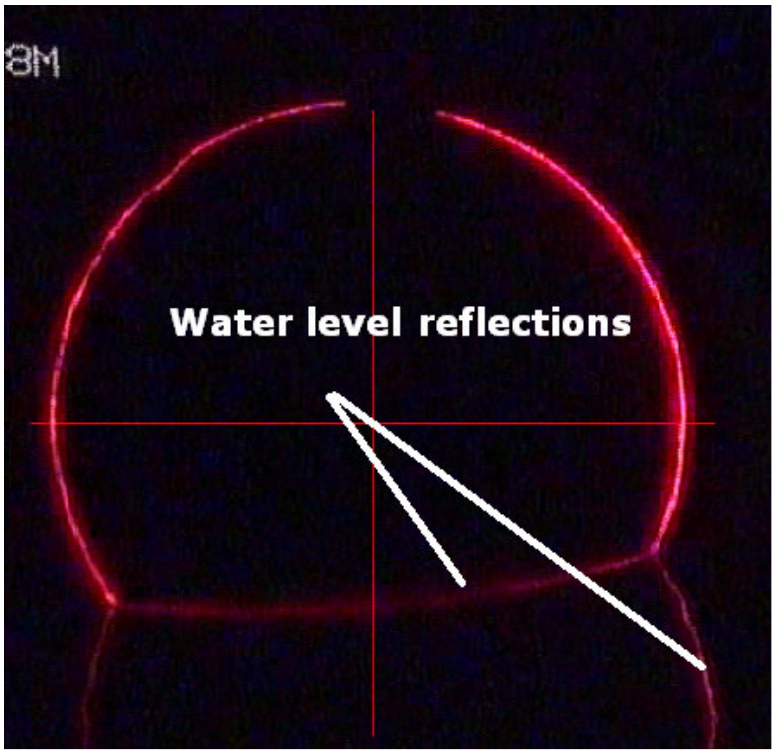
Calibration
Two forms of calibration have been used to verify accuracy.

1. CleanFlow Systems measured the pipe diameter on either side of the cut in at BI-1. Measurement =1208mm. Measurement B = 1217mm. These same diameters can be seen below (with laser ring).
2. 1000mm calibrator placed on the end of laserhead.

Both forms of calibration reconciled.



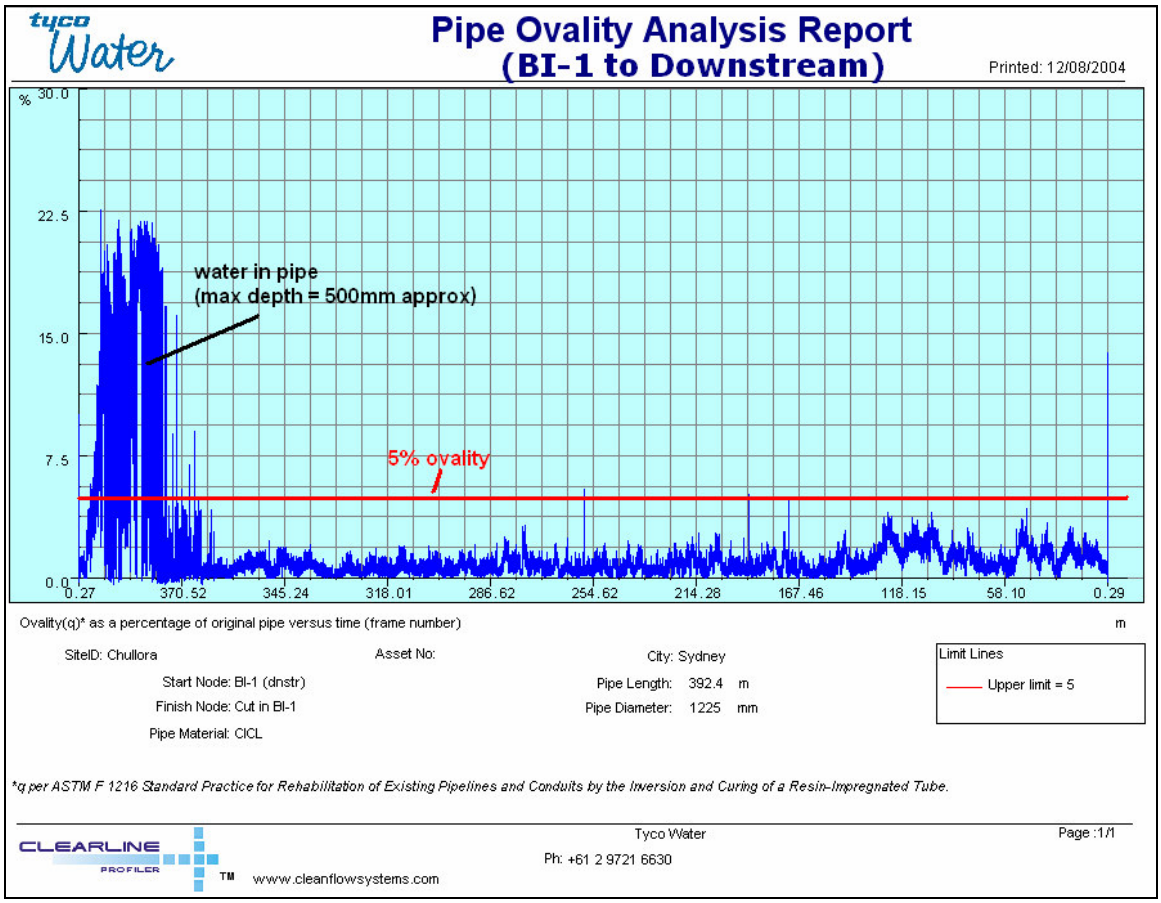
Water Level and debris
At various points within the pipe, water levels became too high for profiling. No analysis can be performed below the water-level (or below debris). Optimum results are achieved with no water. Where water is detected, estimates based on the expected diameter and the shape of the visible pipe is used to predict diameter.



All ClearLine Profiler reports are included individually as pdf documents. For each pipe there is the following;

Ovality graph:
The ovality graph displays ovality (out of round) from start to end manhole. Calculation is based on the American Society for Testing and Materials F1216 standards. The red limit line is set at 5% to highlight variances.

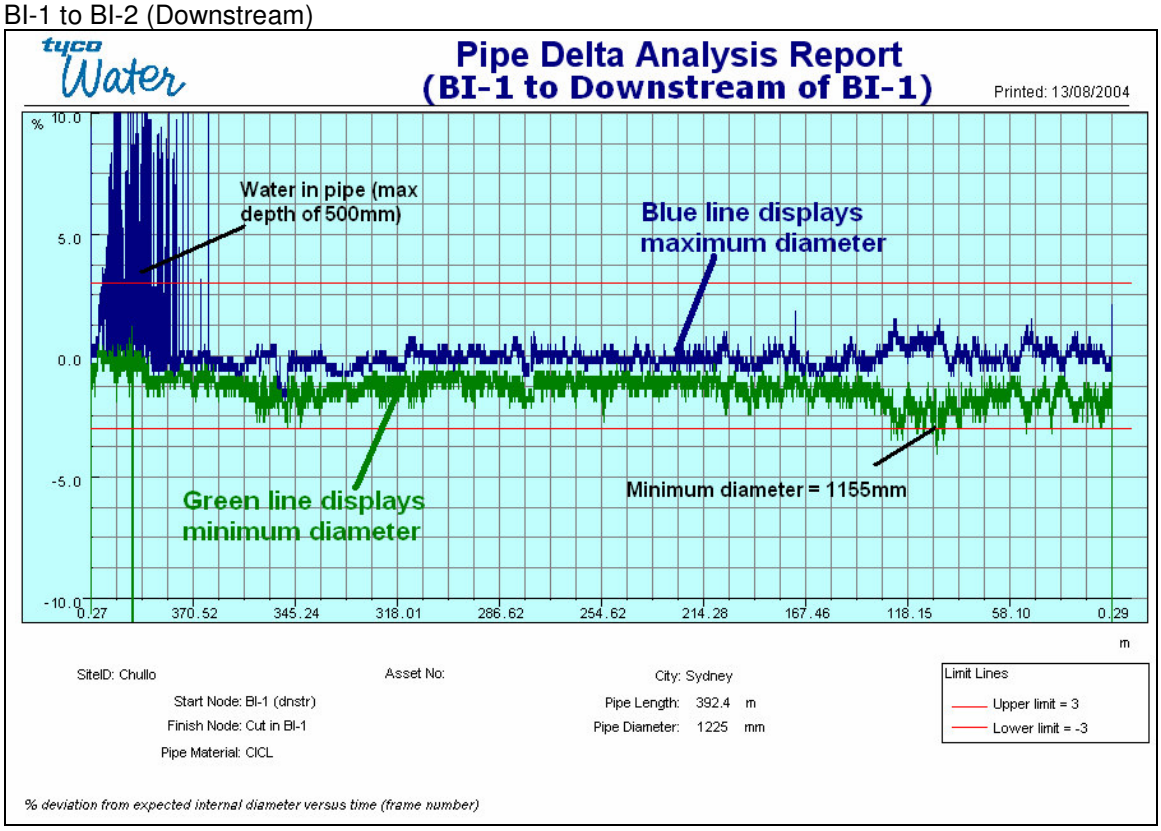
Example
BI-1 to BI-2 (Downstream)



Delta graph:
The Delta graph displays the minimum and maximum radius for each of the 25 profiles recorded per second. This is displayed as a percentage change from the expected internal diameter versus distance in the pipe. Mathmatical calculations are used to find the centre of the pipe.

A green line is used to display the minimum radius while blue is used for the maximum radius.

Example
BI-1 to BI-2 (Downstream)



Pipeline Profile Report
This graph is a cross-section with relevant text. Used to display x and y diameter and note deformations or exceptions. These cross-sections were selected through close analysis of the delta (change in radius) and ovality graphs. SydneyWater have also requested regular cross-sections to verify results.

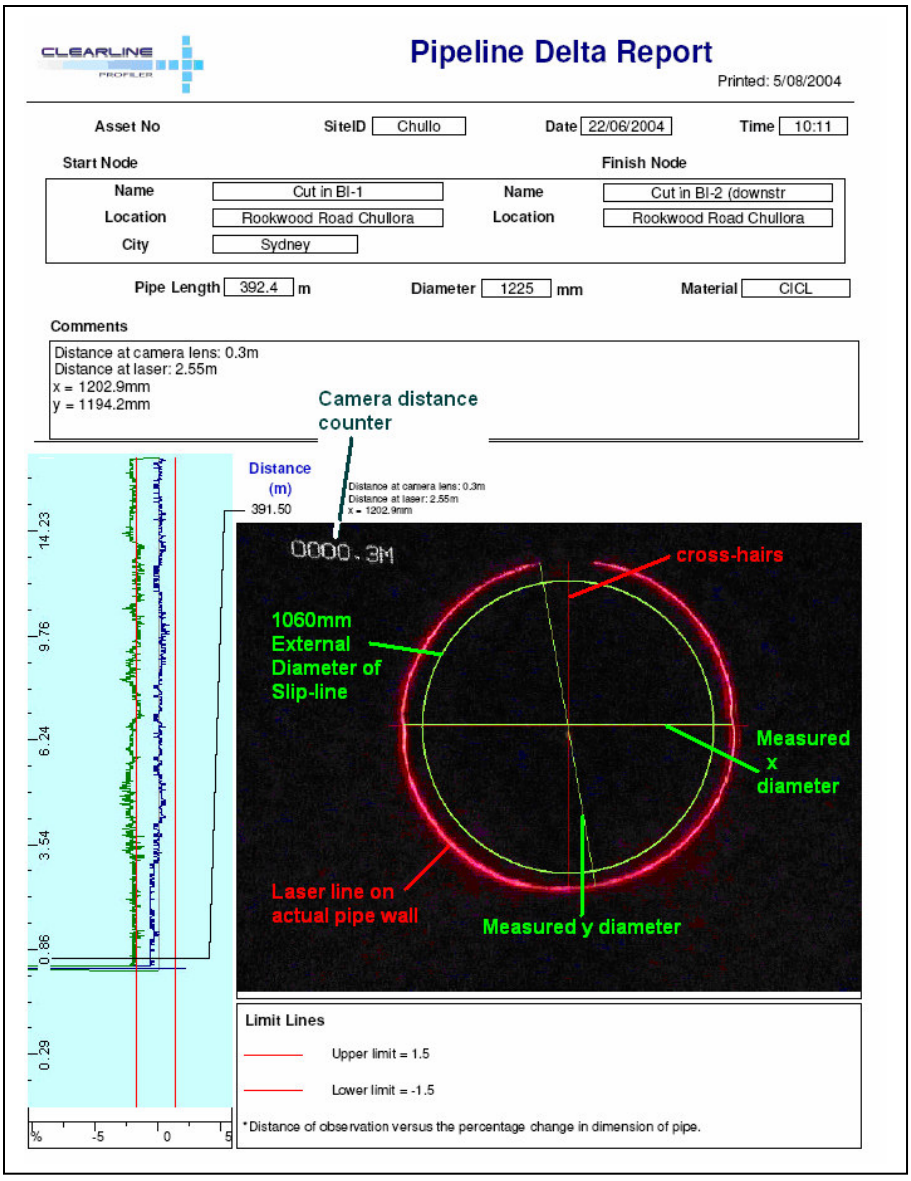
In some cases these graphs will be delta reports, and sometimes ovality reports. This will be dependant on which analysis method was used to locate these profile points.

Example
BI-1 to BI-2 (Downstream) – 0.3m from BI-1

Graph –
Displayed to the left of the profile. Display is the same as for the Pipe Delta and Pipe Ovality Analysis Report.

Profile –

- Actual internal diameter of 1225mm pipe – red laser line
- Expected External Diameter of 1060mm Slip-line – green circle
- Centre of pipe (mathematically calculated by software) - red cross-hairs
- X, Y, selected diameter – green lines from diameter of actual pipe



Results and Discussion

Summary of Results

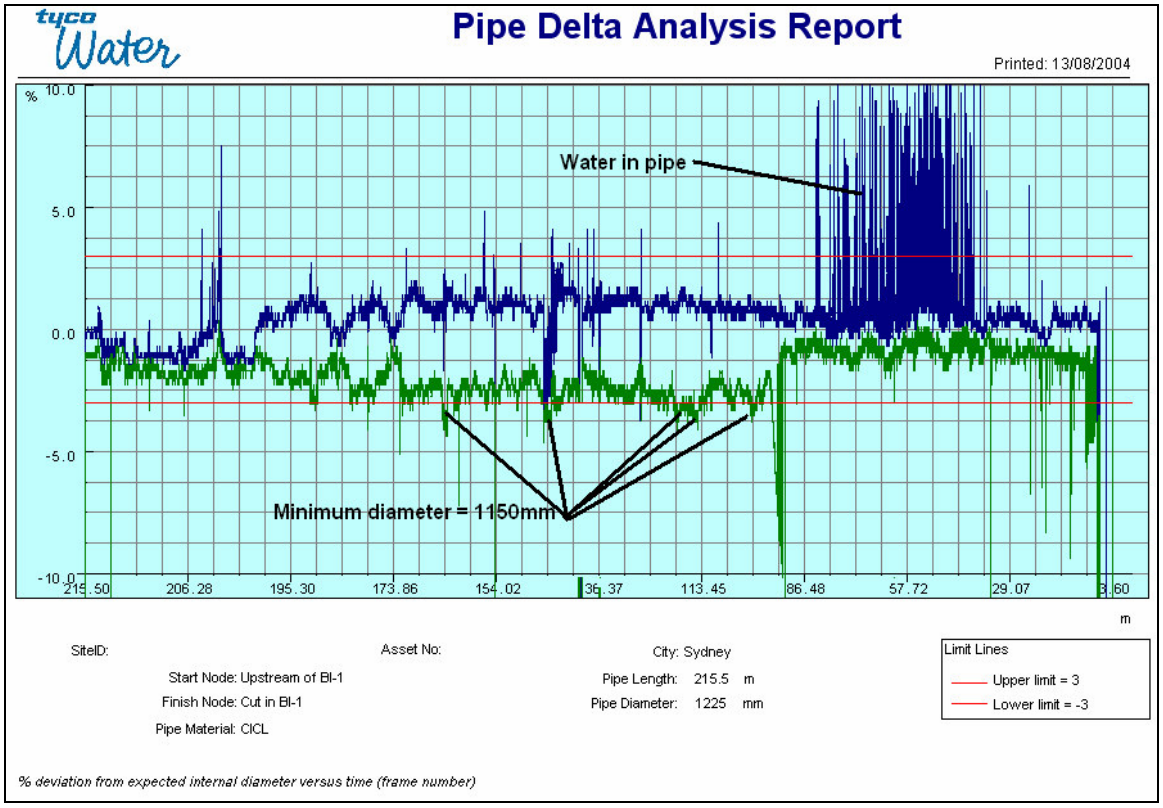
At no point did the minimum diameter become less than 1100mm. The minimum diameter recorded was 1106mm at 46.8m downstream from BI-3.

Upstream of BI-1 to Cut in BI-1

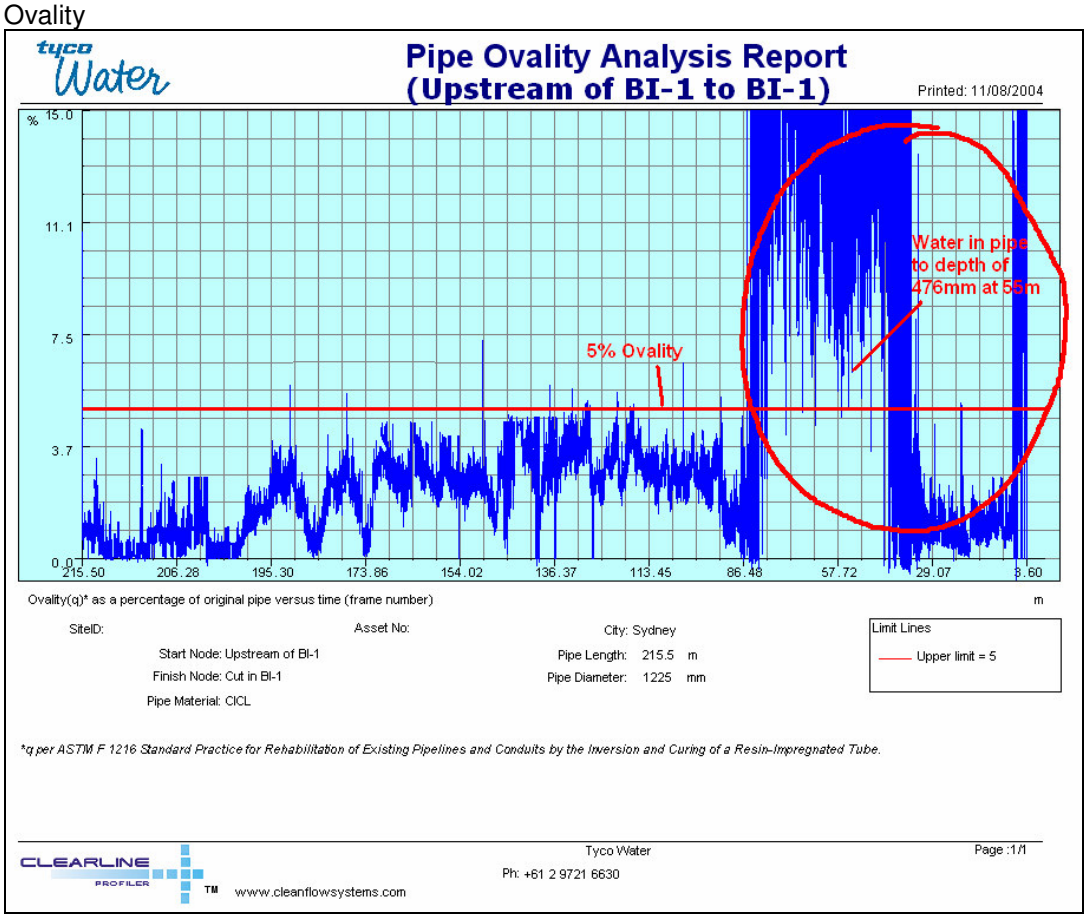
At various points within the pipe, the minimum diameter is 1150mm. These can be seen in the pipe delta report at points 163m (165.25), 140m (142.25), 123m (125.25), 120m (122.25) and 99m (101.25). Included in this report is an example profile at 120m.

Water levels are evident from the 95m point so no exact y diameters can be established, however the shape of the pipe visible do not indicate any serious deformation (past 1150mm).

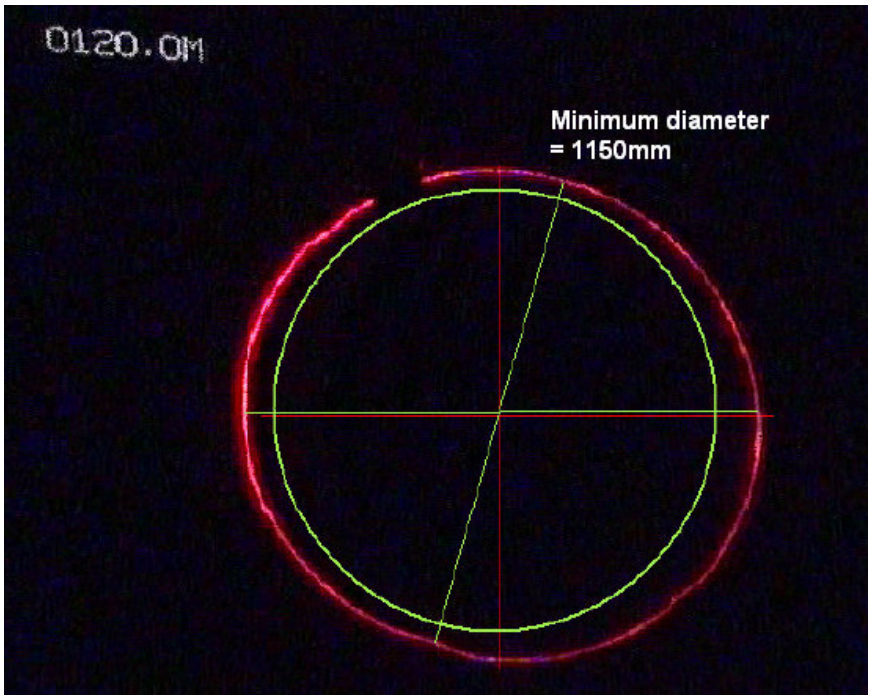
Delta



Ovality

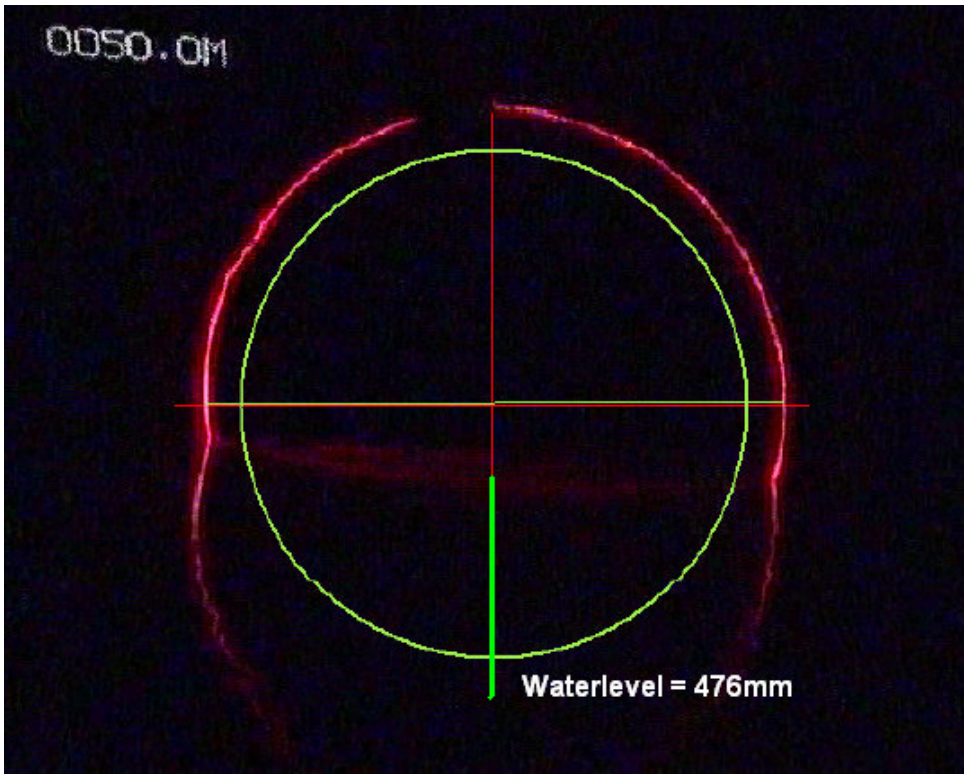


Diameter at 120m



Water is evident in the pipe from 95m (97.25) and increases to a maximum level of approximately 476mm at 50m upstream of BI-1. This then dissipates to almost no water by cut-in BI-1. This indicates a significant dip in the pipe.

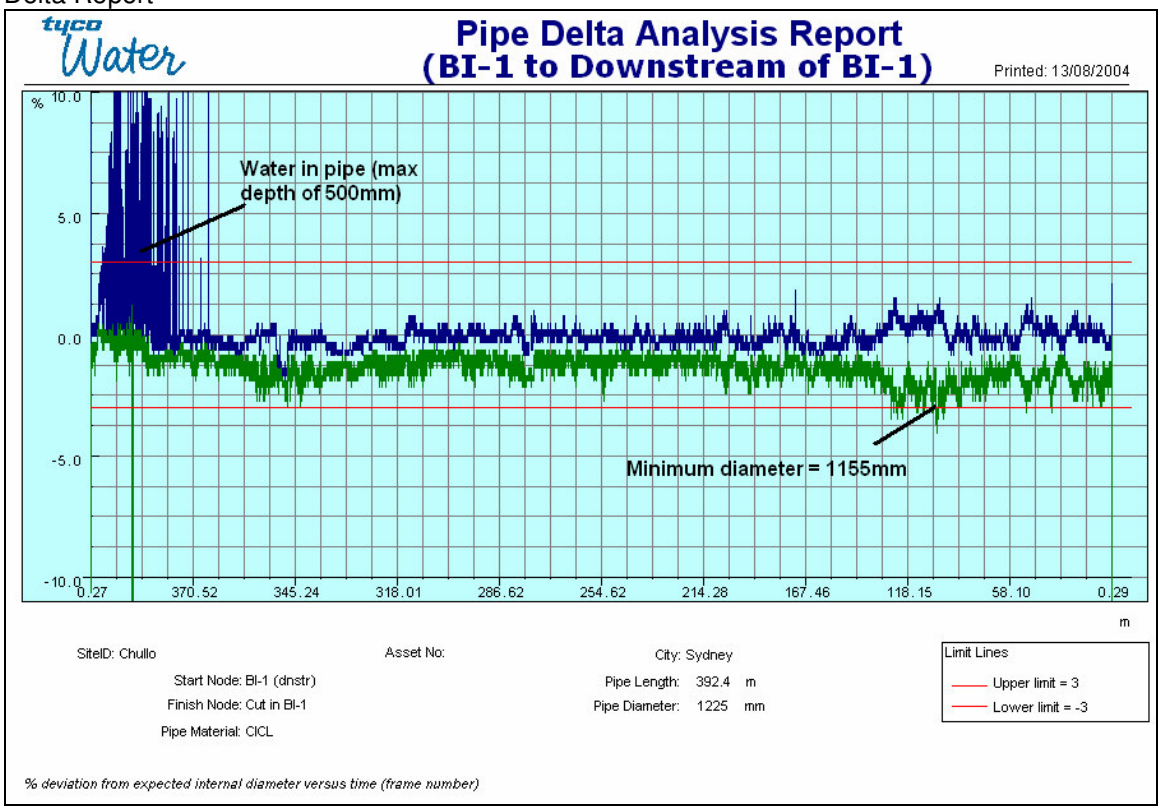
Waterlevel at 50m



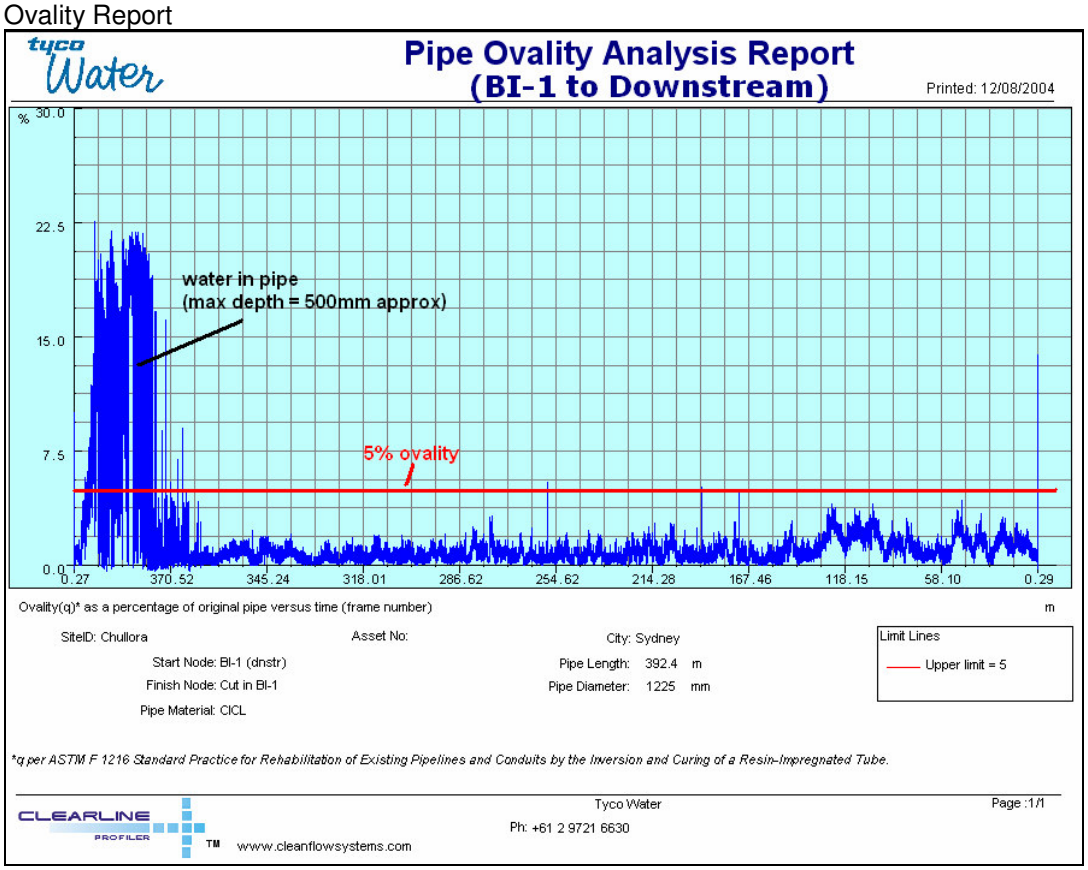
BI-1 (Downstream) to Cut in BI-1
Note: Profile reports are displayed incorrectly as Cut-in BI-1 to Cut-in BI-2 (Downstream).

The minimum diameter for this pipe is 1155mm at 101m (103.25) downstream of BI-1.

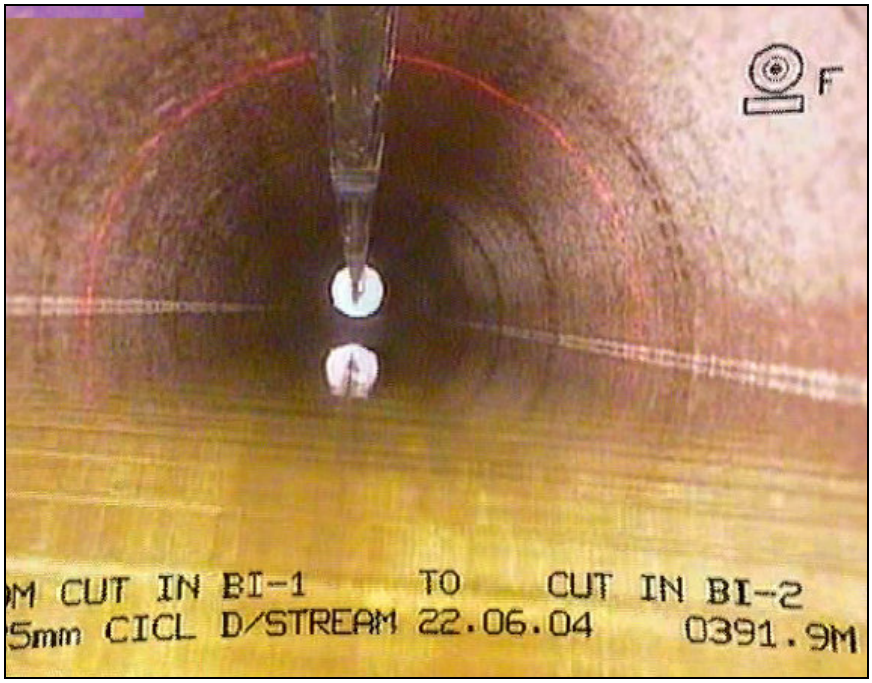
Delta Report



Ovality Report



There is water in the pipe from 346m (348.25) and increases to a maximum level of approximately 500mm at 391m (393.25) downstream of BI-1. At this point, the high water level stops the profiling from continuing. This indicates a significant dip in the pipe.



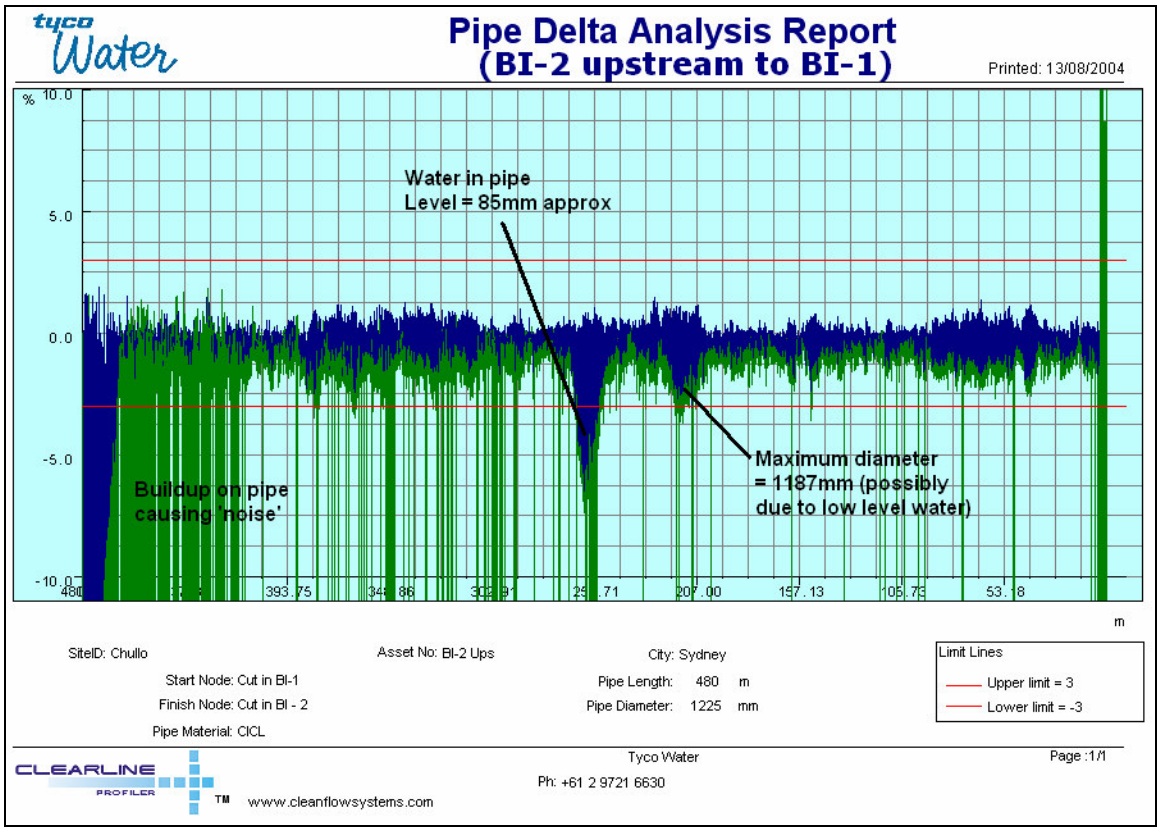
Upstream of BI-2 to Cut in BI-2

Note: There is considerable fungal buildup on the walls of this (and the next section of) pipe. This caused the laser image to become fuzzy and dim. Tyco Water and CleanFlow Systems were able to record digital profiles, however they have some digital 'noise' due to this buildup. This 'noise' can be seen in the delta graphs as spikes (green) and should as such be ignored. The base trend of minimum radius can still be seen. It should also be noted that cross-sectional profiles for the entire pipe lengths have been analysed and are included for review as part of this extended report. For optimum results, we recommend all future profiling is performed post pipe cleaning.

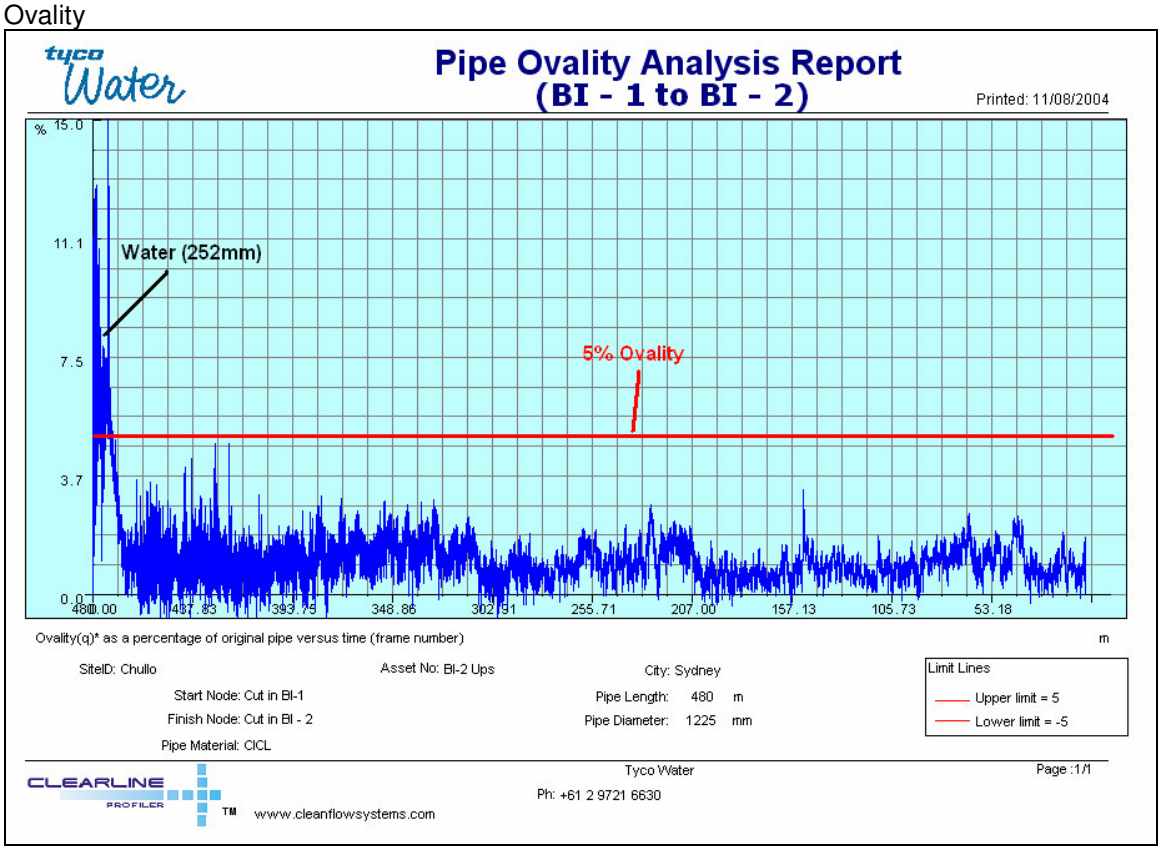
This section of pipe is the least affected by deformation. The minimum diameter for this pipe is 1187mm at 236.6m (238.25) upstream of BI-2. This particular segment of pipe appears to include a small amount of water, so actual y diameter is more than likely similar to the other segments of pipe.

There is a dip of 85mm (water level) in the pipe at 286m (288.25).

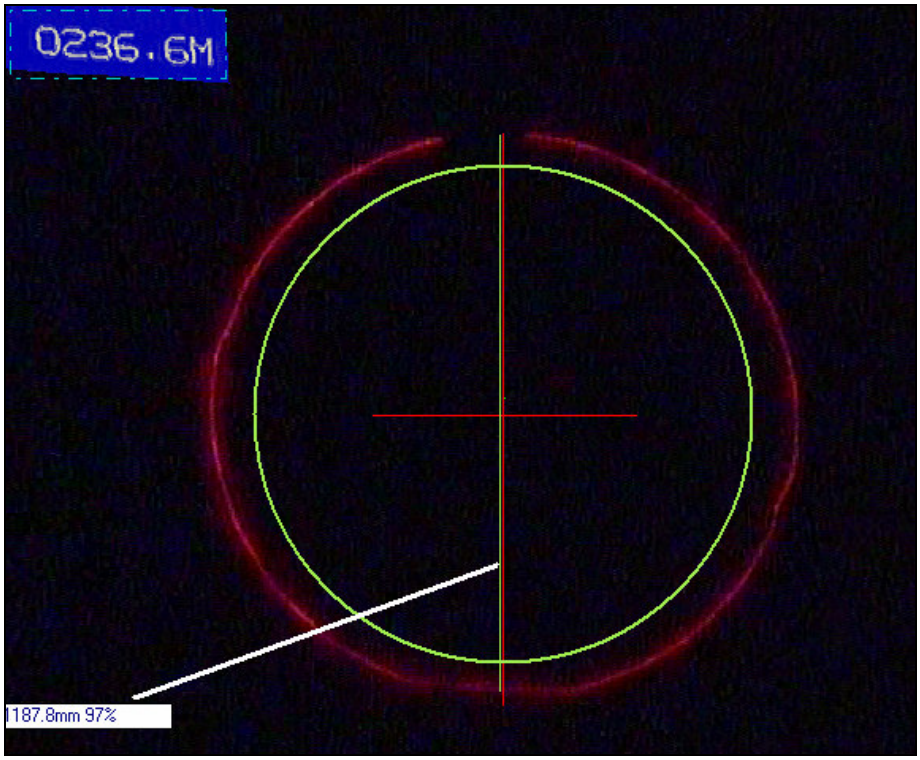
Delta



Ovality



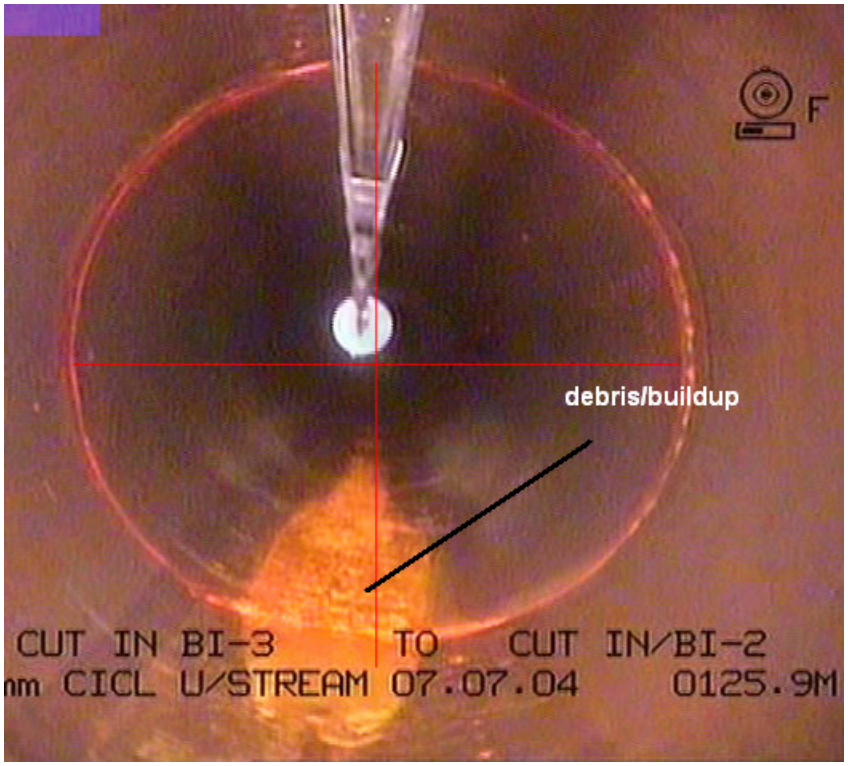
Diameter at 236m



Downstream of BI-2 to Cut-in BI-2
No profiling was performed due to excess water in the pipe 2m downstream of BI-2.

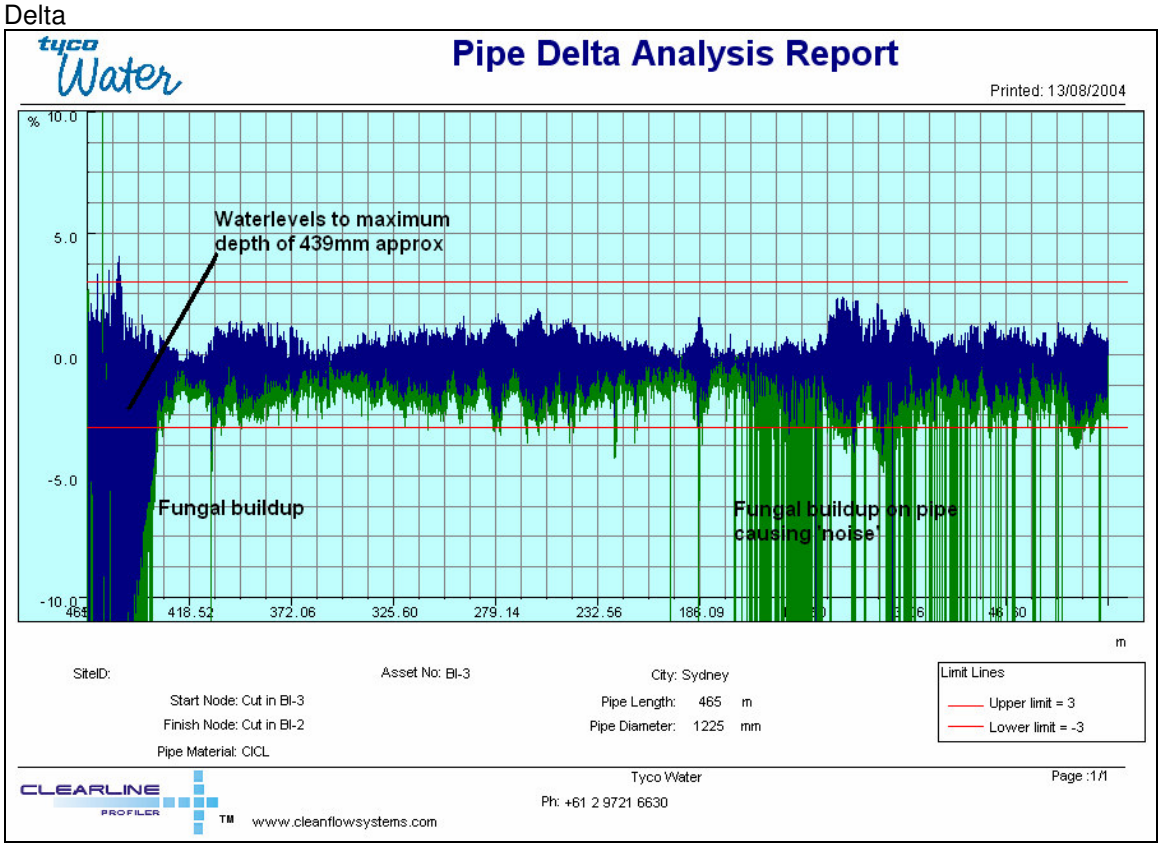
Upstream of BI-3 to Cut-in BI-3

From 160m through to 110m, there is a noticeable pattern of deformation, the greatest deformation in this section of pipe. For the most part, this section remains above 1150mm, however between 154m to 141m, the diameter reduces to 1145mm.

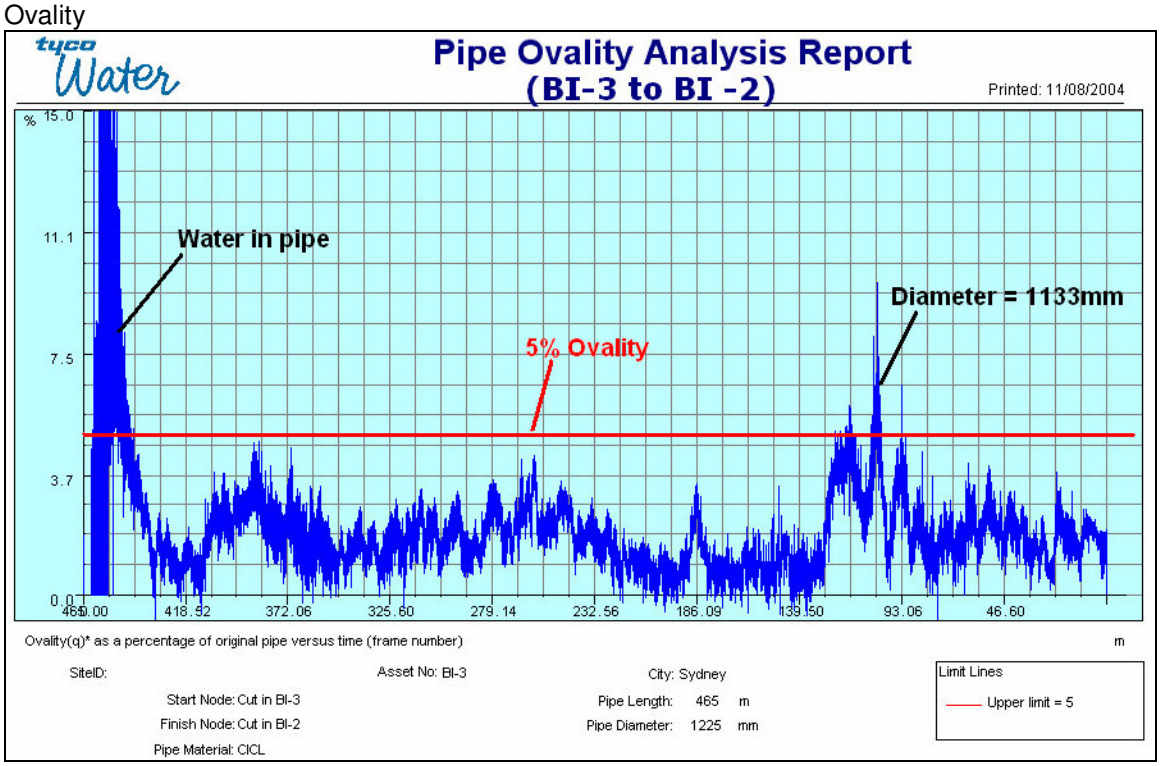


At 126m, there is some debris in the pipe, causing the diameter to reduce to 1115mm. However, the diameter increases to a more realistic minimum of 1131mm at 129m (131.25) from BI-3.

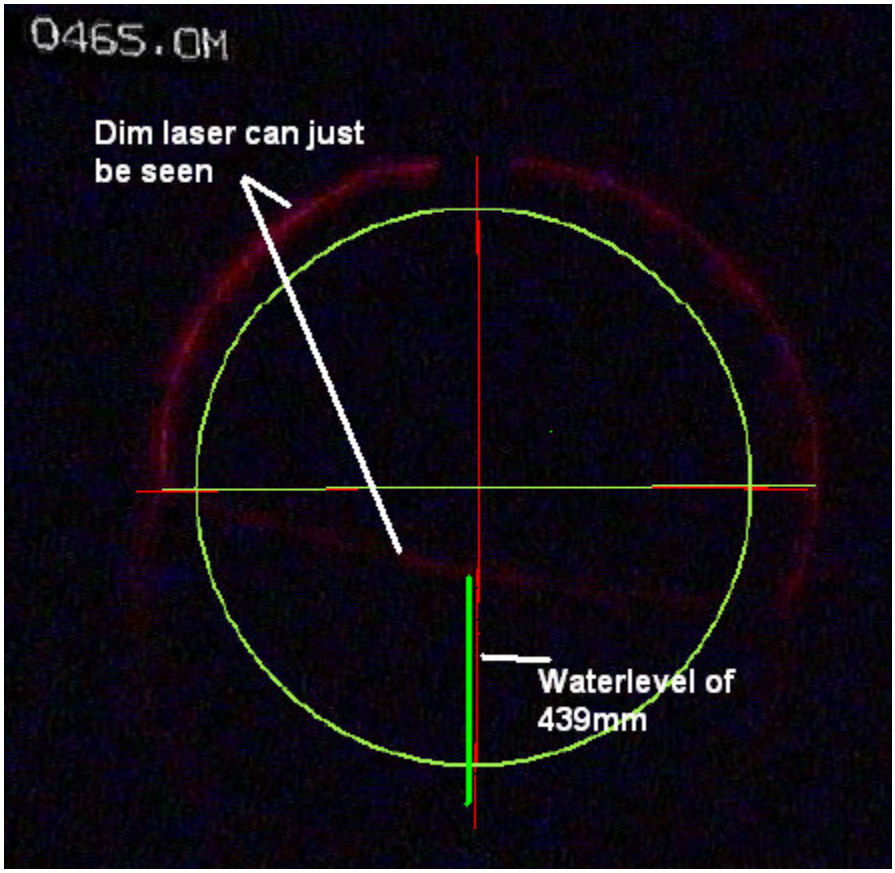
Delta



Ovality



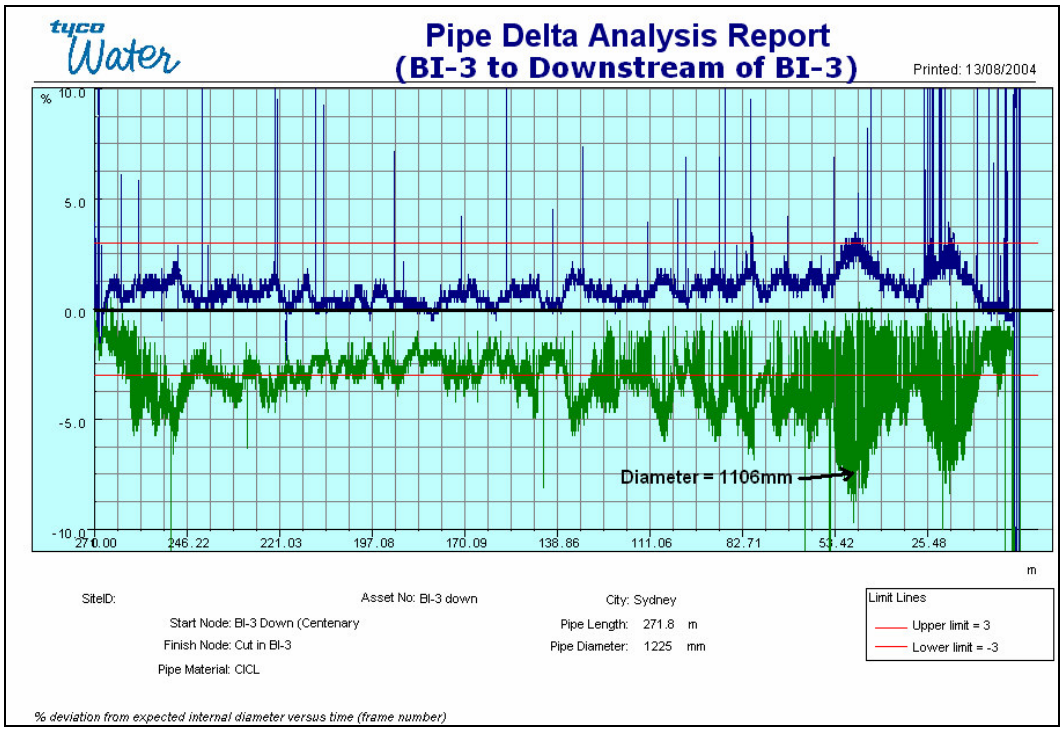
Water becomes visible in the pipe from 444m (446.25) and increases to a level of 439mm at 465m (467.25) upstream of BI-3. This indicates a dip in the pipe. The camera stopped at this point.



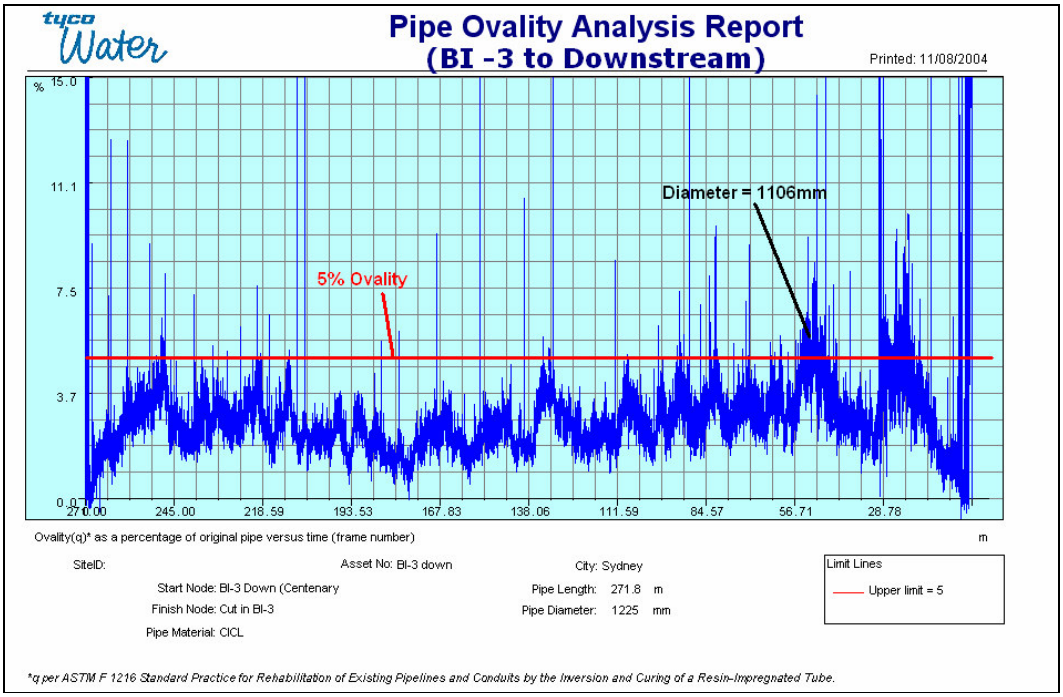
Downstream of BI-3 Cut-in BI-3
This pipe is the most affected by pipe compression. The pipe has a minimum pipe diameter of 1106mm at 46.8m (49.05m true) from BI-3. This deformed section between 43m (45.25) and 53m (55.25) can be seen in the pipe delta and ovality reports.

Similar levels of compression are evident from 23m (25.25m) through to 16m (18.25m).

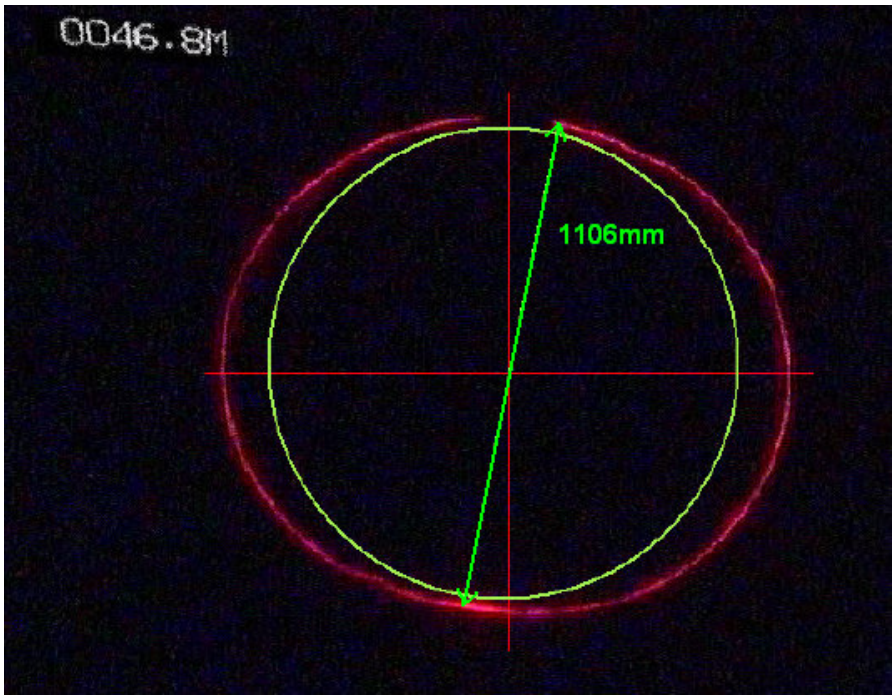
Delta



Ovality



Diameter at 46.8m



Similar levels of compression are evident from 23m (25.25m) through to 16m (18.25m). Minimum diameters of 1130mm or less are consistently found through this 271m length of pipe.

Water can be seen in the pipe from 271.8m (274.05m) through to 263m (265.25m). The maximum depth is at 257mm. This would indicate a large dip in the line.