

Lessons learned from one of New Zealand's most challenging civil engineering projects: rebuilding the earthquake damaged pipes, roads, bridges and retaining walls in the city of Christchurch 2011 - 2016.

## Profilometer Design Guideline

**Story:** Pipe Profilometer and Design Guideline

**Theme:** Design

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A guideline to inform designers of the pipe profilometer operation, including requesting profile surveys, standards and assessments of the survey results.

This document has been provided as an example of a tool that might be useful for other organisations undertaking complex disaster recovery or infrastructure rebuild programmes.

For more information about this document, visit [www.scirtlearninglegacy.org.nz](http://www.scirtlearninglegacy.org.nz)



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**DESIGN GUIDELINE**

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☒ Wastewater      ☐ ~~Stormwater~~      ☐ ~~Geotechnical~~  
☐ ~~Structures~~      ☐ ~~Roading~~      ☐ ~~Water Reticulation~~

**Subject:** Profilometer Design Guideline

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## 1. Purpose of Guideline

This guideline is to inform SCIRT wastewater Designers of the profilometer operation including requesting profile surveys, standards, and assessment of the survey results.

## 2. Background

In February 2012, a profilometer programme was implemented by SCIRT with Geotechnics as the contractor. The purpose of the programme is to measure the magnitude of dips. This is required as:

- The Infrastructure Recovery Technical Standards & Guidelines (IRTSG) requires intervention (repair or renewal) when a dip or dips exceeds 30% of the pipe diameter
- The grading of dips in a CCTV survey is subjective and can lead to inconsistent recording of dip severity.

### What is a Profilometer?

A profilometer is a level sonde that is pulled through the pipe (typically from downstream manhole to upstream manhole), recording the elevation of the sonde in relation to a base station at specified intervals, typically 1 metre.

### How is a Profilometer survey used to assess dips?

The profilometer recordings are used to create a profile plot of the pipe invert for each pipe.

The profile plot shows the location and severity of dips and allows the size of the dips to be calculated as a percentage of the pipe diameter. This information allows the dips to be assessed against the intervention criteria in the IRTSG.

### 3. Designer Request Process

- 1) Determine whether profilometer is required
  - a) Check that profilometer survey has not already been carried out or requested on the pipes of interest. This information is shown under Condition Assessment on the SCIRT GIS viewer.
  - b) Review other condition assessment information (pipe grade and CCTV) if available. Profilometer is best used to confirm the location and severity of dips already indicated by CCTV surveys. Profilometer survey can also be used to check for dips where post earthquake aerial photos indicate heavy liquefaction.
  - c) An area may be profiled in full, or a sample of pipes can be profiled, or only pipes of particular interest can be requested.
  - d) A discussion between Designer and Asset Assessment Team should take place to confirm the value of getting the work done.
- 2) Complete Profilometer request
  - a) Fill in the relevant fields in the request template, located in:  
G:\Profilometer & Polecam Results\Profilometer\Profilometer work requests
  - b) Send the template to the Profilometer Coordinator (currently Pam Wilson) in the Asset Assessment team.
- 3) Allow for fieldwork and review to take place
  - a) It typically takes 4 weeks for profilometer surveys to be carried out and the results assessed by the Asset Assessment Team (including an internal quality audit)
  - b) Assessments are imported into Infonet by the Asset Assessment Team. The Designer will be notified when this has taken place.
  - c) The Profilometer Coordinator should be contacted with queries relating to the request programme and assessment outcomes.
- 4) Review results
  - a) Assessment outcomes can be viewed in Infonet in the base scenario for Wastewater pipelines
  - b) The Designer can refer to the profile plots which are excel graphs. The graphs are located in the file labeled with the request number in the following folder:  
  
<G:\Profilometer & Polecam Results\Profilometer\Profile Results\Profilometer Completed Reviews>
  - c) The SCIRT GIS viewer is updated from Infonet on Fridays. Profilometer assessments can be found under the Condition Assessment > WW Assessments > Profile Assessments layer.

Examples of profile plots and assessment outcomes are shown below in Section 5.

### 4. Applicable Standards

Profilometer Dip Assessments are made in accordance with the IRTSG Section 6.8; Condition Assessment Tools – Profilometer:

- *WWIP.10* - Where dips greater than 30% of the pipe diameter, are identified through profilometer survey, the pipe length shall be repaired or renewed
- *WWIP.11* – Where dips under 30% of the pipe diameter are identified through profilometer survey, they shall be assessed against clause 6.15.2 Sags and Dips

For profilometer assessments, dips are categorised as follows:

- Small Dip: <30% of Pipe Diameter
- Medium Dip:  $\geq 30\%$  and <50% of Pipe Diameter
- Large Dip:  $\geq 50\%$  of Pipe Diameter

Note that this varies slightly from the dip categories specified in the NZPIM for CCTV assessment, where a medium dip is specified as 25-50% of pipe diameter. Using a cut off of 30% for small dips aligns the dip categories with IRTSG intervention points specified above.

Small dips are ignored during assessment and are therefore not recorded, whereas medium and large dips are recorded and flagged up in InfoNet for intervention (repair or renewal).

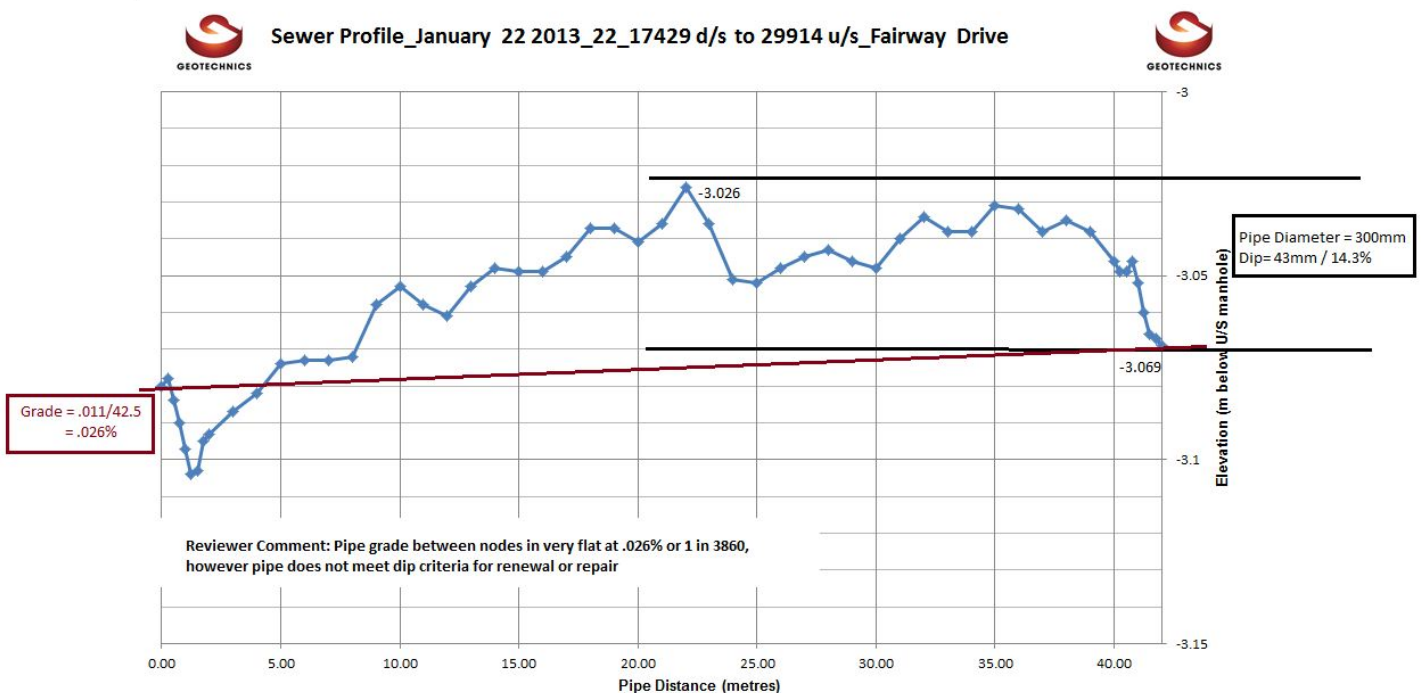
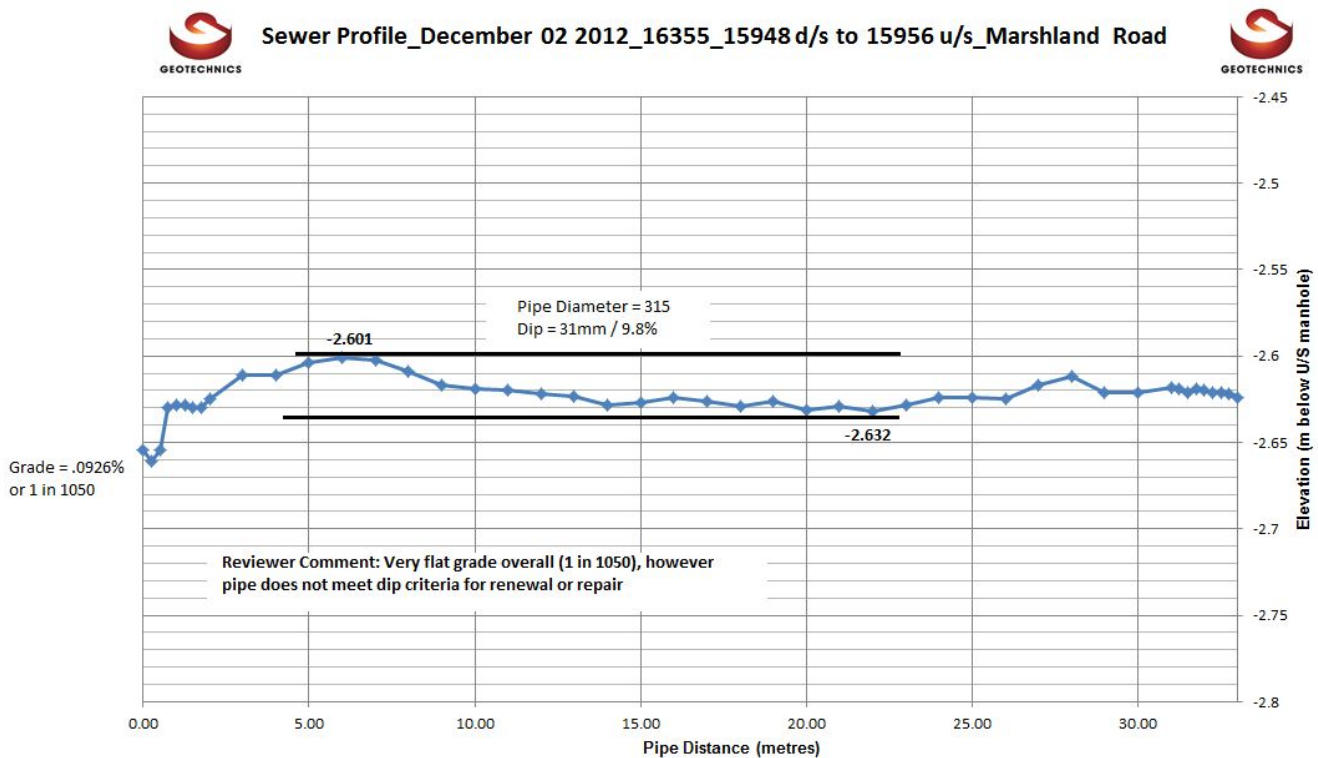
## 5. Dip Assessment

One of the following dip assessments will be given to each profilometer survey

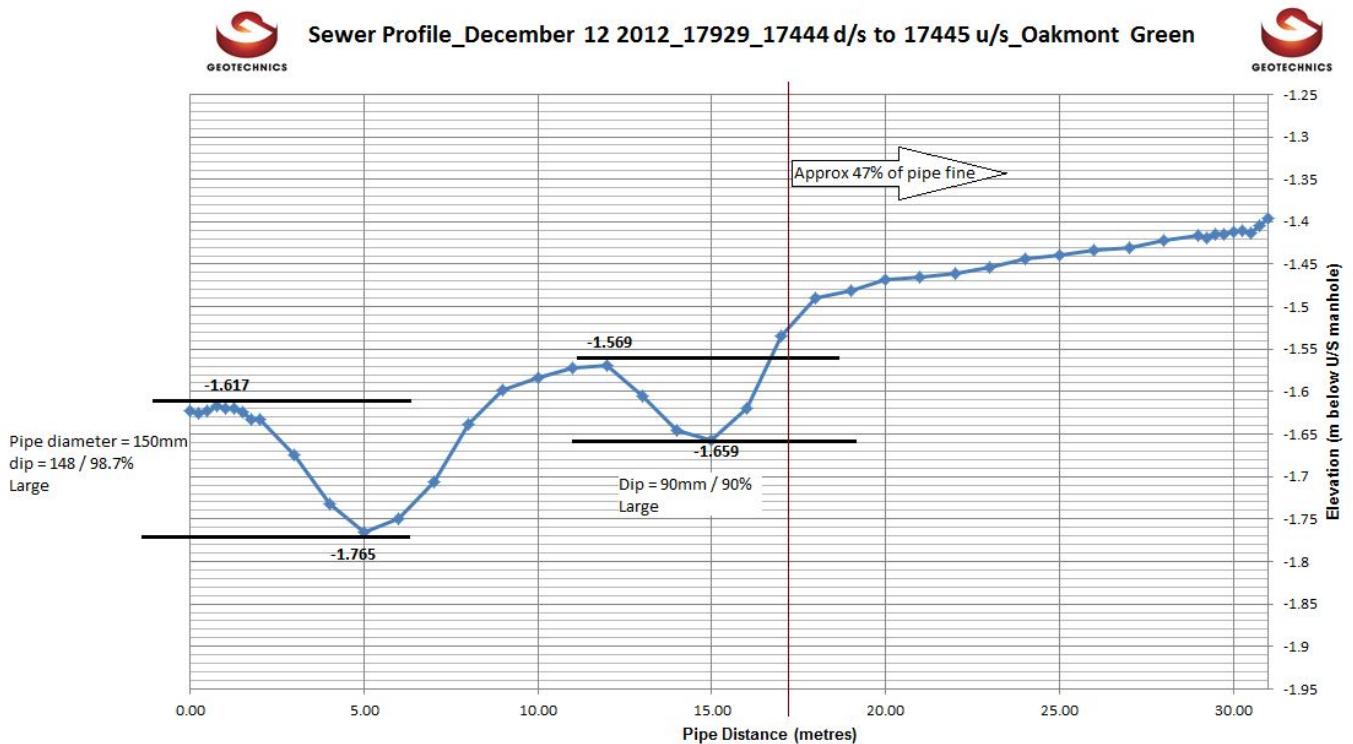
- No Action
- Repair
- Renewal
- Not Surveyed

**No Action:** The survey shows no sign of Medium or Large dipping. As stated in WWIP.11 if a pipe receives a No Action assessment for dips it still needs to be assessed against clause IRTSG 6.15.2 to check it meets the standards for average pipe grade, radius of curvature and joint deflection. Section 6 of this report provides further information regarding these checks.

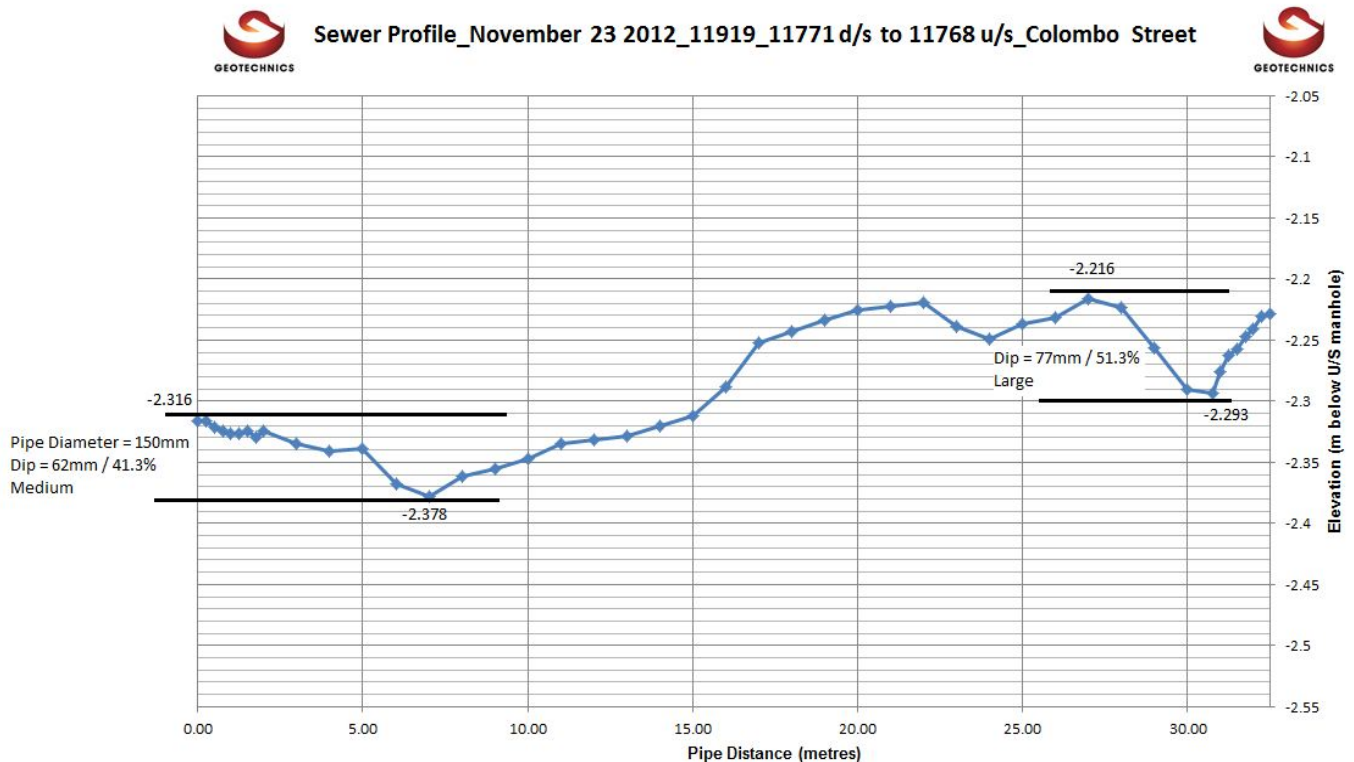
The following examples show two pipes that would be assessed as No Action on dips:



**Repair:** There is 1 or more dip(s) that meet the threshold for repair, however not enough for the Data Assessment Team to make a call to renew the pipe, having no knowledge of other functional assessments. An example of a pipe that would be designated for repair is shown below.



**Renewal:** The pipe shows signs of Medium and/or Large dips along sufficient length of the pipe (around 80% of the pipe length or greater), for the Data Assessment Team to suggest a full relay of the pipe based on dip information alone. An example of a pipe that would be designated for renewal is shown below:



*Not Surveyed:* The pipe was never physically surveyed, for one of many reasons, predominantly:

- No access (manhole covered, private property etc)
- Debris in pipe
- Cancelled from request for specific reason
- Pipe does not exist

In order to make the final call on whether a pipe is to be repaired or renewed Designers should consider the following:

1. The length of pipe that would need to be relayed to remove dips
2. The presence of dips in the upstream and downstream pipes and whether a MH level adjustment could resolve dips in adjacent pipes
3. The presence of structural defects (identified from CCTV) in the pipe

In most cases it will be clear that either a repair or a renewal is required. For borderline repair or renewal decisions the Designer is advised to consult with the Wastewater Technical Lead.

Note: The MH to MH grade assessment (from level survey of MH inverts) is a separate analysis that is typically undertaken prior to dip assessment.

## 6. Further References

A dip assessment is carried out in accordance with IRTSG Section 6.8 Profilometer. The Designer should also confirm that the pipeline complies with section 6.15 Sags and Dips when making the overall assessment.

This assessment is done in accordance with IRTSG Section 6.15 Sag and Dips:

- WWIP 30 – If a pipelines grade complies with clause 6.15: Gravity Pipelines, and no individual sag / dip exceeds 30% of the pipe diameter, the pipe shall not be renewed or repaired.
- WWIP 31 – If a sag / dip (of less than 30% of the pipe diameter) creates a change in gradient which exceeds the jointed pipe deflection tolerances recommended by the pipe manufacturer the pipe length shall be repaired
- WWIP 32 If a sag / dip (of less than 30% of the pipe diameter) creates a change in gradient which exceeds the flexible pipes radius of curvature in the manufacturers installation requirements the pipe length shall be repaired.

In general, the dip assessment will provide the appropriate assessment in relation to sags and dips. A profilometer survey, which typically logs elevation every metre, is not an appropriate tool to make accurate assessments in regard to WWIP 31 and WWIP 32. Judgment will be required from the Designer who should also refer to CCTV survey.