Presenting author

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Practicalities when Applying AS/NZS 4853: 2012 for AC Low Frequency Induction Risk Assessment

Practicalities when Applying AS/NZS4853 for AC Low Frequency Induction Risk Assessment

- Standard’s title … ‘Electrical hazards on metallic pipelines’
- ‘Sets down the minimum requirements for managing the safety of personnel working in the vicinity of pipelines and equipment installed on pipelines and specifically addresses the requirements for the control of electrical hazards on transmission and distribution pipelines.’

Practicalities when Applying AS/NZS4853 for **AC Low Frequency** Induction Risk Assessment

- Sources are current carrying conductors:
  - Overhead distribution or transmission lines
  - Power cables (under or above ground)
- A.C. Low Frequency coupling mechanisms:
  - Induction
  - Capacitive
  - Conductive

Practicalities when Applying AS/NZS4853 for AC Low Frequency Induction

Risk Assessment

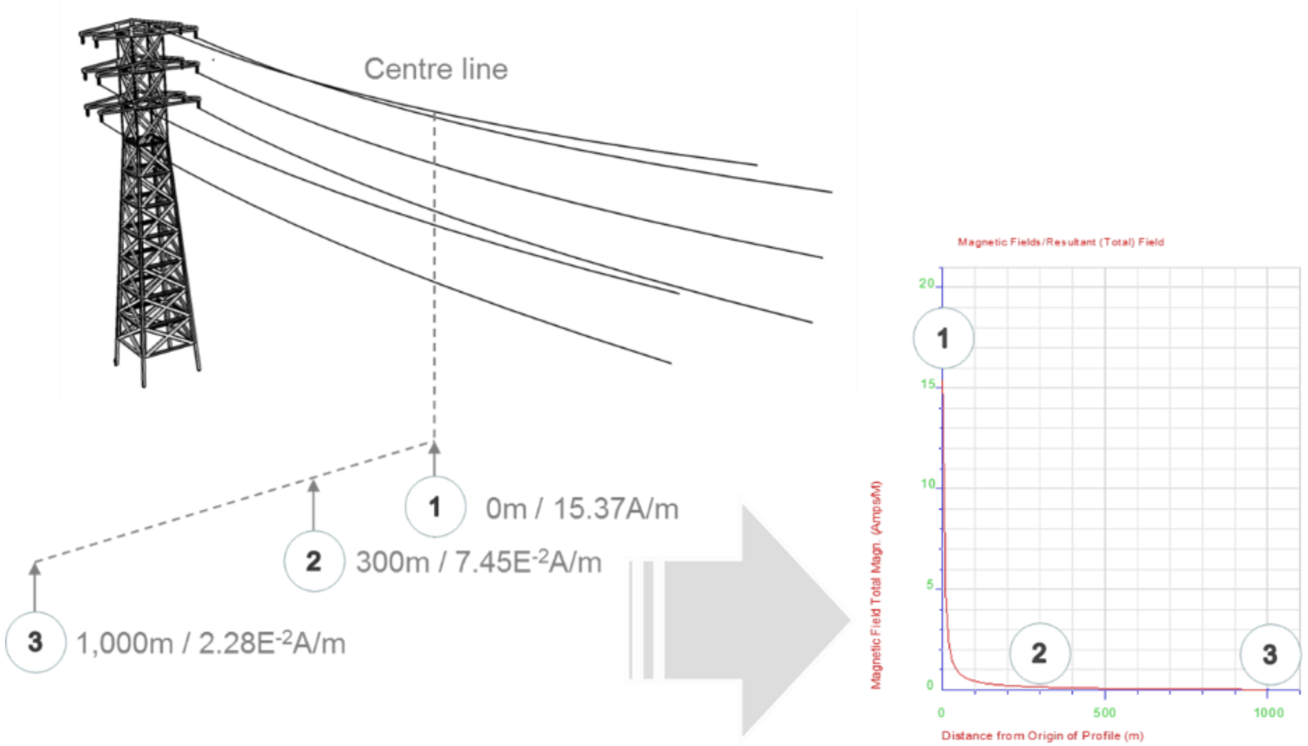
- AC caused corrosion of pipeline
- Equipment integrity:
  - Monolithic Joint
  - Flange insulation
  - Pipeline coating
  - CP equipment
- Human safety

Practicalities when Applying AS/NZS4853 for AC Low Frequency Induction Risk Assessment

Electrical coupling mechanisms

- Inductive
- Capacitive
- Conductive

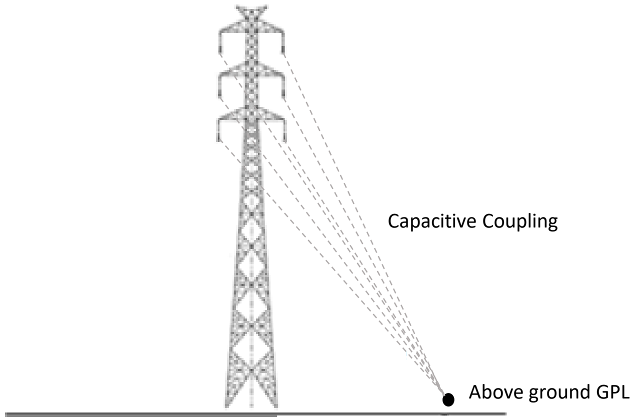
Inductive coupling mechanism



Variables:

- Current flow
- Distance from WPL
- Length of parallism
- Soil resistivity
- Type of coating

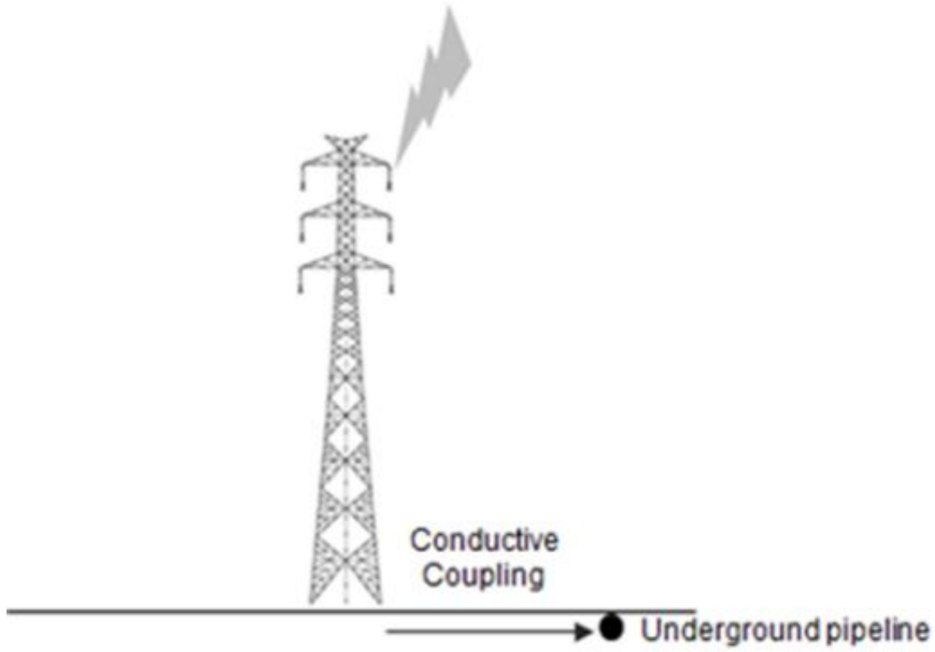
Capacitive coupling mechanism



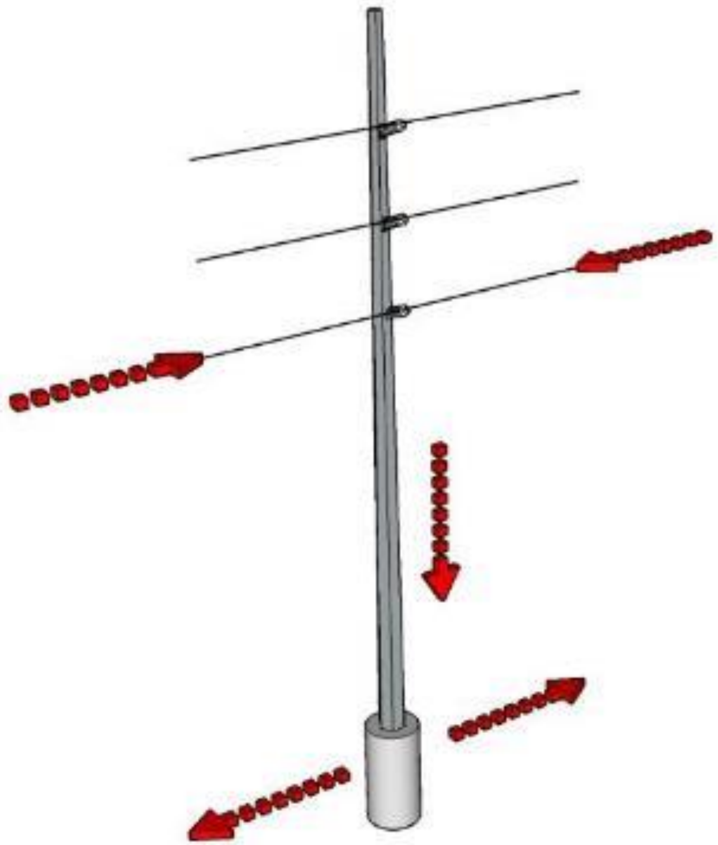
- Contributes towards LFI calculations
- Dependant on the voltage (not current)
- Magnitude of the induced voltage on WPL is not affected by the exposure length
- Present during steady-state conditions
- Relevant to above ground & not underground WPLs

Conductive coupling mechanism

- Contributes towards EPR calculations
- Phase-to-ground fault conditions
- Fault or normal operating current via the earth return
- Affects both above ground & buried GPL
- Normal steady state conditions for AC traction, SWER & HVDC

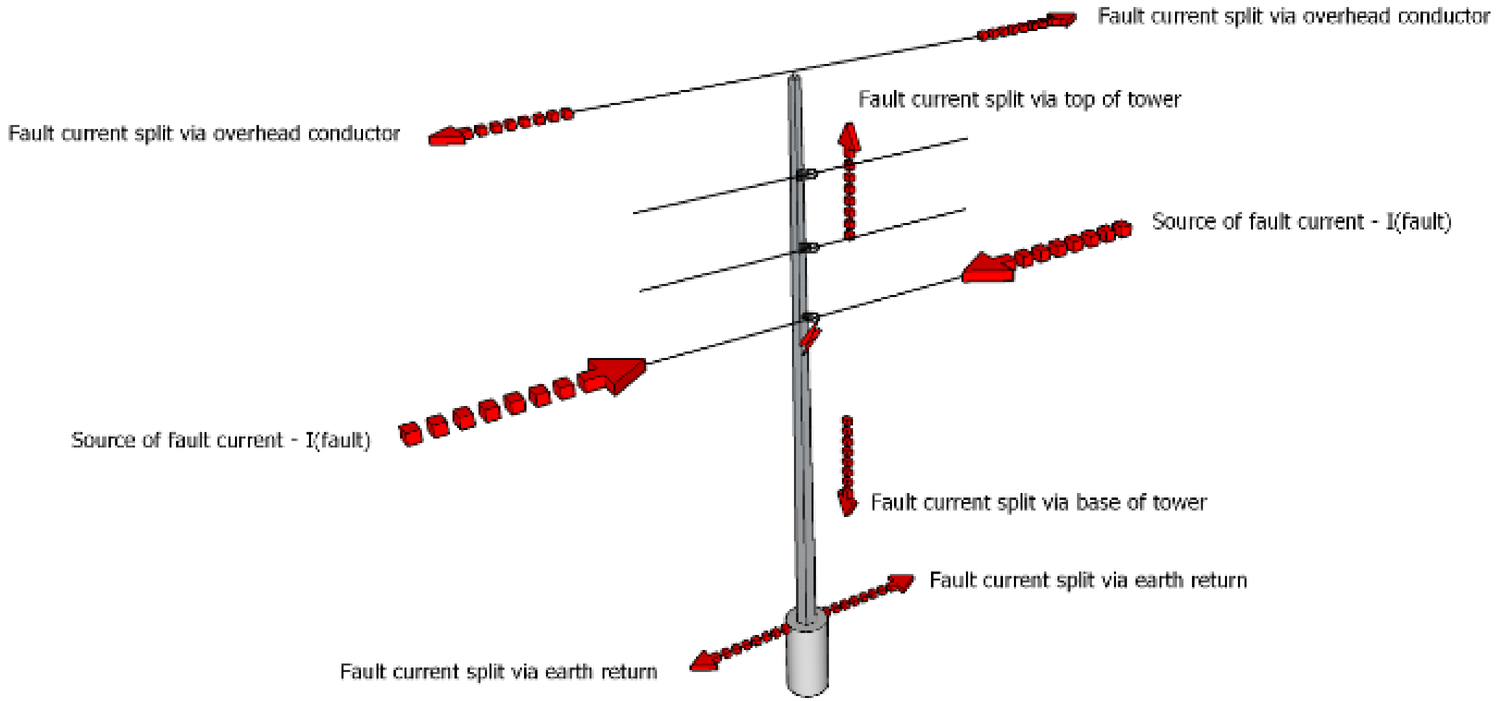


Conductive coupling mechanism …



OHL <u>without</u> OHEC - Typically distribution networks

Conductive coupling mechanism



OHL with OHEC Typically transmission lines

Pipeline Corrosion a.c. Limits

- AS/NZS 4853: 2012 addresses corrosion resulting from steady state LFI by stipulating steady state induced a.c. voltage limits for varying soil resistivity (CIGRE TB 290 guideline)
- These limits are:
  - 4 V a.c. for soil resistivity $\leq$ 25 Ω·m; and
  - 10 V a.c. for soils whose resistivity is > 25 Ω·m

Electrical Sources – Transmission Overhead Lines

Electrical Sources – Distribution Overhead Lines

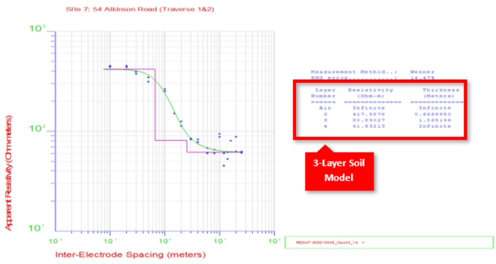
Accuracy Challenges Facing Calculating LFI

Differences between actual & calculated a.c. steady state LFI impressed voltage results attributed to:

- Real-time operating current
- Inconsistency in configurations, phase spacing and average conductor height
- Phasing of multi-circuit powerlines
- Spatial distances between the actual and model may differ due to variations in the provided source of GIS data
- Soil resistivity variation
- Influence of neighbouring services

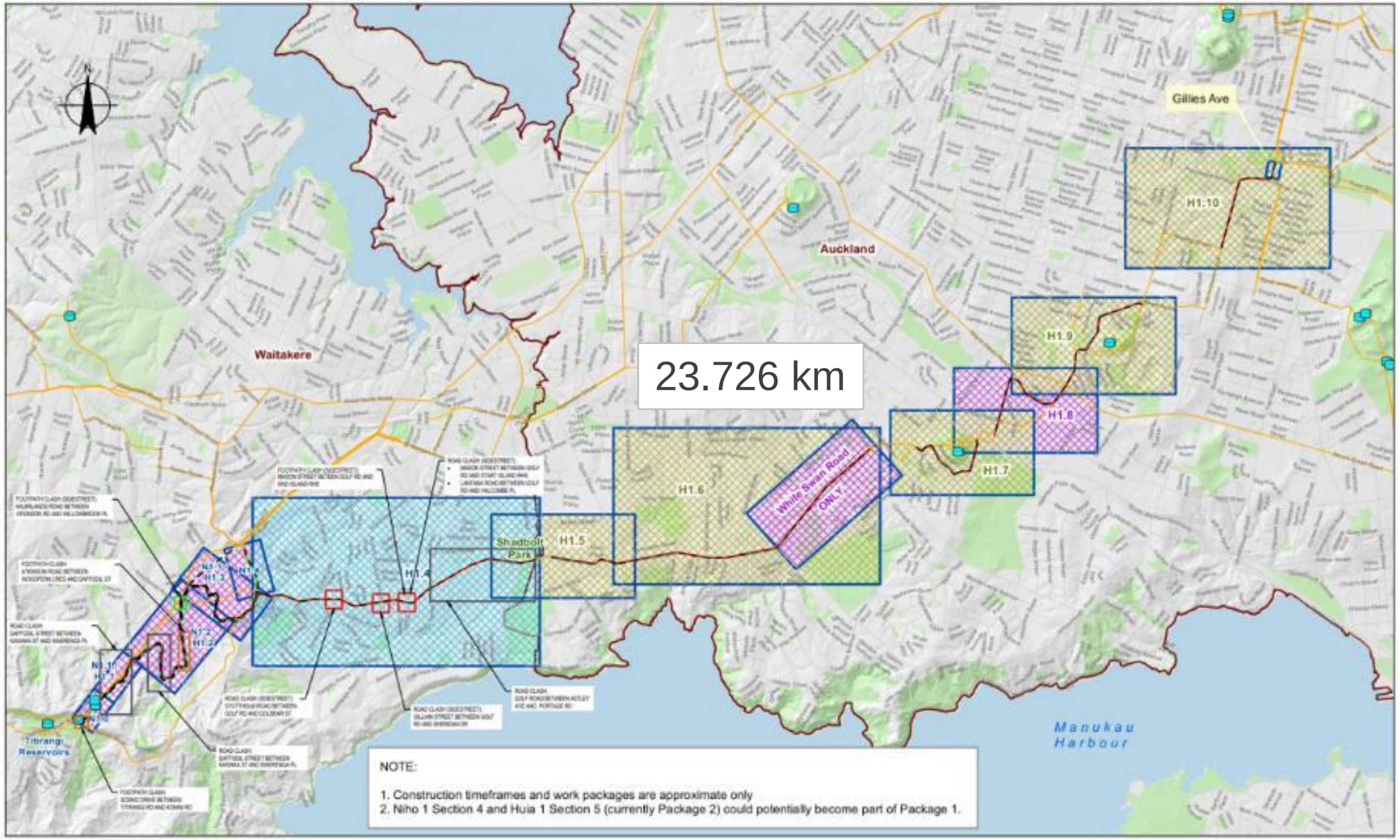
On-site soil measurements

Pin Spacing	Resistivity (Ω·cm)	
	Traverse 1	Traverse 2
0.1	45238.9	43982.3
0.2	43982.3	45238.9
0.3	37699.1	39584.1
0.5	31415.9	34557.5
1	25132.7	26389.4
1.5	15079.6	15079.6
2	11309.7	12566.4
3	8482.3	8293.8
4	7791.1	8293.8
6	6031.9	6785.8
8	6031.9	6534.5
10	8796.5	9424.8
12	4523.9	6031.9
14	6157.5	5277.9
16	8042.5	8042.5
20	6283.2	8796.5

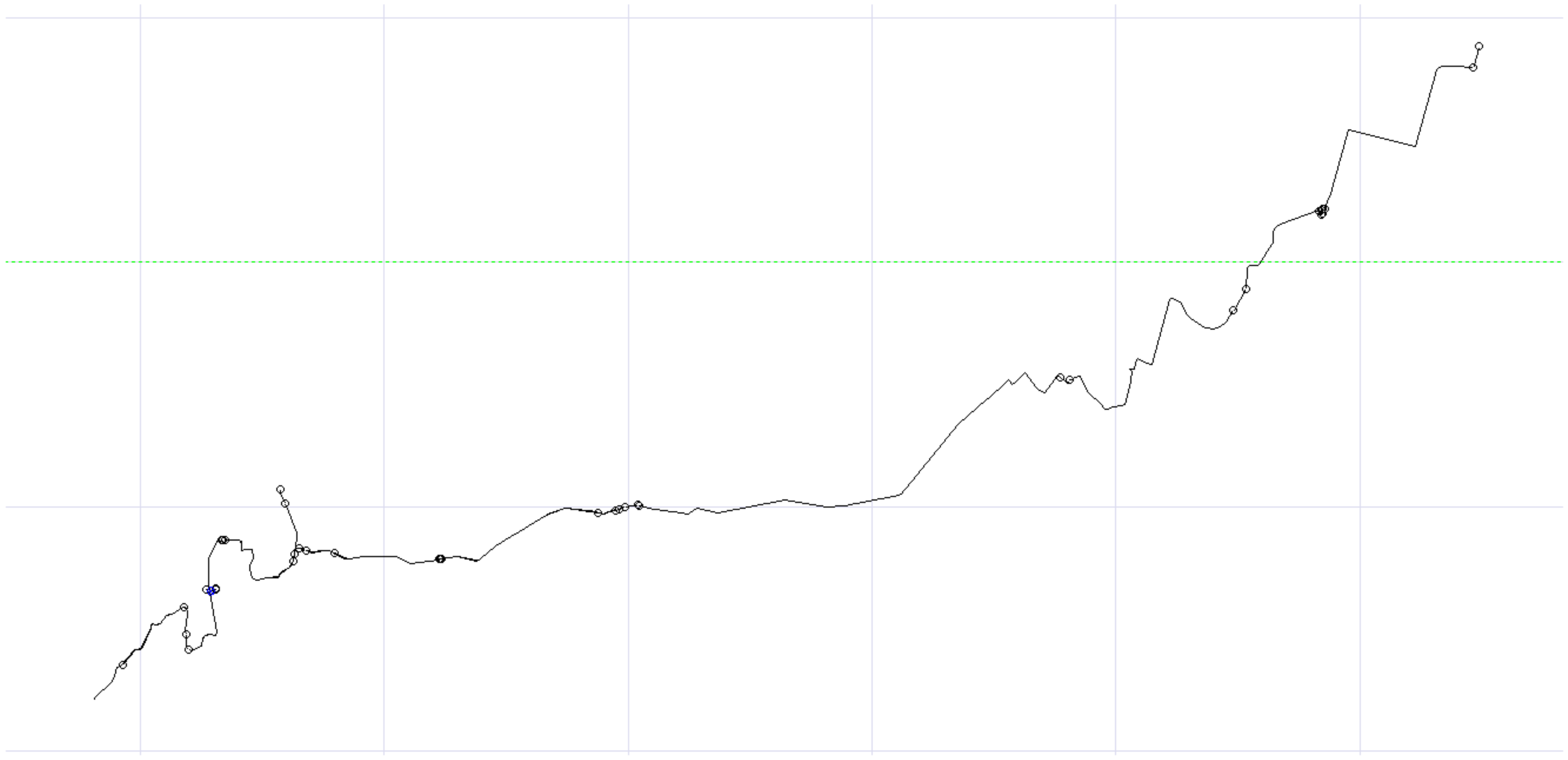


Soil resistivity

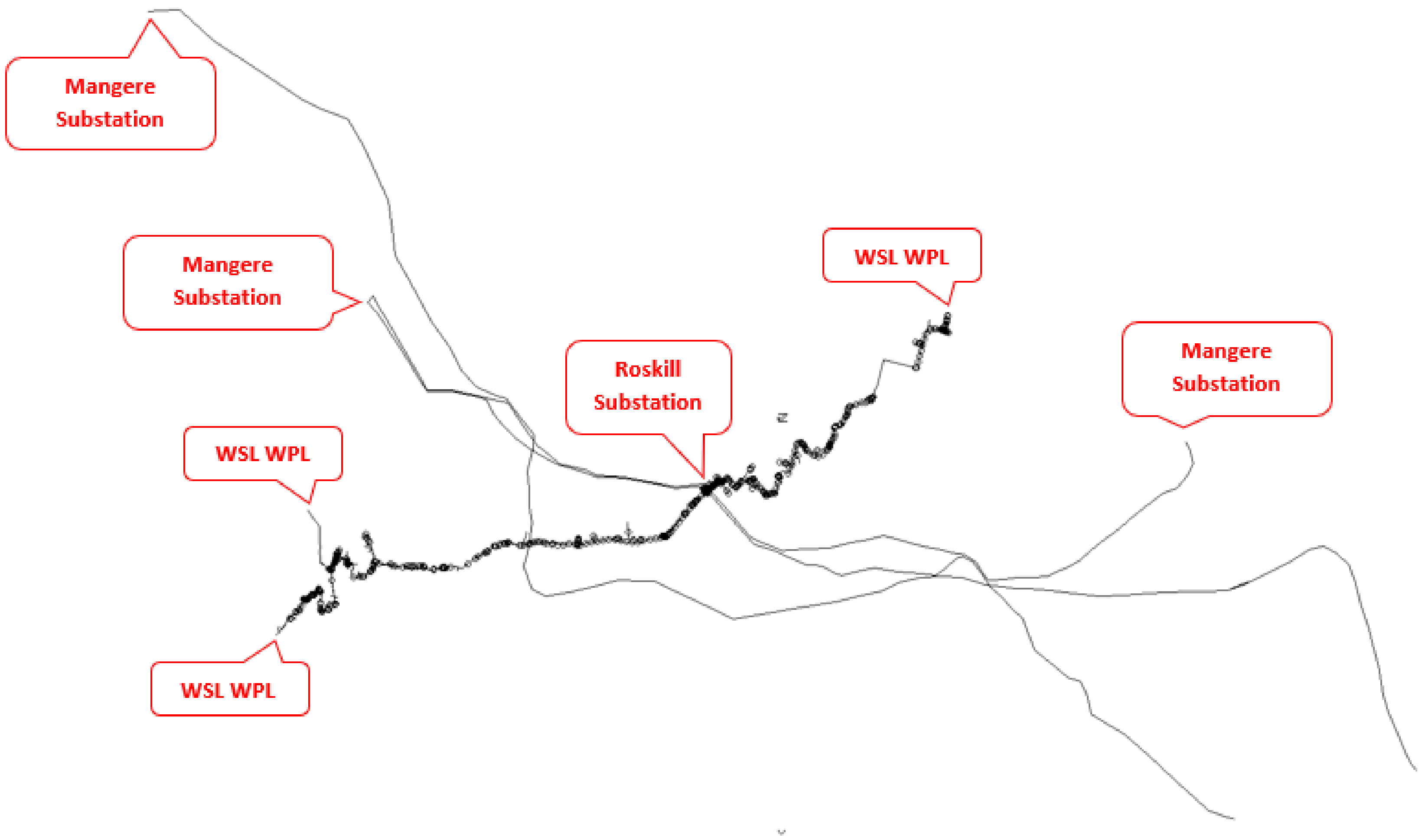
Huia No.1 & Niho No.1 replacement watermain



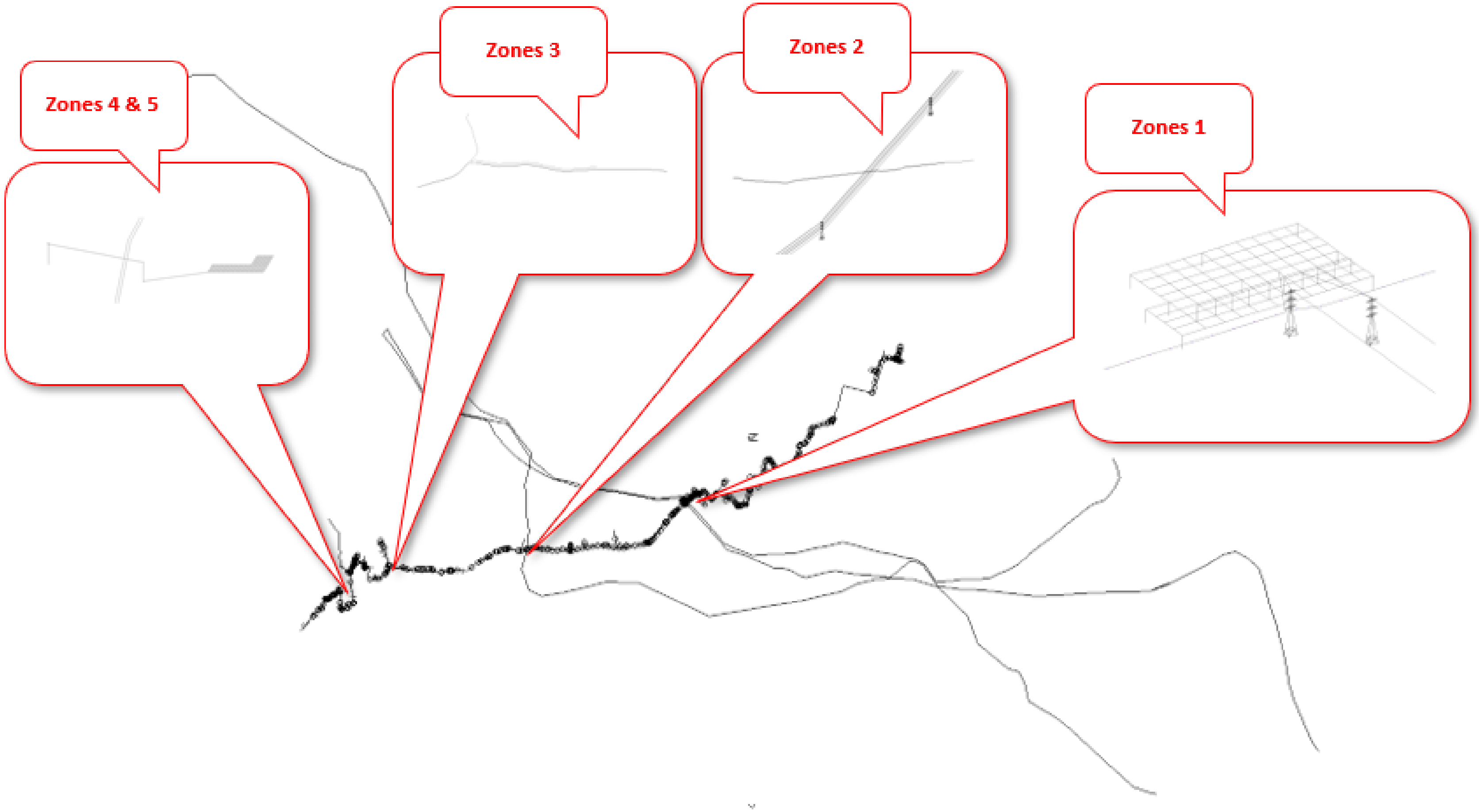
Extent of pipeline



Overall model for LFI/EPR



Zones of Interest for EPR



Installing data loggers

Untitled layer

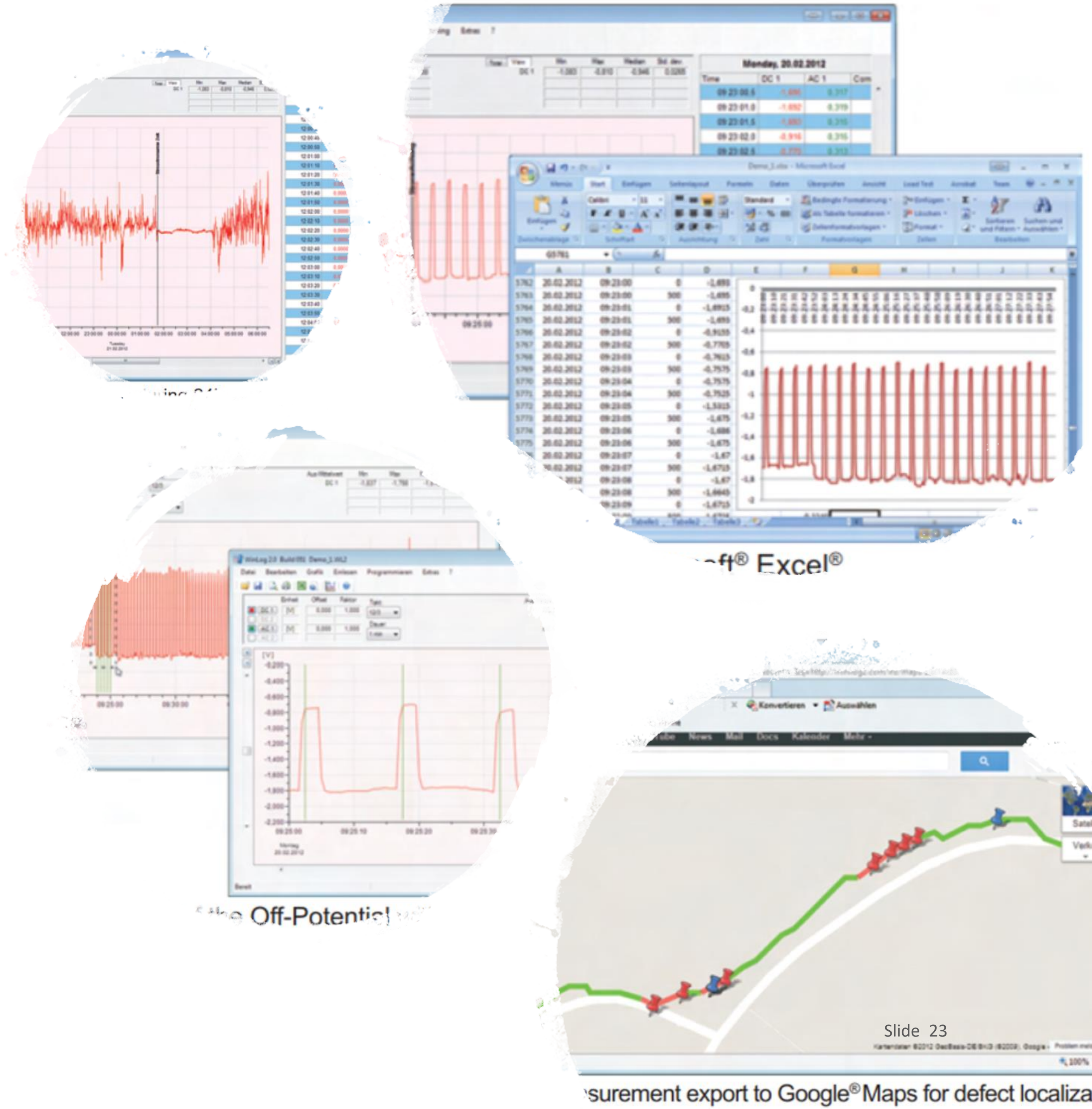
1. 168 Konini Rd
2. 1 Connell St
3. 205 White Swan Rd
4. 173 White Swan Rd
5. 83 White Swan Rd
6. 134 May Rd
7. 67 Winstone Rd
8. Mt Roskill Reservoir
9. 54 Winstone Rd
10. 57 Denbigh Ave

Results from readings

- The highest recorded a.c. voltage of 2.106 V occurred at Mt Roskill TP1 BSP
- Representing 53% & 21% of the 4 V & 10 V limit.

Benefits from installing data loggers

- Eliminates the ‘assumption’ errors in LFI assessments
- Date provided as:
  - Maximum values
  - Minimum values
  - Average values
  - Time of day/month/year
  - Geographical locations
- Sound asset management
  - Future planning
  - Real time condition monitoring



Summary

- AS/NZS4853
- AC LFI
- Practicalities
- Data Loggers