Bonneagar Iompair Éireann
Transport Infrastructure Ireland

NTA
Údarás Náisiúnta Iompair
National Transport Authority

Luas Finglas

Environmental Impact Assessment Report 2024

Appendix A16.4: Soils Resistivity Survey

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Contents

SECTION 1: Introduction and objectives

1.1 Context

Luas Finglas is the proposed new northern extension of the Luas Green Line from its current terminus in Broombridge to a new terminus in Charlestown, near the N2-M50 interchange, it is approximately 4km long, with 4 new stops, two new substations, two main bridges, and a new extension to Broombridge depot. The general environment of the new line runs through a combination of industrial areas, residential areas, street running, green field areas and an interface with an existing railway line.

This Earth Resistivity Measurements report will identify and explain the survey results that have been carried out at the two new substation locations during the preliminary design phase of the Luas Finglas extension.

1.2 Scope

These surveys are required at tram-stops and sub-station locations to determine the optimum location earth rods and earthing systems, and to determine that the earth rod resistance to earth value is sufficiently low enough to provide an effective safety earth. The measurement procedure described is the Wenner (four rod) procedure that is given in BS 7430:2011.

1.3 Background to the Earth Resistivity Measurements and Test Method

A key factor for grounding a system is to provide a reference potential for implementing power supply systems or electrical elements, such as tram stops and substations. To obtain this, a suitable low resistance connection to earth is preferable. However, this can be difficult to achieve and there are a number of factors that influence this, such as:

- Soil resistivity;
- Type of ground conditions;
- Size of area;
- Moisture of soil;

To determine the soil resistivity at different depths, the following calculation is performed:

$$\rho = 2 * PI * R * a$$

- ρ is the soil resistivity in ohm.metres;
- R is the measured resistance value in ohms;
- PI is the equal spacing between the test rods in metres and is also the equivalent depth of the resistivity measurement;

PI is the mathematical constant, representing the ratio between a circle's circumference and diameter.

SECTION 2: Methodology

2.1 Scope Objectives

The main objectives of the measurements are to:

- Determine an optimum position for the earth rods and systems to be installed;
- Provide assurance that suitable low voltage supply disconnection times can be achieved under fault conditions;
- Provide assurance that Earth Potential Rise (EPR) values can be made safe under fault conditions;
- Assess the viability of sub-station candidate locations and assist with their Earthing system design;
- Provide adequate protection of equipment from external fault sources, such as lightning strike and overhead line equipment faults.

The following equipment was used for these tests:

- Fluke 1625-2 GEO Earth Ground Tester;
- Four earth electrodes and cables;

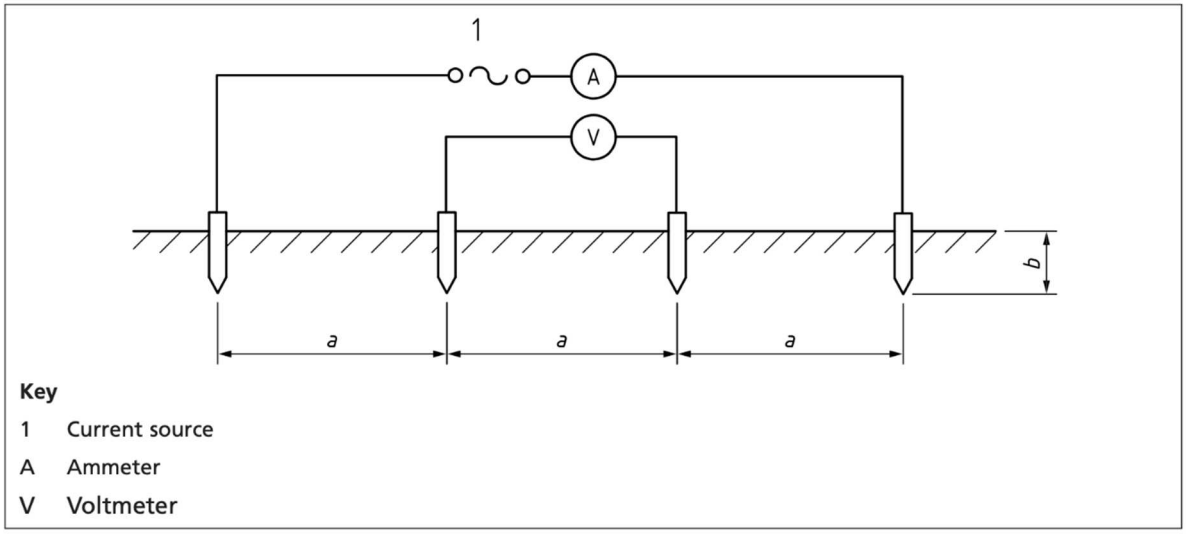

Figure 1 - Diagram of measurement setup

SECTION 3: Test locations & Results

3.1 Finglas Fire Station Substation Location

A new proposed substation is to be located next to the Finglas Fire Station. To determine this to be a suitable site, soil resistivity measurements have been performed to see if the ground resistance is low enough for a proper safety to earth for the future design and build phase. Before testing commenced utility models were analysed to avoid any underground services and associated interference, meaning that testing was performed to the highest and safest levels practicable. Figure 2 - Test Site 1 shows the test area.

Figure 2 - Test Site 1

3.2 Site 1 Test Results

Date – 18/10/2022
Tester – Jack Robbins
Precipitation Levels – Heavy Rain and Thunder
Ground conditions – Damp
Approximate Temperature – 10°C

Test results as below:

Table 1 – Results Finglas Fire Station / Pump House (Perpendicular)

Finglas Fire Station / Pump House (Perpendicular)		
a(m)	R(Ω)	Rho(Ω.m)
2	9.78	122.90
4	3.42	85.95
6	1.8	67.86
8	1.27	63.84
10	0.93	58.43

Table 2 – Results Finglas Fire Station / Pump House

Finglas Fire Station / Pump House		
a(m)	R(Ω)	Rho(Ω.m)
2	9.23	115.99
4	2.78	69.87

3.3 North Road Substation Location

The second proposed substation is to be located adjacent to North Road underneath the pedestrian fly-over. As per site location 1, to determine if this to be a suitable site, the same soil resistivity measurements have been performed. For this location, utility models have also been analysed to prevent interference during the testing. A previous site visit suggested that this site may be at a higher soil resistivity due to the structure that is located upon the ground. In addition to this, upon arrival it became apparent the site may have defects such as contaminated ground due to the evidence of substance usage from the members of public. Extra safety measures were implemented when testing at this site due to the site circumstances such as, full PPE, observational surveys, signage, barriers and working within a minimum group of two personnel at all times.

Figure 3 - Test Site 2

3.4 Site 2 Test Results

Date – 19/10/2022
Tester – Jack Robbins
Precipitation Levels – Overcast
Ground conditions – Damp
Approximate Temperature –10°C

Test results as below:

Table 3 - Results North Road Entrance

North Road Entrance		
a(m)	R(Ω)	Rho(Ω.m)
2	40.1	503.91
4	12.91	324.46
6	2.87	108.20
8	2.78	139.74
10	2.39	150.17

Table 4 - Results Gate Entrance

Gate Entrance		
a(m)	R(Ω)	Rho(Ω.m)
2	6.34	79.67
4	4.6	115.61
6	4.31	162.48
8	5.26	264.40
10	2.39	150.17

SECTION 4: Conclusions

4.1 Finglas Fire Station Conclusions

Overall the Finglas fire station surveys show a steady decrease in values with each 2m spacing. This demonstrates that the site's ground conditions will be sufficient for an effective safety earth as each value decreases with depth. The resistance values are also low enough to suggest that 'test site 1' is an ideal location to install and design an Earthing system for a traction power sub-station or tram stop. These results also suggest that this site is unlikely to result in a 'hot site[1]' due to the acceptably low readings. A key factor to note is during the design for this substation it is important to avoid any present or future utilities as an EPR can cause transferred potentials if not managed correctly.

4.2 North Road Conclusions

North Road substation location does show higher readings than 'test site 1' this may be because of the reasons mentioned in Section 7. However, overall the readings do show a decrease in value with a low resistance per each meter spacings. Test results at the gate entrance may suggest a defect such as metal work under the ground at around 5 meters as the value does rise by 1ohm. As this value is not showing Kohms or a large reading it is still viable to suggest this is a good site to locate a future substation. These readings also give evidence that it is unlikely to be classified as a 'hot site'. As also stated in section 4.1, a key factor to note is during the design and installation it is important to avoid any utilities due to the transferred potentials. It is recommended not to bury spoil or contaminate the ground during the removal of the pedestrian fly-over as these results may differ if this is not managed correctly.

[1] A 'hot site' refers to a site where the installed earthing system results in an EPR of 430 V or more under fault conditions, leading to safety issues such as dangerous Touch and Step Potentials. Finglas Fire Station is likely to be classified as a 'cold site'.

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