

**METROLINK**

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**A25.6**

**Dardistown  
Archaeological  
Geophysical Survey  
Report**

**Dardistown Depot,  
Ballymun Td,  
Surveyed as part of MetroLink,  
County Dublin**

**Archaeological Geophysical Survey**

**Detection Licence No. 18R0196**

**Survey undertaken for  
Jacobs Engineering  
on behalf of  
Transport Infrastructure Ireland**

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**EAG 408**

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## Summary of Results

Between the 14<sup>th</sup> and 22<sup>nd</sup> September 2020, a series of geophysical surveys were undertaken at the proposed site of the Dardistown Depot, Ballymun Townland, County Dublin. The work formed part of the archaeological investigation in advance of the proposed MetroLink scheme and was commissioned by Jacobs Engineering on behalf of Transport Infrastructure Ireland.

Previous geophysical surveys had been undertaken by this company as part of the scheme at selected locations along the MetroLink route in 2018 and 2019 under the same detection licence.

The geophysical survey was conducted over two adjacent fields at Ballymun townland. A magnetometer survey was undertaken at a sample resolution of 0.5m x 0.25m over a total of 12.2 hectares and an electromagnetic survey was undertaken at a sample resolution of 0.5m x 0.25m over 6.1 hectares.

The survey was conducted upon a bedrock geology consisting of Tober Colleen Formation calcareous shale and limestone conglomerate and Lucan Formation dark limestone and shale, beneath grey-brown podzolics and brown earths. The majority of the survey area was covered in newly harvested crop stubble, the northern field was ploughed and seeded during the survey period. An area of overgrown vegetation was present in the southwestern corner of the southern field which could not be surveyed.

The geophysical surveys undertaken for this report have revealed a landscape which has been heavily impacted by agricultural processes. Multiple relict field boundaries were detected; some of these boundaries appear to be associated with the field division visible on historic mapping. Evidence for at least one different field alignment was also identified. Cultivation furrows, land drains and a pipeline were also detected.

Potential archaeological remains were also identified with the detection of a number of arcing ditches, possible compacted earth or stone boundaries and pits. Within the northern field a possible rectangular enclosure is visible, with possible internal divisions. This feature matches an aerial photo anomaly.

In the southern field a large sub-oval enclosure was detected which appears to contain a number of internal divisions. Two further possible enclosures were also identified, a ditched enclosure to the southwest and a compacted earth or stone enclosure with internal rectangular feature to the southeast.

## Statement of Indemnity

A geophysical survey is a scientific procedure that produces observations of results which are influenced by specific variables. The results and subsequent interpretation of the geophysical survey presented here should not be treated as an absolute representation of the underlying archaeological features, but as a hypothesis that must be proved or disproved. **Direct investigations are recommended to confirm the findings of this report.** Verification can only be provided via intrusive means, such as Test Trench excavations.

## **1. Introduction**

### **1.1 Brief Description of the Proposed Development**

EarthSound Geophysics Ltd. were commissioned by Jacobs Engineering on behalf of Transport Infrastructure Ireland to carry out geophysical surveys at a pre-selected site along the proposed MetroLink scheme in Ballymun townland, Dublin. This work forms part of the archaeological investigation in advance of MetroLink.

Previous geophysical surveys had been undertaken by this company as part of the scheme at selected locations along the MetroLink route in 2018 and 2019 under the same detection license. In addition the fields outside the current survey areas had previously been subject to geophysical surveys (Thebaudeau & Harrison 2009, licence no. 08R0117), (Nicholls 2011, licence no. 08R0017) and test excavation (Kyle & Bayley 2011, license no. 11E039). Some of this work was undertaken as part of the old Metro North scheme.

### **1.2 Aims of the Survey**

Transport Infrastructure Ireland (TII) required the archaeological geophysical surveys as part of the archaeological investigations in advance of MetroLink. The site of the surveys will form part of the proposed Dardistown Depot. The techniques to be used were pre-determined by TII and were carried out in accordance with the brief prepared by Jacobs Engineering, using a combination of Magnetic Gradiometer and EM Apparent Electrical Resistivity.

The purpose of these surveys was to ascertain, identify and map the presence of any previously unrecorded and buried archaeological structures and/or features at several key locations along the proposed MetroLink alignment. The results of the geophysical survey may be followed by a programme of invasive archaeological test excavations and will inform the archaeological strategy for the proposed scheme. From these results, it will be possible to identify the effects of the MetroLink project on archaeology in the surrounding environment.

### **1.3 Description of the Survey Area**

The survey area comprises of two agricultural fields within the townland of Ballymun. The majority of the survey area was covered in newly harvested crop stubble, the northern field was ploughed and seeded during the survey period. An area of overgrown vegetation was present in the southwestern corner of the southern field which could not be surveyed.

The survey areas are located upon a bedrock geology of Tober Colleen Formation calcareous shale and limestone conglomerate and Lucan Formation dark limestone and shale. These are overlain by grey-brown podzolics and brown earths.

The climatic conditions were mixed periods of sunshine and overcast weather. The weather is unlikely to have had an impact on the results obtained as the EMI apparent electrical resistivity surveys map contrasts at depth rather than at the surface.

## 1.4 Archaeological Background and Statutory Protections

The northern field contains a recorded burnt mound (DU014-119---). The monument lies outside the survey area and has previously been subject to a geophysical survey (Thebaudeau & Harrison 2009, licence no. 08R0117), (Nicholls 2011, licence no. 08R0017) and test excavation (Kyle & Bayley 2011, license no. 11E039). Some of this work was undertaken as part of the old Metro North scheme. One possible enclosure was noted within aerial images of the site. This feature is located partially within the survey area and was targeted using the resistivity surveys.

## 2. Methodology

Fieldwork was carried out 14<sup>th</sup> and 22<sup>nd</sup> September 2020 by C. Hogan and U. Garner of Earthsound Geophysics.

A detailed magnetometer survey was carried out using a LEA MAX Förster gradiometer system over a total of 12.2 hectares. Apparent Electrical Resistivity data was collected using a GF Instruments CMD Mini-Explorer over a total of 6.1 hectares. The Magnetometer surveys and Electromagnetic surveys were undertaken gridlessly with each data point logged using a Trimble RTK GPS VRS Now system.

The techniques have been used in commercial and research archaeological projects for many years and are considered the most appropriate techniques for a detailed investigation of the underlying archaeology (Clark 1996, Scollar *et al.* 1990, Gaffney & Gater 2003).

Where possible, the use of multiple geophysical techniques allows a greater confidence to be placed in the interpretation of detected anomalies, which is especially useful on small sites such as this. Their combined application can be used to determine the geometry, compositional material and the extent of an archaeological target.

### 2.1 Magnetometer Survey

<b>Instrument</b>	Eastern Atlas LEA MAX <sup>1505</sup> System
<b>Components</b>	LEA D2, 10-channel digitiser
<b>Data Acquisition</b>	0.5m x 0.1m
<b>Sensors</b>	8 x Förster FEREX <sup>®</sup> 4.032 CON650 fluxgate gradiometers
<b>Platform</b>	LEA MAX <sup>1505</sup> System cart
<b>Data Acquisition Method</b>	Gridless, using a Trimble RTK GPS VRS Now system to an accuracy of 5cm
<b>Sensitivity</b>	<0.1 nT
<b>Data Logger</b>	Panasonic Toughbook CF-H2 Field computer
<b>Calibration</b>	According to manufacturers guidelines (Pilz & Goossens 2015)
<b>Data Processing</b>	Ealdec: Profile decoding Ealmat.m: Normalisation, drift correction Surfer 8: Data Gridding (0.5m x 0.25m), using the Kriging Gridding Method
<b>Graphical Display</b>	Greyscale -2nT (white) to 2nT (black)

## 2.2 Resistivity Survey

<b>EMI Measurement</b>	Apparent Electrical Resistivity ( $ER_a$ )
<b>Instrument</b>	GF Instruments CMD-MiniExplorer
<b>Data Acquisition</b>	0.5m x 0.2s
<b>Coil Configuration / Depth range</b>	Vertical Coplanar Coil configuration (VPC) or 'half-depth', effective depth range: 0.25m, 0.5m, 0.9m
<b>Platform</b>	SparrowHawk-1000 cart system, sensor positioned 10cm above the ground
<b>Data Acquisition Method</b>	Continuous mode, Gridless, using a Trimble RTK GPS VRS Now system to an accuracy of 5cm
<b>Measuring Range</b>	$ER_a$ : 1000mS/m, resolution 0.1mS/m
<b>Data Logger</b>	CMD Control Unit
<b>Calibration</b>	According to manufacturers guidelines (GF Instruments 2010)
<b>Data Processing</b>	CMD Data Transfer: conversion to Apparent Electrical Resistivity ( $ER_a$ ) from Apparent Electrical Conductivity (Quadrature) Process-it: Drift correction using a moving filter, Despike, Low Pass Gaussian Filter, Interpolation
<b>Graphical Display</b>	Greyscale 50 mS/m(white) to 90 mS/m (black)

## 2.3 Reporting, Mapping & Archiving

The geophysical survey and report follow the recommendations outlined by relevant best practice guidance documents as a minimum standard (Bonsall *et al.* 2014; David *et al.* 2008; Gaffney *et al.* 2002, Schmidt *et al.* 2015).

Ordnance Survey of Ireland mapping was supplied by TII. Geophysical data, the figures presented here and the text have been archived following the recommendations of the Archaeology Data Service (Schmidt & Ernenwein 2011).

### 3. Results & Discussion

The interpretation figures should not be looked at in isolation but in conjunction with the relevant discussion section and with the information contained in the Appendices. Features are highlighted in the interpretation diagrams and are described and interpreted within the text.

<b>Method of Assessment:</b>		<b>Magnetometer</b>								
<b>Site Description:</b>		Newly harvested crop stubble which was then partially ploughed during the time of the survey.								
<b>Figure No.:</b>		3 & 4								
No.	Form of Anomaly	ITM NGR (E,N)	Possible Source(s) of Anomaly					Comment	Recommendation	
			Ditch	Archaeology	? Archaeology	Ferrous	Geology / Soils		Interference / Modern	Test Excavation
1	Arcing magnetic anomaly	715489.536,741624.215	✓	✓				Probable enclosure ditch, 57m in diameter which contains areas of high magnetic signatures. These signatures are likely to indicate the presence of burnt remains.	✓	
2	Small arcing highly magnetic anomaly	715493.678,741664.582	✓	✓				Small arcing section of possible archaeological ditch. Measuring 11.7m in length, this anomaly is highly magnetic and could contain burnt remains.	✓	
3	Series of small linear and curvilinear magnetic anomalies	715508.865,741634.911	✓		✓			Series of ditches or cut features which appear to be located in the centre of anomaly 1. These anomalies could represent internal divisions.	✓	
4	Sub-circular magnetic anomaly	715366.312,741507.257	✓		✓			Sub-circular ditch or cut feature, 67m in length, encompassing an area 22m in diameter. This anomaly may represent an archaeological enclosure ditch.	✓	
5	Series of linear and interconnecting anomalies	715414.98,741460.335	✓		✓			Series of interconnecting or parallel ditches or cut features which are likely to be agricultural in origin.	✓	
6	Series of linear interconnecting anomalies	Multiple locations	✓		✓			Series of parallel or interconnecting cut features or ditches which cross the southern half of the survey area. These are on a different alignment to anomaly 5 indicating that they are not contemporary. They appear to be agricultural in origin and are likely to be associated with a linear anomaly which runs through the centre of the field, probably a relict field boundary.	✓	

<b>Method of Assessment:</b>		<b>Magnetometer</b>									
<b>Site Description:</b>		Newly harvested crop stubble which was then partially ploughed during the time of the survey.									
<b>Figure No.:</b>		3 & 4									
No.	Form of Anomaly	ITM NGR (E,N)	Possible Source(s) of Anomaly					Comment	Recommendation		
			Ditch	Archaeology	? Archaeology	Ferrous	Geology / Soils		Interference / Modern	Test Excavation	Geophysical Survey
7	Linear magnetic anomaly	715481.943,741417.209	✓		✓				Linear ditch or cut feature, 60m in length. This anomaly crosses part of anomaly 6 and may be archaeological or agricultural in origin.	✓	
8	Linear magnetic anomaly	715496.094,741542.448	✓		✓				Linear ditch or cut feature, 34m in length, which might be associated with anomaly 6.	✓	
9	Linear magnetic anomaly	715486.777,741579.806	✓		✓				Linear ditch or cut feature, 37m in length, which could be agricultural or agricultural in nature.	✓	
10	Linear magnetic anomaly	715534.41,741667.439	✓		✓				Linear ditch or cut feature, 45m in length, which might be agricultural or agricultural.	✓	
11	Series of interconnecting linear responses	715395.309,741715.396	✓		✓				Series of parallel or interconnecting ditches or cut features which truncate the northern half of the survey area. These anomalies are likely to be agricultural in origin.	✓	
12	Two parallel highly magnetic responses	715398.415,741677.789, 715424.993,741511.149						✓	Two relict field boundaries which are shown on the historic mapping. Their highly magnetic nature suggests that they may contain burnt or metal remains.	✓	
13	Linear magnetic anomaly	715588.855,741781.892	✓		✓				Linear ditch or cut feature, 62m in length. This feature runs parallel to anomaly 17 and 21 and is likely to be agricultural.	✓	
14	Linear magnetic anomaly	715580.066,741768.524	✓		✓				Linear ditch or cut feature, 14m in length which could be archaeological or agricultural in origin.	✓	
15	Two arcing magnetic anomalies	715546.494,741794.747, 715545.458,741775.546	✓		✓				Two arcing possible ditches or cut features, 48 & 18m in length. These anomalies may be related to archaeological remains.	✓	
16	Series of linear and curvilinear magnetic anomalies	715534.446,741830.364 Multiple locations	✓		✓				Series of possible ditches or cut features which are located on the northern edge of the survey area. This area contains an aerial photo anomaly and it is possible that these geophysical features are associated. The geophysical anomalies could be archaeological, agricultural or geological.	✓	

<b>Method of Assessment:</b>		<b>Magnetometer</b>									
<b>Site Description:</b>		Newly harvested crop stubble which was then partially ploughed during the time of the survey.									
<b>Figure No.:</b>		3 & 4									
No.	Form of Anomaly	ITM NGR (E,N)	Possible Source(s) of Anomaly					Comment	Recommendation		
			Ditch	Archaeology	? Archaeology	Ferrous	Geology / Soils		Interference / Modern	Test Excavation	Geophysical Survey
17	Series of linear interconnecting anomalies	715383.305,741930.514 Multiple locations	✓		✓				Series of linear ditches or cut features. They all run parallel or perpendicular to each other and many appear to cross or intersect. They are likely to be agricultural in origin and may be associated with anomaly 21.	✓	
18	Four isolated magnetic responses	715336.02,741907.958, 715342.056,741890.899, 715337.685,741882.161, 715335.812,741856.363	✓		✓				Four possible pits which are located on the western edge of the survey area. These pits may contain burnt remains; alternatively they may be associated with agricultural processes or work undertaken on the adjacent roadway.	✓	
19	Two interconnecting magnetic anomalies	715322.101,742045.938	✓		✓				Two possible ditches or cut features, 41 & 48m in length which are likely to be agricultural in origin and appear to cross or intersect.	✓	
20	Two arcing magnetic anomalies	715353.305,742064.507, 715357.634,742047.697	✓		✓				Two arcing possible ditches, 46m & 17m in length. These anomalies could indicate the presence of archaeological remains or be associated with agricultural or geological processes	✓	
21	Linear magnetic anomaly	715447.8,741852.492	✓		✓				Relict field boundary shown on the historic mapping.	✓	
	Highly magnetic linear anomaly	715490.476,741834.437, 715462.201,741561.029						✓	Modern Pipeline. This feature appears to run the length of the survey area, the southern area is more magnetic suggesting that the northern area might be deeper in nature or could possibly represent a highly magnetic relict field boundary.		
	Multiple linear and curvilinear magnetic trends	Multiple locations			✓		✓		Possibly associated with archaeology, agricultural or geology.	✓	
	Linear parallel magnetic responses	Multiple locations						✓	Series of land drains which cross the survey area	✓	
	Zones of modern disturbance	Multiple locations				✓		✓	Magnetic interference from metal fences, debris and a pipeline		

Method of Assessment:		Resistivity									
Site Description:		Newly harvested crop stubble which was then partially ploughed during the time of the survey.									
Figure No.:		5 & 6									
No.	Form of Anomaly	ITM NGR (E,N)	Possible Source(s) of Anomaly					Comment	Recommendation		
			Ditch	Archaeology	? Archaeology	Ferrous	Geology / Soils		Interference / Modern	Test Excavation	Geophysical Survey
	Linear strips of lower and higher resistivity	Multiple locations						✓	Interference pattern, probably associated with Dublin Airport. This can be seen across the majority of the survey area and is not associated with instrumentation error/drift as it occurs across 3m to 4 m swathes. The presence of this interference has made the data difficult to interpret and therefore some features could be obscured by it, while it is possible some of the features interpreted here have been caused by the interference.		
22	Arcing low resistivity anomaly	715482.237,741630.117	✓		✓				Arcing enclosure ditch, 142m in length and with a diameter of 45m. This anomaly matches the ditched enclosure detected in the magnetometer data (anomaly 1).	✓	
23	Arcing low resistivity anomaly	715506.96,741651.029	✓		✓				Arcing ditch or cut feature which is located in the centre of anomaly 22. Measuring 27m in length, it could represent internal archaeological ditches within the enclosure and may be associated with anomaly 3 in the magnetometer data.	✓	
24	Isolated high resistivity response	715501.285,741703.288			✓		✓		Isolated stone or compact earth feature which could be archaeological, agricultural, geological or caused by the interference experienced.	✓	
25	Curvilinear low resistivity anomaly	715460.301,741664.486	✓		✓				Curvilinear ditch or cut feature, 179m in length. This anomaly could be archaeological but is more likely to be agricultural in origin.	✓	
26	Interconnecting linear high resistivity anomalies	715431.687,741693.609			✓				Series of interconnecting stone or compact earth features which are likely to represent a relict field boundary. This anomaly was also partially detected in anomaly 11 in the magnetometer data.	✓	
27	Linear low resistivity anomaly	715387.368,741732.488	✓		✓				Curvilinear ditch or cut feature, 111m in length. This anomaly could be archaeological but is more likely to be agricultural in origin.	✓	
28	Linear low resistivity anomaly	715352.529,741676.087	✓		✓				Linear ditch or cut feature, 49m in length, probably agricultural in origin.	✓	

Method of Assessment:		Resistivity									
Site Description:		Newly harvested crop stubble which was then partially ploughed during the time of the survey.									
Figure No.:		5 & 6									
No.	Form of Anomaly	ITM NGR (E,N)	Possible Source(s) of Anomaly					Comment	Recommendation		
			Ditch	Archaeology	? Archaeology	Ferrous	Geology / Soils		Interference / Modern	Test Excavation	Geophysical Survey
29	Arcing high resistivity anomaly	715368.349,741683.983			✓				Arcing stone or compact earth feature, 46m in length which could be archaeological or agricultural in origin.	✓	
30	Arcing low resistivity anomaly	715483.32,741534.782	✓		✓				Arcing ditch or cut feature, 28m in length which could be archaeological or agricultural in origin.	✓	
31	Isolated high resistivity response	715479.611,741507.731			✓		✓		Isolated stone or compact earth feature which could be archaeological, agricultural, geological or caused by the interference experienced.	✓	
32	Two arcing raised resistivity anomalies	715448.052,741476.12, 715411.461,741443.67			✓				Two arcing stone or compact earth features which appear to form an enclosing element, 47m in diameter. These anomalies are possibly archaeological in nature.	✓	
33	Sub-rectangular raised resistivity anomaly	715424.837,741469.636			✓				Sub-rectangular stone or compact earth feature which is located in the centre of anomaly 32. Measuring 25m by 18m, this anomaly could represent archaeological remains.	✓	
34	Linear high resistivity anomaly	715456.705,741450.923	✓		✓				Linear stone or compact earth feature, 116m in length which is likely to represent a relict boundary.	✓	
35	Two parallel high resistivity anomalies	715469.493,741416.366, 715480.663,741414.396			✓				Two linear stone or compact earth features which run parallel to anomaly 34 and are likely to be related.	✓	
36	Linear low resistivity anomaly	715486.241,741778.908	✓		✓				Curvilinear ditch or cut feature, 67m in length. This anomaly could be archaeological but is more likely to be agricultural in origin.	✓	
37	Linear high resistivity anomaly	715531.429,741786.055			✓		✓		Linear stone or compact earth feature, 79m in length which could be archaeological or agricultural in nature.	✓	
38	Linear low resistivity anomaly	715535.655,741805.87	✓		✓				Linear ditch or cut feature, 38m in length which could be archaeological or agricultural in origin.	✓	
39	Linear high resistivity anomaly	715533.423,741816.375			✓		✓		Linear stone or compact earth feature, 77m in length which could be archaeological or agricultural in nature.	✓	
40	Curvilinear low resistivity anomaly	715550.446,741830.234	✓		✓				Curvilinear ditch or cut feature, 40m in length which could be archaeological or agricultural in origin.	✓	

<b>Method of Assessment:</b>		<b>Resistivity</b>								
<b>Site Description:</b>		Newly harvested crop stubble which was then partially ploughed during the time of the survey.								
<b>Figure No.:</b>		5 & 6								
No.	Form of Anomaly	ITM NGR (E,N)	Possible Source(s) of Anomaly					Comment	Recommendation	
			Ditch	Archaeology	? Archaeology	Ferrous	Geology / Soils		Interference / Modern	Test Excavation
41	Right-angled high resistivity anomaly	715515.987,741823.737, 715542.898,741839.03			✓			Right-angled stone or compact earth feature which matches an anomaly visible on the aerial photography of the area. Measuring 53m by 27m, this possible enclosure is likely to interlink with anomaly 46.	✓	
42	Two isolated high resistivity responses	715497.294,741822.275, 715504.446,741824.549			✓		✓	Two isolated stone or compact earth features which are located within the vicinity of anomaly 41. It is therefore likely that they are archaeological in origin; however they could also be associated with agriculture, geology or caused by the interference experienced.	✓	
43	Isolated high resistivity response	715547.358,741843.065			✓		✓	An isolated stone or compact earth feature which is located within the vicinity of anomaly 41 and may be associated with anomaly 42. It is likely that this anomaly is archaeological in origin; however it could also be associated with agriculture, geology or caused by the interference experienced.	✓	
44	Arcing low resistivity anomaly	715535.33,741841.766	✓		✓			Arcing ditch or cut feature, 29m in length which is located in the centre of anomaly 41. This feature could be archaeological in origin.	✓	
45	Linear low resistivity anomaly	715531.275,741858.075	✓		✓			Linear ditch or cut feature, 30m in length which could be agricultural in origin and/or associated with anomalies 41 and 46	✓	
46	Linear high resistivity anomaly	715516.316,741863.001			✓			Linear stone or compact earth feature which matches an anomaly visible on the aerial photography of the area. Measuring 37m in length this anomaly is likely to interlink with anomaly 41 and may be associated with an enclosure.	✓	
47	Isolated high resistivity response	715494.043,741862.556			✓		✓	Isolated stone or compact earth feature which could be archaeological, agricultural, geological or caused by the interference experienced.	✓	
48	Arcing high resistivity anomaly	715485.74,741840.318			✓			Arcing compact earth or stone feature, 31m in length which could be archaeological, agricultural or geological in origin.	✓	
49	Arcing high resistivity anomaly	715490.601,741827.766			✓			Arcing compact earth or stone feature, 43m in length which could be archaeological, agricultural or geological in origin.	✓	

<b>Method of Assessment:</b>		<b>Resistivity</b>								
<b>Site Description:</b>		Newly harvested crop stubble which was then partially ploughed during the time of the survey.								
<b>Figure No.:</b>		5 & 6								
No.	Form of Anomaly	ITM NGR (E,N)	Possible Source(s) of Anomaly					Comment	Recommendation	
			Ditch	Archaeology	? Archaeology	Ferrous	Geology / Soils		Interference / Modern	Test Excavation
50	Two interconnecting linear high resistivity anomalies	715485.45,741815.76			✓			Two interconnecting linear compact earth or stone features which cross the survey area. These anomalies are likely to represent a relict agricultural boundary.	✓	
	Parallel linear raised resistivity	Multiple locations					✓	Cultivation furrows, visible across the majority of the datasets.		
	Parallel linear raised resistivity anomalies	Multiple locations					✓	Series of land drains which cross the survey area. These anomalies were also detected in the magnetometer data.		
	Zone of very low resistivity responses	715463.915,741580.77					✓	Pipeline		

## 4. Conclusion

### 4.1 Summary of Results

The geophysical surveys undertaken for this report have revealed a landscape which has been heavily impacted by agricultural processes. Multiple relict field boundaries were detected some of which appear to be associated with the field division visible on historic mapping. Evidence for at least one different field alignment was also identified. Cultivation furrows, land drains and a pipeline were also detected.

Potential archaeological remains were also identified with the detection of a number of arcing ditches, possible compacted earth or stone boundaries and pits. Within the northern field a possible rectangular enclosure is visible, with possible internal divisions. This feature matches an aerial photo anomaly.

In the southern field a large sub-oval enclosure was detected which appears to contain a number of internal divisions. Two further possible enclosures were also identified, a ditched enclosure to the southwest and a compacted earth or stone enclosure with internal rectangular feature to the southeast.

### 4.2 Dissemination

The results of this survey were submitted to Jacobs Engineering/TII. Additional copies will be distributed in accordance with the Consent to use a Detection Device (see Appendix 2).

## 5. Acknowledgements

**Report:** Heather Gimson BA (Hons) MSc MIAI  
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**Fieldwork:** Cian Hogan BSc (Hons) MIAI  
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## **7. Figures**

- Figure 1: Location map
- Figure 2: Detailed location map
- Figure 3: Magnetometer data
- Figure 4: Magnetometer interpretation
- Figure 5: Apparent Electrical Resistivity data
- Figure 6: Apparent Electrical Resistivity interpretation

# Technical Appendix

## Appendix 1: Anomaly Classifications

### Magnetometer

Magnetometer surveys are undertaken using magnetic gradiometers which measure the magnetic content of the underlying soils. Measurements are gained using sensors which calculate the difference between the geological / pedological background and anthropogenic remains associated with archaeological activity.

#### Positive Magnetic Anomalies

Burnt features, particularly kilns, but also hearths, furnaces and burnt (specifically 'burnt', not 'heated') mounds of stone will create a strongly magnetic anomaly due to thermoremanence. Cut features, such as pits, ditches or wooden postholes will create anomalies that will vary in shape and magnetic intensity depending on which material they were backfilled by (Fassbinder 2015). For cut features backfilled (or 'refilled') by

- magnetically enhanced topsoil – the refill will generate a positive magnetic anomaly
- homogeneous topsoil – the refill will generate an anomaly proportional to the size and volume of the archaeological feature.

The magnetic anomaly shape and intensity will also be determined by concentrations of pottery, ash or burned material, solid rocks or other material.

#### Negative Magnetic Anomalies

Negative magnetic anomalies have a number of causes (Fassbinder 2015):

- The material remains of the archaeological feature may have a lower magnetic susceptibility (MS) than the adjacent topsoil. In some cases the MS of a ditch may appear as both a positive and negative anomaly, reflecting the variable MS of the refill material. Some stone foundations can also appear as weakly magnetic or negative magnetic anomalies.
- If a cut feature is immediately refilled by the same material e.g. a grave cut excavated before a funeral is (almost) immediately refilled by the human body and the same (unaltered) sediment that was excavated before.
- Geochemical processes (see Fassbinder 2015) can alter the magnetic response, e.g. an archaeological feature identified by a positive anomaly can convert to a negative anomaly due to the combination of stagnant moisture and a changing groundwater table.

#### Dipolar Anomalies

A dipolar anomaly is a response to buried ferrous objects, often in the topsoil. Iron spikes generally are not removed in geophysical data; although often modern in origin (iron agricultural implements, rubbish), they can be indicative of archaeological material.

#### Absence of Anomalies

It is also possible that archaeological features exist that exhibit no magnetic contrast and hence cannot be identified by magnetometer survey.

## Anomaly classification used to interpret Magnetometer data

After Gaffney & Gater (2003) and Gaffney *et al.* (2000).

**A known archaeological feature type e.g. Ditch / Wall / Structure etc:** An anomaly with a magnetic gradient that contrasts strongly with the surrounding sub-soil, where the presence of a type of archaeological feature is known from supporting evidence.

**Archaeology:** A linear, curvilinear or isolated anomaly with a magnetic gradient that contrasts strongly with the surrounding sub-soil, without any supporting evidence from another source.

- **Ditch / Wall:** A linear, curvilinear, annular or penannular anomaly with a magnetic gradient that contrasts strongly with the surrounding sub-soil. A positive polarity suggests a ditch; a negative polarity suggests a stone-filled ditch or wall.
- **Burnt Mound / Spread:** A horseshoe or ovoid shaped anomaly with a positive magnetic gradient that contrasts strongly with the surrounding sub-soil. An associated trough may be observed as a positive/negative anomaly, a hearth may also be expected nearby. Isolated responses in the vicinity could represent spreads of (or ploughed out) heat shattered stones.
- **Hearth:** A small isolated area (<2m diameter) of higher magnetic gradient than the surrounding sub-soil (typically >6nT).
- **Pit:** A small isolated area (>1-2m diameter) of moderate to high magnetic gradient, judged to be caused by a pit-type feature with a fill more magnetic than the surrounding soil.

**Industrial:** An isolated anomaly with a strong positive gradient (>30nT), judged not to be surface iron. This type of anomaly is typically caused by the remains of kilns or furnaces.

**Magnetic Enhancement:** A broad area of moderate positive magnetic gradient that contrasts with the surrounding sub-soil. May represent cultural noise associated with occupation or soil disturbance, judged to be of archaeological origin.

**Ferrous:** Dipolar anomalies indicating ferrous responses, judged to be in the near-surface.

**Cultivation:** Parallel linear responses of positive or negative polarity. Strong responses may indicate added magnetic material (e.g. burnt deposits) as fertiliser. Lower magnetic gradient anomalies 'beneath' the furrow overprint may be obscured. Higher magnetic gradient anomalies may be visualised *in situ* or ploughed out 'beneath' the furrow overprint.

**?Archaeology:** A linear, curvilinear or isolated anomaly with a magnetic gradient that contrasts weakly with the surrounding sub-soil, without any supporting evidence from another source. Such categories may represent possible archaeological or geological sources.

**Modern Disturbance:** Area where the ground has been disturbed in the recent past. Characterised by very large magnetic gradients and a high level of noise often accompanied by concentrations of dipolar, near-surface ferrous responses. This category also represents anomalies whose source may lie beyond the survey area, such as fencelines, vehicles or modern buildings.

**Modern Pipe:** Straight, linear anomaly with very large magnetic gradients alternating regularly between positive and negative polarity.

**Previous Excavation?:** Area of uniform magnetic signal contained within a well-defined boundary in regions otherwise densely covered with archaeological anomalies.

**Geology:** Anomalies of possible geomorphological origin.

## Electromagnetic Apparent Electrical Resistivity

Electromagnetic instruments transmit an alternating current which induces a primary and subsequently a secondary electromagnetic field which interacts with the underlying soils. One of the subsequent responses is the Apparent Electrical Conductivity of the soil, which are subsequently calculated via automated software to Apparent Electrical Resistivity ( $ER_a$ ).

### Anomaly classification used to interpret $ER_a$ data

After Gaffney & Gater (2003) and Gaffney *et al.* (2000).

**A known archaeological feature type e.g. Ditch / Wall / Structure etc:** An anomaly with a  $ER_a$  that contrasts strongly with the surrounding sub-soil, where the presence of a type of archaeological feature is known from supporting evidence.

**Archaeology:** A linear, curvilinear or isolated anomaly with an  $ER_a$  that contrasts strongly with the surrounding sub-soil, without any supporting evidence from another source.

- **Ditch / Wall:** A discrete linear, curvilinear, annular or penannular anomaly with an  $ER_a$  that contrasts strongly with the surrounding sub-soil. A low  $ER_a$  suggests a ditch; a high  $ER_a$  suggests a stone-filled ditch or wall.
- **Mound of Stones:** A discrete horseshoe or ovoid shaped anomaly with a higher  $ER_a$  than the surrounding sub-soil.
- **Pit:** A small isolated area (>1-2m diameter) of  $ER_a$  that contrasts with the surrounding sub-soil, judged to be caused by a pit-type feature.
- **Cultivation:** Parallel linear responses of high or low  $ER_a$ .
- **Disturbed Soil:** A broad area of moderate  $ER_a$  change that contrasts with the surrounding sub-soil. May represent cultural noise associated with soil disturbance, judged to be of archaeological origin.

#### High $ER_a$ Anomalies

Soils comprised of materials of a higher  $ER_a$  than the surrounding soil will exhibit anomalies of 'higher resistivity'. These are likely to include stone walls, masonry, rubble, cobbled or gravel surfaces, as well as near surface geology.

#### Low $ER_a$ Anomalies

Soils that are comprised of materials of a lower  $ER_a$  than the surrounding soil will exhibit anomalies of 'lower resistivity'. These are likely to include ditches, drainage ditches and pits, as well as palaeochannels, drained soils, a high water table, deep topsoil, springs, boggy areas, areas adjacent to rivers and clay soils.

**Modern Disturbance:** Area where the ground has been disturbed in the recent past. Characterised by very large  $ER_a$  gradients and a high level of noise.

**Modern Pipe:** Straight, linear anomaly with an  $ER_a$  contrast.

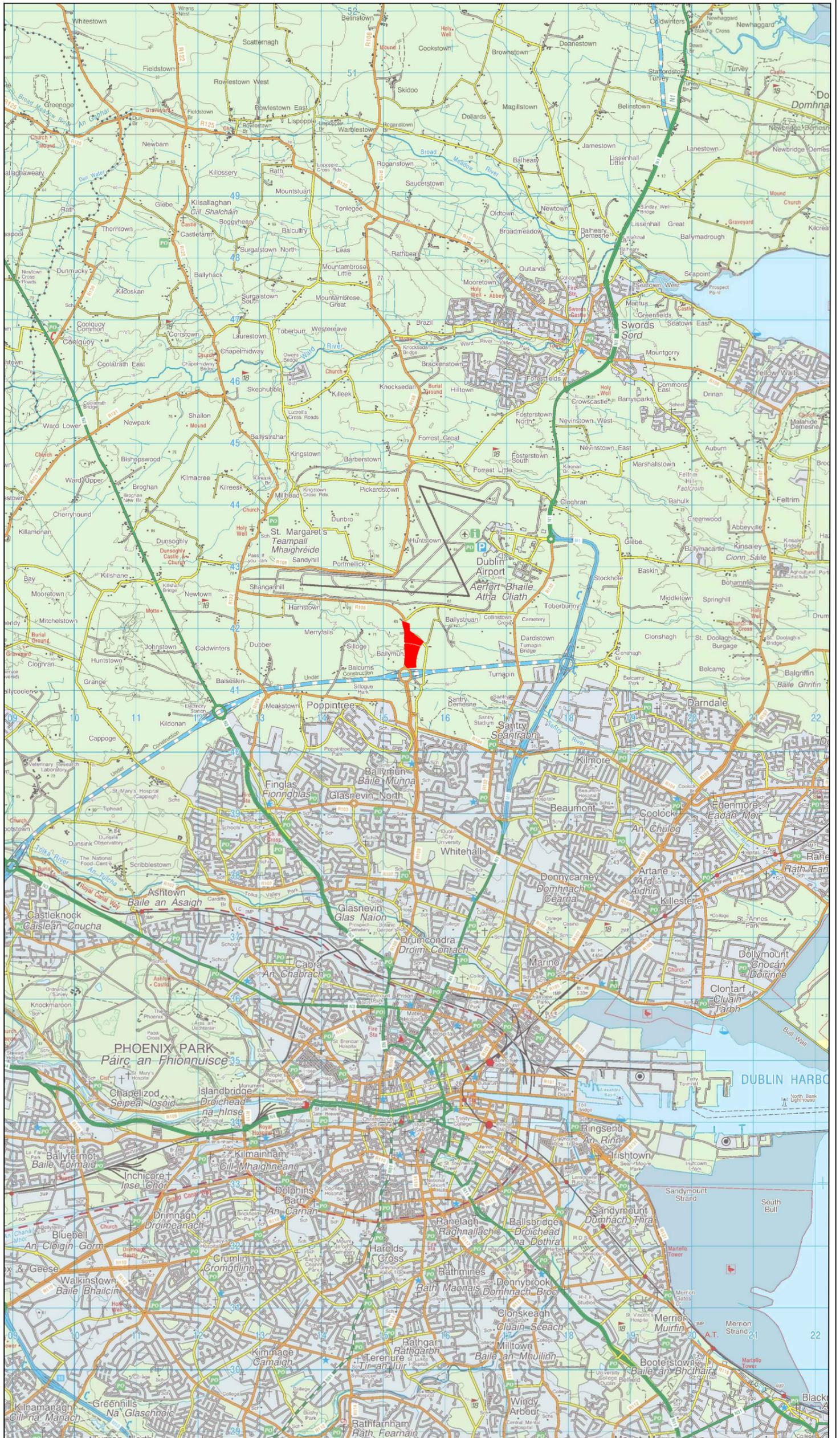
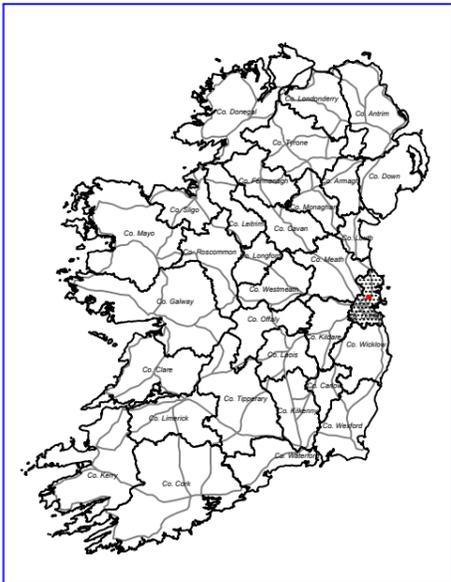
**Geology:** Anomalies of possible geomorphological origin.

#### Absence of Anomalies

It is also possible that archaeological features exist that exhibit no resistivity contrast and hence cannot be identified by Apparent Electrical Resistivity survey.

## Appendix 2: Geophysical Archive

- Copies of the archive are held by Earthsound Geophysics Ltd., at separate locations to ensure preservation against accidental damage or theft.
- The Client, Jacobs Engineering/TII, holds further copies of the report.
- A hard copy and a soft copy will be deposited with the Archaeological Licensing Section, National Monuments Service, Department of Culture, Heritage and the Gaeltacht, Room G50, Custom House, Dublin 1.
- A hard copy will be deposited with the National Museum of Ireland, Kildare Street, Dublin 2.



**Legend**  
 — Geophysical Survey Area



Site Location: MetroLink, Dublin

Client: Jacobs / TII

Drawing Courtesy of: OSI

Date: 16/12/19

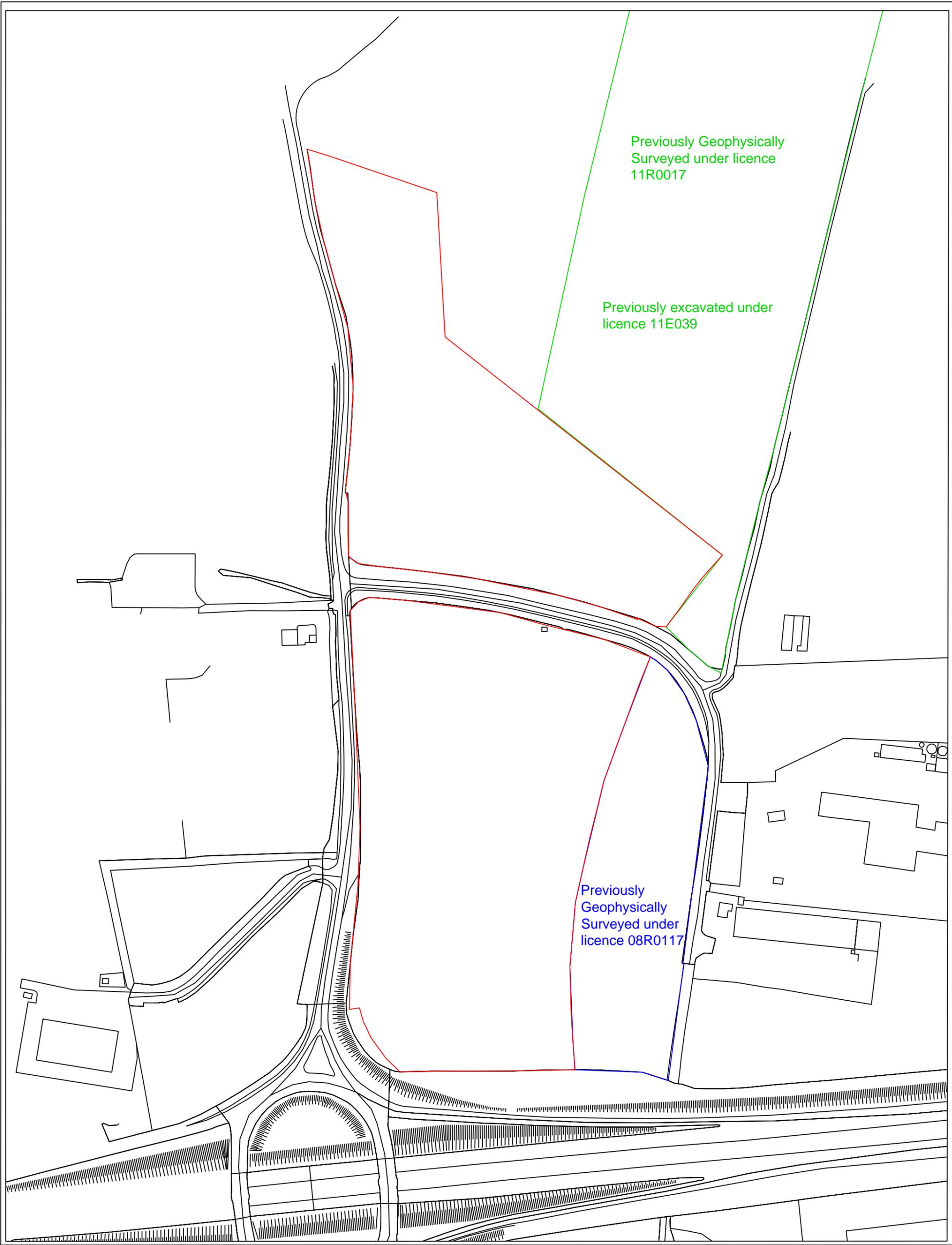
Drawing No.: 18-068/01

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 Copyright Ordnance Survey Ireland Government of Ireland



Figure No. 1: Location Map





**Legend**  
 — Basemap  
 — Geophysical Survey Area



Site Location: MetroLink, Dublin  
 Client: Jacobs / TII  
 Drawing Courtesy of: OSI | Date: 16/12/19 | Drawing No.: 19-068/02  
 Ordnance Survey Ireland Licence No. AR 0047320  
 Copyright Ordnance Survey Ireland Government of Ireland  
 0m 50m 100m

Figure No. 2: Detailed Location Map



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li>— Basemap</li> <li>— Geophysical Survey Area</li> <li>— Unsurveyable Area</li> </ul> <p style="text-align: center;">nT</p> <p style="text-align: center;">-2      0      2</p>		<p>Site Location: MetroLink, Dublin</p> <p>Client: Jacobs / TII</p> <p>Drawing Courtesy of: OSI      Date: 25/09/20      Drawing No.: 19-068/03</p> <p style="text-align: center;">Ordnance Survey Ireland Licence No. AR 0047320 Copyright Ordnance Survey Ireland Government of Ireland</p> <p style="text-align: center;">0m      50m      100m</p>	<p style="text-align: right;"><b>Figure No. 3: Magnetometer Data</b></p>
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<b>Legend</b> — Basemap — Geophysical Survey Area — Unsurveyable ■ Archaeology ■ ? Archaeology ■ Trend ■ Feature on Historic OS ■ Land Drains ■ Modern Disturbance ■ Modern Pipe			 Site Location: MetroLink, Dublin Client: Jacobs / TII Drawing Courtesy of: OSI	Date: 28/09/20 Drawing No.: 19-068/04	
Ordnance Survey Ireland Licence No. AR 0047320 Copyright Ordnance Survey Ireland Government of Ireland 				<b>Figure No. 4: Magnetometer Interpretation</b> 	



<p><b>Legend</b></p> <p>— Basemap</p> <p>— Geophysical Survey Area</p> <p>mS/m</p> <p>50 90</p>		<p>Site Location: MetroLink, Dublin</p> <p>Client: Jacobs / TII</p> <p>Drawing Courtesy of: OSI</p> <p>Date: 30/10/20</p> <p>Drawing No.: 19-068/05</p> <p>Ordnance Survey Ireland Licence No. AR 0047320</p> <p>Copyright Ordnance Survey Ireland Government of Ireland</p> <p>0m 50m 100m</p>	<p><b>Figure No. 5: Apparent Electrical Resistivity Data</b></p>
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<b>Legend</b> — Basemap — Geophysical Survey Area ■ Archaeology ■ ? Archaeology ■ Low ER <sub>a</sub> Anomaly ■ High ER <sub>a</sub> Anomaly ■ Cultivation ■ Land Drains ■ Modern Pipe			Site Location: MetroLink, Dublin Client: Jacobs / TII Drawing Courtesy of: OSI Date: 02/10/20 Drawing No.: 19-068/06		<b>Figure No. 6: Apparent Electrical Resistivity Interpretation</b> 	
			Ordnance Survey Ireland Licence No. AR 0047320 Copyright Ordnance Survey Ireland Government of Ireland 			