Geophysical Survey Report No. 29

NIEA License Number AE/14/92

West Field, Dunluce

Co. Antrim

Dr Siobhán McDermott

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Summary of results

An evaluation resolution electrical resistance survey was carried out over a total area of 2.4 hectares to the south-west of Dunluce Castle, village and gardens (ANT 002:003 & ANT 002:003 respectively). The castle and its environs are currently the focus of a Lottery Heritage Funded project to develop its potential as a unique heritage destination within Northern Ireland. The survey area is situated in the townland of Magheracross.

A regular oval high resistance anomaly, r2, to the centre of the survey area may be of archaeological significance. The anomalies plan and the high resistance returns suggest this is a stone feature perhaps a cairn of stony material. The presence of several linear features, r13 & r16, which lead up to r2 suggest that these might be remnants of a relict field system. The anomaly r1 is a linear cut feature which corresponds with a mid-19th-century field boundary mapped by the 2nd Edition Ordnance Survey. A series of low resistance linear features which are enclosed by r1 are probably cultivation furrows.

Site specific information

Site Name: West Field, Dunluce, Co. Antrim

Townland: Magheracross

SMR No: ANT 002:013 (Souterrain – unlocated), ANT 002:008 (Earthworks associate with town and gardens), ANT 002:003 (Dunluce Castle) are within 250 meters

Grid Ref: C 90238 41148

County: Antrim

Dates of Survey: 9th – 17th June 2014

Surveyor Present: Siobhán McDermott with assistance from Brain Sloan, Harry Walsh and Grace McAlister, Centre for Archaeological Fieldwork, School of Geography, Archaeology and Paleoecology, Queens University, Belfast, and Francis Woods, Joel Goodchild and Annastasia Boomsma.

Size of area surveyed: 2.4 Hectares

Weather conditions: Mild, warm, sunny through to foggy.

Solid Geology: Upper Basalt Formation: Antrim Lava Group

Drift Geology: Diamicton till

Current Land Use: Pasture

Intended Land Use: Heritage tourism amenity

Survey methodology overview

Survey type:
Electrical resistance
Instrumentation:
Geoscan RM85 resistance meter
Probe spacing:
0.5m parallel twin probe array
Grid size:
30m x 30m
Traverse interval:
1m twin parallel three probes (2 x 0.5m)
Sample Interval:
1m
Traverse Pattern:
Zig-zag

Lecia TS06-plus total station
Station setup:
Tied into Irish National Grid using differential GPS
Spatial Accuracy:
Survey grade accuracy (<3cm)
Georeferencing:
The dataset was downloaded from the TS06 and imported into ArcGIS 10.2. The grid points were extracted as a separate feature class and used to georeference the geophysical survey datasets exported from Geolplot v.3.

Data processing:
The geophysical data was processed in Geoplot v. 3 software. The primary processes applied were high pass filtering (HPF) to remove geological 'background' noise and low pass filtering (LPF) which helps to eradicate minor spikes in the data. The datasets were also interpolated which creates a smoothing effect.
Visualisations:
The datasets were visualised within Geoplot v.3 using shade, trace, dot density and relief plots. Processed datasets and bitmap graph plots was exported from Geoplot v.3 and imported into ArcGIS 10.2. Once georeferenced statistical analysis were carried out on the rasters within ArcGIS 10.2 and they were interpreted in relation to the First, Third and Fifth Edition Ordnance Survey maps of the area, the 2006 orthorectified aerial photographs and relevant georeference bitmap imports.

Digital archive:
The geophysical datasets were collected, processed and archived in accordance with Archaeological Data Services best practice.[1]

[1] Schmidt, A. & E. Ernenwein, 2011, Guide to good practice: Geophysical data in Archaeology [Online] http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_Toc

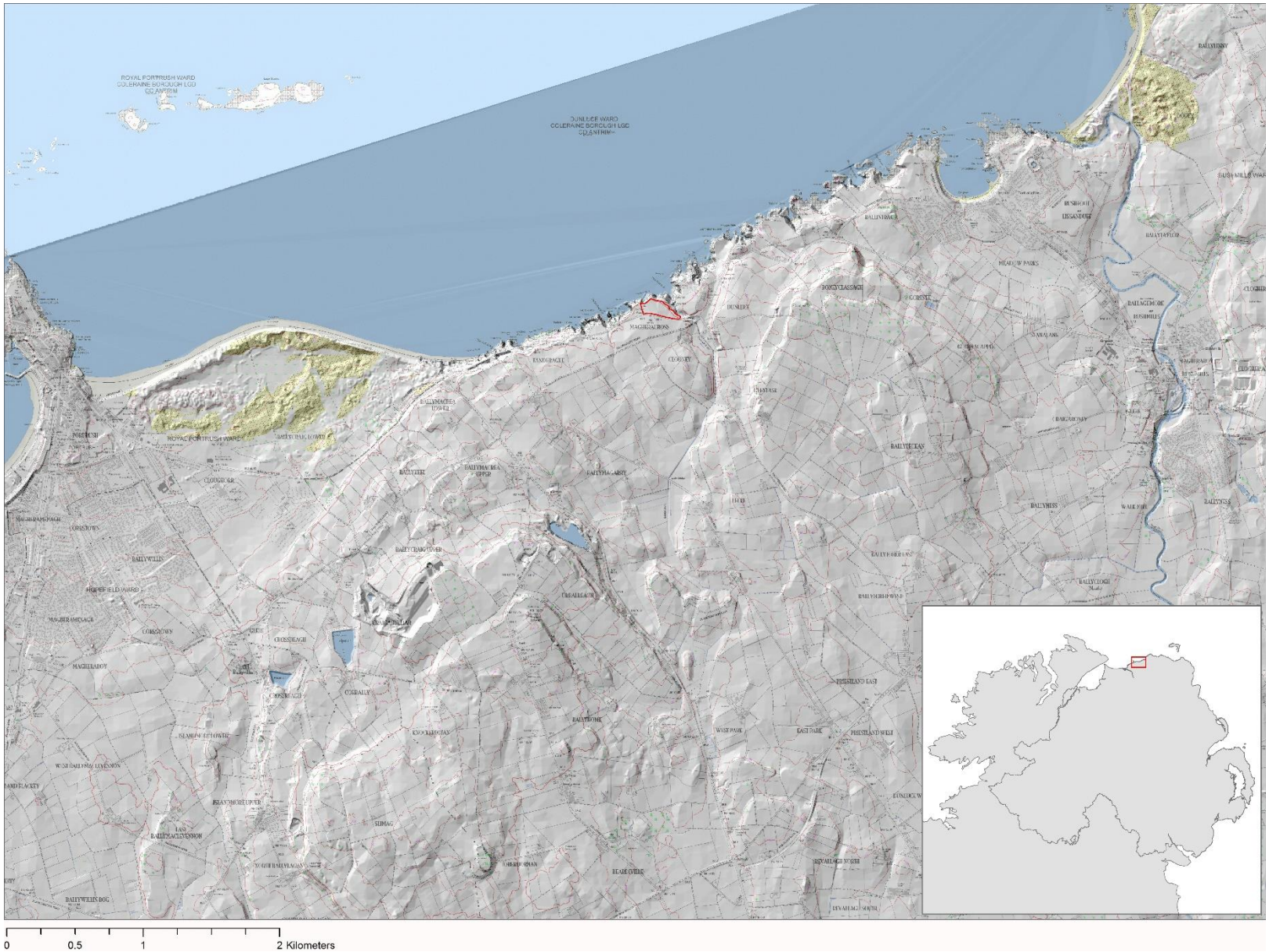

Figure 1 Location and landscape setting of the geophysical survey grid marked in red (OSNI 10km vector data layered over 5km DEM Hillshade).*

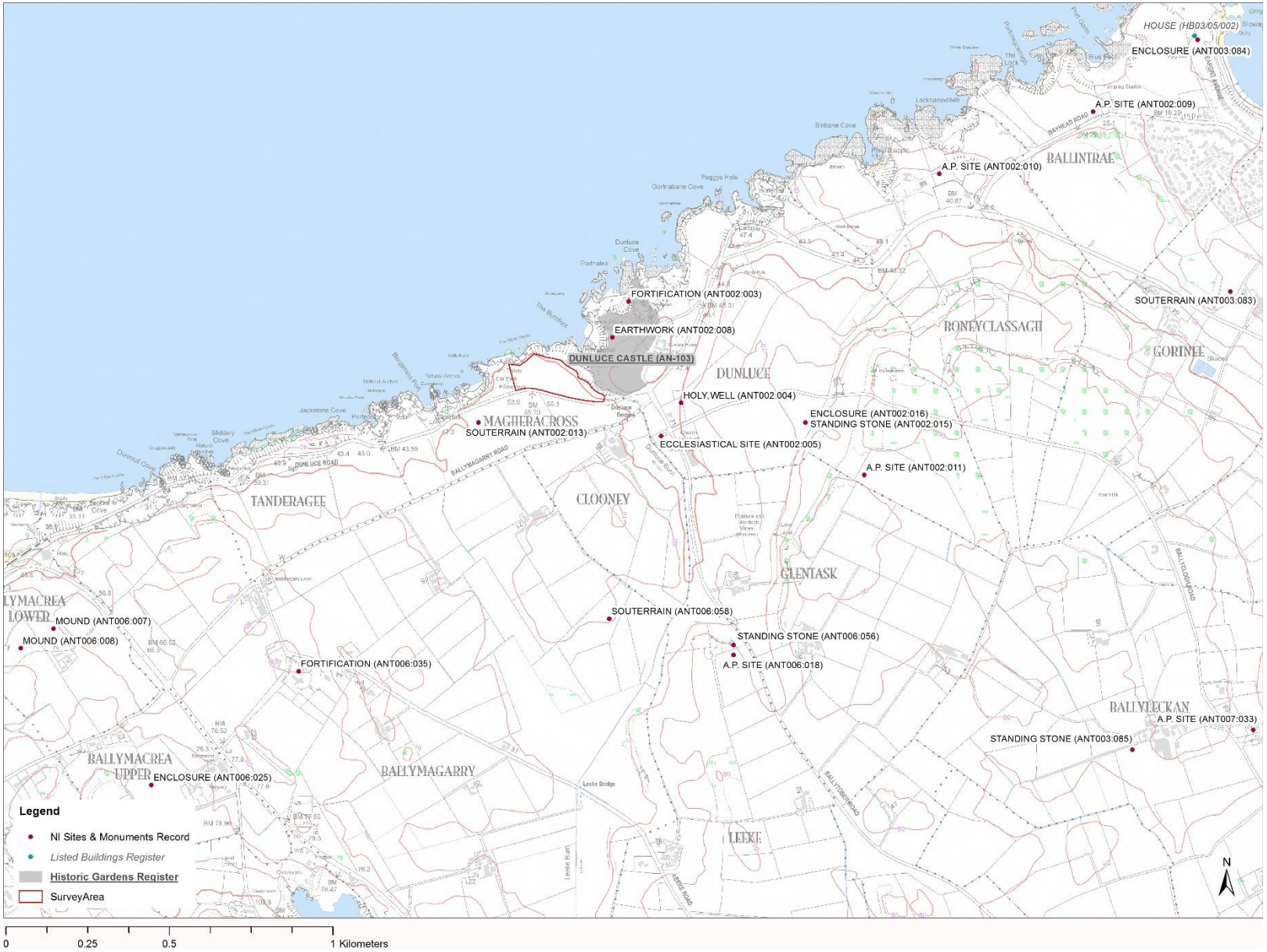

Figure 2 Wider recorded heritage landscape setting. Geophysical survey area in red with NISMR, Listed Buildings and Historic Gardens.**

Figure 3 Location of geophysical survey areas in relation to Dunluce Castle, gardens and settlement overlaid on 2006 ortho-rectified aerial photographs.*

Introduction

This survey was commissioned as part of a Heritage Lottery Funded project to develop the heritage potential of the area. An electrical resistance survey was used to help evaluate the archaeological potential of an area of 2.4 Ha to the west of Dunluce Castle, gardens and village. An extensive programme of archaeological excavation is taking place within the gardens and castle grounds over the summer of 2014.

The survey area is located midway along the A2 between the towns of Portrush and Bushmills, both Co. Antrim. The survey area is bounded by the A2 to the south, a public carpark and picnic area to the west, The White Rocks cliffs to the north and the Dunluce Burn which runs along a narrow north-south valley to the east. It is currently farmed and entered through a gate along its southern boundary. The site is situated *c.* 50m OD, with The White Rocks cliffs providing sheer drops to the Atlantic Ocean below. The survey area is in the townland of Maghercross with Dunluce Burn functioning as the townland boundary between it and

neighbouring Dunluce townland. As such the survey area is not included in the scheduled monument zone[2] associated with ANT 002:008 or the area defined by the Register of Historic Parks, Gardens and Demesnes.[3]

It is designated as part of the Causeway Coast and Rathlin Island Landscape Character Area.[4] This is an area characterised by stepped profiles with rocky Basalt knolls and outcrops. The geomorphology is shaped by multiple basalt lava flows which slope down towards the River Bann and the effects of coastal erosion. As such the cliffs in this area of are best viewed as dynamic – with part of Dunluce Castle being lost to erosion during the mid-19th century (Breen 2012, 14). The land quality is relatively good farmland; mostly pasture with well-drained, thin acidic soils of predominately brown earths and gleys (ibid, 3). Historically this area was part of the medieval territory known as the Route which occupied the riverine valley immediately east of the River Bann and southwards towards Lough Neagh, and was noteworthy for being good agricultural land (ibid, 6). Lewis (1837, 585) described the area as 'fertile and generally in the highest state of cultivation; the system of agriculture is in a very improved state' during the mid-19th-century.

The survey area occupies a field on the cliff tops overlooking Dunluce Castle to the east (Figure 18). The topography of the field is dominated by a knoll, *c.* 58.5m OD, to the centre of the survey area (Figure 19). The ground to the north drops off more sharply than elsewhere in the field leading down to a daisy path (Figure 18) which runs east to west along the northern boundary of the survey area. The daisy path narrows to a hollow-way to the east which leads to the Dunluce Burn and waterfall (Figure 20). The ground from the north of the knoll clockwise to the south-east drops away more gradually. The easternmost limits of the survey area are defined by a sharp break of slope as the gradient of the field slopes down towards the Dunluce Burn. From the south clockwise to the north the gradient is more gradual again with the area between the knoll and the public carpark to the west relatively even.

The west field was surveyed at the (1m x 0.5m) sampling density recommended to evaluate its archaeological potential.[5] The areas Basalt solid geology prevented the application of magnetic prospecting techniques and electrical resistance was applied in isolation. Electrical resistance geophysical survey measures the varying levels of electrical resistance in the soil. It is very useful for identifying stone footings and structures or cut features where the level of moisture in the fill is lesser or greater than the surrounding soil. It cannot identify cut features which do not have varying moisture levels and therefore its application can be limited. The eastern half of the study area was surveyed in a LiDAR survey that focussed on the castle and its immediate environs. Where available the LiDAR data formed part of a wider toolkit (Davis 2012, 4) which supplemented the geophysical data, orthorectified photographs and the Ordnance Survey historical mapping. The most consistently effective technique for identifying topographical features in the survey was Principle Components Analysis (Devereux *et al* 2008) which overcame many of the azimuth-related problems associated with conventional hill-shading. PCA analysis was carried out for sixteen hillshade component

[2] Downloadable polygon dataset available online [http://www.doeni.gov.uk/niea/scheduled_zones.zip].
[3] Downloadable polygon dataset available online [http://www.doeni.gov.uk/niea/gardens.zip].
[4] Northern Ireland Landscape Character Areas available online [http://www.doeni.gov.uk/niea/land-home/landscape_home/country_landscape.htm] and as a downloadable polygon dataset [http://www.doeni.gov.uk/niea/landscape_character_areas.zip].
[5] Geophysical survey in Archaeological field evaluation, (2nd Edition), English Heritage. [Online] https://www.english-heritage.org.uk/publications/geophysical-survey-in-archaeological-field-evaluation/

azimuths at a 14^{o} zenith which mimicked long light and was the most effective angle to light low relief landscapes.

Historical & archaeological background

The survey area is situated *c.* 200m south-west of Dunluce Castle (Ant 002:003), gardens and village (ANT 002:008). The Castle is in State care and the associated gardens and village are within a scheduled monument zone. The contemporary narrative of Dunluce and its wider archaeological landscape setting is dominated by later medieval and post-medieval phases of settlement activity. However there is evidence for prehistoric activity. Roughly 2km west a limited excavation at White Rocks sand dunes, in advance of the construction of Portrush golf course, unearthed multi-period activity. Finds included Neolithic flint lithics, hearths, a cist burial, saddle quern, bronze fibular and sliver Henry III coin from an area measuring roughly 18m x 20m (Collins 1977). There is also a notable distribution of standing stones within a 5km radius of the survey area with a significant number of references to megalithic monuments, which can no longer be located, in the Ordnance Survey Memoirs (Day & McWilliams 1992). During the course of data collection a number of struck and worked flints were identified eroding from the earth. Although lacking diagnostic features they were loosely grouped to the Neolithic and Bronze Age (B. Sloan *pers comm*).

The early medieval period is evident through a strong distribution of souterrains and to a lesser extent raths. Many of these, including an example (ANT 002:013) 200m south-west of the survey area, are referred to in the Ordnance Survey Memoirs by cannot now be located. Another example, which underlays the northeast tower of the castle was revealed during clearance work in 1928 (Breen 2012, 21). Breen (ibid 19) has proposed that 'a fortified headland existed' at the location of Dunluce Castle during the 11th- to 12th-centuries. Evidence for which would have been heavily eroded by the later phases of castle building.

The later and post-medieval history and archaeology of Dunluce Castle and its environs has been extensively and ably covered by Breen (2012). The following is a brief synopsis of his work with notes which may have significance for the interpretation of the geophysical data from the survey area. Historical evidence indicates that an Anglo-Norman manor was established at Dunluce at the end of the 13th-century. Excavations to the south of the castle beside Dunluce House, to test the areas archaeological potential, unearthed high medieval ceramics. However it appears that the main foci for settlement activity in the area, from the 13th to 15th centuries, was at Ballylough Castle, 2.5km south of Bushmills (Breen 2012, 27 – 31). The first significant phase of construction activity in the immediate vicinity of the castle dates to the close of the 15th-century and the lordship of the Route which was then controlled by the MacQuillans. The MacQuillans established themselves in Ulster society relatively quickly after their arrival as Scottish mercenaries. In the mid-15th-century they took Ballylough Castle, probably seizing upon opportunities created by the fall of Anglo-Norman Ulster. They refurbished Ballylough before moving their attention onto Dunluce (ibid 38 – 41). By the mid-16th century the MacQuillans had also established and were patrons to the Franciscan friary at Bonamargy in the style of a typical Gaelic Irish lordship. However by the end of the century the ambitions of their Scottish kinsmen, the MacDonnlls, would see their territory and position lost.

By the 1580s the MacDonnells were identifying themselves as the lords of the Route, had taken Dunluce from the MacQuillans and begun a major phase of refurbishment at the castle in a typically Scottish architectural style (Breen 2012, 68 – 72, 86 – 7). A late 16th-century phase of gentrification retained its medieval antecedents in the form of the 'buttery' – which appears to be a reception hall separated from the lord's private quarters.

Much of what we understand about the castle, gardens and surrounding settlement dates to the period of MacDonnell occupation. By the early 17th-century the MacDonnells were successfully negotiating the complex political landscape of early modern Ireland. Under the leadership of Randal MacDonnell the family maintained the lands initially granted them in the 1580s and consolidated their relationship with the Stuart court. These Gaelic lords began a programme of plantation brining in new Scottish and local Irish settlers, establishing settlements, trade centres and small-scale industries. The changes to Dunluce Castle reflect these emerging cultural norms as an emphasis was placed on consumption and privacy. On the rocky outcrop, the Jacobean manor house was built which incorporated the earlier 'buttery' and a new kitchen was constructed. An ambitious programme of building on the mainland adjacent to the castellated outcrop was started which included stables, brew-house and lodgings. It was during this period that the pleasure gardens and town to the west of the castle date (Figure 9). This was the zenith of the town and castle. By the 1680s after half a century of war and the death of the 2nd earl the town was abandoned and desolate.

Understandably, most research on Dunluce and the MacDonnell lordship to date has focussed on either the castle, its immediate environs or other elite settlements within the territory (Breen 2012, Hill 1873, Jope 1951, McNeill 2004). Less focus has been given to how the MacDonnell's would have organised and worked their estate internally which is unfortunate as the present survey area falls outside of the core of the Dunluce Castle landscape in the modern townland of Maghercross. The first historical reference to the placename Maghercross is in the mid-19th-century Ordnance Survey Names Books[6] which suggests that this is a later subdivision of an earlier land parcel. Maghercross townland was not mapped by the mid-17th-century Down Survey (Figure 10) although the surrounding townlands of Ballymagarry (Ballynagarry – 25), Tanderagee (Culenegore – 26) and Clooney (Conye – 32) were.[7] It would appear that Maghercross was cleaved out of portions of Clooney and Tanderagee sometime before the mid-19th-century. An episode of townland renaming and subdivision has been noted during the 18th- and 19th-centuries in mid-Ulster (McDermott 2013, 7) and something similar may have occurred at Dunluce.

By the 1830s the land surrounding Dunluce was improved to suit the tastes, and agenda, of Samuel Lewis (1837, 585). The ideology of Improvement linked a well-ordered and well-managed landscape with civility and civilising influences (Forsythe 2013, 73). Sixty years previous Arthur Young (Wollaston-Hutton 1892, 161) had noted that the area surrounding the Giant's Causeway was, 'in the rundale and likewise in the change-dale system'. Presumably this meant by the 1770s the collectively farmed system of in-fields, out-fields and common-lands in north Antrim was in the process of being enclosed and privatised.

[6] Magheracross, Co. Antrim, Northern Ireland Placenames Project. Available online [http://www.placenamesni.org/resultdetails.php?entry=18544].

[7] Tanderagee, Co. Antrim, Northern Ireland Placenames Project. Available online [http://www.placenamesni.org/resultdetails.php?entry=18806], Ballymagarry, Co. Antrim, Northern Ireland Placenames Project. Available online [http://www.placenamesni.org/resultdetails.php?entry=18539], Clooney, Co. Antrim, Northern Ireland Placenames Project. Available online [http://www.placenamesni.org/resultdetails.php?entry=15546].

Description and interpretation of anomalies (Figure 4)

General comments:

This dataset contained a significant proportion of high resistance readings a proportion of which are probably related to near surface bedrock. As a consequences of these higher readings high pass filtering introduced a number of false negative values to the dataset – notably the negative value halos associated with r2, r3, r5 and r7 (Figure 8).

A grade of archaeological potential has been identified for each anomaly listed below (Figure 5). Features which have a plan that clearly suggests they are the consequence of human activity have a high level of archaeological potential. Features which appear natural in form but by their association with other anomalies suggest human activity or can be explained by reference to more recent human activity (1910s onwards) are identified as having a medium level of archaeological potential. Features which appear natural in form, are not associated with other anomalies of high or medium potential but cannot be explained due to the processes outline below are given a low level of archaeological potential. Finally features which can be explained due to geology, taphonomic, geomorphology, modern interference and/or agricultural practices (e.g. wire fencing), the survey methodology and data treatment are identified as having no archaeological potential.

It is important to note that these grades of archaeological potential are partly subjective and only applicable to the specific survey data covered in this report. Archaeological anomalies may be present, but undetected by geophysical survey, in all areas of the site and this cannot be mitigated against without further 'ground-truthing' i.e. test trenching or excavation. This is especially relevant in regards to the singular use of electrical resistance without an accompanying magnetic gradiometery survey.

Table 1 Description and interpretation of archaeological anomalies

Code	**Description**	**Interpretation**
r1	Low resistance linear feature running for a distance of *c.* 78m south-west to the north-east in the eastern third of the survey area. The anomaly takes an oblique return at its northernmost limit running towards the south-east. It has an average width of *c.* 3m with a maximum width of *c.* 5m. Mean average readings of 38.4 ohm.	This may be the remnants of a water-logged ditch which functioned as a field boundary dating from at least the mid-19th century. Lower resistance readings are typical of soils which are more waterlogged or contain more moisture then the surrounding soil matrix such as a ditch or drainage feature. A field boundary was mapped by the 2nd Edition Ordnance Survey following the same path (Figure

		13) and may well predate the 1st Edition survey of the area.[8] By the 3rd Edition survey, at the turn of the 20th-century, the land appears to be no longer under cultivation and the field boundary is no longer extant. The linear anomaly also appears to have a subtle topographic expression which is evident on the band 2 display of a Principle Components Analysis of LiDAR data available for the eastern half of the survey area (Figure 11).
r2	An oval area of high resistance situated towards the centre of the survey area on a north-western slope overlooking Dunluce Castle and gardens. The anomaly measures *c.* 15.5m south-west to north-east and 11.5m north-west to south-east with a mean average return of 78.5 ohm.	An oval stone-built, cairn-like structure perhaps related to prehistoric ritual, early medieval settlement or 18th- /19th-century agricultural practices (see Discussion). The regular form of this feature indicates it is human-made. Although without testing there is no way to say 100% that it could not be an unfortunately shaped bedrock outcrop. The anomalies plan is lost somewhat when the data is processed with a HPF although it is still traceable along its south-eastern limits. HPF can have such an effect on large higher resistance features as it attempts to retain and emphasis smaller anomalies so the processed data plot is no reflection on the actual plan of r2. The feature, r3, was not recorded by the Ordnance Survey historical map series. It has the slightest expression topographically and is just visible after PCA analysis (Figure 11) of the LiDAR data captured of the area. The high resistance readings suggest that the feature is constructed from stone.
r3	A high resistance, straight, linear feature running east to west for a length of *c.* 24.5m with a maximum width of *c.* 5m and an average mean return of 77.5 ohm..	While the southern face of r3 appears straight the northern is irregular. The anomaly runs parallel to the cliff edge and there appears to be no other structures associated with it. Given that the underlying geology is quite near surface in general it is probable that this is geological in nature.
r4 (r4a & r4b)	Two parallel higher resistance linear features running east to west extending beyond the northern limits of the survey area.	The higher resistance linear features, r4a & r4b, which comprise r4 appear to define a lower resistance space between them that aligns with the low resistance anomaly r15 to

[8] That this feature was not mapped by the 1st Edition survey should not be taken as evidence of absence in the 1830s – initially the Irish Ordnance Survey did not map field boundaries and the Ulster counties were the first to be mapped.

	The feature r4a runs for a total length of *c.* 40m with a maximum width of *c.* 5.5m while r4b runs for a *c.* 48.5m with a maximum width of *c.* 4.5m. The spacing between r4a and r4b ranges from *c.* 2 – 3m. Both features have a mean average ohm reading of 36 and 39 ohms respectively.	the west. The eastern two-thirds of r4 is surveyed within the available LiDAR data (Figure 11) and the surveyed section does appear to enclose a linear depression. It is possible that r4 maps a route used to access the hollow-way which leads down to Dunluce Burn and waterfall (Figure 20).
r5	An irregular area of very high resistance readings (ranging from 50 – 79 ohms) towards the centre of the survey area. Anomaly measures *c.* 28m east to west and *c.* 25.5m north to south with an average mean resistance reading of 76.6 ohms.	The area of high resistance appears to be associated with a small raised mound to the centre of the survey area. This is probably near surface geology.
r6	Large irregular area of higher resistance readings to the centre of the survey area. Measuring *c.* 52m east to west by *c.* 46.5m north to south.	This series of heighten resistance readings is probably near surface geology.
r7	Irregular area of high resistance readings along the western edge of the survey area. Measuring *c.* 11m north to south.	This feature was only partially mapped during the electrical resistance survey. Its irregular plan is emphasised by high pass filtering, which also creates halos or false artefacts on it southern limit (Figure 8). The feature r7 is probably best explained by the same near surface geology associated with features r3, r5 and r6 although it is not 100% possible to discount that it could be a pit with stony fill.
r8 (r8a, r8b, r8c, r8d, r8e, r8f, r8h, r8i, r8j)	A series of low resistance linear features running parallel to each other in the eastern third of the survey area. They range in length from *c.* 24m (r8h) to *c.* 58m (r8c) with a width of *c.* 2m. They are spaced between *c.* 3.7 – 3.9m apart.	Series of linear features which respect the probable field boundary r1. A number of the geophysical returns coincide with a series of linear depressions captured by the LiDAR survey (Figure 11). The lower resistance linear features probably map moisture rich furrows in-between cultivation ridges which are enclosed by r1 to the west.
r9 (r9a & r9b)	A pair of narrow, higher resistance features running parallel to each other east to west through the northern half of the survey area. To the east of r10.	May be part of a larger feature mapped by r10 & possibly r11 – both of which follow a similar path and have a similar form. LiDAR data (Figure 11) captures a narrow parallel depression running between r9 & r10 and demarcating the western limits of r8. A field boundary is mapped for part of this path in the 2nd Edition Ordnance Survey map of the area (Figure 13). It is possible that r9 relates to this but how is unclear. The higher

	The northern anomaly, r9a, can be traced for a length of *c.* 9m and is *c.* 1m in width. It appears to overlay or cut into feature r1. The southern anomaly, r9b, is traceable for a distance of *c.* 4.5m with a width of *c.* 1m. The two anomalies, r9a & r9b, are *c.* 3m apart.	resistance readings suggest stone footings but parallel wall features 4m apart seem an unusual form for field walls to take.
r10 (r10a 7 r10b)	A pair of narrow, higher resistance features running parallel to each other east to west through the northern half of the survey area. To the west of r9 and to the east of r11. The northern anomaly r10a can be traced for a length of *c.* 12m and is *c.* 1.5m in width. The southern feature, r10b, is traceable for a distance of *c.* 5m with a width of *c.* 1m. The two anomalies, r10a & r10b, are *c.* 3m apart.	May be part of a larger feature mapped by r9 & possibly r11 (see above r9 for discussion).
r11 (r11a & r11b)	A pair of narrow higher resistance features running parallel to each other east to west, through the northern half of the survey area. To the west of r10 & r9. Both these anomalies are less well-defined then r9 & r10. The northern anomaly r11b can be traced for a length of *c.* 9m with a width of about *c.* 1.5m. The southern feature, r11a, is traceable for a distance of *c.* 12m with a width of *c.* 1m. The two features, r11a & r11b, are *c.* 4.5m apart.	Although it is possible that r11 relates to a linear boundary mapped by r9 7 r10, r11b appears to run on a different line and is not expressed as solidly as the returns which makeup r11a, r10 or r9. Unfortunately only a short section of r11b is captured in the LiDAR data but the returns we do have suggest it has no topographical expression. It might be best to discount r11b from the argument and suggest that r11a may be part of the linear feature defined by r9 and r10.
r12	Long, narrow, straight low resistance feature running west-southwest to east-northeast through the western half of the survey area. The feature is	The low resistance anomaly cuts over the north of the knoll which dominates the survey area's topography. The lower resistance readings indicate that r12 retains more moisture than the surrounding soil.

	mapped for a distance of *c.* 145m and measures *c.* 1.5m in width.	Public toilets are marked on the OSNI 1:10,000 vector data to the north of the car parking area which abuts the west of the survey area. There are currently no upstanding toilets in the carpark but it could be possible that the sewage utilities were excavated at some stage post-1930s. The parking area was not mapped by the 5th Edition Ordnance Survey (Figure 16). Another explanation is that r12 could be a water-logged ditch, similar to r1. However it doesn't run parallel to r1 which would suggest that they were not part of the same field-system and it cuts over the top of the knoll which is an unusual place to find a drain.
r13 (r13a & r13b)	Higher resistance linear feature, r13a & r13b, which appears to run south-west to north-east through, or abutting, r2. The southern anomaly, r13a, is traceable for a distance of *c.* 17.5m with a width of *c.* 1.5m. The northern anomaly, r13b, is mapped for a distance of *c.* 13m with a similar width, *c.* 1.5m, to r13a.	The higher resistance anomaly r13 runs parallel to r1 and abuts r2. It has been previously noted that r1 is probably a relict field boundary and r13's spatial relationship with this anomaly suggests it too might be part of that field-system with r2 as some form of clearance cairn (see r2 and Discussion below). In this instance the higher resistance returns of r13 indicate it may be the footings of a wall. This is difficult to explain in relation to r1 which appears to be a ditch. Unless the field boundaries consisted of cut-ditches beside a stone wall. If this were the case you would expect either r1 or r13 to display high and low resistance features running parallel to each other for some of their length. Neither of them to so which makes the explanation of one field system weak. Another interpretation could be that r13 is an earlier landscape feature that was extant, perhaps even as an earthwork, when r1 was laid out. This argument ties in closer with the discussion that r2, r13 and r16 may be related to medieval settlement activity.
r14 (r14a, r14b, r14c, r14d, r14e, r14f & r14g)	Series of subtle, linear high resistance features running parallel to each other south-west to north east in grid squares F3 and F4. These features appear to be partially mapped: ranging from *c.* 5.5m, r14b, to *c.* 22m, r14d with an average width of *c.* 1m.	This series of linear higher resistance features are very subtle, even after high pass filtering (Figure 8). They do not appear evenly spaced, some curve gently and they do not respect r1. However it could be argued that the collection of linear features which comprise r14 do appear to respect a field boundary mapped to the west of the survey area by the 5th Edition Ordnance Survey (Figure 16). The collection of anomalies may be related to machine ploughing, perhaps when the area was taken back under cultivation at some period in the mid to late 20th-century. It is noteworthy that the area is marked as being rough or fallow ground on in the 3rd – 5th Edition maps.

r15	Linear, narrow low resistance feature running south-west to north-east through the northern third of the survey area. The feature is mapped for a distance of *c.* 21.5m with a width of *c.* 2m.	The anomaly r15 appears to align with a lower resistance space defined by r4a and r4b While the anomaly r4 is more pronounced after high pass filtering r15 is eroded by halos or false artefacts created by the process. It is possible that r15 is related to r4 and could map a route used to access the hollow-way which leads down to Dunluce Burn and waterfall.
r16 (r16a & r16b)	Higher resistance linear feature running north to south through the northern half of the survey area and abuts r2. The feature appears to be truncated by r12. The northern section, r16b, is mapped for a distance of *c.* 8m with a width of *c.* 1m. It is more visible after HPF. The southern section, r16a, which is clearly evident in the raw data is traceable for a distance of *c.* 10.5m with a width of *c.* 2m.	The anomaly r16 appears to be truncated by r12. It is quite subtle and only slightly emphasised by high pass filtering. The southern section, r16a, appears to abut the oval anomaly r2 in a similar manner to r13 which would suggest it is a field boundary related to a similar period of activity. Since Improvement period fields favoured regular trapezoid field patterns, a small triangular enclosed area on the edge of a cliff is quite out of character. It has been argued (see r2, r13 and Discussion below) that this might be part of an earlier period of land management.

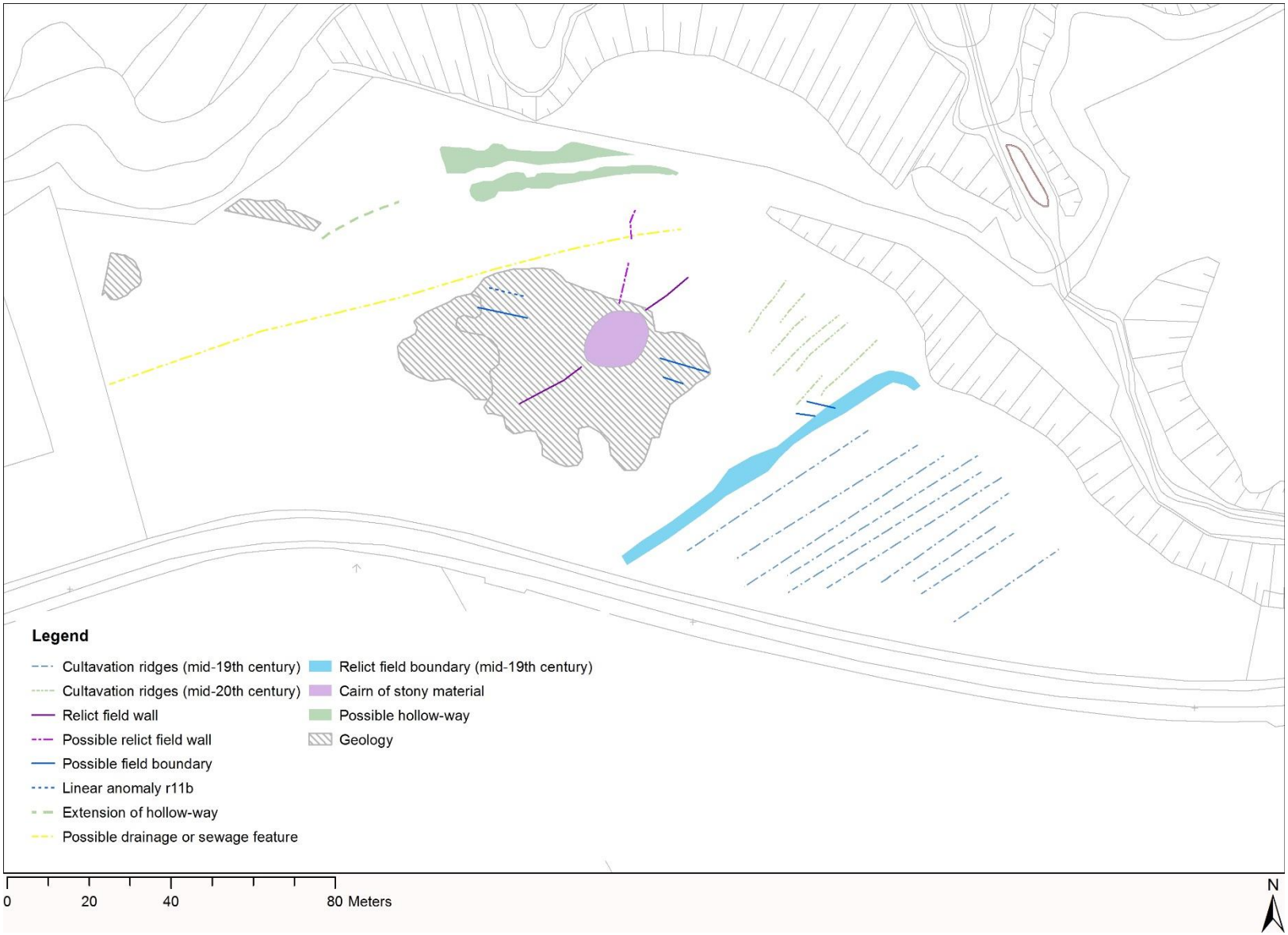

Figure 4 Interpretation diagram. To be used in conjunction with Table 2 and Discussion below.

Discussion

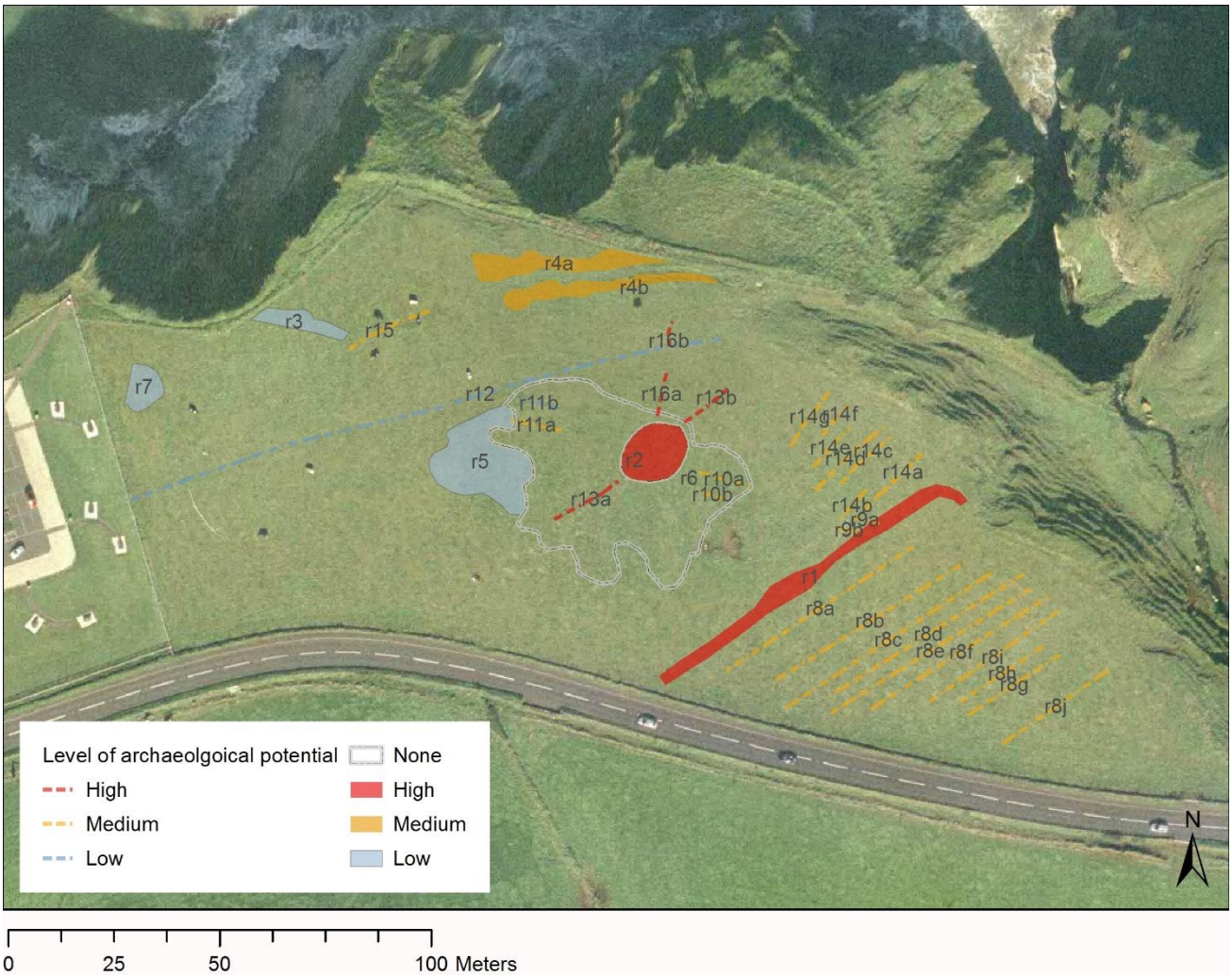

Figure 5 Feature identity codes and level of archaeological potential.* To be used in conjunction with Figure 4 and Table 2.

The geophysical survey of the area referred to in this report as the West Field could only apply one type of prospection technique – electrical resistance. This form of geophysical survey is very useful for identifying stone footings and features where the level of moisture differs from the surrounding soil. Applied in isolation it can be limited as it does not detect the magnetic signals one would expect from kilns, hearths or some cut features such as ditches, pits and post holes.

The electrical resistance survey of the West Field identified a number of features which may have archaeological potential. Primarily an oval, high resistance anomaly to the middle of the survey area identified as r2 upon which two linear anomalies, r13 and r16, appear to converge on it. A number of explanations have been put forward to explain these returns (Table 2). A prehistoric cairn would not be out of character for the wider landscape distribution patterns of prehistoric monuments (Figure 2 and see Historical and archaeological background above). It would also tie in with the evidence of late prehistoric flint working identified as surface finds during the course of data capture but it fails to explain the anomalies r13 and r16.

Small early medieval cashel-like structures are found elsewhere along the north Antrim coast in similar locations (C. McSparron *per comms*). For example, at Tigh-na-siedur (ANT 010:006) East Torr townland, a scarp of stone marks the cliff-top location of a small cashel referred to the mid-19th-century parish memoirs.[9] Although very little remains now, during the mid-19th-century it was described as circular and about 30 feet (9.10m) in diameter. The upstanding remains of a cashel in Altagore townland (ANT 015:018)[10] is larger (external diameter 19m N – S, 21m E – W) then the possible Dunluce example and located further inland. Constructed of thick drystone walls it is situated overlooking a small valley and the sea, 1km to the south-east. If r2 were a small cashel then the intersecting linear features, r13 & r16, could be explained as remnants of an early medieval field system. At Corrymeallagh (ANT 015:064)[11] a small cashel (internal diameter 14m N – S, 13m E – W) is set within a system of irregular, angular fields. The walls of the enclosure are constructed of sandstone boulders standing to a maximum height of 1.35m over the eastern exterior. Situated *c.* 200m from the cliff edge it is probably the closet parallel to what may be present at Dunluce – a small cashel-like structure set within an irregular, angular field system.

A final explanation for r2 is that it is an 18th- or 19th-century clearance cairn perhaps related to Improvement period agriculture and land enclosure. In this scenario r13 would be a field wall running parallel to r1 and possible being part of the same field system. However this latter explanation does not explain r16 – which would form the type of small, irregular field abhorred by 18th-century landlords. Nor, does it satisfactorily address why r13 and r1 which with this explanation would be part of the same field system should have such different geophysical expressions – r13 probably a high resistance wall footing and r1 a low resistance moisture-rich cut feature. However if r13 was still evident in the landscape when r1 was laid out then this may explain their spatial relationship. In a similar vein later land improvement, for example clearing stones, could have removed much of the above ground evidence for earlier settlement features. Defiantly r1 pre-dates the mid-19th-century 2nd Ordnance Survey of the area and encloses a series of cultivation ridges r8. A straight linear feature, which is captured in the LiDAR survey and appears to correspond with anomalies r9, r10 & r11a may be part of this later phase of enclosure activity.

To the north-west of the survey area the anomalies r4 and r15 may be the remnants of a hollow-way which facilitated access to the Dunluce Burn. The feature r4 comprises two higher resistance linear features which define a linear depression captured by the LiDAR survey. Higher resistance returns would be expect from better drained, compact, stonier soils, the type of material that would form the sides of a hollow-way. The anomaly r15 shows up as a low resistance linear which lines up with the area defined by r4. Unfortunately it falls outside the area covered by the LiDAR survey. However these lower resistance readings would be expected from the bottom of a hollow-way which would be more prone to waterlogging.

Recommendations

It must be remembered that the grades of archaeological potential identified by this report are subjective and only applicable to the specific survey data covered in this report. Archaeological anomalies may be present, but remain undetected, in all areas of the site.

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[9] NI SMR ANT 010:006 – available online [http://apps.ehsni.gov.uk/ambit/Details.aspx?MonID=996].
[10] NI SMR ANT 015:018 – available online [http://apps.ehsni.gov.uk/ambit/Details.aspx?MonID=1258].
[11] NI SMR ANT 015:064 – available online [http://apps.ehsni.gov.uk/ambit/Details.aspx?MonID=1304].

It is also recommended that any further testing should include the anomalies r2, r13, r16 and by association r1. It would be prudent to pay attention to the geophysical features, r4 and r15, associated with the hollow-way that leads down to the Dunluce Burn. Given the topographical and geophysical expression of the cultivation ridges, r8, to the east of the survey area with increasing awareness of how fundamental the Improvement process was to shaping the Ulster countryside (Forsythe 2013).

The archaeology suggested by the geophysical survey of the West Field could help inform us how the MacDonells, and other Gaelic and former Gaelic families, internally organised and exploited their estates during the Late Medieval and Early Modern periods – especially how they implemented improvement period practices.

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I would like to thank Brian Sloan, Harry Walsh, Grace McAlister, Francis Woods, Joel Goodchild and Annastasia Boomsma for their assistance during the fieldwork phase of this survey.

I am also very grateful to Cormac McSporran and Dr Harry Welsh, Centre for Archaeological Fieldwork, School of Geography, Archaeology & Paleoecology, Queens University Belfast for their thoughts on interpreting the geophysical dataset.

Appendix one: Georeferenced geophysical survey grid

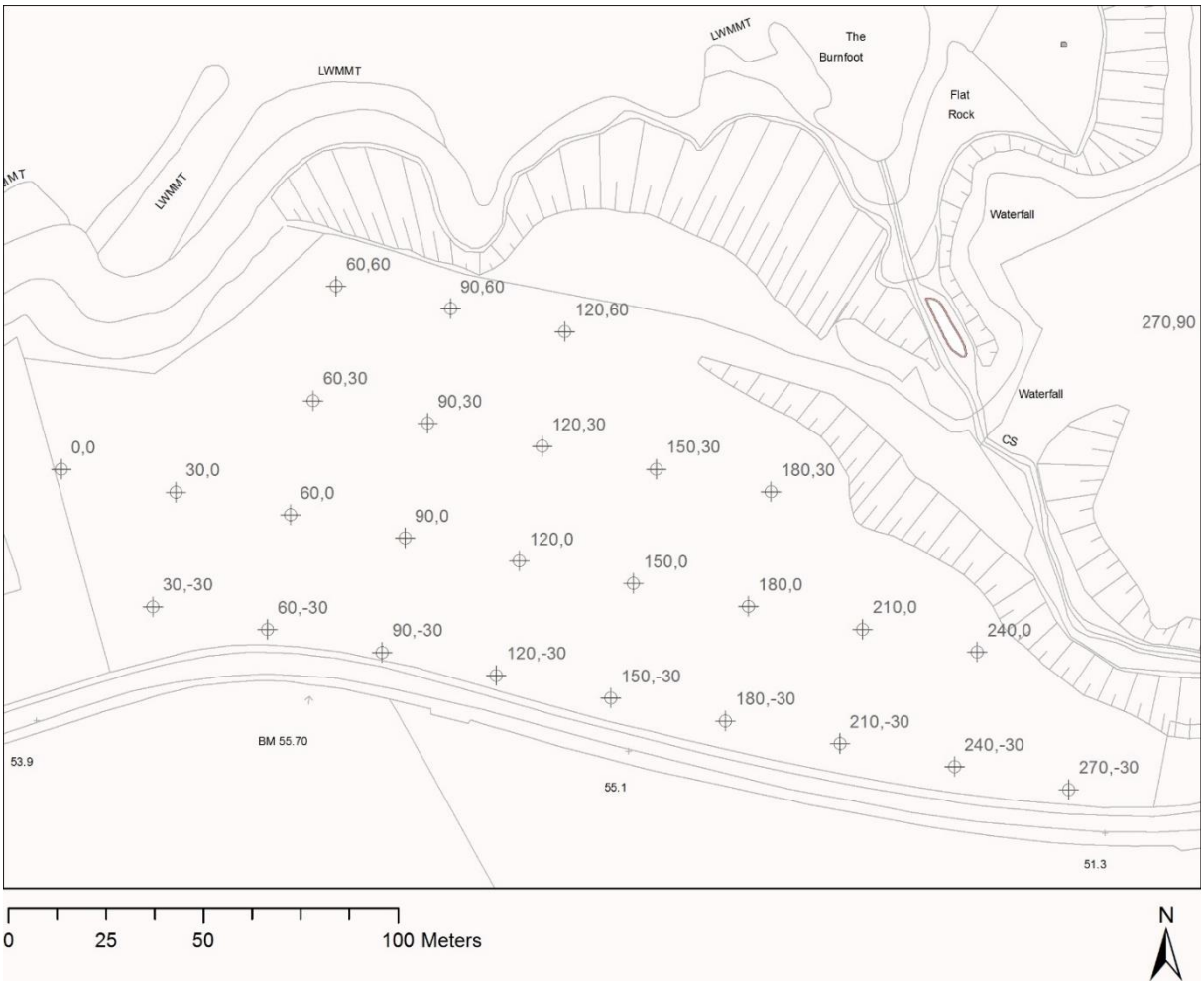

Figure 6 Location and coordinates of local geophysical survey grid.

Local Grid coordinate		Irish National Grid coordinate		Local Grid coordinate		Irish National Grid coordinate	
X	**Y**	**Eastings**	**Northings**	**X**	**Y**	**Eastings**	**Northings**
0	0	290101.84	441150.01	120	30	290225.42	441155.94
30	0	290131.26	441144.14	120	60	290231.30	441185.37
30	-30	290125.34	441114.69	150	-30	290243.10	441091.23
60	-30	290154.86	441108.85	150	0	290248.93	441120.67
60	0	290160.71	441138.26	150	30	290254.83	441150.07
60	30	290166.59	441167.68	180	-30	290272.51	441085.37
60	60	290172.45	441197.10	180	0	290278.39	441114.78
90	-30	290184.28	441102.99	180	30	290284.29	441144.20
90	0	290190.17	441132.40	210	-30	290301.93	441079.49
90	30	290196.01	441161.79	210	0	290307.81	441108.92
90	60	290201.87	441191.25	240	-30	290331.38	441073.60
120	-30	290213.68	441097.09	240	0	290337.24	441103.04
120	0	290219.56	441126.52	270	-30	290360.78	441067.75

Table 2 Geophysical survey grid coordinates georeference to Irish National Grid

Appendix two: Raw data plots

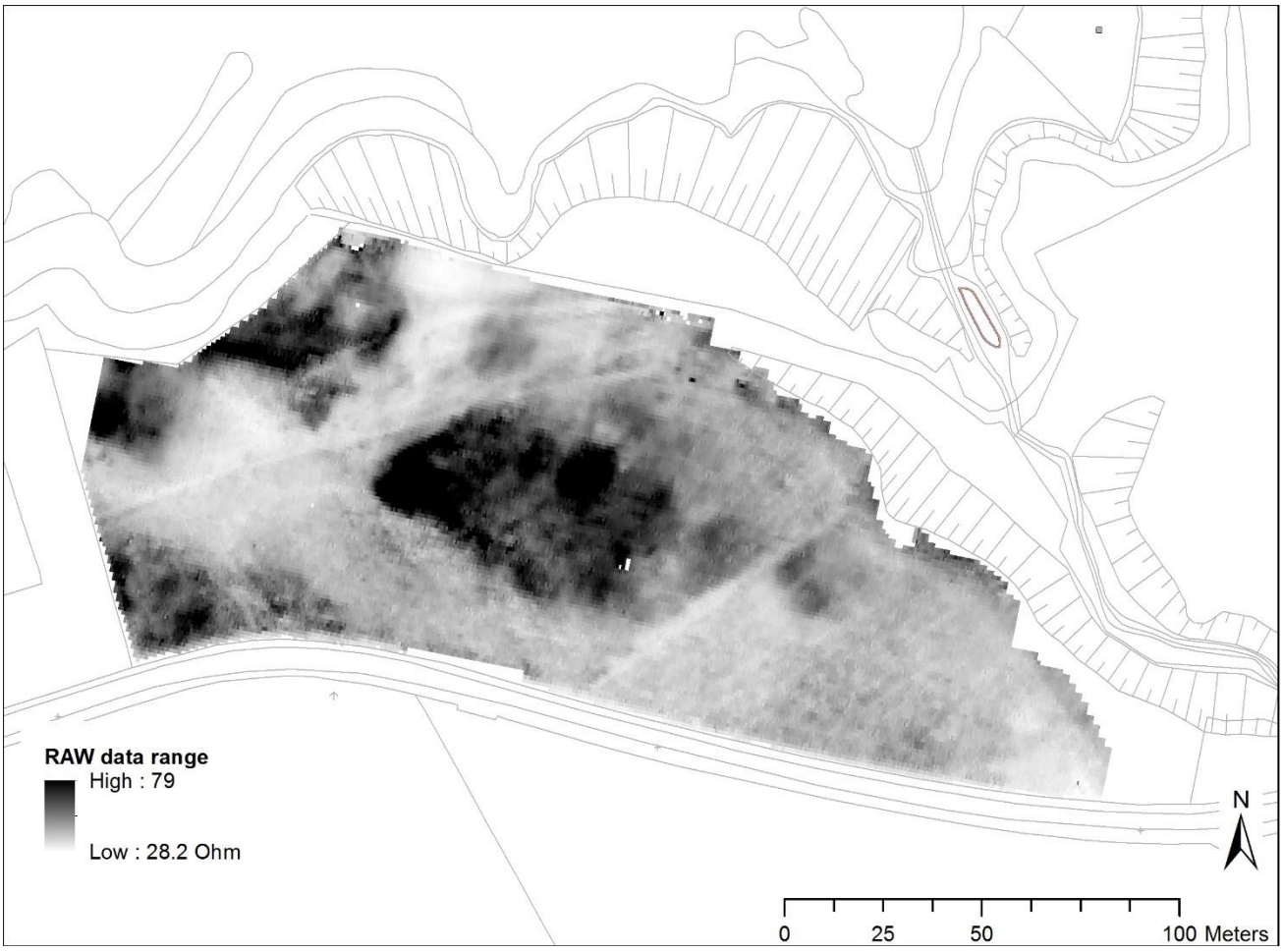

Figure 7 Greyscale plot of raw data despiked and clipped to +/- 3 standard deviation.

Statistics:
Mean: 46.9
Std Dev.: 11.9

Appendix three: Processed data plots

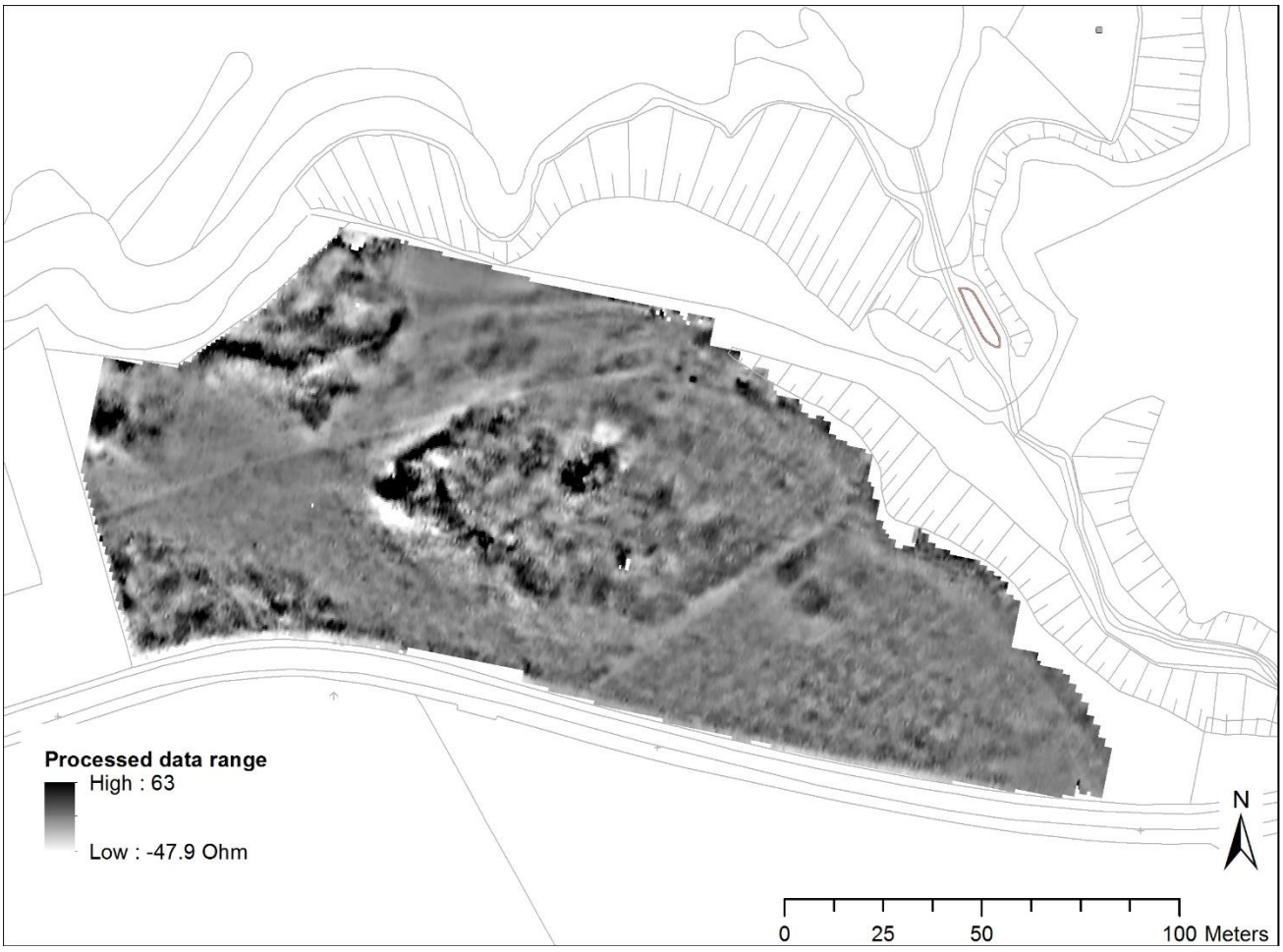

Figure 8 Greyscale plot of processed data. Data was clipped 0/+ 100 ohm, despiked, HPF (Gaussian weighting applied on the x- and y-axis), LPF (Gaussian weighting applied on the x- and y-axis) and interpolated on the x- and y-axis.*

Statistics:
Mean: -4.3 Ohm
Std Dev.: 4.2

Appendix four: Supporting visualisations

Figure 9 Reconstruction painting of Dunluce Castle, gardens and town *c.* 1625, by Phillip Armstrong. The eastern section of the survey area is depicted as under pasture – presumably part of an outfield system (after Breen 2012, 135, fig 6.5).

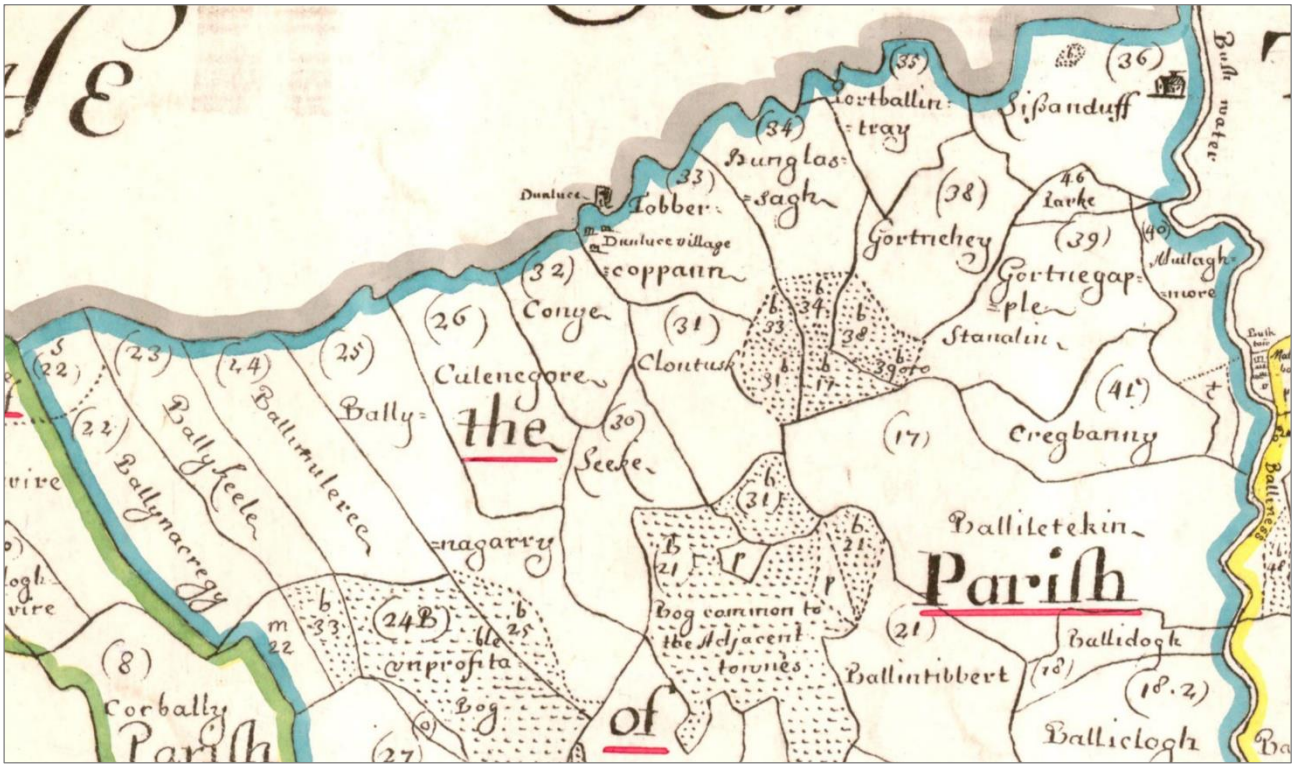

Figure 10 Extract from the Down Survey map of the Barony of Dunluce. Dunluce Castle and town are contained within the land parcel 'Tobbercoppann – 33'.

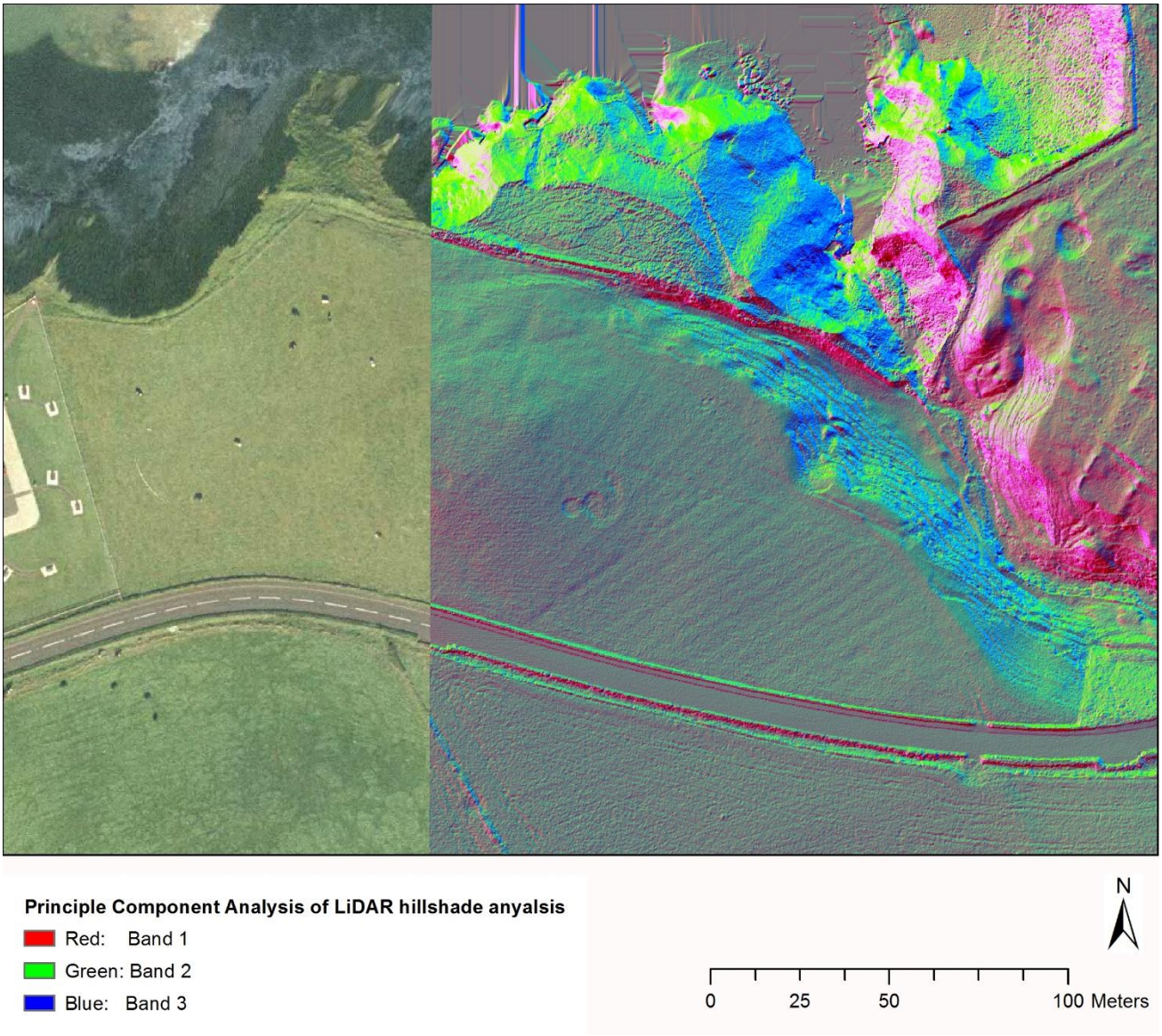

Figure 11 Principle Component Analysis of LiDAR hillshades overlaid on ortho-rectified aerial photography.*

Appendix five: Historical mapping

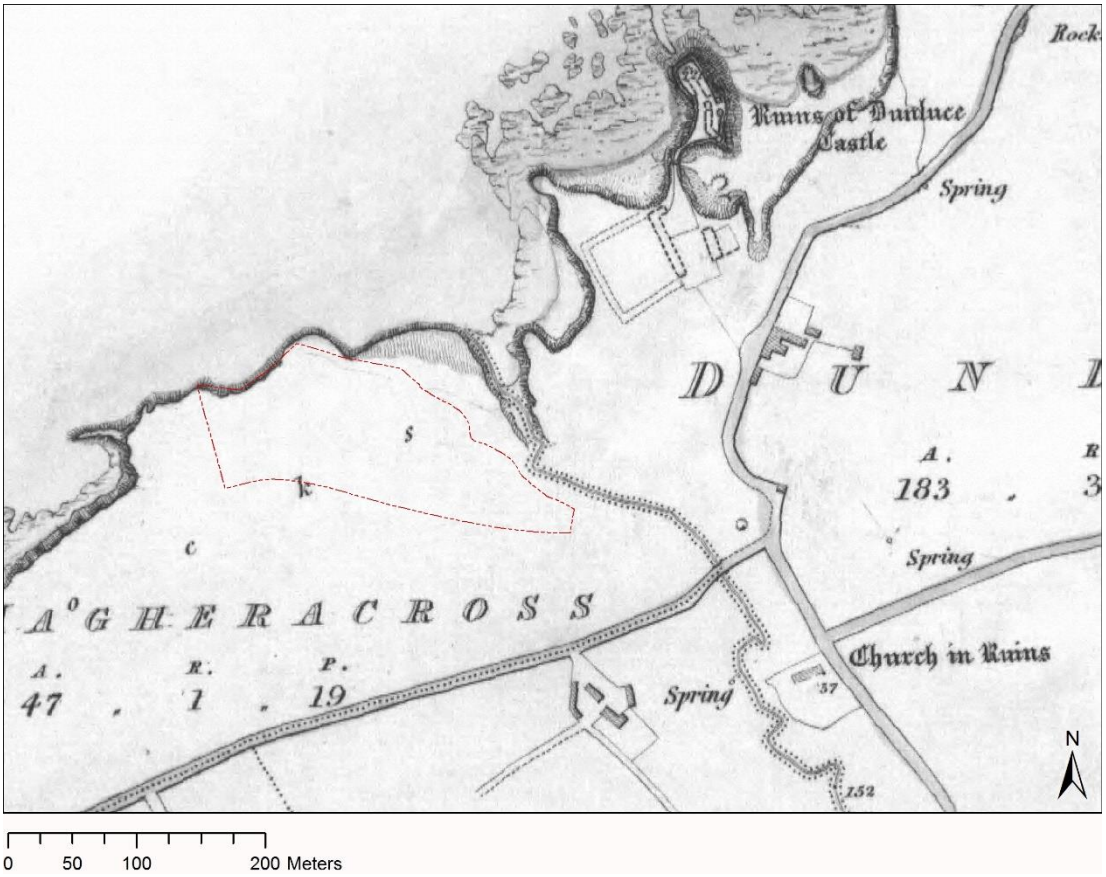

Figure 12 Geophysical survey area (marked in red) in relation to the First Edition Ordnance Survey map series, *c.* 1831-33.

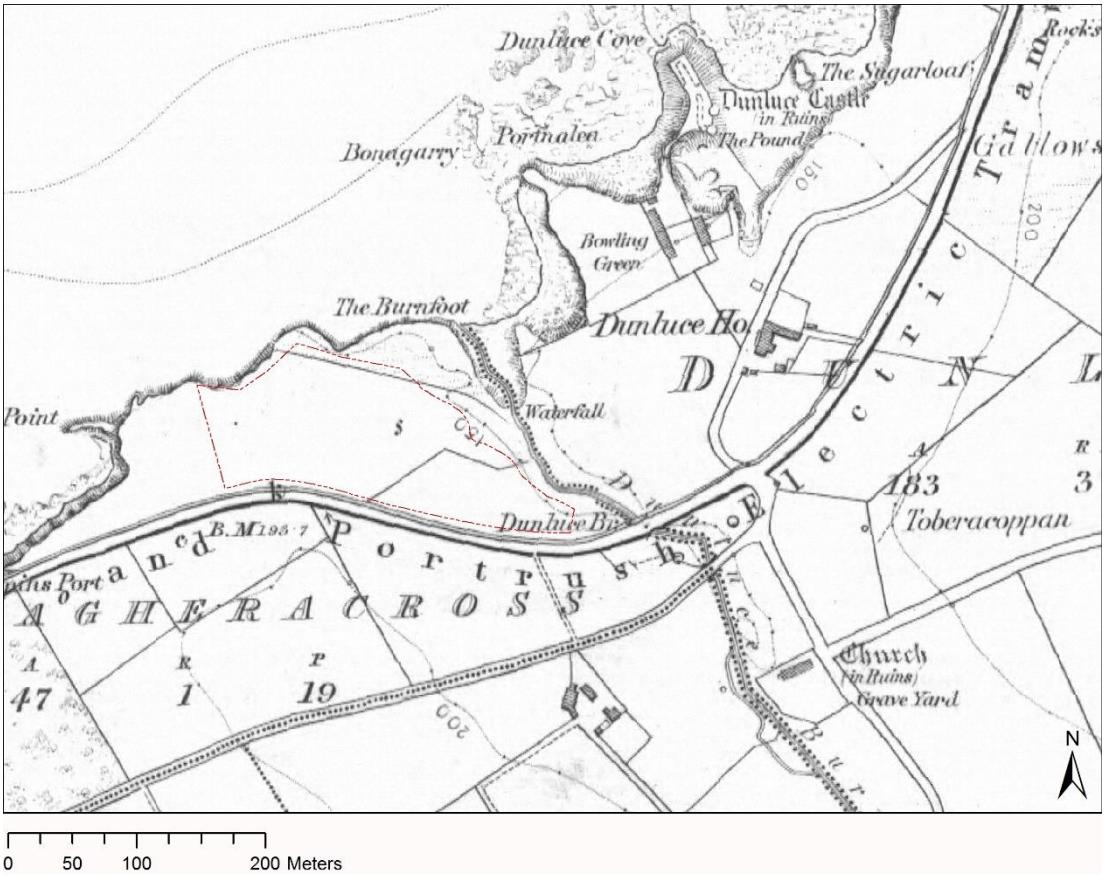

Figure 13 Geophysical survey area (marked in red) in relation to the Second Edition Ordnance Survey map series, *c.* 1853-58.

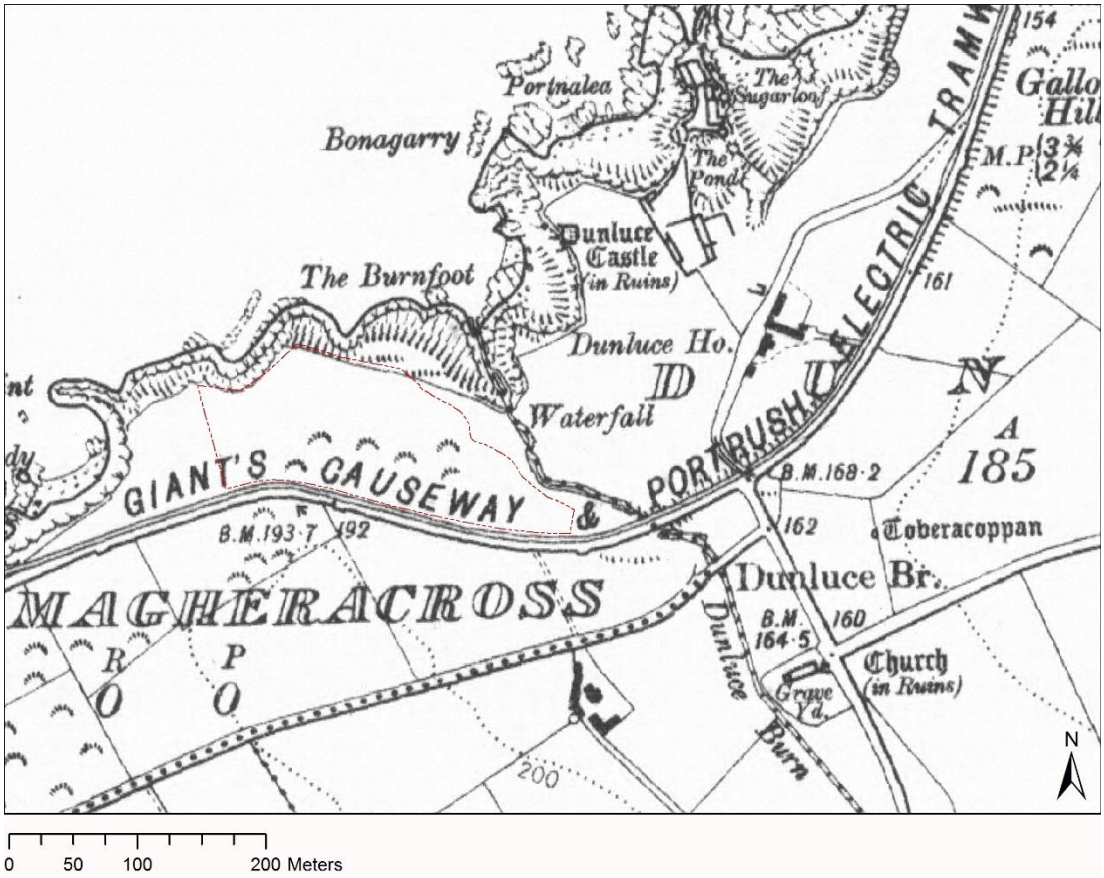

Figure 14 Geophysical survey area (marked in red) in relation to the Third Edition Ordnance Survey map series, *c.* 1900-06.

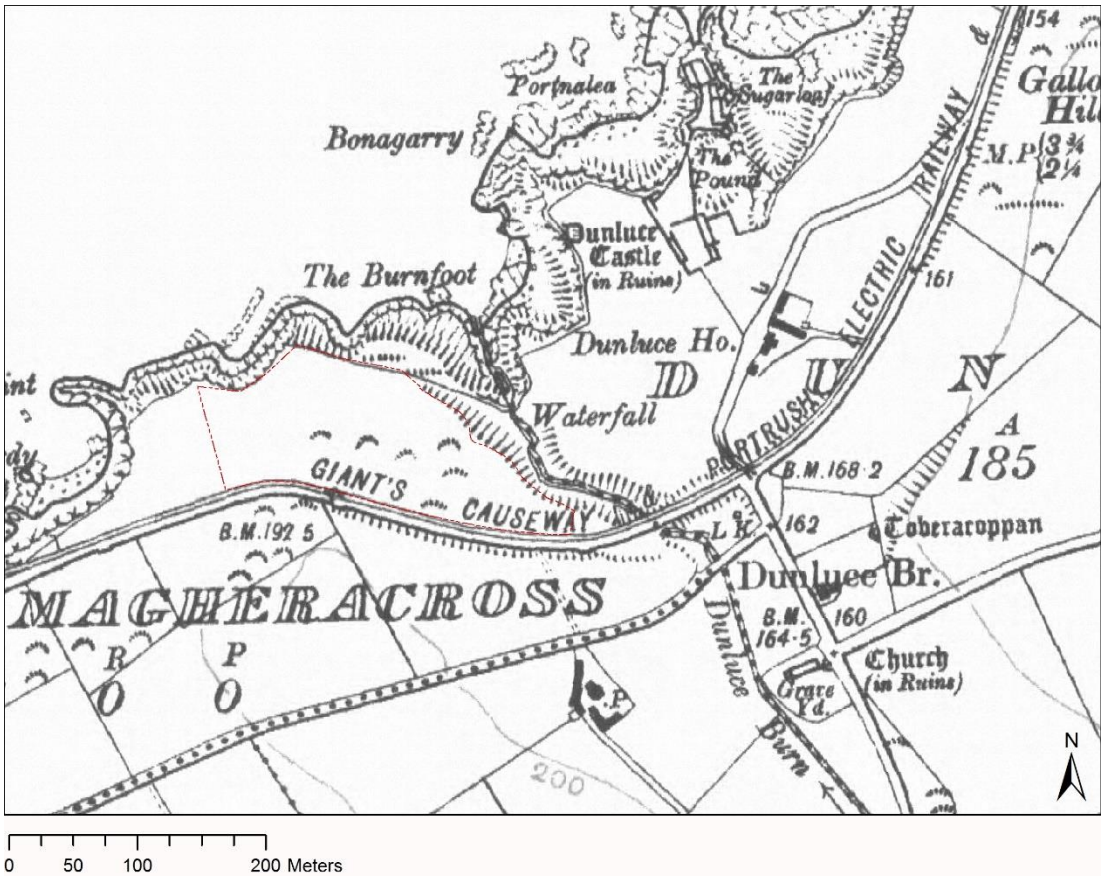

Figure 15 Geophysical survey area (marked in red) in relation to the Fourth Edition Ordnance Survey map series, c. 1920-22.

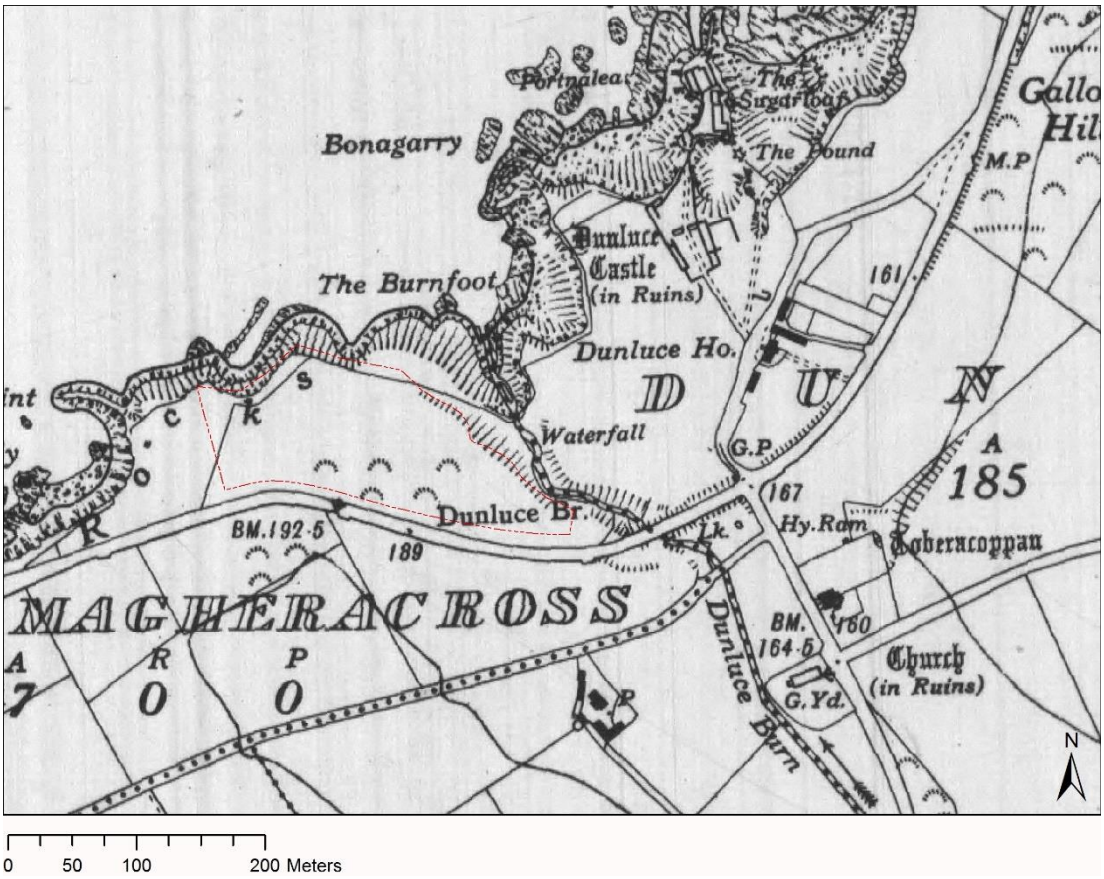

Figure 16 Geophysical survey area (marked in red) in relation to the Fifth Edition Ordnance Survey map series, *c.* 1931-37.

Appendix six: Photographs of survey area

Figure 17 Photograph taken from south-easterly corner of the survey area looking the northwest. Note the field drops away sharply to the north and the hollow-way leading down to the Dunluce Burn.

Figure 18 Photograph of the daisy path which ran the length of the northern boundary. Taken from the west looking along the daisy path as it leads down to the hollow-way and the Dunluce Burn to the east.

Figure 19 Photograph taken from the west looking east-southeast onto the knoll in the centre of the study area. This raised area coincided with features r5 & r6 which suggest it is a bedrock outcrop.

Figure 20 Photograph of hollow-way leading down to Dunluce Burn. Taken from north-eastern corner of survey area looking towards the south. The river passes under the Dunluce to Portrush road through the tunnel in the background.