

Geophysical Survey Report 21

Dunlalong Fort
Co. Tyrone
CAF GSR 21

Ronan McHugh

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Special thanks to each and every volunteer on the Peace III Plantation to Partition programme, and their facilitators John O'Neill and Eilis Hadden for making the survey a unique and enjoyable experience for all who assisted with it.

1. Introduction

1.1 Executive Summary

This report presents the results of a comprehensive geophysical survey at the site of Dunnalong Fort, Co. Tyrone, the location of an English bastioned fort built in 1600 on the site of an existing Gaelic stronghold. The survey forms part of a larger research project at the site, involving The Northern Ireland Environment Agency (NIEA), the Centre for Archaeological Fieldwork at Queen's University Belfast (CAF), the Foyle Civic Trust (FCT), the Centre for Maritime Archaeology at University of Ulster Coleraine (CMA), Derry City Council and Strabane County Councils.

The survey aimed to definitively identify, locate and define the extent of buried remains associated with the fort. The results were then used to form the basis for a small trial excavation at the site, which ran concurrently with the final phase of survey. Future excavation and survey may also be informed by the 2012 survey.

Electrical resistance and magnetometry survey were carried out. The magnetic survey in particular was successful in clearly delineating the outline of much of the fort. It was imaged as a subrectangular area, measuring of 112m north-west/south-east by 91m north-east/south-west. Two of the defensive bastions of the fort, at the west and south corners, were clearly defined, while much of the east side of the fort was slightly obscured by magnetic interference which was interpreted as the results of landfilling in this area. It was suggested by the survey that the curtain of the fort was formed by a defensive ditch, on average 4m in width, and this was verified by the trial excavation.

The survey also detected the remains of possible buildings within the fort, most convincingly in the western bastion. When this area was excavated, it was provisionally interpreted as the site of two possible phases of wooden, post-built buildings, consistent with the geophysical survey results, and typical of the type of structure shown at Dunnalong on contemporary maps of the English fort. The survey also identified other possible buildings within the fort. However, the Gaelic tower house and English brewery, which were perhaps the most notable buildings of the fort, were not definitively located. Beyond the fort, to the east, the survey detected the probable remains of a second, external ditch, which contemporary commentators mentioned as enclosing cabins outside the main defences of the fort itself.

A number of other possible structures were detected to the south-west of the fort which do not appear to be related to it. These structures are not shown on any of the OS maps, raising the possibility that, if they are indeed manmade artefacts, they may date to the early years of the plantation. Evidence of prehistoric activity at Dunnalong is suggested by the detection of a possible Bronze Age ring ditch to the north of the fort.

Overall, the results provide invaluable and definitive information on Dunnalong Fort. They open up a number of avenues for future research into the English fort and its environs, the earlier Gaelic settlement and the place of the archaeological remains in the wider Foyle landscape.

1.2 *Summary of site information*

Site Name: Dunnalong Fort.

Townland: Dunnalong.

SMR No: TYR 001:002.

State Protection: Scheduled Monument.

Grid Ref: C3786010460.

County: Tyrone.

Surveyor(s) Present: Ronan McHugh, Sapphire Mussen, Sarah Gormley, Sarah Kerr, Grace MacAllister, Stewart Alexander (all of the Centre for Archaeological Fieldwork, School of Geography, Archaeology and Palaeoecology, Queen's University Belfast). Various volunteers on the PEACE III funded 'Plantation to Partition' programme.

Survey methods: Electrical Resistance at 1m x 0.5m.

Electrical Resistance at 0.5m x 0.5m.

Magnetometry at 1m x 0.25m.

Weather conditions: Generally fine with some heavy showers.

Solid Geology: Dart Formation psammite with superficial tidal deposits.

Current Land Use: Light grazing.

1.3 *Introduction and overview*

This report presents the results of a detailed geophysical survey carried out at the site of Dunnalong Fort, Co. Tyrone in August 2012 (Northern Ireland Sites and Monuments Record No. TYR 001:002). The survey was carried out as part of a comprehensive archaeological investigation of the site, which also included archaeological excavation at the fort and bathometric survey of the Foyle river-bed adjacent to the site. The terrestrial geophysical survey aimed to detect any subsurface remains associated with the fort, so that the nature, definition, extent and composition of the archaeological features at the site could be determined. The results of the survey were then to be used to locate three targeted excavation trenches to investigate features of potential archaeological significance.

The project was a collaborative venture involving a number of agencies with an interest in promoting and protecting the archaeological heritage of the Foyle basin; The Northern Ireland Environment Agency (NIEA), the Centre for Archaeological Fieldwork at Queen's University Belfast (CAF), the Foyle Civic Trust (FCT), the Centre for Maritime Archaeology at University of Ulster Coleraine (CMA) and Derry City and Strabane District Councils. The first stage of the geophysical survey was funded by NIEA, while a tranche of funding from FCT was dedicated to its completion. This report combines the results from all stages of the survey.

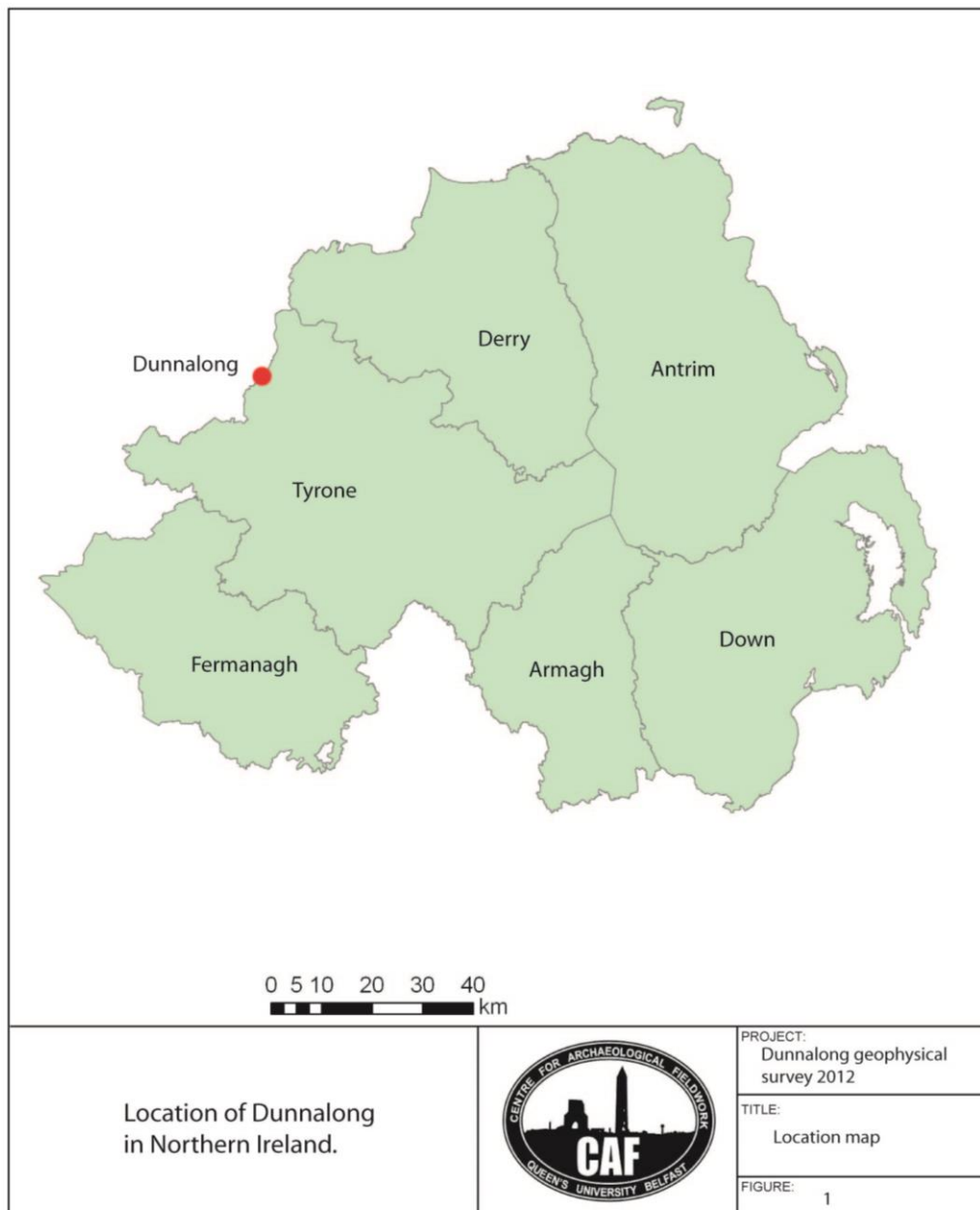
The results of the excavation have not been fully processed, but preliminary findings are referred to in the course of his report where relevant. A separate report on the bathometric survey will be prepared by CMA.

1.4 *Early archaeological sites in the Dunnalong area*

The modern townland of Dunnalong lies on the southern shore of Lough Foyle in north Co. Tyrone (Figure 1 and 2). It is the smallest townland in the parish bearing the same name, and contains an area of just over 12.5 ha. Given its position on a major waterway, it is probable that Dunnalong saw human activity from prehistoric times. Although no visible remains of this period survive in the townland, there are a number of sites from the prehistoric period in the landscape nearby. The earliest of these may be the two standing stones at Lisdivin Lower that could be the remains of a Neolithic portal tomb (TYR 002:012). Early agricultural activity and settlement in the region may be evidenced by the hut platform and pre-bog field systems at Gortmellon (TYR 002:030 and 037), while evidence of ritual and burial in the Bronze Age is reflected in a number of standing stones close to the western shore of the Foyle in Co. Donegal and the cist burials at Clamdernow (LDY 022:035), Altrest (TYR 002:028) and Leckpatrick (TYR 005:022). There is thus demonstrable evidence of a diverse range of prehistoric activity in the area, if not in the townland of Dunnalong itself.

The importance of the wider area around Dunnalong in the early historic period may be reflected in some of the locality's place names. Roulston reports that the name of the neighbouring parish of Leckpatrick, to the south of Dunnalong, translates as 'the flat stone of Patrick' and may refer to an early Patrician ecclesiastical foundation in the area (Roulston 2000, 9). A pre-Norman ecclesiastical centre in this townland is also suggested by 14th century reports of Archbishop Coulton's visit to the area, when it is said the Archbishop encountered the 'Erenaghs of Leckpatrick' (Reeves and Porter 1853, 188); the erenagh

(‘superior’) was a specific, generally hereditary, office originating in the early Irish Church, but which survived the 12th-century ecclesiastical reforms and endured into the medieval period. A similarly early date is suggested for nearby Donagheady Church, which is referred to in the Tripartite Life of Patrick as Domhnach Cati. The putative church of Cruimthir Meascan, reputedly the brewer of St. Patrick, may have been located in the townland of Gortmessan near the Derry/Tyrone border according to Lacy (Lacy, B 1979, 11). An alternative theory, tentatively proposed by Roulston, suggests this church may have been the first ecclesiastical site at Grange, which was later the site of a monastic settlement in the medieval period (Roulston 2000, 12).





The modern
 Dunalong townland.



PROJECT:
 Dunalong geophysical
 survey 2012

TITLE:
 Dunalong and the
 surrounding townlands

FIGURE:
 2

The strategic importance of Dunnalong itself may have had similarly early origins. Roulston suggests that the aforesaid Archbishop Coulton may very well have crossed the Foyle by ferry at Dunnalong in the 14th century (*ibid.* 10), and the ferry became a pivotal feature of the Dunnalong cultural landscape, at least up until the 1920's when the service was discontinued. Dunnalong was therefore an important maritime site on the Foyle for a number of centuries. The name of the townland itself evokes one particular period of seafaring activity, and there is a strong local tradition of Viking settlement at Dunnalong. Dunnalong can be translated as the 'Fort of the Ships', and the 'Long' element in the placename in particular may relate to a fortified Viking settlement or Longphort. Perhaps adding to the suggestion of a Norse presence, souterrains discovered at nearby Ballybeeney (Tyr 002:025) and Cloghboy (Tyr 001:003) have been highlighted as places of refuge in times of unrest (Roulston 2000, 8), and it is recorded that Vikings burned Derry in 812, while in 832, they suffered a reversal at '*Doire Calgaigh*' at the hands of Niall Caille and Murchadh (O'Donovan 1856 at AD 812 and 832). However, as in most of Ulster, material evidence of a Viking presence in the area remains elusive.

1.5 *Turlough Luineach O'Neill and Dunnalong Castle*

The rise to power of the O'Neill Lordship in north-west Tyrone heralded perhaps the most significant phase in the history of Dunnalong. Previously forming part of the lands of the Cenel Moan, and before that the Ui Mhic Cairthinn, the Dunnalong area had fallen under the control of the O'Neills in the 16th century. In 1567 Turlough Luineach O'Neill rose to the chieftaincy of the lordship and almost immediately set about bolstering his position. Dunnalong was at the centre of his plans; it represented Turlough's only outlet to the sea, was already the established site of a ferry crossing and was a frontier outpost, bordering both the O'Donnell territory across the Foyle in Donegal, and the O'Cahan lands further north in Derry.

In 1568, Terence Danyall, the then Dean of Armagh wrote to Lord Justice Weston that 'Turlough Luineach is fortifying Dunnalong, a new castle on this side [of] Lough Foyle' (Calendar of State Papers 1509-73, 369). It quickly became apparent that the new lord of the O'Neills intended to make this his permanent base, as again testified by Danyall, who stated in a follow-up letter that 'Turlough Luineach abides always at Dunnalong by Lough Foyle and builds there a strong fort' (*ibid.* 374). It is not clear whether this was an entirely new construction, but the use of the phrase 'fortifying Dunnalong' suggests there may have been an earlier, no doubt smaller structure at Dunnalong before this. There are no cartographic depictions of Turlough's castle when complete, or any detailed description, but it most likely took the form of the ubiquitous Gaelic tower house which was the typical stronghold of the Irish chieftain, possibly as far back as the 14th century (O'Keefe 2000, 45)(Plate 1). It is likely that this O'Neill castle was the focal point of activity at Dunnalong in the second half of the 16th century.

In addition to the other factors mentioned above, the choice of Dunnalong for Turlough's premier stronghold may have owed something to the site's history as a landing place for Scottish mercenaries (Hayes McCoy 1937, 101) and the Chieftain's desire to bolster his own forces with their number. At the same time as he was fortifying his castle, Turlough married Lady Agnes Campbell, the aunt of the then Early of Argyle, in an attempt to cement alliances with the Scottish lords and secure a reliable supply of mercenaries. Dunnalong was the first

of Turlough's castles, and was initially his most important. There is documentary evidence to suggest that life at Dunnalong Castle was not always peaceful. The Annals of the Four Masters Report that, in 1570, MacSweeney of Fanad and McSweeney-na-dtuath were killed at Dunnalong in the presence of O'Neill and his mercenaries (O'Donovan 1856 at AD 1570). In March 1590, during a dispute with Hugh O'Neill over the supremacy of the O'Neill lordship, Turlough wrote a letter to Queen Elizabeth complaining that Dunnalong had been burned by Hugh, along with three of his other forts (Calendar of State Papers 1588-1592, 327).



Plate 6. Example of a typical Gaelic tower house, from Quin, Co. Clare.

The internecine power struggle with Hugh O'Neill was one which Turlough would eventually lose. In 1593, Hugh became undisputed chief of the O'Neills and located his powerbase at Dungannon. Turlough died in 1595, leaving his son Airt in charge of his lands, including Dunnalong.

1.6 *English fortification at Dunnalong*

By the end of the 16th century, Ireland was in the grip of a fierce conflict between English Crown forces and a confederacy of bellicose Gaelic chiefs under the command of Hugh O'Neill. At the start of this 'Nine Years War', the English suffered a succession of humiliating defeats, principally in the east and centre of Ulster. As part of a new strategy in 1600, a fleet of English warships and transport under the command of Sir Henry Docwra was sent from Dublin to Lough Foyle. The intention of the English was to create a second front in the conflict, thus dividing the Irish forces. Docwra kept his own exhaustive journals of the campaign. In May 1600 Docwra landed in Culmore, to the north of Derry, with, in his own words an 'army consisting of over 4000 foote and 200 horse', before taking the town itself on 22nd May (Kelly 2003, 42). As part of the English strategy, Docwra contacted a number of the local chiefs who had become disaffected with Hugh O'Neill's leadership, and he found in

Airt O'Neill a complicit ally. Thus on 1st July 1600, 800 English troops sailed from Derry to Dunnalong, to be followed the next day by their commander.

The English immediately set about strengthening the defences at Dunnalong, utilising the fortification techniques Docwra had seen used effectively during campaigns in the Low Countries. The entire site was enclosed by a defensive earthen bank, surrounded by a ditch. A number of contemporary depictions of the fort survive, and provide a consistent picture of the nature and extent of the English construction. Two depictions, probably both by Robert Ashby and dating to 1600, show the Dunnalong fort in the context of Docwra's other fortifications in the Foyle valley. In both images, Dunnalong is shown as a large fortification on the banks of the Foyle, of comparable size to Derry and defined by a curtain and four full pointed bastions military fort)(National Library of Ireland, MS 2656, No. 16) (Hereinafter called 'Map 1' and 'Map 2')(See Figure 3a and 3b). On Map 2, an additional line of defence, marked by a fortification with three bastions is shown to the east of the fort.

These maps were enclosed with dispatches sent by Docwra to Robert Cecil on 19 December 1600. Accompanying them was a more detailed depiction of the Dunnalong fortifications (labelled 'Dounalong') (Public Records Office of Northern Ireland 1493/37) ('Map 3'. Figure 4). Usefully, many of the features shown on this third map are labelled and described in an accompanying key, and this is reproduced for the sake of clarity with Figure 4. The fort is this time shown with an additional, fifth bastion, and again all of the corners appear to form full bastions. The defences enclose a rectangular moated area, within which stands the ruins of the tower house, and the garrison commander's quarters. Two canon are shown guarding the entrance to the inner enclosure. The fort contains a number of cabins, while a 'great brewhouse' stands on the banks of the Foyle (NB. In one of the most common reproductions of this map – McGurk 2006, at page 73 - the brewhouse is mistakenly labelled 'bakehouse'). Outside the fort, to the east of the fort is a cluster of huts which are protected by a trench, the line of which is punctuated by a series of angular bastion-type protrusions

Probably the most detailed of the contemporary drawings of the fort itself is by Griffin Cocket (Public Records Office of Northern Ireland T1668/14) ('Map 4'. Figure 5). This depiction shows 'Donalong' as a formidable installation with four full bastions, two of which are armed with canon, and with the brewhouse standing on the banks of the Foyle. The Gaelic O'Neill castle is again shown in a rectangular moated area within the fort, fed by a channel from the Foyle. The castle is shown in a ruined state. Also within the moat is the house of the garrison commander. Elsewhere within the fort there is a series of cabins, mainly arranged in broadly symmetrical rows, while a market place lies at the centre of this streetscape. The image also contains a scale, in roods. While there is no north arrow to properly orient the image, using the Foyle as a fixed point, this image suggests that the fort measured approximately 205m north-west/south-east by 201m north-east/south-west. The large size of the fort suggested by this image is consistent with its portrayal in Maps 1 and 2 as being of similar size to Derry.

A number of the features of the fort as depicted on these maps warrant mention. The Four Masters recorded of the English that, 'After landing they erected on both sides of the harbour three forts.....Dubn-na-long was erected on O'Neill's part of the country.'(The other two forts they referred to were Derry and Culmore). 'The English immediately commenced sinking ditches around themselves and raising a strong mound of earth and a large rampart, so that

they were in a state to hold out against them. They were stronger than the Courts of lime and stone in the erection of which much time and labour may be spent' (O'Donovan 1856 at 1600). It seems therefore that there was contemporary recognition that earthwork defences, with their ditches, banks and bastions, were superior to stone castle in terms of military value. It was also a quicker and more straightforward exercise to construct these types of site in what was a hostile environment.

The stone O'Neill castle itself appears to have been raised prior to the arrival of the English and is said to be 'no more than the remains of the walls with a four square ditch filled with water out of the stream' (See table reproduced in Figure 4). The destruction of the castle may have been part of the deliberate strategy of the Irish to ensure that their own fortifications were of no use to the English, although this would seem to be at odds with Airt O'Neills' attitude to the invaders. Docwra utilised the moat to protect his garrison commander, and, when he himself returned to Derry, he left his second in command, Sir John Bolles, in quarters on the grounds of the castle.

Prominently featured on all of the depictions of Dunnalong is a large brewhouse, standing on the shore of the Foyle but within the fort. Production of beer to supply the rations of the soldiers was an important function of Dunnalong Fort in the Foyle campaign, and its produce was ferried from there to the main camp in Derry; water borne disease was a constant hazard for troops in camp in the 16th and 17th centuries, so a store of weak beer as an alternative helped to assuage their hardships. The brewhouse was built in October 1600 from 2000 deal boards supplied by one Newcome. The many cabins depicted on the map probably served as living and sleeping quarters for the garrison, and were almost certainly also constructed of wood.

The contemporary depictions show an empty space at the centre of the cabins, and this is labelled 'The Market Place' on Map 4 (Figure 5). Muster records suggest that, at the height of its strength, Dunnalong was home to over 1000 soldiers (Roulston 2000, 23), so it was inevitable that they would attract trade and merchants. The market place was, in all likelihood, where much of the commercial activity took place. Indeed Roulston suggests that the merchants may have had an almost permanent attachment to the fort. Both Maps 2 and 3 show a cluster of huts beyond the main walls of the fort, but enclosed by a secondary, less impressive defence. These were labelled on Map 3 as being 'strong enough having the bog about them and a trench cast up for their safety'. Roulston considered these may have been the quarters of the merchants, or else the native Irish followers of O'Neill (*ibid.*).

Another noteworthy feature depicted on these maps is the presence of two canon. Griffin Cocket shows one each of these in the south and east bastions, while on Map 3, they are shown guarding the entrance to the interior moated enclosure containing the old castle and the garrison commander's quarters. There is scant record elsewhere of the use of the Dunnalong artillery, although an inventory of ordnance in the Foyle region dated 30th September 1611, lists a single saker (a type of medium size gun) at Dunnalong (Carew MSS 1603-1623, 95). The whereabouts of the Dunnalong guns are unknown, although there is a local tradition that one is buried somewhere in the townland (D. Jameson 2012. pers. comm.).

The scale of the Dunnalong encampment suggests it was intended to play a major role in the campaigns in north-west Ulster, and a number of significant events were recorded there in the early years of the 17th century. In March 1601, the elderly Catholic Bishop Redmond O'Gallchobhair was cornered and slain by Bolles, the commander of the Dunnalong garrison, possibly near the fort itself (McGurk 2006, 107). The Bishop was an influential figure in Irish-Spanish alliances at that time and was considered a significant enemy of the English Crown. The early months of 1601 saw a number of minor skirmishes at the fort itself, culminating in May of that year. Then, a force of confederate troops, led by Hugh O'Neill himself, were on their way to launch a raid on Dunnalong when they were set upon by a combined force of English troops, under one Captain Windsor, and their Irish allies, led by Niall Garbh O'Donnell. The confederates were further attacked by the Dunnalong garrison itself and suffered heavy losses during their withdrawal and retreat, with some 300 of O'Neill's soldiers being killed and the Earl himself only narrowly escaping death. Following this reversal the confederacy left Dunnalong and the other major English installations on the Foyle, largely untroubled.

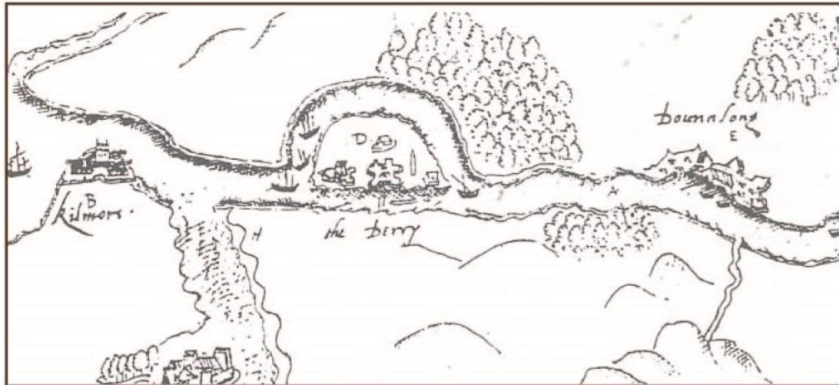
The course of the Nine Years War turned rapidly against the confederacy with their defeat at the Battle of Kinsale on 24 December 1601, and the conflict formally ended with the Treaty of Mellifont in 1603. The importance of Dunnalong, along with most of the other English forts in the north-west, dwindled thereafter as, without the particular circumstances of the war with the Gaelic lords it had no real strategic significance to the English. The fort was abandoned in 1603 (Roulston 2000, 26) before being regarrisoned with a small ward of ten men under Sir John Vaughan in 1607 in the wake of the Flight of the Earls. This was a nominal effort by the Crown to prevent an escalation of unrest resulting from the sudden lack of leadership amongst the native Irish. The success of this tactic was limited and, in the face of Cahir O'Doherty's minor rebellion of 1608, Vaughan and his Dunnalong ward withdrew to Lifford. A survey of Dunnalong Fort in the same year carried out by Bodley showed it to be in poor repair:-

'The great entrenchment at Dunalonge is more fitt to be raised than repaired, but the peece of ground within the same neere the river, which is held by the ward, having no other defence but a deepe and broad ditch about it at this time, if it were sufficiently walled on the inside of the ditch, which considering the stone at hand, and the small circuit of the place, will not cost above 150li [£]. I shoulde it of good strength for a ward of 10 or 12 men, and capable of more if neede required' (Buckley 1910, 63).

The lack of efficacy of the reduced garrison in the face of the 1608 rebellion, combined with the lack of any genuine resurgence in the power of the Gaelic lords, and the cost of maintaining a military presence there, sealed the fate of Dunnalong and many of the other Foyle fortifications as genuine military installations. The English Lord Deputy, Sir Arthur Chichester, ordered that some of these sites (including Dunnalong), should be granted out to private individuals.



3a Map 1



3b Map 2

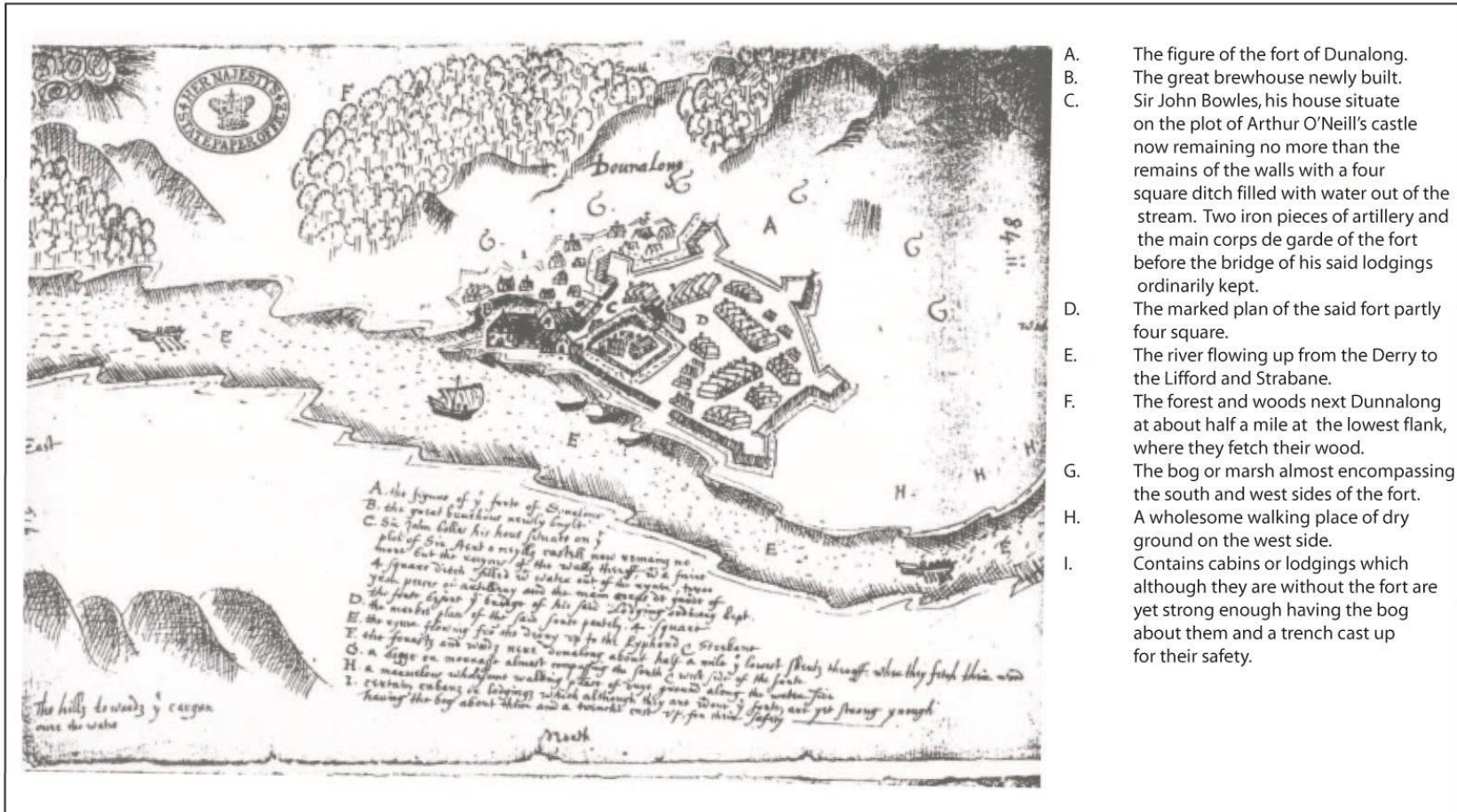
Two depictions of the Foyle fortifications including Dunnalong, c.1600, probably both by Robert Ashby. On both Dunnalong is shown as of comparable size to Derry.



PROJECT:
Dunnalong geophysical
survey 2012

TITLE:
Contemporary Maps 1 and 2

FIGURE:
3



- A. The figure of the fort of Dunalong.
- B. The great brewhouse newly built.
- C. Sir John Bowles, his house situate on the plot of Arthur O'Neill's castle now remaining no more than the remains of the walls with a four square ditch filled with water out of the stream. Two iron pieces of artillery and the main corps de garde of the fort before the bridge of his said lodgings ordinarily kept.
- D. The marked plan of the said fort partly four square.
- E. The river flowing up from the Derry to the Lifford and Strabane.
- F. The forest and woods next Duninalong at about half a mile at the lowest flank, where they fetch their wood.
- G. The bog or marsh almost encompassing the south and west sides of the fort.
- H. A wholesome walking place of dry ground on the west side.
- I. Contains cabins or lodgings which although they are without the fort are yet strong enough having the bog about them and a trench cast up for their safety.

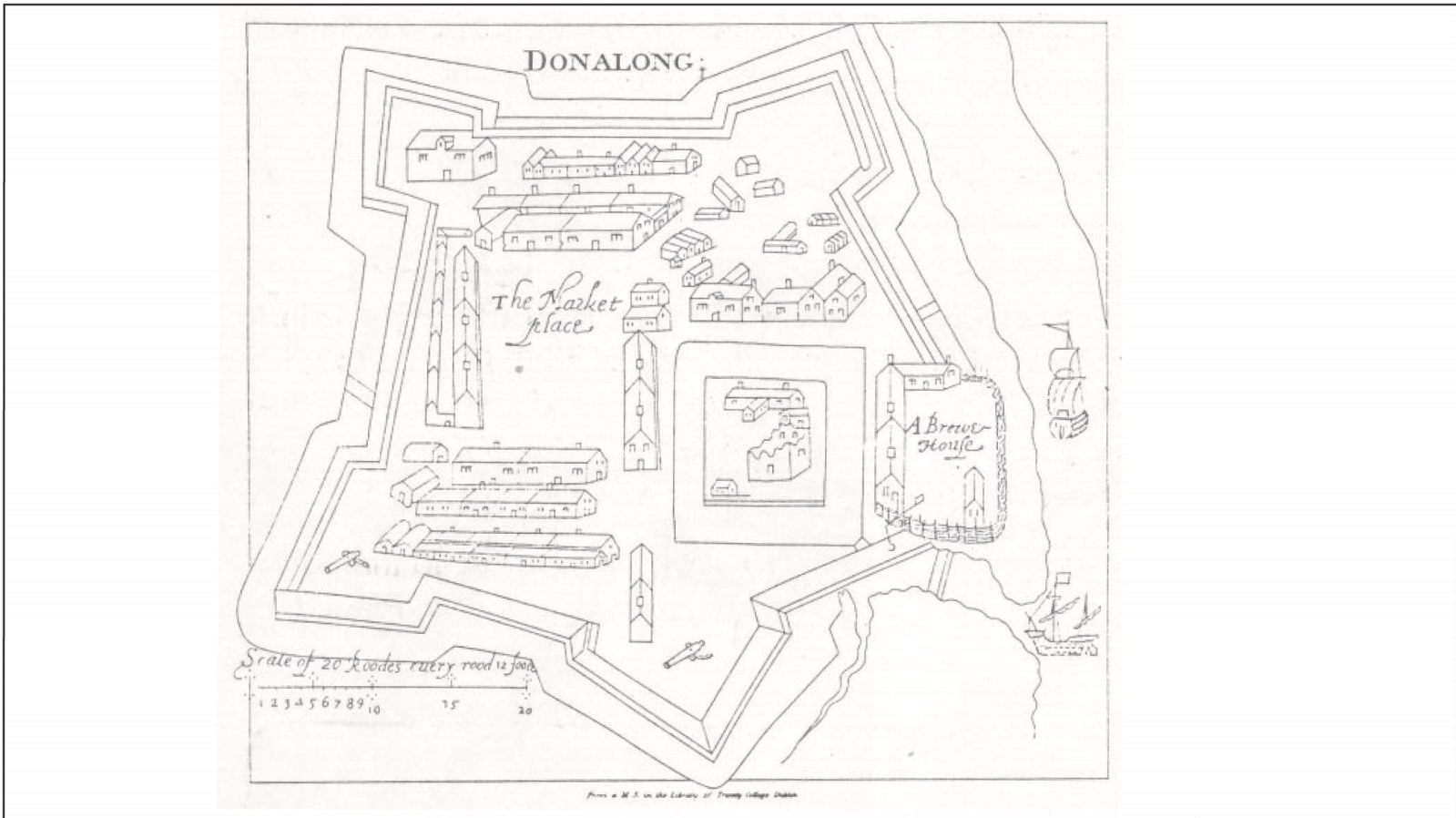
Map of Duninalong ('Dounalong') c.1600.
(Key to the map is reproduced above right).



PROJECT:
Duninalong geophysical
survey 2012

TITLE:
Contemporary Map 3

FIGURE:
4



Map of Dunnaalong Fort ('Donalong') c.1600.



PROJECT:
Dunnaalong geophysical
survey 2012

TITLE:
Contemporary Map 4

FIGURE:
5

1.7 *Dunnalong in later history*

As part of the formal Plantation of Ulster in the early 17th century, the manor of Dunnalong was included in a large grant of territory to The First Earl of Abercorn. At that stage, the entire area was estimated to contain over 2000 acres. Under the conditions of the grant, a fortification, to consist of a 'stone house with strong court or bawn' was to be built to protect the new settlers. By this time, the site of the fort was no longer the focal point of the larger Dunnalong territory, although interestingly, the grant did contain formal provision for the continuation of the ferry route. When the progress of the plantation was reported by Pynnar in 1618, he pointed out that there was 'neither Castle nor Bawne at Dunnalong', confirming both that the old fort was no longer regarded as a viable fortification and that work on a newer stronghold had not yet begun. A second report on the progress of the plantation, dating to 1622 recorded the presence of a castle within the Dunnalong territory, but this new structure was located at Mountcastle, over 6.5km to the south-east of the old fort site. Thereafter, the military significance of the old Dunnalong site faded into memory.

The Civil Survey of the 1650's mentioned the grant of a small parcel of land containing just over 3 acres at Dunnalong to a Michael Marshall. This area probably forms the core of the modern townland, where Dunnalong Farm and the survey site are located. Of interest is that the property at the time supposedly contained a house, garden and maltbarne. The reference to the latter seems to suggest that the brewing activity begun during Docwra's brief occupation of the lands may have endured for some time in the townland (Roulston 2000, 42-43).

1.8 *Cartographic evidence*

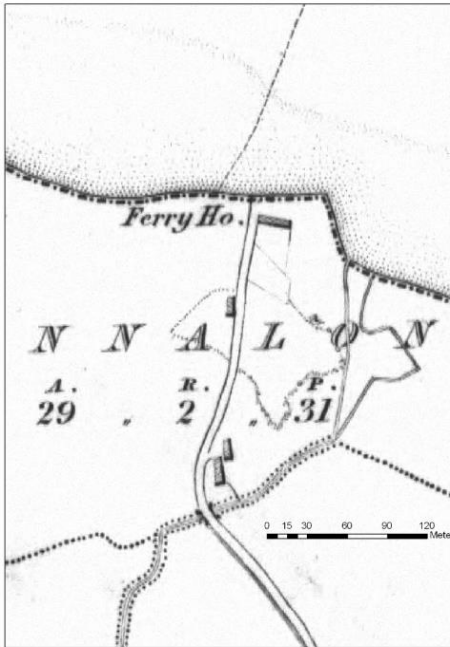
While the strategic importance of the fort site may have declined after 1608, there is some evidence to suggest that the remains were visible for some time afterwards. The 1st edition 6-inch Ordnance Survey (OS) map of Dunnalong from 1833 shows the outline of a fort clearly marked (Fig 6a). It appeared as a subrectangular area, measuring 108m north-west/south-east by 92m north-east/south-west with four irregular, unmatched bastions, and was located in two fields bisected by the Dunnalong Road. The largest portion of the fort lay to the east of the road. In this field, the northern, eastern and southern bastions were shown, although the northern bastion appeared to be both truncated by the road, and partly incorporated in early field divisions. The eastern bastion was shown as a broad, curved protrusion that may have been the damaged remains of a full bastion, while the southern bastion was much smaller, with a more elegant curvilinear profile that may again have been intended to represent the remains of a full bastion. To the west of the road, the western bastion had a flattened, angular appearance, possibly depicting a demi-bastion. On the whole, therefore, the fort appeared somewhat asymmetrical and unbalanced.

Two interesting features were shown to the east of the eastern bastion, and both appeared to extend from the edge of a stream that meanders to the south of the fort. Closest to the edge of the fort was a linear channel which ran almost directly northwards from the stream and passed within metres of the edge of the eastern bastion. The second feature extended from the same point of the stream on a north-eastern course, but expanded eastwards to

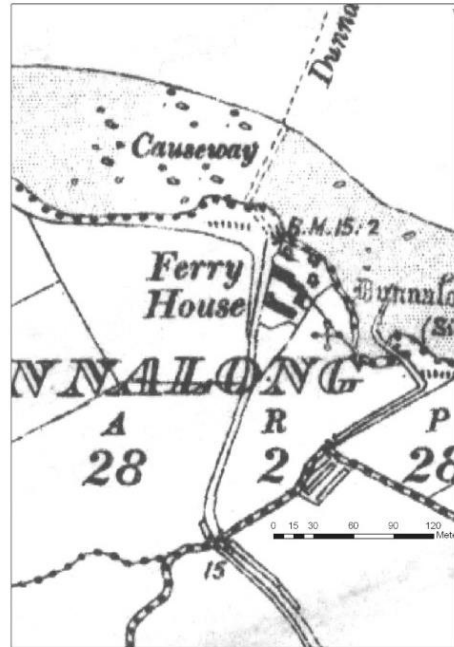
form the shape of an external bastion, mirroring the form of the eastern bastion of the fort, before continuing into the Foyle. As they both originated from the stream, it is probable these features were filled with water. The more eastern feature strikingly took the form of a defensive bastion, and it seems certain to have formed part of the English military site. It is likely that it marked the line and position of the 'trench cast up' for the safety of the settlement outside the fort described in the key to map 3 (Figure 4) and that is depicted on both Maps 2 and 3 (Figures 3a and 4). This would therefore imply that the settlement was located somewhere between the eastern bastion and this feature. The striking linear course of the channel between the two bastion shaped features suggests this may be a later addition, postdating the military use of the site.

There was no 2nd edition map of the Dunnaalong area available for inspection for this report but, by the time of the 3rd edition OS map of 1905, the outline of the fort was no longer visible, and the location was marked 'Dunnaalong Fort (Site of)' (Figure 6b). This suggests that some levelling or infilling of the remains took place in the years between the two maps. By this stage, the farm buildings of Dunnaalong Farm had been built, broadly in the position of the northern bastion of the fort shown on the 1st edition map. The linear channel shown immediately to the east of the fort on the 1833 map was no longer visible, but the stream continued along the line of the outer, bastion-shaped channel. All of the field boundaries that are visible today were shown from this period, and appear to have altered little in the interim. The 4th edition depiction of 1951 is largely identical to the previous map (Figure 6c).

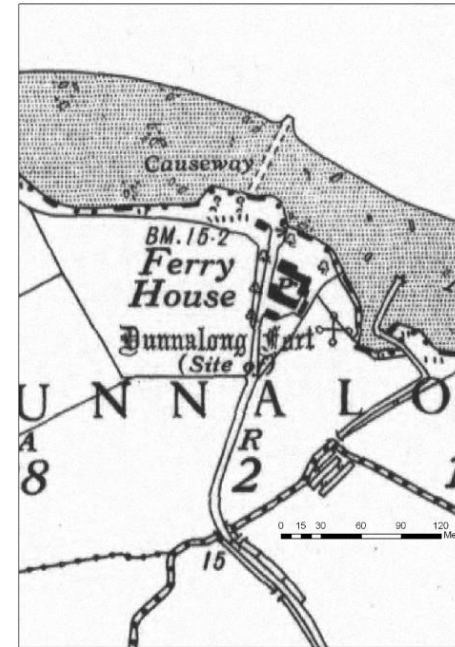
Comparison between these maps and an aerial photograph from 2010 shows only minor development in recent times affecting the fort site, although there has been some alteration in the farm buildings (Figure 7). Within the surrounding fields, the angular bastion-shaped watercourse has been straightened and is no longer visible; Rather than curving northwards, the course of the stream now continues on a starkly linear north-eastern course into the Foyle.



(a) First edition map (1833)



(b) Third edition map (1905)



(c) Fourth edition map (1951)

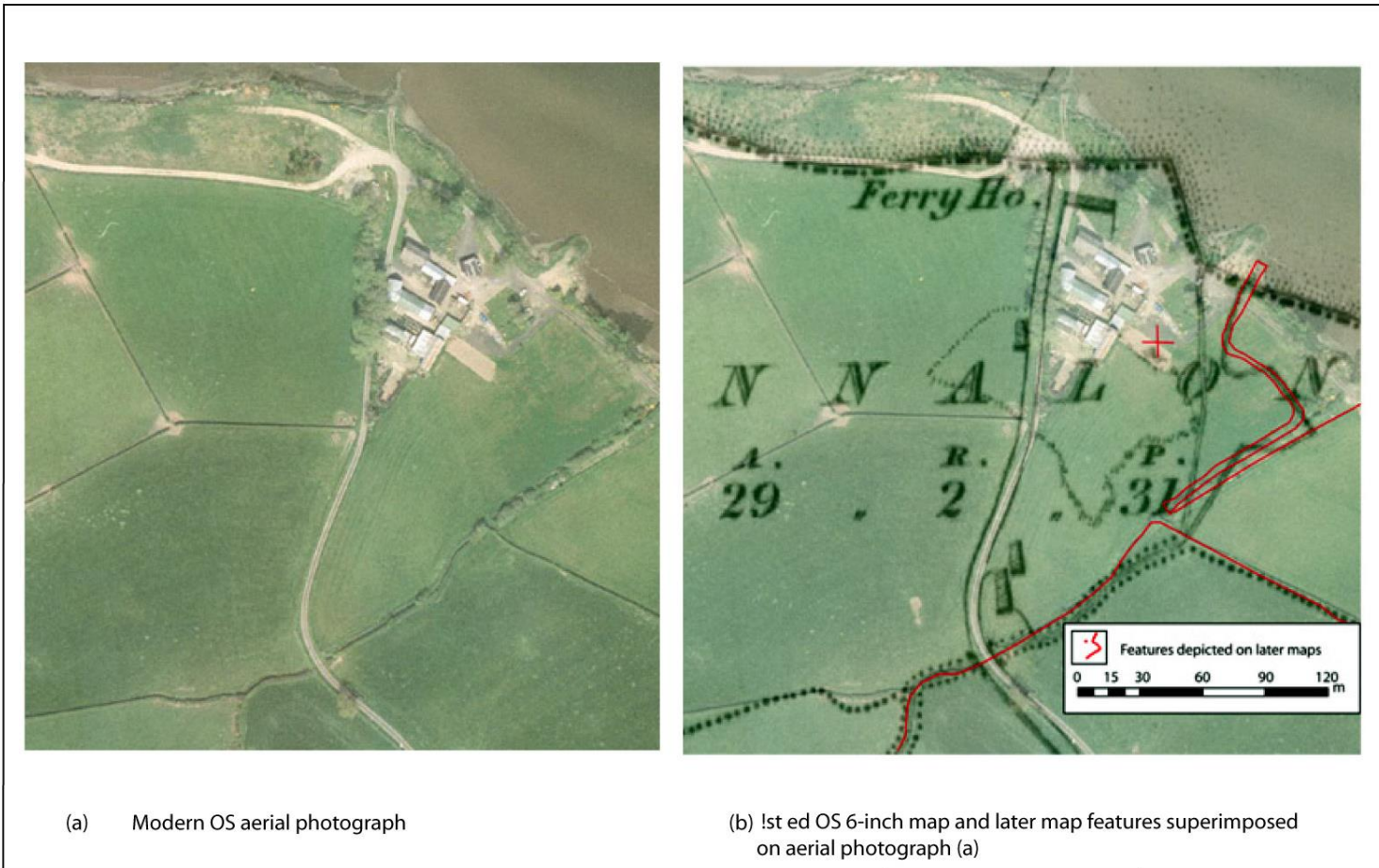
Historical 6-inch Ordnance Survey map representations of the surey area depicting the change in the site since the first survey of 1833. The fort is clearly marked on the first edition map, but thereafter is marked 'Dunalong Fort (Site of)'.



PROJECT:
 Dunalong geophysical
 survey 2012

TITLE:
 OS maps showing survey
 site

FIGURE:
 6



(a) Modern OS aerial photograph

(b) 1st ed OS 6-inch map and later map features superimposed on aerial photograph (a)

(a) (above left) is a modern Ordnance Survey aerial photography image of the survey area. (b) (above right) superimposes the relevant section of the 1833 OS 6-inch map, as well as salient features from the 1905 and 1951 maps, on the aerial image, to depict the location of these features, including the outline of the fort, in the modern landscape.



PROJECT:
 Dunalong geophysical
 survey 2012

TITLE:
 OS map features
 superimposed on modern
 aerial photograph

FIGURE:
 7

2. The Survey

2.1 *The survey area*

The Survey was carried out in two fields attached to Dunnalong Farm belonging to a local farmer, Dougie Jameson (Figure 8). Dunnalong Farm is the centre of the holding, and consists of a cluster of modern buildings and probable 19th-century outhouses separated from the shoreline by a modern laneway. A small parcel of land immediately to the east and south-east has been fenced off into animal paddocks. The farm buildings may formerly have been closer to the shore, as much of the frontage has been built up in relatively modern times. Comparison between the 1833 OS 6-inch map and the modern shoreline has led Rory McNeary of the CMA to suggest that a strip of land over 20m wide along the shore may be reclaimed (R. McNeary 2012, pers. comm.). A cursory inspection of the shore today reveals that modern debris has been used to elevate the ground surface above the level of the Foyle. Dunnalong Road extends south-westwards from the farm, and the two targeted fields lie on either side of the road. Field 1 is to the north-west of the road, and is an angular, diamond-shaped plot bounded on all sides by hedgerows and wire fences. The topography of the field is generally flat, although an area at the south-east is slightly mounded. The field is currently used for pasture. The areas around the gates at the north, west and south-east of the field were boggy and waterlogged at the time of the survey.

Field 2 is to the south-east of the road. The extreme northern part of the field was not surveyed as a section of this area immediately adjacent to the farm is used for the paddocks, while within the field itself, dense growths of rushes made geophysical survey impossible in a small area. This area is prone to waterlogging, and has been built up artificially on a number of occasions in recent years to make the land agriculturally viable (D. Jameson 2012, pers. comm.). A stream runs along the south-east of the field, emptying into the Foyle at the north-west of the site, and forms the field boundary on this side. This stream coincides with the stream shown on the OS maps listed above for most of its course, but the north-eastern end has been straightened in recent times, removing the characteristic angular, bastion-shaped bend shown on the maps. A wire fence follows the line of the stream inside the field. This stream may be the remains of the once-broader channel depicted on the contemporary maps of the fort. The northern part of the field is bordered by the edge of the farm itself, while the Dunnalong Road skirts around the remainder of the field, and is separated from it by a low hedgerow. The field is relatively level, although there is a gradual but appreciable slope down towards the stream. Like field 1, this area is currently used for pasture.

When the site was visited by NIEA in 1987, the presence of a cobbled bridge over the stream was recorded (Foley 1987, unpaginated), but this is no longer visible and was probably removed when the stream was redirected. A rectangular mound visible at this stage was speculated to be the site of the original O'Neill castle (*ibid.*). This was supposedly located broadly in the area of field 2 which was fenced off from the 2012 survey area. Some masonry fragments from the Gaelic castle remain at the site; two splayed window or door quoins are incorporated as basal stones in a doorway of one of the farmbuildings. A rolled moulding, probably from a decorative arch, that was recovered from the shorefront now lies in front on an old shed along the Dunnalong road (Plates 2 and 3).



The 2012 survey area, showing the location and extent of the survey area (fields 1 and 2) and Dunnaalong Farm.



PROJECT:
Dunnaalong geophysical survey 2012

TITLE:
The Survey Area

FIGURE: 8



Plates 2 and 3. Masonry fragments, probably from the O'Neill castle. Plate 2 (above) depicts one of the splayed quoins, incorporated at the base of the modern farmhouse door. Plate 3 (below) shows the rolled arch moulding.



2.2 *The geophysical survey*

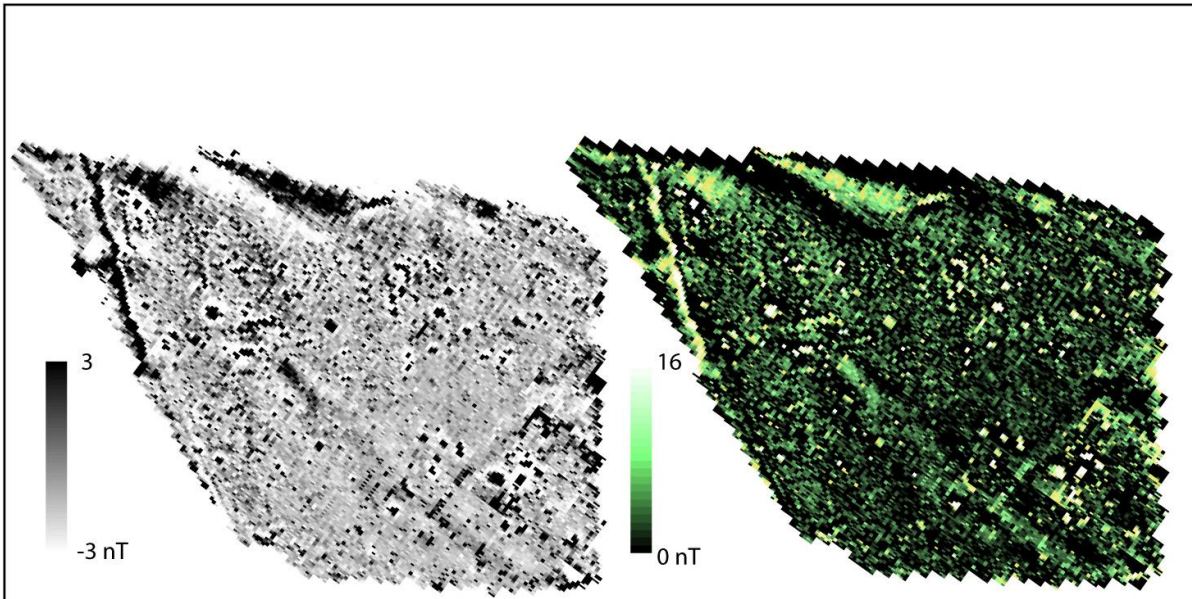
Two geophysical techniques were employed, in two phases of survey. The techniques used were magnetometry and electrical resistance. A simplified introduction to both techniques is supplied at Appendix 1 of this report. A list of the equipment used, technical specifications and survey parameters is provided at Appendix 2.

Phase 1 of the survey consisted of magnetometry survey of field 1, complimented by a resistance survey of field 2, to ascertain the comparative benefits of each method for this site. The magnetometry survey proved to be the more successful, so the priority for Phase 2 was a full magnetometry survey of field 2. These results were then bolstered by a high definition resistance survey in the same field, carried out while excavation was undertaken in field 1. This section of the report presents tabulated results and interpretation of the surveys. Table 1 details the findings of the magnetometer survey in field 1, and is to be read in accordance with Figure 9, which contains graphic depictions of the survey results and an interpretative diagram. Table 2 and Figure 10 similarly detail the results of the magnetometry survey of field 2, while Table 3 and Figure 11 present the results of the high definition resistance survey of field 2 (NB the results of the initial resistance survey of field 2 are not separately included as they do not add to the results shown in table 3). A discussion of the results from all of the surveys is presented in Section 3 below.

Table 1. Results of magnetometry survey in field 1 (See Figure 9).		
Anomaly	Description	Interpretation
m1.1	Stripe of fluctuating dipolar readings, up to 10m wide, extending for 130m along the northern boundary of the field.	Probably a response to wire fence and other ferrous debris deposited in the hedgerow along the northern field boundary.
m1.2	Angular anomaly formed by three linear arms of strong, clearly imaged, magnetic readings. Maximum measurements of approximately 45m north-east/south-west by 38m north-west/south-east, although it extends beyond the south-east boundary of the field. The 'arms' of the anomaly are, on average 2-4m wide, although the western arm is up to 8m wide in places as it merges with the line of anomaly m1.12	<p>This anomaly images the western bastion of Dunnalong Fort. The perimeter is clearly defined, although the strength of the anomaly varies along its course. Best interpretation of this is that the fort is formed by a ditch, the fill of which varies in magnetic character at different places around the perimeter.</p> <p>Excavation of Trench 1 confirmed that a ditch, almost 2m deep and up to 6m wide, was responsible for this anomaly and constituted the outer defences of the fort.</p>
m1.3	Localised zone of strongly dipolar magnetic readings. Measures approximately 14m north-east/south-west by 9m north-west/south-east.	<p>The anomaly suggests the location of significant burning. Possibly this was the site, within the fort, of small scale industrial activity such as ironworking, or else may represent burnt structures.</p> <p>Excavation of Trench 3 revealed the presence of 2 probable stages of post-built structures in this area. Some evidence of burning was revealed.</p>
m1.4	Series of broadly parallel and perpendicular linear trends towards the west of the field. Maximum lengths are approximately 9m north/south by 15m east/west, with the overall area measuring approximately 30m north/south by 20m east-west.	These are not well defined individually, but taken together are not inconsistent with the poorly preserved remains of a wooden structure or structures. These might be buildings outside the defences of the fort, or else belong to a different period. Readings could alternatively be caused by debris in the field.

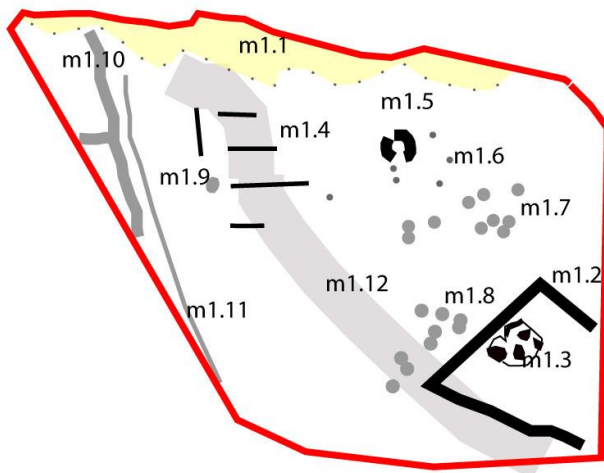
m1.5	Two opposing semi-circular arcs of significantly dipolar signals. Taken together they form a circular anomaly with diameter of approximately 8m.	Strength of the anomalies indicates the feature imaged by these readings may be formed of a ditch filled with burnt material. Shape and dimensions suggest it may be a prehistoric ring ditch.
m1.6	Cluster of at least 6 amorphous dipolar anomalies surrounding m1.5.	These may be areas of burning associated with the ring ditch. More likely these are simply ferrous objects dropped in this area, similar to the nearby grouping m1.7.
m1.7	Broadly linear scatter of magnetic spikes to the north of the fort, stretching for approximately 40m.	Most likely ferrous debris and objects scattered in the field. The linear pattern may mark the former presence of a wire fence, or else may be due to a ploughing direction.
m1.8	Grouping of magnetic spikes immediately outside the fort to the north-west and stretching for approximately 25m.	Given the presence of similar anomalies throughout the field, it is probable that these are simply a scatter of ferrous objects. However, the distribution is broadly parallel to the wall of the fort, and consistently at a distance of between 5-7m from it. It is possible that these spikes relate to the fort, possibly debris from an attack or a fence or barrier.
m1.9	Subcircular dipolar spike with a diameter of approximately 5m towards the west end of the field	The readings forming this anomaly are amongst the highest in the field. Their strength and the good definition of the anomaly suggest this may be an industrial feature, such as a kiln. There are two peaks in this anomaly, which again suggests a kiln. It is close to the linear readings forming anomaly m1.4 and may be related to them.
m1.10	Very strongly magnetic linear anomaly along the north-west edge of the field.	Strength and definition of the anomaly suggests it is of relatively recent date. It may be an earlier alignment of the modern field boundary, although no such realignment is obvious from the OS maps.

m1.11	Linear anomaly of moderate magnetic strength along north-west edge of the field.	Modern pipe trench or drain.
m1.12	Broad curvilinear band of varying magnetic signals extending north-west from the south-east edge of the field for over 100m. It is up to 10m wide in places.	Most probably an old channel, it appears in field 2 as anomaly m2.13. Varying magnetic signals are characteristic of differential silting up. However, it does coincide with the western edge of the fort, offering at least the possibility that it is in some way connected with the defences of the fort.



(a) Greyscale plot

(b) Colour plot



(c) Interpretative Diagram

Key (for interpretative diagram 9c only)

- Archaeology: Dunalong Fort
- Archaeology: Burnt structure
- Archaeology: Ring ditch?
- Magnetic spikes
- Archaeology? Linear trends
- Natural feature
- Magnetic disturbance

0 5 10 20 30 40 Metres

Magnetometry survey results field 1.



PROJECT:
 Dunalong geophysical
 survey 2012

TITLE:
 Magnetometry survey
 results - field 1

FIGURE:
 9

Table 2. Results of magnetometry survey in field 2 (See Figure 10).		
Anomaly	Description	Interpretation
m2.1	Zone of strongly fluctuating dipolar readings, extending 80m south-westwards from the north-east edge of the survey area. For most of its area, the zone is confined to a strip, approximately 20m wide on the banks of the stream, but, towards the north-east edge of the survey area, it appears to extend up to Dunnalong Farm.	Readings caused by modern and regular deposition of landfill material containing ferrous debris. Analogous with r1. Excavation of Trench 2 demonstrated that modern metal debris and tarmacadum made up some of the content of the landfill deposit.
m2.2	Zone of dipolar magnetic readings visible in an arc for approximately 63m along the north-west perimeter of the field.	Responses to the metal gate and fencing in this area.
m2.3	Zone of very low magnetic readings along the edge of the stream.	Very low readings are probably due to flooding and consequent washing of ferrous minerals out of soil.
m2.4	Angular feature defined by sharply imaged, strongly magnetic readings, which extends 50m south-westwards from the entrance to the field before turning north-eastwards for another 57m. After this point it coincides with the zone of disturbance m2.1, and is more difficult to discern. The anomaly is up to 5m wide in places, but generally varies between 1-2m	This anomaly clearly defines the southern bastion of Dunnalong Fort, formed by a filled ditch. The strength of the magnetic signal suggests infill with material significantly different to the surrounding soil, particularly along the western side. The perimeter of the fort is impossible to definitively trace within the zone of disturbance, and is probably defined by the border with the disturbed zone. Overall, the bastion as imaged presents a similar shape to the less clear resistance anomalies r2 and r2a (Table 3) which in turn broadly replicate the depiction of the fort on the 1 st edition OS 6-inch map.
m2.5	Group of 7 dipolar magnetic spikes arranged in a broadly rectangular pattern over an area measuring approximately 12m north-west/south-east by 9m north-east/south-west.	The dipolar nature of these anomalies suggests they image metal objects or else features that have been subjected to burning. Given the regularity of the pattern they form, and their position within the bastion, they are not inconsistent with the

		remains of a wooden structure, possible one where the posts have been destroyed by fire.
m2.6	Localised zone of increased magnetic signals at north of survey area, measuring 20m north-west/south-east by at least 8m north-east/ south-west.	Signals correspond with enhanced magnetic susceptibility of soil at this location, possibly an indication of an area of occupation. Anomaly coincides with resistance anomaly r11, so probably represents the site of a structure. The location is not far from the probable site of the O'Neill castle and the English brewhouse, but cannot be confidently associated with either at this stage as it lies on the very edge of the survey.
m2.7	Linear band of massively dipolar readings ($\pm 100\text{nT}$ in places), and up to 9m wide within zone m2.1.	Although it is largely obscured by the signals from the surrounding landfill zone, the location and line of this anomaly suggest that it represents a response to the angular, bastion shaped feature shown on the 1833 OS 6-inch map, which was preserved in some form on both the 1905 and 1951 maps. This feature was almost certainly part of the original defences of the English fort.
m2.7a	Angular magnetic stripe across north edge of the survey area.	Although this may be an extension of the landfill signal, its position suggests it may conceivably be an extension of the feature represented by m2.7. It is of note that it incorporates a rectangular protrusion, somewhat reminiscent of the bastion shapes shown in the outer defences of the fort shown on Maps 2 and 3.
m2.8	Angular anomaly formed by two linear components of strong magnetic character. Measures 33m north-west/south-east by 10m north-east/south-west.	Anomaly corresponds with resistance anomaly r.4. The readings are slightly dipolar, suggesting construction of fired brick or other burned material. It appears to retain the corner of the bastion, and may possibly be the base of an additional defence outside the bastion, although the most likely explanation is that this anomaly is imaging the foundations of a farm building,

		probably from a later period.
m2.9	Angular anomaly formed by two linear components of medium-strong magnetic signals. Sides are 22m in length and form a regular right angle.	The regularity of the anomaly would suggest it images a manmade feature. It does not have the dipolar intensity of nearby anomalies m2.4 and m2.8, with the readings being, on average 5-6nT above the plot average. It does not respect the similar anomaly m2.7, so does not appear to be related to it. However, it seems to extend from the edge of the bastion. It is conceivably an additional earthwork defence related to the fort, although its precise symmetrical shape suggests it is probably later in date.
m2.10	Broad curvilinear band of varying magnetic signals extending from the edge of the stream, broadly north-north-west through the field and extending beyond the north-west edge. It is up to 10m wide in places. A second arm extends westwards from the same point for approximately 44m from the edge of the stream.	Most probably an old channel, it appears in field 1 as anomaly m1.12. Varying magnetic signals are characteristic of differential silting up. However, it does coincide with the western edge of the fort, offering at least the possibility that it is in some way connected with the defences of the fort.
m2.11	Band of dipolar spikes across the centre of the field.	These readings are probably an indication of ferrous material dropped in the field. Their broadly linear dispersal may suggest a wire fence along this line at some stage in the past. Also possibly related to resistance anomaly r9, which is approximately 5m to the north but approximately on the same alignment.
m2.12	Localised zone of increased magnetic signals at south of survey area, measuring 12m north-west/south-east by 10m north-east/south-west. Partly obscured by anomaly 2.10.	Signals may correspond with increased magnetic susceptibility of soil at this location, possibly an indication of an area of occupation. This is close to the resistance anomaly r13 and likewise may be related to the farm buildings shown on the 1st edition OS map in this area.

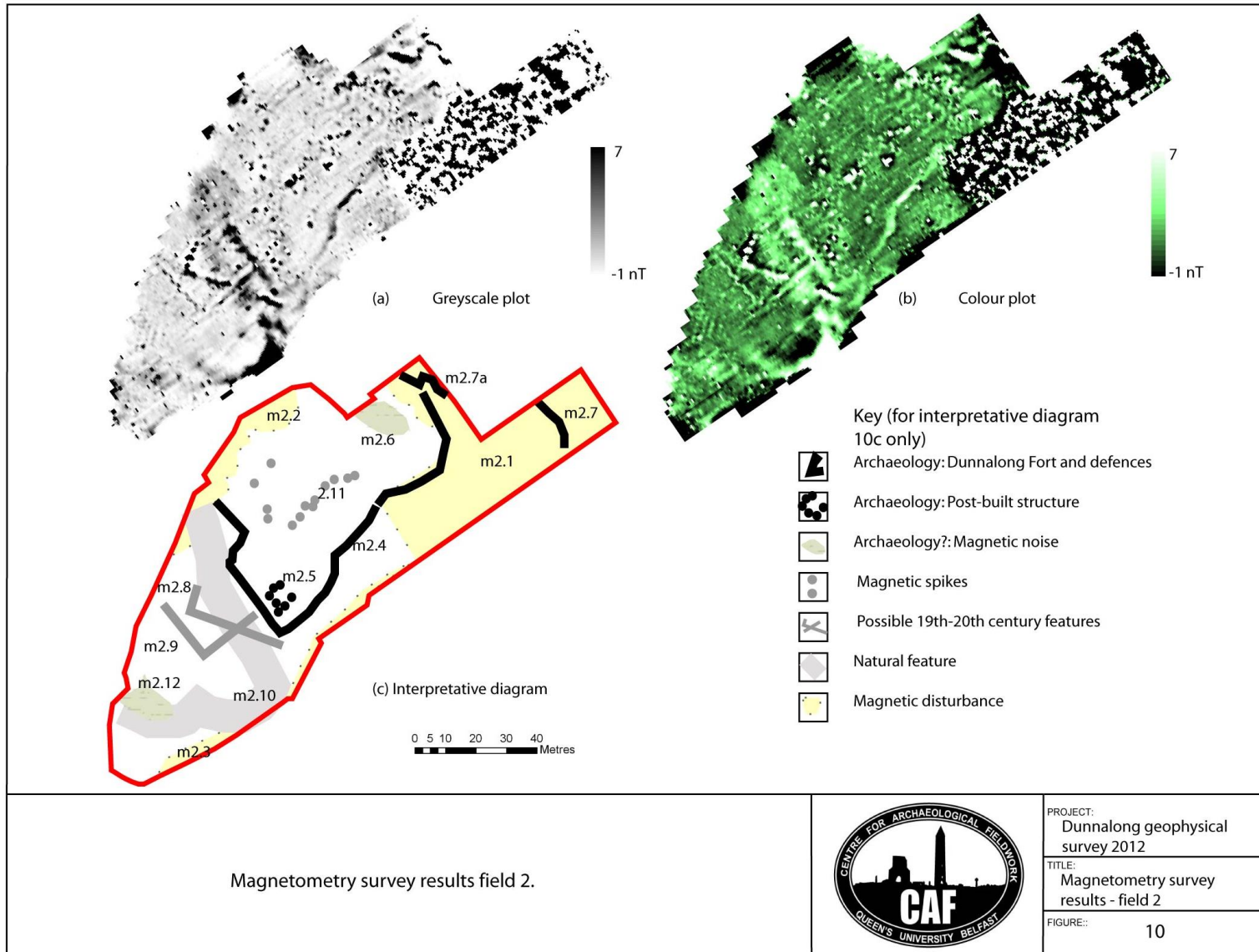


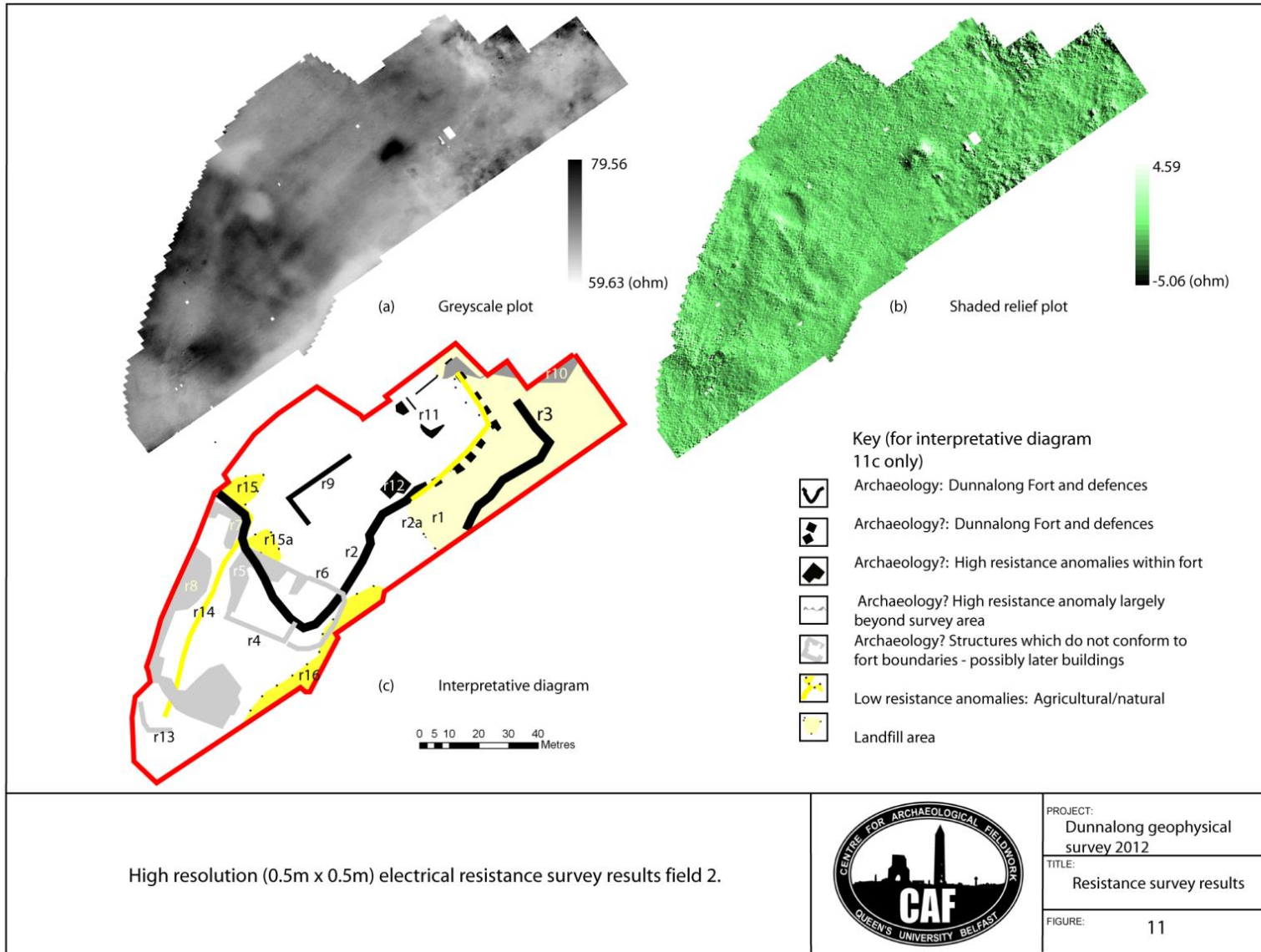
Table 3. Results of high resolution electrical resistance survey in field 2 (See Figure 11).		
Anomaly	Description	Interpretation
r1	Zone of mixed, mottled resistance readings at north-east edge of the field. Maximum dimension 78m north-east/south-west by 55m north-west/south east.	Readings are characteristic of artificially modified ground. Interpreted as landfill and this was confirmed by excavation Trench 2. On one of the contemporary maps (Map 3) a bog is shown to the south and east of the fort (even if the caption to the map says that it lies to the west). The readings in this zone, which coincides with the position of the bog, related to efforts to improve the quality of land of this former bog.
r2	Curvilinear, high resistance anomaly, clearest at the western side, defining the southern bastion of fort. It extends southwards from the north-western edge of the field and is clearly visible for 65m, although it coincides with an area of other high resistance anomalies (r6 and r7). At this stage it curves north-eastwards, and can be traced only as a border between an area of slightly higher resistance readings (to its north) and lower readings (to its south).	This anomaly defines the southern bastion of the fort and some of the perimeter of Dunnalong Fort. It is analogous with m2.4.
r2a	Meandering linear anomaly of low resistance readings which defines the western edge of zone r1, and separates it from the ground interpreted as the interior of the fort to the west. Overall length is approximately 82m and it is on average 1.4-1.6m wide.	Associated with the edge of the fort where it abuts the zone of landfill and therefore probably related to anomalies r1 and r2. However, the anomaly is too insignificant to represent the type of substantial ditch imaged elsewhere around the fort's defensive curtain, and which was substantiated in Trench 1. This anomaly may simply represent a gully, where water has collected, between the made up ground and the interior of the fort which is on the natural drier ground. Excavation of Trench 2 revealed no feature of any kind corresponding with this anomaly, other than the border between the natural and made up ground.

		However, the eastern end of the trench could not be excavated in this area because of the exposure of a water pipe. It is conceivable that the edge of the ditch lay beneath the unexcavated portion of the trench.
r3	Vague, poorly defined, angular anomaly of high resistance values within the landfill zone r1.	This anomaly coincides almost exactly with the course of the external defence, lying outside the line of the bastion, shown on the 1833 OS 6-inch map. The location and course of this anomaly suggest that it represents a response to the angular, bastion shaped feature shown on this map and the form of which was preserved in a later watercourse. This feature was almost certainly part of the defences of the English fort. See anomaly m2.7.
r4	Subrectangular, well-defined high resistance anomaly with three visible sides. It measures approximately 20m north-west/south-east with a maximum visible width of 7m north-east/south-west. The sides of the anomaly are approximately 1.3m wide. The readings comprising this anomaly are amongst the strongest in the survey area.	Strength of readings suggests this is a stone/masonry structure, as does the geometrical form. By itself, it appears to retain the corner of the bastion, and could be interpreted as the base of an additional defence outside the bastion. But the most likely explanation is that this anomaly is imaging the foundations of a farm yard perimeter wall or building, probably from a later period, and is related to other nearby high resistance anomalies, which do not respect the perimeter of the fort (see anomalies r5, r6 and r8)
r5	Coarse, angular anomaly of high resistance readings west of centre of the field. It measures approximately 23m north-west/south-east by 19m north-east/south-west.	This is another of the strongest anomalies in the area. The strength of the readings suggests this is a stone/masonry structure, or else bedrock. It is not as well defined as neighbouring anomaly r5, but its overall angular shape suggests it may be a response to a manmade feature. This is possibly the collapsed foundation of a structure, probably a later farm

		building, and may be related to anomalies r4, r6, r7 and r8.
r6	Subrectangular anomaly of slightly raised resistance levels extending from the south-eastern edges of anomalies r4 and r5, and possibly connecting the two. The combined rectilinear anomaly formed by the 3 would measure approximately 35m north-west/south-east by 25m north-east/south-west. It is most clearly visible in the relief plot of the data (Figure 10c).	Though it is not as strongly imaged as the two neighbouring anomalies r4 and r5, this anomaly may be the north-eastern edge of an enclosure, the south-west side of which is formed by r4 and the north-west side by r5. The presence of this anomaly reduces the possibility that anomaly r4 is related to the fort, as it crosses the perimeter of the fort defined by r2. If the two anomalies r4 and r6 are indeed part of a single feature (as suggested in Figure 10c), it does not respect the perimeter of the fort (r2) and is most likely later than it.
r7	Angular high resistance anomaly, formed by three sides and with overall dimensions of approximately 12m north-west/south-east by 13m north-east/south-west. Sides of the anomaly are up to 5m wide.	High resistance readings are characteristic of stone/masonry or bedrock. Angular symmetrical form of the anomaly suggests it is manmade, probably the remains of a building foundation. This may be a farm building or feature related to anomalies r4, r5, r6 and r8.
r8	Curvilinear high resistance anomaly running along the west of the field for 38m before turning south-east and extending 32m into the field. South-eastern end of the anomaly expands to a width of 15m. Definition of anomaly is obscured in places by low resistance areas r14, r15 and r15a.	Largest of a series of high resistance anomalies in the western area of the field. It is similar in form and strength to anomalies r5 and r7 in particular, with its broadly symmetrical form suggesting anthropogenic activity, though a natural origin is not ruled out. Seems likely this is the image of a stone element to a former field boundary or the surrounds of a yard, probably associated with features postdating the fort but which had disappeared prior to the OS maps, as there are no features shown in this location on any of them.
r9	Very vague angular anomaly at centre of the field. It measures approximately 25m north-east/south-west by 10m north-west/south-east.	This may be the poorly preserved base of a building, possibly a temporary structure. Its position within the fort means that an association with it is possible. It may alternatively represent the

		position of old fences within the field.
r10	Linear band of very high resistance at the north of the survey area. It measures at least 40m in length, but its complete extent, both in length and width, cannot be ascertained as it extends beyond the survey area.	Not possible to cover this anomaly during the survey as it borders the area of Dunnalong Farm fenced off for paddocks, while much of the area in its vicinity is covered in rushes. However, the strength of the anomaly where detected suggests stone/masonry, so it probably relates to a building. Its position, near the modern farm, and close to the Foyle, places it close to the likely position of the tower house. However, it does appear to extend across the boundary of the fort, so is probably more likely to relate to the later farm building activity on the site.
r11	Area of patchy, but seemingly related, linear trends and angular anomalies of slightly raised resistance values. Overall it measures approximately 30m north-east/south-west by 14m north-west/south-east, although it possibly extends beyond the north-west boundary of the survey area.	Possible remnants of a building or buildings within the fort. The location of the anomaly, and overall dimensions, raise the possibility that this anomaly may be related to the original O'Neill castle, or indeed the English brewhouse. However, the linear components are not continuous, so it may represent more than 1 building. The strength of the anomalies (less than 10% above the background readings) suggests they are unlikely to be stone. It is therefore possible that these represent less permanent structures than, for example, the foundations of the castle. Also, proximity to the modern farm buildings may indicate a relationship to later features. Coincides with the magnetic anomaly m2.6.
r12	Rectilinear high resistance block measuring 10m north-east/south-west by 8m north-west/south-east.	High resistance values and broadly regular edges suggest this may be a response to buried stone/masonry foundations, or else a rock outcrop.

r13	Faint curvilinear arc defining an area approximately 8m north-south by 10m east-west.	Possibly the remains of a temporary building or animal enclosure. Broadly coincides with farm building shown on the 1833 OS map. Not within the area of the fort.
r14	Linear low resistance feature extending over 80m broadly from the entrance to the field to the low resistance zone r16 on the banks of the stream.	Cattle track, signalled by the compaction of soil and the consequent pooling of surface water.
r15 and 15a	Amorphous zones of low resistance on either side of the track r14.	Areas of poor drainage caused by soil compaction due to cattle activity.
r16	Area of extremely low resistance on the banks of the stream.	Flood plain.



3. Discussion and Conclusion

3.1 Discussion

The survey was pointedly successful in achieving its principal objectives of defining and identifying the extent of remains associated with Dunnalong Fort. As noted above, the magnetic survey was demonstrably the more successful method, with the combination of surveys from field 1 and field 2 demarcating much of the perimeter of Docwra's fortification from 1600. Figure 12 is an image of the two magnetometry surveys, georectified to a modern aerial photograph of the area. As the geophysical survey was able to precisely locate the features it detected in the landscape, it was used as the basis for the positioning of three exploratory excavation trenches, to investigate some of the most significant anomalies. As noted above (Section 2.2), the excavation was carried out concurrently with phase 2 of the geophysical survey, and was primarily concentrated in field 1. The position of the trenches is shown in the inset Figure 12(a). While the excavation archive has not yet been processed and studied, the broad findings are mentioned in this discussion where they related to, or resolved, features detected as geophysical anomalies during the survey.

At least two of the bastions, at the west (anomaly m1.2) and south (r2 and m2.4), have been clearly imaged, while it is also possible to trace the eastern curtain of the fort (r2a and m2.4). The definition of the east of the fort is hampered, however, because of modern landfilling (detected as anomalies m2.1 and r1). The northern part of the fort, including the position of the northern bastion indicated on the 1833 OS map, coincides with the grounds of Dunnalong Farm, and was therefore beyond the scope of the survey. The longest side of the fort imaged, from the tip of the western bastion to the tip of the southern one, measures almost 112m in length. From the southern bastion to the eastern edge of the fort, the length is approximately 91m, although, as mentioned, this measurement may not represent the full extent of the fort in this direction. These dimensions closely replicate those of the 1833 OS map depiction, but confirm a considerably smaller site than indicated by the scaled Griffen Cocket map (Map 4).

The strongest responses from the perimeter of the fort were detected in the area of the southern bastion, and in patches along the western perimeter (parts of anomaly m1.2, m2.4 and r2). These were recognised as imaging a ditch which has been filled with material of a stronger magnetic signal to the surrounding soil – the fluctuations in the signals along the perimeter reflect variations in the character of the ditch fill. From the survey, it appears that the ditch was probably approximately 4m wide. Such a method of construction is, of course, consistent with Four Masters account of the erection of the Foyle forts mentioned at Section 1.6 above. It was also substantiated by the 2012 excavation. The primary focus of the excavation was to unearth the defences of the fort and Trench 1 was positioned over the perimeter of the western bastion (m1.2). The dig exposed a significant ditch, with a maximum width of 6m at the top, but the main body of which was 4m wide as suggested by the survey. It was cut through the level of the subsoil and had an overall depth of approximately 2m. The remains of an earthen bank immediately inside the ditch were also revealed, although this had been levelled and largely collapsed into the ditch.



The combined magneometry results from the 2012 Dunalong Survey. The perimeter of the 1600 fort is clearly visible. Figure 12(a) inset, shows the location of the excavation trenches. Trenches are not to scale).



PROJECT	Dunalong geophysical survey 2012
TITLE:	Magnetometry results from 2012 survey
FIGURE:	12

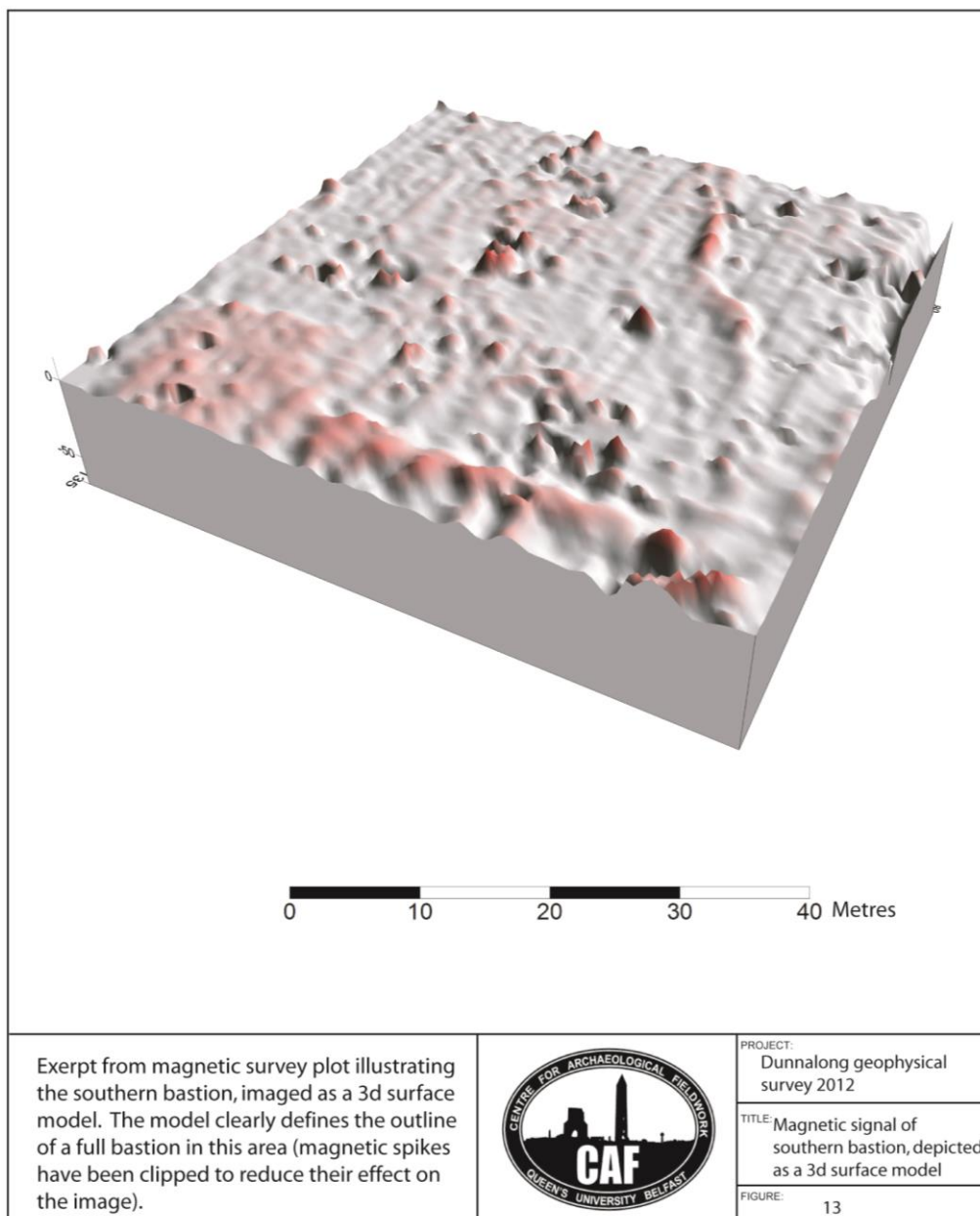


Plate 4. Trench 1, showing excavated section through the ditch.

Bastioned earthwork forts became common in Europe in the early 16th century, and were largely a response to the increasing dominance of artillery in siege and warfare. The forts tended to be formed of a polygonal interior, protected by projecting bastions at the corners. The curtain of the fort, as well as the bastions, was generally formed by a deep ditch, enclosing an earthen bank, usually around 4.5m thick, which offered superior defence against artillery fire to stone castle or bawn walls. In larger examples, the bastions were further strengthened with stone or sod facing, or topped with a parapet. While Ireland was the site of many 16th-century conflicts, few of these involved the use of canon. The bastioned fort was therefore not a regular feature of Irish warfare until the commencement of the Nine Years War. At this stage, a number of crude examples were built at locations on the eastern front of the conflict, such as Mounthorris Co. Armagh and Mullin, Co. Tyrone, at the same time as Docwra was fortifying Culmore, Derry and Dunnaalong. Less is known of

contemporary Irish forts, although the O'Neill fort at Inisloughlin, Co. Armagh may have been of similar form.

The Dunnalong fort appears to be somewhat asymmetric in plan and it is of interest that the form imaged in the 2012 survey very closely imitates the remains shown on the 1833 OS map. Of the corner bastions, only the southern one (r2 and m2.4) appears to be a full bastion, with two flanking and two facing sides. It expands from the curtain of the fort to a maximum width of approximately 34m before tapering to a rounded point (Figure 13). This shape is reflected both in the survey data and the 1833 map. However, the surveyed remains appear larger than the depiction on the map, which suggested the corresponding measurement was roughly 20m.



The second bastion that is well defined by the survey, at the west, has a more flattened wedge shape (m1.2), with a maximum width of approximately 41m, and, again is shown similarly on the 1833 map. This corner may have formed a demi bastion, as it does not have the symmetrical definition of the southern bastion. The OS depiction of the eastern bastion shows it as a more curvilinear protrusion from the body of the fort and, while this is not clearly captured by the survey, a rounded profile can be detected in this area. With its contrasting and mismatched bastions, the form of the fort evidenced by the OS representation and survey images is therefore in contrast with the contemporary maps (Maps 1-4). All of these show finely-shaped, full bastions at all of the corners, even if the number of bastions varies between four and five in the different depictions. Indeed, the Griffen Cocket map in particular gives the fort an almost perfect star shape (Map 4). The contrast between these images and the reality, as suggested by the 1833 maps and demonstrated by the survey results, no doubt attests to the stylistic nature of these contemporary maps, which were often intended to portray an ideal rather than metrically accurate fact (Gowan 1980, 246). Consequently, it is not possible to accurately reconcile any of the contemporary depictions with the survey results and OS maps. However, the consistency in the depiction of the detail on these maps means that they can be used as a guide to the relative positions of certain features within the fort; the brewhouse was obviously located on the shore of the Foyle, while the castle was at the north-east of the enclosed area, somewhere between the northern and eastern bastions, and to the south of the brewhouse.

The definition of the east of the fort is hampered as this area is encroached by a large zone of disturbance, which was picked up in both the magnetic and resistance surveys (m2.1 and r1 respectively). This is most graphically illustrated in the magnetic survey results, where the mottling along the north-east of the survey is in stark contrast with the clarity of readings throughout the rest of the plot. These strongly fluctuating readings are characteristic of dumping of ferrous debris, and landfilling in this area has continued into modern times (D. Jameson 2012 pers. comm.). The Foyle estuary has been the site of reclamation projects for well over 100 years, and it is possible that the eastern edge of the Dunnalong Fort has been impacted by this activity. Indeed, waterlogging to the east of the fort appears to have been a problem from much earlier times. Map 3 above depicts a bog to the east of the fort, and this is labelled 'G'. There appears to be an error in the accompanying key, which refers to 'the bog or marsh almost encompassing the west and south of the fort' – it should be the east and south. (This error is apparently confirmed later in the key to the same map, where item 'H' is explicitly stated to be 'a walking place of dry ground' to the west of the fort). With a bog therefore recorded to the east of the fort, the modern landfilling coincides with an area which has traditionally been waterlogged, at least as far back as Docwra's 1600 campaign.

In the magnetic survey results, the junction between the natural and 'made up' surfaces is the only evidence of the edge of the fort; there is no obvious continuation of a defensive ditch into this area. In the resistance dataset, while there is a slender low-resistance feature (r2a) defining this junction, it is too narrow to reflect a significant defensive ditch and is more likely a gully or drop between the two surfaces where water collects. It is therefore not certain whether the ditch survives in this area, although it is eminently feasible that it is preserved beneath the introduced landfill material, which has obscured its signal. A small cutting of dimensions 2m by 1m (Trench 2) was positioned across the junction between the

regular ground and probable disturbance, with the intention of locating the ditch of the fort and determining the character of the low resistance feature r2a. As suggested by the survey, the eastern half of the trench revealed mixed deposits of modern debris, chunks of tarmacadam and introduced soil. The western half of the trench was excavated to natural subsoil with no features of archaeological significance being discovered. Excavation through the landfill deposits in the eastern half was discontinued when a probably functional water pipe was exposed. The depth of these deposits was therefore not determined and the question of whether the ditch survives beneath was unfortunately not satisfactorily resolved. It should be noted, however, that the junction of the natural and made-up surfaces revealed in the survey, particularly the line of the resistance anomaly r2a, closely correspond with the eastern edge of the fort shown on the 1833 map. Given the close correlation between other elements of the survey results and this cartographic depiction, it seems probable that this junction is close to the actual edge of the fort; if the defensive ditch extended into this area, its signal must have been obscured by the overlying material, and may lie to the east of Trench 2.

That earlier material survives within the landfill zone may be demonstrated by anomalies r3, m2.7 and possibly m2.7a. These anomalies correspond with the angular feature which appears on the 1833 map, broadly replicating the form of the eastern bastion but lying at least 20m to the east of it at its closest point. It appears likely that these anomalies mark the position of an original feature that formed part of Docwra's fortification. An external defence, standing outside the fort but protecting a cluster of cabins located in its shadow, was depicted on both Maps 2 and 3 to the east of the fort. It is probable that the feature shown on the 1833 map, and detected by the survey, is related to this outer line of defence, described as 'a trench cast up for their (the cluster of cabins) safety'. This ditch appears to have later been adapted as a watercourse, shown on the 1905 and 1951 maps. However the character and full extent of the feature is difficult to determine because of the effects of the landfilled material on the geophysical signals. This feature has been destroyed at surface level in recent times by the realignment and straightening of the stream.

The survey has therefore succeeded in precisely locating and defining the remains of the fort, as well as seemingly confirming the accuracy of the 1833 OS 6-inch map representation. There is also evidence in the results of potential remains within the fort itself. Perhaps most graphic is the strong magnetic spiked signal inside the western bastion (m1.3). The strongly contrasting high and low values of the readings in this area point to an area of significant burning, and this has been interpreted either as the location of a building destroyed by fire, or else the site of industrial-type activity such as ironworking. It may be worthy of note that the Griffen Cocket map (Map 4) shows a large building in this location (Plate 4).

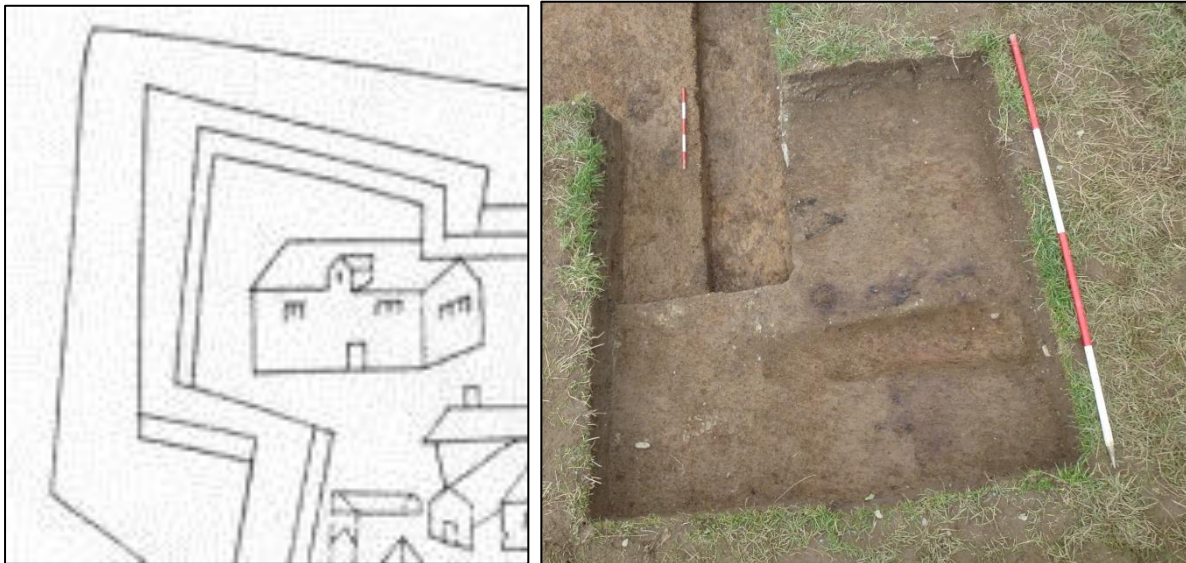


Plate 4 and 5. Plate 4 (above left) Extract from Map 4, showing large building in the west bastion. Plate 5 (above right) birds-eye view of excavations in Trench 3, showing the excavated slot trench and dark patches suggesting post holes, which may be associated with a wooden building, such as the structure shown in Plate 4.

Trench 3 of the excavation was positioned over this anomaly to determine the source of the readings. The excavation provisionally identified the remains of two phases of building in this area. Both of these were post-built structures, suggesting wooden construction, with the later phase being accompanied by a possible slot trench (Plate 5). The post holes for both phases were charcoal-filled, possibly indicative of some burning, although not of the severity suggested by the survey readings.

Both the resistance and magnetometer surveys detected anomalies within the fort in field 2, which may represent internal buildings. Perhaps most convincing of these is the anomaly detected in the north of field 2. This appears as a zone of indistinct magnetic 'noise' in the magnetometry survey (m2.6) and as a cluster of angular high resistance corners and linear features in the resistance survey (r11). The magnetic signal is symptomatic of enhancement of the soil with settlement or building debris, and such areas often do not have clear definition in magnetometry survey. The resistance results in this case have more geometrical form, and appear to comprise an area approximately 30m north-east/south-west by at least 14m north-west/south-east. While the overall dimensions of the anomaly and its location, roughly between the north and east bastions, raise the possibility that this anomaly is related to the original O'Neill castle, the readings are not suggestive of substantial masonry and it is more likely that the anomaly again indicates the position of some of the less permanent structures dating to the period of English occupation. Of course, the position of these anomalies also places them close to the supposed position of the brewhouse. It is recorded that this was a wooden structure, consistent with the geophysical signals. These anomalies are indistinct, however, and there is no indication of the characteristic dipolar spikes in the magnetometry survey at this location that one would expect from the types of hearths and ovens intrinsic to brewing activity (Horning 2009, 128).

Also worthy of note is the cluster of magnetic spikes retained by the southern bastion (m2.5). These form a rectangular pattern measuring approximately 12m by 9m, which possibly represent the footprint of a wooden, post-built structure, the burning of which has caused the postholes to appear as thermoremanent spikes in the dataset. Certainly the dimensions suggested by the anomaly are not inconsistent with a viable building, and it may be significant that the excavations in Trench 3 exposed the remains of wooden buildings in a corresponding location in the western bastion; indeed all of the contemporary depictions show that there was a significant number of buildings within the fort.

The strongest high resistance anomaly within the fort, or at least along its boundary, is the angular block of readings r12. The readings here are not inconsistent with a masonry foundation. The position of the anomaly means it is probably not related to the castle, and there is no building shown at this location on any of the maps. This may alternatively be the position of a dump of material related to the landfill deposits in the east of the field. Also within the fort is the vague angular raised resistance anomaly (r9). The anomaly is very indistinct, but could possibly be the foundation for a long wooden building, again perhaps related to the garrisoning of troops at Dunnalong. The scatter of magnetic dipoles (m2.11) detected in the magnetometry survey close to this position might be related to this structure, possibly indicating nails or other iron fittings.

Amongst the strongest readings detected in the resistance survey were those associated with the 40m-long linear anomaly (r10), which skirts the north of the survey area. This anomaly appears to be obscured in the magnetic survey by the landfill (m2.1). Both the linear character and high resistance levels suggest that this is a response to stone or masonry foundations. Given the position of the anomaly at the north of the survey area, this is again near the supposed location of the original Gaelic tower house, and may warrant further investigation. However, the feature appears to extend beyond the eastern boundary of the fort so it is more likely that it is related to the nearby farm building. As discussed above, however, definition of the fort's eastern boundary is hampered by the encroaching reclamation deposits, so an association with the fort should not be ruled out for this feature.

With the exception of the fort itself, probably the most prominent anomaly of archaeological potential in the survey area is anomaly r4, detected in the magnetometer survey as m2.8. The resistance survey revealed this feature as formed of high resistance values, possibly suggesting masonry or stone, while it is signalled by enhanced magnetic values in the magnetic survey. It appears to comprise two linear 'arms' or walls, measuring 20m and 7m which retain the southern bastion, suggesting at first sight that it may even be related to the defences of the fort. However, intensive filtering of the resistance data and mapping as a relief plot (see Figure 10c), disclosed that this is probably part of a larger sub-rectangular enclosure or yard, that is completed by the much fainter curvilinear anomaly r6 and anomaly r5. The enclosure formed by the combination of these anomalies transgresses the boundary of the fort, making a relationship unlikely. This group of anomalies is part of a large area of relatively strong, high resistance anomalies visible in the resistance data at the south-west of field 2. There are no visible surface remains in this area, although the ground is appreciably more solid in this area, nor do any of the OS maps depict buildings here but, given that they do not appear to be related to the fort, the most probable explanation for these anomalies is that they represent a group of early farm buildings, perhaps dating to the first years of the

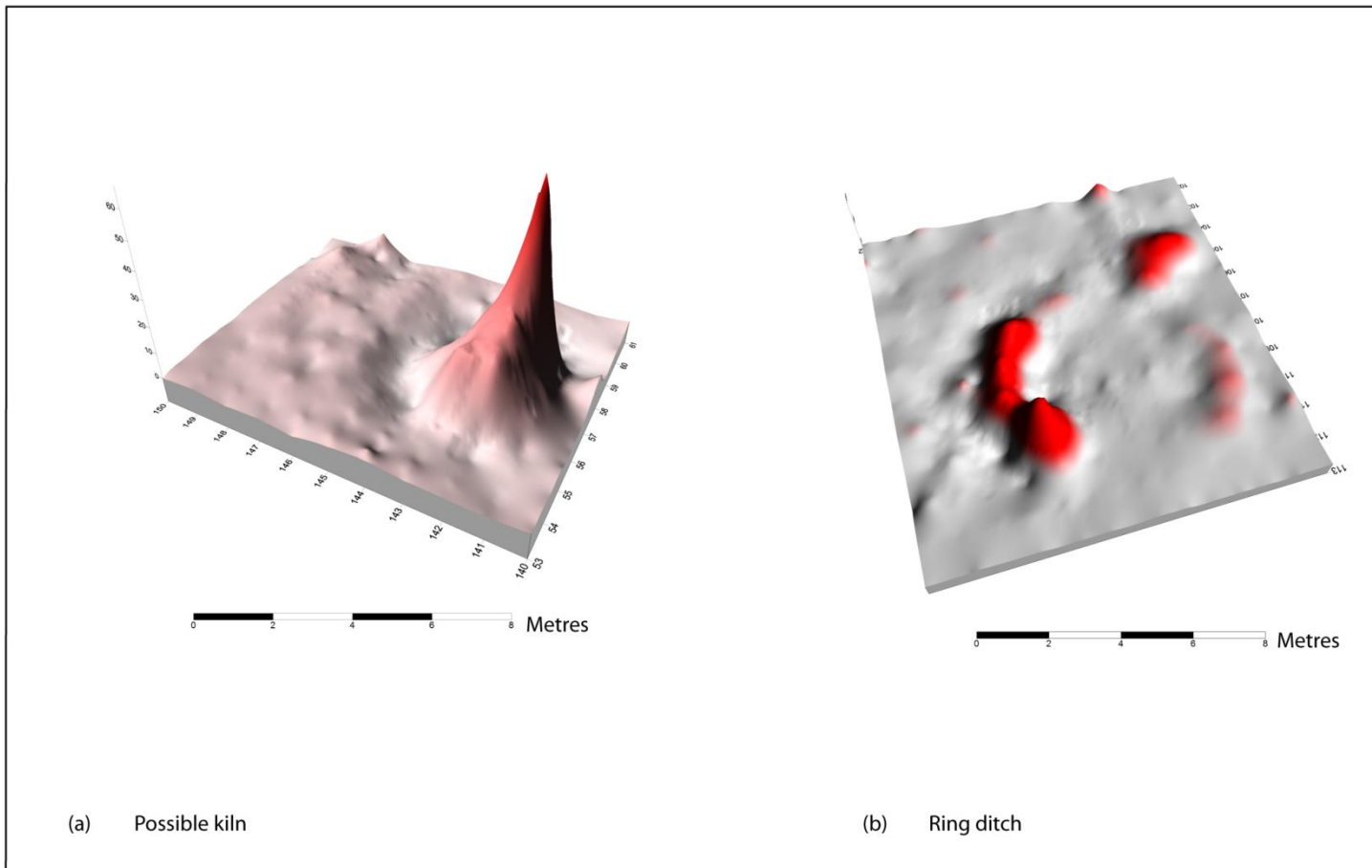
plantation. Some of the raised readings may be due to geological features (and this area is close to the area marked 'H' on Map 3 as a 'wholesome walking place of dry land'), but this is out of character with the rest of the survey area, and the linear shape of many of the anomalies in the area, notably r4/m2.8 and m2.9, points to likely artificial construction.

There may also be an indication of buildings outside the fort in field 1. This is marked by a series of linear trends, just west of centre in the field, which occupy a broadly rectangular area measuring 30m by 20m (m1.4). It is not possible to ascertain for certain whether these trends represent structural remains, let alone their date, as they present only as ephemeral readings. They are located close to a large dipolar spike (m1.9), however, which can be indicative of intensive, industrial scale burning, such as a kiln, large hearth or else a sizeable ferrous object. Modelling of the anomaly as a 3d surface plot using the actual magnetic readings as substitute 'heights'(Figure 14a), shows the characteristic 'dual peak' signal expected from a kiln, although the highest reading appears as an exaggerated 'spike'.

Two particularly prominent high resistance anomalies along the western edge of field 1 are probably not of archaeological significance. The larger of the two (m1.10) is almost 5m wide in places, and is defined by strong magnetic values. It is conceivably some form of buried ditch, but the fact that it so closely follows the existing field boundary suggests that it is merely an early alignment of the edge of the field, probably filled with a variety of ferrous material and debris. As a caveat, however, no such divergence in the boundaries is evident from the OS maps. Almost parallel to this feature is a narrower, fainter linear anomaly defined by lower values (m1.11); this is most likely imaging a pipe trench or conduit.

While the majority of anthropogenic features detected in the survey are likely to date to Docwra's fort or later, the curvilinear anomaly m1.5 may represent evidence of much earlier human activity at Dunnalong. The anomaly is formed by two opposing semicircular arcs, with a total diameter of approximately 8m, and is best viewed as a 3d surface model (Figure 14b). The gaps between the arcs appear as opposing entrances, and the feature is formed by relatively strong magnetic enhancement. It is probable that the anomaly reflects the subsurface remains of a ring ditch, a type of ritual or burial monument which can date from the Late Neolithic (c.5500BC) to the Early Iron Age period (C.600BC), but which is most common in the Middle Bronze Age (c.1500-1000BC). There are a number of magnetic spikes clustered in the area of the anomaly (r6) which could be areas of burning, possibly even associated with cremated burials related to the prehistoric monument. However it is more likely they are simply a response to ferrous debris scattered around the field similar to the groupings m1.7 and m1.8.

The broad curvilinear band extending through both magnetic survey plots (detected as anomalies 1.12 and 2.10) is amongst the largest anomalies detected and is one of the few which appears in both fields. In field 1 in particular, it passes close to the fort and seems to encroach on the edge of the western bastion. It is conceivable that this represents an additional line of defence to the fort, but it is more likely, given its clouded definition, meandering course and fluctuating strength, that this is an old channel of natural origin



3d surface models of two potentially significant features in field 1, as detected by magnetometry survey. (a)(above left) Anomaly m1.9 shows the characteristic double peak anomaly that often indicates an industrial feature which has been intensely heated, such as a kiln (b) (above right) The two arcs forming anomaly m1.5, which may be the remains of a prehistoric ring ditch.



PROJECT:
 Dunalong geophysical
 survey 2012

TITLE:
 Field 1 Features of
 potential significance
 imaged by magnetometry

FIGURE: 14

3.2 Conclusion

The 2012 geophysical survey at Dunnalong has definitively located the English fort of 1600, and has provided superb definition of much of its perimeter. It has resulted in the creation of a robust dataset that is of immense value in its own right; the survey results provide information on the siting, location and dimensions of the fort and, at the west and south at least, define the shape of its defensive bastions. Given the amount of interest that the 2012 project generated, the survey also represents a stand-alone cultural resource for the local community, providing a welcome insight into a well know but heretofore poorly understood landmark.

The survey should, perhaps more crucially, be regarded as a baseline dataset; a starting point for future research at the site and the wider landscape. And, as has been outlined above, it has already been used to target research excavation trenches. These have produced valuable information on the form the fort's defences took, as well as the type of structures used by the English garrison. Analysis of the artefacts will doubtless contribute to our knowledge of the daily lives and activities of the forts inhabitants.

The survey results also open up other avenues for research. For example, with the boundary of the fort now mostly defined, the location of the original O'Neill castle in relation to the site of the fort needs to be established. Field inspections by NIEA (Foley 1987 unpaginated), and local historians Hunter and McConaghy (D. McConaghy 2012 pers. comm.) has suggested that the site of the castle may at least partly lie to the south-east of Dunnalong Farm, in the area of ground which could not be included in the survey. In this respect the anomalies r10, r11 and m2.6, which are all close to this area on the edge of the survey grid, may be relevant, even if r10 appears to extend beyond the boundary of the fort as indicated both by the survey and the 1833 OS map. The position of these anomalies is also close to the supposed site of the brewhouse. Study of ale consumption in the 17th century is in its infancy, and the presence of surviving remains at Dunnalong would add much to a nascent study area.

Further study of the form of the fort is also warranted, most notably at the east, where neither the survey nor the small excavation Trench 2 revealed definite evidence for the ditch. There is very little modern excavation work on 17th-century artillery forts in Ireland and in this respect, the Dunnalong site is of genuinely national significance. The location by the survey of definite wooden buildings in Trench 3 is another valuable contribution to a broader research agenda. While evidence of stone buildings in plantation period Ireland abounds, there is scant evidence of how ordinary people lived. While the Dunnalong evidence must be viewed in a martial context, it is likely that the structures built within the fort were similar to the types of cabin used by the majority of people in the period.

In the wider context, Dunnalong Fort was only one part of a much wider English campaign in the Foyle. The information from this project will hopefully awaken an awareness of its place in the archaeological and cultural landscape of the Foyle. And this research should not be confined to the 17th century; the site was chosen by Docwra for its already significant position in the landscape. The ferry route was long established, as was the O'Neill presence, and there is a possible connection with the Vikings that is not fully understood. The report on the CMA survey is eagerly awaited as, when combined with the terrestrial

survey, the focus may be expanded beyond Dunnaalong Fort to the archaeology of the Foyle basin as a whole. The 2012 Dunnaalong project has therefore been invaluable in its own right, but it is hoped that it will pave the way for a significantly larger and more comprehensive exploration of this unique and important archaeological landscape in the future.

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Appendix 1

Background to survey techniques used at Dunnaalong 2012

1. Magnetometry

Magnetometry is the most frequently used geophysical technique in Ireland, allowing rapid mapping of magnetic anomalies contained within the sub-soil. Magnetometry survey is based on the principal that artificial interference with a soil can change its magnetic signal. Probably the most dramatic and easily detectable effect is that of burning; many archaeological features are detectable because they have gained a strong magnetic signature from a burning or heating process. Other features, such as the fill of ditches and pits, gain an altered magnetic signal over time, due to a change in the magnetic susceptibility in the soil. This can be due to the addition of material to the soil which has a different magnetic signal to that of the parent soil. Habitation debris or fragments of fired brick as well as biological factors can also affect the magnetic susceptibility of a soil, and can therefore be detected by magnetometry survey.

Examples of the type of archaeological feature that are readily detectable by magnetometry are kilns, hearths, burnt mounds and other burnt features, cremation burials, ditches and large pits. The magnetometer is also sensitive to modern ferrous debris and objects such as iron gates and fences. Survey readings are measured in nanotesla (nT).

The most commonly used equipment for magnetometry survey in an archaeological context is the fluxgate gradiometer. The 2012 Dunnaalong survey was undertaken using a Bartington GRAD 601-2 gradiometer, which is a twin sensor apparatus. Each instrument contains sensors which measure the difference between the magnetic content of the earth's magnetic field and the local soil within the survey area, producing a map of the underlying archaeological content. The survey was carried out at a resolution of 1m x 0.25m - the line spacing was 1m with readings taken every 0.25m along the line. Full technical specifications of the magnetometry survey are tabulated in Appendix 2 of this report.

2. *Electrical Resistance*

The principal of electrical resistance survey is that different types of subsurface remains will create a different level of resistance to a weak electrical current passed through the soil. It is based on the amount of interstitial water contained in a soil, but at the most basic level, a buried stone foundation will return a high level of resistance to the current, while a waterlogged ditch will cause a low resistance reading. Modern survey equipment will detect much more subtle variations in the resistance levels between such extremes and readings are measured in ohm (Ω). In practice, the technique is often used to complement magnetometry surveys, with areas of magnetic 'noise' subsequently investigated by resistance survey. The technique can also be used as a survey method in its own right.

Electrical resistance metres pass a small electrical current through the ground to map changes in moisture content in the soil, which can indicate the location of buried archaeological features. The instrument requires contact with the ground surface and surveys can be undertaken either using a hand held frame of probes placed on to the ground or a wheeled cart pulled across the ground. Reconnaissance survey is often carried out at a resolution of 1m x 0.5m, with areas of potential archaeological interest then investigated at a higher resolution of 0.5m x 0.5m. The Dunnalong survey was carried out with a Geoscan RM15 resistance metre with MPXI5 multiplexer set up in a parallel twin array. Full technical specifications of the resistance survey are tabulated in Appendix 2 below.

Electrical resistance is particularly useful for medieval or post-medieval research at castles and ecclesiastical sites, where structural remains are likely. Examples of the type of feature likely to be detected are stone or stone-filled features, buried surfaces, buildings or building foundations, ditches or large pits and ponds.

Appendix 2

Technical information

Survey 1 – Reconnaissance electrical resistances survey of field 2.

Survey type: Electrical resistance.
Instrumentation: Geoscan RM15 resistance metre and MPX15 multiplexer.
Probe configuration: Parallel twin (4-probe).
Probe spacing: 0.5 m.
Grid size: 30m x 30m.
Traverse interval: 1 m.
Sample Interval: 0.5m.
Traverse Pattern: Zig-zag.

Survey 2 –High resolution detailed electrical resistance survey of field 2.

Survey type: Electrical resistance.
Instrumentation: Geoscan RM15 resistance metre and MPX15 multiplexer.
Probe configuration: Parallel twin (3-probe).
Probe spacing: 0.5 m.
Grid size: 20m x 20m.
Traverse interval: 0.5m.
Sample Interval: 0.5m.
Traverse Pattern: Zig-zag.

Survey 3 – Magnetometer survey of field 1.

Survey type: Magnetometer.
Instrumentation: Bartington Grad-601/2 dual sensor fluxgate gradiometer.
Probe spacing: 1 m.
Grid size: 30m x 30m.
Traverse interval: 1m.
Sample Interval: 0.25m.
Traverse Pattern: Zig-zag.

Survey 4 – Magnetometer survey of field 2.

Survey type: Magnetometer.
Instrumentation: Bartington Grad-601/2 dual sensor fluxgate gradiometer.
Probe spacing: 1 m.
Grid size: 20m x 20m.
Traverse interval: 1m.
Sample Interval: 0.25m.
Traverse Pattern: Zig-zag.

Spatial Recording.

Grids for all surveys were set out using Leica TSO6 series Total Station. Grids, control and detail points were georeferenced to the Irish National Grid with differential GPS.