N9/N10 KILCULLEN TO WATERFORD SCHEME, PHASE 4 – KNOCKTOPHER TO POWERSTOWN

Ministerial Direction Scheme Reference No.	A032
Registration No.	E3842
Site Name	AR141, Cranavonane 1
Townland	Cranavonane
County	Carlow
Excavation Director	Tim Coughlan
NGR	268554 167895
Chainage	73900

FINAL REPORT

ON BEHALF OF KILKENNY COUNTY COUNCIL

MARCH 2011

IAC Irish Archaeological Consultancy

PROJECT DETAILS

Project	N9/N10 Kilcullen to Waterford Scheme, Phase 4 – Knocktopher to Powerstown
Ministerial Direction Reference No.	A032
Excavation Registration Number	E3842
Excavation Director	Tim Coughlan
Senior Archaeologist	Tim Coughlan
Consultant	Irish Archaeological Consultancy Ltd, 120b Greenpark Road, Bray, Co. Wicklow
Client	Kilkenny County Council
Site Name	AR141, Cranavonane 1
Site Type	Burnt mound
Townland(s)	Cranavonane
Parish	Tullowcreen
County	Carlow
NGR (easting)	268554
NGR (northing)	167895
Chainage	73900
Height OD (m)	52.079
RMP No.	N/A
Excavation Dates	2–15 January 2008
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This final report has been prepared by Irish Archaeological Consultancy Ltd in compliance with the directions issued to Kilkenny County Council by the Minister for Environment, Heritage and Local Government under Section 14A (2) of the National Monuments Acts 1930–2004 and the terms of the Contract between Kilkenny County Council and Irish Archaeological Consultancy Ltd.

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ABSTRACT

Irish Archaeological Consultancy Ltd (IAC), funded by the National Roads Authority (NRA) through Kilkenny County Council, undertook an excavation at the site of AR141, Cranavonane 1 along the proposed N9/N10 Kilcullen to Waterford Scheme, Phase 4 – Knocktopher to Powerstown (Figure 1). The following report describes the results of archaeological excavation at that site. The area was fully excavated by Tim Coughlan under Ministerial Direction A032 and Excavation Registration Number E3842 issued by the DOEHLG in consultation with the National Museum of Ireland for IAC. The fieldwork took place between the 2 and 15 January 2008.

Cranavonane 1 consisted of a small burnt spread (34.5m2) which sealed a large rectangular trough (4.4m x 3m x 0.48m). The trough contained heat-shattered stones in a charcoal-rich material. A small oval-shaped pit was situated *c*. 25m to the south-west of the burnt spread and did not contain burnt mound material. The site was bordered to the east and north-east by a stream, which was prone to flooding. The site was dated to the middle Bronze Age producing a calibrated date of 1386–1135BC through radiocarbon dating of a charcoal sample.

Cranavonane 1 is an important site locally as it provides the first evidence of activity within the immediate vicinity and adds to some other evidence of early prehistoric activity in the area. The nature of the excavated archaeology is not unexpected within the surrounding marginal physical landscape. The results of the excavation will add to the existing corpus of material that has been derived from burnt mound sites in the wider area, but the site does not have any wider regional significance.

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1 INTRODUCTION

1.1 General

This report presents the results of the archaeological excavation of Cranavonane 1, AR141 (Figure 1), in the townland of Cranavonane undertaken by Tim Coughlan of IAC, on behalf of Kilkenny County Council and the NRA, in accordance with the Code of Practice between the NRA and the Minister for Arts, Heritage, Gaeltacht and the Islands. It was carried out as part of the archaeological mitigation programme of the N9/N10 Kilcullen to Waterford Road Scheme, Phase 4, which extends between Knocktopher in Co. Kilkenny to Powerstown in Co. Carlow. The excavation was undertaken to offset the adverse impact of road construction on known and potential subsoil archaeological remains in order to preserve the site by record.

The site measured 400m^2 and was first identified during testing carried out between 27 March and 6 April 2007 by James Kyle (E3366) for IAC Ltd on behalf of the National Roads Authority. Cranavonane 1 was excavated between 2 and 15 January 2008 with a team of one director and 12 assistant archaeologists.

1.2 The Development

For the purposes of construction, the N9/N10 Kilcullen to Waterford Road Scheme has been divided into separate sections, known as Phases 1–4. Phase 2 of the scheme extends from the tie-in to the Waterford City Bypass at Dunkitt, to Knocktopher in Co. Kilkenny (Ch. 2+000–Ch. 25+400). Phase 4 continues from Knocktopher to Powerstown in Co. Carlow (Ch. 25+400–Ch. 76+000) and includes the Kilkenny Link Road.

The roadway of the entire scheme includes approximately 64km of mainline high quality dual carriageway and 6.2km of the Kilkenny Link Road, which will connect the road development to the Kilkenny Ring Road Extension. The road development requires the realignment and modification of existing national, regional and local roads where the mainline intersects them. It requires the acquisition of 305 hectares of land for its construction. A further link road will connect the scheme to Paulstown in County Kilkenny, while six new grade separated junctions and three roundabouts are part of the road development.

1.3 Archaeological Requirements

The archaeological requirements for the N9/N10 Kilcullen to Waterford Road Scheme, Phase 4: Knocktopher to Powerstown, are outlined in the Archaeological Directions issued to Kilkenny County Council by the Minister for Environment, Heritage and Local Government under Section 14A (2) of the National Monuments Acts 1930–2004 and in the terms of the contract between Kilkenny County Council and Irish Archaeological Consultancy Ltd. These instructions form the basis of all archaeological works undertaken for this development. The archaeological excavation works under this contract are located between the townlands of Knocktopher, Co. Kilkenny, and Powerstown, Co. Carlow.

The proposed N9/N10 was subjected to an Environmental Impact Assessment, the archaeology and cultural history section of which was carried out by Valerie J. Keeley Ltd and published in February 2005. The Record of Monuments and Places, the Site Monument Record, Topographical files, aerial photography, the Kilkenny and Carlow County Archaeological Urban Survey, and literary sources were all consulted. Two phases of geophysical survey were also conducted by Target (post-EIS geophysics carried out by ArchaeoPhysica) and an aerial survey was carried out by Margaret Gowen & Co. Ltd. As a result of the paper survey, field inspections and geophysical

survey, 35 sites were recorded in proximity to this section of the overall route alignment.

A previous archaeological assessment of Phase 2 of the scheme (test trenching conducted by Margaret Gowen & Co. Ltd. in 2006) extended into the lands acquired for Phase 4 to a point at Ch. 37+100 in the townland of Rathclogh, Co. Kilkenny. Thirty-four archaeological sites were identified within this area between Knocktopher and Rathclogh and subsequently excavated by Irish Archaeological Consultancy Ltd. as part of this archaeological contract.

Advance archaeological testing of the area between Rathclogh (Ch. 37+100) and Powerstown (Ch. 76+000) was completed by IAC during March–May 2007 and excavation of the sites identified during this process was also conducted by IAC between August 2007 and April 2008.

1.4 Methodology

The methodology adopted was in accordance with the approved Method Statement. The topsoil was removed to the interface between natural and topsoil using a 20 tonne mechanical excavator equipped with a flat toothless bucket under strict archaeological supervision. The remaining topsoil was removed by the archaeological team with the use of shovels, hoes and trowels in order to expose and identify the archaeological remains. A site grid was set up at 10m intervals and was subsequently calibrated to the national grid using GPS survey equipment.

All archaeological features were fully excavated by hand and recorded on *pro forma* record sheets using a single context recording system best suited to rural environment, with multi context plans and sections being recorded at a scale of 1:50, 1:20 or 1:10 as appropriate.

A complete photographic record was maintained throughout the excavation. Digital photographs were taken of all features and of work in progress.

An environmental strategy was devised at the beginning of the excavation based on IAC in-house post-excavation and site methodologies and guidelines. Features exhibiting large amounts of carbonised material were the primary targets.

No artefacts were uncovered on site. All archive is currently stored in IAC's facility in Lismore, Co Waterford and will ultimately be deposited with the National Museum of Ireland.

All dating of samples from the site was carried out by means of AMS (Accellerator Mass Spectometry) Radiocarbon Dating of identified and recommended wood charcoal samples. All calibrated radiocarbon dates in this report are quoted to two Sigma.

All excavation and post excavation works were carried out in accordance with the relevant approvals and in consultation and agreement with the National Roads Authority (NRA) Project Archaeologist, the National Monuments Section of the DoEHLG and the National Museum of Ireland. Where necessary licences to alter and export archaeological objects were sought from the National Museum of Ireland.

References to other sites excavated as part of the N9/N10 Phase 4: Knocktopher to Powerstown are referenced throughout this report only by their site name e.g. Paulstown 1. A list of these sites and details including director's name and National Monuments Excavation Reference Number can be referenced in Appendix 4.

Final Report Date Ranges

The following date ranges for Irish prehistory and medieval periods are used for all final reports for the N9/N10 Phase 4: Knocktopher to Powerstown excavations.

Mesolithic: 7000–4000BC
Neolithic: 4000–2500BC
Early Bronze Age: 2500–1700BC
Middle Bronze Age: 1700–1200BC
Late Bronze Age: 1200–800BC
Iron Age: 800BC–AD500
Early medieval period: AD500–1100
Medieval period: AD1100–1600
Post-medieval: AD1600–1800

Source:
Carlin, N., Clarke, L. & Walsh, F. 2008 *The M4 Kinnegad-Enfield-Kilcock Motorway: The Archaeology of Life and Death on the Boyne Floodplain*. NRA Monograph Series No. 2, Wordwell, Bray.

2 EXCAVATION RESULTS

The site was situated on flat marshy poorly drained pasture land, with a stream located on its eastern and north-eastern edges. The surrounding fields are being used for pasture and are gently rolling, although the immediate terrain is quite level. There are hills visible to the north and north-west and these span towards the west and south-west. Hills are also visible to the east and north-east. The Blackstairs Mountains are visible to the east and Brandon Hill is visible to the south. Cranavonane 2 is located *c*. 400m to the north-east and would be visible if the view was not obscured by the field boundary.

2.1 PHASE 1 Natural Drift Geology

Context	Fill of	L(m)	W(m)	D(m)	Basic Description	Interpretation
C14	N/A	N/A	N/A	N/A	Yellowish brown sandy clay	Subsoil

The subsoil consisted of a yellowish brown sandy clay.

2.2 PHASE 2 Archaeological Activity

2.2.1 Trough

Context	Fill of	L(m)	W(m)	D(m)	Basic Description	Interpretation
C6	N/A	4.40	3.00	0.48	Rectangular shape with a gradual base	Pit/trough within *fulacht*
C7	C6	1.80	N/A	0.18	Black silty clay with charcoal	Upper fill of pit/trough
C8	C6	1.30	N/A	0.30	Black silty sandy clay with charcoal	Bottom fill of pit/trough

Finds: None

This large rectangular trough (Figures 4 and 5; Plate 2), situated beneath the burnt mound material, contained charcoal-rich, silty clay and heat-shattered stones. No other archaeological features were identified in its vicinity.

Charcoal was retrieved from trough fill C7 during post-excavation soil flotation. This was subsequently identified to species. Fragments of ash (*Fraxinus excelsior*), alder (*Alnus glutinosa*) and blackthorn (*Prunus spinosa*) charcoal were identified and are most likely representative of firewood used on site and associated with ancillary activities at the burnt mound (O' Carroll, Appendix 2.1). The results also suggest the exploitation of a more open scrub type environment rather than a woodland area (*ibid*).

Stone retrieved from trough fill C7 was analysed and was found to be very course grained, quartz rich, red/ yellow sandstone. The material consisted of sub-rounded to sub-angular stones and included broken cobbles. Course grained sandstone is typical of *fulacht fiadh* material (Mandal, Appendix 2.2). Sandstone does not occur in the underlying bedrock in the immediate vicinity of the site and so was likely to have been sourced from glacial tills / river cobbles or from outcrop in the locality. It is significant that sandstone was used for this activity given that the underlying bedrock was limestone. This indicates that sandstone was deliberately being selected for use (*ibid*). Similar material was recovered from burnt mound material C3 (Section 2.2.2).

2.2.2 Burnt Mound Deposits/Spreads

Context	Fill of	L(m)	W(m)	D(m)	Basic Description	Interpretation
C2	N/A	7.50	4.60	0.39	Dark grey/brown/black clayey sand	Burnt mound deposit
C3	N/A	8.00	N/A	0.10	Dark grey silty clay	Burnt mound deposit
C4	N/A	1.60	N/A	0.04	Dark grey silty clay	Burnt mound deposit
C9	N/A	4.50	N/A	0.31	Dark grey/brown/black clayey sand	Burnt mound deposit
C10	N/A	7.50	N/A	0.15	Dark grey silty clay with stones	Burnt mound deposit

Finds: None

The burnt mound (Figures 4–5; Plate 1) covered an area of 34.5m^2 and was 0.39m in depth. The burnt deposits were dark grey silty clays containing an abundance of heat-shattered stones. A nearby stream, located east and north-east of the burnt mound caused frequent waterlogging in this area, therefore making the total resolution of the burnt mound unattainable.

Charcoal was retrieved from burnt mound material C3 during post-excavation soil flotation. This was subsequently identified to species. Fragments of hazel charcoal (*Corylus avellana*) and charcoal from pomaceous woods (*Pomoideae* spp.) were identified (O' Carroll, Appendix 2.1). As mentioned in Section 2.2.1, the charcoal present is most likely representative of firewood used in the activity associated with the burnt mound (*ibid*). A small fragment (1.9g) of hazel was chosen for AMS dating and returned a result of 3021±25 (UBA 12250). The 2 Sigma calibrated result for this was 1386–1135BC (QUB, Appendix 2.3) dating this feature to the middle / late Bronze Age.

Stone retrieved from burnt mound material C3 was analysed and was found to be very course grained, quartz-rich, red / yellow sandstone which is typical of *fulacht fiadh* type material. The material consisted of sub-rounded to sub-angular stones and included broken pebbles (Mandal, Appendix 2.2). As mentioned above, sandstone does not occur in the underlying bedrock and appears to have been deliberately selected for use in the activity on site (*ibid*).

2.2.3 Pit

Context	Fill of	L(m)	W(m)	D(m)	Basic Description	Interpretation
C11	N/A	1.18	0.90	0.27	Oval in shape with a flat oval base	Oval pit
C12	C11	1.19	0.90	0.19	Greyish black silty clay with stones	Upper fill of pit
C13	C11	0.93	0.65	0.08	Yellowish grey silty clay with pebbles	Lower fill of pit

Finds: None

This isolated pit (Figure 4; Plate 3), located *c*. 25m south-west of the trough C6, had no obvious associations with the burnt mound activity. Its function is unknown.

2.3 PHASE 3 Topsoil

Context	Fill of	L(m)	W(m)	D(m)	Basic Description	Interpretation
C1	N/A	N/A	N/A	N/A	Mid to dark brown silty clay	Topsoil

Finds
None

The topsoil consisted of mid- to dark-brown silty clay and sealed the entire site.

3 SYNTHESIS

The synthesis presents the combined results of all of the archaeological analysis carried out at Cranavanone 1. This includes the analysis of the physical and archaeological landscape, the compilation of information gathered during research into the site type, date, and function, and the results of the excavation and specialist analysis of samples taken during the course of on-site works.

3.1 Landscape Setting – compiled by Michelle Brick

3.1.1 The General Landscape

The topography of the region through which the route passes is generally flat with an average height of 70m O.D. The southern periphery of the route is bordered by Kilmacoliver (261m) and Carricktriss Gorse (314m), with Slevenamon (721m) further west. The Slieveardagh hills (340m) are visible on the western horizon in the south of the route and with the exception of Knockadrina Hill (140m), the enclosed landscape is made up of minor undulations. In the centre of the route Freestone Hill (130m) and Knocknagappoge (334m) further north are the significant uplands. A number of hills and mountains are visible in the distance to the east and west of this area of the landscape but the topography remains generally flat. To the north the Castlecomer Plateau influences a rise in the overall topography of the region. This expanse of terrain stretches along the north-east margins of Kilkenny, crosses the county border into Carlow and stretches northwards into Laois. This plateau consists of a variety of hills and peaks including Mountnugent Upper (334m), Baunreagh (310m), Knockbaun (296m), Brennan's Hill (326m) and Fossy Mountain (330m). These hills contain seams of anthracite coal as a result of millions of years of compression, and consequently Shales and Sandstones were formed which are evident throughout the plateau. Mining in the region began in the 17th century, continued for over 300 years and it is for what Castlecomer is best known. According to the Environmental Protection Agency soil maps of Ireland, the underlying bedrock of the entire region primarily consists of Carboniferous Limestone. However there is also a small amount of surface bedrock, sands, gravels, shales and sandstone Tills present along the route. The soil cover of the region is primarily composed of Grey Brown Podzolics, Renzinas and Lithosols. Additional soil types also present along the route include Brown Earths, surface Water Gleys and Ground Water Gleys.

The prevailing water courses within the landscape of the N9/N10 Phase 4 are the Rivers Nore and Barrow. The River Nore rises on the east slopes of the Devil's Bit in Co. Tipperary and flows eastwards through Borris-in-Ossory and then south through Co. Kilkenny, passing through the towns of Durrow (Laois), Ballyragget, Kilkenny, Bennettsbridge and Thomastown to join the River Barrow upstream of New Ross, Co. Wexford. It is 140 kilometres long and drains a total catchment of 1572 square kilometers and runs through the central and southern sections of the route. In the south of the route three main tributaries of the River Nore are evident. The Kings River flows east through Callan and Kells. It is joined by the River Glory which meanders on a north-south axis towards the western margins of the route landscape and the Little Arrigle River flows along the southern fringes. These rivers are flanked by low-lying valleys that are characterised by wet, marshy land. The condition of the soil improves further north beyond the King's River where the influence of these waterways declines. In the northern area of the route the River Dinin is a tributary of the River Nore flowing south-west from Brennan's Hill through the Castlecomer Plateau. The Plateau is the tableland that is the watershed between the Rivers Nore and Barrow (Lyng 1984). The River Barrow is the second longest river (193 kilometres) in Ireland after the River Shannon. It rises in the Slieve Bloom Mountains in Co Laois and flows east across bogs and lowlands and then turns south into the lowland immediately east of the Castlecomer Plateau. It passes through

Portarlington, Athy, Carlow, and Graiguenamanagh and runs through northern section of the route. It is joined by the River Nore at New Ross. The Maudlin River is the notable tributary of the River Barrow within the landscape of the route and flows east from Old Leighlin, with minor tributaries of it flowing through Banagagole. There are also streams and minor watercourses present throughout the entire landscape and these waterways would have been a valuable resource to past communities and would also have had a major influence on settlement and the surrounding land use.

The physical landscape through which the N9/N10 Phase 4 passes can be divided into three principal areas defined by the main rivers and their catchments. The southern area is located in the undulating landscape on the western flanks of the Nore Valley. The central area is dominated by the fertile watershed between the Barrow and Nore systems in the hinterland of Kilkenny City. The northern area is located on the western flanks of the Barrow Valley overlooked by uplands to the north and west. Cranavonane 1 is located in the northern landscape area.

3.1.2 The Northern Landscape

The northern landscape of the N9/N10 crosses the border from Kilkenny into Carlow and traverses the western side of the River Barrow; the Blackstairs Mountains, which are of granite formation, are located to the east of the Barrow. It includes 50 sites discovered during the Phase 4 excavations stretching from Rathcash 1 northwards to Tomard Lower 1. This northern landscape is overlooked to the west by the Castlecomer Plateau, and the excavated sites are all situated on contours of 50–100m OD. From the south-west of the Barrow, and encroaching into the northern landscape, the underlying limestone is dolomitized and consequently the permeability has been increased. The glacial drift comprises slightly sandy (20–60%) slightly gravely clays with a moisture content of 10–20%. There is therefore significantly less sand but higher moisture content than in the southern and central landscapes. This moisture occurs in the wetter deposits in the top 1–2m before ground level in localised areas with silty sand and gravel lenses indicating a high water table. To the east of the River Barrow, localised silty, laminated clays and peat occur. Soft ground was noted in the river's floodplain. The area is also classified as a minor aquifer in the Kilkenny Groundwater Protection Scheme (Buckley & Fitzsimmons, 2002) due to these thick sand and gravel deposits. Progressing northwards, the views become more expansive, and the rising high ground of the Castlecomer Plateau (50–300m OD) bounds the distant landscape. This plateau consists of a variety of hills and peaks, which contain seams of anthracite, the focus of coal mining in the region from the 17th century..The Blackstairs Mountains (735m) are visible on the horizon to the south-east, and most obvious of these is the peak of Mount Leinster (795m). There are impressive views from these plateaus and hills especially to the south, east and west over the Barrow and Nore Valleys.

The prevailing watercourse of this region is the River Barrow which travels north–south through the landscape. The Maudlin River is a tributary of the River Barrow and flows from the west through Old Leighlin; minor tributaries of this river flow through Bannagagole, directly north of Moanmore, and the River Dinin is a tributary of the River Nore which travels south-west from Brennan's Hill through the Castlecomer Plateau. The suffix 'comer' signifies a meeting of the rivers; it also signifies any deep gripe, such, for instance, as the channel formed by a mountain stream (Carrigan 1905). From the hinterland of Kilkenny and the confluence of the Nore and Barrow the Monefelim River contributes to the occurrence of wet grassland and broadleaf woodland. The narrow tributaries of the River Barrow, including the Monefelim River, as well as the Maudlin River, flow from the higher, steep, escarpment located to the west. Subsoils in this area consist of undifferentiated alluvium and soils of mineral alluvium. The route crosses into County Carlow where

at Moanmore (meaning 'great bog') a variety of archaeological features have been recorded. At the most northerly point of the N9/N10 the land is again characterised by its views; here they include the Barrow Valley, Mount Leinster, Brandon Hill, and the Blackstairs Mountains.

3.1.3 Site Specific Landscape

The site was situated on flat marshy poorly drained pasture land, with a stream located on its eastern and north-eastern edges. The surrounding fields are being used for pasture and are gently rolling, although the immediate terrain is quite level. There are hills visible to the north and north-west and these span towards the west and south-west. Hills are also visible to the east and north-east. The Blackstairs Mountains are visible to the east and Brandon Hill is visible to the south. Cranavonane 2 is located *c*. 400m to the north-east and would be visible if the view was not obscured by the field boundary. Coolnakisha 2 is located *c*. 500m to the south-west. There are a number of recorded monuments in the vicinity. An enclosure (CW012-083) is located *c*. 100m to the west, a metal working site (CW011-008) is recorded *c*. 400m to the south-west and an earthwork (CW012-039) is recorded *c*. 500m to the ESE.

3.2 The Archaeological Landscape

As part of the general research relating to sites along the scheme and the specific research relating to Cranavonane 1, the known archaeology within the surrounding landscape was assessed in order to establish the level and type of activity in the surrounding area in the past. This included a review of information from the Record of Monuments and Places, previous excavations and other relevant documentary sources including mapping and other sites excavated as part of the N9/N10 Phase 4 scheme. The excavated archaeology at Cranavonane 1 has been identified as being Bronze Age in date.

3.2.1 General Bronze Age Landscape of the Scheme – compiled by Michelle Brick

The archaeological record implies that the Irish Bronze Age (2500–800BC) population dramatically increased from that of the Neolithic and the evidence for permanent settlements with considerable longevity becomes much more substantial. In addition, a wide range of ritual and funerary activity associated with this settlement is apparent. The overall environmental record for Ireland suggests that there was a general climatic deterioration in the Bronze Age, bringing wetter, colder conditions; during this period there was also accelerated forest clearance with more intensive habitation in the drier lowlands. As a result of extensive development-led projects across the country, understanding of settlement and burial patterns from the early Bronze Age has greatly developed. The distribution of the prehistoric evidence shows that the Rivers Nore and Barrow provided a focus for settlement. In the central part of the current portion of the N9/N10 Phase 4 the fertile Kilkenny lowlands have produced some Bronze Age archaeology, particularly in Danesfort and Ennisnag townlands. In the northern part of the scheme intense settlement is indicated by both burnt mounds and barrows existing on the uplands of the Castlecomer Plateau and the flanking valleys of the Nore and Suir. Hillforts appear to be positioned to overlook the settlement activity, as well as the route of the Nore, the lower saddle to the north of the Slieveardagh Hills, and to the south of the spur surmounted by Clonmantagh. A considerable number of ringditches, cremation and inhumation burials (single and grouped), burnt mound sites, structures and domestic settlement evidence, have been recorded as part of the Bronze Age on the N9/N10 Phase 4.

In the southern landscape the exposure of domestic Bronze Age settlement was less forthcoming than that of the northern landscape. There was little direct evidence for

structures in the southern and central landscapes with the exception of a cluster of structures in the Danesfort area. Instead most of the settlement activity that fell within the roadtake was noted in the northern landscape, further to the north of Kilkenny and in Carlow. Ritual and burial is a dominant feature of the Bronze Age in Kilkenny and Carlow as indicated by the presence of flat cemeteries, burial cairns, ringditches, mounds, barrows and hillforts throughout these counties. Freestone Hill situated in Coolgrange, Co. Kilkenny, in the centre of the present landscape is just one example of these sites. Along the lower part of the Nore Valley, and concentrated in the Foulksrath and Jenkinstown areas, the landscape is dominated by barrows (in this case more specifically ringditches). The contrasting locations of these site types most probably relate to differential landscape exploitation by the same communities with some activities, possibly associated with the seasonal use of upland pasture, confined to higher terrain and settlement and funerary activity taking place in the more sheltered lowlands.

The significant number of burnt mound sites discovered due to the N9/N10 excavations, combined with the previously known examples in the RMP reinforces the concept that Bronze Age activity in Kilkenny and Carlow was considerable. A total of 36 sites with evidence for burnt mound activity were uncovered during the N9/N10 excavations, with an additional example discovered, and preserved outside, the roadtake. The burnt mounds are focussed in the upland area, especially along the river and stream valleys, such as at Clashduff, Coan West and Muckalee on the Dinin and Douglas Rivers, and in the upland hinterland of Freestone Hill.

The distribution of the prehistoric evidence shows that the Rivers Nore and Barrow provided a focus for Bronze Age settlement. The patterning of human activity in the region indicates that these were also the principal route-ways in prehistory; both were navigable by small craft but they, and the major tributaries of the Nore - the Dinin and King's Rivers - were also conspicuous landscape features that facilitated accurate navigation through this landscape. The Barrow and Nore also provided access to wider networks beyond the region.

The Northern Landscape: Domestic Settlement

The domestic settlement evidence from the landscape along the northern sections of Kilkenny and the border with Carlow can be characterised by multi-period sites, such as at Moanduff 2–3, and by clusters of activity represented by multiple burnt mound sites and several, possibly associated, structures. This part of the Barrow is overlooked by the hillforts at Freestone Hill (KK020-018002) (Coolgrange), Ballinkillin (CW019-027) and Killoughternane (CW019-065). However, the distinct clustering of the Paulstown area sites suggests the existence of a community separate to that in the immediate vicinity of Freestone Hill although it is probable that the hillforts reflect a wider landscape control system involving co-operation or alliance between a number of communities in the Kilkenny region. In addition to the indirect evidence in the form of burnt mounds and cultural deposits in pits, several structures, of typical Bronze Age morphology, were recovered. At Garryduff 1 an external ring of 37 postholes and stakeholes was positioned in a shallow, curving slot-trench and enclosed an area 11m in diameter with an inner ring of 10 larger postholes (7m diameter). This structure was located on the edge of a break of slope, which led down to an adjacent river. Other features on site may represent a possible grain stand and pits for food storage/rubbish. In the south-western corner of the site a curving arc (12m long) of 18 postholes and stakeholes was identified which may continue beyond the site. Six kilometres to the north of Garryduff 1 was an oval-shaped structure at Shankill 4. This was most likely a hut (4m x 3m) and consisted of postholes, stakeholes, an internal hearth, and outlying pits. An arc of stakeholes measuring 3m by 2.5m on its north side might have formed an entrance porch.

Sherds from at least one domestic cordoned urn came from the site. A roundhouse at Moanmore 2 consisted of 14 postholes, a central hearth, and up to 50 associated stakeholes and postholes.

As well as two rectangular Neolithic structures at Moanduff 2–3 there were four, or possibly five, separate areas of Bronze Age activity identified. As the features representing this activity were heavily truncated it is impossible to identify their exact function however some may represent Bronze Age structures. A middle-late Bronze Age enclosure (180m x 160m) and late Bronze Age activity in the form of troughs with burnt clay and stone were also excavated on site. At Coneykeare 1 two very tentative structures were identified by the director and a fifth concentration of activity, incorporating burnt mounds and settlement activity; was noted at Coolnakisha 1. A five post, L-shaped possible temporary structure at Coolnakisha 1 was identified along with two pits containing burnt bone and a moderate amount of charcoal and flint. A spread, also containing a moderate amount of charcoal, burnt bone, flint and heat-shattered stones was located to the north-west of the possible structure. It is most likely that the burnt bone deposits within the features on this site are domestic in nature.

The Northern Landscape; Funerary and Ritual activity

Funerary evidence is represented by ringditches at Kellymount 5 and Paulstown 1 and simple pit cremations also at Paulstown 1. Evidence of the Bronze Age is present at Croan (Aghaviller Parish); where a food vessel was discovered, and also at Cruttenclough; where artefacts of amber, gold and bronze were found; there were 14 gold beads discovered with varying decoration together with graduated amber beads (Lyng 1984). The find circumstances of these artefacts is unknown however similar artefacts in the form of a necklace were discovered at Tara, around the neck of an adolescent male, buried in a pit (Herity and Eogan 1977) and it is likely that the Cruttenclough finds came from a similar burial context. They indicate trading links with Europe and a bronze sunflower pin was also discovered in this townland, which is of late Bronze Age type (Lyng 1984; Eogan 1974a, 87) and originally had a gold foil covering. Other material demonstrating a late Bronze Age presence in the area includes the large hoard from Ballytegan, Co. Laois (Eogan 1983); this contained three sunflower (two covered in gold foil) and one disc-headed pin, two socketed axes, a bracelet of twisted strands and a variety of both solid and hollow bronze rings. The rings are characteristic of Eogan's (1974b; 1993) midland province and this hoard demonstrates ritual activity in the region. Early Bronze Age activity is also evident in the adjacent area of Co. Carlow on the east side of the River Barrow. A cist burial at Killinane contained cremated bone and an upright tripartite bowl food vessel (Moore 1984). Similar discoveries were also found close by in Sliguff and Wells; both townlands are located in west Carlow along the Kilkenny border close to the landscape of the present scheme. The Sliguff cist contained a crouched inhumation that was accompanied by a bowl while the pit cemetery at Baunogenasraid was inserted into the mound of the earlier Linkardstown tomb (Raftery 1974). A large cemetery mound at Ballon Hill was discovered in the 19th century, which revealed a large assemblage of vases and collared urns in both pit and cist burials (Waddell 1990, 51–53).

Six of the sites in this northern landscape of the N9/N10 Phase 4 had evidence for prehistoric funerary activity which was represented by barrows, ringditches, cists and cremation deposits at Rathcash East 1, Garryduff 1, Paulstown 1–2, Kellymount 5, and Coolnakisha 1–2. This evidence broadens the funerary landscape of the Bronze Age in this region. A possible ringditch was recorded at Rathcash East 1. It was formed by two very shallow curvilinear cuts creating a circle with a diameter of 6m and potential openings or entrances (1.45m wide) mirroring one another on the

south-east and north-west sides. Nearby activity included a hearth and possible refuse pit. It is possible that this domestic activity was related to funerary practices associated with the ringditch; however, it is perhaps more plausible that, given the lack of associated burial activity (although the enclosed area had been truncated) and the occurrence of two entrances, the ringditch in fact represents a domestic structure.

At Garryduff 1 two unroofed structures, both comprising arcs of post- and stakeholes, may have been associated with a large, northwest-southeast pit (2m x 1.3m x 0.16m) located close to Structure 1. This pit contained a charcoal-rich deposit with burnt bone, heat-cracked stones and charred hazelnuts which had been deliberately deposited. Three postholes also containing similar material in their fills were arranged around the pit and a definite concentration of burnt bone was noted in this area of the site. It is possible that this pit and the adjacent postholes represent the remains of a draught pit for a pyre with the postholes at either side being used to stabilise the pyre structure for the duration of the process. Two cremation pits were located outside the enclosure which contained quite large chunks of human bone and possible pyre material.

The cemetery complex at Paulstown 1 consisted of both pit and cist burials. Three small cists (averaging 0.6m by 0.32m by 0.16m internally) were made expediently with slabs and blocks of local stone. Three other pits were less formally lined with stone. Each contained cremations but one cist produced two discrete deposits. Three other grave pits formed part of the cemetery. In one of these pits an unburnt human skull was placed on top of a washed cremation deposit. Several burials were accompanied by ceramic gravegoods. These gravegoods included burnt sherds from bipartite vases, a miniature cordoned urn and a miniature vase; a burnt flint scraper as well as charred seeds and hazelnuts also came from one of the cists. The largest grave at Paulstown consisted of a large pit or pits. This contained a complex sequence of deposition which appears to have begun with a circular pit which contained an inverted vase; this was disturbed by the insertion of Vessel 1, another inverted vase which survived intact. A miniature vase (No. 6) may have accompanied one of these burials. Subsequently, a second larger pit extended the grave to the south. The fragmentary remains of three pots (No.s 3–5) were deposited on the base of this pit and a large cremation deposit was placed over them. This deposit contained sherds from Vessels 5 and 6 as did a final silty fill. The evidence suggests that the grave was extended to accommodate burials disturbed from other graves. A large circular pit occurred on the edge of the cemetery (1.55m by 1.48m by 0.80m deep). This had originally been maintained as an open feature that filled naturally with water. Subsequently, a complex sequence of layers containing charcoal, burnt and unburnt bone, charred hazelnut shells and seeds, antler and flint (including flakes, blades and debitage), developed or was deposited in the pit. The proximity of this feature, which appears to have been a well, suggests that it was associated with the funerary activity on the site.

A double ringditch was identified at Kellymount 5. The external ringditch (12m diameter x 1.04m deep) was lined with a spread of burnt mound material, possibly relating to the earlier use of the site as a burnt mound complex. The only artefacts in this external ringditch consisted of three Bronze Age pottery sherds. The internal ringditch (5.6m diameter x 0.2m deep) was situated centrally within the external ringditch and also contained heat-shattered stones in its fills. A central pit had burnt bone inclusions. A further two pits were located to the south of the ringditches and both contained burnt bone inclusions. A substantial part of a vase urn came from one of the troughs associated with the burnt mound complex; while this may be derived

from the funerary activity it is evident that the vessel had been used in a domestic context and may have been a deliberate deposit in the base of the trough.

Evidence for funerary activity was also excavated at Coolnakisha 2, where one pit (0.33m x 0.26m x 0.13m) contained 25.5g of charcoal, 0.1g of charred seeds and 390.3g of burnt bone. Other pits and possible pits and spreads also contained burnt bone inclusions, although in much smaller quantities. Both sites produced small quantities of probably middle Bronze Age while residual Neolithic material in the form of three flint scrapers came from Coolnakisha 1.

It is therefore apparent that the central, northern part of Kilkenny contained the most varied evidence for burial and funerary activity. As the N9/N10 progresses northwards sites with a probable continuity of function and chronology emerge: from the Danesfort complex near the King's River to the varied ringditches and cremations at Templemartin 5 and the amalgamation of ritual and burial at Paulstown 1–2.

The Northern Landscape; Burnt Mound Activity

The evidence from the northern landscape, was dominated by clusters of burnt mounds and reinforces the patterning already indicated by the previously known archaeological record. Several previously identified burnt mounds were recorded in Cloghoge (KK020-039, KK020-075–076), Rathcash West (KK020-077–078), Shankill (KK016-003, KK016-010) and at Moanmore (meaning 'great bog') (CW015-007, CW015-014). Twenty seven sites with evidence of burnt mound activity were uncovered as part of the N9/N10 Phase 4 excavations within the northern landscape. The underlying limestone geology/glacial drift consisted of sandy/gravel-clays which have a higher moisture content than the southern and central landscapes resulting in a high water table in localised areas. This helps explain the presence of the considerably sized waterholes at these burnt mound sites, notably within the Jordanstown and Kellymount cluster (Jordanstwon 2&3 and Kellymount 1-3, 5&6). Other clusters of burnt mound activity in the northern landscape occurred at Ballyquirk 1,2&4, Moanmore 1&3, Moanduff 1,2&3, Rathcash 1&2, Blanchesvillespark 2,3&4 and Cranavonane 1&2. Other sites exhibiting burnt mound activity include Shankill 6, Bannagagole 1, Rathcash East 2, Tomard Lower 1 and Ballinvally 1. Due to the poor on-site conditions the sites at Cranavonane 2 and Blanchvillespark 2 were not fully resolved but were identified as burnt mounds. Burnt mounds were not excavated at Kellymount 1, Moanduff 2&3, Ballyquirk 1 and Ballinvally 1; however features associated with burnt mound activity were recovered and excavated at these sites indicating a clear association with this type of activity.

The Northern Landscape; Route-ways and communications

While it is clear that the rivers and streams are a major feature of the settlement networks the distribution of prehistoric activity, for example on the lowland fringes to the south of the Castlecomer Plateau, shows that other route-ways were functioning at both a local and regional scale. Within these network systems it is possible to identify particular concentrations of human activity. Some of these were already important in the early Neolithic while others became prominent only in the Bronze Age. Among the most significant of these are those in the area around Carlow, on the upper Barrow and its tributary the Burren River, which the archaeological work on the Carlow Bypass has highlighted (Dunne 2007). To the south of this, the eastern side of the Barrow in the Goresbridge area formed the core of a settlement zone that in the Bronze Age extended westwards across the river into the Paulstown area of Co. Kilkenny. The immediate environs of Kilkenny City also appear in the Bronze Age as a settlement focus, underlined as a result of the N9N10 excavations, while the southern end of the Castlecomer Plateau, with the major focal site on Freestone Hill,

has been highlighted by the discovery of new sites on the lowlands immediately to the south around Rathcash.

The Northern Landscape; Conclusions
In the northern part of the region, focussed on the uplands of the Castlecomer Plateau and the flanking valleys of the Nore and Suir, intense settlement is indicated by both burnt mounds and barrows. The burnt mounds are focussed in the upland area and especially along the river and stream valleys, such as at Clashduff, Coan West and Muckalee on the Dinin and Douglas Rivers, and in the upland hinterland of Freestone Hill. Along the lower part of the Nore Valley, and concentrated in the Foulksrath and Jenkinstown areas, the landscape is dominated by barrows (in this case more specifically ringditches). The contrasting locations of these site types most probably relate to differential landscape exploitation by the same communities with some activities, possibly associated with the seasonal use of upland pasture, confined to higher terrain and settlement and funerary activity taking place in the more sheltered lowlands. The large number of burnt mounds discovered on the lowland fringe to the east of the plateau, along the Barrow Valley, shows the development of intensive settlement throughout the northern part of the region. In this area the hillforts appear to be positioned to overlook the settlement landscape.

3.2.2 The Site Specific Archaeological Landscape of Cranavanone 1

There was one recorded monument in the immediate vicinity of Cranavonane 1 - an enclosure site (CW012-083) is recorded immediately to the west of the site. An earthwork (CW012-039) is recorded 400m to the east and further to the east a ring barrow (CW012-043) is recorded 1.15km away. To the south-east a possible enclosure site (CW012-041) is recorded 700m away and a mound site (CW012-042) is recorded a further 150m to the south-east. An earthwork site (CW012-061) is located 700m to the south. A *fulacht fiadh* site (CW011-011) is recorded 850m to the south-west and also to the south-west an enclosure site (CW011-010) is recorded 1.1km away. An enclosure (CW011-018) is also recorded 450m to the north-west.

At Cranavonane 1 the excavation revealed a small burnt spread which sealed a large rectangular trough dating to the middle-late Bronze Age period. A number of sites were excavated as part of the N9/N10 Phase 4: Knocktopher to Powerstown works that were in the vicinity of Cranavanone 1. Cranavonane 2 was situated 350m to the north-east of Cranavonane 1 and during testing a deposit of charcoal-rich material with heat-shattered stones was identified as belonging to a small burnt mound however no further excavation or recording was carried out at this site due to flooding. Cranavonane 3 was located 700m to the north-east and a small oval shaped kiln and pit dating to the middle Iron Age period were excavated. Tomard Lower was situated 1km away and three pits excavated in the north of site returned a late Neolithic-early Bronze Age and an early Bronze Age date. A burnt mound and associated features were also excavated at the site and this activity has been dated to the early Bronze Age.

Other sites were excavated to the south of Cranavanone 1 as part of the N9/N10 works. Coolnakisha 2 was located 380m away and consisted of scattered pits and postholes with no definitive structural plan. Dates returned from the site indicate late Neolithic and middle Bronze Age dates indicating this site had more than one phase of occupation. Coolnakisha 1 was located 700m away and consisted of a possible truncated structure with associated pits. The possible structure has been dated to the late Neolithic/early Bronze Age and a late Bronze Age date has been returned for one of the pits indicating this site also had more than one phase of occupation.

3.3 Typological Background of Burnt Mounds

Burnt mound sites (also commonly referred to as *fulacht fiadh*) are one of the most common field monuments found in the Irish landscape. The last published survey (Power *et al*. 1997), carried out over a decade ago, recorded over 7,000 burnt mound sites and in excess of 1,000 sites have been excavated in recent years through development led archaeological investigations. In spite of this no clear understanding of the precise function of these sites has been forthcoming.

Burnt mound sites are typically located in areas where there is a readily available water source, often in proximity to a river or stream or in places with a high water table. In the field burnt mounds may be identified as charcoal-rich mounds or spreads of heat shattered stones, however, in many cases the sites have been disturbed by later agricultural activity and are no longer visible on the field surface. Nevertheless even disturbed spreads of burnt mound material often preserves the underlying associated features, such as troughs, pits and gullies, intact.

Ó Néill (2003–2004, 82) has aptly identified these sites as the apparatus and by-product of pyrolithic technology. This technology involved the heating or boiling of water by placing fire-heated stones into troughs of water. Small shallow round-bottomed pits, generally referred to as pot boiler pits or roasting pits, are often associated with burnt mound sites. The purpose of these pits remains unclear. Occasionally large pits are also identified and may have acted as wells or cisterns. Linear gullies may extend across the site, often linked to troughs and pits, and demonstrate a concern with onsite water management. Post and stakeholes are often found on burnt mound sites and these may represent the remains of small structures or wind breakers.

Burnt mound sites are principally Bronze Age monuments and reach their pinnacle of use in the middle/late Bronze Age (Brindley *et al*. 1989−90; Corlett 1997). Earlier sites, such as Enniscoffey Co. Westmeath (Grogan *et al*. 2007, 96), have been dated to the Neolithic and later sites, such as Peter Street, Co. Waterford (Walsh 1990, 47), have been dated to the medieval period. Thus although burnt mound sites generally form a component of the Bronze Age landscape, the use of pyrolithic technology has a long history in Ireland.

Although there is a general consensus that burnt mound sites are the result of pyrolithic technology for the heating or boiling of water, the precise function of these sites has, to date, not been agreed upon. Several theories have been proposed but no single theory has received unanimous support. The most enduring theory is that burnt mounds sites were used as cooking sites. O'Kelly (1954) and Lawless (1990) have demonstrated how joints of meat could be efficiently cooked in trough of boiling water. The use of burnt mound sites for bathing or as saunas has been suggested as an alternative function (Lucas 1965, Barfield and Hodder 1987, O' Drisceoil 1988). This proposal is largely influenced by references in the early Irish literature to sites of a similar character and is very difficult to prove, or disprove. Others, such as Jeffrey (1991), argue that they may have been centres of textile production for the fulling or dyeing of cloth. More recent demonstrations by Quinn and Moore (2007) have shown that troughs could have been used for brewing, however, this theory has been criticised by leading Irish environmentalists due to the absence of cereal remains from most burnt mound sites (McClatchie *et al*. 2007)

3.4 Summary of the Excavation Results

Cranavonane 1 consisted of a small burnt spread (34.5m2) which sealed a large rectangular trough (4.4m x 3m x 0.48m). The trough contained heat-shattered stones in a charcoal-rich material. A small oval-shaped pit was situated approximately 25m

to the south-west of the burnt spread and did not contain burnt mound material. The site was bordered to the east and north-east by a stream, which was prone to flooding.

3.5 Summary of the Specialist Analysis

A number of specialists provided analysis of samples and artefacts recovered from the site as part of the post-excavation works. This work in part formed the basis for the dating evidence for the site. The detailed reports on the results of all analysis are in Appendix 2

Charcoal and Wood Species identification

Charcoal was examined from two contexts at Cranavonane, from a burnt mound and a trough fill. The identified charcoal is most likely representative of firewood used on site and associated with ancillary activities at the burnt mound. Ash (*Fraxinus excelsior*), hazel (*Corylus avellana*), alder (*Alnus glutinosa*), blackthorn (*Prunus spinosa*), and pomaceous fruitwood (*Pomoideae*) were identified in order of representation. The sample amount and fragment count were low from the assemblage at Cranavonane but the results suggest the exploitation of a more open scrub type environment rather than a woodland area.

Petrographical analysis

Samples of stone from the burnt mound material identified course grained red sandstone that was quartz rich. Coarse grained sandstone does not occur in bedrock in the immediate vicinity of the site. The dominant rock type in the area is limestone. It is important to note that these rock types were not necessarily sourced from bedrock. The sample is clearly a shattered cobble, indicating a secondary source, such as in the glacial tills / river cobbles. It is therefore possible that these rocks were sourced locally.

Coarse grained sandstone is typical of *fulacht fiadh* material (e.g. see Mandal 2004). It is significant that sandstone is the predominant rock type given that, due to the differing underlying bedrock, it would not be the most abundant rock type available, either in outcrop or in the overlying tills. This indicates that sandstones were deliberately being selected for use in preference to the more abundant finer grained rock types in the area.

Radiocarbon Dating

A single sample was sent for AMS radiocarbon dating.

A sample of hazel charcoal from burnt spread material C2 was sent for analysis and returned a 2 sigma calibrated date of 1386–1135BC (UBA 12250).

4 DISCUSSION AND CONCLUSIONS

4.1 Discussion

The excavation at Cranavonane 1 has produced evidence of burnt mound related activity that has been dated to the Bronze Age. Burnt mounds are often located in low-lying, marginal land and the immediate area surrounding the site is low lying and poorly drained, indeed the site was located adjacent to a small stream, which caused extensive waterlogging during the course of the excavation. The physical location of the site is very well suited to the site type.

There was no evidence for lining within the trough which is quite large in comparison to may other excavated examples. The mound material was also quite substantial suggesting that the site was potentially used more than once. The dearth of other significant archaeological features suggests that the main activity at the site was solely focussed on heating the water in the trough. There is no evidence from Cranavonane 1 as to what the heated water was subsequently used for. A small pit, to the south-west of the burnt spread, had no clear association with the burnt mound activity and its precise function is unknown.

Analysis of the surrounding area shows little previously known prehistoric evidence in the area. Indeed prior to the excavations that were carried out as part of the N9/N10 project there was no known prehistoric activity in the immediate area, although the presence of an enclosure less than 100m away may provide some evidence of potential continuity of settlement in the area. Along the route of the N9/N10 it was not uncommon to find clusters of sites, suggesting that certain areas of the landscape were more favourable to settlement over time, however Cranavanone 1 was somewhat isolated with the nearest site located *c*. 370m to the north – Cranavonane 2. This site consisted of a very small burnt spread but it was not possible to excavate it due to continued flooding and waterlogging. To the south Coolnakisha 2 provides evidence of early prehistoric activity with late Neolithic/early Bronze Age and middle Bronze Age dates returned. Further south at Coolnakisha 1 one of the dated pits was broadly contemporary with Cranavonane 1 but this site also had features dated to the early Bronze Age. The surrounding landscape shows scattered isolated prehistoric activity and this is probably consistent with the marginal nature of the general physical landscape of the wider area.

4.2 Conclusions

Cranavonane 1 is an important site locally as it provides the first evidence of activity within the immediate vicinity and adds to some other evidence of early prehistoric activity in the area. The nature of the excavated archaeology is not unexpected within the surrounding marginal physical landscape. The results of the excavation will add to the existing corpus of material that has been derived from burnt mound sites in the wider area, but the site does not have any wider regional significance.

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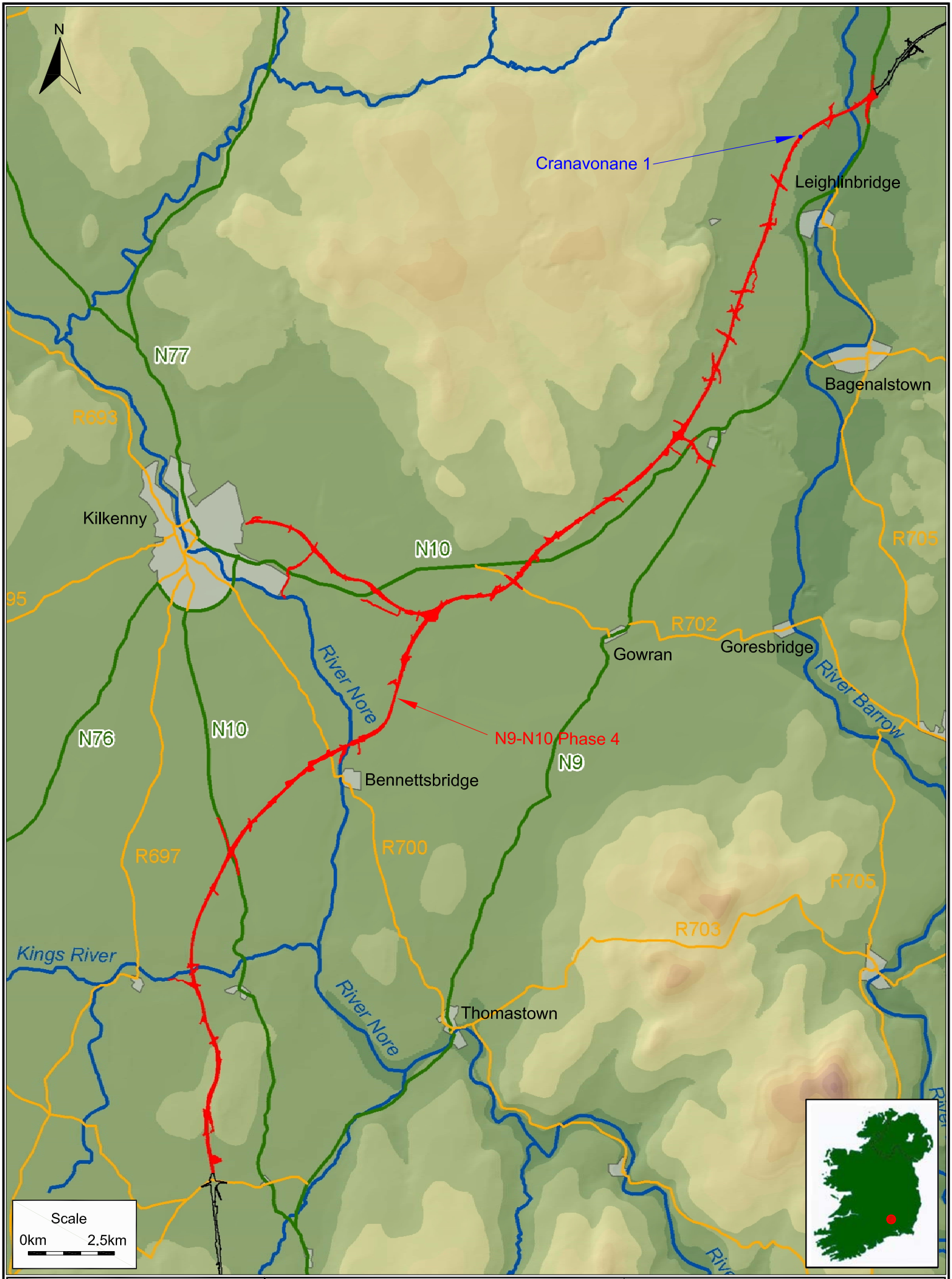

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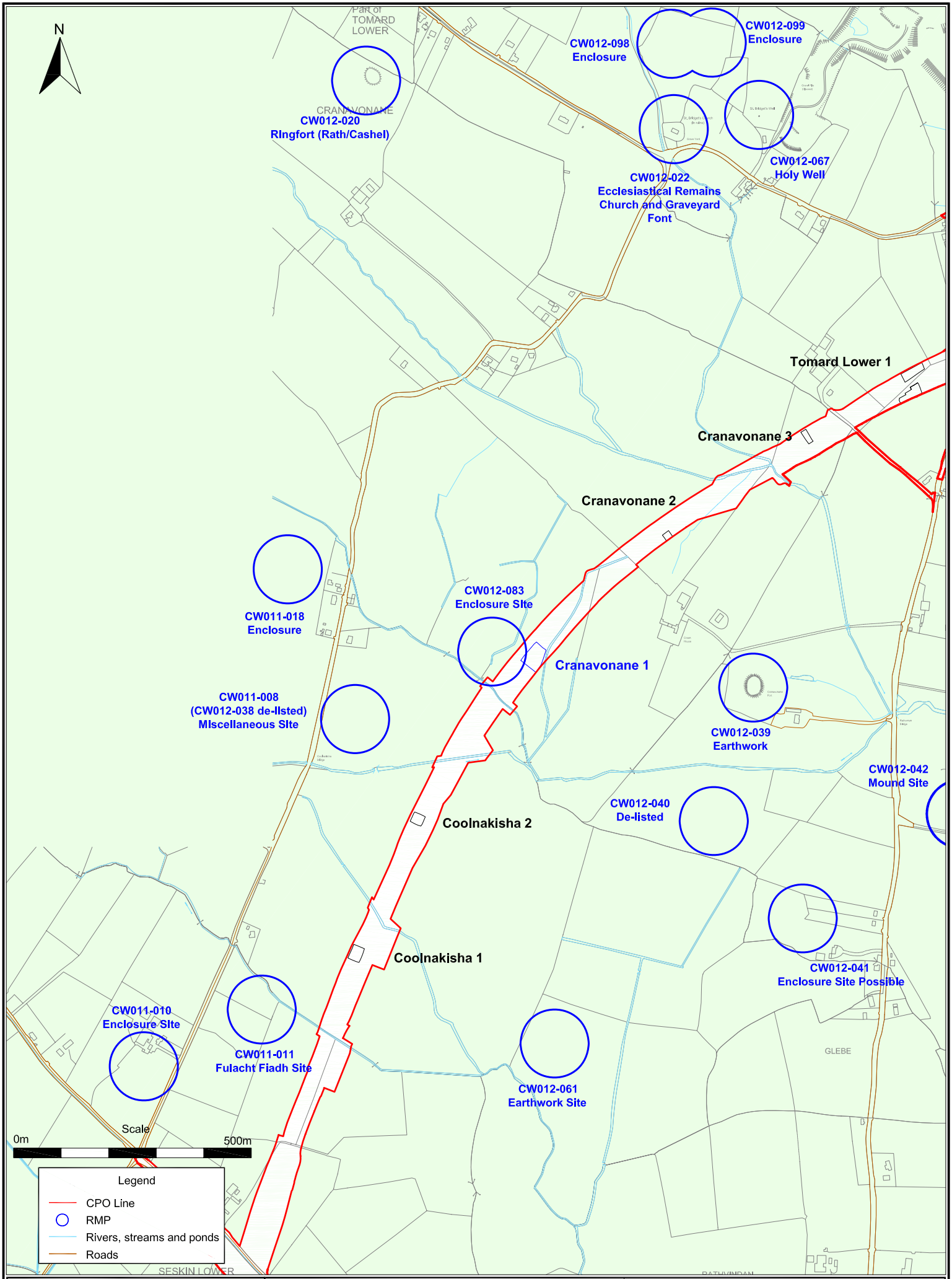

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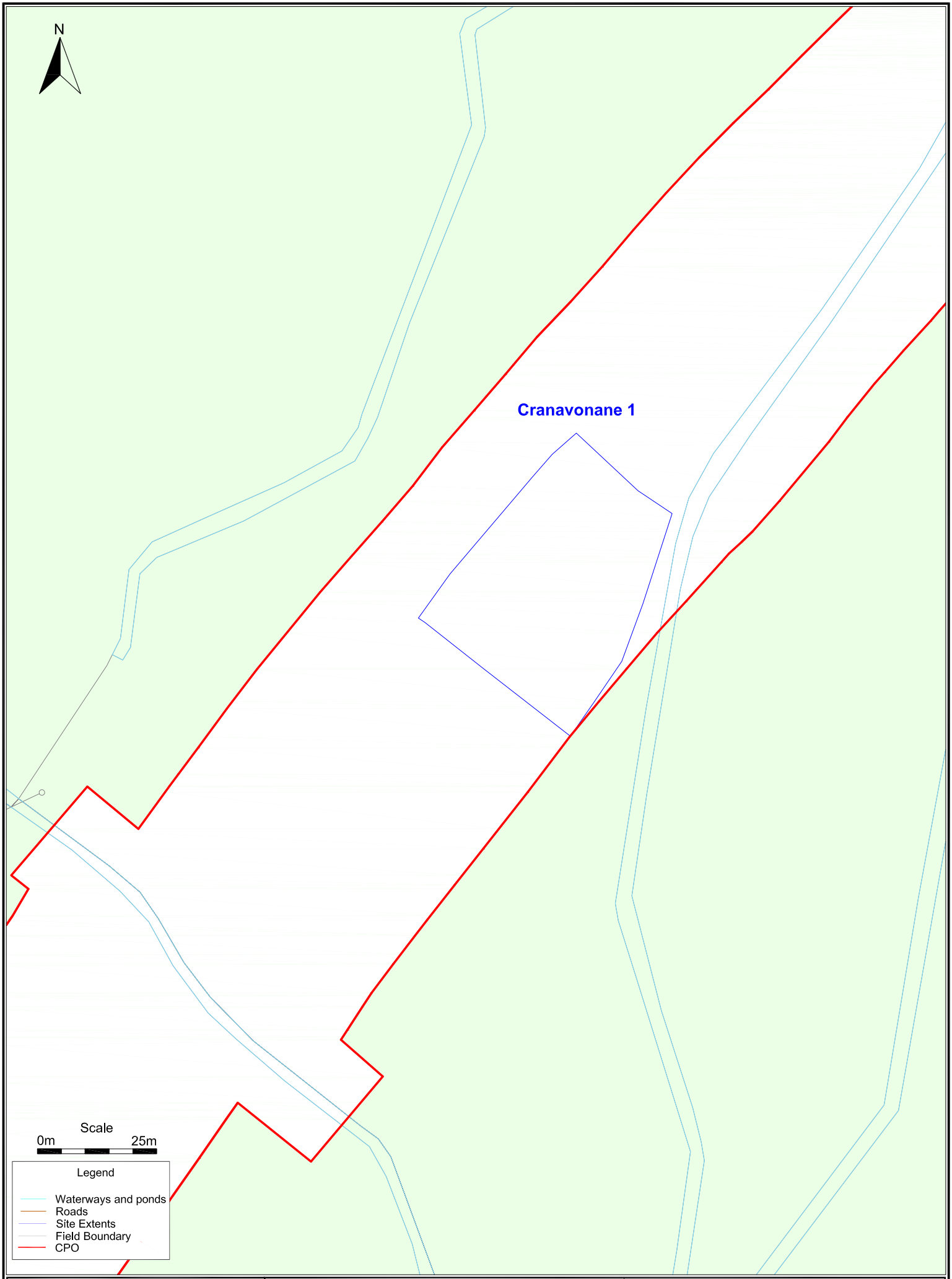

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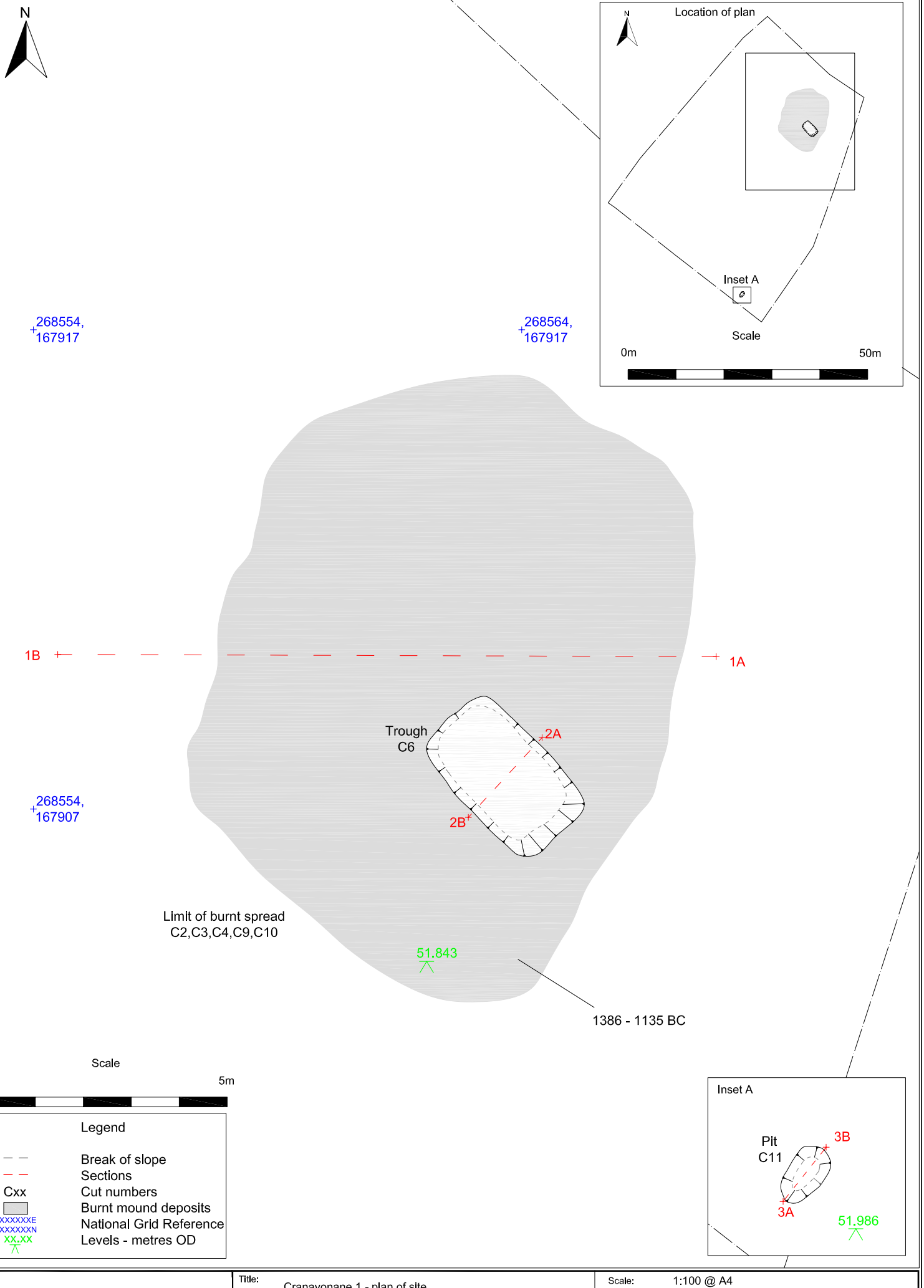
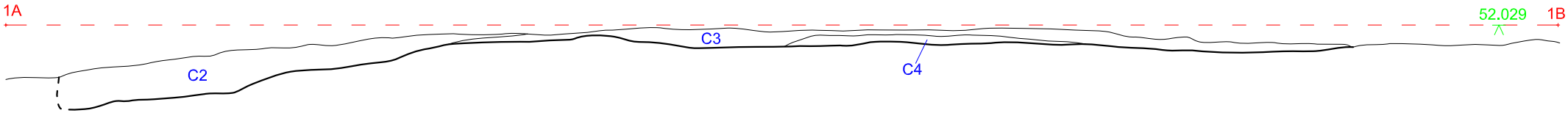
Figure No:	3

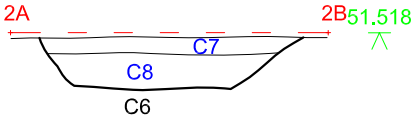


IAC Irish Archaeological Consultancy	Title:	Cranavonane 1 - plan of site	Scale: 1:100 @ A4
	Project:	N9/N10 Phase 4: Knocktopher to Powerstown	Date: 17/05/10
	Client:	Kilkenny County Council	Produced by: G Kearney
			Job No: J2432.1
			Figure No: 4

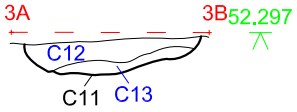
North facing section of burnt spread C2,C3,C4



Northwest facing section of C6



Southeast facing section of C11



Scale

0m 2.5m

Legend

Cxx	Cut numbers
Cxx	Fill numbers
xx.xx	Levels - metres OD

IAC Irish Archaeological Consultancy

Title:	Cranavonane 1 - sections 1-3
Project:	N9/N10 Phase 4: Knocktopher to Powerstown
Client:	Kilkenny County Council

Scale:	1:50 @ A4
Date:	17/05/10
Produced by:	G Kearney
Job No:	J2432.1
Figure No:	5

PLATES

Plate 1: Burnt spread C3, pre-excavation, facing north-west

Plate 2: Trough C6, post-excavation, facing south-west

Plate 3: Oval pit C11, post-excavation, facing south-east

APPENDIX 1 CATALOGUE OF PRIMARY DATA

Appendix 1.1 Context Register

Context	Fill of	L(m)	W(m)	D(m)	Interpretation	Description	Context Above	Context Below
C1	N/A	N/A	N/A	N/A	Topsoil	Topsoil	N/A	C14
C2	N/A	7.50	4.60	0.39	Burnt mound deposit	Moderately compacted dark grey brown black clayey sand with frequent heat shattered stones and charcoal	C1	C3
C3	N/A	8.00	N/A	0.10	Burnt mound deposit	Moderately compacted dark grey silty mouldy clay with frequent pebbles and charcoal	C2	C4
C4	N/A	1.60	N/A	0.04	Burnt mound deposit	Loosely compacted dark grey silty mouldy clay with frequent charcoal	C3	C14
C5	N/A	N/A	N/A	N/A	N/A	N/A		
C6	N/A	4.40	3.00	0.48	Pit/trough	Rectangular in shape, gradual break of slope with sloping sides leading to a gradual basal break of slope and a waterlogged rounded base	C8	C14
C7	C6	1.80	N/A	0.18	Upper fill of pit/trough	Loosely compacted black silty mouldy clay with frequent charcoal, burnt stone and roots	C1	C8
C8	C6	1.30	N/A	0.30	Bottom fill of pit/trough	Loosely compacted silty sandy clay with frequent pebbles, stones and charcoal	C7	C6
C9	N/A	4.50	N/A	0.31	Burnt mound deposit	Moderately compacted mouldable sticky dark grey/brown/black clayey sand with frequent heat shattered stones and charcoal	C1	C10
C10	N/A	7.50	N/A	0.15	Burnt mound deposit	Loosely compacted mouldable dark grey silty clay with frequent stones	C9	C14
C11	N/A	1.18	0.90	0.27	Oval pit	Oval in shape, sharp break of slope with angled sides leading to an imperceptible break of slope and a flat oval base.	C13	C14
C12	C11	1.19	0.90	0.19	Upper fill of pit	Sticky plastic mouldable greyish black silty clay with occasional small rounded and angular stones	C1	C13
C13	C11	0.93	0.65	0.08	Lower fill of pit	Sticky plastic mouldable yellowish grey silty clay with occasional pebbles	C12	C11
C14	N/A	N/A	N/A	N/A	Subsoil	Subsoil	C1	N/A

Appendix 1.2 Catalogue of Artefacts

There were no artefacts recovered from Cranavonane 1

Appendix 1.3 Catalogue of Ecofacts

During post excavation works specific samples were processed with a view to further analysis. A total of two soil samples were taken from features at Cranavonane 1 and were processed by flotation and sieving through a 250µm mesh. The following are the ecofacts recovered from these samples.

Context #	Sample #	Feature type i.e. Structure A, hearth C45	charcoal	Seeds & Hazelnut	Animal bone	Burnt animal bone	human bone	Shell	Other
C2	1	Burnt mound deposit	8.4g						
C7	2	Trough	0.8g						

Appendix 1.4 Archive Index

Project: N9/10 Phase 4 Knocktopher to Powerstown		
Site Name: Cranavanone 1		
Excavation Registration Number E3842		
Site director: Tim Coughlan		
Date: 03.06.10		
Field Records	**Items (quantity)**	**Comments**
Site drawings (plans)	5 plans	3 Pre-ex, & 2 Post-ex plans
Site sections, profiles, elevations	1 sheet	4 drawings, on 1 sheet
Other plans, sketches, etc.	0	
Timber drawings	0	
Stone structural drawings	0	
Site diary/note books		
Site registers (folders)	1	
Survey/levels data (origin information)		
Context sheets	14	
Wood Sheets	0	
Skeleton Sheets	0	
Worked stone sheets	0	
Digital photographs	27	
Photographs (print)	0	
Photographs (slide)	0	
Security copy of archive	Yes	Digital copy

APPENDIX 2 SPECIALIST REPORTS

Appendix 2.1 Charcoal and Wood Report – Ellen O' Carroll

Appendix 2.2 Petrographical Report – Dr. Stephen Mandal

Appendix 2.3 Radiocarbon Dating Results – QUB Laboratory

Appendix 2.1 Charcoal and Wood Report – Ellen O' Carroll

Client – Irish Archaeological Consultancy Ltd
Site Name- Cranavonane 1
Excavation number –E3842 AR141
County – Kilkenny
Author- Ellen O' Carroll

Date –4/9/09

Illustrations

Table & Figure

1 Introduction

Two charcoal samples were identified and analysed from excavations associated with burnt mound activity at Cranavonane 1, Co. Kilkenny as part of the resolution of the N9/N10 Kilcullen to Waterford Scheme, Phase 4b – Rathclogh to Powerstown. The site at Cranavonane 1 consisted of a small burnt spread which sealed a large rectangular trough. A small oval-shaped pit was situated approximately 25m to the south-west of the burnt spread. The site was bordered to the east and north-east by a stream, which was prone to flooding (Coughlan 2008).

Charcoal analysis is an important component of any post-excavation environmental work as it can help in re-constructing an environment hitherto lost to us, although this must be done with caution as sufficient sample numbers are required for a complete and full understanding of the immediate environment. Keepax suggest 50 charcoal samples in a European temperate climate (Keepax 1988). Charcoal and wood are also analysed and identified to determine what species are used and selected for particular functions on site i.e. post-holes, wall posts, firewood, burnt remains of wattle and other structural uses.

The results of the analysis from Cranavonane 1 will later form part of an overall scheme-wide charcoal study for the N9/N10 (Lyons, O'Donnell & OCarroll forthcoming).

2 Methodology (After IAC Ltd)

2.1 Processing

A mechanical flotation tank using a pump and water recycling system is used for soil flotation

- The soil is washed using a 1mm mesh in the flotation tank and a 300 micron and 1mm sieve is used to catch floated material.
- The volume of all soil samples are recorded in litres using a measuring jug.
- The sample is then placed into the 1mm mesh in the flotation tank, the tank is then filled with water and the sample washed. Any large lumps of soil can be carefully broken down by hand, but the jets of water in the flotation tank gently clean the rest of the sample.
- Once the sample is clean (just stones, charcoal, artefacts remaining in the mesh) the tank is fill up with water and at this stage any floating material (charcoal, seeds etc) should flow over the spout and into the sieves.
- The retent is then gently poured into a labelled tray (containing site code, site name, sample number and context number) and place on a shelf to dry.
- The flots are securely packaged in tissue, labelled and hung up to dry. This prevents any loss of light material (seeds) which could result once the flots are dry and being moved (if they are dried on trays).
- Before washing a new sample all equipment used (measuring jugs, 1mm mesh, sieves etc) are thoroughly washed using clean water.
- The large black settling tanks (and water) are cleaned between every site, or if a large site is being processed, every 1-2 weeks.
- Any samples containing high clay content will be soaked in water for 1-2 days to aid the sieving process.

2.2 Charcoal identification

The identification of charcoal material involves breaking the charcoal piece along its three sections (transverse, tangential and radial) so clean sections of the charcoal pieces can be obtained. This charcoal is then identified to species under a universal compound microscope reflected and transmitted light sources at magnifications x 10-400. By close examination of the microanatomical features of the samples, the

charcoal species are determined. Fifty fragments were identified from each sample, where possible.

A number of wood taxa cannot be identified to species or sub-species level anatomically. These include sessile oak (Quercus petraea) and pedunculate oak (Quercus robur); Hairy birch (Betula pubescens Ehrh) and silver birch (Betula pendula Roth) and English elm (Ulmus procera) and wych elm (Ulmus glabra), all of which are native to Ireland. In addition, taxa referred to as pomoideae in this report include apple, pear, hawthorn and mountain ash, which cannot be identified microscopically. There are also over 13 species of willow (Salix sp) and these species can-not be differentiated microscopically.

Details of charcoal recording
Each species was identified, bagged together and then weighed and each fragment counted. Insect channels and holes as well as fungal hyphae were noted on the charcoal fragments identified, as this may indicate the use of dead or rotting wood used for fuel or other such functions. The distinction can sometimes be made between trunks, branches and twigs if the charcoal samples are large enough. This was noted where possible by the presence of strongly or weakly curved rings. When charcoal samples showed indications of fast or slow growth this was also recorded. Finally the annual rings present on each charcoal fragment were counted.

3 Results

Charcoal was examined from a burnt mound deposit C2, and the trough fill C7 and a range of native taxa was identified from the assemblage. Some of the charcoal fragments identified from the burnt mound deposit were iron stained and thereby difficult to identify. There was only 9 charcoal fragments present in the trough fill and these were all identified. The weight and fragment count identified from each taxa type at each site is represented below in Figure 1 and Table 1.

Five wood taxa or trees were identified from the Cranavonane 1 samples. These were ash (Fraxinus excelsior), hazel (Corylus avellana), alder (Alnus glutinosa), pomaceous fruitwood (Pomoideae) and blackthorn (Prunus spinosa) in order of representation. Although the fragment count was low the results are dominated by ash and hazel, oak and pomoideae (Fig. 1).

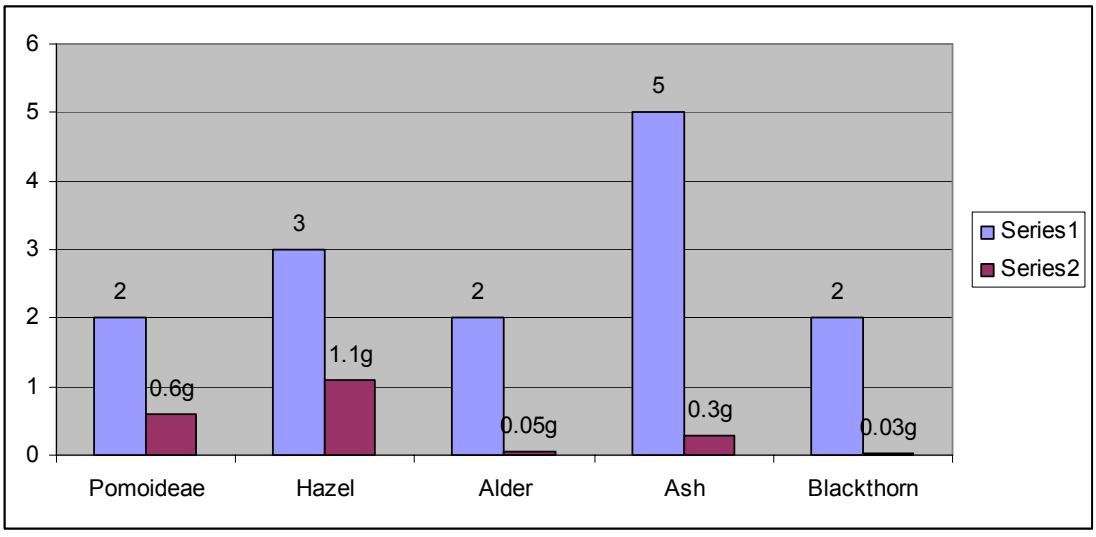


Fig. 1

4 Discussion

The wood identified from the burnt mound site excavated at Cranavonane is most likely representative of firewood used on site.

Five fragments of ash were identified from the trough fill. Ash is a native species to Ireland preferring lime rich freely draining soils. It is not a very durable timber in waterlogged conditions but has a strong elastic nature and is easily worked. Ash appears to have colonised the open land after the first farmers removed much of the native woodland therefore it is frequently used as structural timber in the later Bronze Age periods. Ash is also abundant in native hedgerows and was quite common in the later historic period.

Hazel, which was only identified from the burnt mound deposit, is a native species and was very common up to the end of the 17th century. McCracken (1971, 19) points out that “it was once widespread to a degree that is hard to imagine today”. With the introduction of brick, steel and slate the crafts associated with hazel became obsolete, and today the woods that supplied hazel have diminished rapidly. Hazel is normally about 3-5m in height and is often found as an understory tree in broadleaf woods dominated by oak. It also occurs as pure copses on shallow soils over limestone as seen today in The Burren in Co. Clare and survives for 30 to 50 years. Its main advantage is seen in the production of long flexible straight rods through the process known as coppicing. Hazel also makes good fuel.

Alder was present in the trough fill. Alder is a widespread native tree and occupies wet habitats along stream and river banks. Though it certainly flourishes best where its main roots are just above the water, the alder is also tolerant of stagnant water. The wood of the tree is white when growing, but when it is cut, turns red. It is soft, with short fibres, giving it a homogeneous texture and of moderate density. It is a very durable wood and was specially selected for boat-making and for dug-out canoes, as it is an easily worked and split timber and therefore quite commonly manufactured into planks. As fuel the alder is inferior in heating power to other woods, but for this reason, it is useful where a slow heat is required.

Pomoideae, which was only identified from the burnt mound deposit, includes apple, pear, hawthorn and mountain ash. It is impossible to distinguish these wood species anatomically but as wild pear is not native and crab apple is a rare native species in Ireland, it is likely that the species identified from the sites at Cranavonane is either hawthorn or mountain ash (rowan; Nelson 194-200, 1993). Hawthorn (Crataegus monogyna) is a native species, and is found in many hedgerows throughout Ireland. Mountain ash (Sorbus aucuparia) is also a common tree in Ireland growing particularly well in rocky and hilly mountainous places. Both species produce a very hard close grained wood, suitable for small implements such as mallets and splitting wedges. Both also make excellent fuel. C. monogyna is noted for being the hottest firewood (Gannon in Taylor 2006, 7).

The sloe bush, as blackthorn is commonly referred to, is a very durable wood and is as strong as oak. It is a thorny shrub found in woods and scrubs on all soil types. In a woodland situation it is more likely to occur in clearings and at the woodland edges, where it forms dense thickets.

The charcoal identifications, albeit from a small assemblage suggest the inhabitants were exploiting more of a scrub like environment rather than a dense woodland area. Alder prefers wetter ground.

5 Summary

Charcoal was examined from two contexts at Cranavonane, from a burnt mound and a trough fill. The identified charcoal is most likely representative of firewood used on site and associated with ancillary activities at the burnt mound. Ash (*Fraxinus excelsior*), hazel (*Corylus avellana*), alder (*Alnus glutinosa*), blackthorn (*Prunus spinosa*), and pomaceous fruitwood (*Pomoideae*) were identified in order of representation. The sample amount and fragment count were low from the assemblage at Cranavonane but the results suggest the exploitation of a more open scrub type environment rather than a woodland area.

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Table 1 Charcoal identification details from Cranavonane 1

Context number	Sample number	Flot weight (grams)	Context description	Wood species	No. of fragments	Charcoal weight (grams)	Size of fragments (mm)	No. of growth rings	Comments
2	1	8.4g	Burnt mound deposit	Pomoideae	2	0.6g	2-4mm	3-6 rings	Hard, iron stained, distorted microstructure, difficult to identify
				Corylus avellana (hazel)	3	1.1g	2-5mm	3-7 rings	
7	2	0.8g	Trough fill	Prunus spinosa (blackthorn)	2	0.03g	1-2mm	2-4rings	All identified
				Alnus glutinosa (alder)	2	0.05g	1-2mm	2- 4 rings	
				Fraxinus excelsior (ash)	5	0.3g	1-2mm	1-2 rings	

Appendix 2.2 Petrographical Report – Dr. Stephen Mandal

PETROGRAPHICAL REPORT ON STONE SAMPLES TAKEN DURING ARCHAEOLOGICAL EXCAVATIONS AT CRANAVONONE 1 (E3842)

EURGEOL DR STEPHEN MANDAL MIAI PGEO

1. Introduction

This report is based on the macroscopic (hand specimen) examination of stone samples taken during archaeological excavations in advance of the N9/N10 Phase 4b Knocktopher to Powerstown Road Scheme. The purpose of the study was to identify the rock types from which the stone objects were made, to highlight potential sources for them, and to comment on their possible function. It is important to note that macroscopic petrographical studies have been considered of limited value in comparison to microscopic (thin section and geochemical analysis) studies. On the other hand, macroscopic studies provide an excellent preliminary assessment tool and have proven to be of considerable value in petrographical studies (e.g. see Mandal 1997; Cooney and Mandal 1998).

2. Solid Geology and Soils of the Site (see Figure 1; McConnell 1994)

The bedrock under the site consists of crinoidal wackestone/ packstone limestone belonging to the Ballyadams Formation (shown on Figure 1 as BM).

The stratigraphical sequence in the area consists of the following. Gaps in the stratigraphically sequence are represented by line breaks.

Carboniferous (Silesian)
Coolbaun Formation (CQ) – Shale and mudstone with this coals

Moyadd Coal Formation (MC) – Shale, siltstone and minor sandstone
Bregaun Flagstone Formation (BE) – Thick flaggy sandstone and siltstone
Killeshin Silstone Formation (KN) – Muddy siltstone and silty mudstone
Luggacurren Shale Formation (LS) – Mudstone and shale with chert and limestone

Carboniferous (Dinantian)
Clogrenan Formation (CL) – Cherty, muddy calcarenite limestone
Ballyadams Formation (BM) – Crinoidal wackestone/ packstone limestone
Milford Formation (MI) – Peloidal calcarenite limestone
Butlersgrove Formation (BU) – Very dark grey argillaceous limestones

Ballysteen Formation (BA) – Fossiliferous dark-grey muddy limestone
Ballymartin Formation (BT) – Limestone and dark grey calcareous shales
Quinagh Formation (QU) – Lenticular mudstone and coarse siltstone

Porter's Gate Formation (PG) – Sandstones, shales and thin limestones

Devonian
Kiltorean Formation (KT) – Yellow and red sandstones, green mudstones
Carrigmaclea Formation (CI) – Red, brown conglomerates and sandstones

Ordovician
Oaklands Formation (OA) – Green, red-purple, buff shale, siltstone
Maulin Formation (MN) – Dark blue-grey slate, phyllite, schist

Igneous Intrusions
The Tullow Pluton (Tw) – Fine to coarse granites dating to *c*. 405Ma

The geology of the area is generally dominated by Lower Carboniferous Age rocks, principally limestones. These rocks, which also make up much of the Midlands of Ireland, represent the northward return of the sea at the end of the Devonian, *c*. 360 million years ago, owing to the opening of a new ocean to the south called the Palaeo-Tethys in what is now central Europe.

To the south of the study area occur Ordovician-Devonian Age rocks. The Devonian Age rocks consist of coarse sandstone and conglomerates representing terrestrial sediments resulting from a period of tectonic uplift.

The older, Ordovician Age rocks represent tectonic activity, relating to the closure of the Iaepetus Ocean, a major ocean which at its widest was probably greater than 3000km across. These rocks have been metamorphosed to slates, phyllites and schists by the intrusion of the Tullow granite pluton *c*. 405 million years ago.

Bedrock is not exposed at surface at the site; instead the overburden consists of boulder clay; surface drift from early glaciations. The area is part of a physical region known as the Caledonian province of the south-east. The soils of the area consist of acid brown earths (Aalen et al. 1997).

3. Results

Site	Ministerial Direction		NMS Reg.	Sample	Context	Notes		
Cranavonane 1	A032/164	AR141	E3842	1	2	Burnt;	Sub-rounded to sub-angular; includes broken cobbles;	Sandstone, very coarse to medium grained, quartz rich, red/yellow
Cranavonane 1	A032/164	AR141	E3842	2	7	Burnt;	Sub-rounded to sub-angular; includes broken cobbles;	Sandstone, very coarse to medium grained, quartz rich, red/yellow

4. Potential Sources

Coarse grained sandstone does not occur in bedrock in the immediate vicinity of the site. The dominant rock type in the area is limestone. Whilst there are minor sandstones within some of the limestone formations, the closest bedrock source for coarse grained yellow / red sandstone is within the Devonian Age Kiltorean Formation (yellow and red sandstones, green mudstones) and Carrigmaclea Formation (red, brown conglomerates and sandstones) (see Figure 1, shown as KT and CI respectively). It is important to note that these rock types were not necessarily sourced from bedrock. The sample is clearly a shattered cobble, indicating a secondary source, such as in the glacial tills / river cobbles. It is therefore possible that these rocks were sourced locally.

5. Discussion

Whilst it is not possible to determine a definitive source for these stone samples based on macroscopic examination alone, it can be stated that these rock types are available locally in outcrop and within the glacial tills / sub-soils. It is therefore probable that the material in these samples were sourced in the vicinity of the site.

A total of 159 samples were examined from the scheme across 33 sites (see Table 2). The samples showed a remarkable consistency across the scheme in terms of the principal rock type utilised; very coarse to medium grained sandstone, typically red to yellow in colour. All samples contained a variation of this type of rock as their principal component. Just under half (73) of the samples are clearly burnt / altered, but this does not rule out the possibility that the stone from other samples had been burnt. All bar one (a sample from Kellymount 5 (E3858:43:156)) contained angular pieces of stone, and 122 (77%) also contained sub-rounded to rounded pieces. A total of 63 of the samples contained pebbles and / or cobbles, in most cases broken. Five of the samples contained minor amounts of limestone as a secondary rock type to sandstone.

Site	Licence			No.	Burnt	Angular	Rounded	Pebbles	Limestone
Kilree 1	A032/107	AR091	E3728	1	0	1	0	0	0
Dunbell Big 2	A032/130	AR095	E3853	1	1	1	1	0	0
Holdenstown 4	A032/101	AR100	E3682	7	7	7	7	0	0
Rathcash 1	A032/133	AR102	E3859	3	0	3	3	3	0
Rathcash 2	A032/134	AR103	E3860	12	12	12	12	12	0
Rathcash East 2	A032/136	AR105	E3893	3	0	3	3	0	0
Blanchvillespark 3	A032/140	AR109	E3913	3	0	3	3	3	0
Blanchvillespark 4	A032/141	AR110	E3914	3	3	3	0	0	0
Ballyquirk 1	A032/143	AR112	E3863	1	1	1	1	0	0
Ballyquirk 2	A032/144	AR113	E3864	5	5	5	1	0	0
Ballinvally 1	A032/146	AR115	E3836	1	0	1	1	0	0
Garryduff 1	A032/147	AR116	E3852	4	0	4	0	0	0
Jordanstown 2	A032/151	AR120	E3851	4	4	4	0	0	0
Kellymount 6	A032/122	AR121	E3758	3	3	3	3	0	0
Jordanstown 3	A032/152	AR122	E3916	2	2	2	2	2	0
Kellymount 2	A032/111	AR124	E3757	11	4	11	11	9	1
Kellymount 3	A032/112	AR125	E3856	13	2	13	2	0	1
Kellymount 5	A032/114	AR127	E3858	27	10	26	24	21	3
Shankill 4	A032/153	AR130	E3838	5	1	5	4	0	0
Shankill 5	A032/154	AR131	E3850	2	1	2	1	0	0
Moanmore 1	A032/156	AR133	E3835	6	1	6	1	0	0
Moanmore 2	A032/157	AR134	E3843	2	0	2	2	0	0
Bannagagole 1	A032/159	AR136	E3844	3	2	3	3	3	0
Moanduff 1	A032/160	AR137	E3839	7	1	7	7	3	0
Coolnakisha 1	A032/128	AR139	E3768	1	0	1	1	1	0
Cranavonane 1	A032/164	AR141	E3842	2	2	2	2	2	0
Tomard Lower 1	A032/117	AR144	E3733	1	0	1	1	1	0
Paulstown 1	A032/093	AR145	E3642	3	1	3	3	2	0
Rathgarvan or Clifden 1	A032/125	AR147	E3760	1	0	1	1	0	0
Maddockstown 1	A032/126	AR148	E3759	3	3	3	3	0	0
Leggetsrath East 1	A032/118	AR154	E3734	1	1	1	1	0	0
Moanduff 3	A032/120	AR156	E3736	1	0	1	1	1	0
Ballyquirk 4	A032/167	AR157	E3848	17	6	17	17	0	0
Grand Total :				159	73	158	122	63	5

Table 2. Results of petrographical analysis of stone samples from the N9/N10 Phase 4b Road Scheme

Coarse grained sandstone is typical of *fulacht fiadh* material (e.g. see Mandal 2004). The use of angular and rounded pieces is interesting. Rounded pieces and / or the use of pebbles / cobbles is clear evidence of the use of secondary sources. Angular pieces are more indicative of the use of bedrock sources, but it is important to note that they could also represent angular blocks occurring in tills.

It is significant that sandstone is the predominant rock type given that, due to the differing underlying bedrock, it would not be the most abundant rock type available, either in outcrop or in the overlying tills. This indicates that sandstones were deliberately being selected for use in preference to the more abundant finer grained rock types in the area.

6. Bibliography

Aalen, F H A, Whelan, K and Stout, M 1997 *Atlas of the Irish Rural Landscape*. Cork University Press: Cork.

Cooney, G and Mandal, S 1998 *The Irish Stone Axe Project: Monograph I*. Wordwell: Wicklow.

Mandal, S 1997 Striking the balance: the roles of petrography and geochemistry in stone axe studies in Ireland. *Archaeometry* 39(2), 289-308.

Mandal, S 2004 Petrographical Report on Stone Samples found during Archaeological Investigations relating to the Sligo Inner Relief Road (Licence No. 03E0535). *Unpublished report commissioned by ACS Ltd for the NRA.*

McConnell, B (ed.), 1994 *Geology of Carlow-Wexford: A Geological Description to Accompany the Bedrock Geology 1:100,000 Map Series, Sheet 19, Carlow-Wexford*. Geological Survey of Ireland Publications. Westprint: Sligo.

Appendix 2.3 Radiocarbon Dating Results – QUB Laboratory

The "Measured radiocarbon age" is quoted in conventional years BP (before AD 1950). The error is expressed at the one-sigma level of confidence.

The "Calibrated date range" is equivalent to the probable calendrical age of the sample material and is expressed at the two-sigma (95.4% probability) level of confidence

Calibration data set: intcal04.14c

Context	Sample No	Material	Species id/ Weight	Lab	Lab Code	Date Type	Calibrated date ranges	Measured radiocarbon age (BP)	13C/12C Ratio ‰
C2, burnt spread material	1	Charcoal	*Corylus avellana* 1.9g	QUB	UBA 12250	AMS (std)	1370 - 1219 BC (1 sigma), 1386 - 1135 BC (2 sigma)	3021 ± 25	- 28.4

References for calibration datasets:
PJ Reimer, MGL Baillie, E Bard, A Bayliss, JW Beck, PG Blackwell, C Bronk Ramsey, CE Buck, GS Burr, RL Edwards, M Friedrich, PM Grootes, TP Guilderson, I Hajdas, TJ Heaton, AG Hogg, KA Hughen, KF Kaiser, B Kromer, FG McCormac, SW Manning, RW Reimer, DA Richards, JR Southon, S Talamo, CSM Turney, J van der Plicht, CE Weyhenmeyer (2009) Radiocarbon 51:1111–1150.

Comments:
* This standard deviation (error) includes a lab error multiplier.
** 1 sigma = square root of (sample std. dev.^2 + curve std. dev.^2)
** 2 sigma = 2 x square root of (sample std. dev.^2 + curve std. dev.^2)
where ^2 = quantity squared.
[ ] = calibrated range impinges on end of calibration data set
0* represents a "negative" age BP
1955* or 1960* denote influence of nuclear testing C-14
NOTE: Cal ages and ranges are rounded to the nearest year which may be too precise in many instances. Users are advised to round results to the nearest 10 yr for samples with standard deviation in the radiocarbon age greater than 50 yr.

APPENDIX 3 LIST OF RMP IN AREA

RMP No	Description
CW012-020	Ringfort
CW012-098	Ringditch
CW012-099	Enclosure
CW012-022001	Church
CW012-022002	Font
CW012-022003	Graveyard
CW012-067	Holy well
CW012-083	Enclosure
CW012-061	Earthwork
CW012-041	Enclosure
CW012-039	Earthwork
CW011-018	Enclosure
CW011-008	Metalworking site
CW011-011	*Fulacht fiadh*
CW011-010	Enclosure

See Figure 2 for location.

APPENDIX 4 LIST OF SITE NAMES

Site Name	Site Code	E Number	Director	NGR
Baysrath 2	AR055	E3627	Fintan Walsh	251593/137855
Baysrath 3	AR056	E3628	Fintan Walsh	251672/138000
Baysrath 4	AR057	E3629	Fintan Walsh	251515/138280
Danganbeg 1	AR058	E3606	Emma Devine	251462/138754
Danganbeg 2	AR059	E3607	Emma Devine	251397/138939
Danganbeg 3	AR060	E3671	Emma Devine	251430/139245
Danganbeg 4	AR061	E3676	Emma Devine	251401/139372
Knockadrina 1	AR062	E3677	Ed Lyne	251422/139420
Tinvaun 1	AR063	E3678	Ed Lyne	251482/139625
Tinvaun 2	AR064	E3680	James Kyle	251445/139736
Tinvaun 3	AR065	E3608	James Kyle	251501/139832
Tinvaun 4	AR066	E3609	James Kyle	251508/139917
Stonecarthy West 1	AR067	E3610	James Kyle	251538/140023
Knockadrina 1	AR068	E3611	James Kyle	251647/140237
Rathduff 1	AR069	E3612	Ed Lyne	251286/142167
Rathduff Upper 1	AR070	E3613	Ed Lyne	251280/142559
Kellsgrange 1	AR071	E3575	James Kyle	250911/143732
Kellsgrange 2	AR072	E3577	James Kyle	250967/143861
Kellsgrange 3	AR073	E3576	James Kyle	250948/144003
Ennisnag 1	AR074	E3614	Richard Jennings	251416/145690
Ennisnag 2	AR075	E3615	Richard Jennings	251638/146068
Danesfort 12	AR076	E3616	Richard Jennings	251669/146186
Danesfort 13	AR077	E3617	Richard Jennings	251765/146384
Danesfort 2	AR078	E3540	Richard Jennings	251953/146745
Danesfort 4	AR079	E3539	Richard Jennings	251880/147579
Danesfort 3	AR080A	E3542	Richard Jennings	252221/146845
Danesfort 1	AR080B	E3541	Richard Jennings	252267/146707
Croan 1	AR081	E3543	Emma Devine	252280/147332
Danesfort 5	AR082	E3546	Emma Devine	252567/147767
Danesfort 6	AR083	E3538	Emma Devine	252764/147995
Danesfort 7	AR084	E3537	Emma Devine	252878/148099
Danesfort 8	AR085	E3461	Richard Jennings	253020/148246
Danesfort 9	AR086	E3468	Richard Jennings	253089/148345
Danesfort 10	AR087	E3459	Richard Jennings	253229/148414
Danesfort 11	AR088	E3460	Richard Jennings	253245/148462
Rathclogh 1	AR089	E3726	Patricia Lynch	253365/145515
Rathclogh 2	AR090	E3727	Patricia Lynch	253650/148848
Kilree 1	AR091	E3728	Patricia Lynch	254088/149310
Kilree 2	AR092	E3729	Patricia Lynch	254320/149500
Kilree 3	AR093	E3643	Patricia Lynch	254449, 149639
Kilree 4	AR094	E3730	Patricia Lynch	255330/150084
Dunbell Big 2	AR095	E3853	Yvonne Whitty	256684/151066
Holdenstown 1	AR096	E3681	Yvonne Whitty	256737/151253
Holdenstown 2	AR097/98	E3630	Yvonne Whitty	256891/151781
Holdenstown 3	AR099	E3854	Yvonne Whitty	256990/152085
Holdenstown 4	AR100	E3682	Yvonne Whitty	256828/152048
Dunbell Big 1	AR101	E3855	Yvonne Whitty	257034/152315
Rathcash 1	AR102	E3859	Tim Coughlan	258178/154199
Rathcash 2	AR103	E3860	Tim Coughlan	258294/154293
Rathcash East 1	AR104	E3892	Tim Coughlan	259419/154546
Rathcash East 2	AR105	E3893	Tim Coughlan	259555/154566
Rathcash East 3	AR106	E3861	Tim Coughlan	259821/154653
Blanchvillespark 1	AR107	E3894	Richard Jennings	260535/155212
Blanchvillespark 2	AR108	E3895	Tim Coughlan	260637/155449

Site Name	Site Code	E Number	Director	NGR
Blanchvillespark 3	AR109	E3913	Tim Coughlan	260785/155653
Blanchvillespark 4	AR110	E3914	Tim Coughlan	261442/156269
Blanchvillespark / Ballyquirk 1	AR111	E3862	Ruth Elliott	261531/156323
Ballyquirk 1	AR112	E3863	Ruth Elliott	261531/156323
Ballyquirk 2	AR113	E3864	Ruth Elliott	261811/156508
Ballyquirk 3	AR114	E3865	Ruth Elliott	261875/156559
Ballinvally 1	AR115	E3836	Emma Devine	263258/157521
Garryduff 1	AR116	E3852	Emma Devine	263933/157991
Kilmacahill 1	AR117	E3915	Tim Coughlan	264267/158369
Kilmacahill 2	AR118	E3833	Tim Coughlan	264380/158453
Jordanstown 1	AR119	E3834	James Kyle	264546/158643
Jordanstown 2	AR120	E3851	James Kyle	264893/159038
Kellymount 6	AR121	E3758	Przemaslaw Wierbicki	265130,159277
Jordanstown 3	AR122	E3916	Przemaslaw Wierbicki	265103/159227
Kellymount 1	AR123	E3756	Przemaslaw Wierbicki	265250/159397
Kellymount 2	AR124	E3757	Przemaslaw Wierbicki	265164/159463
Kellymount 3	AR125	E3856	Przemaslaw Wierbicki	265338/159597
Kellymount 4	AR126	E3857	Przemaslaw Wierbicki	265412/159803
Kellymount 5	AR127	E3858	Przemaslaw Wierbicki	265530,159977
Shankill 2	AR128	E3738	Richard Jennings	265924/160651.
Shankill 3	AR129	E3737	Richard Jennings	266052/161141
Shankill 4	AR130	E3838	Richard Jennings	266286/161526
Shankill 5	AR131	E3850	Richard Jennings	266374/161730
Shankill 6	AR132	E3840	Richard Jennings	266403/161836
Moanmore 1	AR133	E3835	Richard Jennings	266476/162016
Moanmore 2	AR134	E3843	Sinead Phelan	266756/162866
Moanmore 3	AR135	E3837	Sinead Phelan	266856/163259
Bannagagole 1	AR136	E3844	Sinead Phelan	266942/163569
Moanduff 1	AR137	E3839	Robert Lynch	267261/164397
Coneykeare 1	AR138	E3683	Sinead Phelan	267836/166209
Coolnakisha 1	AR139	E3768	Ellen O'Carroll	268175/167274
Coolnakisha 2	AR140	E3767	Ellen O'Carroll	268306/167559
Cranavonane 1	AR141	E3842	Tim Coughlan	268554/167895
Cranavonane 2	AR142	E3732	Ellen O'Carroll	268830/168154
Cranavonane 3	AR143	E3731	Ellen O'Carroll	269123/168362
Tomard Lower 1	AR144	E3733	Ellen O'Carroll	269349/168496
Paulstown 1	AR145	E3642	Ruth Elliot	265889/158499
Paulstown 2	AR146	E3632	Ruth Elliot	265664/158651
Rathgarvan or Clifden 1	AR147	E3760	Przemaslaw Wierbicki	257026/154123
Maddockstown 1	AR148	E3759	Przemaslaw Wierbicki	256886/154199
Templemartin 3	AR149	E3845	Emma Devine	255095/155200
Templemartin 4	AR150	E3841	Emma Devine	254920/155427
Templemartin 5	AR151	E3846	Emma Devine	254706/155636
Templemartin 1	AR152	E3849	Emma Devine	254504/155826
Templemartin 2	AR153	E3847	Emma Devine	254173/156236
Leggetsrath East 1	AR154	E3734	Emma Devine	253793/156484
Moanduff 2	AR155	E3735	Sinead Phelan	267470/164887
Moanduff 3	AR156	E3736	Sinead Phelan	267515/164979
Ballyquirk 4	AR157	E3848	Richard Jennings	262596/157025
Shankill 1	AR158	E3766	Przemaslaw Wierbicki	265707/160269
Rathgarvan or Clifden 2	AR159	E3921	Tim Coughlan	257095/154119
Ballynolan 1	AR160	E3755	Sinead Phelan	267714/165597
Stonecarthy West 2	UA2	E3974	Tim Coughlan	251372/142037
Rathduff Bayley 1	UA4	E4011	Tim Coughlan	251005/143564