



**Ennis Watermains Rehabilitation Project
Co. Clare**

An Archaeological Monitoring Report

for

Ward & Burke Construction Ltd

15E0130

Graham Hull and Kate Taylor

TVAS Ireland Ltd

J15/06

September 2017

NGR 133500 177500 (centre)

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Summary

Site name: Ennis Watermains Rehabilitation Project

Townlands: Clonroad More, Clonroad Beg, Lifford and Cloghleagh, in the parish of Drumcliff, Barony of Islands and the townlands of Dulick and Ballycorey in the parish of Templemaley

Baronies: Bunratty Upper

County: Clare

Planning Ref. No: Part 8 Planning Clare County Council

Client: Ward & Burke Construction Ltd, Stradbally East, Kilcolgan, Co. Galway

National Grid Reference: 133500 177500 (centre)

Naturally occurring geology: Limestone bedrock and glacial till

TVAS Ireland Job No: J15/06

Licence No: 15E0130

Licence Holder: Kate Taylor

Fieldwork: Nora Bermingham, Graham Hull, and Kate Taylor

Site activity: Monitoring

Date of fieldwork: Sporadically between 30th April 2015 and 2nd February 2016

Date of report: September 2017

Report authors: Graham Hull and Kate Taylor

Summary of results: Archaeological monitoring of ground disturbance associated with pipe-laying in Ennis town and its suburbs located disarticulated human bone in two locations in the town centre. Whilst most of the bone is likely to date to the post-medieval period and relate to a demolished graveyard, one piece of bone was radiocarbon dated to the period between the early 14th and mid 15th century AD.

Monuments identified: None

Location and reference of archive: The primary records (written, drawn and photographic) are currently held at TVAS Ireland Ltd, Ahish, Ballinruan, Crusheen, Co. Clare.

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Ennis Watermains Rehabilitation Project, Co. Clare An Archaeological Monitoring Report

Graham Hull and Kate Taylor

Report J15/06a

Introduction

This report documents the results of archaeological monitoring undertaken on the Ennis Watermains Rehabilitation Project, Co. Clare (NGR 133500 177500 - centre) (Figs 1-7).

The following Government publications set out many of the procedures relating to planning/development and archaeology:

Framework and Principles for the Protection of the Archaeological Heritage (DAHGI 1999a)

Policy and Guidelines on Archaeological Excavation (DAHGI 1999b)

Archaeology and Development: Guidelines for Good Practice for Developers (ICOMOS 2000)

Review of Archaeological Assessment and Monitoring Procedures in Ireland (Lambrick and Doyle 2000)

The planning background

Irish Water in partnership with Clare County Council undertook the Ennis Watermain Rehabilitation project in 2015-2016. The project involved the replacement of old watermains that were prone to leakage, regular bursts and interruptions to supply in Ennis Town. A total of 12km of new polyethylene and ductile iron watermains was laid and 95 backyard and over 970 front of house service connections were replaced. Over 40 service connections were transferred to a recently constructed watermain in Clarecastle and a ring watermain between Claureen Roundabout, Lahinch Road and Kilrush Road will be re-commissioned. Upon completion, the project is expected to save approximately 1,343m³ of water a day with reduced levels of leakage or unaccounted for water, resulting in improved levels of water pressure to customers.

The scheme was granted Part 8 permission by Clare County Council.

An archaeological assessment was undertaken in advance of development (Tobin 2013). The report identified several areas of potential archaeological impact and recommended the following:

It is recommended that all ground works, including site investigations, associated with the proposed development within the zone of archaeological potential for the historic town of Ennis (SMR CL033-082) and within c. 50m of the following SMR sites be monitored by a suitably qualified archaeologist. Full provision should be made for the resolution of any archaeological features/deposits that may be discovered.

Lifford – bridge CL033-082014, riverside location opposite Franciscan Friary CL033-082001

Ballycorey – ringfort site CL033-038

Clonroad More – earthwork site CL033-117

Cloghleagh – water mill site CL033-138

The original assessment also made recommendations regarding land near Newmarket-on-Fergus that is not included in the current construction contract and so that reference has not been reproduced here.

The construction contract requests that the contractor engage a licensed archaeologist to undertake monitoring as recommended and to produce a report on the results of the monitoring:

The archaeologist shall prepare and submit a report describing the results of the archaeological monitoring work to the Planning Authority and the Department of Arts, Heritage and the Gaeltacht. The contractor shall engage the services of a licensed archaeologist for the preparation of the report.

Location, topography and geology

The monitored areas lie within the townlands of Clonroad More, Clonroad Beg, Lifford and Cloghleagh, in the parish of Drumcliff, Barony of Islands and also in the townlands of Dulick and Ballycorey in the parish of Templemaley, Barony of Bunratty Upper, Co. Clare. The works took place mostly along existing roads in Ennis town centre and in various housing estates both to the south and north of the town (Figs 1-7).

Naturally occurring limestone bedrock and glacial till was observed in some trenches.

Archaeological and historical background

The medieval settlement at Ennis grew up around the royal residence, castle and friary built by the O'Brien Kings of Thomond who moved from Limerick to *Cluain Ramhfada* (Clonroad) in AD 1216. The town lies within the rich archaeological landscape surrounding the River Fergus with numerous prehistoric and early medieval monuments and sites known in the area. Large-scale archaeological works associated with the N18 Ennis Bypass and N85 Western Relief Road identified many previously unknown sites (Bermingham et al. 2012), demonstrating the potential for buried archaeological material in this area.

The previous archaeological assessment (Tobin 2013) details the archaeological background to the scheme area and only a summary is presented here.

The proposed pipeline route passes within the zone of archaeological potential for a number of sites or groups of sites listed on 1996 Record of Monuments and Places and/or on the Sites and Monuments Record on the National Monuments Service website (www.archaeology.ie). These monuments are detailed in Table 1.

Table 1: Sites and Monuments Record / Record of Monuments and Places monuments adjacent to pipeline

RMP No	Townland	Classification	NGR
CL033-038----	Ballycorey, Dulick	Ringfort	134233 179754
CL033-082----	Cloghleagh, Clonroad More, Clonroad Beg, Lifford	Historic town	133780 177410
CL033-082001	Clonroad Beg	Religious house - Franciscan friars	133927 177642
CL033-082014	Clonroad Beg, Lifford	Bridge	133875 177674
CL033-085----	Lifford, Clonroad More	Settlement deserted - medieval	134559 177870
CL033-085001-	Clonroad More	Castle - tower house	134562 177850
CL033-085002-	Clonroad More	House - 16th/17th century	134562 177850
CL033-085003-	Clonroad More, Lifford	Bridge	134524 177878
CL033-085004-	Clonroad More, Lifford	Bridge	134602 177912
CL033-085006-	Clonroad More	Castle - ringwork	134562 177850
CL033-117----	Clonroad More	Earthwork	133601 175679

RMP No	Townland	Classification	NGR
CL033-038----	Ballycorey, Dulick	Ringfort	134233 179754
CL033-082----	Cloghleagh, Clonroad More, Clonroad Beg, Lifford	Historic town	133780 177410
CL033-082001	Clonroad Beg	Religious house - Franciscan friars	133927 177642
CL033-082014	Clonroad Beg, Lifford	Bridge	133875 177674
CL033-138001	Cloghleagh	Water mill - vertical-wheeled	133375 177719
CL033-138002	Cloghleagh	Water mill - vertical-wheeled	133458 177691

The earthwork and ringfort may represent early medieval activity that pre-date the establishment of Ennis, whilst the remainder of the monuments relate to the early development of Ennis and to the town centre itself.

The results of archaeological investigations in Ireland are published in summary form in *Excavations* (Bennett 1987-2010) and online at www.excavations.ie. A search of both sources was made for Clonroad More, Clonroad Beg, Lifford, Cloghleagh, Dulick and Ballycorey townlands. Numerous investigations have taken place over the last ten years. Two that are significant, given the isolated finds of human bone described below, relate to works on a new farmers' market at Garraunakilla where no archaeological remains were encountered (Hull 2014; Hull 2015). This area at Garraunakilla (*Garrán na Cille* – the church grove) was thought to be particularly sensitive due to potential for a sub-surface medieval or post-medieval graveyard and potential church ruins (see Ó Dálaigh 2012).

Monitoring – Objectives and methodology

The National Monuments Acts 1930-2004 provide the legislative framework within which archaeological excavation can take place. The grant of planning permission required archaeological monitoring. This work was licensed by the Department of Arts, Heritage and the Gaeltacht to Kate Taylor. The licence number is 15E0130.

Monitoring took place in order to supplement the documentary research for this assessment and, specifically, to establish the nature and extent of any archaeological deposits and features.

Excavations were mostly carried out using a tracked excavator fitted with a 0.80m wide bucket. The excavation of pipe trenches was sporadically monitored and trench faces were cleaned by hand when it was deemed necessary. A written, drawn and photographic record was made according to the TVAS Ireland Field Recording Manual (First Edition 2003).

Monitoring took place in the main at the specific locations identified in the previous assessment as being of particular archaeological potential. These areas are indicated on Figures 1-7.

Monitoring – Results (Figs 1-8 and Plates 1-12)

The groundworks took place between 30th April 2015 and 2nd February 2016. Monitoring of trench excavations took place at five separate locations and the results are described below. The trenches were typically between 0.60m and 0.80m wide and had maximum depths of 1.40m (Plate 1). Pipe junctions allowing tie-in to existing watermains had wider trenches at those locations. Trenches carrying pipes from the watermain to private properties were typically narrower and shallower (c. 0.30m wide and 1.00m deep) (Plate 2).

Zone of archaeological potential for the historic town of Ennis (SMR CL033-082) (Figs 6 and 8)

Monitoring of the groundworks took place in the existing roads of Upper Drumbiggie Road, Lower Drumbiggie Road, Market Place, Old Barrack Street and Carmody Road.

Stratigraphy (measured down from the modern surface) was typically tarmac and road gravel (0.00-0.20m) over fill (0.20-1.30m max). The fill was a mix of clay, limestone cobbles, loose stones and occasional brick fragments. Probable natural geology was seen at depths ranging from 0.40m to 1.30m. This probable natural geology was pale grey clayey sand with limestone cobbles and boulders.

Artefacts, including pottery, glass, animal bone and disarticulated human bone was found in several locations (Fig. 8).

East end of Old Barrack Street (Plates 3-5)

Human bone was found at depths between 0.40m and 1.30m within made ground deposits (contexts 57 and 58). This made ground underlay layers of tarmac (0.22m thick) and was a mix of clay, limestone cobbles, loose stones and occasional brick fragments. Natural geology beneath Old Barrack Street was seen to rise from 1.30m below the modern surface at the west end to 0.40m near the junction with O'Connell Street at the east. It appears that the made ground was imported material used to level the area before the street was constructed.

The human bone was disarticulated and represents only parts of human burials and was derived in the main from adults.

A small amount of animal bone was found in deposit 58, suggesting that domestic waste was also mixed in with the made ground layer.

A human tooth from deposit 58 was radiocarbon dated to cal. AD 1304-1441 (UBA-33330; 543BP±43), the period between the early 14th century and the mid 15th century.

Junction of Kilrush Road, Carmody Street and Market Street

Human bone was found beneath tarmac and stone make-up (0.40m thick) within a deposit (59) of sandy silt with frequent small to medium stones. This deposit was up to 1.00m thick and overlay light greyish brown stony clay (glacial till). In places, lenses of redeposited soil with inclusions of human bone, post-medieval pottery and glass was noted.

Finds from deposit 59 include 19th century glass, 17th – 19th century pottery and a copper alloy coin or token with fabric adhering to its surface. A piece of wood, identified as part of a coffin, was also recovered.

The human bone was disarticulated and represents only parts of human burials and was derived in the main from infants and children.

Animal bone was also found to be mixed with the human bone and domestic material in deposit 59.

Market Street

In Market Street, outside the butcher shop, a deposit of made ground below the road surface (52) yielded animal bone at a depth of approximately 1m.

Upper and Lower Drumbiggle Road (Fig. 8, Plates 6-9)

A limestone wall built of coarse blocks was recorded in the trench in Upper Drumbiggle Road (Plate 6 and Fig. 8). This wall was seen in a 5.00m section of trench and was 0.40m high and sealed beneath the modern tarmac. The wall is very probably a remnant of the 19th century forge shown in Plate 7 and demolished in 1970 (Brennan 2013, 4). The wall was left *in situ*.

The road adjacent to the find spot of an earlier 19th century gravestone (Fig. 8 and Plate 8) in Lower Drumbiggle Road was monitored (Plate 9). The gravestone was found by a local trader approximately 1.20m below the modern surface while digging footings for a gate post. Also found there was reportedly a stone font but this has since been stolen. The observed stratigraphy in the trench by this find spot was made ground (deposits 53 and 54) down to a depth of 1.40m and therefore it is very probable that the gravestone and the font derived from this deposit. These made ground deposits both yielded animal bone and a piece of 18th – 19th century glass bottle was also found in deposit 54.

Elsewhere on Lower Drumbiggle Road two other deposits of made ground beneath the road surface (55 and 56) also yielded animal bone at depths of up to 2m.

Lifford – bridge CL033-082014, riverside location opposite Franciscan Friary CL033-082001 (Fig. 6)

Harmony Row was monitored from the Club Bridge (Plate 10) at the east to the Maid of Erin Statue in the west (Plate 11). Typical stratigraphy was tarmac and levelling gravel (0.00-0.45m) over made ground composed of orangish brown gravels with limestone pieces (0.40-1.40m). Naturally deposited glacial till (mid brown clay matrix with gravel and small stone inclusions) was seen at the west end of the road at a depth of 0.60m. A thin soil (0.20m), presumably *in situ*, was seen above this. No archaeological finds features or deposits were observed.

Ballycorey – ringfort site CL033-038 (Fig. 2)

The trenching took place within modern roads within a housing estate at the north of the town. The works were not monitored as the contractor did not notify the archaeological consultant.

Clonroad More – earthwork site CL033-117 (Fig. 5)

The trenching took place within modern roads within a housing estate at the north-east of the town. The works were not monitored as the contractor did not notify the archaeological consultant.

Cloghleagh – water mill site CL033-138 (Fig. 4 and Plate 12)

The observed stratigraphy in the trenches (Plate 12) was tarmac (0.00-0.20m) over gravel levelling (0.20-0.35m) over made ground (0.35-1.00m) over naturally deposited glacial till (1.00-1.40m). No archaeological finds features or deposits were observed.

Finds

Finds include human bone, animal bone, post-medieval pottery, bottle glass, a metal button (or coin), wood and cloth. The finding of human bone was reported to the National Monuments Service and to Ennis Gardaí. Some human bone was removed by gardaí and it was confirmed by osteoarchaeologist Lauren Buckley to be human but not recent. This bone was returned and is included in the bone report below.

Human bone by Mara Tesorieri (Plates 13-30)

Summary

Analysis of the disarticulated remains from Ennis Watermain Rehabilitation Project revealed a minimum of 22 individuals. This included 1 foetus (3rd trimester), 2 perinates (1 month before to 1 month after birth), 8 infants (between the ages of new born to 2 years), 3 young juveniles (between the ages of 2 to 5 years), 2 older juveniles (between the ages of 6 to 12 years), one adolescent (between the ages of 13 to 17 years) and at least five adults including 2 females and 3 males, with the two females between the ages of 18-25 years, one male between the ages of 18 to 20 years and one between the ages of 18 to 25 years. An adult of unknown sex was between the ages of 18 to 25 years old. Pathology included cribra orbitalia, porotic hyperostosis, dental enamel hypoplasia, possible scurvy, possible tuberculosis, degenerative joint disease and osteoarthritis, along with trauma including a fractured radius and a fractured rib. A single radiocarbon date provided a 14th century date, however based on several wood coffin fragments discovered in the assemblage (context 59), along with the high number of infants, the assemblage most likely represents remains of individuals dating from multiple periods.

Methodology

The human skeletal remains were cleaned using toothbrushes dipped in tepid water. Once the remains were cleaned, they were laid out to dry at room temperature. Any animal fragments were separated from the human skeletal fragments, with the latter separated between non-adult and adult remains. Once adult and non-adult remains were separated, fragments were divided by bone area, including skull, upper limb, lower limb, pelvic girdle, thorax, vertebral column, hand, foot and loose teeth (Appendices 3-5). The fragments were then identified by element and side. Once placed in the correct group, the minimum number of individuals (MNI) was determined by first counting the left sided elements and then the right sided elements and comparing them to identify any matching elements deriving from the same individual.

The estimation of age and determination of sex was carried out when possible. Due to the nature of disarticulated remains, many fragments were not identifiable beyond the category of adult or non-adult. When possible, metrical analysis for sex determination was used, including measurement of the humeral, radial and femoral head diameter, humeral epicondylar breadth and clavicular length (Buikstra and Ubelaker 1994). Age estimation was determined based on dental eruption, epiphyseal fusion and long bone length (Schaefer et al. 2009).

After identifying the MNI, each fragment was carefully examined to identify any pathologies or trauma. All methods of recording, cleaning and analysis follow the code of practice laid out by the IAI (Buckley et al 2004) and BABAO/IFA (Brickley and McKinley 2004).

Osteological analysis

A total of 1,237 human skeletal fragments were identified from the assemblage, including 593 non-adult fragments, 612 adult fragments and 32 loose teeth. Of the identified fragments, 403 were cranial fragments, 58 were identified as belonging to the vertebral column, 86 identified as rib fragments, 16 shoulder girdle fragments, 58 fragments of the upper limb, 21 hand fragments, 24 pelvic girdle fragments, 106 lower limb fragments, 26 foot fragments, 90 unidentified long bone fragments, 316 unidentified fragments, 32 loose teeth and 1 epiphysis (Appendices 3-5). As shown in Table 2, most of the non-adult fragments were found in deposit 59, while adult fragments were found primarily within deposits 57 and 58.

Deposits 57 and 58, located at the east end of Old Barrack Street, were composed of ground deposits of clay, limestone cobbles, loose stones and brick fragments, most likely used to level the area prior to street construction. The skeletal remains were found at a depth of between 0.40m and 1.30m. Deposit

59, in which most of the non-adult remains were found, was located at the junction of Kilrush Road, Carmody Street and Market Street. Here, the remains were found underneath the tarmac in a sandy silt deposit. From this material, in addition to human bone, fragments of post-medieval pottery and glass were also recovered.

Table 2: Distribution of human bone fragments

Cut	Deposit	Adult	Non-adult	Loose teeth	Total
-	57	182	3	1	186
-	58	316	4	6	326
-	59	114	586	25	725
Total		612	593	32	1,237

In order to date the disarticulated assemblage, an adult right upper molar (with slight calculus on the buccal side) from deposit 58 was sent to the Chrono Lab at Queen's University Belfast. The results (Table 13 below) suggest the remains, at least for the tooth in question, to date to the 14th century. This date is surprisingly early, and would suggest the occupation of Ennis town to begin at least by the late medieval period. Unfortunately, it is not possible to say with any certainty that all the remains date to the same period. The high number of non-adult remains, in particular children aged between birth and infancy, would suggest the disturbance of a local Cillín. The archaeological dating evidence for these designated burial areas for unbaptised children suggests a 16th – 17th century origin (Donnelly and Murphy 2008). As such, it is highly likely the disarticulated assemblage recovered from Ennis town reflects multiple periods of occupation. It is recommended that additional radiocarbon dating be carried out.

Minimum number of individuals

The minimum number of individuals (MNI) refers to the minimum number of individuals needed to account for all of the elements found in an assemblage (White and Folkens 2005). In assessing the MNI for non-adults, Appendix 6 was compiled using skeletal elements where it was possible to identify the side of the element as well as age estimation, with each bone category recorded separately. As shown, many of the non-adult remains were well preserved and complete, assisting in identifying the age of the individuals (Table 3). Based on the single bone categories, there were at least eleven different individuals represented in the femur and frontal / orbit category.

Table 3: MNI for each bone category

Bone	Non-Adult MNI
Humerus	3
Radius	5
Ulna	5
Femur	11
Tibia	8
Temporal/Petrous	10
Pars Lateralis	7
Frontal/orbit	11
Maxilla	5

Once age categories of each fragment were taken into consideration however, the MNI increased to 17 non-adults, based on additional age ranges represented in the frontal, mandible, petrous/temporal and radius categories (Table 4). This included 1 foetus (3rd trimester), 2 perinates (1 month before to 1 month after birth), 8 infants (between the ages of new born to 2 years), 3 young juveniles (between the ages of 2 to 5 years), 2 older juveniles (between the ages of 6 to 12 years) and one adolescent (between the ages of 13 to 17 years).

Table 4: MNI divided by age category for non-adults

Category	Description	MNI
Foetus	1 (3rd trimester)	1
Perinate	2	2
Infant	3 (c. 1.5 months old) 2 (c. 6 months old) 3 (1.5 years – 2 years old)	8
Young juvenile	2 (2- 4 years old) 1 (3.5 years – 6.5 years old)	3
Older juvenile	1 (4 years – 8 years) 1 (5 years – 12 years)	2
Adolescent	1 (< 17 years old)	1
TOTAL	--	17

Assessment of MNI for the adult assemblage was based on the number of right and left elements. Table 5 provides the list of elements where at least two duplicates were observed. As shown, the highest count came from the distal half/distal 3rd of the left femur, with a minimum of 5 adults represented.

Table 5: MNI count for adult assemblage

Bone	R.	L.
Calcaneus	2	3
Humerus - Complete or middle 3 rd of shaft	2	1
Radius – Proximal half or proximal 3 rd	2	1
Radius – Distal half or distal 3 rd	-	2
Radius – Complete or middle 3 rd of shaft	2	3
Ulna – Proximal half or proximal 3 rd	1	2
Ulna – Distal half or distal 3 rd	2	-
Femur – Proximal half or proximal 3 rd	3	-
Femur – Distal half or distal 3 rd	1	5
Femur – Complete or middle 3 rd of shaft	3	-
MC2 – Complete or proximal half	1	2
Patella	-	2
Clavicle – Complete or acromial end	-	2

Adult fragments where it was possible to determine sex or estimate age have been placed in Table 6. Based on the results, the assemblage includes at least 2 females and 3 males, with the two females between the ages of 18 and 25 years, one male between the ages of 18 and 20 years and one between the ages of 18 and 25 years. An adult of unknown sex was 18 to 25 years old. While age determination resulted in all young ages, the relatively high number of joints with DJD and OA would suggest older to mature adults also represented in the assemblage.

Table 6: Sex determination and age estimation of adult remains

Deposit	Bone	Side	Description	Age estimation	Sex	Pathology
57	Clavicle	L	A complete left clavicle with an unfused sternal end	<30 years	-	-
57	Radius	L	Shaft and proximal end present	-	M	-
57	Femur	R	Complete	-	M	-
57	Humerus	R	Distal 3rd present	-	M	OA
58	Scapula	R	Lateral half present	-	M	-
58	Radius	R	Proximal half present	-	F	-
58	Radius	R	Proximal 3rd present	-	M	-

Deposit	Bone	Side	Description	Age estimation	Sex	Pathology
58	Radius	U	Proximal epiphysis present	-	M	-
58	Humerus	L	Proximal 3rd present	-	M	-
58	Os Coxa	L	80% complete	19-20 years	M?	-
58	Os Coxa	L	Auricular surface present	18-25 years	M	-
58	Mandible	R	Crypt 47 to 33 present	18-25 years	M?	Calculus
58	Mandible	R	Crypt 48-44 present	18-25 years	-	Calculus
58	Mandible	L	Crypt 38-35 present	18-25 years	M?	-
58	Mandible	U	alveolus present	-	F?	-
58	Occipital	R	occipital protuberance present	-	F?	-
58	Temporal	L	Mastoid process present	-	F?	-
59	Radius	L	Shaft complete	-	F?	-
59	Radius	R	Middle 3rd	-	M?	-
59	Radius	L	Middle 3rd	-	F?	-
59	Mandible	L	Crypts 36-38 present, with tooth 36 to 38 present	18-25 years	F?	-
59	Mandible	R	Crypts 47-48 present, with tooth 47 and 48 present	18-25 years	F?	-
59	Femur	R	Proximal half present	-	M?	-
59	Femur	R	Proximal and middle 3rds present	-	M?	-
59	Femur	L	Distal 3rd present	-	M	-

Pathology

The following section describes the pathological conditions or abnormalities observed in the disarticulated assemblage from Ennis Watermains Rehabilitation Project. Human remains are a valuable source of information for the interpretation of past environments; including diet and nutrition, health and disease, physical behaviour and lifestyle. Unfortunately, skeletal pathology can be restrictive, as many diseases and disorders affect the soft tissues only, with the preservation and completeness of the assemblage also affecting the analysis and interpretation. As shown in Tables 7 and 8, a variety of trauma and pathological conditions were observed in the assemblage, ranging from dental disease such as calculus to infectious diseases including osteomyelitis and tuberculosis, each of which will be discussed in turn.

Table 7: List of adult pathology

Deposit	Area	Bone	Side	Segment	Age	Sex	Pathology
57	Foot	Calcaneus	L	Complete	A		Enthesophytes on calcaneal tuberosity
57	Vertebrae	T12		Body	A		Left and posterior wedging
57		Lumbar		Body fragment	A		Schmorl's Nodes
57	Lower limb	Patella	L	Complete	A		Possible vastus notch
59	Upper limb	Humerus	R	Distal 3rd	A	M	OA on capitulum. Psuedofacet just above capitulum on anterior side
59		Humerus	L	Distal 3rd	A		Osteomyelitis. The entire distal fragment is covered in new bone formation (striated compact), with severe destruction on the posterior side. On the anterior/lateral side there is a small cloaca
59		Radius	L	Distal epiphysis	A		OA where radius articulates with scaphoid. Possible Colle's fracture
59		Ulna	R	Distal 3rd	A		DJD
59		Ulna	L	Proximal 3rd	A		DJD. Possibly belongs to the humerus with osteomyelitis. There is severe new bone growth around the olecranon process to make the facet bigger, with bone destruction to the lateral side of the olecranon process. This was not counted in the joints available.
59	Cranium	Mandible	L	Crypt 36-38	YA	F?	Slight calculus on lingual, mesial and distal sides. Tooth 36 to 38 present, no wear
59		Mandible	R	Crypt 47-48	YA	F?	Tooth 47 slight calculus on lingual and mesial sides
59	Hand	MC1	L	Complete	A		DJD proximal end and OA distal end
59		Scaphoid	R	Complete	A		OA
59		Trapezoid	R	Complete	A		OA
59	Shoulder girdle	Clavicle	L	Acromial half	A		OA
59	foot	Calcaneus	R	Incomplete	A		Enthesophytes on calcaneal tuberosity
59	Cranium	Parietal		Fragment	A		Porotic hyperostosis - healed slight
59		Os coxa	L	Acetabulum frag	A		DJD
59		Rib head	R	Fragment	A		One fragment with DJD
59	Vertebrae	Thoracic		Body	A		body fragments of upper thoracic vertebrae. Fragments are very porotic with one showing osteophytic lipping on anterior/inferior side
59	Upper limb	Humerus		Head	A		OA - highly porotic with eburnation
59		Humerus/ Femur?		Head	A		What appears to either be a slipped head or severe OA. New bone formation on the inferior aspect of head and neck
59	Lower limb	Femur	R	Proximal half	A	M?	Thickening of the neck on the anterior side most likely a result of DJD. Slight osteophytic lipping and porosity.
59		Femur	R	Proximal and middle shaft	A		Periostitis - small plaque of striated compact on lateral side of middle 3rd

Deposit	Area	Bone	Side	Segment	Age	Sex	Pathology
57	Foot	Calcaneus	L	Complete	A		Enthesophytes on calcaneal tuberosity
57	Vertebrae	T12		Body	A		Left and posterior wedging
57		Lumbar		Body fragment	A		Schmorl's Nodes
59		Femur	R	Proximal and middle 3rds	A	M?	Enthesophytes on lesser trochanter
59		Femur	L	Distal epiphysis	A	M	DJD - osteophytic lipping around margin of medial condyle
59		Femur	U	Distal epiphysis fragment	A		OA – eburnation present
59		Fibula	U	Shaft fragment	A		Periostitis – one plaque of woven (14.45) and one plaque of porotic compact
59		Fibula	U	Shaft fragment	A		Periostitis - severe compact striated bone formation encompassing the fragment with small nodules along the interosseous crest
59		Tibia	R	Proximal 3rd of shaft	A		Periostitis - nodule of compact bone formation on lateral side adjacent to tibial tuberosity
59		Tibia	L	Middle and distal 3rd of shaft	A		Periostitis - small amount of striated compact bone on lateral side of distal 3rd
59		Tibia	L	Prox. 3rd of shaft	A		Periostitis - compact striated on lateral and medial sides and compact on tibial tuberosity
58		Femur	L	Distal epiphysis	A		Osteochondritis dissecans on medial condyle
58		Patella	L	Complete	A		Vastus notch
58	Cranium	Mandible		Crypt 47-33	YA	M?	Severe calculus on lingual side of all four incisors and moderate calculus on lingual side of both canines and moderate on buccal side of incisors.
58		Mandible		Crypt48-44	YA		Slight calculus on lingual side (48-45), with severe calculus on lingual side of tooth 48
58	Vertebrae	C2		Complete	A		DJD
58		L3		Complete	A		Enthesophytes and Schmorl's Nodes

Table 8: List of non-adult pathology

Deposit	Area	Bone	Side	Segment	Age	Pathology
59	Upper limb	Ulna	L	Proximal 1/2 of shaft	Older juvenile	TB affecting the elbow joint. The proximal end is missing, however the remaining fragment shows thickening, a result of several layers of new bone formation. A mixture of porotic and striated compact bone, with the compact bone found primarily on the posterior side and the woven bone on the anterior, medial and lateral sides.
59	Lower limb	Tibia	L	Shaft only	3-6 months	Periostitis. The shaft is completely encased in new bone formation in woven porotic and striated bone.
59	Thorax	Ribs		Sternal	Infant - young juvenile	Three sternal end rib fragments, one of which shows a healed fracture.

Deposit	Area	Bone	Side	Segment	Age	Pathology
59	Cranium	Maxilla	L	Complete	5 yrs +/-16 months	Erupting 26 showing CEH
59		Frontal		Complete	Juvenile	Cribra Orbitalia: mixed severe CO in left orbit and healed medium CO in right orbit
59		Frontal		Incomplete	Young juvenile	Possible scurvy: porotic new bone formation on and above orbits
59		Frontal	L	Orbit	Young juvenile	Cribra orbitalia - mixed moderate
59		Frontal	R	Orbit	Infant	Cribra orbitalia - active slight
59		Frontal	R	Orbit	Infant	Cribra orbitalia - active slight
59		Frontal	L	Orbit	Infant	Possible scurvy: new bone formation in orbit, porotic woven
59		Frontal	R	Right half	Young juvenile	Cribra orbitalia - mixed moderate
59		Parietal	U	Fragment	Young juvenile	All fragments (7 in total) show evidence of PH. 3 fragments show severe active PH, appear to belong to either a young juvenile or infant. 1 fragment shows moderate active, and 3 fragments show slight active. At least 2 separate individuals, one slightly older than the first severe case
59		Parietal	U	Fragment	Juvenile	Capillary lesions
59		Occipital		Squasma	Infant-young juvenile	Capillary lesions
59		Occipital		Squasma	infant-young juvenile	Two out of ten fragments (which match up) are affected by periostitis
58		Maxilla	L	Crypt 21-27	12yrs+36 months	Non-liner array of pits on tooth 26

Calculus

Calculus is mineralized plaque (which derives from saliva) that adheres to the tooth surface. It occurs in an alkaline environment, is often linked to a high protein diet (Hillson 2000) and generally increases with an individual's age (MacPhee and Cowley 1975). Due to the mineralization of calculus, it often survives in the archaeological record and is a useful indicator of the general diet and oral hygiene of a population, as well as determining the degree of periodontal disease (Lieverse 1999).

A total of four mandibular fragments with teeth exhibited various levels of dental calculus. Three of the four fragments showed slight to moderate calculus, primarily located on the lingual side of the teeth. One fragment, belonging to a young adult male, had severe calculus on the lingual side of the incisors and moderate on the buccal side (Plates 13-14).

Degenerative Joint Disease

Degenerative joint diseases are a group of abnormalities which are caused by the deterioration with advancing age. The everyday wear and tear of the body affects the skeleton and therefore as age increases, deterioration increases. DJD will normally affect more than one joint in the body, and can take on a symmetrical pattern, unless caused by a specific traumatic event.

The habitual movement of a specific joint eventually leads to new bone formation (known as osteophytes), and bone destruction (porosity). Osteophytes are simply the body's method of enlarging the joint surface for the increased movement. Once the surrounding cartilage is destroyed and the bones of the joints are exposed to one another, eburnation begins to form. At this stage, the degenerative joint becomes arthritic. Osteoarthritis (OA) is the most commonly occurring joint disease seen in archaeology. It is non-inflammatory and affects the synovial joints. The presence of eburnation, osteophytes, sclerosis, subchondral cysts and porosity are the main criteria (Aufderheide and Rodríguez-Martín 1998). Eburnation manifests itself in the form of a polished area on the joint surface caused by the constant rubbing against another bone and is the only feature of osteoarthritis on its own that can give a definite diagnosis of the pathology (Rogers and Waldron 1995). Joints which are most commonly affected are the hands and wrists, the acromio-clavicular joint and the first metatarso-phalangeal joint, followed by the hip and knee (Rogers and Waldron 1995).

Table 9 provides a breakdown of each identified joint in the assemblage and the number with either DJD or OA (not including the hands, feet and vertebral column). As shown, relatively few joints were available for analysis, however a slight pattern emerges where the joints of the upper extremities appear to be affected more so than those of the lower extremities. In particular, the shoulder joint (left side) elbow joint (right side), the wrist (left and right sides) and hand (left side).

Table 9: DJD and OA joints

LEFT					RIGHT				
57	59	58	Total L		Total R	57	59	58	Total Joints
-	0/1	-	0/1	TMJ	0/1	-	0/1	-	0/2
-	1/1	-	1/1	Lateral clavicle	-	-	-	-	1/1
-	-	-	-	Glenoid fossa	0/1	-	-	0/1	0/1
-	-	0/1	0/1	Proximal humerus	-	-	-	-	0/1
-	-	-	-	Capitulum	1/1	-	1/1	-	1/1
0/1	-	-	0/1	Proximal ulna	0/1	-	-	0/1	0/2
-	-	-	-	Distal ulna	1/1	-	1/1	-	1/1
0/1	-	-	0/1	Proximal radius	0/2	-	-	0/2	0/3
0/1	1/1	-	1/2	Distal radius	-	-	-	-	1/2
-	-	-	-	Scaphoid	1/1	-	1/1	-	1/1
-	-	-	-	Lunate	0/1	-	0/1	-	0/1

LEFT					RIGHT				
57	59	58	Total L		Total R	57	59	58	Total Joints
-	0/1	-	0/1	Trapezium	0/1	-	-	0/1	0/2
-	-	-	-	Trapezoid	1/1	-	1/1	-	1/1
-	-	-	-	Capitate	0/1	-	0/1	-	0/1
-	-	-	-	Hamate	0/1	-	0/1	-	0/1
-	1/1	0/1	1/2	MC1 Proximal	-	-	-	-	1/2
-	1/1	0/1	1/2	MC1 Distal	-	-	-	-	1/2
0/2	-	-	0/2	MC2 Proximal	-	-	-	-	0/2
0/1	-	-	0/1	MC2 Distal	-	-	-	-	0/1
-	-	0/1	0/1	MC5 Proximal	-	-	-	-	0/1
-	-	0/1	0/1	MC5 Distal	-	-	-	-	0/1
-	0/1	0/3	0/4	Acetabulum	-	-	-	-	0/4
-	-	-	-	Proximal femur	1/3	0/1	1/2	-	1/3
0/1	1/2	0/2	1/5	Distal femur	0/1	0/1	-	-	1/6
-	-	-	-	Distal fibula	0/1	-	-	0/1	0/1
0/1	-	-	0/1	Patella	-	-	-	-	0/1
0/1	-	-	0/1	Talus	0/1	-	-	0/1	0/2
0/1	-	0/2	0/3	Calcaneus	0/1	-	0/1	-	0/4
0/1	-	-	0/1	Navicular	-	-	-	-	0/1
-	-	-	-	Cuneiform 1	0/1	0/1	-	-	0/1
-	-	0/1	0/1	Cuneiform 2	-	-	-	-	0/1
-	-	-	-	MT1 proximal	0/1	-	-	0/1	0/1
-	-	0/2	0/2	MT1 distal	0/1	-	-	0/1	0/3
-	-	-	-	MT3 proximal	0/1	-	-	0/1	-

Cases of interest include a right humerus belonging to an adult male (Plate 15). The individual displayed osteoarthritis of the elbow joint, with eburnation and porosity located on the capitulum (articulation with the radius). Above the capitulum on the anterior side is a pseudofacet, perhaps a result of the joint relocating due to the arthritis. An example of OA resulting from a traumatic event was observed in a fragment of the distal epiphysis of a left radius. The individual had a healed Colle's fracture (see trauma section), resulting in the formation of osteoarthritis of the wrist joint (Plate 16). A proximal 3rd fragment of a left ulna displayed DJD, with severe new bone growth around the olecranon process, enlarging the articulation with the humerus. Bone destruction is present on the lateral side of the olecranon process, and could possibly articulate with a left humerus affected by osteomyelitis (see infectious disease section). A small fragment belonging to the humeral head (side unknown), also showed severe OA, with the fragment highly porotic and eburnation present. A similar small fragment, which unfortunately was not identifiable as belonging to either the proximal humerus or proximal femur, showed severe OA. Moderate lipping and new bone formation is present on the inferior aspect of the head and neck, suggesting perhaps a slipped femoral or humeral head. However, due to the small fragment size, it is not possible to say with any certainty.

DJD and OA affecting the vertebral column was evident on only several fragments, with Table 10 listing vertebrae which were identifiable to a specific number rather than region. As can be seen, only five vertebrae were present in assessing vertebral degenerative joint disease (including one C1, C2, T1, T12 and L3). Of the vertebrae present, DJD was observed on the C2 and T12. As the C1 present did not manifest any degenerative changes matching to the C2 present, it can be assumed that the vertebral fragments present represent at least two separate individuals. DJD was also present in a right rib head fragment. Degeneration of the spine would have simply caused minor back aches and discomfort.

Two vertebrae, an L3 and a fragment from a lumbar vertebra were affected by Schmorl's Nodes. These are small depressions found posteriorly on the superior and inferior sides of the vertebral bodies and are caused by herniation of the intervertebral disc, where the nucleus pulposus protrudes over the

vertebral endplate. Schmorl's Nodes have been suggested to be related to mechanical stress and axial compression of the spine at a young age before the endplates have become resilient to penetration by the disc (Faccia and Williams 2008). Trauma is usually the cause of Schmorl's Nodes, as well as congenital defects of the spine, infection, osteoporosis and neoplastic disease, which all weaken the bone structure, enabling Schmorl's Nodes to develop (Roberts and Manchester 2005).

Table 10: DJD of the vertebral column

	Deposit 57	Deposit 59	Deposit 58
#L Ribs head	-	0/1	-
#L Ribs tubercle	0/1	0/1	0/1
#R Ribs head	0/1	-	-
#R Rib tubercle	0/1	1/2 (DJD)	0/2
C1 dens articulation	-	-	0/1
L C1 superior facet	-	-	0/1
L C1 inferior facet	-	-	0/1
R C1 superior facet	-	-	0/1
R C1 inferior facet	-	-	0/1
C2 dens	-		1/1 (slight DJD)
L C2 superior facet	-	-	0/1
R C2 sup inferior facet	-	-	0/1
R C2 inferior facet	-	-	0/1
C2 inferior centrum	-	-	0/1
C2 inferior centrum: Schmorl's Nodes	-	-	0/1
L T1 superior facet	0/1	-	-
L T1 inferior facet	0/1	-	-
T1 superior centrum	0/1	-	-
T1 superior centrum: Schmorl's Nodes	0/1	-	-
R T1 superior facet	0/1	-	-
R T inferior facet	0/1	-	-
L T12 superior facet	0/1	-	-
T 12 superior centrum	1/1 (slight DJD)	-	-
R L3 superior facet	-	-	0/1
R L3 inferior facet	-	-	0/1
L3 inferior centrum	-	-	0/1
L3 inferior centrum: Schmorl's Nodes	-	-	1/1

Osteomyelitis

Osteomyelitis is an infection of the medullary cavity and can either be the secondary cause of another disease or trauma or be the primary infection. Three main characteristics identify osteomyelitis; a cloaca, an involucrum, and a sequestered bone. A cloaca is simply a perforating lesion which is usually funnel shaped and has rounded edges, this lesion perforates the medullary cavity and allows liquids to drain out. Sequestered bone is bone which has been cut off by a blood supply and has died. The involucrum is the reaction to the death of the original bone, and is new bone formation that envelopes the dead bone. Any combination of the above three can occur in osteomyelitis, however occasionally none of these features occur, and osteomyelitis may simply manifest itself in the form of irregular and mix bone formation (Ortner 2008). Two fragments, including a left distal humerus fragment and a left proximal ulna fragment (most-likely belonging to the same individual) showed signs of osteomyelitis. The humerus fragment was encased in new bone formation, with a cloaca found on the anterior/lateral side (Plates 17-18). The ulna (Plate 19), although showing no evidence of a cloaca, had extensive new bone formation and destruction of the olecranon process (possibly a result of a cloaca).

Tuberculosis

Tuberculosis is an infectious disease with many manifestations, the bacteria causing the disease obtained by two separate means. The first, termed the *respiratory route*, is when the bacteria are passed through coughing, sneezing and speaking. The second, and the most common in the archaeological record, is by the consumption of infected cow's milk, known as the *gastrointestinal route* (Roberts and Buikstra 2008). The spine is the most commonly affected area, followed by the ribs, knee, sternum, hip, shoulder, clavicle, sacro-iliac joint, femur, elbow and scapula (Kelly and El-Najjar 1980).

A fragment from the proximal half of a left ulna (older juvenile) shows manifestations possibly associated with tuberculosis (Plates 20-21). While the proximal end is missing, the remaining fragment shows thickening due to several layers of new bone formation. Tuberculosis of the elbow joint is often the most frequently joint affected, and normally manifests between the ages of 1 and 20 years, with the focal point often located in either the distal humerus or proximal ulna, such as in the case of present example. As foci are often located in the olecranon process, this could be the reason for the missing proximal end (Ortner 2008). However, without the complete skeleton, a diagnosis of tuberculosis can only be suggested as a possibility.

Periostitis

Periostitis is a common occurrence in the archaeological record and can affect any bone, although lesions occur most commonly in the long bones. Periostitis refers specifically to new bone formed on the cortical surface under the periosteum due to infection or inflammation (Tesorieri 2014). The infection or inflammation of the periosteum can be caused by a large array of diseases, such as tuberculosis, leprosy, scurvy, osteomyelitis, rickets, non-specific infection, hypertrophic osteoarthropathy, trauma and stress (such as shin splints) which all promote new bone formation (Weston 2008). Due to the nature of disarticulated remains, it is not possible to identify the cause of the periostitis in any of the cases discussed below.

A total of seven fragments showed signs of periostitis. This included three adult tibia fragments, two adult fibula fragments, one adult femur fragment and one tibia fragment belonging to an infant between the ages of 3 and 6 months. The fragment from the infant is particularly severe, with the shaft completely encased in woven bone (Plate 22). In this case, the extent of periostitis is likely disease related, possibly associated with scurvy.

Four cranial fragments, all belonging to non-adults, were found with periostitis endocranially. This included three fragments of the occipital bone belonging to an infant/young juvenile, and a parietal fragment belonging to a juvenile. The location of the new bone formation on the occipital fragments is most likely indicative of a sinus infection as the new bone formation was found along the transverse and sagittal sinus of the occipital. The fragments from the parietal and occipital (Plate 23) which displayed small clusters of capillary lesions could possibly be indicative of meningitis, a result of inflammation of the meninges normally caused by a bacterial infection (Lewis 2004).

Dental enamel hypoplasia

Incidents such as periods of malnutrition, starvation, congenital infections, low birthweight, disease or fever can temporarily stop the progress of enamel formation, leaving horizontal lines, pits or grooves on the enamel crown (Ogden 2008; Ogden et al. 2007). Due to the nature of enamel formation, defects associated with enamel cannot be remodelled, and therefore provide a permanent record of incidents for the first seven years of life (Lewis and Roberts 1997).

DEH in the form of non-linear array of pits, was present in tooth 26 (upper left first molar), belonging to an older juvenile. The maxilla of a young juvenile also showed evidence of DEH in the form of CEH (cuspal enamel hypoplasia) on tooth 26. The only other example of DEH in the assemblage came from a loose tooth (55) from a non-adult, where CEH was also present. The occurrence of CEH would

suggest the mothers of these children were malnourished during pregnancy, as the cusp of these teeth form in utero.

Porotic hyperostosis and cribra orbitalia

Small, macroscopic porous lesions found on the superior margin of the orbits are known as cribra orbitalia, when these lesions are found on the parietals it is known as porotic hyperostosis. The porosity is formed as a result of anaemia, which can be caused by a number of factors including parasitic involvement, continuous blood loss and malnutrition (Lewis and Roberts 1997).

A total of thirteen fragments (one adult and twelve non-adult fragments) showed evidence of either cribra orbitalia or porotic hyperostosis. This included cribra orbitalia for a total of four non-adults; two infants and at least two juveniles (Plate 24). Porotic hyperostosis was present in one adult parietal fragment as well as seven parietal fragments from non-adults. The fragments represent at least two individuals, including one infant (Plate 25) and one juvenile (Plate 26). The fragments show a mixture of moderate mixed and severe active lesions.

Scurvy

Scurvy results from a low intake of Vitamin C, necessary for the production of collagen. Within human populations, low levels of Vitamin C are primarily a result of poor diet due to a lack in the necessary amount of fresh fruits and vegetables (Brickley and Ives 2008). Although the condition can manifest at any age, scurvy is primarily a childhood condition, particularly affecting children aged 6-18 months (Kozłowski and Witas 2012). Scurvy is difficult to diagnose within skeletal assemblages as many of the diagnostic lesions can also be caused by other diseases. Thus for a true diagnosis of scurvy, it is desirable to have more than one of the common lesions present within the skeletal system. Bones commonly affected by porosity and new bone formation include the sphenoid, occipital, temporal, parietal, frontal, zygomatic, mandible and maxillae, scapulae, distal and proximal ends of the long bones, ribs and ilium (Stark 2014).

Two fragments showed possible evidence of scurvy. This included a fragment of the frontal bone belonging to a young juvenile where new bone formation is present both in and above the orbits (Plate 27). A fragment of a left orbit belonging to an infant was also found to have woven bone formation in the orbit, possibly suggesting scurvy. Unfortunately, without a relatively complete skeleton, it is not possible to diagnose the lesions found on the two fragments with any certainty.

Fractures

Two fragments from the assemblage showed evidence of healed fractures. This included a fracture to the left distal radius (Plate 28) of an adult (known as a Colle's fracture) and a fracture to the sternal end of an infant (Plate 29). Colle's fractures, which often result in dorsal angulation, proximal displacement and radial deviation of the distal fragment (Mays 2006), are normally caused by a fall onto an outstretched hand, while rib fractures can be caused by events such as accidental falling, interpersonal violence, work-related accidents or a result of an underlying pathology such as osteoporosis. Due to the number of events which can cause rib fractures, it is often difficult to pinpoint an exact cause, and nearly impossible in disarticulated. However, as the rib belongs to an infant, a fracture as a result of an underlying pathology or a work-related accident can be dismissed.

Osteochondritis dissecans

Osteochondritis dissecans was observed on a left distal femur fragment belonging to an adult of unknown age and sex (Plate 30). The condition is caused by a traumatic event to the cartilage, resulting in the affected cartilage to separate from the underlying subchondral bone (known as a sequestrum) (Ortner 2003). The lesion left on the subchondral bone is usually round, with well-defined edges and a porotic cavity. The knee (such as in the current case) has been found to be the most

frequent joint affected by the condition, and seems to affect young individuals, particularly males (Roberts and Manchester 2005).

Conclusion

The disarticulated remains from Ennis Watermain Rehabilitation Project included a minimum of 22 individuals, comprising 17 non-adults and 5 adults. Unfortunately, without complete skeletons providing demographic data and contextual information, it is not possible to compile a clear picture of the population from which the remains derive. While the nature of disarticulated remains causes difficulty in ascertaining any pathological and demographic data, the analysis resulted in several general conclusions. Regarding dating, the assemblage represents individuals from as early as the 14th century (based on the radiocarbon date) and at least as late as the 17th century (based on the demographic data and coffin fragments from deposit 59). Based on the pathological analysis, it would appear several non-adults suffered through periods of malnutrition, based on the presence of dental enamel hypoplasia, with CEH in the remains of at least one non-adult suggesting the mother was also, to some degree, physically stressed. The possible identification of scurvy in several of the fragments would also suggest discrepancies in diet. However, very little dental pathology such as caries and ante-mortem tooth loss were identified (only one cavity was observed on a non-adult loose tooth), which would suggest individuals with a relatively healthy diet. The presence of DJD, OA and Schmorl's nodes in the assemblage would suggest individuals which were involved in habitual strenuous activities (such as farming). The identification of these pathologies, along with infection and inflammation as observed by the presence of osteomyelitis, periostitis and the possible case of tuberculosis, are common findings in both medieval and post-medieval populations from Ireland.

Animal bone by Natasia Duhau

Introduction

The following details the faunal material found during archaeological monitoring for the Ennis Watermain Rehabilitation Project. Animal bone was retrieved from several locations: contexts 52, 53, 54, 55, 56, 57, 58, and 59. Disarticulated human remains were also found in contexts 57, 58 and 59. All the faunal material is considered to be post-medieval.

Methodology

All fragments were analysed and taxonomic and element identifications were made using the University College Cork, Department of Archaeology's animal bone comparative collection and also reference was made to Schmidt (1972). All bone material was analysed and the fragments that could not be identified to species level were categorized, where possible, to the relative size of animal represented. "Large mammal" includes cattle, horse, and red deer, "medium mammal" includes pig, sheep, goat, roe deer, and large dog, and "small mammal" includes, cat, rodent, lagomorph, and small dog. All other fragments are considered as unidentifiable.

Results

The faunal remains are constituted of 204 fragments of bone and one oyster shell (Table 12). Of these, 44 fragments could be identified to species and element (Table 11). The remainder consisted of rib, vertebrae, cranial and longbone fragments of medium and large mammals. Of the species identified, cattle bones are the most frequent followed by sheep and/or goat, horse, and dog.

Preservation of the material was medium and the majority of the material was fragmented. Three elements, a cattle metapodial and humerus and a rib from a large mammal displayed chopmarks and represent the only evidence for butchery.

Table 11: Distribution of identifiable specimens (NISP)

	Cattle	Sheep / Goat	Horse	Dog
Horn	3			
Skull				
Maxilla	1			
Mandible	2			
Teeth	5		1	
Atlas				
Axis				
Scapula	1			
Humerus	1			
Radius	1			1
Ulna	1	1		
Metacarpal	2		1	
Pelvis				
Femur	1	1		
Tibia	1	2		
Fibula				
Calcaneus	2			
Astragalus	2	1	1	
Metatarsal	1			
Metacarpal/Metatarsal	4	2		
Phalanx 1	1	1		
Phalanx 2	1			
Phalanx 3	1			
NISP	31	8	3	2

Table 12: Catalogue of animal bone

Context	Quantity	Element	Taxon	Fusion	Butch	Burn	Gnaw
52	1	P1	BOS	FUSED PX	N	N	N
52	1	P3	BOS	N/A	N	N	N
52	1	TI	BOS	UE	N	N	N
52	1	RA	CAF	FUSED DX	N	N	N
52	1	RIB	CAF	N/A	N	N	N
52	1	SHELL	INVERT	N/A	N	N	N
52	1	RIB	ULM	N/A	Y	N	N
52	8	RIB	ULM	N/A	N	N	N
52	2	LBF	ULM	N/A	N	N	N
52	1	MC/MT	ULM	N/A	N	N	N
52	5	POST-CRANIAL	ULM	N/A	N	N	N
52	3	RIB	UMM	N/A	N	N	N
52	1	LBF	UMM	N/A	N	N	N
52	10	POST-CRANIAL	UMM	N/A	N	N	N
53	1	MC/MT	BOS	INDIT	CHOP	N	N
53	2	INDIT	INDIT	N/A	N	N	N
53	1	PE	LM	N/A	N	N	N
53	1	P1	OVIS/CAPRA	UNFUSED PD	N	N	N
54	1	ULNA	BOS	FUSED PX	N	N	N
54	3	HC	BOS	N/A	N	N	N
54	2	N	BOS	N/A	N	N	N
54	1	FE	BOS	FUSED DX	N	N	N

Context	Quantity	Element	Taxon	Fusion	Butch	Burn	Gnaw
54	1	HU	BOS	FUSED DX	Y	N	N
54	1	SC	BOS	N/A	N	N	N
54	1	CA	BOS	UNFUSED	N	N	N
54	1	X	BOS	N/A	N	N	N
54	1	MANDIBULAR MOLAR	BOS	N/A	N	N	N
54	3	MAXILLARY MOLAR	BOS	N/A	N	N	N
54	1	MC	EQ	N/A	N	N	N
54	1	MC/MT	OVIS/CAPRA	FUSED DX	N	N	N
54	1	TI	OVIS/CAPRA	N/A	N	N	N
54	1	UL	OVIS/CAPRA	N/A	N	N	N
54	1	FE	OVIS/CAPRA	N/A	N	N	N
54	3	RIB	ULM	N/A	N	N	N
54	2	VERT	ULM	N/A	N	N	N
54	1	LBF	ULM	N/A	N	N	N
54	1	CR	ULM	N/A	N	N	N
54	2	LBF	ULM	N/A	N	N	N
54	4	CR	UM	N/A	N	N	N
54	13	POST-CRANIAL	UM	N/A	N	N	N
55	2	RIB	ULM	N/A	N	N	N
55	2	N	ULM	N/A	N	N	N
56	1	TI	OVIS/CAPRA	FUSED DX	N	N	N
56	1	MC/MT	OVIS/CAPRA	N/A	N	N	N
57	1	MC/MT	BOS	FUSED DX	N	N	N
57	1	MT	BOS	N/A	N	N	N
57	17	VERT	ULM	N/A	N	N	N
57	1	TI	ULM	N/A	N	N	N
57	33	POST-CRANIAL	ULM	N/A	N	N	N
57	1	LBF	UMM	N/A	N	N	N
58	1	P2	BOS	FUSED PX	N	N	N
58	1	TOOTH	BOS	N/A	N	N	N
58	2	AS	OVIS/CAPRA	N/A	N	N	N
58	5	INDIT	UM	N/A	N	N	N
58	4	POST-CRANIAL	UMM	N/A	N	N	N
59	2	MC	BOS	N/A	N	N	N
59	1	MC/MT	BOS	FUSED DX	N	N	N
59	2	AS	BOS	N/A	N	N	N
59	1	RA	BOS	N/A	N	N	N
59	1	CA	BOS	FUSED DX	N	N	N
59	1	AS	EQ	N/A	N	N	N
59	1	MANDIBULAR MOLAR	EQ	N/A	N	N	N
59	3	VERTEBRAE	ULM	N/A	N	N	N
59	4	MN	ULM	N/A	N	N	N
59	1	RIB	ULM	N/A	N	N	N
59	2	LBF	ULM	N/A	N	N	N
59	2	LBF	ULM	N/A	N	N	N
59	13	POST-CRANIAL	UM	N/A	N	N	N
59	2	POST-CRANIAL	UM	N/A	N	N	N
59	7	LBF	UMM	N/A	N	N	N

Conclusion

Due to the very small amount of animal bones retrieved from several contexts, secondary analysis was not possible. This faunal material likely represents small deposits of industrial and domestic waste material.

Recommendation

This post-medieval animal bone assemblage is too small to be of any value for future research, and as such it is not recommended for retention.

Post-medieval pottery by Gordana Baljkas

The only post-medieval pottery fragment (15E0130:59:2) has been identified as black glazed red earthenware (17th-19th century). The find comprises two co-joining body fragments that are likely to have originated from a large, thick-walled storage vessel. The fragment is glazed on both sides and ribbed.

Black glazed red earthenware was manufactured from coal-measure clays found in west Scotland and England (Meenan 2007, 398). This pottery type is characterised by fabric colour ranging from orange to dark purple, while the black glaze is achieved by the addition of iron to the lead glaze (ibid.). Black glazed wares were produced in a number of different centres and are therefore difficult to identify; however, the use of the black glazed ware produced in Buckley in east Wales was well documented as having been used throughout Ireland, which lent them a name of Buckley ware (ibid.). Black-glazed red earthenware is mostly found along the eastern coast, namely in Dublin and Drogheda (ibid.). Archaeological evidence from the Dublin Castle excavations suggested that the black-glazed wares were exclusively English until the mid-18th century when the local productions appeared; one of the first recorded manufacturers was James Walker of Mullinahack in the 1760s (ibid.). The commonest forms of the black wares are large, thick-walled storage vessels. Their form changed somewhat over the time, so that the early 17th century examples boast plain everted rim while the late 17th and early 18th century examples had much heavier squared rims (Meenan 1994, 55–56). They commonly have horizontal handles under the rims, while the application of decoration is sporadic (ibid.). Other forms are tygs or multi-handled drinking vessels, chamber pots, etc.

Glass by Gordana Baljkas

Two glass fragments were recovered, both are bottle base fragments. The first fragment (15E0130:54:1) has been identified as belonging to an aqua-coloured torpedo bottle. Torpedo bottles were used to store soda and mineral water and instead of standing upright, the pointed base was designed to ensure that the bottle was laid on its side so that the wired down cork would not dry out and shrink allowing the contents to loose carbonation and/or evaporate (Riley 1958). The torpedo style was first used in England at least as early as 1809 when a patent was granted to William F. Hamilton. The production of this type of bottle had ceased by the 20th century. Torpedo bottles are often referred to as “Hamilton's” and also called “bombs” or “eggs” or “egg-shaped” by others (McKearin and Wilson 1978).

The second fragment (15E0130:59:1) is likely to have belonged to an 18th-19th century black-coloured utility bottle. However, as the fragment is very small it is impossible to date it with more precision. The bottle appears to have had thick walls and traces of a pontil scar are visible on the underside of the base.

Metal and fabric by Gordana Baljkas

The only metal find recovered from the Ennis excavation comprises a copper/copper alloy coin or token (15E0130:59:3) attached to what appears to be a piece of fabric (15E0130:59:4). These items

have been conserved. The coin or token measures 28mm in diameter and is 2mm thick. The surface of the coin/token is heavily worn and no markings are visible. The find was found adhering to a bone fragment and, as a graveyard is known to have existed in the area and been destroyed during road construction, it is possible that the find is associated with it and can be tentatively dated to the 18th-19th century.

Wood by Susan Lyons

The wood id from the coffin (15E0130:59:5) is European larch (*Larix decidua*). Earliest records of larch in Ireland date to the 1740s and by 1776 it is listed as a tree in managed woodlands. Comparisons have recently been found from coffin wood dating to the mid-late 18th century on Spike Island.

This small piece of wood from a disturbed post-medieval context is not recommended for retention.

Samples

No samples were taken.

Radiocarbon dating

One radiocarbon determination was obtained from Queens University Belfast (Table 13) and calibrated using IntCal13 (Reimer et al. 2013). The determination is from a human tooth recovered from deposit 58. The result places the date of death of the individual as between the early 14th and mid 15th century.

Table 13: Radiocarbon determination

Lab code	Cut	Deposit	Find no.	Sample material	Radiometric age	Calendrical calibrations
UBA-33330	-	58	15E0130:58:1	Human tooth	543 BP±43	2 sigma (95.4%) Cal. AD 1304-1364 (0.426) Cal. AD 1384-1441 (0.574) 1 sigma (68.3%) Cal. AD 1323-1346 (0.346) Cal. AD 1393-1429 (0.654)

Discussion

Archaeological monitoring of the trench excavations demonstrated an absence of archaeological deposits in most parts of the scheme. Archaeological deposits were however discovered within the south part of the Ennis' historic core. These deposits were characterised by disarticulated human bone dating from the medieval period found at Old Barrack Street and further disarticulated human bone likely dating to the post-medieval period at the junction of Kilrush Road and Carmody Street, as well as a small amount of post-medieval domestic waste. A relatively modern stone wall was recorded at Upper Drumbiggle Road.

Medieval

Human bone was found in the water pipe trench in Old Barrack Street. The bone was disarticulated, representing partial remains, and had likely been disturbed by earlier development or moved from elsewhere. This bone was almost exclusively from adults and a radiocarbon determination obtained

from a tooth showed that the person died between the early 14th and mid 15th century. Local informants have reported (to the authors but not to the statutory authorities) that human bone has been found at a number of other locations nearby (Fig. 8). A report in the Clare Journal dated 31st July 1902 states:

Discovery of Remains in Ennis. On Wednesday while some workmen were carrying out excavations in connection with sewerage and sanitary works for Mr Leonard Costelloe, plumber, in Upper Jail St. [now O'Connell Street] leading into Barrack Square, they came on a quantity of human remains and a number of small bones, with the remains of a coffin. They seemed of great age.

That 1902 findspot is approximately 10m east of the bone found in 2015 and undoubtedly represents the same deposit likely disturbed in the 19th century or earlier. This disturbance may have been associated with the construction of Ennis Cathedral in the period 1828-42.

It is likely then, given the radiocarbon date, that a previously unknown graveyard was present at the south side of Ennis in the medieval period. The precise location of this burial site is confounded by the disturbed nature of the burials and the ad hoc and unreported finds of other bone in the immediate vicinity. It is known that fairs were held on the triangle of ground at Barack St prior to 1641 and there is good historical evidence that fairs were held in graveyards and cemeteries in medieval Ireland (Fry 1999, 48-53). Brian Ó Dálaigh observes that such an arrangement found in Ennis may not be surprising (per comm.) although the discovery of evidence for a medieval graveyard just outside the southern extent of the medieval town was unexpected. The friary cemetery at the north of the town was thought to have been the sole focus of Ennis' burials from the mid 13th century until at least the post-medieval period when the Garraunakilla graveyard (Figs 8 and 9) was thought to have commenced. Ó Murchadha (2009), for example notes that from the early 17th century the bulk of Ennis' burials took place at either the Friary or the extensive cemetery at Garraunakilla. The cemetery was already overcrowded and may have been closed by the time of the 1832 cholera epidemic. Ó Dálaigh (in Brennan 2013, 4) is of the opinion that the graveyard at Garraunakilla was unofficial and used by the poor and for infants to avoid the expenses of the Friary or Drumcliff graveyards.

Post-medieval

As noted above, the Garraunakilla graveyard was likely to have been located near what is now the junction of Kilrush Road and Carmody Street (Figs 8 and 9) and was in use from perhaps the 17th century until the earlier 19th century as a burial ground for the poor and for infants. The archaeological material discovered in the waterpipe trenches at the crossroads is dominated by infants' and children's bones many of which exhibit poor nourishment. The documentary and osteological evidence indicate that this was a poor person's graveyard (if not a cillín or children's burial ground) and the single sherds of pottery and glass as well as the larch from a coffin support the dating to the 17th to 19th centuries. The construction of Carmody Street in the later 19th century and associated housing extensively disturbed the graveyard. Other finds of human bone have been reported (again, to the authors but not to the statutory authorities) in the immediate vicinity (Larry Brennan pers comm.).

Given the fragmentary nature of the human remains and the disturbed contexts in which the bone was found it is not possible to say whether there were two graveyards (a medieval one centred on Barrack Street and a post-medieval one centred on the Kilrush Road and Carmody Street junction) or a large medieval burial ground that shrank by incremental development over time to the small site shown on the 1840 Ordnance Survey map (Fig. 9).

Early modern

The remnants of the limestone wall found in Drumbiggle Road Upper is very probably part of the 19th century forge shown in Plate 7 and demolished in 1970 (Brennan 2013, 4). The wall was left *in situ*.

Recommendations and further work

Fieldwork

Monitoring of this pipe laying scheme has demonstrated the potential for archaeological deposits, albeit disturbed and mixed, to survive beneath the streets of Ennis. Any future development in the town should therefore be subject to archaeological assessment and/or monitoring to mitigate any impact on potential deposits.

In particular, development driven archaeological intervention is recommended for the area at the south of the medieval town core at Old Barrack Street and in the vicinity of the Kilrush Road and Carmody Street crossroads as further human remains, and perhaps *in situ* burials, dating from the medieval period onwards might be found.

Record of Monuments and Places / Sites and Monuments Record

It is recommended that the results of the monitoring be added to the SMR file for Ennis town CL033-082.

Post-excavation

The finds have been cleaned and will be conserved (where necessary), numbered, labelled, properly packed and will be deposited with the National Museum of Ireland in accordance with *Advice Notes for Excavators* (NMI 2010).

In accordance with the recommendations of the specialists the wood and animal bone will be discarded.

An accessible archive of primary records (Appendix 7) will be prepared for long term storage and will be deposited with the National Monuments Service's Archive Unit in Swords in accordance with their guidelines (Barrett 2012).

Publication and dissemination plan

A summary of the findings of the monitoring has been submitted to *Excavations 2015* and *Excavations 2016*.

A more detailed report on the excavation results will be published in a suitable local journal such as *The Other Clare*.

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Appendix 1: Catalogue of features and deposits

Cut	Deposit	Description	Finds
-	50	Tarmac	-
-	51	Stone make-up layer under road surface	-
-	52	Deposit 1m down in Market St outside butcher	Animal bone
-	53	Deposit in Drumbiggie Lower by coal yard	Animal bone
-	54	Deposit in Drumbiggie Lower 0.3-1.4m down	Animal bone, glass
-	55	Deposit in Drumbiggie Lower outside Safeway Tyres	Animal bone
-	56	Deposit in Drumbiggie Lower outside EpicValu 2m down	Animal bone
-	57	Deposit in Old Barrack St outside Clare Champion office	Animal bone, human bone
-	58	Deposit in Old Barrack St outside SIPTU office	Animal bone, human bone
-	59	Deposit at Kilrush Rd / Carmody St junction	Animal bone, human bone, glass, pottery, fabric, metal, wood

Appendix 2: Catalogue of finds

Find No	Cut	Deposit	Category	Description	Number	Weight (g)
15E0130:52:1	-	52	Organic -bone	Animal	37	402
15E0130:53:1	-	53	Organic -bone	Animal	5	100
15E0130:54:1	-	54	Glass - bottle	Black glass utility bottle base and body fragment. Pontil scar visible. Poss. 18th-19th C.	1	144
15E0130:54:2	-	54	Organic -bone	Animal	46	1,107
15E0130:55:1	-	55	Organic -bone	Animal	4	32
15E0130:56:1	-	56	Organic -bone	Animal	2	48
15E0130:57:1	-	57	Organic -bone	Human	186	1,594
15E0130:57:2	-	57	Organic -bone	Animal	54	524
15E0130:58:1	-	58	Organic -bone	Human	326	2,245
15E0130:58:2	-	58	Organic -bone	Animal	13	149
15E0130:59:1	-	59	Glass - bottle	Aqua glass torpedo bottle base fragment. Made in mold. 19th C.	1	33
15E0130:59:2	-	59	Ceramic - pottery	Black glazed red earthenware (17th-19th C.). Body fragment, 2 co-joining pieces.	2	65
15E0130:59:3	-	59	Metal - non-ferrous	Copper/copper alloy coin/token. No marking visible on the coin which is attached to fabric (59:4). D: 28mm; T: 2mm. 18th-19th C.?	1	13
15E0130:59:4	-	59	Fabric	Fabric attached to copper/copper alloy coin/token (59:3).	1	2
15E0130:59:5	-	59	Wood	Coffin timber	6	16
15E0130:59:6	-	59	Organic -bone	Human	725	2,756
15E0130:59:7	-	59	Organic -bone	Animal	43	989

Appendix 3: Human bone - adult assemblage

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
57	Hand	MC2	L	Complete	100%	1	1	Adult		No	No	Large MC2 likely belonging to an adult male
57		MC2	R	Proximal & middle 3 rd	90%	1	1	Adult		No	No	Small MC2 does not belong to the above individual.
57		mid phalanx	U	Distal half	70%	1	1			No	No	
57	Foot	Calcaneus	L	Complete	95%	1	1	Adult		Yes	No	Enthesophytes on calcaneal tuberosity.
57		Talus	L	Complete	100%	1	1	Adult		No	No	
57		Cunei. 1	R	Complete	100%	1	1	Adult		No	No	
57		Navicular	L	Incomplete	75%	1	1	Adult		No	No	Missing tuberosity
57		Proximal Phalanx 1	U	Proximal end	25%	1	1	Adult		No	No	
57	Thorax	Rib 1	R	Rib head	25%	1	1	Adult		No	No	
57		Rib bodies	U	Fragments	<25%	1	5	Adult		No	No	
57		Rib sternal	U	Fragments	<25%	1	2	Adult		No	No	
57		Rib head	L	Facet + neck	<25%	1	1	Adult		No	No	
57	Cranium	Parietal	L	Sagittal + lambdoidal border + frontal angle	50%	1	6	Adult		No	No	
57		Vault	U	Fragments	<25%	1	6	Adult		No	No	
57		Occipital	U	Fragments	<25%	1	1	Adult		No	No	
57	Upper Limb	Humerus	R	Complete shaft	75%	1	1	Adult		No	No	
57		Humerus	U	Shaft fragment	<25%	1	1	Adult		No	No	
57		Humerus	U	Head fragments	<25%	1	3	Adult		No	No	
57		Radius	L	Proximal end and shaft	75%	1	1	Adult	M	No	No	
57		Radius	U	Shaft fragments	<25%	1	2	Adult		No	No	
57		Radius	L	Distal end	<25%	1	1	Adult		No	No	
57		Ulna	L	Proximal end	<25%	1	1	Adult		No	No	
57	Vertebrae	T12		Body	75%	1	1	Adult		Yes	No	Wedging on left and posterior sides.
57		Lumbar		Body fragment	<25%	1	2	Adult		Yes	No	Schmorl's Nodes

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
57		Lumbar	L	Inferior facet	<25%	1	1	Adult		No	No	
57		Lumbar	L	Inferior facet	<25%	1	1	Adult		No	No	
57		Lumbar	R	Superior facet	<25%	1	1	Adult		No	No	
57		Lumbar	U	Spinous process	<25%	1	1	Adult		No	No	
57		T12	U	Complete	>75%	1	1	Adult		No	No	
57		Thoracic	U	Body fragment	<25%	1	3	Adult		No	No	
57		Thoracic	U	Spinous process frags.	<25%	1	2	Adult		No	No	
57		Thoracic	U	Transverse process frags.	<25%	1	2	Adult		No	No	
57	Long Bones	Unknown	U	Shaft fragments	<25%	1	22	Adult		No	No	
57	Misc. Frags.	Unknown	U			1	71	Adult		No	No	
57	Lower Limb	Femur	L	Neck + trochanters	<25%	1	1	Adult		No	No	
57		Femur	L	Neck	<25%	1	1	Adult		No	No	
57		Femur	L	Distal 3 rd of shaft	25%	1	1	Adult		No	No	
57		Femur	R	Proximal 3 rd of shaft	<25%	1	1	Adult		No	No	
57		Femur	L	Proximal 3 rd of shaft	<25%	1	1	Adult		No	No	
57		Femur	U	shaft fragments	<25%	1	8	Adult		No	No	
57		Femur	L	Distal epiphysis	25%	1	1	Adult		No	No	
57		Femur	R	Complete	100%	1	1	Adult	M	No	No	
57		Femur	U	Distal epiphysis	<25%	1	5	Adult		No	No	
57		Tibia	R	Shaft	50%	1	1	Adult		No	No	
57		Tibia	U	Shaft fragment	<25%	1	1	Adult		No	No	
57		Fibula	U	Shaft fragment	<25%	1	1	Adult		No	No	
57		Patella	L	Complete	100%	1	1	Adult		Yes	No	Possible vastus notch.
57	S. Girdle	Clavicle	L	Complete	100%	1	1	<30 yrs		No	No	
57		Clavicle	U	Shaft fragment	<25%	1	1	Adult		No	No	
57		Scapula	U	Acromion	<25%	1	3	Adult		No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
57	Pelvic Girdle	Os coxa	U	Acetabulum fragment	<25%	1	1	Adult		No	No	
57		Os coxa	U	Ilium	<25%	1	3	Adult		No	No	
59	Upper Limb	Humerus	R	Distal 3 rd	25	1	1	Adult	M	Yes	Yes	OA on capitulum, with a psuedofacet just above capitulum on anterior side.
59		Humerus	L	Distal 3 rd	<25	1	1	Adult		Yes	Yes	severe osteomyelitis. The entire distal fragment is covered in new bone formation (striated compact), with severe destruction on the posterior side. On the anterior/lateral side there is a small cloaca.
59		Radius	L	Complete shaft	80%	1	1	Adult	F?	No	No	
59		Radius	R	Middle 3 rd of shaft	25%	1	1	Adult	M?	No	No	
59		Radius	L	Middle 3 rd of shaft	25%	1	1	Adult	F?	No	No	
59		Radius	L	Distal epiphysis	25%	1	1	Adult		Yes	Yes	OA where radius articulates with scaphoid. Colle's fracture.
59		Ulna	R	Distal 3 rd	25%	1	1	Adult		No	No	
59		Ulna	R	Distal 3 rd	25%	1	1	Adult		Yes	No	DJD
59		Ulna	L	Proximal 3 rd	25%	1	1	Adult		Yes	Yes	DJD, possibly belongs to the humerus with osteomyelitis. There is severe new bone growth around the olecranon process to make the facet bigger, with bone destruction to the lateral side of the olecranon process. This was not counted in the joints available.
59	Cranium	Mandible	L	Crypt 36-38	25%	1	1	YA (18-25)	F?	Yes	No	Slight calculus on lingual, mesial and distal sides. Tooth 36 to 38 present, no wear.
59		Mandible	R	Crypt 47-48	25%	1	1	YA (18-25)	F?	Yes	No	Tooth 47 slight calculus on lingual and mesial sides.
59		Mandible	R	Gonial angle	2%	1	1	Adult		No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
59	Hand	MC1	L	Complete	100%	1	1	Adult		Yes	No	DJD at proximal end and OA at distal end.
59		MC fragment		Distal half	50%	1	1	Adult		No	No	
59		Prox. Phalanx		Complete	100%	1	1	Adult		No	No	
59		Scaphoid	R	Complete	100%	1	1	Adult		Yes	No	OA
59		Lunate	R	Complete	100%	1	1	Adult		No	No	
59		Hamate	R	Complete	100%	1	1	Adult		No	No	
59		Capitate	R	Complete	100%	1	1	Adult		No	No	
59		Trapezium	L	Complete	100%	1	1	Adult		No	No	
59		Trapezoid	R	Complete	100%	1	1	Adult		Yes	No	OA
59		MC fragment		Distal fragment	2%	1	1	Adult		No	No	
59	Shoulder girdle	Clavicle	L	Acromial half	50%	1	1	Adult		Yes	No	OA
59		Scapula	R	Spine + part of acromion	10%	1	1	Adult		No	No	
59	foot	Calcaneus	R	Incomplete	80%	1	2	Adult		Yes	No	Enthesophytes on calcaneal tuberosity.
59	Cranium	Parietal		Fragment	<25%	1	1	Adult		Yes	No	Healed slight PH.
59		Cranial vault		Fragments	<25%	1	14	Adult		No	No	
59		Occipital		Fragment	<25%	1	1	Adult		No	No	
59		Nasal	R+L	Complete	100%	1	1	Adult		No	No	
59	Pelvic girdle	Sacrum	S1	Incomplete	25%	1	1	Adult		No	No	
59		Os coxa	L	Acetabulum fragment	25%	1	1	Adult		Yes	No	DJD
59	Thorax	Rib head	L	Fragment	<25%	1	1	Adult		No	No	
59		Rib head	R	Fragments	<25%	1	2	Adult		Yes	No	One fragment with DJD.
59		Rib body		Fragments	<25%	1	6	Adult		No	No	
59	Vertebrae	Thoracic		Body fragments	<25%	1	5	Adult		Yes	No	Fragments are very porotic with one showing osteophytic lipping on anterior/inferior side.
59		Thoracic		Arch fragments	<25%	1	4	Adult		No	No	
59	Upper limb	Humerus		Head	<25%	1	2	Adult		Yes	No	OA - highly porotic with eburnation
59		Humerus		Neck	<25%	1	1	Adult		No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
59		humerus/ femur?		Head	<25%	1	1	Adult		Yes	No	What appears to either be a slipped head or severe OA. New bone formation on the inferior aspect of head and neck.
59	Long bones	Shaft		Fragment	<25%	1	18	Adult		No	No	
59	Cranium	Unknown		Fragment	<25%	1	1	Adult		No	No	
59	Lower limb	Femur	R	Proximal half	50%	1	3	Adult	M?	Yes	No	Thickening of the neck on the anterior side most likely a result of DJD. Slight osteophytic lipping and porosity.
59		Femur	R	Proximal & middle 3 rd of shaft	45%	1	2	Adult		Yes	No	Periostitis - small plaque of striated compact on lateral side of middle 3 rd .
59		Femur	R	Proximal & middle 3 rd	75%	1	1	Adult	M?	UEs	Yes	Green staining on posterior side of femoral neck. Enthesophytes on lesser trochanter.
59		Femur	R	Complete shaft	75%	1	1	Adult		No	No	
59		Femur	R	Proximal 3 rd of shaft	25%	1	1	Adult		No	No	
59		Femur	U	Shaft fragment	<25%	1	3	Adult		No	No	
59		Femur	L	Distal epiphysis	25%	1	1	Adult	M	Yes	No	DJD - osteophytic lipping around margin of medial condyle
59		Femur	L	Distal epiphysis lateral condyle only	<25%	1	1	Adult		No	No	
59		Femur	U	Distal epiphysis fragment	<25%	1	1	Adult		Yes	No	OA
59		Fibula	U	shaft fragment	25%	1	1	Adult		Yes	Yes	Periostitis - one plaque of woven (14.45mm) and one plaque of porotic compact
59		Fibula	U	Shaft fragment	25%	1	1	Adult		Yes	Yes	Periostitis - severe compact striated bone formation encompassing the fragment with small nodules along the interosseous crest

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
59		Fibula	U	Proximal shaft fragment	<25%	1	1	Adult		No	No	
59		Fibula	U	Shaft fragment	<25%	1	1	Adult		No	No	
59		Patella	U	Fragment	<25%	1	1	Adult		No	No	
59		Tibia	R	Proximal 3 rd of shaft	25%	1	1	Adult		Yes	No	Periostitis - nodule of compact bone formation on lateral side adjacent to tibial tuberosity.
59		Tibia	L	Middle & distal 3 rd of shaft	50%	1	1	Adult		Yes	No	Periostitis - small amount of striated compact bone on lateral side of distal 3 rd .
59		Tibia	L	Proximal 3 rd of shaft	25%	1	1	Adult		Yes	No	Periostitis - compact striated on lateral and medial sides and compact on tibial tuberosity.
59		Tibia	L	Tibial tuberosity	<25%	1	1	Adult		No	No	
59		Tibia	R	Proximal epiphysis	<25%	1	1	Adult		No	No	
59		Tibia	R	Proximal epiphysis	<25%	1	1	Adult		No	No	
59		Tibia	U	Tibial tuberosity	<25%	1	1	Adult		No	No	
59		Tibia	R	Distal tuberosity	<25%	1	1	Adult		No	No	
59	Foot	Talus?	U	Fragment	<25%	1	1	Adult		No	No	
58	Long bones	Long bone	U	Fragments	<25%	1	45	Adult		No	No	
58	Shoulder girdle	Scapula	R	Glenoid+spine+medial border+coracoid+acromion		1	3	Adult	M	No	No	
58		Clavicle	U	Shaft fragment	<25%	1	1	Adult		No	No	
58	Lower limb	Fibula	R	Distal 3 rd	25%	1	1	Adult		No	No	
58		Fibula	U	Shaft fragment	<25%	1	1	Adult		No	No	
58		Femur	R	Proximal and middle 3 rd of shaft	50%	1	2	Adult		No	No	
58		Femur	R	Proximal 3 rd of shaft	25%	1	1	Adult		No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
58		Femur	R	Distal 3 rd of shaft	25%	1	1	Adult		No	No	
58		Femur	U	Shaft fragment	<25%	1	5	Adult		No	No	
58		Femur	U	Distal epiphysis	<25%	1	3	Adult		No	No	
58		Femur	L	Distal epiphysis	25%	1	1	Adult		No	No	
58		Femur	L	Distal epiphysis	25%	1	2	Adult		Yes	Yes	Osteochondritis dissecans on medial condyle
58		Tibia	R	Middle 3 rd of shaft	<25%	1	1	Adult		No	No	
58		Tibia	L	Entire shaft	50%	1	1	Adult		No	No	
58		Tibia	L	Proximal 3 rd of shaft	25%	1	1	Adult		No	No	
58		Tibia	U	Shaft fragment	<25%	1	4	Adult		No	No	
58		Tibia	U	Distal epiphysis	<25%	1	2	Adult		No	No	
58		Patella	L	Complete	100%	1	1	Adult		Yes	Yes	Possible vastus notch
58	Upper limb	Ulna	R	Proximal half	50%	1	1	Adult		No	No	
58		Ulna	L	Proximal & middle 3 rd of shaft	50%	1	1	Adult		No	No	
58		Ulna	R	Middle 3 rd of shaft	25%	1	1	Adult		No	No	
58		Radius	R	Proximal half	50%	1	1	Adult	F	No	No	
58		Radius	R	Proximal 3 rd	20%	1	1	Adult	M	No	No	
58		Radius	R	Middle 3 rd of shaft	25%	1	1	Adult		No	No	
58		Radius	L	Middle 3 rd of shaft	25%	1	2	Adult		No	No	
58		Radius	U	Shaft fragment	<25%	1	1	Adult		No	No	
58		Radius	U	Proximal epiphysis	<25%	1	1	Adult	M	No	No	
58		Humerus	L	Proximal 3 rd	25%	1	1	Adult	M	No	No	
58		Humerus	R	Middle & distal 3 rd of shaft	50%	1	1	Adult		No	No	
58		Humerus	L	Middle & distal 3 rd of shaft	50%	1	2	Adult		No	No	
58		Humerus	U	Shaft fragments	<25%	1	1	Adult		No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
58	Misc. Fragments			Fragments	<25%	1	85			No	No	
58	Pelvic Girdle	Os coxa	L	Incomplete	80%	1	2	YA (19-20)	M?	No	No	
58		Os coxa	L	Incomplete	60%	1	4	Adult		No	No	
58		Os coxa	L	Auricular surface	25%	1	1	YA (18-25)	M	No	No	
58		Os coxa	U	Misc. fragments	<25%	1	8	Adult		No	No	
58	Thorax	Ribs	U	Body fragments	<25%	1	21	Adult		No	No	
58		Ribs	U	Sternal end fragments	<25%	1	2	Adult		No	No	
58		Ribs	L	Rib head fragments	<25%	1	3	Adult		No	No	
58		Ribs	R	Rib head fragments	<25%	1	5	Adult		No	No	
58	Foot	Calcaneus	L	Complete	100%	1	1	Adult		No	No	
58		Calcaneus	L	Complete	100%	1	1	Adult		No	No	
58		Calcaneus	R	Complete	100%	1	1	Adult		No	No	
58		Talus	R	Complete	100%	1	1	Adult		No	No	
58		MT1	R	Complete	100%	1	1	Adult		No	No	
58		MT1	L	Distal end	25%	1	1	Adult		No	No	
58		MT1	L	Distal end	25%	1	1	Adult		No	No	
58		Middle cuneiform	L	Complete	100%	1	1	Adult		No	No	
58		MT1	U	Proximal end	25%	1	1	Adult		No	No	
58		Distal phalanx	U	Complete	100%	1	1	Adult		No	No	
58		MT	U	Fragment	<25%	1	1	Adult		No	No	
58		MT3	R	Proximal half	50%	1	1	Adult		No	No	
58		Misc. Foot frag.	U	Fragment	<25%	1	6	Adult		No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
58	Cranium	Mandible		Crypt 47-33	50%	1	1	YA (18-25)	M?	Yes	Yes	Teeth 47-33 present. Severe calculus on lingual side of all four incisors (photo), moderate calculus on lingual side of both canines and buccal side of incisors.
58		Mandible		Crypt 48-44	25%	1	1	YA (18-25)		Yes	No	Teeth 48-45 present. Slight calculus on lingual side of teeth, with severe calculus on lingual side of tooth 48.
58		Mandible		Crypt 38-35	25%	1	1	YA (18-25)	M	No	No	
58		Mandible		Alveolus fragment	>25%	1	1	Adult	F?	No	No	
58		Maxilla	R	Nasal + Frontal process	<25%	1	1	Adult		No	No	
58		Occipital	R	Occipital protuberance	<25%	1	1	Adult	F?	No	No	
58		Zygoma	L	Incomplete	25%	1	1	Adult		No	No	
58		Parietal	U	Fragment	<25%	1	6	Adult		No	No	
58		Temporal	L	Mastoid	<25%	1	1	Adult	F?	No	No	
58		Sphenoid	L	Greater wing	100%	1	1	Adult		No	No	
58		Sphenoid	R	Greater wing	100%	1	1	Adult		No	No	
58		Sphenoid	U	Fragment	<25%	1	2	Adult		No	No	
58		Frontal	M	Metopic suture	<25%	1	1	Adult		No	No	
58		Frontal	U	Orbital plate	<25%	1	1	Adult		No	No	
58		Frontal	L	Zygomatic process	<25%	1	1	Adult		No	No	
58		Nasal	L	Complete	100%	1	1	Adult		No	No	
58		Cranial vault	U	Fragment	<25%	1	28	Adult		No	No	
58	Vertebrae	C2		Complete	100%	1	1	Adult		Yes	No	DJD
58		C1		Incomplete	80%	1	2	Adult		No	No	
58		Thoracic		Body fragments	<25%	1	3	Adult		No	No	
58		Thoracic		Arch fragments	<25%	1	2	Adult		No	No	
58		Thoracic	L	Inferior facets	<25%	1	3	Adult		No	No	
58		L3		Complete	100%	1	1	Adult		Yes	No	Enthesophytes and Schmorl's Nodes

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Sex	Path.	Photo	Comment
58		Lumbar	L	Inferior facets	<25%	1	4	Adult		No	No	
58		Misc. Foot		Fragments	<25%	1	2	Adult		No	No	
58	Hand	MC2	L	Complete	100%	1	1	Adult		No	No	
58		MC5	L	Distal half	50%	1	1	Adult		No	No	
58		Trapezium	R	Complete	100%	1	1	Adult		No	No	
58		MC5	L	Proximal end	<25%	1	1	Adult		No	No	
58		Prox. phalanx	U	Complete	100%	1	1	Adult		No	No	
58		Prox. phalanx	U	Distal end	<25%	1	2	Adult		No	No	
58		Middle phalanx	U	Complete	100%	1	1	Adult		No	No	

Appendix 4: Human bone - non-adult human remains assemblage

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Path.	Photo	Comment
57	Upper limb	Radius	R	Distal half	50%	1	1	5-12 years	No	No	
57	Vertebrae	Thoracic		Complete	>75%	1	1	c.6 years	No	No	
57	Lower limb	Femur	L	Proximal 3 rd of shaft	<25%	1	1	< 17 years	No	No	
59	Shoulder girdle	Scapula	R	Complete	100%	1	1	Perinate	No	No	
59	Upper limb	Ulna	R	Complete	100%	1	1	NB – 6 months	No	No	
59		Ulna	R	Proximal 3 rd	25%	1	1	NB - 6 months	No	No	
59		Ulna	R	Incomplete	98%	1	1	3rd trimester	No	No	
59		Ulna	L	Complete	100%	1	1	3rd trimester	No	No	
59		Ulna	L	Proximal 3 rd	25%	1	1	NB-6 months	No	No	
59		Ulna	L	Complete	100%	1	1	Perinate	No	No	
59		Radius	L	Complete	100%	1	1	c.6 months	No	No	
59		Radius	L	Proximal half	50%	1	1	c.6 months	No	No	
59		Radius	L	Middle 3 rd of shaft	25%	1	1	NB – 6 months	No	No	
59		Radius	R	Complete	100%	1	1	3rd trimester	No	No	
59		Radius	R	Proximal 3 rd	25%	1	1	NB – 6 months	No	No	
59		Radius	U	Shaft fragment	25%	1	2	NB - 6 months	No	No	
59	Lower limb	Femur	R	Complete	100%	1	1	c.1.5 months	No	No	
59		Femur	R	Complete	100%	1	1	Perinate	No	No	
59		Femur	R	Proximal half	50%	1	1	c.1.5 years	No	No	
59		Femur	R	Distal 3 rd of shaft	25%	1	1	c.1.5 years	No	No	
59		Femur	R	Proximal 3 rd of shaft	25%	1	1	c. 6 months	No	No	
59		Femur	R	Distal 3 rd of shaft	25%	1	1	c. 6 months	No	No	Does not belong to the above entry
59		Femur	L	Complete	100%	1	1	c.1.5 years	No	No	
59		Femur	L	Proximal half	50%	1	1	c.1.5-2 years	No	No	
59		Femur	L	Shaft fragment	80%	1	1	c.1.5 years	No	No	
59		Femur	L	Incomplete	90%	1	1	1.5 months	No	No	
59		Femur	L	Incomplete	85%	1	1	1.5 months	No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Path.	Photo	Comment
59		Femur	L	Proximal half	75%	1	1	1.5 months	No	No	
59		Femur	U	Shaft fragment	10%	1	1	Infant	No	No	
59	Upper limb	Humerus	R	Complete	100%	1	1	c. 2yrs	No	No	
59		Humerus	R	Complete	100%	1	1	Neonate	No	No	
59		Humerus	R	Distal 3 rd	25%	1	1	c.1.5 years	No	No	
59		Humerus	L	Incomplete	90%	1	1	c.1.5 years	No	No	
59		Humerus	L	Middle 3 rd of shaft	25%	1	1	c. Neonate	No	No	
59	Long bones	Unknown	U	Shaft fragments	25%	1	5	Infant	No	No	
59	Thorax	Ribs	R	Complete	100%	1	3	Perinate - infant	No	No	
59		Ribs	L	Complete	100%	1	11	Perinate - infant	No	No	
59	Upper limb	Ulna	L	Proximal half of shaft	60%	1	1	Older juvenile		Yes	Possible TB affecting the elbow joint. While the proximal end is missing, the remaining fragment shows thickening, a result of several layers of new bone formation. A mixture of porotic and striated compact bone, with the compact bone found primarily on the posterior side and woven bone on the anterior, medial and lateral sides.
59	Vertebrae	Cervical		Complete arch	100%	1	4	2-4 years	No	No	
59		Cervical	R	Complete arch	100%	1	1	2-4 years	No	No	
59		Cervical		Centrum	100%	1	1	NB- 2 years	No	No	
59		C1	R	Arch	100%	1	1	Neonate	No	No	
59		C2	R	Arch	100%	1	1	Neonate	No	No	
59		C1	R	Arch	100%	1	1	Perinate	No	No	
59		Cervical	R	Arch	100%	1	1	Neonate	No	No	
59		Thoracic	R	Arch	100%	1	1	Neonate	No	No	
59		Thoracic	L	Arch	100%	1	1	Neonate	No	No	
59		Thoracic	L	Arch	100%	1	1	Perinate	No	No	
59		Thoracic		Centrum	25%	1	2	older juvenile	No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Path.	Photo	Comment
59	Pelvic girdle	Ilium	R	Complete	100%	1	1	Neonate	No	No	
59		Ischium	R	Incomplete	90%	1	1	Neonate	No	No	
59	Lower limb	Tibia	R	Complete	100%	1	1	Neonate	No	No	
59		Tibia	R	Complete	100%	1	1	Perinate	No	No	
59		Tibia	R	Proximal & middle 3 rd	90%	1	1	Neonate	No	No	
59		Tibia	R	Complete	95%	1	1	NB – 6 months	No	No	
59		Tibia	R	Proximal 3 rd	<25%	1	1	3-6 months	No	No	
59		Tibia	L	Complete	100%	1	1	c.1.5 months	No	No	
59		Tibia	L	Complete	98%	1	1	Perinate	No	No	
59		Tibia	L	Proximal half	50%	1	1	NB – 6 months	No	No	
59		Tibia	L	Shaft only	80%	1	1	3-6 months	Yes	Yes	The shaft is completely encased in woven and striated bone.
59		Tibia	L	Proximal half	50%	1	1	1.5-5 years	No	No	
59		Tibia	L	Shaft only	50%	1	1	1.5-2.5 years	No	No	
59	Shoulder girdle	Clavicle	L	Acromial end	25%	1	1	Older juvenile	No	No	
59		Clavicle	L	Sternal end frag.	25%	1	1	Older juvenile	No	No	
59		Clavicle		Shaft fragments	<25%	1	2	Older juvenile	No	No	
59	Thorax	Ribs	R	Rib head fragments	<25%	1	3	Infant-young juvenile	No	No	
59		Ribs	L	Rib head fragments	<25%	1	5	Infant-young juvenile	No	No	
59		Ribs	U	Body fragments	<25%	1	12	Infant-young juvenile	No	No	
59		Ribs	U	Sternal end	<25%	1	3	Infant-young juvenile	Yes	Yes	1 sternal fragment with healed fracture at sternal end.
59	Epiphysis	Unknown		Complete	100%	1	1	infant-young juvenile	No	No	
59	Cranium	Zygomatic	L	Complete	100%	1	1	Juvenile	No	No	
59		Zygomatic	R	Complete	100%	1	1	3rd trimester	No	No	
59		Zygomatic	L	Complete	100%	1	1	Juvenile	No	No	
59		Temporal	R	Complete	100%	1	1	Juvenile	No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Path.	Photo	Comment
59		Temporal	R	Complete	100%	1	1	Juvenile	No	No	
59		Petrous	R	Complete	100%	1	1	NB - 1 year	No	No	
59		Petrous	R	Incomplete	75%	1	1	NB – 1year	No	No	
59		Petrous	R	Complete	100%	1	1	NB -1 year	No	No	
59		Petrous	L	Complete	100%	1	1	Juvenile	No	No	
59		Petrous	R	Incomplete	50%	1	1	NB-1year	No	No	
59		Temporal	L	Complete	100%	1	1	Juvenile	No	No	
59		Temporal	L	Incomplete	80%	1	1	Juvenile	No	No	
59		Temporal	L	Incomplete	80%	1	1	Young juvenile	No	No	
59		Temporal	L	Complete	100%	1	1	c.1 year	No	No	
59		Petrous	L	Complete	100%	1	1	NB - 1 year	No	No	
59		Petrous	L	Complete	100%	1	1	Juvenile	No	No	
59		Petrous	L	Complete	100%	1	1	Juvenile	No	No	
59		Petrous	L	Complete	100%	1	1	Juvenile	No	No	
59		Mandible		Complete	100%	1	1	3yrs+/- 12 months	No	No	Teeth present include 74, 75, 84, 85. With teeth 46 and 36 in crypt. The rest have been lost post-mortem.
59		Mandible	R	Crypt 85-74	75%	1	2	4 yrs+/- 12 months	No	No	Mandible in two fragments. Tooth 85 and 73 present.
59		Mandible		Crypt 74-82	50%	1	1	> 4 years	No	No	Tooth 74 present.
59		Mandible	R	Hemimandible	100%	1	1	< 1 year	No	No	
59		Mandible	R	Hemimandible	100%	1	1	<1 year	No	No	
59		Mandible	L	Hemimandible	100%	1	1	<1 year	No	No	
59		Mandible		Fragments	<25%	1	2	Juvenile	No	No	Alveolus fragments
59		Mandible	L	Ascending ramus	<25%	1	1	Juvenile	No	No	
59		Maxilla	R	Complete	100%	1	1	3-5 years	No	No	Tooth 54 and 55 present.
59		Maxilla	R	Complete	100%	1	1	3-4 years	No	No	Tooth 54 and 55 present.
59		Maxilla	R	Crypt 51-54	75%	1	1	Young juvenile	No	No	Tooth 54 present.
59		Maxilla	R	Crypt 51-53	50%	1	1	Young juvenile	No	No	No teeth present.
59		Maxilla	L	Complete	100%	1	1	6yrs +/-24 months	No	No	Tooth 64 and 65 present. Erupting 21 and 26
59		Maxilla	L	Complete	100%	1	1	5yrs +/-16 months	Yes	No	Tooth 64 and 65 present. Erupting 26 with CEH,

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Path.	Photo	Comment
59		Maxilla	L	Complete	100%	1	1	3yrs+/- 12 months	No	No	Tooth 64 and 65 present.
59		Maxilla	L	Complete	100%	1	1	3yrs+/- 12 months	No	No	Tooth 64 and 65 present.
59		Maxilla	R	Crypt 51-52	50%	1	1	Young juvenile	No	No	No teeth present.
59		Cranial vault		Misc. fragments	<25%	1	131	Non-adult	No	No	
59		Frontal		Complete	100%	1	1	Juvenile	Yes	Yes	Cribra orbitalia - mixed severe in left and healed medium in right
59		Frontal		Incomplete	75%	1	1	Young juvenile	Yes	Yes	Possible scurvy - porotic new bone in and above orbits.
59		Frontal	R	Orbit	25%	1	1	Young juvenile	No	No	
59		Frontal	L	Orbit	25%	1	1	Young juvenile	Yes	Yes	Cribra orbitalia - mixed moderate
59		Frontal	L	Orbit	25%	1	1	Young juvenile	No	No	
59		Frontal	L	Orbit	25%	1	1	NB-1year	No	No	
59		Frontal	R	Orbit	25%	1	1	Infant	Yes	No	Cribra orbitalia – active slight
59		Frontal	R	Orbit	25%	1	1	Perinate	No	No	
59		Frontal	R	Orbit	25%	1	1	Infant	No	No	
59		Frontal	L	Orbit	25%	1	1	Infant	No	No	
59		Frontal	R	Orbit	25%	1	1	Perinate	No	No	
59		Frontal	R	Orbit	25%	1	1	Infant	Yes	No	Cribra orbitalia – active slight
59		Frontal	M	Metopic suture	25%	1	1	Juvenile	No	No	
59		frontal	M	Metopic suture	25%	1	1	Juvenile	No	No	
59		Frontal	L	Orbit	25%	1	1	Infant	Yes	No	Possible scurvy – woven bone in orbit
59		Frontal	M	Fragments	<25	1	11	Juvenile	No	No	
59		Frontal		Complete	85%	1	1	Young juvenile	No	No	
59		Frontal	R	Right half	50%	1	1	Young juvenile	Yes	No	Cribra orbitalia - mixed moderate
59		Sphenoid	R	Greater wing	100%	1	1	Non-adult	No	No	
59		Sphenoid	R	Greater wings	>75%	1	2	Non-adult	No	No	
59		Sphenoid	R	Pterygoid plate and hamulus	100%	1	1	Non-adult	No	No	
59		Sphenoid	m	Clivus+clinoid process	50%	1	1	Perinate	No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Path.	Photo	Comment
59		Sphenoid	m	Clivus+clinoid process	100%	1	1	Young juvenile	No	No	
59		Sphenoid	L	Greater wings	100%	1	4	Non-adult	No	No	
59		Sphenoid	U	Fragments	<25%	1	4	Non-adult	No	No	
59		Parietal	L	Fragments	50%	6	13	juvenile	No	No	
59		Parietal	R	Fragments	50-100%	3	6	Juvenile	No	No	
59		Parietal	U	Fragments	<25%	1	33	Juvenile	No	No	
59		Parietal	U	Fragments	<25%	2	7	Young juvenile	Yes	Yes	All fragments show evidence of PH. 3 fragments show severe active PH and appear to belong to either a young juvenile or infant. 1 fragment shows active moderate and 3 fragments show active slight. At least 2 separate individuals, one slightly older than the first severe case.
59		Parietal	U	Fragments	<25%	1	1	Juvenile	Yes	Yes	Endocranial infection
59		Parietal	L	Incomplete	75%	1	1	Infant-young juvenile	No	No	
59		Parietal	U	Fragments	<25%	1	1	Infant-young juvenile	No	No	
59		Occipital		Squasma	100%	1	1	Neonate	No	No	
59		Occipital		Squasma	50%	1	1	Infant	No	No	
59		Occipital		Squasma	50%	1	1	Infant	No	No	
59		Occipital		Squasma	50%	1	1	Infant-young juvenile	No	No	
59		Occipital		Squasma	<25%	1	1	Infant-young juvenile	Yes	Yes	Possible endocranial infection
59		Occipital		Squasma	<25%	1	10	Infant-young juvenile	Yes	Yes	Two fragments (which match up) have possible endocranial infection
59		Pars lateralis	R	Complete	100%	1	1	3rd trimester	No	No	
59		Pars lateralis	R	Complete	100%	1	1	Neonate	No	No	
59		Pars lateralis	R	Complete	100%	1	1	Infant	No	No	

Deposit	Area	Bone	Side	Segment	Completeness	MNI	No frags	Age	Path.	Photo	Comment
59		Pars lateralis	R	Complete	100%	4	4	<3 years	No	No	
59		Pars lateralis	L	Complete	100%	1	1	Perinate	No	No	
59		Pars lateralis	L	Complete	100%	2	2	<3 years	No	No	
59		Basilar		Incomplete	50%	3	3	<3 years	No	No	
59		Cranial vault	U	Incomplete	<25%	1	18	Perinate	No	No	
59	Unknown	Misc. fragments		Fragments	<25%	1	160	Non-adult	No	No	
58	Lower limb	Femur	R	Distal epiphysis	25%	1	2	Older juvenile	No	No	
58		Femur	U	Proximal 3 rd	<25%	1	1	Juvenile	No	No	
58	Cranium	Maxilla	L	crypt 21-27	50%	1	1	12yrs+36 months	Yes	No	Non-linear array of pits on tooth 26

Appendix 5: Human bone - loose teeth

Adult loose teeth																
Tooth number	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Deposit 57																
Deposit 59			1(un)											1(un)		
Deposit 58			1							1(LPH)			1 (<14yrs)			
Tooth number	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Deposit 57														1		
Deposit 59														1(just forming)		
Deposit 58						1 (<15yrs)						1				1 (<25yrs)
Non-adult teeth																
Tooth number				55	54	53	52	51	61	62	63	64	65			
Deposit 59				1(un)*	1	1	2	1	1	3*	1		1(un)			
Tooth number				75	74	73	72	71	81	82	83	84	85			
Deposit 59						1		1	1	1	1	2+(1un)	2			

*: tooth 55 has CEH and linear pits. One 62 has a small cavity on mesial side

Appendix 6: Human bone - age estimates and MNI of non-adults

Deposit	Bone	Side	Description	Age	Pathology
59	Radius	L	Middle 3 rd present	NB-6 months	-
59	Radius	L	Complete	c.6 months	-
59	Radius	L	Proximal half present	c.6 months	-
59	Radius	R	Complete	3rd trimester	-
59	Radius	R	Proximal 3 rd present	NB-6 months	-
57	Radius	R	Distal half present	5-12 years	-
59	Ulna	L	Complete	3rd trimester	-
59	Ulna	L	Complete	Perinate	-
59	Ulna	L	Proximal 3 rd present	NB-6 months	-
59	Ulna	L	Proximal half of shaft present	older juvenile	TB
59	Ulna	R	Incomplete	3rd trimester	-
59	Ulna	R	Complete	NB-6 months	-
59	Ulna	R	Proximal 3 rd present	NB-6 months	-
59	Humerus	L	Middle 3 rd present	Neonate	-
59	Humerus	L	Incomplete	c.1.5 years	-
59	Humerus	R	Complete	Neonate	-
59	Humerus	R	Distal 3 rd present	c.1.5 years	-
59	Humerus	R	Complete	c.2 years	-
59	Femur	L	Incomplete	1.5 months	-
59	Femur	L	Proximal half present	1.5 months	-
59	Femur	L	Incomplete	1.5 months	-
59	Femur	L	Shaft	c.1.5 years	-
59	Femur	L	Complete	c.1.5 years	-
59	Femur	L	Proximal half present	c.1.5-2 years	-
57	Femur	L	Proximal 3 rd of shaft present	Adolescent (<17 years)	-
59	Femur	R	Complete	Perinate	-
59	Femur	R	Complete	c.1.5 months	-
59	Femur	R	Proximal 3 rd of shaft present	c. 6 months	-
59	Femur	R	Distal 3 rd of shaft present	c. 6 months*	-
59	Femur	R	Proximal half present	C.1.5 years	-
59	Femur	R	Distal 3 rd of shaft	c.1.5 years	-
58	Femur	R	Distal epiphysis	older juvenile	-

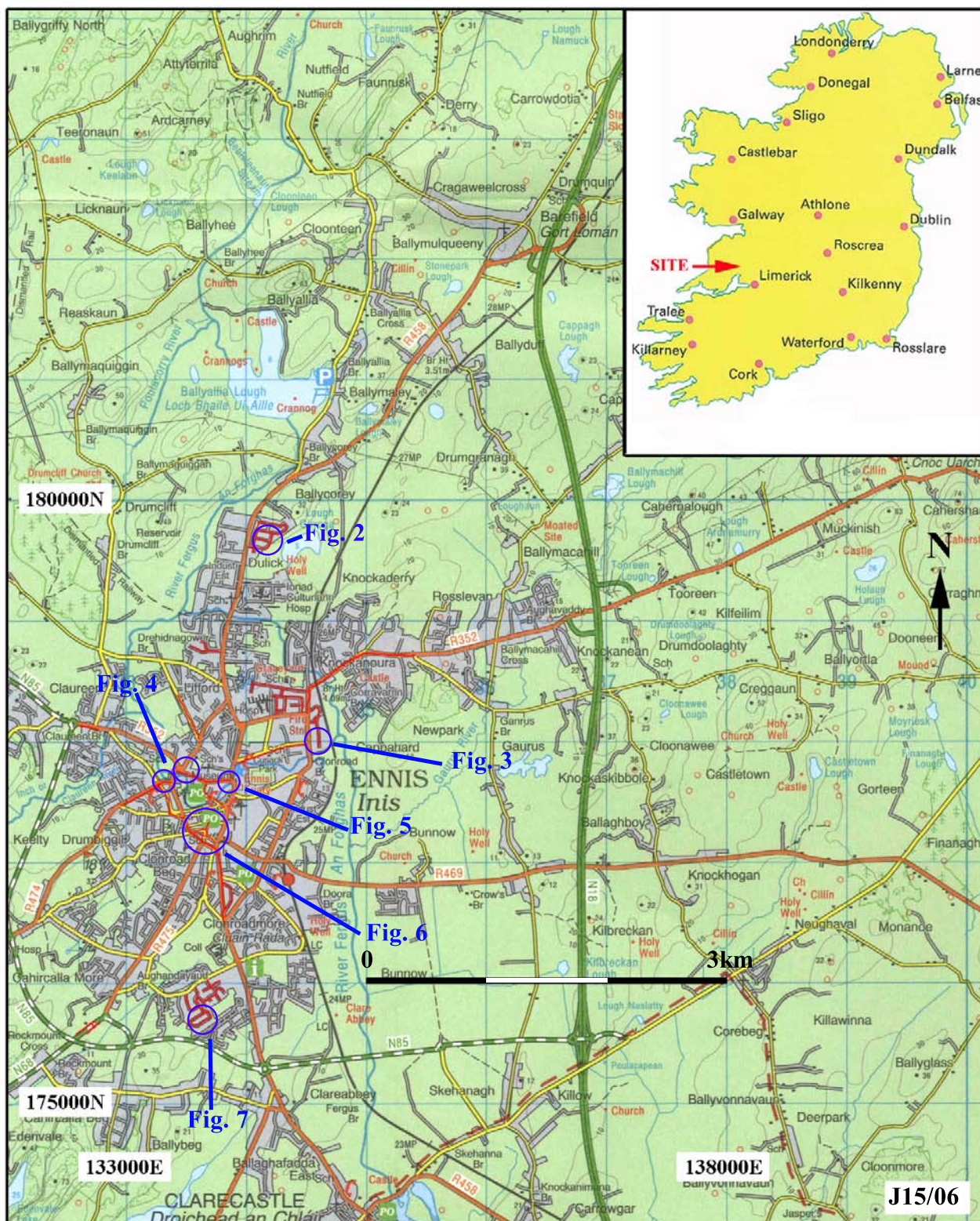
Deposit	Bone	Side	Description	Age	Pathology
59	Tibia	L	Complete	Perinate	-
59	Tibia	L	Complete	c.1.5 months	-
59	Tibia	L	Proximal half present	NB – 6 months	-
59	Tibia	L	Shaft only	3-6 months	periostitis
59	Tibia	L	shaft only	1.5- 2.5 years	-
59	Tibia	L	Proximal half present	1.5 – 5 years	-
59	Tibia	R	Complete	Neonate	-
59	Tibia	R	Proximal and middle 3 rd s	Neonate	-
59	Tibia	R	Complete	Perinate	-
59	Tibia	R	Complete	NB – 6 months	-
59	Tibia	R	Proximal 3 rd	3-6 months	-
59	Petrous	L	Complete	NB - 1 year	-
59	Petrous	L	Complete	Juvenile	-
59	Petrous	L	Complete	Juvenile	-
59	Petrous	L	Complete	Juvenile	-
59	Petrous	L	Complete	Juvenile	-
59	Temporal	L	Complete	Juvenile	-
59	Temporal	L	Complete	c. 1 year	-
59	Petrous	R	Complete	NB - 1 year	-
59	Petrous	R	Incomplete	NB – 1 year	-
59	Petrous	R	Complete	NB -1 year	-
59	Petrous	R	Incomplete	NB-1yr	-
59	Temporal	R	Complete	Juvenile	-
59	Temporal	R	Complete	Juvenile	-
59	Pars lateralis	L	Complete	Perinate	-
59	Pars lateralis	L	Complete	<3yrs	-
59	Pars lateralis	R	Complete	3rd trimester	-
59	Pars lateralis	R	Complete	Neonate	-
59	Pars lateralis	R	Complete	Infant	-
59	Pars lateralis	R	Complete	<3 years	-
59	Pars lateralis	R	Complete	<3 years	-
59	Pars lateralis	R	Complete	<3 years	-
59	Pars lateralis	R	Complete	<3 years	-
59	Mandible		Complete. Tooth 74, 75, 84 and 85 present	3yrs+/- 12 months	-
59	Mandible	L	Hemimandible	<1 year	-

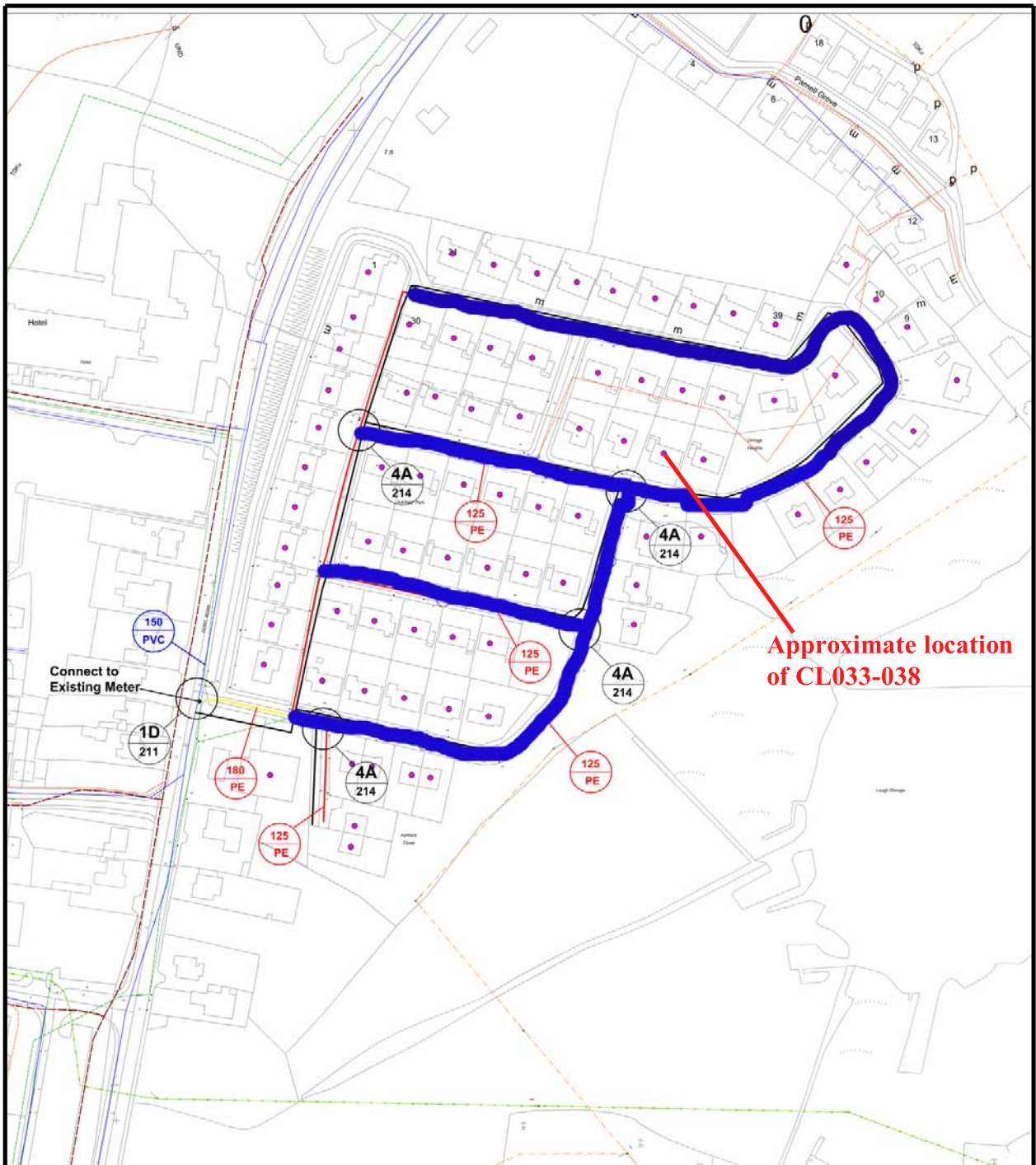
Deposit	Bone	Side	Description	Age	Pathology
59	Mandible	L	Ascending ramus fragment	Juvenile	-
59	Mandible	R	Hemimandible	< 1year	-
59	Mandible	R	Hemimandible	<1 year	-
59	Mandible	R	Crypts 85-74. Tooth 85 and 73 present	4yrs +/- 12 months	-
59	Mandible		Crypts 82-74. Tooth 74 present	> 4 years	-
59	Maxilla	L	Crypts 61-65. Tooth 64 and 65 present	3yrs+/- 12 months	-
59	Maxilla	L	Crypts 61-65. tooth 64 and 65 present	3yrs+/- 12 months	-
59	Maxilla	L	Complete. Tooth 64 and 65 present, erupting 26	5yrs +/-16 months	CEH
59	Maxilla	L	Complete. Tooth 64 and 65 present, erupting 21 and 26	6yrs +/-24 months	-
58	Maxilla	L	Crypt 21-27	12yrs+36 months	DEH
59	Maxilla	R	Complete. Tooth 54 and 55 present	3-4 years	-
59	Maxilla	R	Complete. Tooth 54 and 55 present	3-5 years	-
59	Maxilla	R	Crypts 51-54 present with tooth 54	Young juvenile	-
59	Maxilla	R	Crypts 51-53 no teeth present	Young juvenile	-
59	Maxilla	R	Crypts 51 and 52, no teeth	Young juvenile	-
59	Frontal	L	Orbit	Infant	-
59	Frontal	L	Orbit	Infant	Scurvy?
59	Frontal	L	Orbit	NB-1yr	-
59	Frontal	L	Orbit	Young juvenile	Cibra Orbitalia
59	Frontal	L	Orbit	Young juvenile	-
59	Frontal	R	Orbit	Perinate	-
59	Frontal	R	Orbit	Perinate	-
59	Frontal	R	Orbit	Infant	Cibra Orbitalia
59	Frontal	R	Orbit	Infant	-
59	Frontal	R	Orbit	Infant	Cibra Orbitalia
59	Frontal	R	Orbit	Young juvenile	-
59	Frontal	R	Orbit	Young juvenile	Cibra Orbitalia
59	Frontal	L+R	Complete	Juvenile	Cibra Orbitalia
59	Frontal	L+R	Complete	Young juvenile	-
59	Frontal	L+R	Incomplete	Young juvenile	Scurvy?

Appendix 7: Archive contents

Category	Item	Quantity	Condition
Paper records	Monitoring sheets	25	Good
	Context index sheets	1	Good
	Context sheets	0	Good
	Plan keys	0	
	Sample index sheets	0	
	Level sheets	0	
Plans	1:100 pre-ex plans (A2)	0	
	1:20 mid-ex plan sheets (A2)	0	
	1:20 post-ex plan sheets (A2)	0	
Sections	Section sheets (A2)	0	
	1:10 section drawings (on those sheets)	0	
Photographs	Digital photographs	214	Digitally stored & backed-up

The archive is currently stored at the TVAS (Ireland) Ltd office, Ahish, Ballinruan, Crusheen, Co. Clare.






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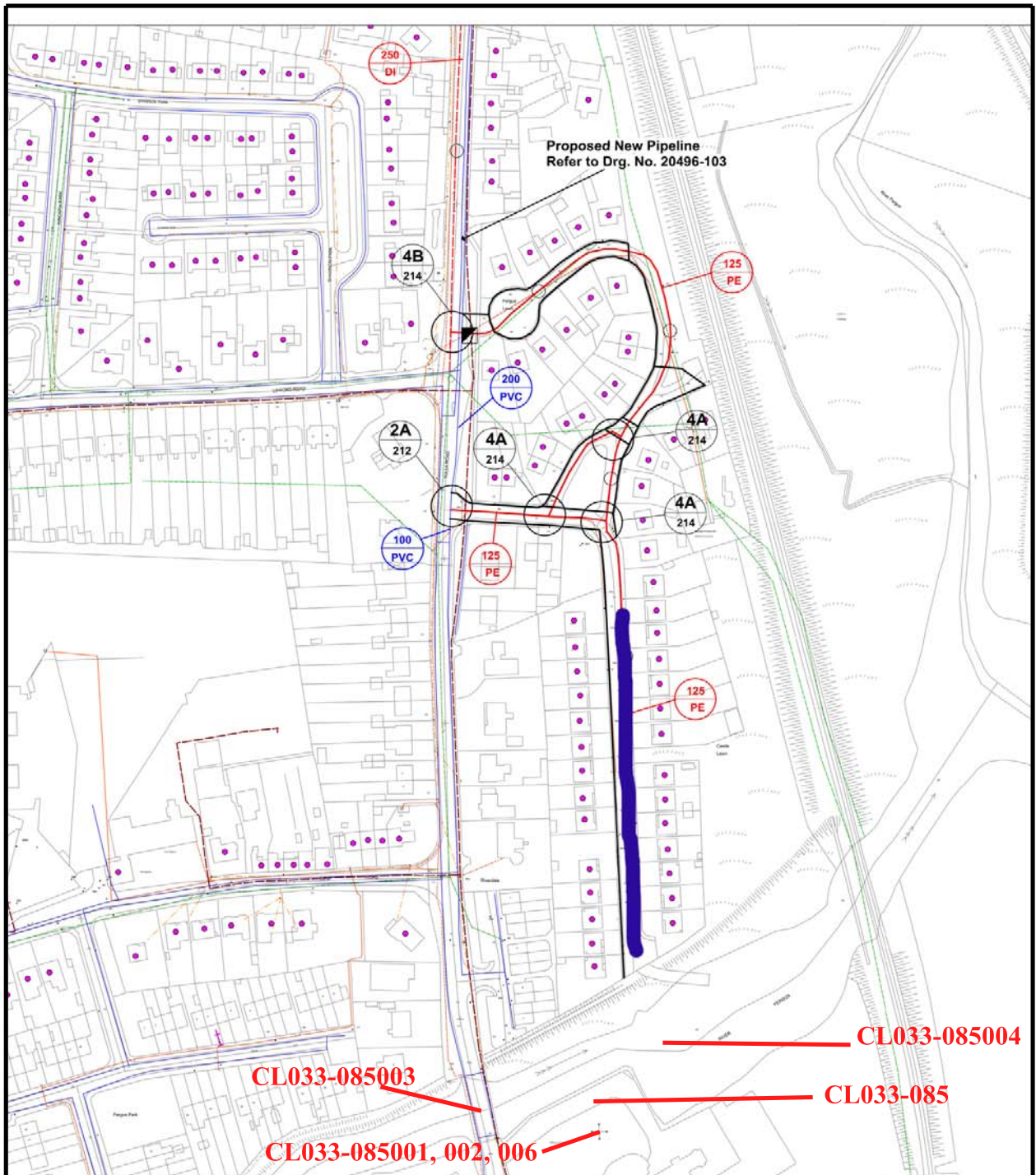
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**Figure 2: Monitoring in Dulick and
Ballycorey**

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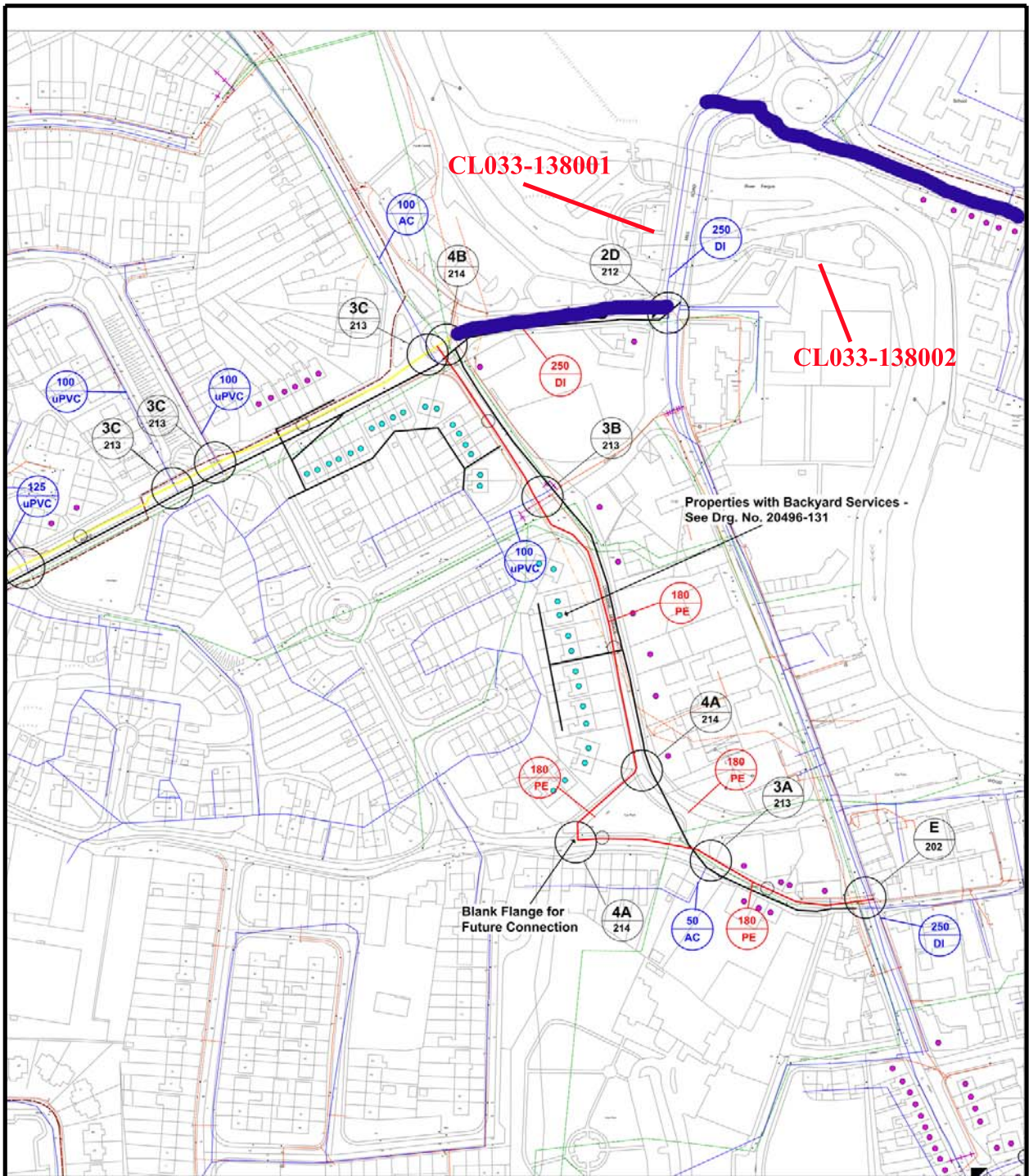
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Figure 3: Monitoring opposite Clonroad More

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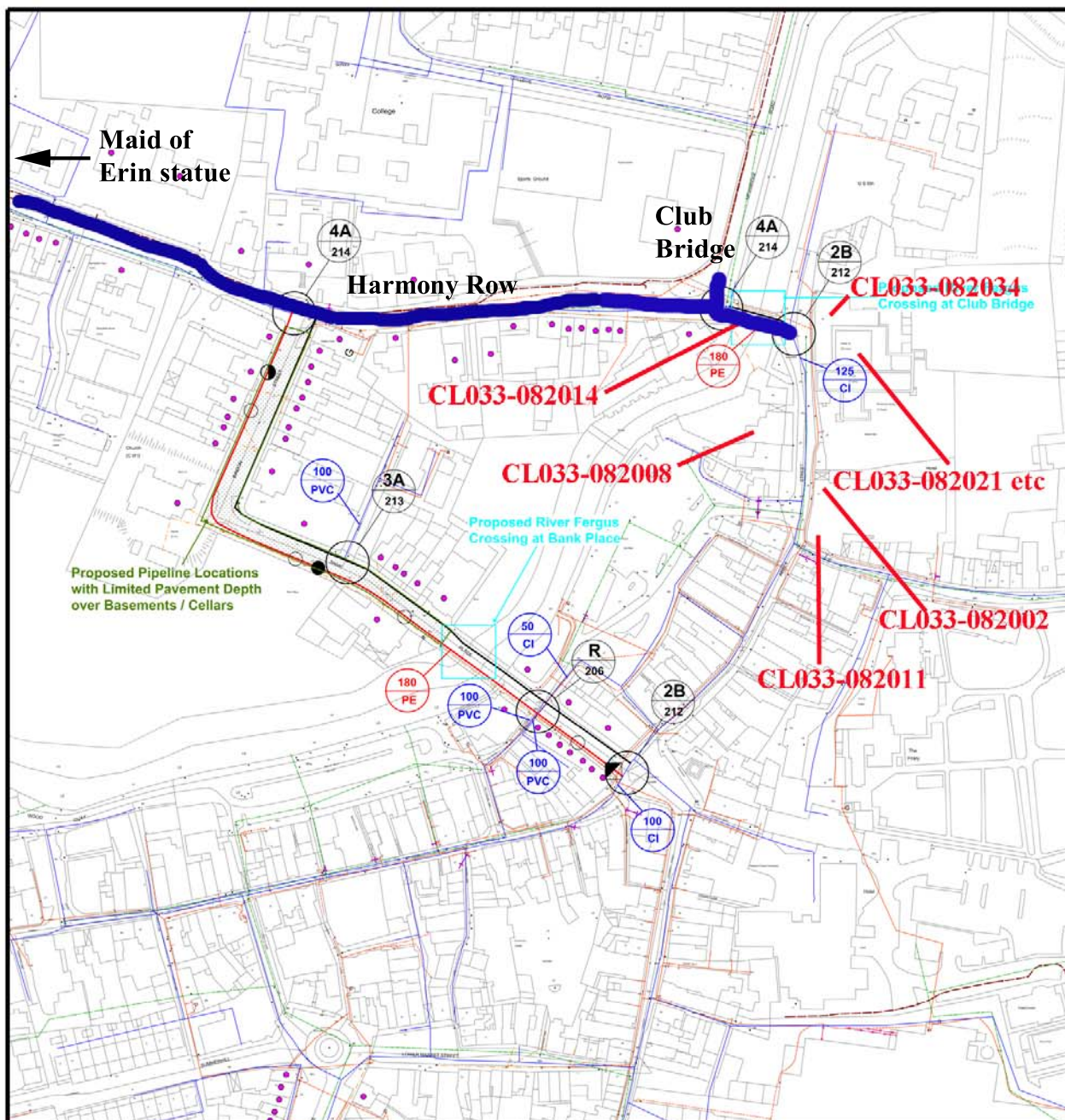
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**Figure 4: Monitoring in Cloghleigh and
Lifford**

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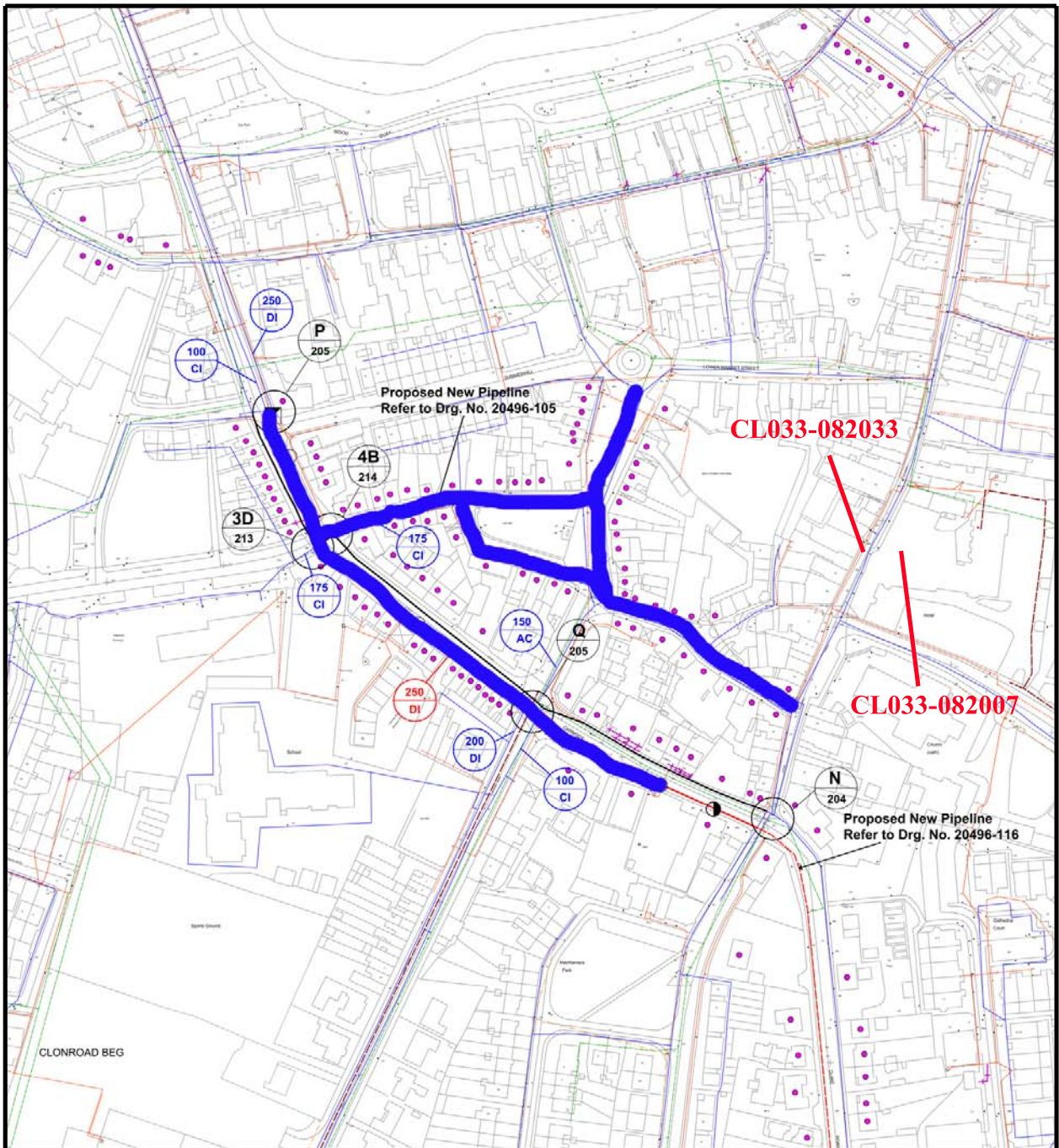
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Figure 5: Monitoring at Club Bridge

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Blue line = Pipes to be monitored

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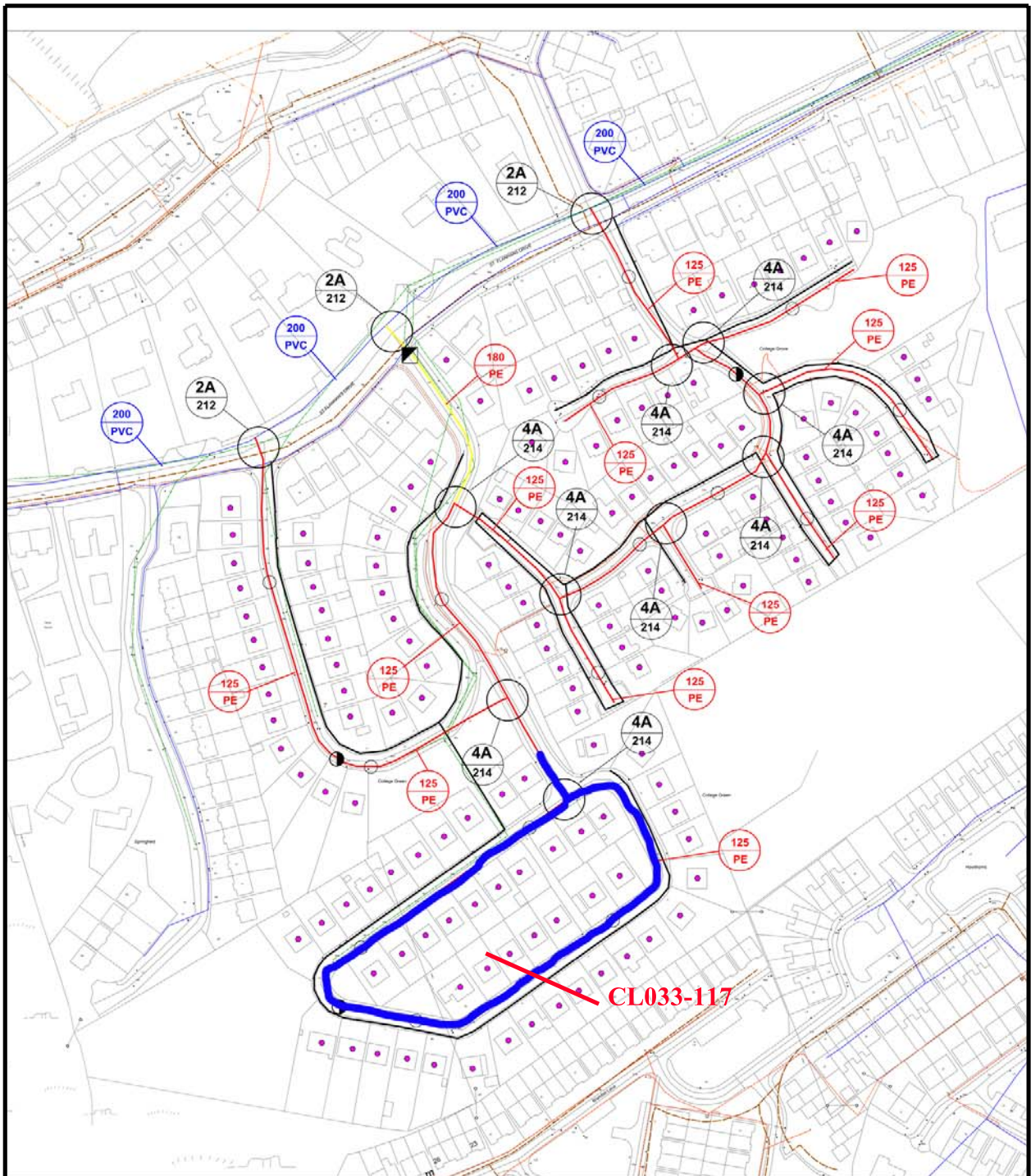
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**Figure 6: Monitoring inside town centre
CL033-082**

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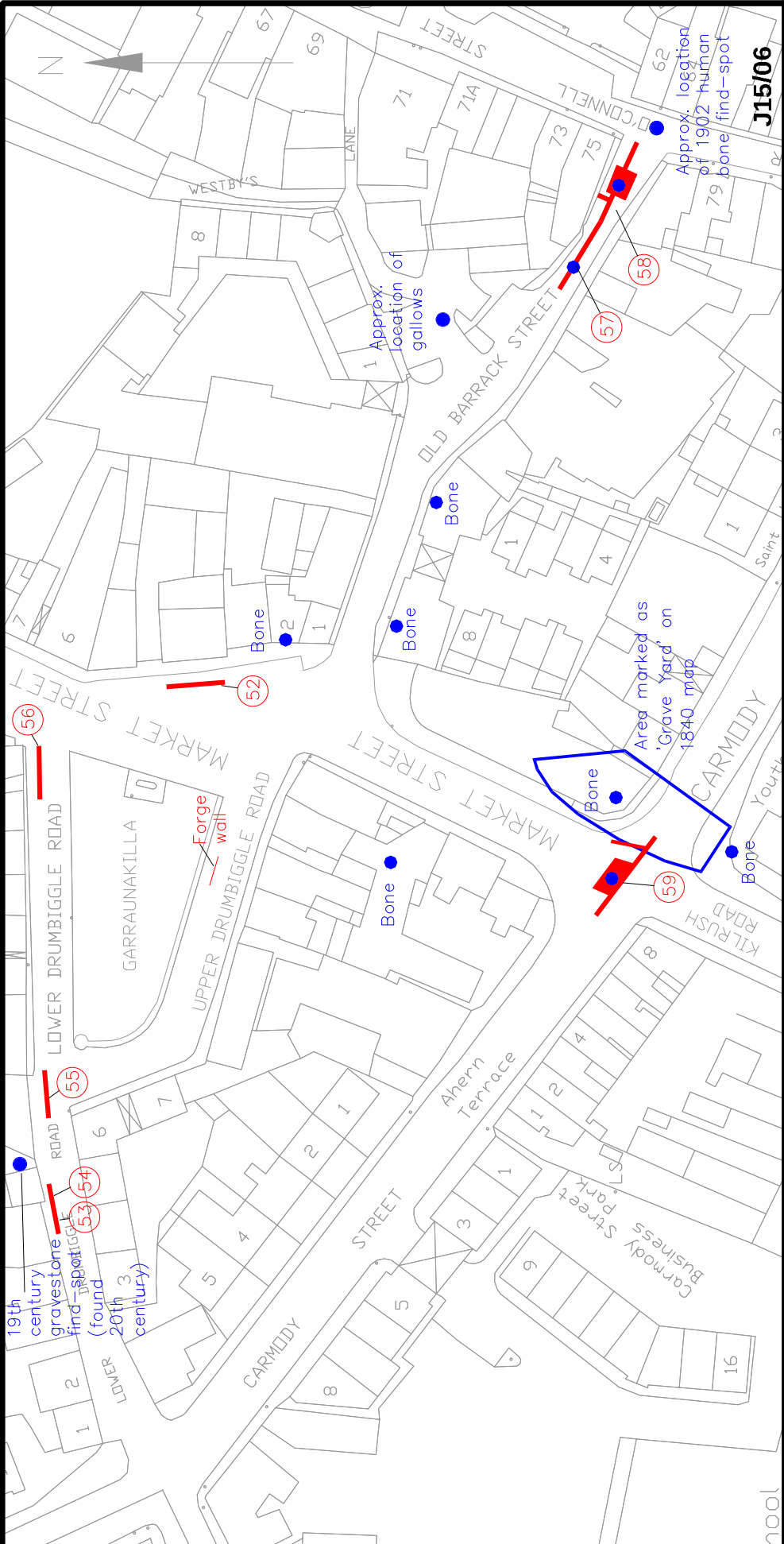
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Figure 7: Monitoring at College Green

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Figure 8: Find-spots of bone and other deposits

Ordnance Survey digital mapping provided by client
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0 50m

Scale 1:1,000 @ A4

- KEY
- Found under 15E0130
 - Bone findspots and previously known sites

T V A S

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LTD

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Figure 9: Ordnance Survey 1st edition fair plan 1840

Ordnance Survey fair plan sheet CL033. Surveyed 1840
(From Ó Dálaigh 2012, map 10)

0 100m

Scale 1:2,000 @ A4

T V A S

IRRELL AND
LTD



Plate 1: Typical watermain trench.
Scale 0.5m



Plate 2: Typical side trench



Plate 3: Trench junction box at east end of Old Barrack Stret. Looking north.
Human bone found beneath line



Plate 4: Human femur *in situ* within deposit 58



Plate 5: Human skull fragment *in situ* within deposit 58



Plate 6: Wall in Upper Drumbiggle Road (old forge). Looking north

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Plates 1-6

T V A S
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**Plate 7: Garraunakilla Lane c. 1954
(after Brennan undated)**



**Plate 8: Gravestone of Jane Percy,
7th October 1828, aged 1 year
(approx 0.8m high)**



FINDSPOT

**Plate 9: Lower Drumbiggle Road. Near findspot
of 19th century gravestone**



**Plate 10: Trench at Harmony Row at
Club Bridge end**



**Plate 11: Trench in Harmony Row at
Maid of Erin end**



**Plate 12: Typical stratigraphy in trench
near mill site**

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Plates 7-12

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Plate 13: Moderate calculus on the buccal surface of the lower incisors (fragment from deposit 58)



Plate 14: Severe calculus on the lingual surface of the lower incisors (fragment from deposit 58)



Plate 15: Right distal humerus of adult male showing eburnation and porosity of the capitulum



Plate 16: Fragment of the distal 3rd of a left radius showing eburnation, porosity and new bone formation



Plate 17: Anterior view of left distal humerus showing mixed new bone formation and cloaca (on lateral side)



Plate 18: Posterior view of left distal humerus showing bone destruction and cloaca



Plate 19: Anterior view of left proximal ulna showing similar destruction and bone formation

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Plates 13-19

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Plate 20: Superior view of left ulna showing multiple layers of new bone formation



Plate 21: Anterior/ lateral view of left ulna showing deposits of porotic and striated woven bone



Plate 22: Tibia shaft fragment from an infant between the ages of 3 and 6 months showing extensive new bone formation



Plate 23: Cranial fragment with capillary lesions



Plate 24: Cribra orbitalia of the left orbit (juvenile)



Plate 25: Severe active lesions of PH in a possible infant



Plate 26: Moderate mixed lesions of PH in a possible juvenile

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Plates 20-26

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Plate 27: Frontal bone showing evidence of new bone formation possibly associated with scurvy



Plate 28: Colle's fracture to the left radius



Plate 29: Healed rib fracture



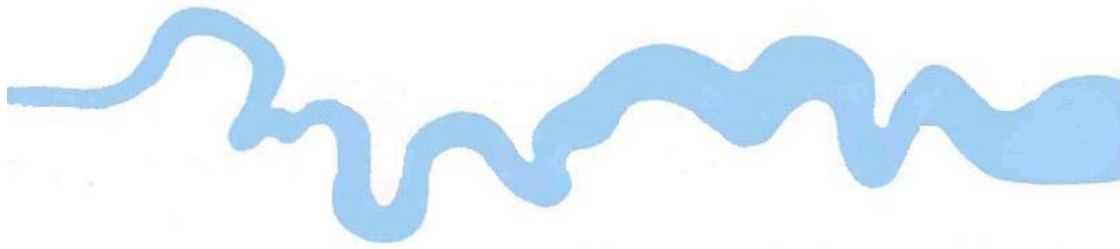
Plate 30: Osteochondritis dissecans

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Plates 27-30

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