UWF GRID CONNECTION

REFERENCE DOCUMENTS

UWF REPLACEMENT FORESTRY

VOLUME F7:

EIAR APPENDICES (PART 3 OF 3)

Volume A	Planning Application Documents – Application Form; Site/Newspaper Notice; Letters of Consent; Schedule of Submitted Documents etc.	
Volume B	Planning Drawings	
Volume C	UWF Grid Connection EIA Report (EIAR)	Volume C1: EIAR Non-Technical Summary Volume C2: EIAR Main Report Volume C3: EIAR Figures Volume C4: EIAR Appendices
Volume D	Environmental Management Plan for UWF Grid Connection	
Volume E	Appropriate Assessment Reporting	
VOLUME F	**REFERENCE DOCUMENTS FOR OTHER ELEMENTS OF THE WHOLE UWF PROJECT**	Volume F1 to F3: UWF Related Works EIA Report Volume F4: Environmental Management Plan For The UWF Related Works Volume F5 TO F7: 2018 UWF Replacement Forestry EIA Report **VOLUME F7: EIAR APPENDICES (3 PARTS)** Volume F8 to F9: Upperchurch Windfarm **DETAILS OVERLEAF**

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Project Website: www.upperchurchwindfarmgridconnection.ie

Reference

REFERENCE DOCUMENTS DETAILS

Volumes F1 to F3: 2018 UWF Related Works EIA Report

Volume F1: EIAR Non-Technical Summary & EIAR Figures

Volume F2: EIAR Main Report (2 Parts)

Volume F3: EIAR Appendices (3 Parts)

Volume F4: Environmental Management Plan for the UWF Related Works

Volumes F5 to F7: 2018 UWF Replacement Forestry EIA Report

Volume F5: EIAR Non-Technical Summary & EIAR Figures

Volume F6: EIAR Main Report (2 Parts)

Volume F7: EIAR Appendices (3 Parts)

Volumes F8 to F9: Upperchurch Windfarm

Volume F8: 2013 EIS for Upperchurch Windfarm

Volume F9: 2013 RFI for Upperchurch Windfarm & 2014 ABP Inspector's Report for Upperchurch Windfarm & 2014 Grant of Permission & Conditions for Upperchurch Windfarm

Reference

Upperchurch Windfarm Replacement Forestry (UWF Replacement Forestry)

UWF Replacement Forestry EIA Report (EIAR)

VOLUME C4: EIAR APPENDICES

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EIA Report Authors:

EIAR Coordinator:

February 2018

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Appendix to Chapter 11: Water

The data and descriptions in this appendix have informed Chapter 11: Water of the EIA Report.

The information presented in this Appendix 11 is outlined below and the relevant element(s) of the Whole UWF Project are also identified.

Appendix 11 Section	Section Heading	Relevant Individual Project Element
A11.1	Survey of Existing and Proposed Watercourse Crossing Locations	UWF Grid Connection UWF Related Works
A11.2	Surface Water Sampling Results	UWF Grid Connection UWF Related Works
A11.3	Flood Risk Assessment	UWF Grid Connection UWF Related Works
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Appendix 11.1: Survey of Existing and Proposed Watercourse Crossing Locations

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A11.1.1 Classification for UWF Grid Connection Watercourses

Table 1: Watercourse Classification, Colour Code and Inventory

Watercourse Classification	UWF Grid Connection	UWF Grid Connection Access Haul Routes	Total UGC (inc Haul Route)	Instream works
EPA Blue Linen - Fisheries Value	14	6	20	9
EPA Blue Line Equivalent - Fisheries Value	9	5	14	6
Sub-Optimal - Low Fisheries Value	5	5	10	4
Drain - No Fisheries Value	37	9	46	19
	65	**25**	**90**	**38**

Watercourse crossings are colour coded in table 2 below with the same colours as those in the above table 1 for the relevant watercourse classification.

Blue: EPA Blue Linen - Fisheries Value

Red: EPA Blue Line Equivalent - Fisheries Value

Yellow: Sub-Optimal - Low Fisheries Value

Pink: Drain - No Fisheries Value

A11.1.2 Survey of Existing and Proposed Watercourse Crossing Locations

Table 2: Survey Results for the UWF Grid Connection W1 – W65 (Cable Route Crossings)

WC_No	WC_TYPE	Watercourse Description	Ecology Notes	Best Practice Measure for Crossing Method
W1	Stream	c. 2 m wide, c. 10 cm deep, gravel (70), cobbles (5), boulders (5), sands/silts (20)	Very clayey soil - important to have good silt protection measures at crossing and along edges of roadways next to the stream. Bund along edge of road - protection measure for road construction. Avoid mature beech tree. 5 m buffer from stream.	BPM 2 - Flume / Pipe
W2	Drainage Ditch	c. 0.5 m wide, c. 10 cm deep, silts/muds (100)	3 Immature beech to be removed, possibly mature oak to be removed - 12 m between mature oaks	BPM 2 - Flume / Pipe
W3	Stream	c. 1 m wide, c. 10 cm deep, cobbles (20), gravels (40), sands/silts (40)	Waterlogged field adjacent - Potential for introduction of silts	BPM 2 - Flume / Pipe
W4	Stream	c. 0.75 m wide, 10 cm deep, gravel (50), sands/silts (50)	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W5	Drainage Ditch	c. 0.5 m wide, 5 - 10 cm deep, stagnant/slow flowing drain, silt/mud (100)	Mature oaks [4678] around excavation to have root protection.	BPM 2 - Flume / Pipe
W6	Drainage Ditch	c. 1 m wide, c. 30 cm deep, slow/stagnant flow. Vegetation growing in drainage ditch.	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W7	Stream	c. 1.5/2 m wide, up to 0.5 m deep, gravel (50), sand/silt (50), PRG	Electrofishing survey required by IFI.	BPM 3 - Channel Diversion
W8	Stream	c. 2 m wide, c. 15 cm deep, PRG,gravel (100)	Electrofishing survey required by IFI.	BPM 4 – Replace Culvert - Over Pump
W9	Drainage Ditch	c. 1 m wide, c. 30 cm deep, slow flow	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W10	River	c. 6 m wide, > 1 m deep to cm's deep, PRG	Newport (Mulkear) River - SAC, Otter, Salmon, etc.	BPM 11 – Directional Drill
W11	Stream	c. 1.5 m wide, 10 cm deep, sandy/silty bottom	Electrofishing survey required by IFI. Field east of WC is in SPA.	BPM 2 - Flume / Pipe
W12	Stream	c. 1 m wide, 5 - 10 cm deep, gravel (60), sands/silts (35), cobbles (5)	No specific notes - general silt protection, etc. to be observed.	BMP1 or BMP2 - Flume / Pipe or Over Pump if flow very low
W13	Stream	c. 0.5 m wide, 5 - 10 cm deep, fast flowing, bedrock (100)	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W14	Culverted Drain		No specific notes - general silt protection, etc. to be observed.	No in-stream works
W15	Culverted Drain	Shallow, narrow forestry drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W16	Culverted Drain	Shallow, narrow forestry drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W17	Culverted Drain	Shallow, narrow forestry drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works

W18	Forestry Drain	c. 60 cm wide, 30 cm deep	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W19	Forestry Drain	c. 20 cm wide, 10 cm deep	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W20	Forestry Drain	c. 20 cm wide, 10 cm deep	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W21	Forestry Drain	c. 20 cm wide, 10 cm deep	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W22	Forestry Drain	c. 60 cm wide, 30 cm deep	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W23	Drainage Ditch	c. 30 m wide, 5 - 10 cm deep, eroded through peat down to subsoil.	Important Hen Harrier habitats west of crossing with heath/immature forestry to be protected.	BPM 2 - Flume / Pipe
W24	Culverted Drain	Shallow, narrow forestry drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W25	Culverted Drain	Shallow, narrow forestry drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W26	Culverted Drain	Shallow, narrow forestry drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W27	Stream	c. 50 cm wide, 10 cm deep, fast flowing stream	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W28	Drainage Ditch	c. 30 cm wide, 5 - 10 cm deep, shallow forestry drain. Runs parallel to road on southern side and crosses beneath road flowing to north.	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W29	Drainage Ditch	Field drain, c. 30 cm wide, c. 10 cm deep, flowing across wet grassland field, vegetated with soft rush	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W30	Drainage Ditch	Field drain, c. 30 cm wide, c. 10 cm deep, flowing adjacent earth bank boundary - same stream as with WC22 adjacent	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W31	Drainage Ditch	Field drain, c. 30 cm wide, c. 10 cm deep, flowing adjacent earth bank boundary	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W32	Stream	c. 4 m wide, fast flowing cobble (50) and gravel (45) with a fine cloaking of silt all over river bed (5)	Electrofishing required.	BMP1 or BMP2 - Flume / Pipe or Over Pump if flow very low
W33	Drainage Ditch	Slow flowing shallow drain, c. 1 m wide, c. 5 cm deep. Silt/mud (100), vegetated	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W34	Culverted Drain	Forestry drain	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W35	Drainage Ditch	Slow flowing drain c. 30 cm wide, 5 cm deep, gravel (20), mud/silt (80)	No specific notes - general silt protection, etc. to be observed.	BPM 4 – Replace Culvert – silt fence or Over Pump if flow is high

W36	River	c. 5 m wide, 1 m to 5 cm deep, PRG	Clare River, Otter, Salmonids, Floating Ranuculus habitat	BPM 11 – Directional Drill
W37	Drainage Ditch	c. 1 m wide drainage ditch within willow scrub	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W38	Stream	c. 30 cm wide, 10 cm deep, fast flowing	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W39	Culverted Drain	Drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W40	Culverted Drain	Drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W41	Culverted Drain	Drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W42	Stream	Stream c. 1.0 m wide, fast flowing, Boulder (20), Cobble (50) and gravel (30).	Stone bridge - Need bat inspection if proposed works are to impact on structure of bridge in anyway.	No in-stream works
W43	Drainage Ditch	Drain running along edge of road, c. 10 cm wide, c. 5 cm deep, fast flowing, gravels (50), cobbles (50)	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W44	Drainage Ditch	Drain on edge of field, c. 10 cm wide, c. 5 cm deep. Vegetated drain.	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W45	Drainage Ditch	Drain on boundary of field with adjacent earth bank, c. 10 cm wide, c. 5 cm deep. Vegetated drain.	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W46	Stream	Stream c. 0.5 m wide, fast flowing, Boulder (20), Cobble (50) and gravel (30).	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W47	Culverted Drain	Drain c. 0.5 m wide, 10 cm deep. Gravel bed. Culverted at gate between two fields	No specific notes - general silt protection, etc. to be observed.	BPM 4 – Replace Culvert – Over Pump
W48	Stream	Stream c. 30 cm wide and 10 cm deep at the bottom of ravine c. 5 m deep.	Protection of watercourse from material falling into stream off edge of box culvert.	BPM 2 - Flume / Pipe
W49	Drainage Ditch	Overland flow. Nearly dry at visit. Evidence of past flows.	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W50	Culverted Drain	New crossing built by Coillte.	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W51	Dry Drain	Currently dry drain with evidence of former high flows. Currently overland flow which is beginning to cut a new drain through forestry downslope.	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W52	Culverted Drain	Newly created drainage, currently not flowing. Culverted under track.	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W53	Culverted Drain	Forestry drain	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W54	Stream	c. 1.0 m high bank, c. 30 m wide and 5 cm deep. Cobble/gravel bed, fast flowing through forestry	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W55	Stream	Slow flowing/stagnant stream through forestry.	No specific notes - general silt protection, etc. to be observed.	BPM 2 - Flume / Pipe
W56	Dry Stream	Dry stream bed	No ecological observations	No in-stream works

W57	River	c. 4/6 m wide, cobble/gravel bed.	Bilboa River - LR Shannon SAC, Salmonids, Otter, Floating Ranunculus vegetation, etc. (LAMPREY and EEL)	BPM 11 – Directional Drill
W58	Drainage Ditch	Shallow, slow moving/stagnant field drain	Potential linkage with Bilboa River - Silt protection measures to be undertaken.	BPM 2 - Flume / Pipe
W59	Drainage Ditch	Shallow, slow moving/stagnant field drain	Potential linkage with Bilboa River - Silt protection measures to be undertaken.	BPM 2 - Flume / Pipe
W60	Drainage Ditch	Shallow, slow moving/stagnant field drain	Potential linkage with Bilboa River - Silt protection measures to be undertaken.	BPM 1 - Over Pump
W61	Stream	c. 0.5 m wide, c. 10 cm deep, cobble (50), gravel (50) bed	No specific notes - general silt protection, etc. to be observed.	BMP1 or BMP2 - Flume / Pipe or Over Pump if flow very low
W62	Drainage Ditch	c. 30 cm wide, c. 5 cm deep, sand/silt bottom.	No specific notes - general silt protection, etc. to be observed.	No in-stream works
W63	Farm Drain	Plastic pipe c.30cm wide		No in-stream works
W64	Drainage Ditch	Drain c. 0.5 m wide, 10 cm deep	No specific notes - general silt protection, etc. to be observed.	BPM 1 - Over Pump
W65	Drainage Ditch	Slow flowing, shallow forestry drain	No specific notes - general silt protection, etc. to be observed.	BPM 1 - Over Pump

Table 3: Survey Results for the UWF Grid Connection W66 – W90 (Access Route Crossings)

WC_ No	Riffle %	Glide %	Pool %	Bed rock %	Cobble %	Gravel %	Boulder %	Sand /Silt %	Bank Stability	Canopy/ Tunnelling %	Riparian Vegetation (Fossitt)	Fisheries Suitability Assessment	
W66	60	0	40	0	10	55	5	30	Poor, active erosion	0%	GS4, WL2, WD1	Potential salmonid habitat. Livestock access, some poaching and siltation. Coarse woody debris in channel. Filamentous green algae downstream. Boulder & cobble dam downstream possible barrier to migration during periods of low flow. Moderate fisheries suitability.	No works to existing culvert
W67	50	0	50	0	20	40	10	30	Moderate, some evidence of erosion	50	WS1, WD4	Tributary stream of Clare River. Knockacullin stream on EPA database. Moderate fisheries suitability.	No works to existing culvert
W68	20	0	80	0	10	40	0	60	Moderate, some evidence of erosion	0	WS5	Low flow/stagnant forestry drain. No fisheries suitability.	No works to existing culvert
W69	50	0	50	0	40	40	10	10	Moderate, some evidence of erosion	100	WD4	Low flow pool and cascade forestry drain. No fisheries suitability.	No works to existing culvert
W70	50	0	50	0	40	50	0	10	Moderate, some evidence of erosion	100	WD4	Low flow stream. Low fisheries suitability. Same watercourse as WC78.	No works to existing culvert
W71	50	0	50	0	0	40	0	60	No active erosion	100	WD4	Near dry/stagnant forestry drain. No fisheries suitability.	No works to existing culvert
W72	100	0	0	0	70	10	0	20	Moderate, some evidence of erosion	100	WD4	Low flow stream, culvert elevated c. 50 cm above stream on downslope site. Barrier to migration. Low fisheries suitability downstream.	No works to existing culvert
W73	50	0	50	0	40	50	0	10	Moderate, some evidence of erosion	100	WD4	Low flow/near dry stream. No fisheries suitability.	No works to existing culvert

W74	50	0	50	0	20	60	0	20	No active erosion	50	GS4, WD4	Low flow forestry stream. Low fisheries suitability.	No works to existing culvert
W75	50	0	50	0	20	70	0	10	Moderate, some evidence of erosion	100	WD4	Low flow stream. Low fisheries suitability.	No works to existing culvert
W76	N/A	N/A	N/A	0	0	80	0	20	No active erosion	100	WD4	Near dry/stagnant forestry drain. No fisheries suitability.	No works to existing culvert
W77	0	0	100	0	0	50	0	50	No active erosion	100	WD4	Near dry/stagnant forestry drain. No fisheries suitability.	No works to existing culvert
W78	N/A	N/A	N/A	0	0	0	0	100	No active erosion	50	WD4, HH3	Dry forestry drain. No fisheries suitability.	No works to existing culvert
W79	0	0	100	0	0	25	0	75	No active erosion	100	WD4	Stagnant forestry drain. Existing culvert under forestry road. No fisheries suitability.	No works to existing culvert
W80	0	0	100	0	0	0	0	100	No active erosion	100	WD4	Dry forestry drain, stagnant pool downstream of culvert. No fisheries suitability.	No works to existing culvert
W81	0	0	100	0	0	0	0	100	No active erosion	100	WD4	Near dry/stagnant forestry drain. No fisheries suitability.	No works to existing culvert
W82	0	0	100	0	0	0	0	100	No active erosion	100	WD4	Near dry/stagnant forestry drain. No fisheries suitability.	No works to existing culvert
W83	N/A	N/A	N/A	0	0	25	0	75	No active erosion	100	WD4	Dry stream, existing culvert under a road. No fisheries suitability.	No works to existing culvert
W84	0	0	100	0	0	0	0	100	No active erosion	50	WD4, HH3	Stagnant forestry drain. Existing culvert under forestry road. No fisheries suitability.	No works to existing culvert
W85	N/A	N/A	N/A	0	0	80	0	20	No active erosion	100	WD4	Very low flow, near dry watercourse. No fisheries suitability.	No works to existing culvert
W86	50	0	50	0	0	50	0	50	No active erosion	100	WD4	Very low flow, near dry watercourse. No fisheries suitability.	No works to existing culvert

W87	N/A	N/A	N/A	0	0	0	0	100	No active erosion	100	WD4	Dry stream, existing culvert under a road. No fisheries suitability.	No works to existing culvert
W88	10	0	90	0	10	80	0	10	Moderate, some evidence of erosion	100	WD4	Pool and cascade system, low flow during site visit - negligible fisheries suitability.	No works to existing culvert
W89	50	0	50	0	0	10	0	90	No active erosion	100	WS1	Low fisheries potential. Existing culvert under farm roadway.	No works to existing culvert
W90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No active erosion	0	GA1, GS4	No defined watercourse at this location. Existing culvert under farm roadway. Area consists of a poorly drained, poached, rush dominated area draining between the hills. Potential that there is enough overland flow in winter for water to drain through culvert. No fisheries potential.	BPM 1 - Over Pump

Table 4: Survey Results for the Related Works Crossings

WC_No	Riffle %	Glide %	Pool %	Bed rock %	Cobble %	Gravel %	Boulder %	Sand /Silt %	Bank Stability	Canopy/ Tunnelling %	Riparian Vegetation (Fossitt)	Fisheries Suitability Assessment	Crossing Method
WW1	N/A	N/A	N/A	0	0	80	0	20	No active erosion	0	HH1/GS4 /WD4	Near dry drain, heavily vegetated, No fisheries suitability	BPM 2 - Flume / Pipe
WW2	80	0	20	0	0	60	0	40	No active erosion	0	GS4/WS1	Stream, deepened and resectioned, Existing culvert under access track d/s, Barrier to migration, heavily vegetated, Low fisheries suitability	Permanent Clear Span Bridge
WW3	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1/BL2	Dry field drain, heavily vegetated, No fisheries suitability	VPM 1 - Over Pump
WW4	100	0	0	0	40	30	20	10	Evidence of erosion	0	GS4/WD 4	Near dry stream, evidence of previous high flows/erosion, c. 1.5 m cascade barrier to migration, No fisheries suitability	BPM 2 - Flume / Pipe
WW5	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GS4/WD 4	Near dry field drain, heavily vegetated, No fisheries suitability	BPM 2 - Flume / Pipe
WW6	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1/GS4	Dry field drain, heavily vegetated, No fisheries suitability	No-Instream Works
WW7	80	0	20	0	10	70	0	30	No active erosion	0	GA1/GS4	Stream, steady flow to 15 cm deep with wetted width of c. 75 cm. Nice gravel bed. High fisheries suitability.	BPM 2 - Flume / Pipe
WW8	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1	Dry field drain, heavily vegetated, No fisheries suitability	BPM 2 - Flume / Pipe
WW9	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1	Dry field drain, heavily vegetated, No fisheries suitability	BPM 1 - Over Pump
WW10	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1	Dry field drain, heavily vegetated, No fisheries suitability	BPM 1 - Over Pump
WW11	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1/GS4	Near dry field drain, heavily vegetated, No fisheries suitability	No-Instream Works
WW12	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	WL1/BL2 /GA1	Near dry drain culverted under road joining small slow flowing drain on downstream side. No fisheries suitability	BPM 4 – Replace Culvert – silt fence or Over Pump if flow is high

WW13	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1	Dry field drain, heavily vegetated, No fisheries suitability	BPM 2 - Flume / Pipe
WW14	80	0	20	0	10	70	0	20	No active erosion	0	GA1	Slow flowing, shallow drain, heavily vegetated, Low fisheries potential	BPM 2 - Flume / Pipe
WW15	0	0	100	0	0	0	0	100	Evidence of erosion	0	GA1	Near stagnant drain, heavily poached and cow dung in stream, Vegetated, No fisheries suitability	BPM 2 - Flume / Pipe
WW16	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1/WD4	Dry field drain, heavily vegetated, No fisheries suitability	BPM 1 - Over Pump
WW17	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1	Near dry field drain, heavily vegetated, No fisheries suitability	BPM 1 - Over Pump
WW18	0	100	0	0	0	50	0	50	No active erosion	0	GA1	Slow flowing, shallow drain. Deepened and resectioned, heavily vegetated, Low fisheries potential	BPM 1 - Over Pump
WW19	30	40	30	0	10	70	0	20	No active erosion	0	GA1/GS4	Stream, steady flow up to 10 cm deep with wetted width c. 1.0 m, Nice gravel/cobble bed. High fisheries suitability	BMP1 or BMP2 - Flume / Pipe or Over Pump if flow very low
WW20	N/A	N/A	N/A	0	30	50	10	10	No active erosion	0	GA1	Dry drain with culvert under road	BPM 1 - Over Pump
WW21	0	0	100	0	0	0	0	100	No active erosion	0	GA1/BL2	Stagnant field drain, No fisheries suitability	BPM 4 – Replace Culvert – silt fence or Over Pump if flow is high
WW22	60	10	30	0	20	40	10	30	No active erosion	50	WD4/GS2	Stream, steady flow to to 20 cm deep with wetted width of c. 1 m. Nice gravel bed. High fisheries suitability.	BPM 2 - Flume / Pipe
WW23	N/A	N/A	N/A	0	0	80	0	20	No active erosion	0	GA1/BL3/WL1	Dry field drain, No fisheries suitability	No-Instream Works
WW24	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1/ED2	Dry field drain, heavily vegetated, No fisheries suitability	BPM 2 - Flume / Pipe
WW25	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	BL2/GS4	Dry field drain, heavily vegetated, No fisheries suitability	BPM 2 - Flume / Pipe
WW26	N/A	N/A	N/A	0	0	0	0	100	No active erosion	100	WL1	Dry field drain, willlows creating full tunnelling, No fisheries suitability	BPM 1 - Over Pump

WW27	N/A	N/A	N/A	0	0	0	0	100	No active erosion	0	GA1/BL2	Dry field drain, heavily vegetated, No fisheries suitability	BPM 2 - Flume / Pipe
WW28	25	25	50	0	25	70	0	15	No active erosion	0	GS4	Stream, nice gravel/cobble bed, steady flow up to 15 cm deep with wetted width c. 1.0 m. Good fisheries suitability	BMP1 or BMP2 - Flume / Pipe or Over Pump if flow very low
WW29	0	0	100	0	0	0	0	100	No active erosion	0	BL2/GS4	Stagnant, silted up field/forestry drain with existing culvert under track. No fisheries suitability.	No-Instream Works
WW30	0	0	100	0	0	0	0	100	No active erosion	0	BL2/GS4	Stagnant drain, existing culvert. No fisheries suitability	No-Instream Works
WW31	0	0	100	0	0	0	0	100	No active erosion	0	BL2/GS4	Drain culverted under road joining small slow flowing drain on downstream side. No fisheries suitability	BPM 4 – Replace Culvert – silt fence or Over Pump if flow is high
WW32	0	0	100	0	0	0	0	100	No active erosion	0	BL2/GS4	Near dry drain culverted under road joining small slow flowing drain on downstream side. No fisheries suitability	No-Instream Works

Appendix 11.2: Surface Water Sampling Results

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Table 1	Surface Water Sampling Results – UWF Grid Connection
Table 2	Surface Water Sampling Results – UWF Related Works
Table 3	Surface Water Sampling Results – Max, Min & Average

Notes:
UGC – UWF Grid Connection Route
RW – UWF Related Works
RF – Replacement Forestry

Table 1: Surface Water Sampling Results – UWF Grid Connection

Sample ID	Project Element	Sampling Date	Ammonical Nitrogen (mg/L)	BOD (mg/L)	Chloride (mg/L)	Electrical Conductivity (uS/cm)	Nitrate (mg/L)	Nitrite (mg/L)	Ortho-Phosphate (mg/L)	pH (pH Units)	Suspended Solids (mg/L)	Total Phosphorous (mg/L)	Total Nitrogen (mg/L)
			≤0.065 (mean) or ≤0.140 (95%ile)	≤1.5 (mean) ≤2.6 (95%ile)					≤0.035 (mean) or ≤0.075 (95%ile)	**6 - 9**			
W1	UGC	06-04-2017	<0.08		18	281	7	0.65	<0.01	7.8	1	0.10	2
W1	UGC	10-08-2017	<0.08	<2	15	268	4	<0.20	<1	8.1	4	0.09	2
W1	UGC	26-09-2017	<0.08	<5	16	293	5	<0.20	<1	7.9	3	0.06	1
W7	UGC	06-04-2017	<0.08		13	252	3	0.34	<0.01	7.7	2	<0.05	1
W7	UGC	10-08-2017	<0.08	<2	13	438	3	<0.20	<1	8.0	2	0.13	1.00
W7	UGC	26-09-2017	0.14	<2	12	291	3	<0.20	<1	8.1	<1	<0.05	2
W8	UGC	06-04-2017	<0.08		18	374	4	0.53	<0.01	7.2	12	<0.05	1
W8	UGC	10-08-2017	<0.08	<2	13	437	3	<0.20	<1	7.6	2	<0.05	2
W8	UGC	26-09-2017	<0.08	<2	12	423	3	<0.20	<1	8.1	1	<0.05	1
W10	UGC	06-04-2017	<0.08		10	163	2	0.20	<0.01	7.4	<1	<0.05	<1
W10	UGC	10-08-2017	<0.08	<2	9	153	2	<0.20	<1	7.9	<1	<0.05	1
W10	UGC	26-09-2017	<0.08	<2	10	164	2	<0.20	<1	7.9	1	<0.05	<1
W11	UGC	06-04-2017	<0.08		12	146	2	0.16	<0.01	6.9	2	<0.05	<1
W11	UGC	10-08-2017	<0.08	<2	10	110	1	<0.20	<1	8.1	6	<0.05	2
W11	UGC	26-09-2017	<0.08	<5	8	121	1	<0.20	<1	7.4	1	<0.05	<1
W12	UGC	06-04-2017	<0.08		15	214	2	0.45	0.26	7.5	3	<0.05	<1
W12	UGC	10-08-2017	<0.08	<2	16	316	2	<0.20	<1	7.9	11	<0.05	4
W12	UGC	26-09-2017	<0.08	<2	16	268	2	<0.20	<1	7.9	<1	<0.05	<1
W13	UGC	06-04-2017	<0.08		11	53	<0.10	0.29	<0.01	5.0	1	<0.05	<1
W13	UGC	10-08-2017	<0.08	<2	9	47	1	<0.20	<1	8.2	<1	<0.05	3
W13	UGC	26-09-2017	<0.08	<2	15	52	1	<0.20	<1	6.6	<1	<0.05	<1

W27	UGC	06-04-2017	<0.08		10	82	0.38	0.31	<0.01	6.0	5	0.05	<1
W27	UGC	10-08-2017	<0.08	<2	8	90	<0.50	<0.20	<1	8.0	6	0.08	3
W27	UGC	26-09-2017	<0.08	<3	9	72	<0.5	<0.20	<1	6.5	2	0.06	<1
W32	UGC	06-04-2017	<0.08		11	86	1	0.34	<0.01	6.9	<1	<0.05	<1
W32	UGC	10-08-2017	<0.08	<2	9	97	1	<0.20	<1	8.3	1	<0.05	1
W32	UGC	26-09-2017	<0.08	<5	11	82	1	<0.20	<1	7.2	1	<0.05	<2
W36	UGC	06-04-2017	<0.08		9	126	1	0.21	<0.01	7.2	<1	<0.05	<1
W36	UGC	10-08-2017	<0.08	<2	10	94	1	<0.20	<1	8.1	2	<0.05	2
W36	UGC	26-09-2017	<0.08	<2	9	127	2	<0.20	<1	7.6	1	<0.05	<1
W46	UGC	06-04-2017	<0.08		9	77	3	0.15	<0.01	5.9	<1	<0.05	1
W46	UGC	10-08-2017	<0.08	<2	9	166	3	<0.20	<1	7.9	145	0.17	3
W46	UGC	26-09-2017	<0.08	<3	8	98	4	<0.20	<1	6.4	88	<0.05	1
W47	UGC	06-04-2017	<0.08		10	90	2	0.14	<0.01	7.3	8	<0.05	<1
W47	UGC	10-08-2017	<0.08	<2	9	124	2	<0.20	<1	7.8	1	<0.05	2
W47	UGC	26-09-2017	<0.08	<2	9	118	2	<0.20	<1	7.8	1	<0.05	1
W48	UGC	06-04-2017	<0.08		8	111	1	0.19	<0.01	7.1	<1	<0.05	<1
W48	UGC	10-08-2017	<0.08	<2	8	137	2	<0.20	<1	7.7	2	<0.05	3
W48	UGC	26-09-2017	<0.08	<2	5	127	1	<0.20	<1	7.3	1	<0.05	<1
W57	UGC	06-04-2017	<0.08		11	180	3	0.23	<0.01	7.2	<1	<0.05	<1
W57	UGC	10-08-2017	<0.08	<2	9	137	4	<0.20	<1	8.1	2	<0.05	3
W57	UGC	26-09-2017	<0.08	<2	9	165	3	<0.20	<1	7.6	<1	<0.05	1
W61	UGC	06-04-2017	<0.08		9	168	4	0.25	<0.01	7.1	1	<0.05	1
W61	UGC	10-08-2017	<0.08	<2	10	233	6	<0.20	<1	8.0	2	<0.05	4
W61	UGC	26-09-2017	<0.08	<2	9	206	5	<0.20	1	7.7	3	<0.05	1
W64	UGC/RW	06-04-2017	<0.08		8	100	3	0.15	<0.01	6.2	19	0.12	1
W64	UGC/RW	10-08-2017	<0.08	<2	6	139	1	<0.20	<1	7.8	4	<0.05	3
W64	UGC/RW	26-09-2017	0.08	4	9	138	4	<0.20	<1	6.9	118	0.08	3
WW7	RW	10-08-2017	<0.08	<2	14	330	6	<0.20	<1	8.0	5	<0.05	4
WW7	RW	26-09-2017	<0.08	<2	12	268	6	<0.20	<1	7.8	10	<0.05	1
WW19	RW	10-08-2017	<0.08	<2	13	308	4	<0.20	<1	7.9	2	<0.05	3

Table 2: Surface Water Sampling Results – UWF Related Works

WW19	RW	26-09-2017	<0.08	<2	12	248	4	<0.20	<1	7.9	<1	<0.05	1
WW20	RW	10-08-2017	<0.08	<2	7	168	1	<0.20	<1	8.1	20	0.07	3
WW20	RW	26-09-2017	<0.08	<2	9	181	2	<0.20	<1	7.7	<1	<0.05	2
WW28	RW/RF	10-08-2017	<0.08	<2	12	331	2	<0.20	<1	7.9	<1	<0.05	2
WW28	RW/RF	26-09-2017	<0.08	<2	8	195	1	<0.20	<1	8.0	<1	<0.05	2

Table 3: Surface Water Sampling Results – Max, Min & Average

	Ammonical Nitrogen (mg/L)	BOD (mg/L)	Chloride (mg/L)	Electrical Conductivity (uS/cm)	Nitrate (mg/L)	Nitrite (mg/L)	Ortho-Phosphate (mg/L)	pH (pH Units)	Suspended Solids (mg/L)	Total Phosphorous (mg/L)	Total Nitrogen (mg/L)
MAXIMUM	0.14	4	18	438	7	0.65	<1	8.3	145	0.17	4
MINIMUM	<0.08	<2	5	47	<0.10	0.14	<0.01	5	<1	<0.05	<1
AVERAGE	<0.08	<2	10.7	183.3	2.6	<0.20	<0.01	7.5	12.6	0.09	1.97

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REFERENCE DOCUMENTS

APPENDIX 11.3

FLOOD RISK ASSESSMENT

UWF GRID CONNECTION AND UWF RELATED WORKS, CO. TIPPERARY

FLOOD RISK ASSESSMENT
FINAL REPORT

Prepared for:
Ecopower Developments Ltd

Prepared by:
Hydro-Environmental Services

DOCUMENT INFORMATION

DOCUMENT TITLE:	**UPPERCHURCH WINDFARM GRID CONNNECTION AND UWF RELATED WORKS, CO. TIPPERARY** **FLOOD RISK ASSESSMENT**
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PROJECT REPORTING HISTORY:	**NONE**
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AUTHOR(S):	**MICHAEL GILL** **DAVID BRODERICK** **BRIAN COFFEY**
SIGNED:	 **Michael Gill B.A., B.A.I., M.Sc., MIEI** **Managing Director – Hydro-Environmental Services**

Disclaimer:
This report has been prepared by HES with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our terms and conditions and taking account of the resources devoted to it by agreement with the client. We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above. The flood risk assessment undertaken as part of this study is site-specific and the report findings cannot be applied to other sites outside of the survey area which is defined by the site boundary. This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.

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A11.3.1. INTRODUCTION

A11.3.1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by the Promoter to undertake a Flood Risk Assessment (FRA) for the proposed Upperchurch Windfarm (UWF) Grid Connection, UWF Related Works and the UWF Replacement Forestry, Co. Tipperary. A site location map is shown below as **Figure A**.

This FRA is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009).

The UWF Grid Connection comprises the following main elements:

- Mountphilips 110kV Substation near Newport, Co. Tipperary
- Mountphilips – Upperchurch 27.5km 110kV Underground Grid Connection
- UWF Grid Connection Temporary Access Roads (9.3km) and Permanent Access Roads (4.4km)
- Ancillary Grid Connection Works

The UWF Related Works comprises the following main elements:

- Internal Windfarm Cabling,
- Realigned Windfarm Roads,
- Haul Route Works
- Telecoms Relay Pole
- Ancillary UWF Related Works

The UWF Replacement Forestry at Foilnaman near the Upperchurch Windfarm will fulfil the replanting obligation which will arise from the felling of forestry at UWF Grid Connection, UWF Related Works and Upperchurch Windfarm locations.

Each element of Whole UWF Project is discussed in more detail below.

A11.3.1.2 KEY OBJECTIVES

The primary objective of this FRA is to identify areas potentially prone to fluvial and pluvial flooding along the UWF Grid Connection route and UWF Related Works areas with a focus being on residual risk to permanent infrastructure that will be present during the operational phase of the development.

Of particular importance will be access to the UWF Grid Connection Mountphilips Substation and the 110kV UGC Joint Bays (and their communication and link box chambers) for testing, inspection and maintenance purposes. Access to the Joint Bays and the Mountphilips Substation will be via permanent access roads.

The second objective of this FRA is to assess whether these projects have the potential to increase flood risk locally or downstream of the development.

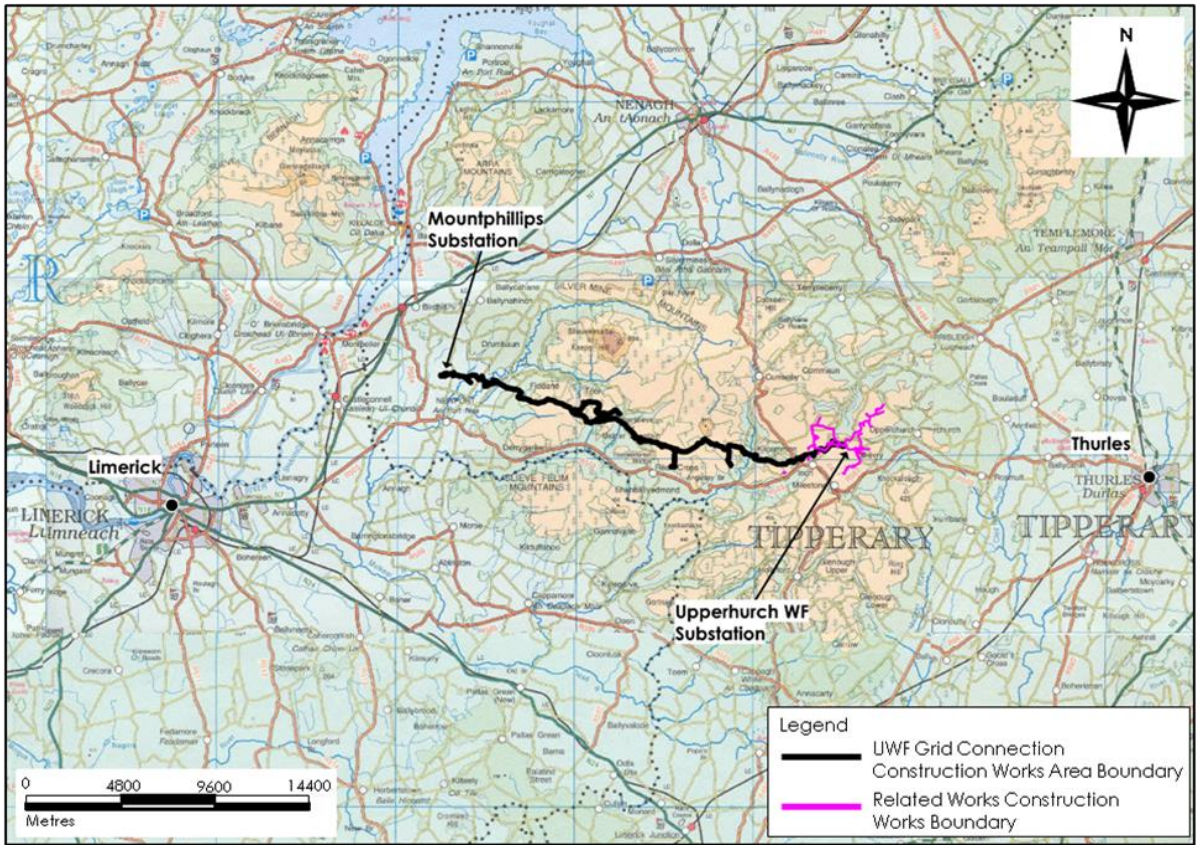


Figure A: Site Location Map

A11.3.1.3 STATEMENT OF EXPERIENCE

Hydro-Environmental Services ("HES") are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core area of expertise and experience is hydrology and hydrogeology, including flooding assessment and surface water modelling. We routinely work on surface water monitoring and modelling, and prepare flood risk assessment reports.

Michael Gill is an Environmental Engineer with 17 years environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological assessments for various developments across Ireland. Michael has significant experience in surface water drainage issues, SUDs design, and flood risk assessment.

David Broderick is a hydrogeologist with over 12 years environmental consultancy experience across Ireland. David has completed numerous Flood Risk Assessments for all types of developments, and he regularly uses HEC-RAS and FlowMaster modelling software.

A11.3.1.4 REPORT LAYOUT & METHODOLOGY

This FRA report has the following format:

- Section 2 describes the proposed development setting and details of the proposed development;
- Section 3 outlines the hydrological and geological characteristics of the local surface water catchments in the vicinity of the proposed development;
- Section 4 deals with a site-specific flood risk assessment (FRA) undertaken for the proposed development which was carried out in accordance with the above-mentioned guidelines;
- Section 5 provides commentary in relation to the Justification Test; and,
- Section 6 presents the FRA report conclusions.

As stated above this FRA is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009). The assessment methodology involves researching and collating flood related information from the following data sources:

- Base maps – Ordnance Survey of Ireland;
- Flood Hazard Maps and flooding information for Ireland, www.floodmaps.ie;
- Office of Public Works (OPW);
- Geological Survey of Ireland (GSI) maps on superficial deposits;
- EPA hydrology maps;
- Preliminary Flood Risk Assessment (PFRA) Maps, and CFRAM maps and studies where available; and,
- Site walkover surveys (undertaken during the winters of 2016 and 2017.

A11.3.2. BACKGROUND INFORMATION

A11.3.2.1 INTRODUCTION

This section provides a general overview of the proposed developments along with a description of the local setting and topography.

A11.3.2.2 PROPOSED DEVELOPMENT DETAILS

A11.3.2.2.1 UWF Grid Connection

The project comprises an 110kV substation at Mountphilips near Newport, the Mountphilips – Upperchurch 110kV Underground Grid Connection (27.5km), UWF Grid Connection Access Roads and Ancillary Grid Connection Works such as watercourse crossings.

The Mountphilips 110kV substation is proposed for a location 150m east of the existing Killonan - Nenagh 110kV line in agricultural grassland in Mountphilips townland, 2km north of Newport, Co. Tipperary which is approximately 23km west of the C at Upperchurch (also in Co. Tipperary).

The 110kV UGC will connect the Mountphilips 110kV Substation to the Consented UWF Substation, through the installation of underground cables. The route of the underground cables, which is c.27.5km in length, will follow a generally west/east course through a mix of agricultural grassland, commercial forestry plantations, private roads (c.12km) and public roads (c.1.7km). There are 65 no. watercourse crossings along the direct cable route of the 110kV UGC and 1 no. watercourse crossing along access road AR9. The cable will either be placed under these watercourses (by open trench or directional drilling) or over/under or within existing structures.

The watercourses intersected range from drains / small headwater streams to larger rivers such as the Newport (Mulkear) River, Bilboa River and Clare River.

To facilitate construction and operational access to the Mountphilips 110kV Substation and the Mountphilips – Upperchurch 110kV UGC, a new permanent access road will be constructed at Coole/Mountphilips, and new access road will also be constructed at various other locations along the route of the 110kV UGC. These permanent access roads will be used to access the Mountphilips Substation and the joint bays (~38 no.) during the operational stage for inspection and maintenance purposes.
UWF Grid Connection Access Roads also include the use of existing farm and forestry roads, these roads will be upgraded during or immediately after construction works. Ancillary grid connection works infrastructure also includes temporary access roads and temporary compounds.
In addition, there will also be a requirement to construct 12 no. permanent watercourse crossing structures (culvert/bridge) along the UWF Grid Connection and 1 no. permanent watercourse crossing structure along access road AR9 to allow access during the construction and operational phases.

A11.3.2.2.2 UWF Related Works

The UWF Related Works, which are generally located at or in the area of Upperchurch Windfarm site, will consist of UWF Internal Windfarm Cabling, UWF Realigned Windfarm Roads, UWF Haul Route Works, a Telecom Relay Pole and UWF Ancillary Works.

The total length of the internal windfarm cabling is approximately 17.9km and 11.1km of this will be laid within the Upperchurch Windfarm access roads. There are approximately 32 no. watercourse crossings along the windfarm internal cabling and these watercourses range from drains / small headwater streams to larger 1st - 2nd order streams. There will be a

requirement to construct 8 no. permanent watercourse crossing structures at the UWF related works areas.

A11.3.2.2.3 UWF Replacement Forestry

The UWF Replacement Forestry at Foilnaman will fulfil the replanting obligation which will arise from the felling of forestry at UWF Grid Connection, UWF Related Works and Upperchurch Windfarm locations. The UWF Replacement Forestry currently comprises 6ha of grassland which exists just north of Upperchurch Windfarm.

A11.3.2.3 PROJECT LOCATION AND TOPOGRAPHY

The proposed Mountphilips 110kV Substation is located in the townland of Mountphilips which exists approximately 2km to the north of Newport Town in Co. Tipperary. The site is located on a low-lying, north-south trending ridge with the slope of the site being to the west/southwest. The current land use is grassland. The elevation of the site is at approximately 70m OD.

The UWF grid connection runs in an easterly direction from the substation site and crosses over the southern hills of the Silvermine Mountains towards the Upperchurch Windfarm substation. The straight line distance between the proposed Mountphilips substation and the Upperchurch Windfarm substation is ~23km while the actual length of the UWF Grid Connection is ~27.5km. The topography along the majority of the UWF Grid Connection is hilly with an overall elevation range of between 70 and 310m OD (Ordnance Datum). The UWF Grid Connection follows a mix of agricultural grassland, commercial forestry plantations, private roads (c.12km) and public roads (c.1.7km). The route within grassland areas is typically off-road whereas within forestry it is typically along/below the existing forestry tracks.

The UWF related works are spread across a number of hills in the area of the Upperchurch Windfarm. The elevation ranges between approximately 360 and 410m OD and the hills are generally at heights of 100m above the intervening valleys. The main landuse is agriculture with some commercial forestry.

The UWF Replacement Forestry at Foilnaman is currently grassland.

A11.3.3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

A11.3.3.1 INTRODUCTION

This section gives an overview of the hydrological and geological characteristics in the area of the UWF Grid Connection and related works.

A11.3.3.2 BASELINE HYDROLOGY

A11.3.3.2.1 Regional and Local Hydrology

UWF Grid Connection

On a regional scale the UWF Grid Connection is located within the River Shannon (Shannon River Basin District) and the River Suir (South Eastern River Basin District) surface water catchments. Approximately 26.3km of the 27.5km 110kv UGC route (including the Mountphilips Substation) is located in the River Shannon catchment while the remainder (1.2km) is located within the River Suir catchment.

Within the River Shannon catchment, the grid connection route and the Mountphilips Substation site exist within the regional Mulkear River catchment. The local surface water bodies within the Mulkear River catchment that the UWF Grid Connection passes (list from west to east) through include the Newport River (also referred to as the Mulkear), Small River, Clare River (also referred to as the Annagh River) and the Bilboa River (refer to **Table A** below). A Local hydrology map is attached below as **Figure 1**.

Within the River Suir catchment the UWF Grid Connection route (1.2km of the total 27.5km), exists within the Clodiagh River local surface water body.

As stated above, the UWF Grid Connection crosses 65 no. watercourses along the route of the cable and 1 no. crossing along access road AR9, the number of crossings within each sub-catchment is also shown in **Table A** below.

Table A: Summary of Watercourse Crossings along the 110kv UGC

Regional Catchment	Sub-catchment[1]	Length of Route (km)	No. Watercourse Crossings
Mulkear (Shannon)	Newport River[2]	3.7	10
	Small River	5	13
	Clare River	7.2	26
	Bilboa River	10.4	15
Clodiagh (Suir)	Clodiagh River	1.2	2

[1] Catchments are listed from west to east along the grid connection route from the Mountphilips Substation to the Consented UWF Substation

[2] Also referred to as the Mulkear River

UWF Related Works

The majority of the UWF related works areas (16.2km of Internal Windfarm Cabling, all Realigned Windfarm Roads and the Telecom Relay Pole) are located in the River Suir catchment with the remainder (c 1.7km of Internal Windfarm Cabling and some of the Haul Route Works) in the River Shannon catchment.

Within the River Suir catchment, of the 16.2km of the Internal Windfarm Cabling within the River Suir catchment, 11.6km exists within the Clodiagh River catchment, 3.8km within the Owenbeg River catchment and 0.8km within the Turraheen River catchment.

As shown in **Table B** below there are a total of 32 no. watercourse crossings required for the UWF related works and there are largely required for the Internal Windfarm Cabling (24 of 32 no.). The majority of the watercourse crossings are located within Clodiagh River catchment (26 no. of 32 no. crossings). There is only 1 no. watercourse crossing in the River Shannon catchment.

Due to the elevated nature of the location of the construction works associated with the UWF related works, the majority of the watercourse crossings relate to forestry drains or agricultural drains.

Table B: Summary of Watercourse Crossings at the UWF Related Works

Regional Catchment	Sub-catchment	Internal Cable (km)	No. Watercourse Crossings
Suir	Turraheen	0.88	0
	Clodiagh Upper	11.44	26
	Owenbeg Upper	3.8	5
Shannon	Bilboa	1.74	1

UWF Replacement Forestry

All of the UWF Replacement Forestry is located within the Clodiagh River catchment (Clodiagh_010), which is part of the River Suir Catchment. The UWF Replacement Forestry site is located in the townland of Foilnaman to the northwest of the Upperchurch Windfarm. The lands to be planted comprise two agricultural landholdings that are separated by a watercourse. The watercourse is a headwater stream of the Clodiagh River and flows in an easterly direction through the UWF Replacement Forestry site. There will be no new crossing of this stream during replanting works.

A11.3.3.2.2 Rainfall and Evaporation

The SAAR (Standard Average Annual Rainfall) recorded at Silvermine Mountains (Curreeny) (station no: 4819), which is located approximately 4.2km north of the 110kV UGC, is 1,713mm. The average potential evapotranspiration (PE) at Shannon Airport is taken to be 543mm and AE is calculated to be 516mm. Using the above figures the ER for the area is calculated to be 1,197mm.

A11.3.3.3 GEOLOGY

The superficial geology (*i.e.* overburden) along the UWF Grid Connection and UWF Related Works areas, and also within the UWF Replacement Forestry, comprises mainly mineral or organic topsoil over glacial tills with very minor sections of blanket bog along off-road forestry sections. Alluvium and fluvio-glacial sand and gravels are present at the larger watercourse crossings (Bilboa River, Clare River and Newport (Mulkear) River) which are intercepted by the UWF grid connection route.

The underlying bedrock along the UWF Grid Connection comprises sandstone, limestone and Silurian meta-sediments with the latter been most predominant. The UWF Related Works areas and the UWF Replacement Forestry areas are exclusively underlain by Silurian meta-sediments.

A11.3.4. SITE SPECIFIC FLOOD RISK ASSESSMENT

A11.3.4.1 INTRODUCTION

The following assessment is carried out in accordance with '*The Planning System and Flood Risk Management Guidelines for Planning Authorities*' (DoEHLG, 2009). The basic objectives of these guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and,
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

A stage 1 assessment of flood risk requires an understanding of where the water comes from (*i.e.* the source), how and where it flows (*i.e.* the pathways) and the people and assets affected by it (*i.e.* the receptors). It is necessary to identify whether there may be any flooding or surface water management issues related to the proposed site that may warrant further detailed investigation.

As per the guidance (DOEHLG, 2009), the stages of a flood risk assessment are:

- *Flood risk identification* – identify whether there are surface water flooding issues at a site; and,
- *Initial flood risk assessment* - confirm sources of flooding that may affect a proposed development.

Further to this, a stage 2 assessment involves the confirmation of sources of flooding, appraising the adequacy of existing information and determining what surveys and modelling approach may be required for further assessment.

A11.3.4.2 FLOOD ZONE MAPPING

Flood zones are geographical areas within which the likelihood of flooding is in a particular range. There are three types or levels of flood zones defined for the purposes of according to OPW guidelines:

- Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);
- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and,
- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

A11.3.4.3 FLOOD RISK IDENTIFICATION

A11.3.4.3.1 Soils Maps – Fluvial Maps

A review of the soil types in the vicinity of the site was undertaken as soils can be a good indicator of past flooding in an area. Due to past flooding of rivers deposits of transported silts/clays referred to as alluvium build up within the flood plain and hence the presence of these soils is a good indicator of potentially flood prone areas.

Alluvial is typically mapped at the larger streams and rivers along the route of the UWF Grid Connection with the most extensive areas being mapped at the Newport Mulkear) River, Clare River and Bilboa River which have relatively expansive floodplains at the crossing locations.

Soils maps, however, tend to be generalised and therefore are not definitive, and further analysis is required as outlined below.

A11.3.4.3.2 Historical Mapping

There is no text on local available historical 6" or 25" mapping for the route that identify areas that are "*prone to flooding*".

A11.3.4.3.3 OPW National Flood Hazard Mapping

The OPW Indicative Flood Maps have no records of recurring flood incidences along the UWF Grid Connection, UWF Related Works or UWF Replacement Forestry areas or immediately downstream of them (**Figure B** below refers). The closest mapped recurring flooding event is mapped approximately 1km west of the Mountphilips Substation site. There is no proposed development relating to the grid connection upstream of downstream of this mapped flood location.

There are further afield recurring flood incidences mapped to the south (>3km downstream) of the route along the Newport (Mulkear) River channel.

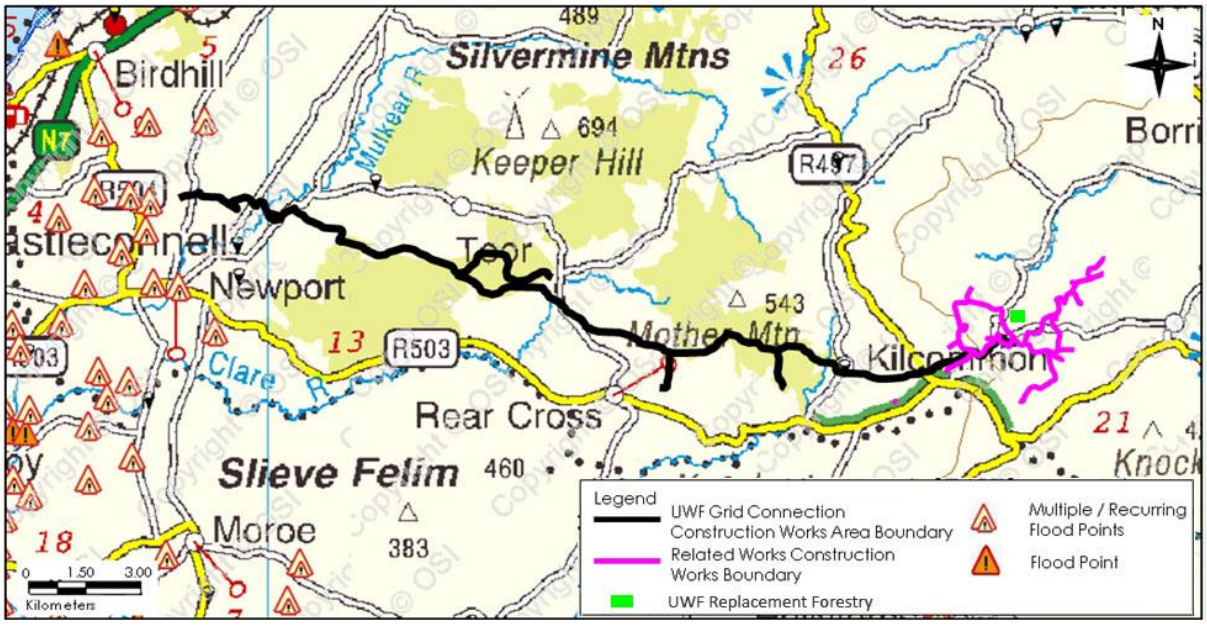


Figure B: OPW Flood Hazard Mapping **(www.floods.ie)**

A11.3.4.3.4 Preliminary Flood Risk Assessment Maps – Fluvial and Pluvial Flooding

UWF Grid Connection

The OPW PFRA mapping relevant for the UWF Grid Connection include Maps no. 148, 149, and 150 (www.cfram.ie/pfra/interactive-mapping/).

The PFRA mapping indicates that fluvial flooding along the 110kV UGC route is relatively localised to the larger stream and river crossing locations, namely; crossing locations W7, W8, W10 (Newport (Mulkear) River), W11, W32, W36 (Clare River) and W57 (Bilboa River) which are all mapped to be within the 100-year flood zone (Flood Zone A).

Access to the above mentioned crossing locations will only be required during the construction phase and this will be facilitated by temporary access roads (*i.e.* there are no joint bays located within the mapped flood zones associated with the aforementioned watercourse crossing locations).

There are 38 no. joint bays (and their communication and link box chambers) located along the 110kV UGC and none of the joint bay locations or their associated permanent access roads are located within a mapped fluvial flood zone. The Mountphilips Substation site is also not located within a mapped fluvial flood zone.

There are no significant mapped pluvial flood zones along the UWF Grid Connection route. Due to the elevated and hilly nature of the topography in the area of the UWF Grid Connection development no significant pluvial flooding is anticipated. None of the proposed joint bays or their permanent access roads are located within a mapped pluvial flood zone.

UWF Related Works

Also, there are no mapped pluvial or fluvial flood zones in the area of the UWF related works. Due to the elevated and hilly nature of the topography in the area of the UWF related works no significant fluvial or pluvial flooding would be expected.

UWF Replacement Forestry

A section of the UWF Replacement Forestry site at Foilnaman is within a mapped fluvial flood zone. However, there is no new permanent infrastructure associated with this afforestation site.

PFRA flood mapping for the area of the proposed development are shown attached below as **Figure 2** to **Figure 5**.

A11.3.4.3.5 CFRAM Maps – Fluvial and Coastal Flooding

Where complete the Catchment Flood Risk Assessment and Management (CFRAM)[1] OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the Preliminary Flood Risk Assessment Maps (PFRA) maps. CFRAM mapping is not currently available for the area of the UWF Grid Connection, UWF Related Works or UWF Replacement Forestry.

[1] *CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011, and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.*

A11.3.4.3.6 Summary – Flood Risk Identification

UWF Grid Connection

Based on the information gained through the flood identification process, it appears that fluvial flood zones mapped along the UWF Grid Connection route are typically associated with the larger stream and river crossing locations.

The route of the 110kV UGC passes through these flood zones, however no permanent over ground infrastructure such as access roads, joint bays or new permanent culverts are mapped within these flood zones (*i.e.* 100-year and Extreme Event flood zones). Also, none of the joint bays or their permanent access roads are located within a mapped pluvial flood zone.

UWF Related Works

Based on the information gained through the flood identification process, it appears that there are no mapped fluvial or pluvial flood zones at the UWF Related Works areas which includes the watercourse crossing locations. The works will therefore have no potential to cause increased flood risk.

UWF Replacement Forestry

A section of the UWF Replacement Forestry site at Foilnaman is within a mapped fluvial flood zone. However, there is no new permanent infrastructure associated with this afforestation site.

This is discussed further in **Section 4.4** below where a site-specific flood risk assessment was carried out to further assess the risk of potential flooding at the proposed development sites.

A11.3.4.4 INITIAL FLOOD RISK ASSESSMENT

A11.3.4.4.1 Site Survey

A detailed survey of all watercourse crossings along the UWF Grid Connection 110kV UGC route and at UWF Related Works was completed as part of this assessment. The walkover surveys were completed in the winter months of 2016 and 2017 and therefore streams and rivers were seen in medium to high flow conditions.

Due to the upland nature of the majority of the UWF Grid Connection and UWF Related Works areas, many of the watercourses in proximity of the works area are small headwater streams or drains. A summary of the watercourse types intercepted by the UWF Grid Connection and UWF Related Works are shown in **Table C** and
Table D below respectively. No new river or stream crossings are required within the UWF Replacement Forestry area.

Most of the larger watercourse crossings along the UWF Grid Connection are located at the lower-lying agricultural land on the west of the route (Sections S1 – S36), or at the bottom of the main valleys within the local surface water bodies.

The main watercourse crossings along the grid connection include the Newport (Mulkear) River, Clare River and the Bilboa River. However, no above ground permanent infrastructure is required at these crossing locations.

With the exception of the Newport (Mulkear) River, the Clare River, and the Bilboa River crossing locations (floodplains), there was no evidence of past significant flood events at any other water crossing location.

Due to the elevated nature of the UWF related works area, the watercourse crossings comprise mainly drains along with several headwater streams (1st – 2nd order).

Table C: Watercourse Crossing Types along the UWF Grid Connection works areas

Type	Watercourse Description	Total No.
1	EPA mapped blue line, major river or stream	14
2	Headwater Stream, equivalent to EPA blue line but not mapped	10
3	Ephemeral watercourse, heavily vegetated with low or no flow during dry periods	5
4	Manmade Drain	37
	Total	**66**

Table D: Watercourse Crossing Types at UWF Related Works areas

Type	Watercourse Description	Total No.
1	EPA mapped blue line, major river or stream	1
2	Headwater Stream, equivalent to EPA blue line but not mapped	5
3	Ephemeral watercourse, heavily vegetated with low or no flow during dry periods	2
4	Manmade Drain	24
	Total	**32**

A11.3.4.4.2 Hydrological Flood Conceptual Model

Potential flooding in the vicinity of the proposed development can be described using the Source – Pathway – Receptor Model ("S-P-R"). The primary potential source of flooding in this area, and the one with most consequence for the proposed site, is fluvial.

The primary potential pathway would be overbank flooding of the various larger watercourses intersected by the UWF Grid Connection and UWF Related Works infrastructure during significant rainfall events. The potential receptors in the area are infrastructure and land as outlined below.

A11.3.4.4.3 Summary – Initial Flood Risk Assessment

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process the sources of flood risk for the site are outlined and assessed in **Table E**.

Table E: S-P-R Assessment of Flood Sources for the site

Source	Pathway	Receptor	Comment
Tidal	Not applicable	Land and infrastructure.	The UWF Grid Connection route is at least 25km from the coast and there is no risk of coastal flooding.
Fluvial	Overbank flooding of the various watercourses in the area of the grid connection and related works	Land and infrastructure.	There are 7 no. watercourse crossing locations mapped within a fluvial flood zone (Flood Zone A) along the 110kV route. Temporary access to these locations will only be required during the construction stage which is likely to happen during the summer months for the large crossing locations (due to IFI fisheries restrictions). There is no permanent infrastructure located within a mapped fluvial flood zone (*i.e.* joint bays, permanent access road or new permanent culvert). There are no mapped fluvial flood zones in the area of the UWF Related Works. A section of the UWF Replacement Forestry site at Foilnaman is within a mapped fluvial flood zone. However, there is no new permanent infrastructure associated with this afforestation site.
Pluvial	Ponding of rainwater / surface water	Land and infrastructure.	There is no significant risk of pluvial flooding at the proposed development areas as the topography is elevated and sufficiently sloped to adequately convey waters during heavy rainfall events. There is no permanent infrastructure located within a mapped pluvial flood zone (*i.e.* joint bays or permanent access road).

Surface water	Surface ponding/ Overflow	Land and infrastructure	Same as above (pluvial).
Groundwater	Rising groundwater levels	Land and infrastructure.	Based on local hydrogeological regime, elevated nature of the majority of the development and PFRA mapping, there is no apparent risk from groundwater flooding.

A11.3.4.5 DEVELOPMENT INFRASTRUCTURE AND FLOOD RISK

A11.3.4.5.1 Introduction

The proposed development largely involves the installation of underground cables for the grid connection and the UWF related works internal wind farm cabling. These elements of the development have no potential to increase flood risk due to their subsurface nature. The ground will be reinstated back to its natural condition after the works are completed.

There are certain elements of the permanent infrastructure that will be above ground level and these are looked at below in terms of flood risk.

A11.3.4.5.2 New Permanent Watercourse Crossing Culverts

New permanent culverts / bridges will be required at the following watercourse crossing locations (12 no.) along the UWF Grid Connection: W18, W19, W20, W21, W22 and W23 (Type 4 watercourse), also W2 (Type 3 watercourse), also W3, W4 and W13 (Type 2 watercourse), also W48 and W55 (Type 1 watercourse) and (1 no.) along access road AR9: W90 (Type 2 watercourse).

New permanent culverts / bridges will be required at the following watercourse crossing locations (8 no.) at the UWF Related Works areas: WW1, WW13, WW24 and WW25 (Type 4 watercourse), also WW14 (Type 3 watercourse), also WW4 and WW22 (Type 2 watercourse), and also WW15 (Type 1 watercourse).

The following measures are proposed to ensure that there is no increased flood risk locally:

- All permanent culverts/bridges will be sized to cope with a minimum 100-year flood event;
- A freeboard of 300mm will be kept below the crossing structure during a 100-year flood event;
- At a minimum, all new pipe culverts will be 900mm in diameter regardless of the anticipated flood flow (i.e. minimum 900mm culvert will be used in Type 3/Type 4 watercourses regardless of flows);
- There will be consultation with the OPW to determine if a Section 50 application is required for new crossings and upgrades. A Section 50 application requires the submission of a hydraulic assessment of the proposed culvert / culvert upgrade to ensure it adequacy from a flood prevent perspective ; and,
- Culvert design and construction will adhere to best practise and conform to the OPW (2013) guidance document "Construction, Replacement or Alteration of Bridges and Culverts

There will be no requirement for new permanent culverts/bridges at the UWF Replacement Forestry site.

A11.3.4.5.3 Permanent Hardstanding Areas

Permanent infrastructure along the UWF Grid Connection will mainly include 4.4km of access roads and the Mountphilips Substation building.

Permanent infrastructure associated with the UWF Related Works will be limited to 0.6km of realigned windfarm access roads.

This permanent infrastructure is not expected to increase flood risk for the following reasons:

- The permanent hardstanding areas are distributed over a large geographical area (latitudinal distance of 27.5km) and within several local surface water bodies (i.e. Mulkear River, Small River, Clare River Bilboa River and Clodiagh River);
- The permanent hardstanding areas are negligible in comparison to the area of the local surface water body;
- It is proposed that the permanent access roads will have permanent road side drains in place which will include check dams for reduction of runoff rates; and,
- It is proposed that the Mountphilips Substation will have a permanent surface water drainage network in place which will allow for surface water attenuation.

There will be no requirement for new permanent infrastructure at the UWF Replacement Forestry site.

A11.3.5. PLANNING POLICY AND JUSTIFICATION TEST

A11.3.5.1 PLANNING POLICY AND THE NORTH TIPPERARY COUNTY DEVELOPMENT PLAN

The following policies in **Table F** below are defined in North Tipperary County Development Plan (CDP) 2010-2016 in respect of flooding, and we have outlined in the column to the right how these policies are provided for within the proposed developments design.

Table F: North Tipperary CDP Policies and Project Responses

No.	Policy	Development Design Response
CEF8	**Management of Flood Risk** It is the policy of the Council to apply a sequential approach to the assessment of developments in areas of flood risk. Developments on lands identified as being at risk of flooding shall be subject to a Flood Risk Assessment in accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities, (DEHLG 2009) and any amendment thereof*, and shall include a Justification Test and have regard to non-vulnerable uses. *Flood Risk Assessments will be required, as appropriate, in areas identified to be of risk of flooding.	This site-specific FRA is consistent with the DoEHLG/OPW guidelines and its accompanying technical appendix.
TI9	**Storm Water Disposal** It is the policy of the Council to require the implementation of Sustainable Drainage Systems (SuDS) as an integral part of the design of new developments to reduce the generation of storm water run-off, and to ensure that all storm water generated is disposed of on-site or is attenuated and treated prior to discharge to an approved storm water system.	All drainage proposals for permanent infrastructure will be consistent with SUDs principles and best practice SUDs drainage design.

A11.3.5.2 REQUIREMENT FOR A JUSTIFICATION TEST

The matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test[2] is shown in **Table G** below.

It may be considered that the proposed developments is a 'Highly Vulnerable Development – utilities distribution'. While all of proposed above ground permanent infrastructure is located in Flood Zone C (Low Risk), there are sections of the grid route mapped in Fluvial Flood Zone A and these are typically within flood plains at the larger stream and river crossing locations.

The permanent infrastructure (*i.e.* 110kV UGC cabling) within the mapped fluvial flood zones will be placed below ground level (within a trench) and beneath the watercourse and as such no impacts on the proposed developments are expected. The construction of the cable trench will be temporary and transient (not all occurring at once). Also, there will be no potential of increased flood risk as a result of the proposed development for the reasons described in **Section 4.5** above.

Notwithstanding this and in the interest of being conservative, a justification test for this layout is presented as illustrated in **Table G** below.

[2] *A 'Justification Test' is an assessment process designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk, (DoEHLG, 2009).*

Although a section of the UWF Replacement Forestry site at Foilnaman is within a mapped fluvial flood zone a Justification Test is not completed for the UWF Replacement Forestry as there is no new permanent infrastructure associated with this afforestation site, and the proposed works are considered Less Vulnerable Development.

Table G: Matrix of Vulnerability versus Flood Zone

	Flood Zone A	**Flood Zone B**	**Flood Zone C**
Highly vulnerable development (including essential infrastructure)	**Justification test**	**Justification test**	**Appropriate**
Less vulnerable development	Justification test	Appropriate	Appropriate
Water Compatible development	Appropriate	Appropriate	Appropriate

Note: Taken from Table 3.2 (DoEHLG, 2009)
Bold: *Applies to this project.*

Box 5.1 of "The Planning System and Flood Risk Management Guidelines" (PSFRM Guidelines) outlines the criteria required to complete the "Justification Test".

Table H: Format of Justification Test for Development Management

Box 5.1 Justification Test for Development Management (to be submitted by the applicant)
When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied: 1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines. 2. The proposal has been subject to an appropriate flood risk assessment that demonstrates: i. The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk; ii. The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible; iii. The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and iv. The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes. The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: *this table has been adapted from Box 5.1 of "The Planning System and Flood Risk Management Guidelines", (2009).*

Referring to Point 1 and Points 2 (i) to (iv) inclusive:

1. The sections of the UWF Grid Connection 110kV UGC route located in the mapped flood zones are within private lands and therefore can be considered appropriate for installation of underground services such as grid cable connections.

2. The proposed developments has been the subject of a flood risk assessment (this report) and this assessment shows that the infrastructure design proposed for these

watercourse crossings is appropriate in areas of the route mapped in Fluvial Flood Zone A.

i. The proposed developments is predicted to have **No Impact** on flood risk elsewhere in the locality.

a. The UWF Grid Connection largely involves the installation of underground cables for the grid connection 110kV UGC and the UWF Related Works internal wind farm cabling which have no potential to increase flood risk;

b. The footprint of the permanent above ground infrastructure (i.e. permanent access roads, realigned wind farm roads and Mountphilips Substation is minimal and therefore associated surface water runoff will not result in increased downstream flood risk; and,

c. Where new permanent watercourse crossings culverts are required, the hydraulic capacity of the culvert will be suitably designed for peak flood flows.

ii. The nature of the proposed developments means there will be no flood risk to people, property, the economy or the environment during extreme flood events

a. The proposed developments have no potential to increase flood risk for the reasons outlined in (i) above; and

b. Where the proposed route of the grid connection 110kV UGC passes through mapped fluvial flood zones, there are no permanent over ground infrastructure such as access roads, joint bays or new culverts within these flood zones (i.e. 100-year and Extreme Event flood zones). Therefore, there is no risk to property or people during the operation of the development;

iii. There will be no residual risks to the area and to the proposed developments during extreme flood events.

a. The proposed developments largely involve the installation of underground cables for the grid connection and the internal wind farm cabling and therefore there will be no residual risk;

b. Where new permanent watercourse crossings culverts are required, the hydraulic capacity of the culvert will be suitably designed for peak flood flows.

iv. The proposed development is compatible with the wider planning objectives of the area.

a. The proposed development will serve the Upperchurch Windfarm which has been granted permission. The Upperchurch Windfarm is consistent with the County Development Plan on renewable energy.

A11.3.6. CONCLUSIONS

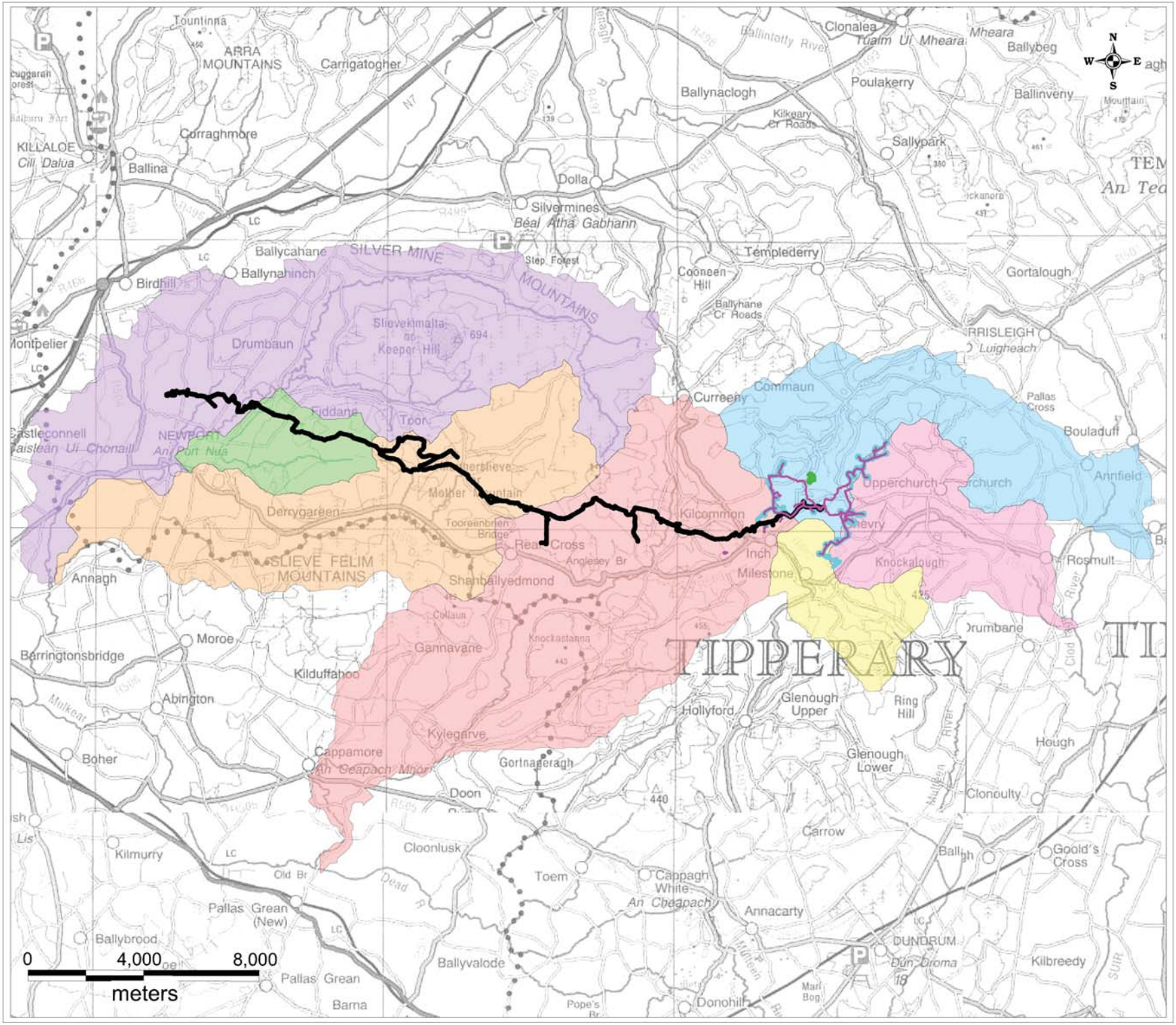
- A flood risk identification study was conducted to identify potential flood risks associated with the proposed UWF Grid Connection, UWF Related Works and UWF Replacement Forestry for the Upperchurch Wind Farm, Co. Tipperary. From this study:
    - No instances of historical flooding were identified in historic OS maps;
    - No instances of recurring flooding were identified on OPW maps along the proposed route, associated access roads or UWF related works; and,
    - Sections of the UWF Grid Connection 110kV UGC route and the UWF Replacement Forestry were identified with the PFRA Flood Zones as described.
- The available Preliminary Flood Risk Assessment (PFRA) mapping indicates that there are sections of the 110kV UGC route located in the fluvial Flood Zone A (100-year flood zone) and these are largely associated with the larger stream and river crossings;
- The available Preliminary Flood Risk Assessment (PFRA) mapping indicates that there is a section of the UWF Replacement Forestry site located in the fluvial Flood Zone A (100-year flood zone). However, there is no new permanent infrastructure associated with this afforestation site;
- All of the above ground permanent infrastructure is located in Flood Zone C – where the probability of flooding is low (less than 0.1% or 1 in 1,000);
- The sections of the UWF Grid Connection 110kV UGC route in the areas of the mapped fluvial flood zones will only need to be accessible during the construction phase which is likely to occur during the summer months due to IFI restrictions. The construction at each crossing will be short duration (temporary) and transient (will not occur at all crossing locations at once) in nature;
- Temporary works will only be required in these (main river crossing) areas during the construction phase. All permanent structures will be underground and beneath the watercourse bed so they cannot effect future flooding events;
- As outlined in Section A11.3.5 above, the proposed developments are consistent with the relevant planning objectives and policies from the North Tipperary County Development Plan;
- No impacts on the proposed developments are expected as a result of potential flooding. Also, there will be no potential of increased local flood risk as a result of the proposed developments as the majority of the UWF Grid Connection and UWF Related Works are underground and the footprint of the over ground permanent infrastructure is minimal and distributed over several catchments. Also, there is no new permanent infrastructure associated with this afforestation site; and,
- Where new permanent watercourse crossings culverts are required for the UWF Grid Connection, the hydraulic capacity of the culvert will be suitably designed for peak flood flows of the watercourse.

* *

A11.3.7. REFERENCES

AGMET	1996	Agroclimatic Atlas of Ireland.
DOEHLG	2009	The Planning System and Flood Risk Management.
Met Eireann	1996	Monthly and Annual Averages of Rainfall for Ireland 1961-1990.

A11.3.8. FIGURES



REFERENCE DOCUMENTS

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Job: Upperchurch WF Grid Connection	
Title: Local Hydrology Map	
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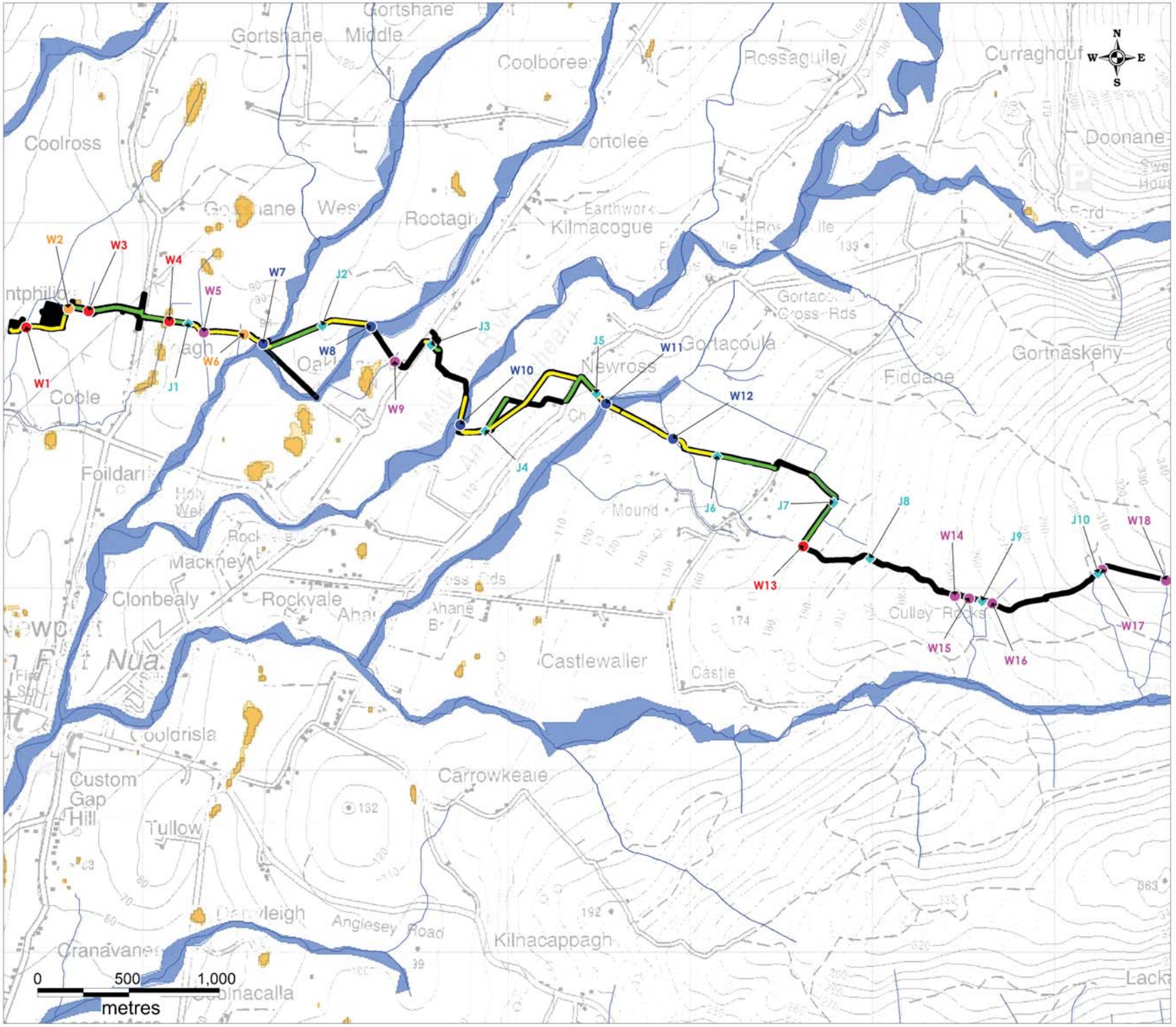

Legend

- UWF Grid Connection Construction Works Area Boundary
- Related Works Construction Works Boundary
- Permanent Acees Roads (110kV)
- Temporary Acees Roads (110kV)
- Joint Bay Locations
- Replacement Forestry Border
- Watercourse
- Fluvial - 1% AEP Event
- Fluvial - Extreme Event
- Pluvial - 1% AEP Event
- Pluvial - Extreme Event

Watercourse Crossing Class Type

- Class 1_EPA Blueline
- Class 2_EPA Blueline Equivalent
- Class 3_Sub Optimal/Ephemeral
- Class 4_Drainage Ditch

*Note: W - Grid Connection Watercourse Crossing
WW - Related Works Watercourse Crossing

REFERENCE DOCUMENTS

KEY PLAN

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Job: Upperchurch WF Grid Connection	
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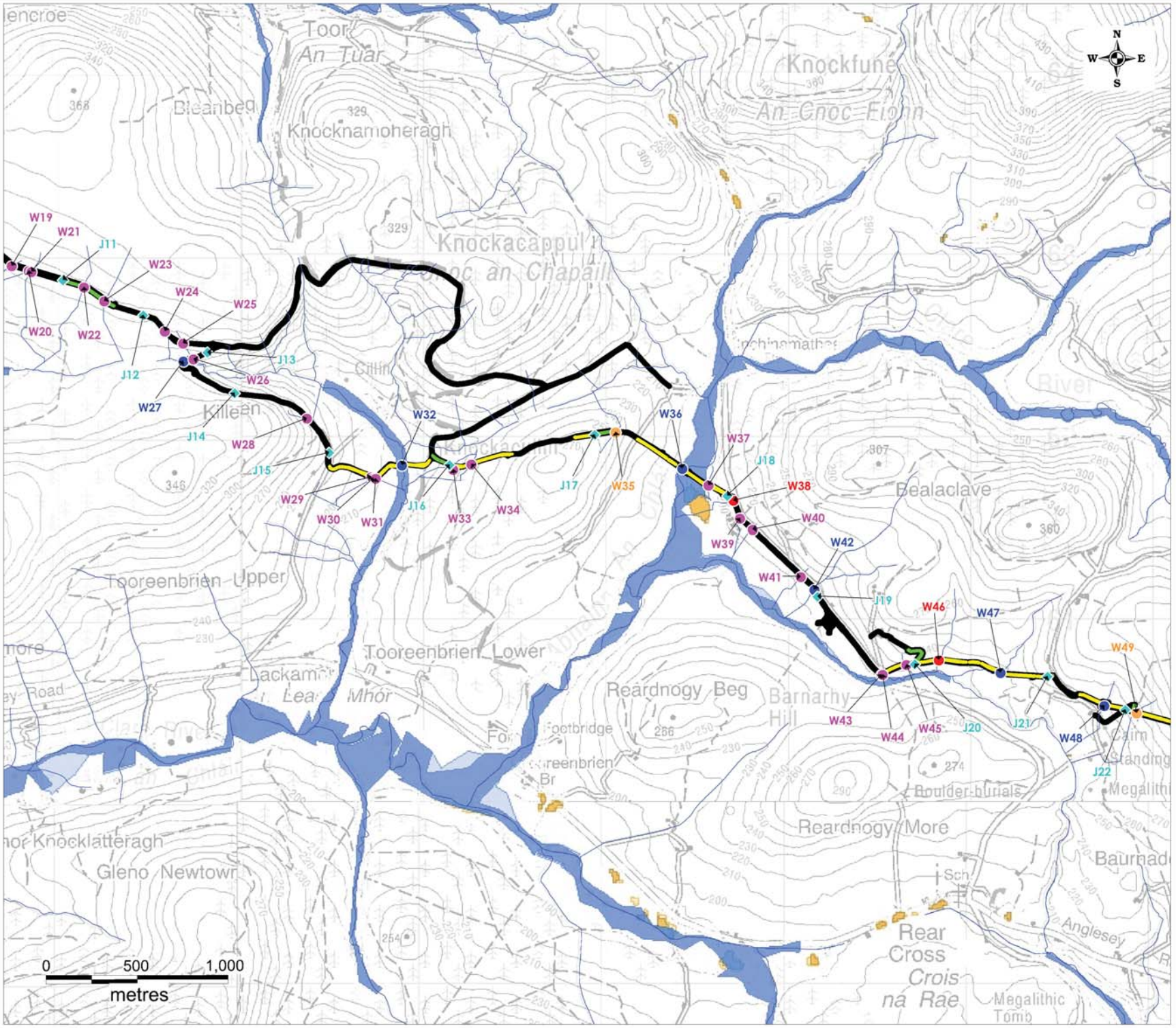


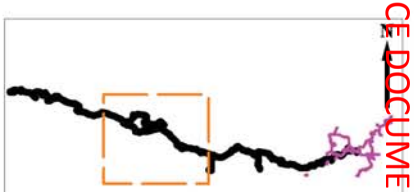
Legend

- UWF Grid Connection Construction Works Area Boundary
- Related Works Construction Works Boundary
- Permanent Acees Roads (110kV)
- Temporary Acees Roads (110kV)
- Joint Bay Locations
- Replacement Forestry Border
- Watercourse
- Fluvial - 1% AEP Event
- Fluvial - Extreme Event
- Pluvial - 1% AEP Event
- Pluvial - Extreme Event

Watercourse Crossing Class Type

- Class 1_EPA Blueline
- Class 2_EPA Blueline Equivalent
- Class 3_Sub Optimal/Ephemeral
- Class 4_Drainage Ditch

*Note: W - Grid Connection Watercourse Crossing
WW - Related Works Watercourse Crossing



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Job: Upperchurch WF Grid Connection	
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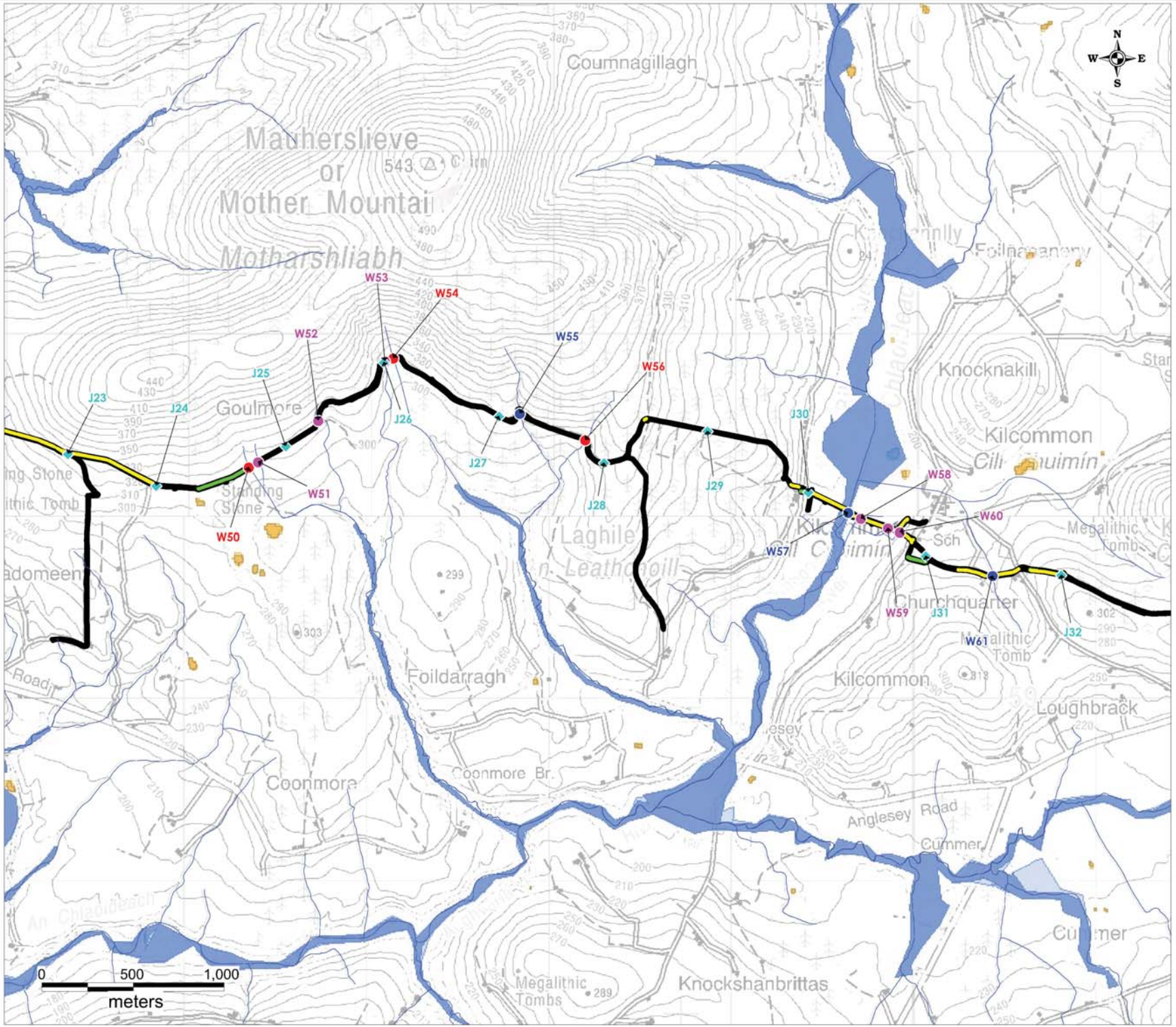


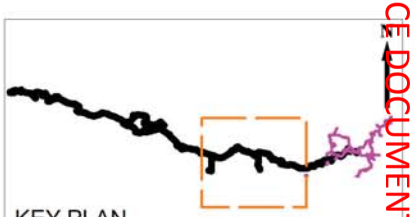
Legend

- UWF Grid Connection Construction Works Area Boundary
- Related Works Construction Works Boundary
- Permanent Acees Roads (110kV)
- Temporary Acees Roads (110kV)
- Joint Bay Locations
- Replacement Forestry Border
- Watercourse
- Fluvial - 1% AEP Event
- Fluvial - Extreme Event
- Pluvial - 1% AEP Event
- Pluvial - Extreme Event

Watercourse Crossing Class Type

- Class 1_EPA Blueline
- Class 2_EPA Blueline Equivalent
- Class 3_ Sub Optimal
- Class 4_ Drainage Ditch

*Note: W - Grid Connection Watercourse Crossing
WW - Related Works Watercourse Crossing



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Client: Ecopower Developments Ltd.	
Job: Upperchurch WF Grid Connection	
Title: PFRA Flood Mapping 3	
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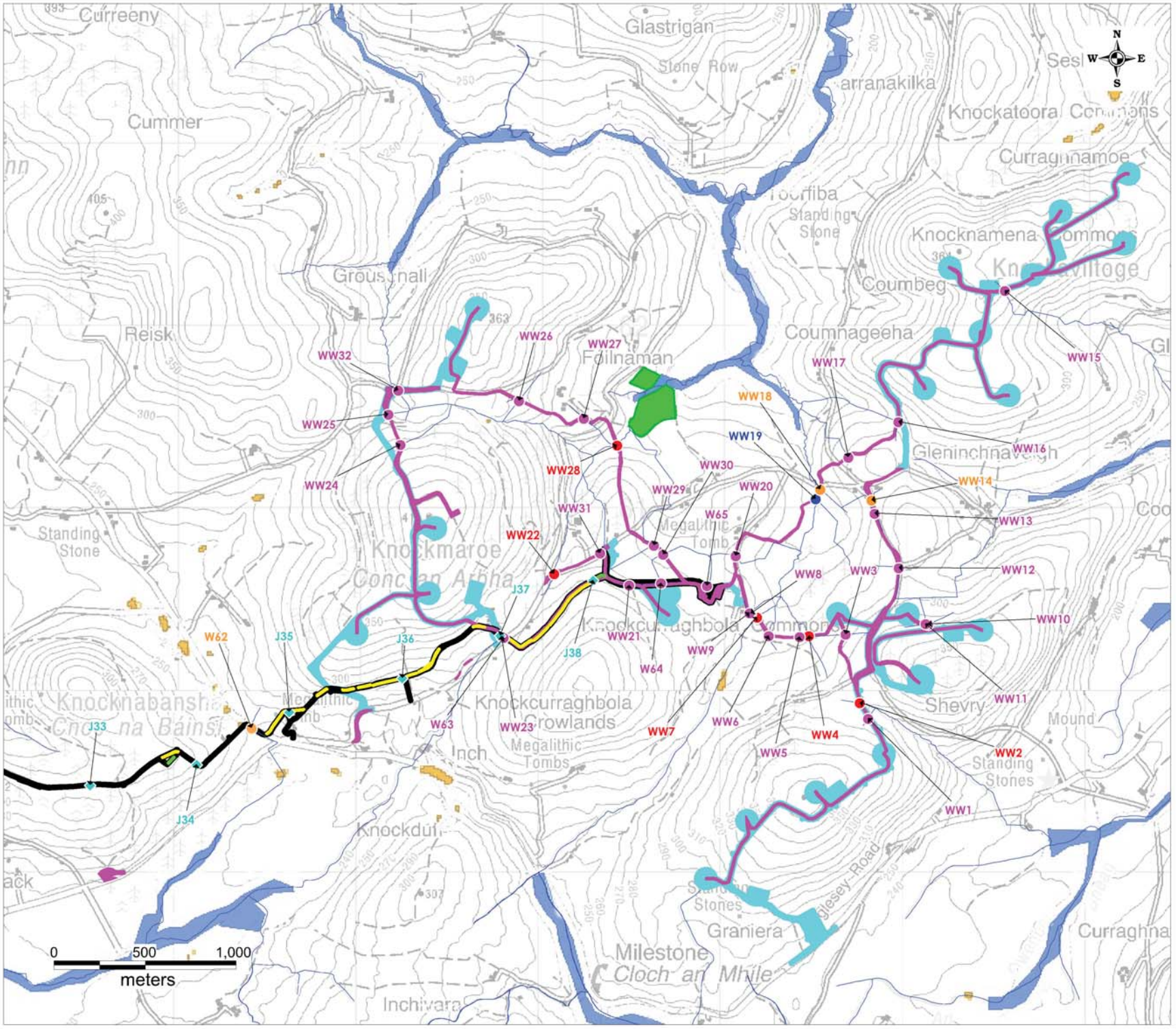


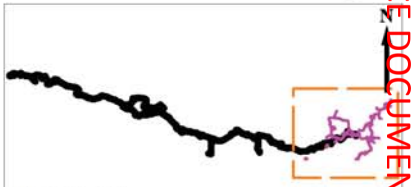
Legend

- UWF Grid Connection Construction Works Area Boundary
- Related Works Construction Works boundary
- Upperchurch Windfarm Construction Works Boundary
- Permanent Access Roads (110kV)
- Temporary Access Roads (110kV)
- Replacement Forestry Border
- Join Bay Locations
- Watercourse
- Fluvial - 1% AEP Event
- Fluvial - Extreme Event
- Pluvial - 1% AEP Event
- Pluvial - Extreme Event

Watercourse Crossing Class Type

- Class 1_EPA Blueline
- Class 2_EPA Blueline Equivalent
- Class 3_Sub Optimal/Ephemeral
- Class 4_Drainage Ditch

*Note: W - Grid Connection Watercourse Crossing
WW - Related Works Watercourse Crossing



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Client: Ecopower Developments Ltd.	
Job: Upperchurch WF Grid Connection	
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Date: 16/02/2018	Checked By: MG

UWF GRID CONNECTION HDD RISK ASSESSMENT.

A preliminary report reviewing the potential for frac-out using HDD at three river crossing locations.

Project Reference No. FR_EN1695
Client: Ecopower Ltd
Zetec House, Purcellsinch IDA Business Park, Co. Kilkenny
Rev: 001
February 11, 2018

Geo Trenchless Solutions Ltd. t/a Geo Drilling Solutions
Dunmahon, Ardee Road, Dundalk County Louth, Ireland. A91 TYT4

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NOMENCLATURE

BGL – Below Ground Level

BH – Borehole

CP – Cable Percussion

ERT – Electrical Resistivity Tomography

GDS – Geo Drilling Solutions

GL – Ground level

GSI – Geological Society Ireland

GWB - Ground Water Body

GWL – Ground Water Level

HDD – Horizontal Directional Drilling

ID – Internal Diameter

OD – Outside Diameter

PDC - Polycrystalline Diamond Materials

PE – Polyethylene

RDX – Road Crossing

ROP – Rate of Penetration

RVX – River Crossing

RC – Rotary Core

SDC - Specialist Drilling Contractor.

SPT – Standard Penetration Test

TD – Total Depth

WF - Windfarm

INTRODUCTION

OVERVIEW

Geo Drilling Solutions (GDS) are a specialist ground engineering consultancy, with over 20 years' experience in drilling design and construction. Niall Meehan director of GDS is accredited with a Bachelors of Engineering in Environment Engineering, a member of the Pipe Industry Guild and Engineers Ireland and is on the panel of experts for Geoscience Ireland. Over the years Niall has operated in the Water well, HDD, geothermal, geotechnical, environmental and hydrocarbon sectors providing a design and build service, see Appendix B.

GDS have prepared this report in relation to the three locations where HDD is required on the UWF Grid Connection route.

The UWF Grid Connection includes the installation of underground cables along a 27.5km route (110kV UGC) between Mountphilips townland near Newport and Knockcurraghbola Commons townland near Kilcommon, County Tipperary.

There are three river crossing locations on the route of the 110kV UGC – Watercourse Crossing No. W10 at the Mulkear River, W36 at the Clare River and W57 at the Bilboa River.

Each crossing will utilise drilling techniques to install the ducts for the cables beneath the river bed. HDD using rock tooling will be used at the Mulkear River (W10) crossing, while conventional HDD jetting assemblies will be used at the crossing points of the Clare River (W36) and the Bilboa River (W57).

The probability of a frac-out during drilling activities at the three river crossings is evaluated in this report.

SCOPE OF WORKS

Each river crossing where horizontal directional drilling (HDD) is proposed to underground the cable is to be assessed under the following criteria:

- Site visit and inspection of each drilling location by GDS
- Review the geophysical and geotechnical data.
- Assess the risk of a frac out at each location.
- Prepare a Frac Out Contingency Plan

SITE VISIT

A site visit was carried out on the 17th of November 2017.

Site address:

Mulkear RVX: Newport, County Tipperary. 52°43'33.3"N 8°22'29.1"W

Clare RVX: Bealaclave, County Tipperary. 52°42'28.3"N 8°15'38.8"W

Bilboa RVX: Kilcommon, County Tipperary. 52°41'29.8"N 8°09'14.9"W

The locations can be found in Appendix A, Figure 11 – RVX locations for proposed HDD.

MULKEAR RVX

Observations: The overburden was observed as a sandy soil on the western river banks, Figure 2. Bedrock can be seen outcropping (horizon bedding planes) on the east side of the waterway and in the river channel, Figure 1. Fast flowing water way. The topography rises steeply on the east side of the crossing which may indicate a fault line which has the potential of creating a pathway for inadvertent drilling fluids returning to surface.

3rd Party Utilities: No other utilities observed.

Figure 1 – Outcropping bedrock on the eastern river bank.

Figure 2 – Sandy overburden on the western river bank.

CLARE RVX

Observations: Shallow fast flowing waterway. Steeply flanked valley, Figure 3.
Soft peat/clay formation in the base of the valley. Valley floor is flat. Gravel deposits in the riverbed, Figure 4.

3rd Party Utilities: No other utilities observed.

Figure 3 – Elevated view over the site from the east.

Figure 4 – Shallow fast flowing waterway.

BILBOA RVX

Observations: No bedrock observed in the waterway. Shallow fast flowing waterway. Rolling landscape towards the valley floor where the river is located, Figure. Soft peat/clay formation in the base of the valley, undrained grasslands. Gravel deposits in the riverbed, Figure 5.

3rd Party Utilities: None observed.

Figure 5 – Shallow narrow water way, observed from the western bank.

Figure 6 – Undulating landscape on the western side of the RVX, falling towards the river.

REVIEW OF THE GEOPHYSIC SURVEY OF THE MULKEAR RIVER

APEX Geoservices Limited was requested by ECOPOWER to carry out a geophysical investigation at the Mulkear River, Newport, County Tipperary. The investigation was requested prior to directional drilling beneath the river for the grid connection element of the Upperchurch Wind Farm. The investigation was carried out over a single session on the 11th January 2018 and involved the collection of 2no. ERT profiles (2 x 93m) and 4 no. seismic refraction profiles (4 x 46m) across the site. See Appendix 10.5 of the UWF Grid Connection EIA Report.

The area under investigation is underlain by the Keepers Hill Formation consisting of sandstone, grits and claystone.

The geophysical investigation comprised of Electrical Resistivity Tomography and Seismic Refraction profiling.

The objectives of the investigation were to provide information on the type and thickness of the soils, estimate soil stiffness, assess depth to and weathering of bedrock, identify bedrock type and identify any faults / fissures in the bedrock.

RESULTS

ERT

The ERT profiles and geological interpretations are displayed in Figure 7. The recorded electrical resistivities have been broadly interpreted in conjunction with the borehole data on the following basis:

Apparent Resistivity (Ohm-m)	Interpretation
80 - 275	Sandy Gravelly CLAY
275 - 550	Clayey Sandy GRAVEL
95 - 380	Shaley SANDSTONE
380 - 905	SANDSTONE

SEISMIC REFRACTION PROFILING

The seismic data, in conjunction with the ERT profiles and geological interpretations are displayed in Figure 7.

The data indicated three velocity layers that have been interpreted in conjunction with the borehole data on the following basis:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Interpretation	Stiffness/Rock Quality	Excavatability
1	278 - 400	350	Soil	Soft / Loose	Diggable
2*	1506 - 1800	1664	Soil	Stiff / Dense	Diggable
			Possible Highly-Moderately Weathered Bedrock	Poor	Marginally Rippable
3	3011 - 3198	3099	Slightly Weathered-Fresh Bedrock	Good	Break/Blast

* Note; Layer 2 velocities may be indicative of stiff to very stiff soil and/or highly to moderately weathered bedrock.

SUMMARY

Soil material has been interpreted as comprising sandy gravelly clay and clayey sandy gravel. The soil has been interpreted as ranging in thickness from c. 0m across part of the river bed to c. 2.0 – 3.6m thick away from the river. This formation should not present a problem for HDD.

Bedrock type has been interpreted as slightly weathered to fresh shaley sandstone and sandstone with a possible unconformable / faulted contact beneath the river bed. If the unconformity is tightly packed there should be little concern of fluid losses or borehole collapse.

Lateral variation in the bedrock resistivity values indicates contact between the two rock types, close to the southern bank of the river may be unconformable / faulted. However as both rock types are recorded as sandstone the likelihood of formation instability is unlikely.

Beneath the river bed the depth to the proposed directional drilling route is c. 5m, within interpreted slightly weathered – fresh bedrock, a positive result for HDD.

There is a good correlation between the interpreted depth to bedrock and the bedrock levels in the client supplied rotary borehole data.

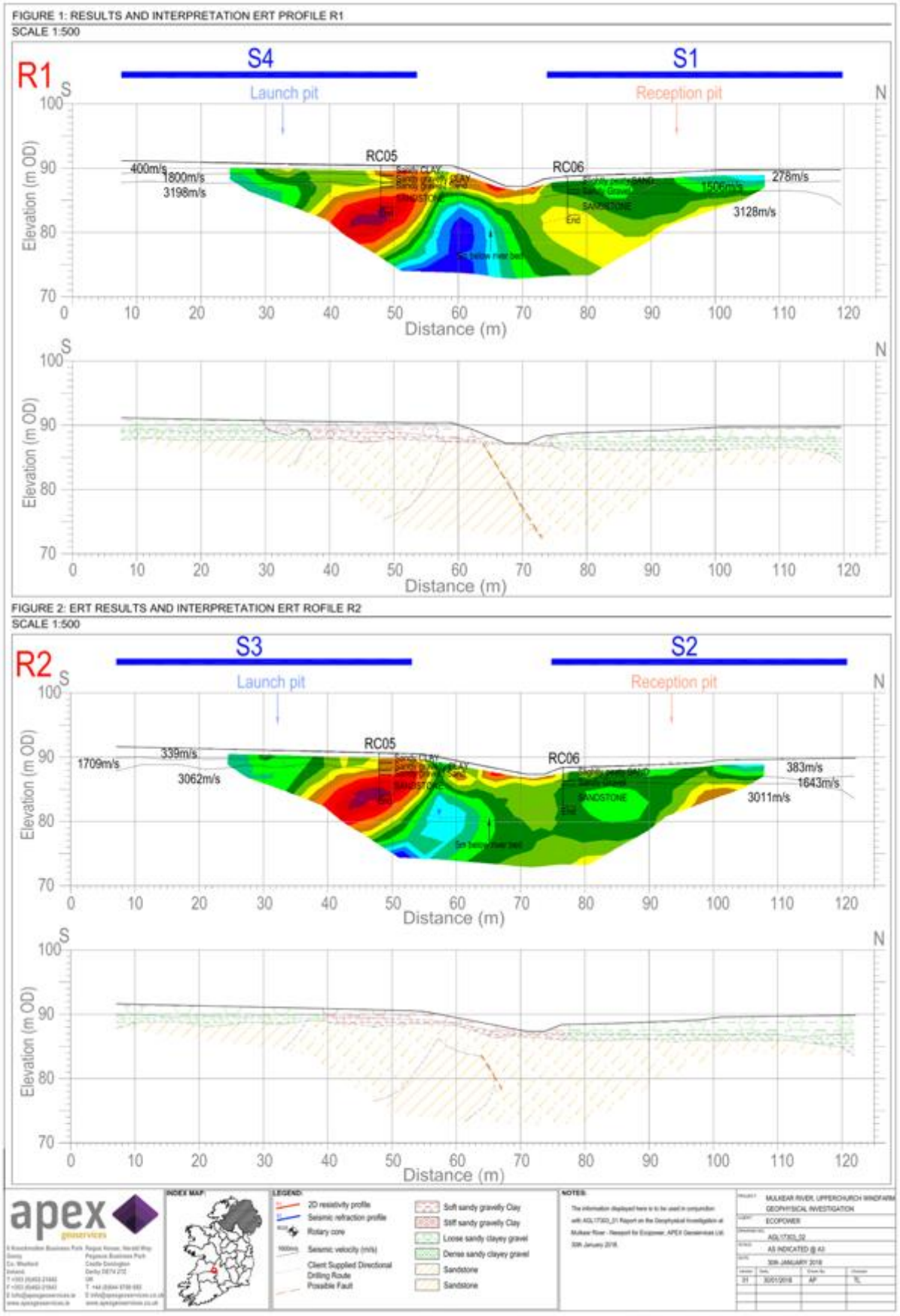

Figure 7 Geophysics results

HDD FRAC-OUT ANALYSIS

MULKEAR RVX

To understand why frac out calculations are not available for the Mulkear we must first understand the definition of a frac out. A frac out is defined as 'the unintentional return of drilling fluids to the surface during HDD'. Common causes include a restricted or blocked annulus created by a build-up of cuttings which requires mechanical agitation and fluid flow to re--suspend and remove the blockage. This situation is more likely to occur when drilling clays that are prone to plugging the borehole, bedrock chippings once suspended in the drilling fluids are easily removed.

A frac out occurs when:

a) The down hole mud pressure exceeds the overburden pressure (i.e. shallow or loose sections of the bore). A frac out is most likely to occur during the drilling of the pilot-hole at the entry and exit curves, when the depth of cover is shallow and the formation consolidation and confining strength are at a minimum. This is largely subjective to a combination of poor fluid selection for the geology encountered and poor drilling practices. One or both of these factors can lead to increased downhole pressure. If the pressure exerted by the overburden above the bore is less than the pressure exerted inside the bore, the fluid will seek to balance this pressure imbalance by taking the path of least resistance. This path is almost always going to be the ground surface. Due to the shallow depth of overburden on the Mulkear (bedrock outcropping beneath the river) this scenario does not apply.

or b) The fluid finds a preferential seepage pathway such as fault lines and fractures. These fractures can be natural or induced by over pressurising the formation. Although the results of the ERT survey beneath the Mulkear river show a dynamic geological structure the seismic results prove the formation is a competent fresh bedrock. The more competent the bedrock the less likelihood of seepage to surface.

The calculations used to evaluate frac out for the Bilboa and Clare RVX cannot be applied for the Mulkear as the calculations is based on standard penetration values, a value that is unobtainable in bedrock.

In summary the probability of a frac out/seepage on the Mulkear RVX is unlikely due to:

- the small hydrostatic head in the proposed HDD borehole,
- the five metre depth of cover beneath the river,
- the high seismic readings recorded in the geophysical survey,
- the fact the HDD borehole will be predominantly in a competent fresh sandstone,
- and the drill is relatively short, less than <100 metres in length.

BILBOA AND CLARE RVX

As both crossings are to be drilled through a fine-grained alluvium and glacial till calculations were performed in accordance with the guidance of Kennedy et al. (2004, 2006) and Xia and Moore (2007) to estimate the maximum allowable drilling fluid pressure, P_{max}.

Two modes of hydraulic fracture were considered:

1. Blowout (confined plastic flow)
2. Tensile fracture

Two river crossings were considered, and are shown in Table 1.

Table 1 River crossings considered

River crossing	Approx. length (m)	Anticipated ground conditions
Bilboa	35	Fine-grained alluvium and glacial till
Clare	36	Fine-grained alluvium and glacial till

For the Bilboa and Clare river crossings, the following assumptions were made based on the borehole logs, Appendix E:

- Drill path is through cohesive/fine-grained alluvium and glacial till. Insufficient detail exists to confirm depths of layers.
- Unit weight assumed as 18 kN/m^3 (BS 8002:2015).
- Undrained shear strength c_u = 5 SPT N (Clayton, 1995).
- Undrained shear strength increases with depth in accordance with Figure 8 and the equation c_u = 10 + 9z where z is metres below ground level.
- Coefficient of earth pressure at rest K_0 = 1.0 (Long & Menkiti, 2007).

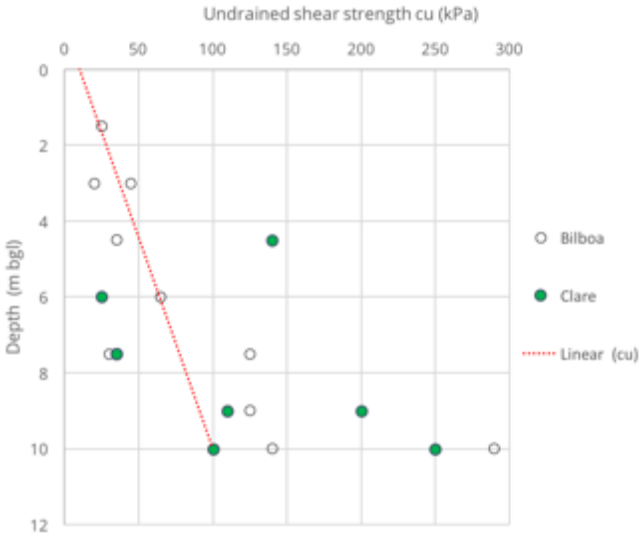

Figure 8 Undrained shear strength derived from SPT N values

In accordance with the method presented by Xia and Moore (2007), the predicted value of P_{max} was selected as the lesser of:

- $P_{max,1} = P_0(3K_0 - 1)$
- $P_{max,2} = 2c_u$

where P_0 is the initial overburden pressure and the other parameters are as given above.

Based on appraisal of the initial proposed drilling profiles, alternate drilling profiles (Appendix C) are suggested which allow for:

- A minimum of 2 metres of cover beneath the rivers.
- Entry angle of at least 11 degrees.

The resulting drilling profiles and values of maximum allowable drilling fluid pressure P_{max} to reduce the risk of hydraulic fracture for the Bilboa and Clare river crossings are presented in Figure 9 and Figure 10.

The avoid the possibility of a frac out it is very important that the selected drilling contractor applies good working practices which would include:

- Correct fluid pumping rates and allowing the fluid time to carry the cuttings to surface.
- Correct drilling fluids that are capable of building a filter cake, stop the formation from swelling, carry the cutting out of the borehole, and lubricate the pipe and tooling.
- Pre reaming if and when necessary.
- RPM and rate of penetration of the drill bits/reamers.
- Pipe pulling speeds.

It is equally important that the crew is competent and experienced being able to demonstrate that they have completed similar works.

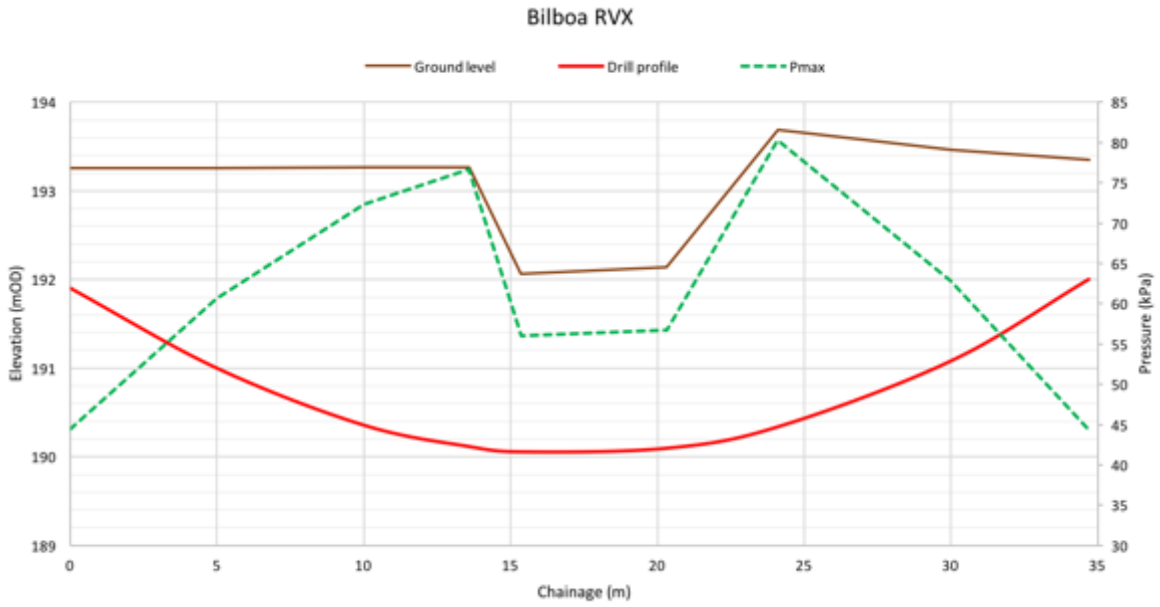

Figure 9 Bilboa river crossing profile and estimated maximum drilling fluid pressure, Pmax

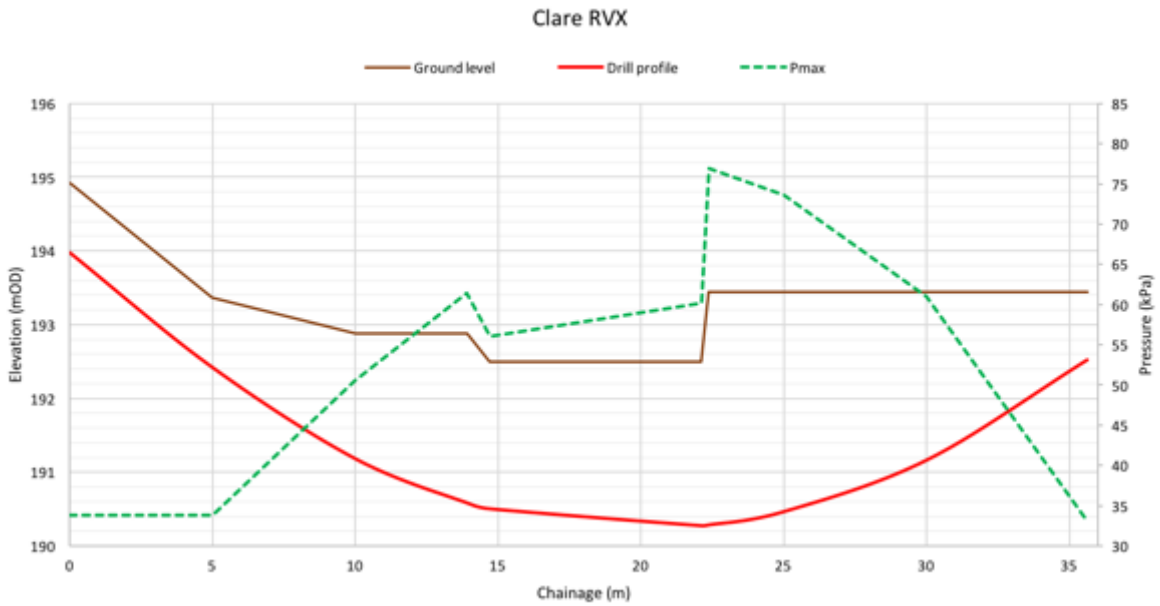

Figure 10 Clare river crossing profile and estimated maximum drilling fluid pressure, Pmax

BEST PRACTICES TO AVOID FRAC OUT

The works should be supervised and managed by a competent and experienced person who understands the technicalities and challenges of the project.

The success of HDD is closely linked to making sure that reamer and fluid selection fits the ground conditions. However, what is sometimes overlooked is the fact that we should also link good drilling practices with the reamer and drilling fluid selection, and managing correctly situations such as excessive downhole pressure build-up.

The drilling contractor should continually monitor the drilling fluid properties i.e. mud weight, viscosity, gel strength, volume and pressure, to prevent frac--outs.

Where necessary a pressure sub for real--time down hole pressure monitoring can be fitted into the bottom hole assembly allowing actual annular pressure readings to be obtained in real--time and then plotted against the modelled values.

If any unexpected variations or trends are observed then drilling should immediately cease and the cause investigated.

In all cases once punch out at exit point has been achieved, the annular pressure within the bore are relieved. Frac out during hole opening/reaming and pipe pulling operations is therefore much less likely to occur.

FRAC OUT CONTINGENCY PLAN

The purpose of a Frac-out Contingency Plan is to:

- Minimize the potential for a frac-out associated with horizontal directional drilling activities;
- Provide for the timely detection of frac-outs;
- Protect areas that are considered environmentally sensitive (streams, wetlands, other ecological resources, cultural resources);
- Ensure an organised, timely, and "minimum-impact" response in the event a frac-out and release of drilling mud occur.

To minimize the potential for a frac-out, a detailed Contingency Plan would include the following:

- Design protocols to be implemented for the protection of sensitive ecological receptors;
- Design protocols to require a geotechnical engineer or trenchless consultant to make recommendations regarding the suitability of the formations to be bored to minimize the potential for frac-out conditions (noting that the boreholes undertaken indicate that the HDD would not pass through fractured bedrock).
- Prior to drilling, sensitive ecological resources will be protected by implementing the following measures:
    - A walk-over survey will be conducted of the drilling entry and exit areas, surrounding work areas, and the drilling route (to the extent it is accessible) to ensure that there are no ecological receptors present.
    - If present, and dependent upon the sensitivity of the receptor, informed by relevant legislation, areas containing ecological receptors will be identified for avoidance or construction limits will be clearly marked;
    - Barriers (straw bales or sedimentation fences) will be erected between the bore site and nearby sensitive resources prior to drilling, as appropriate, to prevent released material from reaching the resource;
    - Toolbox talks will be conducted for the drilling crew to identify and locate sensitive resources at the site;
    - Ensure that all personnel understand their responsibility for timely reporting of frac-outs;
    - Maintaining necessary response equipment on-site or at a readily accessible location and in good working order;
- During operations the Mud Engineer will monitor fluid density, viscosity and solids content and any increases in pump pressure will be investigated immediately to prevent the risk of pressure build up within the annulus. Monitoring of fluid tank volumes will also be undertaken to identify any unexpected changes.
- Rates of Penetration and circulated cuttings volumes will be monitored to ensure that drilled cuttings are being flushed from the bore and are not building up creating pressure restrictions.
- Annular fluid velocity will be kept below Critical Velocity to prevent eddying and subsequent erosion caused by turbulent flow.
- When applicable a biodegradable drilling fluid should be selected such as Clear-Bore™

With the above measures in place Frac-out is considered unlikely to occur. However should in the event of a break-out the following recommendations may be included within the detailed Plan:

- In the event of break-out occurring in the river bed, the rig will immediately shut off the pumps and the drilling assembly will be pulled off bottom to reduce annular pressures.

- In the event of break-out on land an excavator will be made available to dig a pit to contain fluid with vacuum trucks/pumps available to transfer drill fluid from the containment point back to the recycling point.
- Drilling fluid additives design to plug the formation will be introduced to the circulation system and let set.

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APPENDIX A *MAPS*

Figure 11 – RVX locations for proposed HDD.

APPENDIX B: PREVIOUS SUCCESSFUL HDD PROJECTS COMPLETED BY GDS

NAME OF PROJECT: KNOCKAUNNANOON RIVER CROSSING FOR ESB

Year: 2015

Location: Knockaunnanoon, Co. Kerry

Client: ESB; Main Contractor, Reach Active.

Main project features: Design and install 5 x 125mm polyethylene ducts beneath a river along proposed cable routing from a windfarm. A combination of compressed air and mud rotary drilling techniques were utilized.

Positions held: Design, Project Manager and rig operator

Activities performed: Drafted HDD construction drawings, selecting both entry and exit locations, analysis of geotechnical information, and appropriate equipment selection. Drilled and installed.

Formation: Shale bedrock formation with a overlying boulder clay.

Reference: David Cleary, Senior Project Manager for Reach Active.

NAME OF PROJECT: LYRACRUMPANE RIVER CROSSING FOR ESB

Year: 2018

Location: Lyracrumpane, Co. Kerry

Client: ESB; Main Contractor, MDCE.

Main project features: Design and install a 125mm polyethylene ducts beneath the Smerlagh river along proposed cable routing from a windfarm. A mud rotary drilling techniques were utilized to drill the shale bedrock.

Positions held: Design engineering and project managment

Activities performed: Drafted HDD construction drawings, selecting both entry and exit locations, analysis of geotechnical information, and selection appropriate equipment. Drilled and installed.

Formation: Shale bedrock formation with a overlying boulder clay.

Reference: James Ireland, Michael Doyle Civil Engineering.

NAME OF PROJECT: ADSIL DUB56 ESB NETWORKS CABLE INSTALLATION

Year: 2017 - Present

Location: Ballycoolin, County Dublin

Client: Clifton Scammal Emerson and Associates and New Century Engineering Limited

Main project features: Assess the feasibility of completing sections of a new cable installation for the ESB using HDD. The deisgn involved installing 8 x 125mm polyethylene ducts beneath a river, Luas and roads including the M50.

Positions held: Design Engineer

Activities performed: Desk top study, Drafted HDD design drawings, analysis of geotechnical information, completion of trial HDD in Tymon park and geophysical survey, and selection of appropriate equipment. Tender review.

Formation: Limestone bedrock formation with a overlying boulder clay.

Reference: Leo McGinley, Operations Director for New Century Engineering Limited.

Note: Project is ongoing.

NAME OF PROJECT: ARKLOW OFFSHORE WINDFARM LANDFALL DUCT INSTALLATION

Year : 2002

Location : Arklow Pier, Arklow Town, Co. Wicklow.

Client : Airtricity, Main Contractor, Tristway

Main project features: Design and install a 315mm HDPE carrier duct from the pier into a water depth of 8 meters to facilitate the cable installation.

Positions held: Operations & Project Manager

Activities performed: Design and draft a methodology taking into consideration water depth, logistics, Health & Safety, Geotechnical data, Environmental constraints, Wireline steering tools, Drilling fluids, Working over water. Drilled and installed.

Formation: Soft silts, running sands and gravel

Reference: Paul Blount, Director of ABO Wind Energy

NAME OF PROJECT: M1 & M4 MOTORWAY CROSSINGS FOR APPLE GREEN SERVICE STATIONS.

Year : 2010

Location : Castlebellingham, Co. Louth ; Swords, Co. Dublin ; Enfield, Co. Meath

Client: Apple Green/NRA; Main Contractor: Pierce Contracting

Main project features: Design and install multiple utilities beneath a live motorway to interlink the new service stations using horizontal directional drilling. Wireline steering technology was utilised to mitigate the necessity for personnel on the carriageway.

Positions held: Project manager and Director

Activities performed: Strategic Planning, analysis of geotechnical data, draft construction drawings, and risk assessed. Drilled and installed.

Formation: Stiff black boulder clay.

Reference: Client has ceased trading.

NAME OF PROJECT: NORTH-SOUTH GAS PIPELINE.

Year : 2006

Location: Moira, Co. Antrim.

Client: Bord Gais.

Main Contractor: Lagan/Ferrovial

Main project features: Design and install a 450mm heavy wall high pressure steel gas main beneath the M1 motorway west of Belfast. Steering technique was a Para trak 2 wireline guidance system.

Positions held: Project Manager and Director.

Activities performed: Designed the profile of the crossing based on the parameters of the product pipe. Managed the operations of the project.

Formation: A conglomerate of Mercia Mudstones and Sherwood sandstones.

Reference: Niall McGuinness, Vantage Three Limited.

NAME OF PROJECT: RIVER CROUCH CROSSING.

Year : 2006

Location : Hullbridge, Hockley SS5 6ND, UK.

Client: Essex & Suffolk Water.

Contractor: M.Holleran Civil Engineering

Main project features: Design and install a 450mm HDPE watermain beneath a tidal estuary. Steering technique was a walk over guidance system. Due to the reactive formation and site constraints, two rigs were mobilised for the project, allowing reaming and pulling the pipe to take place on opposite sides of the river.

Positions held: Project Manager and Director.

Activities performed: Contract geotechnical drilling contractor to sample and analysis the formation. Reviewed the data and drafted a methodology taking into consideration the formation risks. Managed the project.

Formation: Swelling London Clays.

APPENDIX C *SOURCE DATA FOR GRAPHS*

Bilboa						
Chainage	Elevation	Drill path	Cover	Pmax,K0	Pmax,cu	Pmax
m	m	m	m	kPa	kPa	kPa
0	193.26	191.9	1.36	48.96	44.48	44.48
5	193.26	191	2.26	81.36	60.68	60.68
10	193.27	190.36	2.91	104.76	72.38	72.38
13.58	193.27	190.12	3.15	113.4	76.7	76.7
15.35	192.06	190.06	2	72	56	56
20.31	192.14	190.1	2.04	73.44	56.72	56.72
24.1	193.69	190.34	3.35	120.6	80.3	80.3
30	193.46	191.08	2.38	85.68	62.84	62.84
34.71	193.35	192	1.35	48.6	44.3	44.3

Clare						
Chainage	Elevation	Drill path	Cover	Pmax,K0	Pmax,cu	Pmax
m	m	m	m	kPa	kPa	kPa
0	194.92	193.98	0.94	33.84	36.92	33.84
5	193.36	192.42	0.94	33.84	36.92	33.84
10	192.88	191.18	1.7	61.2	50.6	50.6
13.91	192.88	190.58	2.3	82.8	61.4	61.4
14.7	192.5	190.5	2	72	56	56
22.11	192.5	190.27	2.23	80.28	60.14	60.14
22.37	193.44	190.28	3.16	113.76	76.88	76.88
25	193.44	190.46	2.98	107.28	73.64	73.64
30	193.44	191.16	2.28	82.08	61.04	61.04
35.62	193.44	192.52	0.92	33.12	36.56	33.12

APPENDIX D *PROFILE DRAWINGS*

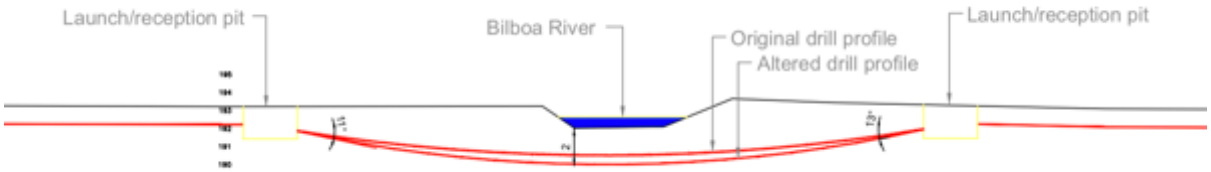

Figure 12 – Bilboa RVX suggested profile.

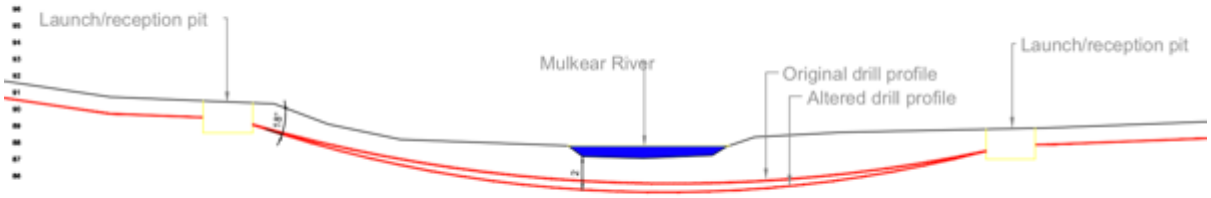

Figure 13 – Mulkear RVX suggested profile.

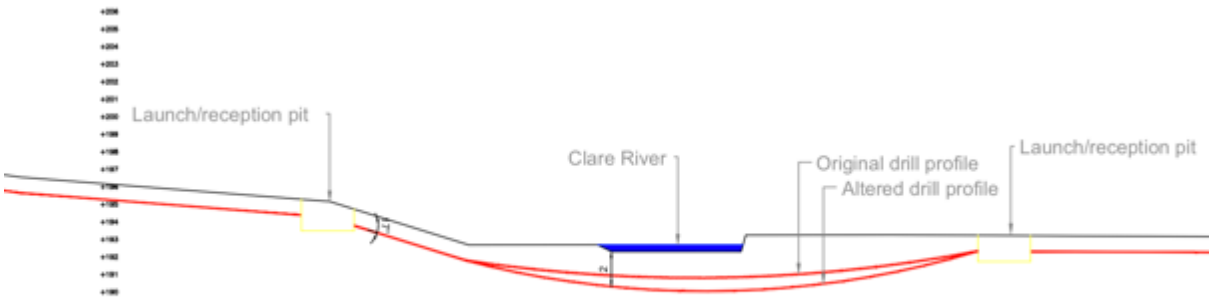

Figure 14 – Clare RVX suggested profile.

APPENDIX E: BOREHOLE LOGS

Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By:	Borehole No.
GW	**RC05**
Logged By:	Sheet 1 of 1
AH	

Project Name:	Upperchurch Windfarm	**Project No.** P16074	**Co-ords:**	**Hole Type** RC
Location:	Upperchurch Windfarm, Co Tipperary.		**Level:**	**Scale** 1:50
Client:	Ecopower		**Date:**	19/05/2016 -

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.60			Open hole boring. Driller described: Sandy Clay.
		1.50	SPT	N=45 (6,8/13,10,10,12)	1.60			Open hole boring. Driller described: Sandy gravelly Clay.
					2.70			Open hole boring. Driller described: Gravel.
		3.00	SPT	0 (75 for 20mm/0 for 0mm)	3.00			Open hole boring. Driller described: Sandy Gravel with boulder content.
	▼				3.40			Open hole boring. Driller described: Sand with boulder content.
		3.60	SPT	0 (75 for 2mm/0 for 0mm)	3.60			Open hole boring. Driller described: Rock. Assumed Sandstone. Lithology: Weak to moderately weak, dark red, fine to medium grained SANDSTONE with cross bedding and carbonaceous deposits. Weathering: Slightly weathered with orange oxidation colouration, clay smearing on fracture surfaces and minor loss of strength in part. Fracturing: 2 apparent sets. Set 1 dipping 15 degrees with planar smooth to planar rough fracture surfaces and close spacing. Set 2 is dipping 30 to 40 degrees with undulating smooth to undulating rough fracture surfaces and close spacing. *Non-intact.* *Carbonate calcretes, 2cm dia.* *Cross bedding.*
					6.60			End of Borehole at 6.60m

Groundwater:

Struck	Rose to	After	Sealed	Comment
3.40				See shift data.

Hole Information:

Hole Depth (m)	Hole Diameter (mm)	Casing Diameter (mm)
6.60		

Equipment & Methods: Deltabase 520.

Remarks:

Borehole terminated ta 6.60m bgl.

Shift Data:

Groundwater	Shift	Hole Depth	Remarks
	19/05/2016 08:00	0.00	Start of shift.
3.4	19/05/2016 18:00	6.60	End of borehole.

Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By:	Borehole No.
GW	**RC06**
Logged By:	Sheet 1 of 1
AH	

Project Name:	Upperchurch Windfarm	**Project No.** P16074	**Co-ords:**	**Hole Type** RC
Location:	Upperchurch Windfarm, Co Tipperary.		**Level:**	**Scale** 1:50
Client:	Ecopower		**Date:**	20/05/2016 -

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		1.50	SPT	N=6 (2,1/1,1,2,2)				Open hole boring. Driller described: Slightly peaty Sand.
					2.10			Open hole boring. Driller described: Sandy Gravel.
	▼				2.70			Open hole boring. Driller described: Rock. Assumed Sandstone.
		3.00	SPT	0 (75 for 0mm/0 for 0mm)	3.00			Lithology: Weak to moderately strong, thinly laminated dark red, fine to medium grained SANDSTONE with carbonaceous rich laminae. Weathering: Slightly weathered with minor orange oxidation colouration, apparent loss of strength in part, surface colour bleaching and clay smearing on fracture surfaces. Fractures: 1 apparent set dipping 0 - 10 degrees with planar smooth to planar rough fracture surfaces and close to very close spacing. *Carbonaceous calcretes.*
					6.00			End of Borehole at 6.00m

Groundwater:

Struck	Rose to	After	Sealed	Comment
2.80				See shift data.

Hole Information:

Hole Depth (m)	Hole Diameter (mm)	Casing Diameter (mm)
6.00		

Equipment & Methods: Deltabase 520.

Remarks:
Borehole terminated at 6.00m bgl.

Shift Data:

Groundwater	Shift	Hole Depth	Remarks
	20/05/2016 08:00	0.00	Start of shift.
2.8	20/05/2016 18:00	6.00	End of borehole.

Appendix to Chapter 12: Air

Appendix 12.1: Air Quality Monitoring & Standards

The data and descriptions in this appendix have informed Chapter 12: Air of the EIA Report, in relation to air quality levels in the existing environment.

The information presented in this Appendix 12.1 is outlined below and the relevant element(s) of the Whole UWF Project are also identified.

Appendix 12.1 Section	Section Heading	Relevant Individual Project Element
A12.1.1	Baseline Air Quality	UWF Grid Connection & UWF Related Works
A12.1.2	Air Quality Standards	UWF Grid Connection & UWF Related Works Consented UWF

A12.1.1 EPA Monitoring Programme Results

The EPA and Local Authorities have undertaken air quality monitoring programmes in recent years. They have divided the country into various Air Quality Zones[1]. Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The Whole UWF Project is within Zone D. The most recent annual report on air quality "*Air Quality Monitoring Report 2015*"[2], details the range and scope of monitoring undertaken throughout Ireland.

Long-term PM_{10} monitoring is carried out at two rural Zone D locations (EPA 2016). The average concentration measured at these sites in 2013 and 2014 were 13 and 10.3 µg/m^3 respectively. Long-term PM_{10} measurements carried out at a rural Zone D location in 2015 gave an average level of 10.7 µg/m^3 [2]. Hence long-term average PM_{10} concentrations measured at these locations were significantly lower than the annual average limit value of 40 µg/m^3.

Based on the above information an estimate of the 2017 background PM_{10} concentration for the region of the Whole UWF Project is 10 µg/m^3.

The results of $PM_{2.5}$ monitoring at a Zone D site in 2015[2] indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.6. Long-term average $PM_{2.5}$ concentrations measured at these locations were significantly lower than the annual average limit value of 25 µg/m^3. Based on this information, the conservative ratio of 0.6 was used to generate a rural background $PM_{2.5}$ concentration in 2017 of 6 µg/m^3.

Long-term NO_2 monitoring was carried out at the three rural Zone D locations in Ireland[2]. The NO_2 annual average in 2015 across all three sites was 4.3 µg/m^3. The NO_2 annual average in 2015 and 2014 at the three rural Zone D sites was 4.7 and 6.3 µg/m^3 respectively. Hence long-term average concentrations measured at these locations were substantially lower than the annual average limit value of 40 µg/m^3. Based on the above information, a conservative estimate of the background NO_2 concentration, for the region of the Whole Windfarm Project is 5 µg/m^3.

In summary, existing baseline levels of PM_{10}, $PM_{2.5}$ and NO_2 based on extensive long-term data from the EPA are well below ambient air quality limit values in the vicinity of the Whole Windfarm Project. There is no monitoring of baseline dust concentrations (PM greater than 10 microns) but these are also predicted to be low.

[1] EPA (2017) Air Monitoring Data (http://www.epa.ie/whatwedo/monitoring/air/)

[2] EPA (2016) Air Quality Monitoring Report 2015 (& previous annual reports 2009 – 2014)

A12.1.2 Air Quality Standards

Air Quality Standards were established under EU Directive 2008/50/EC which sets limit values for certain air pollutants in order to protect against human health and ecological impacts. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors, such as natural background levels, environmental conditions and socio-economic factors, may be considered.

The limit values are presented in Table 1 below.

Table 1: Air Quality Standards Regulations 2011

Pollutant	Regulation[3]	Limit Type	Value
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3 PM_{10}
		Annual limit for protection of human health	40 µg/m^3 PM_{10}
$PM_{2.5}$	2008/50/EC	Annual limit for protection of human health	25 µg/m^3 $PM_{2.5}$
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3 NO_2
		Annual limit for protection of human health	40 µg/m^3 NO_2
		Critical Load for protection of vegetation	30 µg/m^3 NO + NO_2

[3] Based on EU Directive 2008/50/EC

Appendix to Chapter 12: Air

Appendix 12.2: Noise Modelling & Background Noise Measurement

The data and descriptions in this appendix have informed Chapter 12: Air of the EIA Report, in relation to noise emissions. The information presented in this Appendix 12.1 is outlined below and the relevant element(s) of the Whole UWF Project are also identified.

Appendix 12.2 Section	Section Heading	Relevant Individual Project Element
A-12.2.1	Construction Stage Noise Modelling	UWF Grid Connection & UWF Related Works
A-12.2.2	Mountphilips 110kV Substation – Operational Noise	UWF Grid Connection
A-12.2.2.1	Quiet Area Screening	UWF Grid Connection
A-12.2.2.2	Low Background Noise Area Screening	UWF Grid Connection
A-12.2.2.3	Mountphilips 110kV Substation Noise Emissions	UWF Grid Connection

The surveys and modelling described in this appendix has been undertaken in accordance with the reference documents as appropriate in Section 12.1.6 of Chapter 12.

A-12.2.1 Construction Stage Noise Modelling

There are no extraordinary sources of noise amongst the equipment to be used. The works will proceeded quickly and during normal working hours.

The main item of plant which will be used for the excavation of the trench will be a tracked or wheeled excavator. This is a piece of machinery with similar noise emissions to an agricultural tractor, which are commonplace in the area. Noise emissions for a 30 to 50 tonne tracked excavator is 79dB at 10m. This data is sourced from the British Standard 5228, Code of Practice for noise and vibration control on construction and open sites.

Table 1 below is a typical list of plant and machinery involved in substation construction activities. The noise levels from the equipment identified above have been sourced from BS5228 Noise Database for Noise and Vibration Control on Construction and Open Site 1& 2: 2014+A1.

Table 1 Typical Construction Plant and Machinery which will be used during the Construction Stage

Plant and Machinery	Octave Banding (Hz)								Sound Power Level dB(A)	Sound Pressure Level @10mdB(A)
	63	125	250	500	1k	2k	4k	8k		
Telescopic Handler	86.8	86.9	85.4	92.8	98	96.2	88	78.9	102	71
Mobile Crane	84.8	90.9	93.4	90.8	95.0	95.2	88.0	79.9	101	70
30-50T Excavator	89.8	92.9	99.4	104.8	104	103.2	100	92.9	110	79
15-30T Excavator	99.8	98.9	104.1	100.8	101	100.2	96	86.9	109	78
12T Roller	94.8	98.9	99.4	108.8	104	100.2	97	90.9	111	80
Dump truck	89.8	94.9	99.4	98.8	105	102.2	97	87.9	109	78
Tractor & Trailer	97.8	100.9	98.4	103.8	104	104.2	96	88.9	110	79
15-20T Rubber Tired Excavator	78.8	80.9	86.4	91.8	94	92.2	91	79.9	99	68
3-10T mini digger	85.8	86.9	90.4	90	95.0	90	92	84.9	100	69
Diesel Generator	84.8	88.9	79.4	81.8	84	80.2	77	66.9	92	61

The decibel sum of all of the items of plant listed above totals 86 dBA at 10 metres.

The construction works will be sequenced and all the noise sources presented in Table 7 will not be in operation continuously for the duration of the construction phase, and likely noise levels will be in the order of the excavator, i.e. 79dB at 10m.

Using the inverse square law rule (In decibel terms a doubling (or halving) of sound intensity corresponds to an increase (or reduction) of 6dB), the sound pressure level, or magnitude of noise impact for both the Worst Case Noise levels (all plant in operation in the same location at the same time) and the Realistic Noise Levels, can be determined. The results are presented in Table 2, at increasing distances from the works. The appropriate construction noise threshold levels (as per NRA *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (2004), are also included in Table 2.

Table 2 Determining Worst-Case and Realistic-Case Noise Levels

Distance from noise source	Worst Case Scenario	Realistic Scenario	NRA Guidance Levels
10m	86 dB	79 dB	65 dB
20m	80 dB	73 dB	65 dB
40m	74 dB	67 dB	65 dB
80m	68 dB	61 dB	65 dB
160m	62 dB	55 dB	65 dB
320m	56 dB	49 dB	65 dB

It is expected that the 65dB threshold will not be exceeded at distances of 120m and 60m, under worst-case and realistic scenarios, respectively.

A-12.2.2 Mountphilips 110kV Substation – Operational Noise

A-12.2.2.1 Quiet Area Screening

As the Mountphilips Substation will be a permanent fixture with noise emissions a Quite Area screening was carried out for the location of the substation. The criteria for a 'Quiet Area' classification, as per the EPA NG4 Guidance Note, are listed in the first column of Table 2, and the results of the screening are outlined in the second column.

Table 3 Quiet Area Screening – location criteria

'Quiet Area' screening criteria	**Screening Results: Context in relation to the Mountphilips 110kV Substation**
At least 3 km from urban areas with a population >1,000 people	Criteria **not** met: Newport with a population of approximately 1,800 is approximately 2 km south of the substation site
At least 10 km from any urban areas with a population >5,000 people	Criteria met Annacotty and Castletroy is approximately 11 to 12 km from the site.
At least 15 km from any urban areas with a population >10,000 people	Criteria met: Limerick city, with a population of 190,000 is approximately 16 km south west of the site
At least 3 km from any local industry	Criteria **not** met: Newport Memorials is approximately 1 km east of the site.
At least 10 km from any major industry centre	Criteria **not** met: Annacotty Business Park is 9.6 km south west of the site.
At least 5 km from any National Primary Route, and	Criteria **not** met: The R504 is approximately 500m west of the substation site.
At least 7.5 km from any Motorway or Dual Carriageway	Criteria **not** met: M7 motorway is approximately 2 km west of the site

As all criteria in Table 2 are not met, **the area is not classed as a 'Quiet Area'**.

A-12.2.2.2 Low Background Noise Area Screening

As **all** of the criteria in Table 2 are not met, then screening was carried out to see if the area met the criteria for a low background noise area, as per the EPA NG4 Guidance Note. This criteria is outlined in Table 3.

Table 4: Low Background Noise Area Screening

'Low Background Noise Area' screening criteria
Average Daytime Background Noise Level ≤40dB LAF90, and;
Average Evening Background Noise Level ≤35dB LAF90, and;
Average Night-time Background Noise Level ≤30dB LAF90

A-12.1.2.2.1 Background Noise Measurement

To facilitate the screening exercise, existing background noise levels were measured during an environmental noise survey. As the Mountphilips Substation will operate throughout each 24 hour period, day, evening and night time noise surveys were carried out.

A site visit was undertaken on the 24th April 2017 and baseline environmental noise survey was undertaken between the 28th April and 2nd May 2017. This included weekend and weekday periods, both day and night. The survey was conducted adjacent to the nearest noise sensitive receptor which is a local residence approximately 385m east on the L2166-0 of the Mountphilips Substation location (See Plate 1).

The measurements were made using a Bruel & Kjaer type 2250 Light Logging integrating Sound Level Meter. This instrument is a Type 1 instrument in accordance with IEC 651 regulations. The Time Weighting used was Fast and the Frequency Weighting was A-weighted as per IEC 651. A frequency analysis was also undertaken. The calibration certificate and serial number for the sound level meters and calibrator used during the survey work are attached at the end of this Appendix 12.1.

Several parameters were measured in order to be able to interpret the noise levels correctly. These included the;

- L_{Aeq} Time-averaged A weighted noise level.
- L_{A90} Noise level exceeded for 90% of measurement period (steady underlying noise level).
- L_{A10} Noise level exceeded for 10 % of measurement period.
- L_{Amax} Maximum A weighted noise level measured.

The noise monitoring location and set up can be seen in Plate 1 and Plate 2 below.

The results of the baseline survey are presented in full in Table 4.

Plate 1 Noise Monitoring Location and Set Up

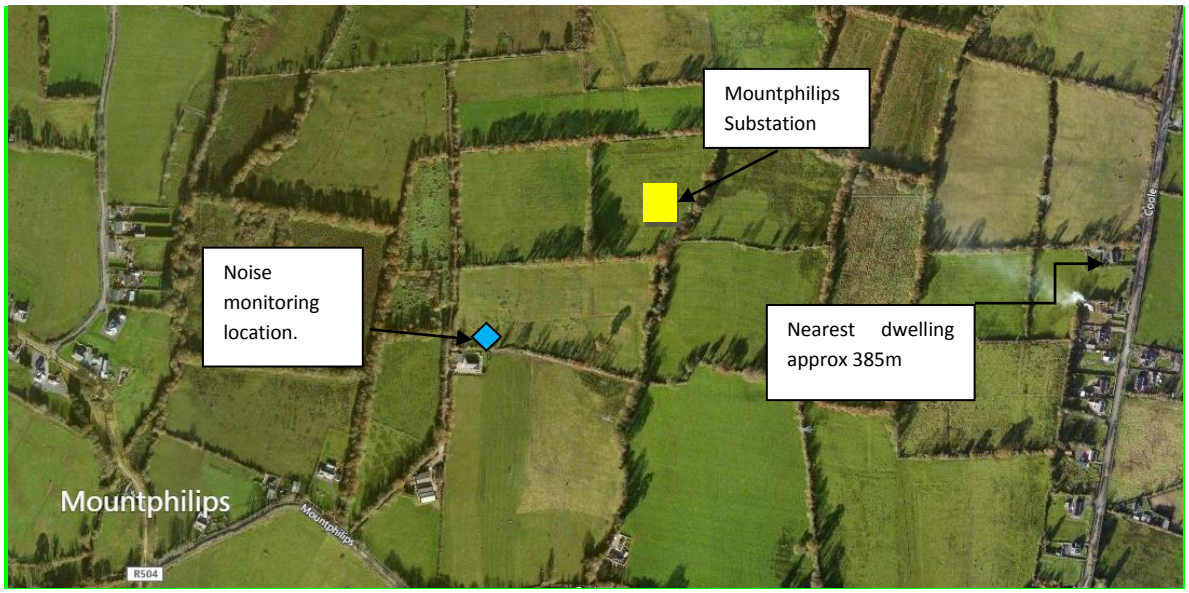

Plate 2 Baseline Noise Monitoring Location and Nearest Dwelling

The area is rural in nature and there are many mature hedgerows and trees in the vicinity of the nearest house (see Plate 2). There was blustery weather on Saturday and this is reflected in the higher background noise levels recorded in Table 4.

The noise monitoring location while not exactly at the nearest property is at a location adjacent and representative. The noise levels would be similar and this proxy location has the added advantage of not being impacted by cars in the driveway and occupier activity.

Table 5: Results of Baseline Noise Survey at Mountphilips

Start Time	LAeq	LAF90.0	LAFmax	LAFmin
Friday 11 am to 7 pm				
28/04/2017 11:00	42	31	68	27
28/04/2017 11:30	44	33	67	28
28/04/2017 12:00	46	32	65	27
28/04/2017 12:30	47	33	64	29
28/04/2017 13:00	47	34	68	27
28/04/2017 13:30	38	32	56	28
28/04/2017 14:00	42	33	61	29
28/04/2017 14:30	47	33	63	28
28/04/2017 15:00	47	32	68	28
28/04/2017 15:30	39	31	56	28
28/04/2017 16:00	47	33	72	29
28/04/2017 16:30	43	33	67	30
28/04/2017 17:00	39	32	61	29
28/04/2017 17:30	46	33	66	28
28/04/2017 18:00	39	34	59	30
28/04/2017 18:30	47	34	67	30
28/04/2017 19:00	48	35	70	32
Average	**44**	**33**	**65**	**29**
Friday Evening 7 pm to 11 pm				
28/04/2017 19:30	45	35	63	31
28/04/2017 20:00	44	34	68	30
28/04/2017 20:30	51	34	71	31
28/04/2017 21:00	42	34	70	30
28/04/2017 21:30	42	33	76	30
28/04/2017 22:00	44	33	77	29
28/04/2017 22:30	35	31	55	27
28/04/2017 23:00	34	30	57	27
Average	**42**	**33**	**67**	**29**
Friday Night 11 pm to 7 am				
28/04/2017 23:30	36	32	58	30
29/04/2017	38	31	65	28
29/04/2017 00:30	36	31	46	28
29/04/2017 01:00	35	32	45	28
29/04/2017 01:30	39	31	50	27
29/04/2017 02:00	42	35	53	32
29/04/2017 02:30	41	36	54	32
29/04/2017 03:00	32	25	44	21
29/04/2017 03:30	32	24	49	21
29/04/2017 04:00	39	29	50	24
29/04/2017 04:30	35	27	44	24
29/04/2017 05:00	45	36	61	31
29/04/2017 05:30	58	36	81	29
29/04/2017 06:00	50	34	75	28
29/04/2017 06:30	43	36	62	31
Average	**40**	**32**	**56**	**28**
Saturday 7 am to 7 pm				
29/04/2017 07:00	44	38	59	33
29/04/2017 07:30	45	40	61	37

Start Time	LAeq	LAF90.0	LAFmax	LAFmin
29/04/2017 08:00	46	37	66	33
29/04/2017 08:30	47	40	63	35
29/04/2017 09:00	45	39	71	35
29/04/2017 09:30	50	41	75	36
29/04/2017 10:00	52	45	66	37
29/04/2017 10:30	54	44	74	39
29/04/2017 11:00	58	49	82	42
29/04/2017 11:30	56	48	74	43
29/04/2017 12:00	59	49	81	41
29/04/2017 12:30	55	46	71	42
29/04/2017 13:00	57	48	70	43
29/04/2017 13:30	56	48	65	43
29/04/2017 14:00	57	49	77	44
29/04/2017 14:30	59	52	72	46
29/04/2017 15:00	59	47	86	42
29/04/2017 15:30	55	47	67	41
29/04/2017 16:00	51	44	69	40
29/04/2017 16:30	48	42	66	38
29/04/2017 17:00	50	41	75	36
29/04/2017 17:30	52	45	68	41
29/04/2017 18:00	52	44	67	40
29/04/2017 18:30	50	42	63	38
Average	**52**	**44**	**70**	**39**
Saturday evening 7 pm to 11 pm				
29/04/2017 19:00	49	42	66	37
29/04/2017 19:30	49	39	69	35
29/04/2017 20:00	46	35	61	31
29/04/2017 20:30	50	38	69	31
29/04/2017 21:00	52	47	64	43
29/04/2017 21:30	49	42	61	35
29/04/2017 22:00	52	45	70	41
29/04/2017 22:30	50	43	62	38
Average	**50**	**41**	**65**	**37**
Saturday night 11 pm to 7 am				
29/04/2017 23:00	46	39	60	34
29/04/2017 23:30	43	36	56	30
30/04/2017	46	38	62	31
30/04/2017 00:30	48	40	57	33
30/04/2017 01:00	46	38	60	32
30/04/2017 01:30	47	38	61	34
30/04/2017 02:00	50	41	64	37
30/04/2017 02:30	53	44	74	39
30/04/2017 03:00	50	43	62	40
30/04/2017 03:30	54	46	67	42
30/04/2017 04:00	53	46	64	40
30/04/2017 04:30	50	42	63	37
30/04/2017 05:00	50	44	63	40
30/04/2017 05:30	50	44	63	37
30/04/2017 06:00	47	41	63	37
30/04/2017 06:30	53	44	64	39
Average	**49**	**41**	**63**	**36**

Start Time	LAeq	LAF90.0	LAFmax	LAFmin
Sunday 7 am to 7 pm				
30/04/2017 07:00	51	40	70	35
30/04/2017 07:30	54	47	68	40
30/04/2017 08:00	56	46	69	39
30/04/2017 08:30	56	49	67	44
30/04/2017 09:00	51	44	62	40
30/04/2017 09:30	53	44	67	39
30/04/2017 10:00	52	42	73	37
30/04/2017 10:30	50	38	74	33
30/04/2017 11:00	47	37	65	33
30/04/2017 11:30	44	38	60	34
30/04/2017 12:00	47	39	69	34
30/04/2017 12:30	48	39	70	30
30/04/2017 13:00	47	39	67	35
30/04/2017 13:30	49	39	67	33
30/04/2017 14:00	44	37	64	32
30/04/2017 14:30	46	37	71	33
30/04/2017 15:00	44	37	64	32
30/04/2017 15:30	48	41	71	35
30/04/2017 16:00	53	38	74	34
30/04/2017 16:30	50	42	70	38
30/04/2017 17:00	47	40	67	34
30/04/2017 17:30	43	36	61	33
30/04/2017 18:00	47	39	69	34
30/04/2017 18:30	47	36	66	32
30/04/2017 19:00	54	38	74	31
30/04/2017 19:30	49	36	71	31
30/04/2017 20:00	44	33	61	28
30/04/2017 20:30	43	31	65	27
30/04/2017 21:00	44	29	69	26
30/04/2017 21:30	48	25	68	22
30/04/2017 22:00	26	22	46	20
30/04/2017 22:30	38	22	72	20
Average	**48**	**38**	**67**	**33**
Sunday night 11 pm to 7 am				
30/04/2017 23:00	29	23	61	21
30/04/2017 23:30	25	23	38	21
01/05/2017	25	21	44	19
01/05/2017 00:30	28	24	36	21
01/05/2017 01:00	29	23	38	20
01/05/2017 01:30	29	24	38	21
01/05/2017 02:00	21	18	33	17
01/05/2017 02:30	24	20	39	18
01/05/2017 03:00	25	20	44	18
01/05/2017 03:30	23	19	37	18
01/05/2017 04:00	26	18	61	17
01/05/2017 04:30	26	19	39	18
01/05/2017 05:00	57	27	84	22
01/05/2017 05:30	46	37	72	31
01/05/2017 06:00	41	33	65	28
01/05/2017 06:30	45	34	66	29

Start Time	LAeq	LAF90.0	LAFmax	LAFmin
Average	**31**	**24**	**50**	**21**
Bank Holiday Monday 7 am to 7 pm				
01/05/2017 07:00	45	36	64	32
01/05/2017 07:30	46	35	69	30
01/05/2017 08:00	42	35	66	30
01/05/2017 08:30	45	34	61	29
01/05/2017 09:00	51	33	78	28
01/05/2017 09:30	43	32	63	27
01/05/2017 10:00	43	33	60	28
01/05/2017 10:30	46	32	67	28
01/05/2017 11:00	40	33	59	30
01/05/2017 11:30	44	32	72	28
01/05/2017 12:00	53	33	87	30
01/05/2017 12:30	43	32	68	30
01/05/2017 13:00	40	33	63	30
01/05/2017 13:30	46	32	65	28
01/05/2017 14:00	45	33	68	30
01/05/2017 14:30	49	32	74	29
01/05/2017 15:00	42	33	64	29
01/05/2017 15:30	48	32	68	27
01/05/2017 16:00	40	29	62	26
01/05/2017 16:30	48	33	78	27
01/05/2017 17:00	43	33	64	28
01/05/2017 17:30	47	33	77	29
01/05/2017 18:00	38	33	61	29
01/05/2017 18:30	44	32	67	28
Average	**45**	**33**	**68**	**29**
Bank Holiday Monday evening 7 pm to 11 pm				
01/05/2017 19:00	50	31	74	26
01/05/2017 19:30	43	31	61	27
01/05/2017 20:00	42	33	69	29
01/05/2017 20:30	46	34	64	29
01/05/2017 21:00	41	34	66	29
01/05/2017 21:30	46	30	69	27
01/05/2017 22:00	41	27	72	25
01/05/2017 22:30	30	23	51	20
Average	**42**	**30**	**66**	**27**
Bank Holiday Monday night 11 pm to 7 am				
01/05/2017 23:00	23	20	40	19
01/05/2017 23:30	34	20	55	18
02/05/2017	24	21	40	19
02/05/2017 00:30	29	20	52	19
02/05/2017 01:00	40	22	67	20
02/05/2017 01:30	30	20	52	18
02/05/2017 02:00	23	20	42	19
02/05/2017 02:30	22	20	43	19
02/05/2017 03:00	25	21	51	18
02/05/2017 03:30	29	20	54	19
02/05/2017 04:00	34	20	56	18
02/05/2017 04:30	28	22	48	19

Start Time	LAeq	LAF90.0	LAFmax	LAFmin
02/05/2017 05:00	54	34	83	29
02/05/2017 05:30	48	36	72	31
02/05/2017 06:00	46	35	68	30
02/05/2017 06:30	43	36	75	30
Average	**33**	**24**	**56**	**22**
Tuesday 7 am to 11 am				
02/05/2017 07:00	46	36	71	32
02/05/2017 07:30	49	37	75	33
02/05/2017 08:00	44	36	73	32
02/05/2017 08:30	45	35	77	31
02/05/2017 09:00	44	32	68	28
02/05/2017 09:30	45	32	71	28
02/05/2017 10:00	45	32	66	28
02/05/2017 10:30	46	32	65	28
02/05/2017 11:00	50	31	66	29
Average	**46**	**34**	**70**	**30**

The results were then evaluated against the criteria for an area of low background noise (see Table 3), whether or not the existing background noise measurements meet the criteria is provided in Table 5.

Table 6: Determination of Low Background Noise Area near Mountphilips substation locations

Time Period 28th April to 2nd May	Average Background Noise Level LA dB	Low Background Noise Criteria	Do the results meet the screening criteria for a Low Background Noise Area? Yes/No, and Comments
Friday	33	≤40	Yes, meets Low Background Noise Area Criteria
Friday Evening	33	≤35	Yes, meets Low Background Noise Area Criteria
Friday Night	32	≤30	No, does not meet Low Background Noise Area criteria. Windy Weather increasing noise levels.
Saturday	44	≤40	No, does not meet Low Background Noise Area criteria. Windy Weather increasing noise levels.
Saturday Evening	41	≤35	No, does not meet Low Background Noise Area criteria. Windy Weather increasing noise levels.
Saturday Night	41	≤30	No, does not meet Low Background Noise Area criteria.
Sunday	40	≤40	No, does not meet Low Background Noise Area criteria. Windy Weather increasing noise levels.
Sunday Evening	38	≤35	No, does not meet Low Background Noise Area criteria.
Sunday Night	24	≤30	Yes, meets Low Background Noise Area Criteria
Monday	33	≤40	Yes, meets Low Background Noise Area Criteria
Monday Evening	30	≤35	Yes, meets Low Background Noise Area Criteria
Monday Night	24	≤30	Yes, meets Low Background Noise Area Criteria
Tuesday	24	≤40	Meets Quiet Area Criteria

The results show, when averaged for each of the day, evening and night time periods that the noise monitoring location can be considered an area of low background noise, during calm weather at least.

As per the EPA NG4 Guidance Notes, where all three of the criteria for Low Background Noise Areas are met (See Table5), then those locations are deemed to be in areas of low background noise, and the reduced noise limits, detailed in Table 6, are applicable to the operational Mountphilips Substation.

Table 7: Low Background Noise - Limit Criteria at Nearest Dwelling (EPA NG 4)

Scenario	Daytime Noise Limit, dB (LAr, T) (07:00 to 19:00hrs)	Evening Noise Limit, dB (LAr, T) (19:00 to 23:00hrs)	Night Noise Limit dB (LAr, T) (23:00 to 07:00hrs)
Area of Low Background Noise	45dB	40 dB	35dB

A-12.2.2.3 Mountphilips 110kV Substation – Operational Noise

In order to determine the noise emissions from the operational Mountphilips Substation, a noise measurement was taken from a representative substation, in Kerry. The representative substation was considered a worst case scenario and was of similar size and scale to the proposed Mountphilips Substation.

A noise level of 60 dB(A) was measured at a distance of 5m from the representative substation. Using the inverse square law rule, which means a 6 dB decrease in noise levels per doubling of distance from a point source, as per:

- 60 dB at 5 m distance
- 54 dB at – 10 m distance
- 48 dB at – 20 m distance
- 42 dB at – 40 m distance
- 36 dB at – 80 m distance
- 30 dB at – 160 m distance
- 24 dB at – 320 m distance
- 18 dB at – 640 m distance

Worse case noise emission levels from the operational substation, at the closest house (which is 385m distance) will be just under 24dB, and will be well below EPA noise limit criteria for areas of low background noise and most likely will also be below the existing background noise levels.

A-12.2.3 Sound Meter – Serial Number & Calibration Certificate

CERTIFICATE OF CALIBRATION

Issued by: **MTS Calibration Ltd.**

Laboratory address: 17 Elvington Close, Billingham TS23 3YS, England

Telephone: +44 (0)1642 876 410

Please note delivery address below

UKAS CALIBRATION 0607

Date of Issue: 05 July 2017 **Certificate Number:** 30463U

Sound Calibrator

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Brüel & Kjær **Model 4231** **Serial Number 2665058**

A Reference Calibrator, calibrated by a National Standards Laboratory, was used to establish the sensitivity of the measurement chain. The same measurement chain is then used to determine the output level of the Object Calibrator by the difference between its output and that of the nominated Reference Calibrator. Four independent measurements of the third-octave band sound pressure levels produced by the Reference Calibrators and the Object Calibrator are averaged to minimise uncertainties of the calibration. The measurement chain consists of a calibrated, Reference Microphone, Reference Preamplifier and Reference Analyser.

As well as providing a traceable measurement of the sound pressure level in the cavity of the Object Calibrator, the Calibrator's frequency and total harmonic distortion are also measured. Frequency is determined from the average of four independent measurements using a multimeter with a current UKAS-accredited calibration. The total harmonic distortion is measured from the average of three independent measurements by third octave analysis, subtracting the level of the fundamental frequency from the sum of the combined harmonics in the frequency band to 20kHz. The complete procedure is detailed in the MTS Calibration Ltd work procedure WP01.

The sound pressure level generated by the calibrator in its WS2 configuration was measured by reference to B&K Model 4133 Microphone and referance Sound Calibrator as shown in the Test Equipment section below.

The measured values were:

Output Level 1:	94.04	dB re 20µPa	+/- 0.16 dB (k= 2.00)
Fundamental Frequency 1:	999.96	Hz	+/- 0.11 Hz (k= 2.00)
Total Harmonic Distortion 1:	0.581	%	+/- 0.015 % (k= 2.00)
Output Level 2:	114.11	dB re 20µPa	+/- 0.19 dB (k= 2.05)
Fundamental Frequency 2:	999.97	Hz	+/- 0.11 Hz (k= 2.00)
Total Harmonic Distortion 2:	0.393	%	+/- 0.015 % (k= 2.00)

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k (individually calculated as above), providing a coverage probability of approximately 95%. The uncertainty evaluation has been calculated in accordance with the current version of UKAS publication M3003. The uncertainty quoted for the Distortion Measurement is the Distortion Percentage as measured, multiplied by our Uncertainty as calculated for the individual measurement or our BMC, whichever is the larger.

Measurement Conditions:

Temperature	24	°C	± 1 °C
Atmospheric Pressure	1019	mBar	± 2 mBar
Relative Humidity	45	%	± 5 %

This measurement is valid only for the above device configured for calibration of a WS-2 microphone under the above environmental conditions. For deviation of prevailing conditions, the manufacturer's literature for the calibrator should be referred to.

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Calibration Due
Reference Calibrator	Brüel & Kjær	4231	2343058	TE 133	Aug-19
Multimeter	Agilent	34401A	US36106159	TE 202	Sep-17
Signal Generator (set 2)	Agilent	33120A	MY40007806	TE 160	Sep-17
Real-Time Analyser (set 1)	Larson Davis	2900	0492	TE 108	Nov-17

Date of Receipt: 30 June 2017
Date of Measurement: 05 July 2017

Approved Signatory: *Tony Sherris*

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This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to recognised national standards and to units of measurement realised at a recognised national standards laboratories. This Certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

PLEASE SEND ALL DELIVERIES TO:

MTS Calibration Ltd

Company Registration Number: 06588525 England and Wales

The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG, England

Telephone: 0044 1642 876410 E-Mail: dmarsh@slmcal.co.uk or tsherris@slmcal.co.uk http\\www.slmcal.co.uk

CERTIFICATE OF CALIBRATION

Issued by: **MTS Calibration Ltd**

Laboratory address: 17 Elvington Close
Billingham TS23 3YS
England

Telephone: +44 (0)1642 876 410

Please note delivery address below

Date of Issue: **28 June 2017** **Certificate Number:** **30446**

Sound Level Meter Periodic Tests to BS EN 61672-3: 2006 Class 1

Client: Environmental Measurements on behalf of Malachy Walsh
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make:	**Brüel & Kjær**	***Microphone Make:***	**Brüel & Kjær**
Instrument Model:	**2250**	***Microphone Model:***	**4950**
Serial Number:	**2654709**	***Serial Number:***	**1657422**
Preamplifier Make:	**Bruel & Kjaer**	***Calibrator Make:***	Bruel & Kjaer
Preamplifier Model:	**ZC0032**	***Calibrator Model:***	4231
Serial Number:	**10489**	***Calibrator Serial Number:***	2343058
		Calibrator Adaptor:	UC0210
		Calibrator Certification Ref:	S6718

Other Accessories supplied:
none

MTS Calibration Ltd has obtained evidence which is generally available to the public that an independent testing organisation responsible for pattern approvals has demonstrated that this model of sound level meter has successfully completed the pattern evaluation tests of IEC 61672-2: 2003. This instrument, which was constructed to the requirements of BS EN 61672-1:2002 Class 1, has been tested using the procedures for periodic testing as specified in BS EN 61672-3: 2006.

The sound level meter submitted for testing has successfully completed the Class 1 periodic tests of IEC 61672-3: 2006 for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1: 2002, the sound level meter submitted for testing conforms to the Class 1 requirements of IEC 61672-1: 2002

In conducting these measurements, it was necessary to use manufacturer's data. This was taken from the instruction manual of the instrument. BE 1712-16

The instrument was within the above specification as received - no modifications were made

Ambient Temperature at Calibration (deg C ± 1)	23.9	Calibration check frequency (Hz)	1000.0
Ambient Pressure at Calibration (mPa ± 2)	1000.4	Reference Sound Pressure Level (dBA)	94.0
Ambient Relative Humidity at Calibration (% ± 5)	50.05	Reference Level Range dB	Single Range

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Condenser Microphone	Larson Davis	2541	7300	TE 157	Oct-17
Acoustic Calibrator 1kHz	Brüel & Kjær	4231	2343058	TE 132	Aug-19
Acoustic Calibrator	Brüel & Kjær	4226	2141963	TE 206	Oct-17
Signal Generator (set 2)	Agilent	33120A	MY40007806	TE 160	Sep-17
Real-Time Frequency Analyser (set 3)	Larson Davis	2900	0510	TE 165	Oct-17

Authorised signatory:

Date of Receipt: **26 June 2017**
Date of Periodic Test **28 June 2017**
Date of Certificate: **28 June 2017**

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of: **12**

Tony Sherris

MTS Calibration Ltd
The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG
Telephone: 01642 876410 **Fax:** 01642 876411 **E-Mail:** dmarsh@slmcal.co.uk **or** tsherris@slmcal.co.uk

Appendix to Chapter 12: Air

Appendix 12.3: Explanation and Modelling of EMF

The data and descriptions in this appendix have informed Chapter 12: Air of the EIA Report, in relation to noise emissions. The information presented in this Appendix 12.1 is outlined below and the relevant element(s) of the Whole UWF Project are also identified.

Appendix 12.3 Section	Section Heading	Relevant Individual Project Element
A-12.3.1	Explanation of Electric Fields and Magnetic Fields	
A-12.3.2	Typical Electric and Magnetic Fields in Residential and Working Environments	UWF Grid Connection UWF Related Works Upperchurch Windfarm
A-12.3.3	Criteria for Modelling Theoretical Worst-Case Effects	UWF Grid Connection UWF Related Works Upperchurch Windfarm
A-12.3.4	Worst Case EMF Emissions from the UWF Grid Connection	UWF Grid Connection
A-12.3.5	Worst Case EMF Emissions from the UWF Related Works	UWF Related Works
A-12.3.6	Worst Case EMF Emissions from the Upperchurch Windfarm	Upperchurch Windfarm
A-12.3.7	Worst Case EMF Emissions from Other Projects - Castlewaller Windfarm - Killonan to Nenagh 110kV OHL - Shannonbridge to Killonan 220kV OHL	UWF Grid Connection

The surveys and modelling described in this appendix has been undertaken in accordance with the reference documents as appropriate in 12.1.6 of Chapter 12.

A-12.3.1 Explanation of Electric Fields and Magnetic Fields

Electrical objects and anything connected to them produce two types of fields - electric fields and magnetic fields. The term "field" is used to describe the way an object influences its surrounding area. A temperature field, for example, surrounds a warm object, such as a space heater. EMF's surround any object that is generating, transmitting or using electricity, including appliances, wiring, office equipment, generators, batteries and any other electrical devices. EMFs are invisible and they cannot be felt or heard.

Electric fields occur as a result of the electric potential (or voltage) on these objects, and magnetic fields occur as a result of electric current flowing through these objects. Just like a temperature field, electric and magnetic fields can be measured and their levels depend on, among other things:

- Characteristics of the source of the field (voltage, current, cable configuration and formation; and
- Distance from the source of the field.

The Electric Field is measured in volts per metre (V/m) or (kV/m). Magnetic Fields are measured in microtesla (µT). Electric Fields and Magnetic Fields are highest closest to the source and their level reduces quickly with distance from the source. This is similar to the way that the heat from a candle or campfire weakens as you move farther away. Although ordinary objects do not block magnetic fields, electric fields can be easily blocked by objects such as trees and buildings.

A-12.3.1.1 Electromagnetic Fields in the Natural Environment

Both electric and magnetic fields occur naturally in our environment and even in our own bodies as part of the normal functioning of our cardiac and nervous systems. There is a natural electric field at the earth's surface that is created by electric charges in the upper atmosphere, also known as the ionosphere. During fair weather, these electric field levels vary between 100 and 150 volts per meter (V/m) over flat surfaces. During stormy weather, on the other hand, storm clouds often contain large quantities of electric charge, and the electric field may reach intensities up to 20,000 V/m over flat surfaces and can be considerably higher above hillocks or near the tops of objects such as trees. The Earth's magnetic field, which is due mainly to currents circulating in the outer layer of the Earth's core, extents from the Earth's core out into space. Its magnitude at the Earth's surface varies between about 30 µT (microTesla) at the equator and about 60 µT at the poles.

Such naturally occurring electric and magnetic fields do not change direction and are, therefore, referred to as static or direct current (DC) fields. Naturally occurring electric and magnetic fields differ from the extremely low frequency electromagnetic Fields (ELF-EMF) produced by the power system, which fluctuate at a fixed frequency and are referred to as alternating current (AC) fields. For this reason, the existing levels of naturally occurring static EMF fields are not taken into account in this EIA Report chapter.

A-12.3.1.2 Electromagnetic Fields in the Built Environment

In the built environment, man-made sources of EMF include the power system and communication networks. In Ireland, the AC electric and magnetic fields produced by the power system vary at a frequency of 50-Hertz (Hz) (i.e. the fields alternate direction and intensity back and forth 50 times each second). Electric and magnetic fields are produced in all residential and working environments as a result of nearby electrical wiring, appliances, power lines and telecommunication masts, among other things. A comparison of electric and magnetic fields from 110kV electrical power system infrastructure with the typical electric and magnetic fields emitted by common household appliances is included in **Section A-12.2.2.** In summary this comparison demonstrates that in many cases, residential electrical appliances and tools can generate higher magnetic and electric fields in their close proximity (30cm) than at either the fence of an 110kV substation compound or directly above 110kV underground cables.

In a recent study of homes in the UK, most of homes had average magnetic field levels in the range 0.2µT to 0.4µT which were attributed to low voltage sources (i.e., wiring, appliances, and distribution circuits) (Mastanyi et al, 2007). Electric field measurements in residential environments, average exposures were found to be less than 10 V/m (Bracken et al, 1990)

A-12.3.2 Typical Electric and Magnetic Fields in Residential and Working Environments

Field measurements, carried out by CEI, of the electric fields and magnetic fields near 110kV substations and underground cables are shown below in Table 1 and Table 2.

Table 1: Electric Fields measured from electrical power system infrastructure

Electrical power system	**0 meter distance[1] (V/m)**	**30 meters distance (V/m)**	**100 meters distance (V/m)**	**ICNIRP Limit**
110kV Substation	40	20	Less than 1	5000 V/m
110kV Underground Cables[2]	n/a	n/a	n/a	5000 V/m

Table 2: Magnetic Fields measured from electrical power system infrastructure

Electrical power system	**0 meter distance (µT)**	**30 meters distance (µT)**	**100 meters distance (µT)**	**ICNIRP Limit**
110kV Substation	1	0.4	Less than 0.01	100µT
110kV Underground Cables	10 (See footnote 3)	Less than 0.1	Less than 0.05	100µT

Measurements of the typical electric and magnetic fields near domestic appliances are shown in Table 3 and Table 4 below.

Table 3: Typical Electric Fields Household Appliances

Electric appliance	**Electric field strength (V/m) at 30cm**	**ICNIRP Limit**
Stereo receiver	180	**5000 V/m**
Iron	120	**5000 V/m**
Refrigerator	120	**5000 V/m**
Mixer	100	**5000 V/m**
Toaster	80	**5000 V/m**
Hair dryer	80	**5000 V/m**
Colour TV	60	**5000 V/m**
Coffee machine	60	**5000 V/m**
Vacuum cleaner	50	**5000 V/m**
Electric oven	8	**5000 V/m**
Light bulb	5	**5000 V/m**

[1] A distance of 0 m corresponds to the central point above the underground cable, or at the substation fence.

[2] There is no electric field above ground level for underground cables, as the soil, earth materials and metallic sheath, which surrounds each cable, removes the potential for electric fields outside the cable.

3 Scaled to reflect similar level expected based on the maximum MVA load 94MW for the grid connection.

Table 4 Typical Magnetic Fields Household Appliances

Electric appliance	3 cm distance (µT)	30 cm distance (µT)	1 m distance (µT)	ICNIRP Limit
Hair dryer	6 – 2000	0.01 – 7	0.01 – 0.03	**100µT**
Electric shaver	15 – 1500	0.08 – 9	0.01 – 0.03	**100µT**
Vacuum cleaner	200 – 800	2 – 20	0.13 – 2	**100µT**
Fluorescent light	40 – 400	0.5 – 2	0.02 – 0.25	**100µT**
Microwave oven	73 – 200	4 – 8	0.25 – 0.6	**100µT**
Electric oven	1 – 50	0.15 – 0.5	0.01 – 0.04	**100µT**

The ICNIRP limit[3] for EMF exposure for electric fields is 5000 V/m. As can be seen from Table 3, the typical exposure levels from common household appliances are below and in compliance with the ICNIRP limits in close proximity to the appliance. For example, an operational refrigerator can expose the user or resident to 120 V/m at a distance of 30cm from the appliance. Any exposure to electric fields at this level is typically for momentary or brief periods at any one time.

The ICNIRP limit[4] for EMF exposure for magnetic fields is 100µT. Low voltage sources, such as home appliances, contribute significantly to our overall exposure to magnetic fields. In a recent study of homes in the UK, for example, 77% of homes had average magnetic field levels above 0.2 µT and 57% of homes had average magnetic field levels above 0.4 µT which were attributed to low voltage sources (i.e., wiring, appliances, and distribution circuits) (Mastanyi et al, 2007). The typical[5] magnetic fields which people can be exposed to, at various distances from electrical equipment and appliances, in residential and public premises are presented in Table 4. As can be seen from Table 4, the use of a vacuum cleaner can expose the user to 200µT at a distance of 3cm and up to 20µT at a 30cm distance from the appliance.

While the comparison between operational 110kV substations or underground cables and domestic appliances provides valuable perspective, and indeed demonstrate that some common household appliances breaches the ICNIRP limit at very close proximity, it is limited by several differences between power lines and appliances. First, electric and magnetic fields are only associated with appliances for the duration that the appliance or tool is in use, while power lines are typically in service at all times. Furthermore, the field levels from appliances drop off at a faster rate with distance, compared to electricity transmission networks.

[3] http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf

[4] http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf

[5] Source: http://www.who.int/peh-emf/about/WhatisEMF/en/index3.html

A-12.3.3 Criteria for Modelling Theoretical Worst-Case Effects

In order to categorically demonstrate that the maximum possible power load of the electric cables and equipment associated with the UWF Grid Connection and the UWF Related Works and the Upperchurch Windfarm (in order to facilitate a cumulative evaluation), will comply with the EU EMF Exposure Recommendations and the ICNIRP limits, the theoretical worst-case contribution of the various electrical plant to EMF levels in the environment is evaluated in this report. The worst-case levels of EMF have been modeled using the criteria outlined in Table 5, the results of the modelling are summarized in Table 6 and provided in full in Sections A-12.3.5 to A-12.3.7.

Table 5: Criteria for modelling theoretical worst-case effects

Whole UWF Project Element	Worse-Case Scenario Criteria
UWF GRID CONNECTION	
Mountphilips Substation	The closest piece of electrical apparatus from the Substation Compound perimeter fence is 5m. The worst case scenario EMF from the equipment in the compound is modelled from the perimeter fence, and is referred to throughout this report as the measurement of EMF at '0 meters'
Mountphilips Substation Compound – End Masts Underground Cables	EMF from the underground 110kV cables which will loop the Mountphilips 110kV Substation onto the existing OHL, via the 2 No. End Masts, was modelled using: an electrical current of 1149 Amps based on the maximum possible power load, which is the winter power load of 219 MVA and 120 kV maximum voltage variation as specified by EirGrid.
Mountphilips – Upperchurch 110kV Underground Cables (UWF Grid Connection)	The maximum capacity possible of the electricity which the 110kV Mountphilips – Upperchurch UWF Grid Connection will be capable of delivering – i.e. 155 MW, and the associated electrical current of 856 Amps. It should be noted that this is the maximum possible power load for the electrical cables and has been modelled to demonstrate categorically compliance with the EU EMF Exposure Recommendation. The configuration of the cable design is the worst case flat configuration where the cable passes over existing services, which is a flat formation cable design (rather than trefoil formation), and therefore less cancelation of magnetic fields between cables. The minimum distance between the cables and the ground surface using this flat formation – i.e. 0.6m.
UWF RELATED WORKS	
Internal Windfarm Cables	The maximum capacity possible of the electricity which a 33kV wind turbine cable will be capable of delivering – i.e. 32 MW, and the associated electrical current of 280 Amps. And at the Consent Windfarm Substation there are two cable sets routed adjacent to each other, into the Substation, with a combined maximum of 64MW. It should be noted that this is the maximum possible power load for the electrical cables and has been modelled to demonstrate categorically compliance with the EU EMF Exposure Recommendation. The configuration of the cable design is the trefoil configuration. The minimum distance between the cables and the ground surface using this flat formation – i.e. 0.8m.
UPPERCHURCH WINDFARM	
Consented UWF Substation	The closest piece of electrical apparatus from the Substation Compound perimeter fence is 5m. The worst case scenario EMF from the equipment in the compound is modelled from the perimeter fence, and is referred to throughout this report as the measurement of EMF at '0 meters'
Consented UWF Turbines	The closest distance of a member of the public to electrical parts – i.e. at ground level, right beside the turbines (0m distance)

The results of this modelling (see Table 6 and Sections A-12.3.5 to A-12.3.7) demonstrate that the electric field and magnetic field emissions from the Mountphilips 110kV Substation, 110kV UWF Grid Connection, Internal Windfarm Cables, Consented UWF Turbines and Consented UWF Substation will be at a level **substantially less the ICNIRP limit of 5000 V/m and 100µT respectively.** Furthermore, the magnetic field levels will rapidly dissipate with increasing distance from the source.

A-12.3.3.1 Summary of Modelling Results

Table 6: Summary of Worst-case Scenario EMF Modelling Results

Whole UWF Project Elements	**Electric Fields**	**Magnetic Fields**
Mountphilips 110kV Substation	Electric fields will be very low due to the shielding which will be provided by the extensive metalwork within the substation compound, which will include electrical equipment housings, steelwork, the control building and metal palisade perimeter fence. Immediately outside the perimeter fence, the **worst-case EMF** from the substation are expected to be **40 V/m.**	Magnetic fields will be very low due to the shielding which will be provided by the extensive metalwork within the substation compound, which will include electrical equipment housings, steelwork, the control building and metal palisade perimeter fence. Immediately outside the perimeter fence, the **worst-case EMF** from the substation are expected to be **1µT**
Mountphilips – Upperchurch 110kV UWF Grid Connection (UWF GC)	The electric fields generated by the underground cables will be *completely screened* by the earth materials such as soil and a metallic sheath which will surround each cable, and **no electric fields** will be emitted above ground.	Directly above the UWF Grid Connection, the **maximum possible level** of the magnetic fields, generated by the underground cables, will be **54 µT**
Internal Windfarm Cables	The electric fields generated by the underground cables will be *completely screened* by the earth materials such as soil and a metallic sheath which will surround each cable, and **no electric fields** will be emitted above ground.	Directly above the Internal Windfarm Cables, the maximum level of the magnetic fields, generated by the underground cables, will be **7.6µT**
Consented UWF Turbines	The electric field generated by the transformer, generator and cables are screened internally by the housing over the generator, and by the steel turbine tower. The turbine's transformer and generator are also at a substantial height above ground level and **will not contribute to the ambient electric field levels**.	Magnetic fields will be very low due to the shielding which will be provided by the extensive metalwork within the substation compound, which will include turbine housings and steelwork. The turbine and transformer are also at a substantial height about ground level. Right beside the turbine, worst case EMF are expected to be **0.2µT**[6]
Consented UWF Substation	Electric fields will be very low due to the shielding which will be provided by the extensive metalwork within the substation compound, which will include electrical equipment housings, steelwork, the control building and metal palisade perimeter fence. Immediately outside the perimeter fence, the worst-case EMF from the substation are expected to be **40 V/m.**	Magnetic fields will be very low due to the shielding which will be provided by the extensive metalwork within the substation compound, which will include electrical equipment housings, steelwork, the control building and metal palisade perimeter fence. Immediately outside the perimeter fence, the worst-case EMF from the substation are expected to be **1µT.**

[6] https://www.ncbi.nlm.nih.gov/pubmed/24529028

A-12.3.4 Worst Case EMF emissions from the UWF Grid Connection

The electric fields and magnetic fields were modelled, at various distances from electrical plant, using worst-case scenario criteria outlined in Table 5 and Table 6. The results of the modelling in relation to the 110kV Mountphilips Substation and the 110kV UWF Grid Connection are presented in Table 7 (electric fields) and Table 8 (magnetic fields), and Plate 1.

Table 7: Contribution to ambient electric fields (worst case scenario) by the UWF Grid Connection

UWF Grid Connection	Distance from operational electrical apparatus or cables (m)	Existing Ambient Electric Fields (V/m)[7]	Worst Case Electric Field Contribution from the UWF Grid Connection (V/m)	Predicted Worst Case Ambient Electric Field levels during the operation stage (V/m)[8]	ICNIRP Guideline Limit (V/m)
Substation Compound	0m	less than 1	40	41	5000
Substation Compound	30m	less than10	20	30	5000
Substation Compound	100m	less than 20	less than 1	21	5000
Cables on End Masts	0m	less than 20	1,040	1060	5000
Cables on End Masts	30m	less than 50	50	100	5000
Cables on End Masts	100m	less than 100	less than 10	110	5000
Mountphilips to Upperchurch 110kV GC	0m	less than 1	None	No increase	5000
Mountphilips to Upperchurch 110kV GC	30m	less than 1	None	No increase	5000
Mountphilips to Upperchurch 110kV GC	100m	less than 1	None	No increase	5000

Table 8: Contribution to ambient magnetic fields (worst case scenario) by the UWF Grid Connection

UWF Grid Connection	Distance from operational electrical apparatus or cables (m)	Existing Ambient Magnetic Fields (µT)[9]	Worst Case EMF Contribution from the UWF Grid Connection (µT)	Predicted Worst Case Ambient EMF levels during the operation stage (µT)	ICNIRP Guideline Limit (µT)
Substation Compound	0m	0.05	1	1.05	100
Substation Compound	30m	0.02	0.4	0.42	100
Substation Compound	100m	0.07	0.16	0.23	100
Cables on End Masts	0m	0.01	35	35.01	100
Cables on End Masts	30m	0.04	1.3	1.34	100
Cables on End Masts	100m	0.1	0.1	42	100
Mountphilips to Upperchurch 110kV GC	0m	0.2	54	54.2	100
Mountphilips to Upperchurch 110kV GC	30m	0.2	0.13	0.33	100
Mountphilips to Upperchurch 110kV GC	100m	0.2	0.01	0.21	100

[7] Assumption: Information based on distances approaching the existing 110 kV OHL to the west of the proposed substation

[8] Assumption: Electric fields are cumulative which is unlikely

[9] Assumption: Information based on distances approaching the existing 110 kV OHL to the west of the proposed substation

The worst case scenario magnetic field from the UWF Grid Connection is illustrated on Plate 1 below.

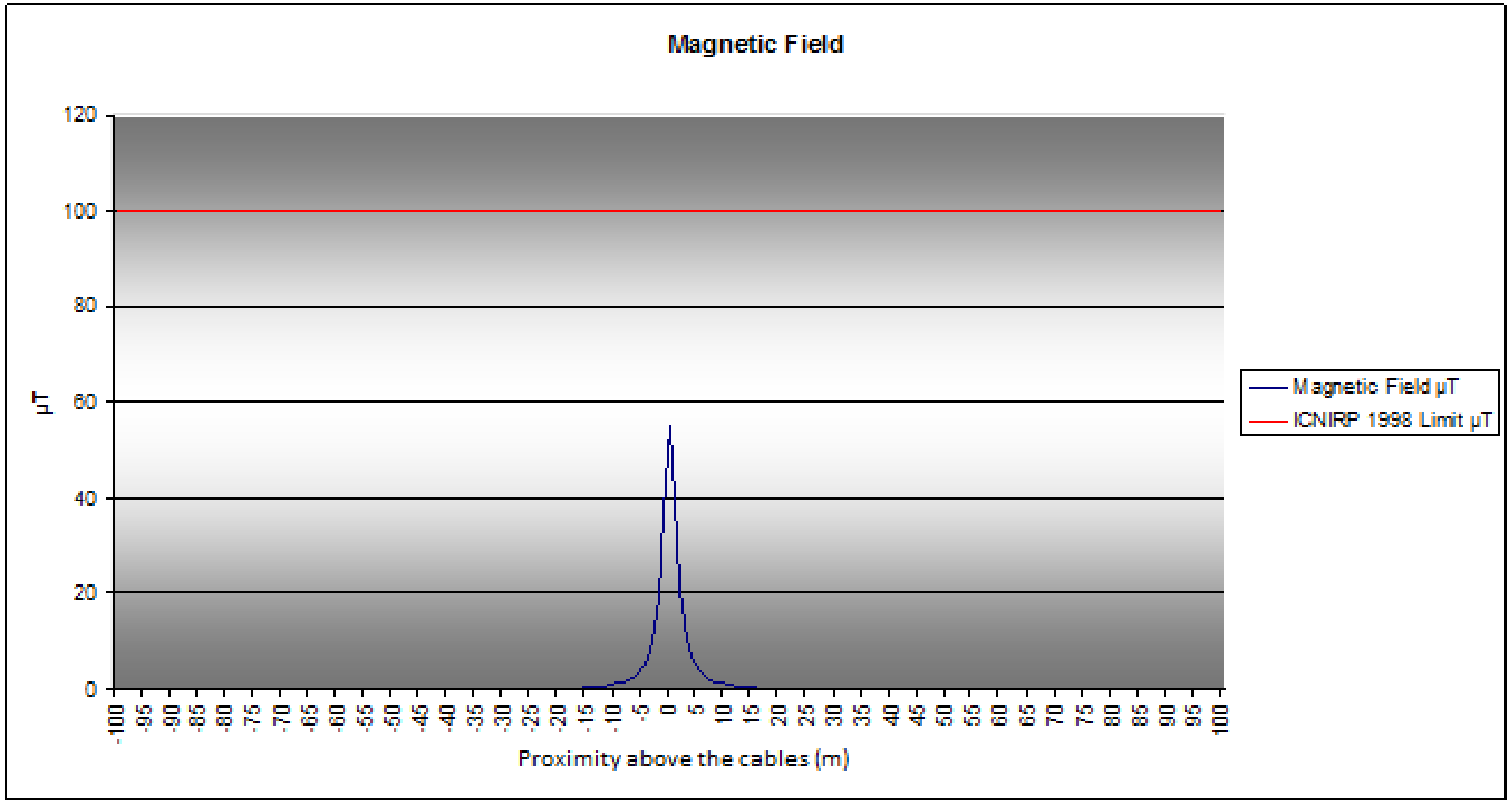


Plate 1: Maximum Possible Magnetic Field from the Mountphilips – Upperchurch 110kV UWF Grid Connection (modelled at 155 MW)

REFERENCE DOCUMENTS

A-12.3.5 Worst Case EMF emissions from the UWF Related Works

The electric fields and magnetic fields were modelled, at various distances from UWF Related Works electrical plant, using worst-case scenario criteria outlined in Table 5. The results of the modelling in relation to the Internal Windfarm Cabling are presented in Table 9 (electric fields) and Table 10 (magnetic fields).

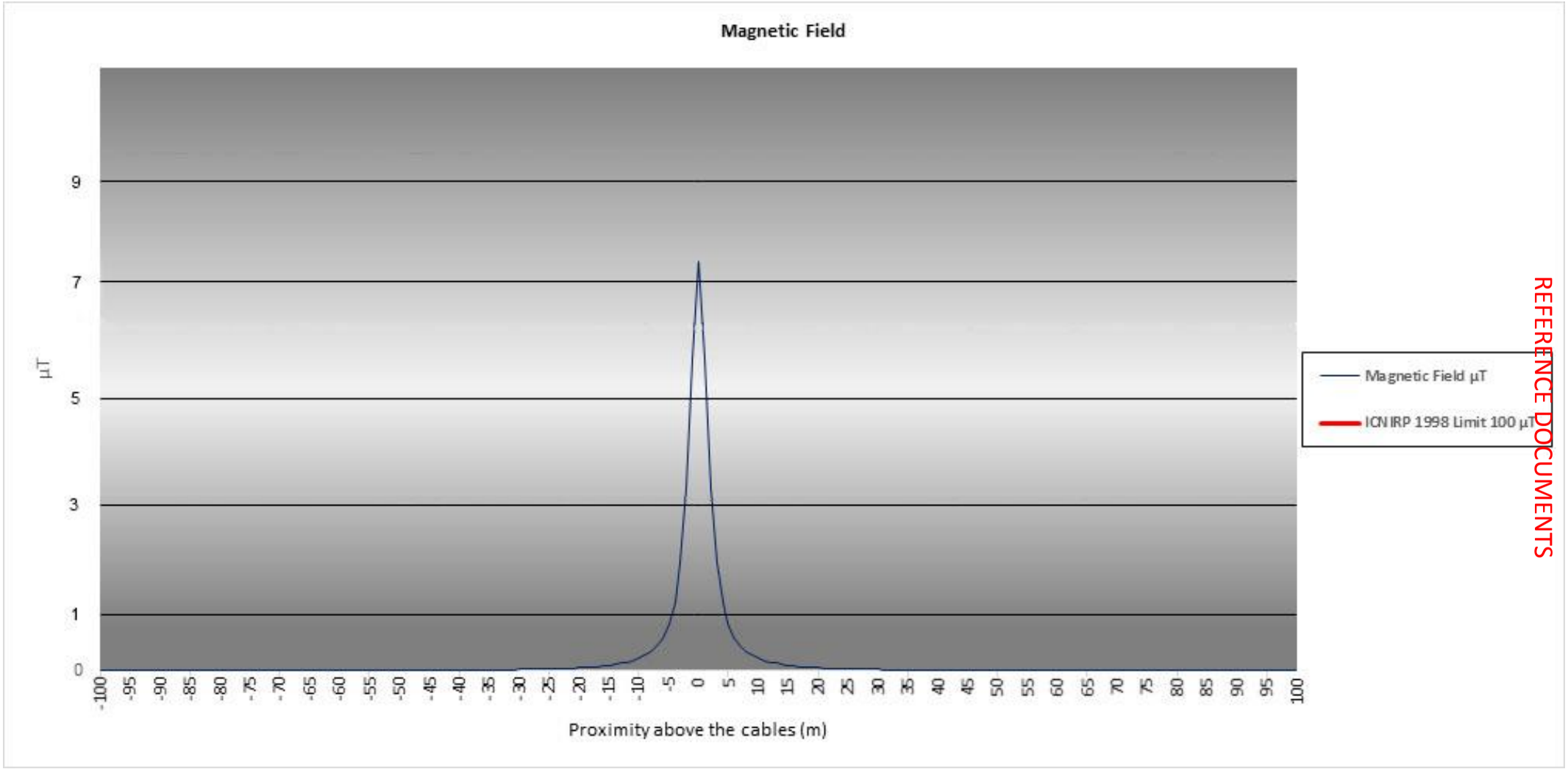
Table 9: Contribution to ambient electric fields (worst case scenario) by the UWF Related Works

UWF Related Works Relevant Electrical Plant	Distance from operational electrical apparatus or cables (m)	Existing Ambient Electric Fields (V/m)	Worst Case Electric Field Contribution from the Internal Windfarm Cabling (V/m)	Predicted Worst Case Ambient Electric Field levels during the operation stage (V/m)	ICNIRP Guideline Limit (V/m)
Internal Windfarm Cabling	0m	less than 1	None	No increase	5000
Internal Windfarm Cabling	30m	less than 1	None	No increase	5000
Internal Windfarm Cabling	100m	less than 1	None	No increase	5000

Table 10: Contribution to ambient magnetic fields (worst case scenario) by the UWF Related Works

UWF Related Works Relevant Electrical Plant	Distance from operational electrical apparatus or cables (m)	Existing Ambient Magnetic Fields (µT)	Worst Case EMF Contribution from the Internal Windfarm Cabling (µT)	Predicted Worst Case Ambient EMF levels during the operation stage (µT)	ICNIRP Guideline Limit (µT)
Internal Windfarm Cabling	0m	0.2	7.6	7.8	100
Internal Windfarm Cabling	30m	0.2	0.03	0.23	100
Internal Windfarm Cabling	100m	0.2	0.003	0.203	100

The worst case scenario magnetic field from the Internal Windfarm Cabling is illustrated on Plate 2.



REFERENCE DOCUMENTS

Plate 2: Maximum Possible Magnetic Field from the Internal Windfarm Cabling (UWF Related Works)

A-12.3.6 Worst Case EMF emissions from the Upperchurch Windfarm

In order to facilitate a cumulative evaluation of the Whole UWF Project, the electric fields and magnetic fields were modelled, at various distances from Upperchurch Windfarm electrical plant, using worst-case scenario criteria outlined in Table 5. The results of the modelling in relation to the Consented UWF Substation and the Consented UWF Turbines are presented in Table 11 (electric fields) and Table 12 (magnetic fields).

Table 11: Contribution to ambient electric fields (worst case scenario) by the Upperchurch Windfarm

Upperchurch Windfarm part	Distance from operational electrical apparatus or cables (m)	Existing Ambient Electric Fields (V/m)	Worst Case Electric Field Contribution from the Upperchurch Windfarm (V/m) [10]	Predicted Worst Case Ambient Electric Field levels during the operation stage (V/m)	ICNIRP Guideline Limit (V/m)
Consented UWF Substation (compound)	0m	less than 1	40	41	5000
Consented UWF Substation (compound)	30m	less than10	20	30	5000
Consented UWF Substation (compound)	100m	less than 20	less than 1	21	5000
Consented UWF Turbines	0m	less than 1	none	less than 1	5000
Consented UWF Turbines	30m	less than 1	none	less than 1	5000
Consented UWF Turbines	100m	less than 1	none	less than 1	5000

Table 12: Contribution to ambient magnetic fields (worst case scenario) by the Upperchurch Windfarm

Upperchurch Windfarm part	Distance from operational electrical apparatus or cables (m)	Existing Ambient Magnetic Fields (µT)	Worst Case EMF Contribution from the Upperchurch Windfarm (µT)[11]	Predicted Worst Case Ambient EMF levels during the operation stage (µT)	ICNIRP Guideline Limit (µT)
Consented UWF Substation (compound)	0m	0.05	1	1.05	100
Consented UWF Substation (compound)	30m	0.02	0.4	0.42	100
Consented UWF Substation (compound)	100m	0.07	0.16	0.23	100
Consented UWF Turbines	0m	0.2	0.2	0.4	100
Consented UWF Turbines	30m	0.2	0.07	0.207	100
Consented UWF Turbines	100m	0.2	0.07	0.207	100

[10] The electric field generated by turbine's transformer and generator are screened by the housing and are also at a substantial height above ground level so will not contribute to the ambient electric field levels.

[11] Scaled to reflect similar level expected based on the expected MVA load from the Consented UWF Turbines.

A-12.3.7 Worst Case EMF emissions from Other Projects

In order to facilitate a cumulative assessment of the UWF Grid Connection with Other UWF Projects/Activities in the area, namely the internal windfarm cables associated with the Castlewaller Windfarm, the existing Killonan to Nenagh 110kV Overhead Line, and the Shannonbridge to Killonan 220kV Overhead Line.

The worst case scenario electric fields and worst case magnetic fields associated with these three projects are illustrated on Plates 2, 3, 4, 5 and 6 below.

A-12.3.7.1 Worst Case EMF emissions from Castlewaller Windfarm (internal windfarm cables)

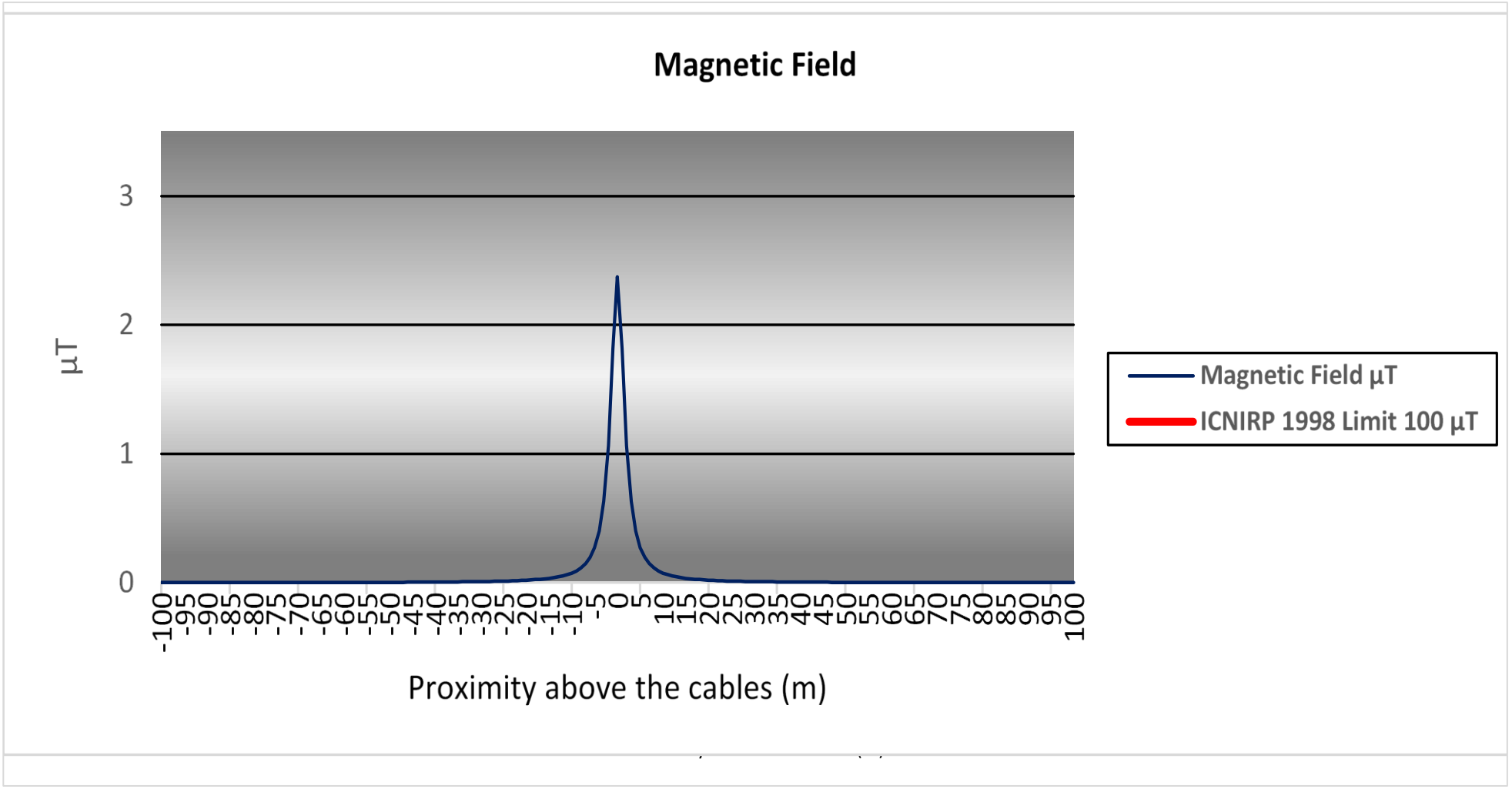


Plate 3: Maximum Possible Magnetic Field from Castlewaller Windfarm internal cables (modelled at 16 MW)

REFERENCE DOCUMENTS

A-12.3.7.2 Worst Case EMF emissions from Killonan – Nenagh 110kV Overhead Line

Worst Case Magnetic Fields - Killonan – Nenagh 110kV Overhead Line:

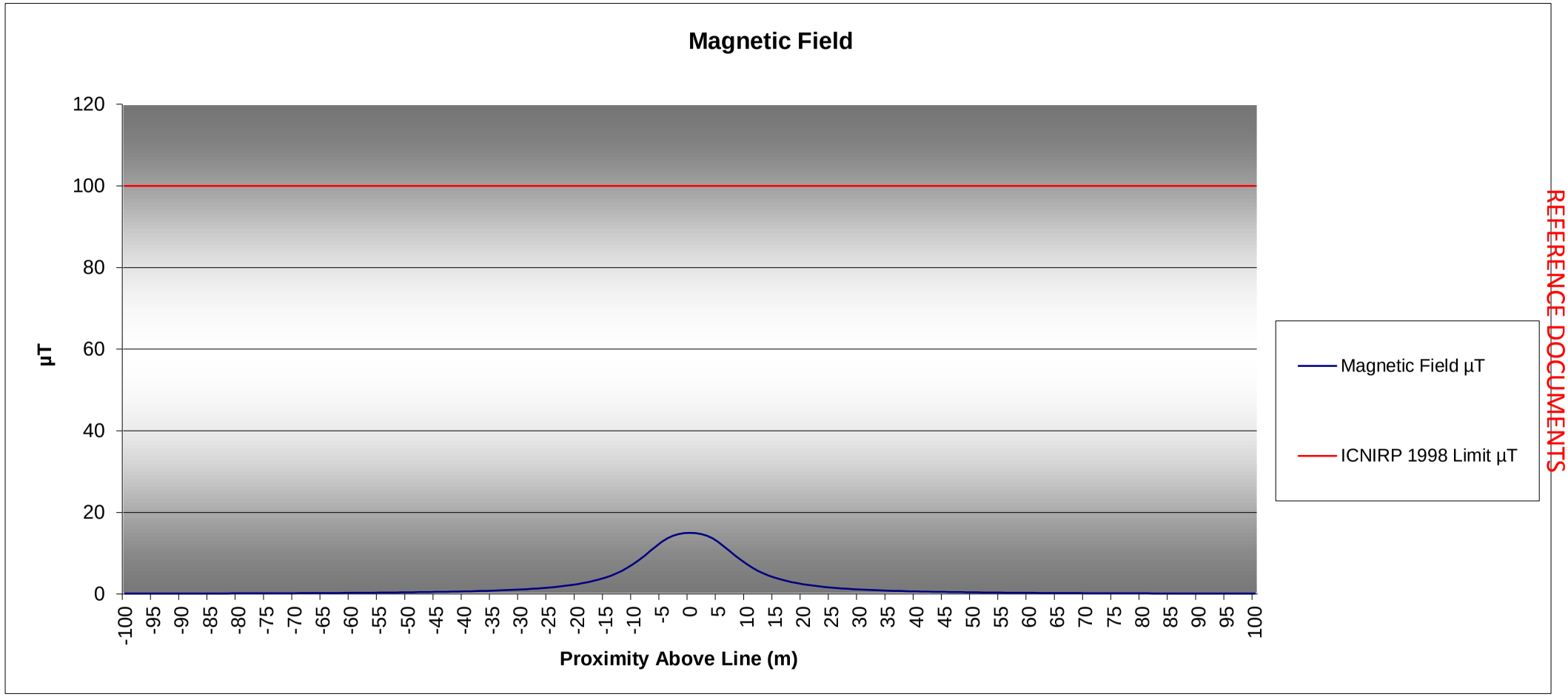


Plate 4: Maximum Possible Magnetic Field from the 110 kV OHL Cables (modelled at 127 MW)

Worst Case Electric Fields - Killonan – Nenagh 110kV Overhead Line:

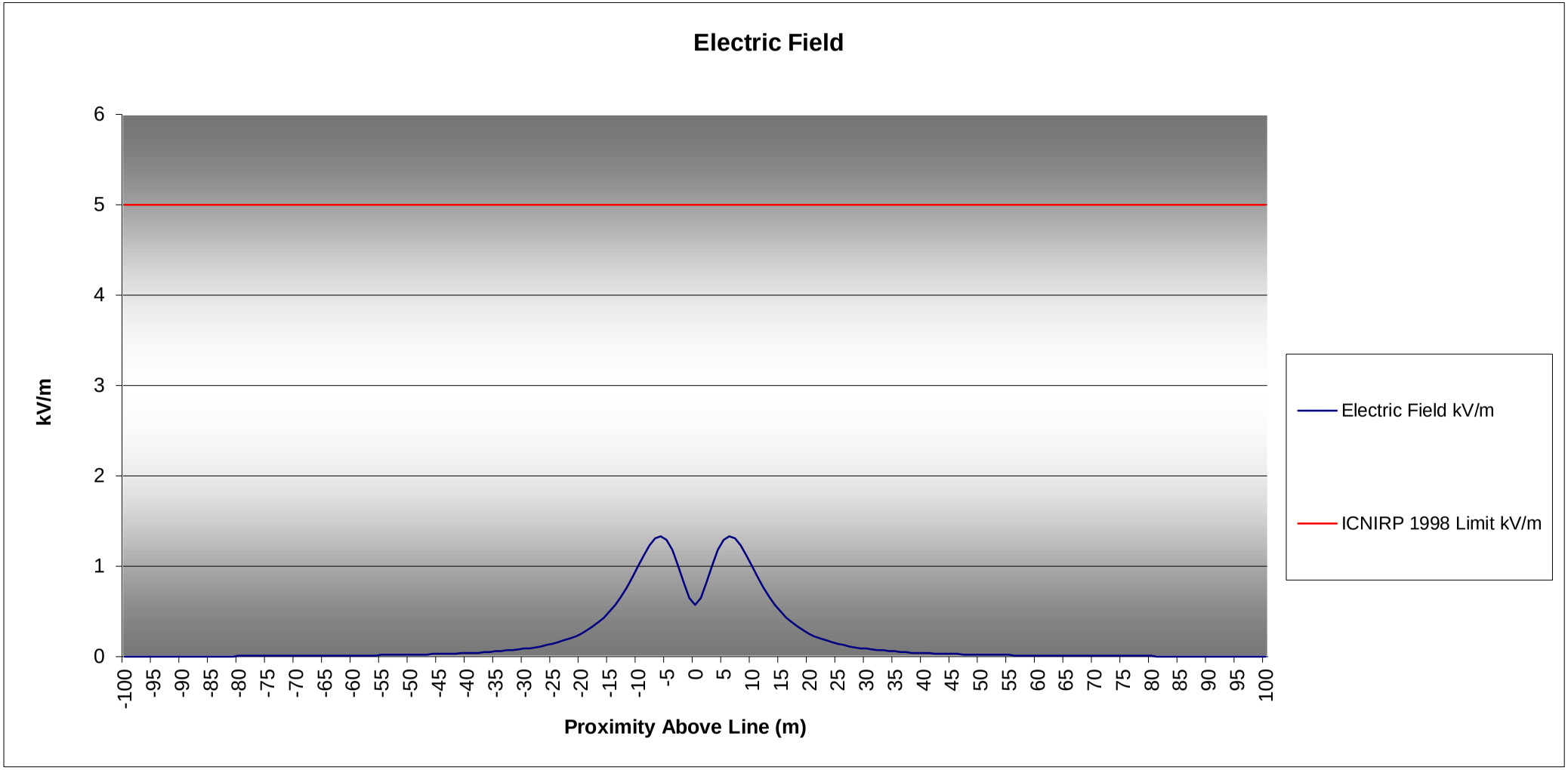


Plate 5: **Maximum Possible Electric Field from the 110 kV OHL Cables (modelled at 127 MW)**

REFERENCE DOCUMENTS

A-12.3.7.3 Worst Case EMF emissions from Shannonbridge to Killonan 220kV Overhead Line

Worst Case Magnetic Fields - Shannonbridge to Killonan 220kV Overhead Line:

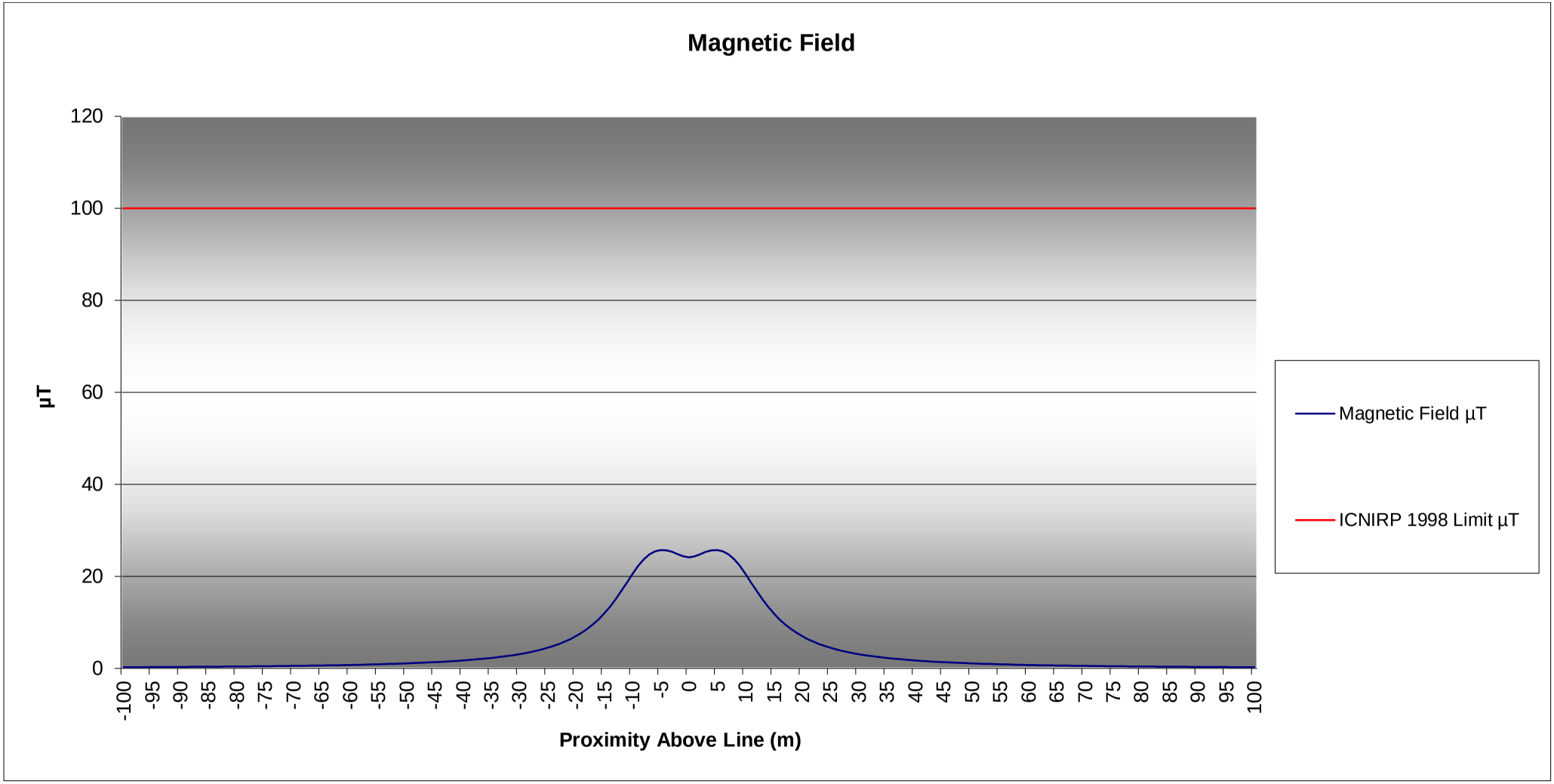


Plate 6: Maximum Possible Magnetic Field from the 220 kV OHL Cables (modelled at 376 MW)

REFERENCE DOCUMENTS

Worst Case Electric Fields - Shannonbridge to Killonan 220kV Overhead Line:

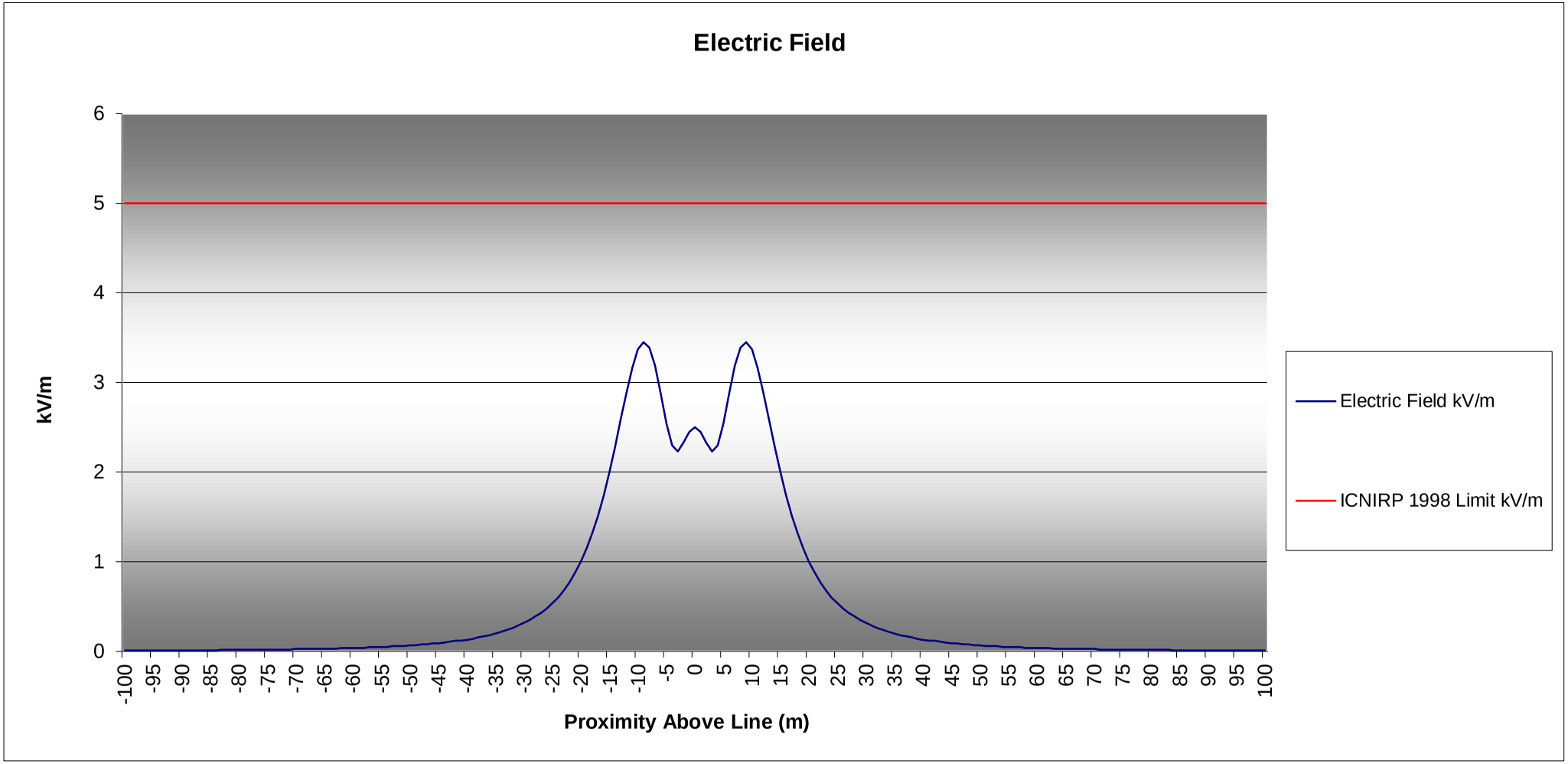


Plate 7: Maximum Possible Electric Field from the 220 kV OHL Cables (modelled at 376 MW)

REFERENCE DOCUMENTS

REFERENCE DOCUMENTS

Appendix to Chapter 13: CLIMATE

No Appendices for Chapter 13

Appendix to Chapter 14: Built Services & Built Service Users

Appendix 14.1: Location of Built Services and Built Service Users in the Study Area

The data and descriptions in this appendix have informed Chapter 14: Built Services and Built Service Users of the EIA Report, in relation to the location of built services in the study area and the number of users connected to these services. . The information presented in this Appendix 14.1 is outlined below and the relevant element(s) of the Whole UWF Project are also identified.

Appendix 14.1 Section	Section Heading	Relevant Individual Project Element
A-14.1.1	Built Services within the UWF Grid Connection Study Area	UWF Grid Connection
A-14.1.2	Built Services located within the UWF Related Works Study Area	UWF Related Works
A-14.1.3	Built Services located within the Upperchurch Windfarm Study Area	Upperchurch Windfarm

A-14.1.1 Built Services within the UWF Grid Connection Study Area

Road ID	Irish Water Mains		ESB overhead lines/underground cables		EIR overhead lines/underground cables	
	Infrastructure	**No. Users**	**Infrastructure**	**No. Users**	**Infrastructure**	**No. Users**
L-2166-0 (R1 on Figure GC 5.2)	Construction works to run perpendicular to water main at crossing location	31	220kV OHL: Construction works to run perpendicular to OHL in field west of the L-2166-0 crossing. MV OHL: Construction works to run perpendicular to OHL in fields west and east of the L-2166-0 crossing.	36	Construction works to run perpendicular to Telephone OHL at crossing location.	26
L-2156-11 (R2 on Figure GC 5.2)	None	0	MV OHL: Construction works to run perpendicular to OHL in field west of the L-2156-11 crossing.	20	Construction works to run perpendicular to Telephone OHL at crossing location.	20
L-2157-5 (R3 on Figure GC 5.2)	Construction works to run perpendicular to water main at crossing location	8	MV OHL: Construction works to run perpendicular to OHL in field west of the L-2156-11 crossing. Construction works to run under two sections of the same line.	9	Construction works to run perpendicular to 2 No. Telephone OHL at crossing location.	9
L-6011-10 (R4 on Figure GC 5.2)	Construction works to run parallel to water mains within road carriageway for 30m prior to crossing the water main	29	None	0	Construction works to run perpendicular to Telephone OHL at crossing location.	29
L-95032-8 (R5 on Figure GC 5.2)	None	0	None	0	None	0
L-21141-0 (R6 on Figure GC 5.2)	None	0	None	0	Construction works to run perpendicular to 2 No. Telephone OHL at crossing location.	9

Road ID	Irish Water Mains		ESB overhead lines/underground cables		EIR overhead lines/underground cables	
	Infrastructure	**No. Users**	**Infrastructure**	**No. Users**	**Infrastructure**	**No. Users**
L-2114-0 (R7 on Figure GC 5.2)	None	0	MV OHL: Construction works to run perpendicular to OHL in field west of the north end of the L-2114-0 road section. LV OHL: Construction works to run perpendicular to 3 sections of underground electricity cables suppling local houses 10kV -20kV OHL: Construction works to run perpendicular to OHL in field east of the south end of the L-2114-0 road section.	28	Construction works to run parallel to Telephone OHL along the L-2114-0 (R7).	13
L-6085-0 (R8 on Figure GC 5.2)	Construction works to run parallel to water mains within road carriageway for 170m prior to crossing the water main	16	MV OHL: Construction works to run perpendicular to OHL in field west of the north end of the L-6085-0 road section.	8	Construction works to run parallel to Telephone OHL along the L-6085-0 (R8).	15
L-6086-5 (R9 on Figure GC 5.2)	None	0	MV OHL: Construction works to run perpendicular to OHL in field west of the L-6086-5 crossing. LV OHL: Construction works to run perpendicular to OHL in field east of the L-6086-5 crossing.	2	None	0
L-2266-0 (R10 on Figure GC 5.2)	Construction works to run perpendicular to water main at crossing location	30	MV OHL: Construction works to run perpendicular to OHL in field east of the L-2266-0 crossing. LV OHL: Construction works to run perpendicular to OHL in field east of the L-2266-0 crossing.	35	Construction works to run perpendicular to Telephone OHL at crossing location.	32
L-6182-0	Construction works to run perpendicular to water main at	4	MV OHL: Construction works to run perpendicular to OHL in field east of the L-6182-0 crossing.	26	Construction works to run perpendicular to Telephone OHL	6

Road ID	Irish Water Mains		ESB overhead lines/underground cables		EIR overhead lines/underground cables	
	Infrastructure	**No. Users**	**Infrastructure**	**No. Users**	**Infrastructure**	**No. Users**
(R11 on Figure GC 5.2)	crossing location*s*				at crossing location.	
R-497-0 (R12 on Figure GC 5.2)	Construction works to run perpendicular to water main at crossing location	5	MV OHL: Construction works to run perpendicular to OHL in field west of the R-497-0 crossing.	9	Construction works to run runs perpendicular to Telephone OHL at crossing location.	7
L-2264-50 (R13 on Figure GC 5.2)	Construction works to run perpendicular to water main at crossing location	19	MV OHL: Construction works to run perpendicular to OHL in field east of the L-2264-50 crossing.	27	Construction works to run perpendicular to Telephone OHL at crossing location	19

A-14.1.2 Built Services within the UWF Related Works Study Area

Road ID	Irish Water Mains		ESB overhead lines/underground cables		EIR overhead lines/underground cables	
	Infrastructure	No. Users	Infrastructure	No. Users	Infrastructure	No. Users
L-4139-0 (HW1 – HW4 on Figure RW 5.2)	None	0	None		Haul Route Works (HW1 - 4) are parallel to Telephone OHL along the L-4139-0. This OHL is broken in places.	0
L-4138-12 (HW5 - HW6 on Figure RW 5.2)	None	0	LV OHL: Haul Route Works HW5 runs perpendicular to OHL. MV OHL: Haul Route Works HW6 runs perpendicular to OHL.	5	Haul Route Works (HW6) are parallel to Telephone OHL along the L-4138-12.	12
L-4139-16 (RW2 on Figure RW 5.2)	None	0	MV OHL: Internal Windfarm Cable runs perpendicular to OHL in field west of RW2.	2	Haul Route Works (HW12) are parallel Internal Windfarm Cable runs perpendicular to OHL at RW3 and W9.	5
L-61880-0 (RW3 on Figure RW 5.2)	None	0	MV OHL: Internal Windfarm Cable runs parallel to OHL along a forestry firebreak south of the RW3 crossing location and again along the side of the L-61880-0.	10	Internal Windfarm Cable runs perpendicular to OHL at RW2.	8
R-503 (HW7 on Figure RW 5.2)	None	0	None	0	None	0
L-2264-50 (HW8-HW11 on Figure RW 5.2)	Yes: Haul Route Works (HW8-HW11) are parallel to water main along L-2264-50.	19	MV OHL: Internal Windfarm Cables run perpendicular to OHL in field east of the L-2264-50 crossing.	27	Haul Route Works (HW8-HW11) are parallel and Internal Windfarm Cables (RW6) are perpendicular to Telephone OHL along the L-2264-50.	19

Road ID	Irish Water Mains		ESB overhead lines/underground cables		EIR overhead lines/underground cables	
	Infrastructure	**No. Users**	**Infrastructure**	**No. Users**	**Infrastructure**	**No. Users**
L-6188-0 (HW11-HW12: and RW6	Haul Route Works (HW11-HW12) are parallel to water main along L-6188-0.	6	MV OHL: Haul Route Works HW12 runs perpendicular to OHL.	27	Haul Route Works (HW11-HW12) are parallel to Telephone OHL along the L-6188-0	3
RW9 on Figure RW 5.2)	Internal Windfarm Cables run perpendicular to water main at RW9 crossing location		MV OHL: Internal Windfarm Cables run perpendicular to OHL in field north of the L-6188-0 crossing.	18 (0 of above 27)	None	0
L-6185-13 (RWR2 Fields south of L-6185-13	None	0	MV OHL: Realigned Windfarm Road (RWR2) runs perpendicular to OHL in fields south of the L-6185-13.	1	None	0
HW13	None		None		Haul Route Works (HW13) are parallel to Telephone OHL along the L-6185-13.	6
RW7 on Figure RW 5.2)	None		None		Internal Windfarm Cables run perpendicular and parallel to Telephone OHL along the L-6185-13 at the RW7 crossing location.	1 (1 of above 6)
L-2264-34 (RW8 on Figure RW 5.2)	None	0	MV OHL: Internal Windfarm Cable runs perpendicular to OHL north of the RW8 crossing location.	2	Internal Windfarm Cables run perpendicular Telephone OHL north of the RW8 crossing location.	3
			LV OHL: Internal Windfarm Cable runs perpendicular to underground electricity cables suppling 1 No. dwelling house.			
L-2264-0 Replacement Forestry Entrance	None	0	NONE	0	NONE	0

A-14.1.3 Built Services within the Upperchurch Windfarm Study Area

Road ID	Irish Water Mains		ESB overhead lines/underground cables		EIR overhead lines/underground cables	
	Infrastructure	**No. Users**	**Infrastructure**	**No. Users**	**Infrastructure**	**No. Users**
R-2264-50: Site Entrance No.8 and No.9	Water main at Site Entrance No.8 and No.9	19	None	0	Telephone OHL at Site Entrance No.8 and No.9	30
L-6188-0: Site Entrance No.7	Water main at Site Entrance No.7	6	None	0	Telephone OHL at Site Entrance No.7	4
South of L-6185-13.	None	0	MV OHL: Consent Windfarm Road runs perpendicular to OHL in fields south of the L-6185-13.	1	None	
L-6185-13: Site Entrance No.10 and No.11	None	0	None	0	Telephone OHL at Site Entrance No.10 and No.11	6

Appendix to Chapter 15: Material Assets (Roads)

Appendix 15.1: Traffic and Transportation Assessment Report

The data and descriptions in this appendix have informed Chapter 15: Material Assets (Roads) of the EIA Report.

The information presented in this Appendix 15.1 is outlined below and the relevant element(s) of the Whole UWF Project are also identified.

Appendix 15.1 Section	Section Heading	Relevant Individual Project Element
A-15.1.1	Non-Technical Summary	All
A-15.1.2	Introduction to the Traffic & Transportation Assessment Report	All
A-15.1.3	Existing conditions	All
A-15.1.4	Traffic forecasting	All
A-15.1.5	Description of the individual project elements	All
A-15.1.6	Trip generation, assignment & distribution	UWF Grid Connection UWF Related Works Upperchurch Windfarm
A-15.1.7	Impact assessment	UWF Grid Connection UWF Related Works Upperchurch Windfarm
A-15.1.9	Requirement for mitigation measures	UWF Grid Connection UWF Related Works Upperchurch Windfarm

A15.1 TRAFFIC AND TRANSPORTATION ASSESSMENT REPORT

A15.1.1 EXECUTIVE SUMMARY – (NON-TECHNICAL)

This Traffic & Transport Assessment Report assesses the cumulative impact of the subject development in addition to all other elements of the whole Upperchurch Windfarm Project.

The whole UWF project consists of a series of related supporting projects associated with the consented Upperchurch Windfarm (identified herein within Section A15.1.5). The whole project, when built, will involve the export of the renewable electricity generated at the permitted Upperchurch Windfarm to the national grid.

This report has been prepared in accordance with Transport Infrastructure Ireland's Traffic & Transportation Assessment Guidelines and addresses the worst case vehicular traffic impact of the Whole UWF Project, for both the construction and operational phases. The adequacy of the road network to safely and appropriately accommodate the worst-case Transportation demands of the development are addressed.

A comprehensive classified traffic survey (counts) of the road network in the vicinity of the projects was undertaken and this information, together with observation of the performance of the road network, forms the basis for this assessment. Traffic Data was collected using temporary Automatic Traffic Counters known as 'ATC tube counters', and these allowed full vehicle classification and traffic speeds to be measured and recorded.

The assessment included a photographic condition survey of the existing roads and associated affected structures, together with extensive Falling Weight Deflectometer (FWD) testing in order to determine the strength of the affected local roads. It is proposed to undertake a condition survey following the works in order to confirm that no adverse impact has occurred.

The construction programme and plans prepared for the Whole UWF Project allowed the associated daily traffic volumes to be calculated. The worst case daily traffic associated with each element of the works was assigned to the roads in accordance with industry guidelines for an assumed commencement year of 2019. The impact of the traffic has been assessed and quantified.

The Report sets out the temporary and permanent traffic management measures which are to be put in place at the construction and operational access points in order to ensure the continued operation of the roads in

a safe manner and without any impact upon capacity in order to ameliorate and minimise impact upon road users.

Based on our studies, we believe that, with some checks and balances in place in the form of temporary Traffic Management and road condition surveys, there will be no adverse traffic/transportation capacity or road safety issues associated with the construction or operation of the Whole UWF Project.

A15.1.2 INTRODUCTION TO THE TRAFFIC & TRANSPORTATION ASSESSMENT

This Traffic and Transportation Assessment (TTA) has been prepared by NRB Consulting Engineers Ltd and addresses the Traffic/Transportation and Construction/Operational Access issues arising from the development of the Whole UWF Project.

Evaluations contained within this Transportation Assessment are based upon site visits, observations of operational performance of the existing road network, a comprehensive classified interval movement and speed survey, a comprehensive Falling Weight Deflectometer (FWD) Test, and our experience in assessing and designing for developments of this nature.

The Report has been prepared following consultation with Tipperary County Council Roads Department and Transport Infrastructure Ireland. Further details on these consultations are included in Appendix 3.1 in Volume C4 of the EIA Report.

The Report has been prepared broadly in accordance the following information and industry accepted practices:

- Transport Infrastructure Ireland's (TII) Traffic and Transport Assessment Guidelines (2014)
- TII Design Manual for Roads and Bridges
- The Department for Transport Traffic Signs Manual (2010),
- TII Specification for the Reinstatement of Openings in National Roads (2013).

A15.1.3 EXISTING CONDITIONS

The existing roads environment consists for the most part of lightly trafficked sections of Regional Roads, mainly the R503, along with a mix of local roads which are generally rural in nature and lightly trafficked and used for local residential access, forestry access and farming access purposes.

A15.1.3.1 ROADS

The affected roads include those subject to road works associated with cable laying or temporary road widening; roads with temporary or permanent site access points, and roads along the concentrated haulage routes.

All of these roads are 2-way roads, with the trafficked pavement varying in width from 2.5 to 8.3m, with narrow verges, and are generally bounded by low level earthen embankments or hedgerows along either side.

The roads relevant to the UWF Grid Connection and the UWF Related Works elements of the Whole UWF Project are listed in Table 1, and identified on Figure GC 15.2 and Figure RW 15.2. The subject development figure is at Tab 15 of Volume C3: EIA Report Figures. The other element figure is in Volume E: Reference Documents to the Planning Application. These figures are also available on **www.upperchurchwindfarm.ie**. Any roads marked with an asterisk appear on both lists. It should also be noted that the roads associated with the UWF Related Works will also be used for access to the Consented Upperchurch Windfarm. The UWF Replacement Forestry entrance is located off the L2264-34, (also indicated on Figure RW 15.2).

Table 1: Roads affected by the UWF Grid Connection and the UWF Related Works

UWF Grid Connection	UWF Related Works
R503*	R503*
R497	L4139-0
L2166-0	L4138-12
L2156-11	L4139-16
L5337-1	L6188-0*
L51853-0	L61881-0
L2157-0	L2264-50*
L2157-5	L6185-13
L6011-0	L2264-34
L6011-10	
L95032-8	
L2114-0	
L21141-0	
L6085-0	
L6086-0	
L6086-5	
L2266-0	
L2266-11	
L6182-0	
L2264-50*	
L6188-0*	

A15.1.3.1.1 Road Pavements

The road pavements consist of traditional surface-dressed flexible pavement ('tar and chippings'), with narrow verges and road surface water drained to open drains, generally running along each of the roadsides.

Falling Weight Deflectometer (FWD) Testing: In order to accurately determine the load bearing capacity of the affected local roads, a comprehensive FWD Test of the affected local road network was undertaken by specialist supplier, Milestone Pavement Technologies Ltd. The FWD is a non-destructive test which determines the load bearing capacity of a pavement structure. The FWD drops a known mass from a pre-defined height onto a loading plate. The load pulse generated is similar to the dynamic load pulse generated by a moving wheel of a heavy goods vehicle travelling at normal traffic speed. Measurements of the pavement deflection in response to the load provides information on the overall bearing capacity of the pavement. The extent of the testing and the results are included as Appendix 15.2.

In summary, the FWD testing shows that there is stiff to moderate subgrade support under the roads, and while the local road surfaces were observed during site investigations to be generally in good condition with few potholes, the FWD testing indicates that the pavements themselves are weak.

A15.1.3.1.2 Buried Structures

There are 10 No. existing buried road structures which are located in roads at road works locations, 7 no. structures at locations associated with cable trenching for the 110kV UGC and 3 No. structures at locations associated with the temporary road widening works at Haul Route Works locations. The location of these buried structures is identified on Figure GC 15.2 and Figure RW 15.2.

On the route of the 110kV UGC (UWF Grid Connection), there are 7 No. buried structures under the L2114-0 road, comprising 6 No. concrete culverts routing storm water under the road at watercourse crossings W38, W39, W40, W41, W43 and W44 and 1 No. stone structure routing a small stream under the road at W42. All of these structures are located on the route of the 110kV UGC. There are an additional 4 No. buried structures along construction material haulage routes – one each on the L51853-0 at Rockvale, the L6011-0 at Castlewaller, the L2114-0 at Bealaclave and the L6086 -0 at Laghile. These structures were visually inspected by TLI Group (civil engineer) during site investigations, there were no visible signs of degradation of the structures, and no cracks or depressions in the road surfaces above. Photographs of these structures are included in Appendix 15.3. It is considered that these road structures are currently in good condition and will be capable of supporting the cable trenching works and the increased traffic loading associated with the construction works. All structures will be monitored during the construction stage, particularly during trenching works.

At UWF Related Works locations, there are 3 No. buried structures under affected roads; concrete culverts routing storm water under the L6188-0 at WW31 and under the L4139-0 at WW12 and a square masonry culvert routing a small stream under the L6185-13 road at WW32. All three structures have been inspected by Wind Prospect Ireland (civil engineer) who found that the structures are in good condition and are not subject to vehicular weight restrictions, therefore it is considered that these structures will not be affected by either the 1m extension to the two concrete culverts or the additional construction traffic associated with the UWF Related Works and the Consented Upperchurch Windfarm.

A15.1.3.1.3 Current Weight Restrictions

There are no vehicle weight restrictions in place along any of the roads affected by the works. This provides a useful guide to the acceptability of the roads and buried structures and their adequacy to facilitate the movement of HGV vehicle types, subject to the normal legally allowable axle loading on Irish Roads.

A15.1.3.1.4 Road Boundaries

Road boundaries consist of a mix of hedgerows and simple mounded embankments, which are aligned beyond drainage channels that occur in many roadside verges.

A15.1.3.2 TRAFFIC

A15.1.3.2.1 Existing Traffic Volumes

24-hour classified 'ATC Tube Counts' surveys were carried out at on each of the affected roads in order to establish background traffic conditions, in terms of volume and ambient speed. All vehicles recorded during the traffic survey are expressed in terms of “Passenger Car Units” (PCUs), sometimes referred to as “Car Equivalents”. This is the methodology which has been employed here (with for example specific industry standard conversion factors to convert HGVs, Skip Lorries, Cars/Trailers and Bin Lorries to PCUs). The conversion factors used are in accordance with industry-standard recommendations.

The existing traffic conditions of the affected roads, as recorded during the surveys, are presented in Table 2. The Electoral Districts in which each of the affected roads are located, are also identified in the Table, for ease of reference to the CSO data in Table 3. In summary, it is clear from Table 2 and Table 3, that the roads in the area are generally very lightly trafficked, reflecting the rural nature of the study area.

Table 2: Summary of Existing Traffic Conditions on affected Roads

Road ID	Electoral District	85% ile Traffic Design Speed Km/Hr	24Hr 2-Way AADT (PCUs)	% HGVs	AM Peak Hr 2-Way Flow (PCUS)	PM Peak Hr 2-Way Flow (PCUS)
L-2166-0	Kilcommenty	87	665	0.46	69	63
L-2156-11	Killoscully	90	977	0	77	80
L-2157-5	Kilnarath	58	442	0.7	36	44
L-6011-10	Kilnarath	70	92	0	12	13
L-51853-0	Newport	67	1795	0.17	161	162
L-2157-0	Kilnarath	70	850	0.5	80	67
L-6011-0	Kilnarath	76	358	0	28	30
L-95032-8	Kilnarath	42	48	0	2	1
L-21141-0	Abington	41	30	0	0	4
L-2114-0	Abington	73	166	5	10	11
L-6085-0	Abington	45	60	0	8	9
L-6086-5	Abington	36	47	0	5	4
L-2266-0	Foilnaman	60	305	0	13	26
L-6182-0	Foilnaman	57	42	0	4	3
L-2266-11	Foilnaman	74	358	0	16	17
L-497	Foilnaman	57	535	0.6	34	43
L-2264-50	Foilnaman	76	211	1.5	14	19
L-6188-0	Foilnaman	49	63	0	2	8
L-4139-0	Foilnaman/ Upperchurch	49	31	0	5	2
L-4138-12	Foilnaman	58	92	0	4	9

Road ID	Electoral District	85% ile Traffic Design Speed Km/Hr	24Hr 2-Way AADT (PCUs)	% HGVs	AM Peak Hr 2-Way Flow (PCUS)	PM Peak Hr 2-Way Flow (PCUS)
L-4139-16	Foilnaman	50	42	0	4	2
L-61881-0	Foilnaman	48	17	0	3	0
L-6185-13	Foilnaman	46	13	0	0	1
L-2264-34	Foilnaman	53	147	0.7	3	11
R-503	Newport/Abington/Foilnaman	81	766	1	42	72

Survey results indicate that on average 98.8% of traffic counted comprised cars or vans, 0.7% comprises heavy vehicles which would include buses, articulated and rigid trucks, and 0.5% comprises bicycles or motorcycles. The traffic count survey, in addition to observations during site investigations, confirms that the affected roads have low traffic volumes and are not congested roads.

A15.1.3.2.2 CSO Data

The POWSCAR 2016 Census, outlined in Table 3, shows a high usage of cars and a very low usage of bicycles and walking as modes of transport in the Electoral Districts associated with the UWF Grid Connection (Kilcomenty, Newport, Kilnarath, Killoscully, Abington, Foilnaman) and the UWF Related Works (Foilnaman and Upperchurch).

Table 3: Extract from CSO 2016 POWSCAR data

POWSCAR 2016 - Theme 11 Commuting	**Kilcomenty**	**Newport**	**Killoscully**	**Kilnarath**	**Abington**	**Foilnaman**	**Upperchurch**
Commuting to Work							
On foot - Work	3	39	1	1	2	2	4
Bicycle - Work	0	7	0	0	0	0	0
Bus, minibus or coach - Work	2	11	2	0	4	0	0
Train, DART or LUAS - Work	0	1	1	0	1	1	1
Motorcycle or scooter - Work	0	2	0	1	0	1	0
Car driver - Work	232	868	158	113	158	88	86
Car passenger - Work	7	61	5	1	4	4	0
Van - Work	30	86	16	17	26	16	10
Other (incl. lorry) - Work	3	7	0	2	7	4	1
Work mainly at or from home - Work	22	42	19	12	26	21	27
Not stated - Work	5	30	8	6	6	4	11
Total – Commuting to Work	**304**	**1154**	**210**	**153**	**234**	**141**	**140**
Commuting to School or College							
On foot - School or college	15	189	0	2	14	5	4
Bicycle - School or college	0	3	0	1	0	0	0
Bus, minibus or coach - School or college	19	36	57	23	47	31	33
Train, DART or LUAS - School or college	1	0	0	0	0	0	2

POWSCAR 2016 - Theme 11 Commuting	Kilcomenty	Newport	Killoscully	Kilnarath	Abington	Foilnaman	Upperchurch
Motorcycle or scooter - School or college	0	0	0	0	0	0	0
Car driver - School or college	14	39	7	5	9	2	4
Car passenger - School or college	150	473	53	41	61	39	21
Van - School or college	2	3	0	1	0	0	0
Other (incl. lorry) - School or college	0	0	0	0	0	0	0
Work mainly at or from home - School or college	4	0	0	0	0	0	0
Not stated - School or college	3	22	4	4	4	3	3
Total – Commuting to School or College	**208**	**765**	**121**	**77**	**135**	**80**	**67**
Total per Mode of Transport							
On foot - Total	18	228	1	3	16	7	8
Bicycle - Total	0	10	0	1	0	0	0
Bus, minibus or coach - Total	21	47	59	23	51	31	33
Train, DART or LUAS - Total	1	1	1	0	1	1	3
Motorcycle or scooter - Total	0	2	0	1	0	1	0
Car driver - Total	246	907	165	118	167	90	90
Car passenger - Total	157	534	58	42	65	43	21
Van - Total	32	89	16	18	26	16	10
Other (incl. lorry) - Total	3	7	0	2	7	4	1
Work mainly at or from home - Total	26	42	19	12	26	21	27
Not stated - Total	8	52	12	10	10	7	14
Total per ED	**512**	**1919**	**331**	**230**	**369**	**221**	**207**

A15.1.3.2.3 Tourist/Walking/Cycling Routes

Both the R497 and the R503 are designated scenic routes in Tipperary North County Development Plan. The waymarked walking routes that exist in the area consist of the Slievefelim Way, Kilcommon Pilgrim Loop, Eamon a Chnoic Loop and the Ormond Way walking route, (this walk is currently being developed). There is also a waymarked cycle route, the Ormond Way Cycle, part of which is routed along the L2264-50 and L2264-34 (locally called the Borrisoleigh Road) through Knockmaroe and Foilnaman. These walks and cycle route are identified on Figure GC 6.3 *or* Figure RW 6.3 in Tab 6 of Volume C3 EIA Report Figures

All of these trails include public road sections to some degree; the Slievefelim Way is routed along the R503 for c. 1.3km just outside Rearcross village; sections of the Kilcommon Pilgrim Route are along the L6086-5 and L2266-0; part of the Ormond Way walking route (currently being developed) is along the L4139-0; and all of the Ormond Way Cycle route is along public roads, starting in Milestone and ending in Portumna.

Both the CSO data and the traffic count surveys show a very low usage of the road network by cyclists. A very low usage of the local roads by cyclists was recorded during 2017 traffic count surveys, with no cyclists recorded on half of the roads, and one or two trips on the vast majority of the remaining roads. The exception

to this low usage was on the R503 in Newport where 15 cycle trips were recorded in a 24hour period in July 2017, which would correspond to the CSO data. There were also 2 groups of 4 cyclists, recorded on the L2264-34 and the eastern extent of the R503 in the study area during July 2017, the use of the L2264-34 road corresponds with it being a waymarked cycle route (Ormond Way Cycle). This road was surveyed again, for a one week period in November 2017, only one cyclist was recorded.

A15.1.3.3 Road Safety

A15.1.3.3.1 Recorded Traffic Speeds

The traffic data collected confirmed that the traffic speeds are generally maintained well within the posted speed limits (i.e. less than 80kph which is generally the speed limit on the affected roads) – See Table 4.

Table 4: Summary of 85th percentile speeds at Permanent and Temporary Site Entrances

Road ID	Entrance ID	85% ile Traffic Design Speed Km/Hr	24Hr 2-Way AADT (PCUs)	% HGVs	AM Peak Hr 2-Way Flow (PCUS)	PM Peak Hr 2-Way Flow (PCUS)
L-2166-0	E1 & E2	87	665	0.46	69	63
L-2156-11	E4 & E5	92	941	0	77	80
L-2157-5	E6 & E7	58	442	0.7	36	44
L-6011-10	E8 & E9	70	92	0	12	13
L-51853-0	N/A	67	1795	0.17	161	162
L-2157-0	N/A	70	850	0.5	80	67
L-6011-0	N/A	76	358	0	28	30
L-95032-8	E10	42	48	0	2	1
L-21141-0	E11, E12 & E13	41	30	0	0	4
L-2114-0	E14, E15 & E16	73	166	5	10	11
L-6085-0	E18 & E19	45	60	0	8	9
L-6086-5	E22, E23 & E24	36	47	0	5	4
L-2266-0	E25, E26 & E27	60	305	0	13	26
L-6182-0	E28 & E29	57	42	0	4	3
L-2266-11	N/A	74	358	0	16	17
L-497	E30	57	535	0.6	34	43
L-2264-50	E33, EW19, EW20 & EW21	76	211	1.5	14	19
L-6188-0	E34, EW5, EW6, EW16, EW17 & EW22	49	63	0	2	8
L-4139-0	EW1	49	31	0	5	2
L-4138-12	EW2	58	92	0	4	9
L-4139-16	EW3 & EW4	50	42	0	4	2
L-61881-0	EW7, EW8, EW9 & EW10	48	17	0	3	0
L-6185-13	EW11 & EW12	46	13	0	0	1
L-2264-34	EW13, EW14 & EW15	53	147	0.7	3	11
R-503	EW18	81	766	1	42	72

A15.1.3.3.2 RSA Online Collision Database

A review of the Road Safety Authority (RSA) online collision database indicates that there is no record of any significant collision proximate to the site, between 2005-2013 inclusive (save for some mostly single vehicle accidents which are classified as 'minor' on the database).

The RSA collision statistics demonstrate that the local and regional roads in the study area do not have a significant history of accidents.

The Data from the RSA on-line tool is reproduced below as *Plate 1* to Plate 5 below.

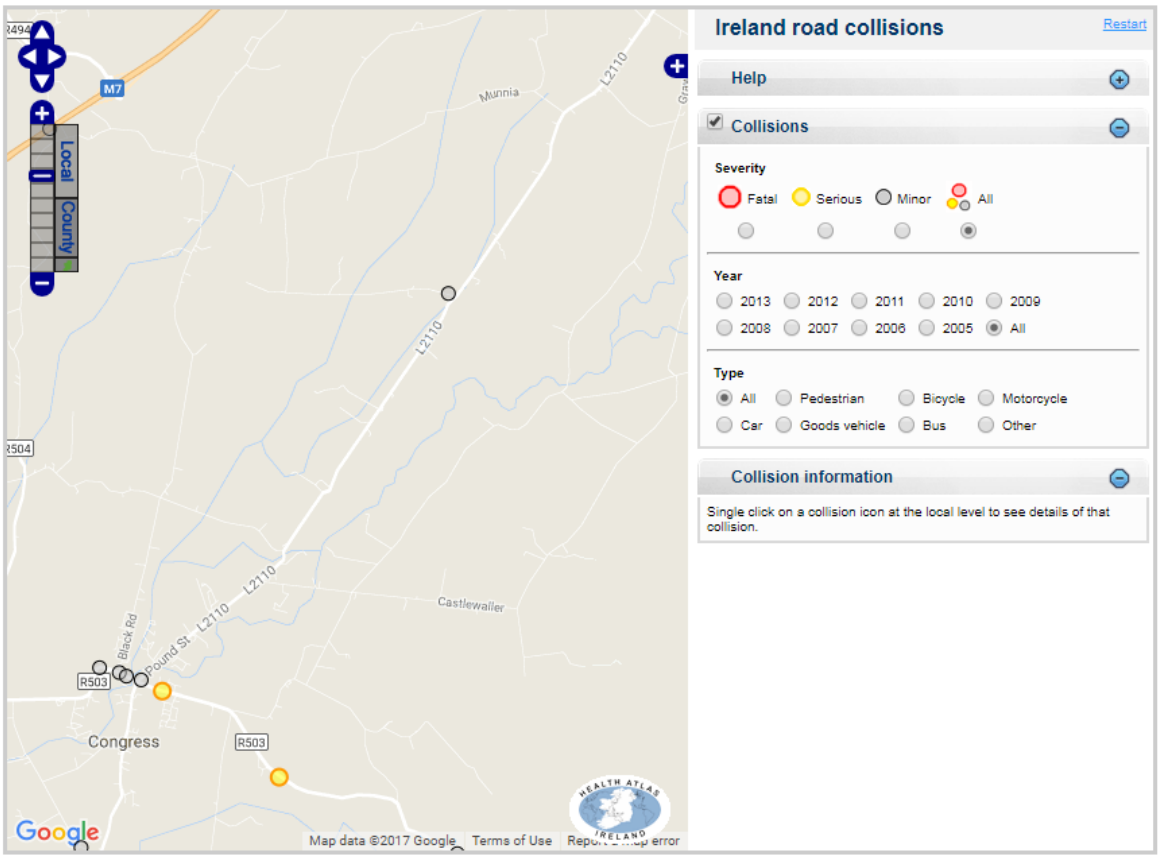


Plate 1: RSA Database Accident Statistics Extract - Map 1

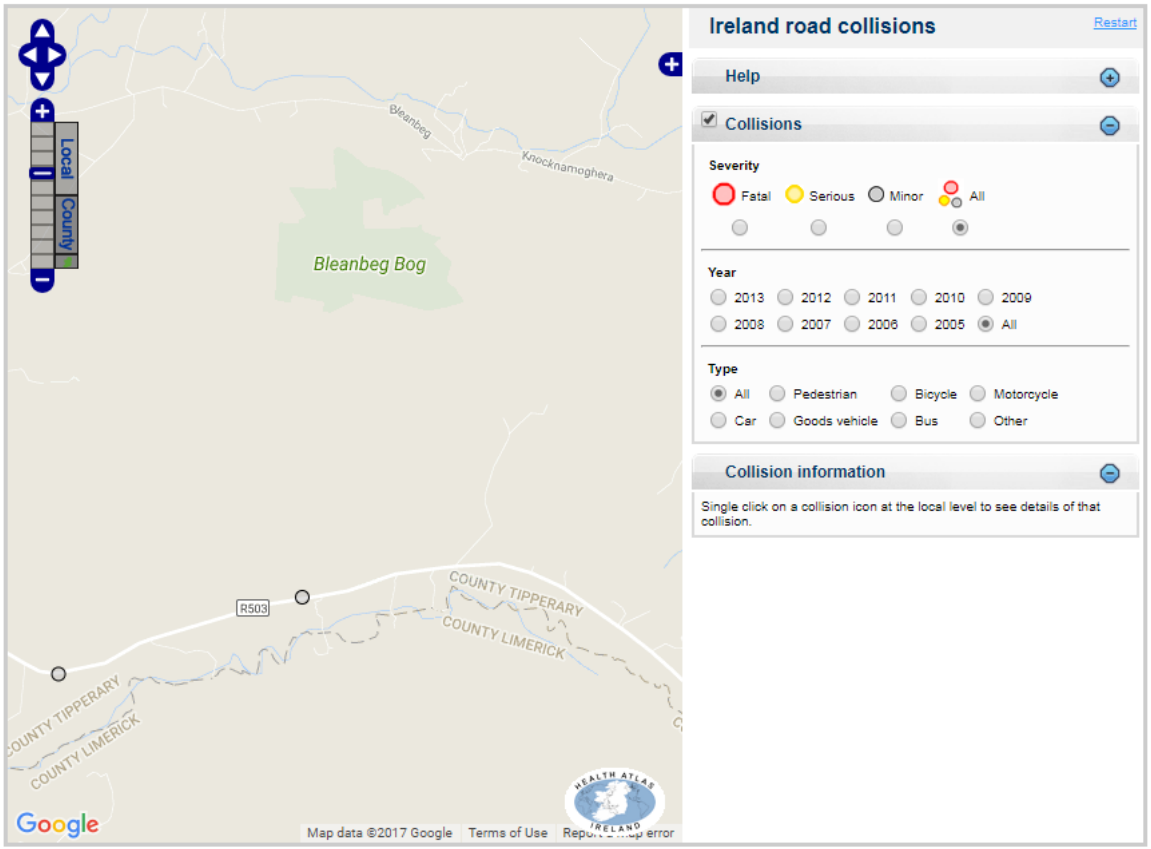


Plate 2: RSA Database Accident Statistics Extract - Map 2

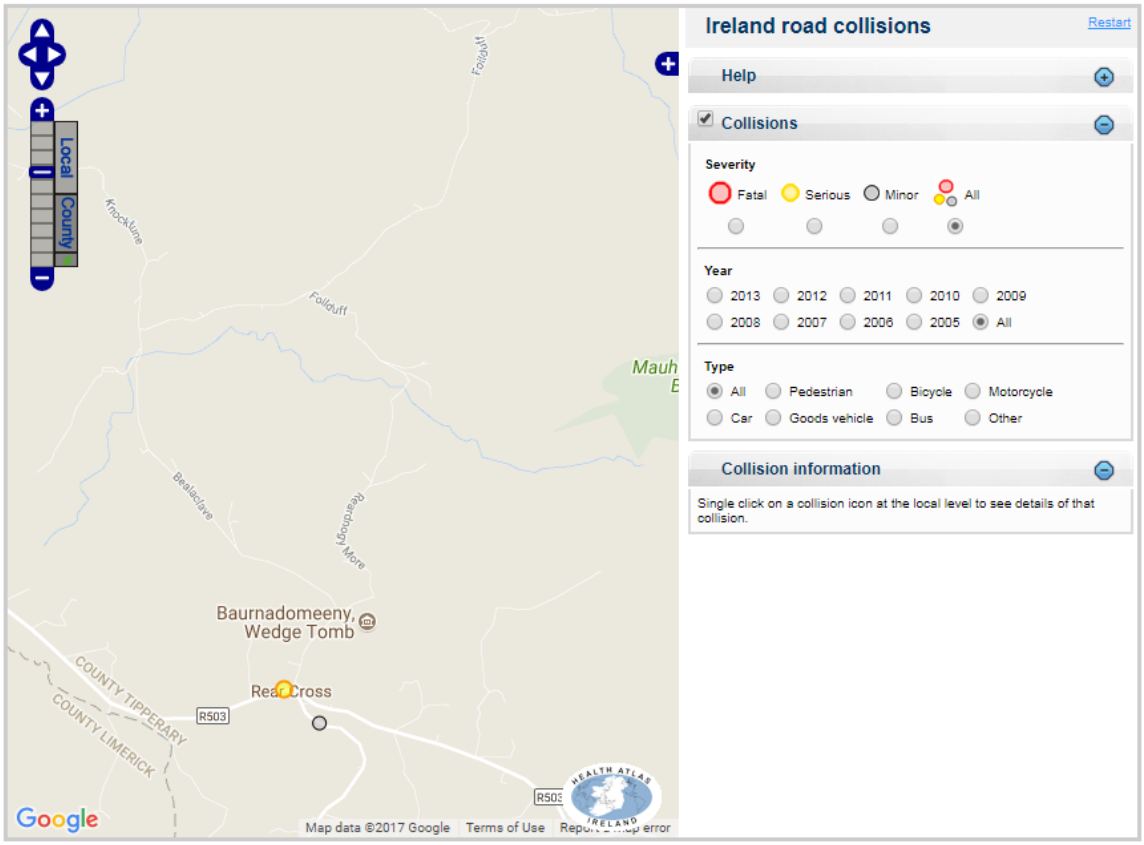


Plate 3: RSA Database Accident Statistics Extract - Map 3

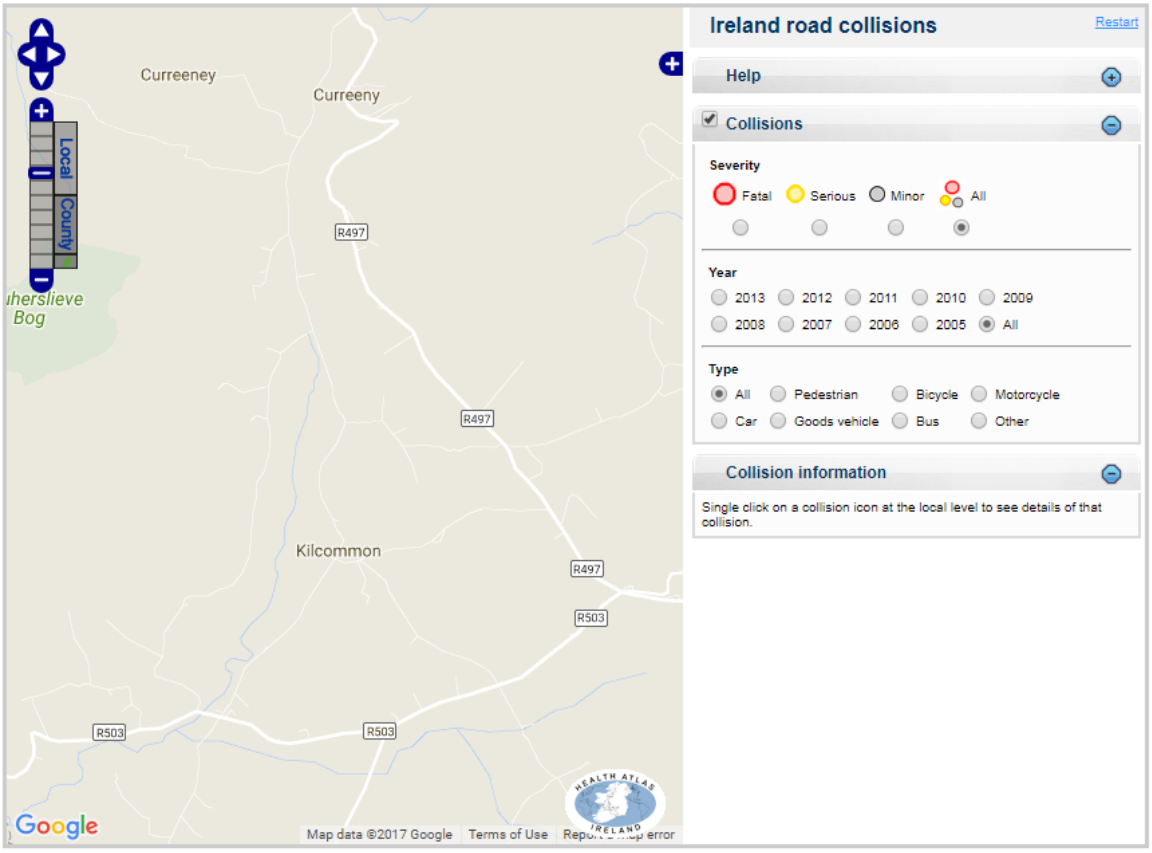


Plate 4: RSA Database Accident Statistics Extract - Map 4

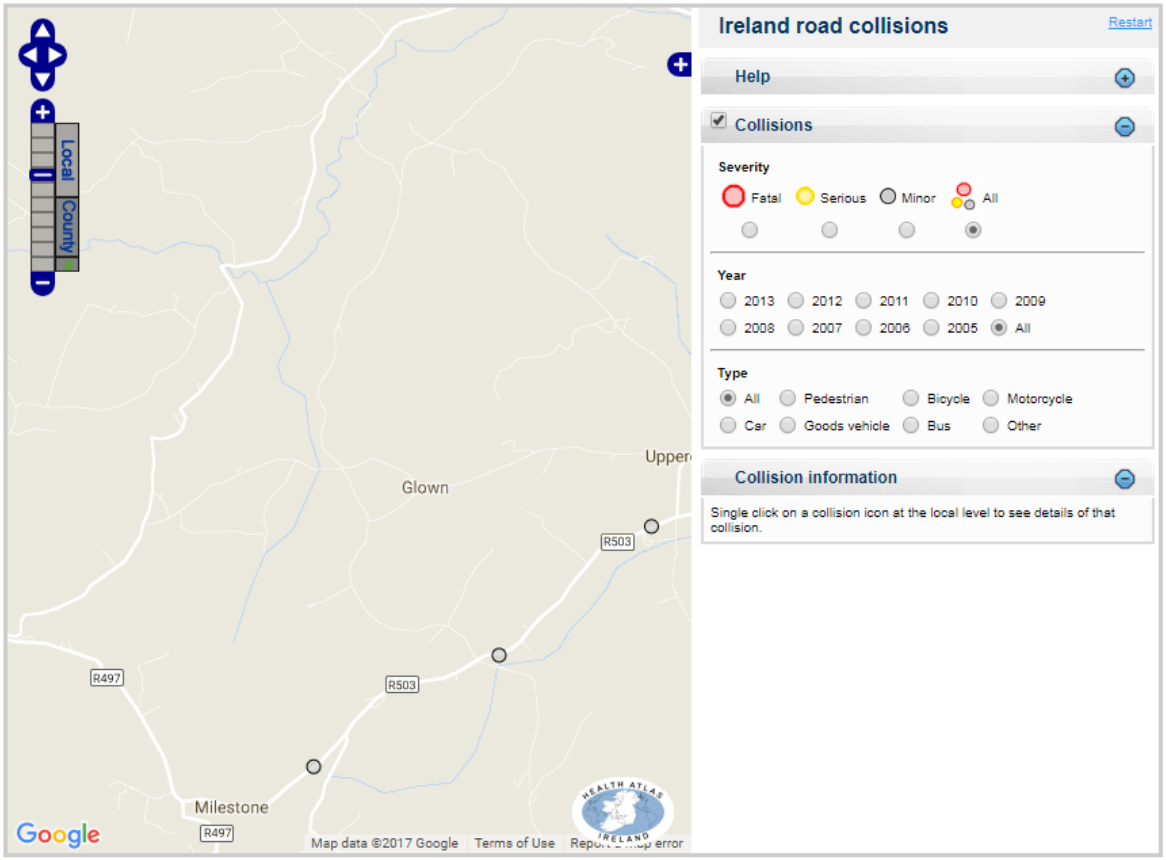


Plate 5: RSA Database Accident Statistics Extract - Map 5

A15.1.4 TRAFFIC FORECASTING

Construction traffic volumes were assigned to the various affected roads, based on the reasonable and industry standard assumption that the trip patterns associated with the construction stage will naturally gravitate to and from the temporary construction compound locations.

While construction is expected to commence in 2018, it is likely that construction works will continue into 2019. In order to evaluated the worst case traffic volumes on the affected roads during construction works, an opening year of 2019 was selected for the purposes of this assessment.

Traffic growth factors for 2019 were calculated from data obtained in the TII PE-PAG-02017 Project Appraisal Guidelines for National Roads Unit 5.3 (Travel Demand Projections October 2016, Table 5.3.2: Link-Based Growth Rates: Annual Growth Factors) which provides the recommended method of predicting future year traffic growth on public roads.

Calculations of the relevant growth factors are included in Table 5.

Table 5: Tii Traffic Growth Rates

Traffic Growth		
From Year	To Year	NRA Link Based Growth Rates
2017	2019	1.028

It should be noted that any requirement to use different or higher growth factors will have no implications for the conclusions of the study, as the available road capacity on the affected roads is very high (average 97%).

A15.1.5 DESCRIPTION OF THE INDIVIDUAL PROJECT ELEMENTS

The UWF Grid Connection, UWF Related Works, UWF Replacement Forestry, Upperchurch Windfarm (UWF) and UWF Other Activities are collectively referred to as the Whole UWF Project.

The purpose of the UWF Grid Connection, UWF Related Works, UWF Replacement Forestry and UWF Other Activities elements is to facilitate the construction and operation of the already consented Upperchurch Windfarm (UWF). Upperchurch Windfarm when operational, will produce renewable electricity from the wind to supply the National Grid.

Table 6: Overview of the Individual Elements of the Whole UWF Project

	Element of the whole UWF project	Composition of each Element	Planning Status and Competent Authority for each Element
1	UWF Grid Connection (GC)	Mountphilips Substation Mountphilips – Upperchurch 110kV UGC Grid Connection Access Roads Grid Connection Ancillary Works	Current planning application to An Bord Pleanála
2	UWF Related Works (RW)	Internal Windfarm Cabling Realigned Windfarm Roads Haul Route Works Telecom Relay Pole RW Ancillary Works	Current planning application to Tipperary County Council
3	UWF Replacement Forestry (RF)	Replacement Forestry at Foilnaman	Current afforestation license application to the Minister for Agriculture, Food and the Marine
4	Upperchurch Windfarm (UWF)	Consented UWF Turbines Consented UWF Substation Consented UWF Roads UWF Ancillary Works	Already consented under Planning Reference: Tipperary Co.Co. 13/51/0003, ABP PL 22.243040
5	UWF Other Activities (OA)	Haul Route Activities Upperchurch Hen Harrier Scheme Monitoring Activities Overhead Line Activities	No planning permission required

Three separate Environmental Impact Assessment Reports (EIA Report also called EIAR) have been prepared, one each for the UWF Grid Connection, the UWF Related Works and the UWF Replacement Forestry. The individual EIA Reports accompany the application to the relevant Competent Authorities, for example the UWF Grid Connection EIA Report accompanies the SID application to An Bord Pleanála.

The EIA Reports are included with the applications as Volume C. A description of the location, layout, size and design, the construction stage, operational stage, and changes to the project, along with a description of the use of natural resources, emissions and wastes, and the vulnerability of the element to natural disasters and events is provided in Chapter 5 of the relevant EIA Report Main Report (Volume C2).

This information is also available on the following website: www.upperchurchwindfarmgridconnection.ie, where the full UWF Grid Connection EIA Report is available. A description of UWF Grid Connection is included in Chapter 5: Description of UWF Grid Connection. A description of the Other Elements of the Whole UWF Project are included as Appendices 5.3, 5.4, 5.5 and 5.6 of the UWF Grid Connection EIA Report (EIAR Volume C4).

A15.1.5.1 Project Design Environmental Protection Measures

The design of the UWF Grid Connection and UWF Related Works includes the Project Design Environmental Protection Measures listed on Table 7, which were devised to avoid, prevent or reduce likely or potentially significant effects to public roads or road users.

Table 7: Project Design Environmental Protection Measures

Project Design Environmental Protection Measure
Construction works in Knockmaroe and Knockcurraghbola Commons townlands, which are within 350m of local residences, will not take place at the same time as either the UWF Related Works or Upperchurch Windfarm.
Confirmatory consultations with Irish Water, Eir and ESB and confirmatory ground surveys at service locations will be carried out ahead of works; 'Goal Posts' will be used to identify and highlight the height of nearby overhead lines; and a foreman will look out for underground pipes during excavations near services.
Flag-men will be used at temporary site entrances rather than creating sightlines by the removal of roadside boundaries. These flagmen will control the movement of traffic on the public road, so that road users can continue to use the local road network in a in a safe and efficient manner.
All deliveries of construction materials that pass Kilcommon National School will be scheduled to take place outside of school drop-off/pick-up times - 9am to 9.30 am and 3pm to 3.30pm
All construction works will be carried out during daylight hours

A15.1.6 TRIP GENERATION, ASSIGNMENT & DISTRIBUTION

The trips associated with the construction stage only have been modelled. Operational stage trip generation will be negligible and does not require or warrant further evaluation.

Similar to the operational stage, **the trips associated with the UWF Replacement Forestry and the UWF Other Activities will be very low and will have no effect on traffic or transport**. Consequently, the very low number of trips generated by these two elements are not included in the model.

The construction traffic associated with the UWF Grid Connection and the UWF Related Works have been quantified and are included in the model. Furthermore, the cumulative volumes associated with both of these developments along with the already Upperchurch Windfarm have been calculated in order to evaluate the whole project impact on any local roads which are affected by more than one element of the whole project.

The modelling of trip generation, assignment and distribution to the road network has been based on information[1] in Chapter 5 of the relevant EIA Report Main Report (Volume C2).

In order to quantify the impact on traffic and transport, the construction traffic volumes and movements to and from the site compounds and the various site entrances and to and from quarries and the various construction works areas was calculated, and the daily and peak hour construction traffic movements associated with each site entrance or road works location was then calculated for the relevant local road.

This was undertaken for a typical 24 Hour Annual Average Daily Traffic volume, and for the traditional weekday AM and weekday PM peak hours.

[1] This information is also available on the following website: www.upperchurchwindfarmgridconnection.ie, where the full UWF Grid Connection EIA Report is available. A description of UWF Grid Connection is included in Chapter 5: Description of UWF Grid Connection. A description of the Other Elements of the Whole UWF Project are included as Appendices 5.3, 5.4, 5.5 and 5.6 of the UWF Grid Connection EIA Report (EIAR Volume C4).

A15.1.7 IMPACT ASSESSMENT

A15.1.7.1 Introduction

TII's Traffic and Transportation Assessment Guidelines (2014), recommends that a threshold assessment & analysis is undertaken to determine the increases in traffic associated with any particular development, and whether this might be considered as significant. The threshold levels are outlined in Table *8*.

Table 8: Tii Threshold Analysis

Traffic Management Guidelines Thresholds for Transport Assessments	**Criteria met? Yes/No?**
Traffic to and from the development exceeds 10% of the traffic flow on the adjoining road.	Yes, due to the extremely low existing traffic volumes on some of the local roads in the study area.
Traffic to and from the development exceeds 5% of the traffic flow on the adjoining road where congestion exists or the location is sensitive	No, There are no roads are classed as 'congested' (A junction or link is considered to be congested when traffic flows are at 85% of the estimated capacity of the junction or link)
Residential development in excess of 200 dwellings.	No Not applicable
Retail and leisure development in excess of 1,000m^2.	No Not applicable
Office, education and hospital development in excess of 2,500m^2.	No Not applicable
Industrial development in excess of 5,000m2.	No Not applicable
Distribution and warehousing in excess of 10,000m2	No Not applicable

As the construction related traffic on some of the local roads associated with the UWF Grid Connection and the UWF Related Works will meet the first listed threshold in Table 8 above, this Traffic and Transport Assessment has been prepared and the Annual Average Daily Traffic volumes in PCUs without the works, for each of the affected roads has been measured through traffic counts, which were carried out on each affected road.

The transport impact of the additional construction traffic has been evaluated against the existing volumes and the future volumes, together with the quantified road link capacity based on the existing pavement width and conditions, using industry standard methods *(TD76/99 Link Capacity Assessment*) of link capacity assessment traffic volumes and link capacity details for each affected road.

The distribution of traffic to the local road network for each separate site entrance or road works location associated with the UWF Grid Connection and the UWF Related Works and cumulatively with the Upperchurch Windfarm is included on Table 9. The resultant increase in projected 2019 traffic levels is provided in Table 10. It should be noted that some percentage changes in traffic conditions due to the addition of the cumulative construction traffic appear large because the existing traffic levels are so low.
The results of the transport modelling are presented below.

A15.1.7.2 Traffic and Transportation Modelling

Table 9: Construction Traffic Distribution in relation to the UWF Grid Connection, UWF Related Works and Upperchurch Windfarm and combined cumulative traffic

		Projected Construction Related Development Traffic									*Total Combined Works Traffic (Cumulative)*		
		UWF Grid Connection			*UWF Related Works*			*-Upperchurch Windfarm*					
Road Label	**Road 2-Way Capacity Based on conditions (PCUs/Hr 2-way)**	**24Hr 2-Way AADT (PCUs)**	**AM Peak Hr 2-Way Flow (PCUS)**	**PM Peak Hr 2-Way Flow (PCUS)**	**24Hr 2-Way AADT (PCUs)**	**AM Peak Hr 2-Way Flow (PCUS)**	**PM Peak Hr 2-Way Flow (PCUS)**	**24Hr 2-Way AADT (PCUs)**	**AM Peak Hr 2-Way Flow (PCUS)**	**PM Peak Hr 2-Way Flow (PCUS)**	**24Hr 2-Way AADT (PCUs)**	**AM Peak Hr 2-Way Flow (PCUS)**	**PM Peak Hr 2-Way Flow (PCUS)**
L-2166-0	2000	67	18	18	0	0	0	0	0	0	67	18	18
L-2156-11	1500	8	1	1	0	0	0	0	0	0	8	1	1
L-2157-5	1650	8	1	1	0	0	0	0	0	0	8	1	1
L-6011-10	150	8	1	1	0	0	0	0	0	0	8	1	1
L-51853-0	1350	16	2	2	0	0	0	0	0	0	16	2	2
L-2157-0	1810	16	2	2	0	0	0	0	0	0	16	2	2
L-6011-0	1333	16	2	2	0	0	0	0	0	0	16	2	2
L-95032-8	150	8	1	1	0	0	0	0	0	0	8	1	1
L-21141-0	300	8	1	1	0	0	0	0	0	0	8	1	1
L-2114-0	1480	28	8	8	0	0	0	0	0	0	28	8	8
L-6085-0	300	8	1	1	0	0	0	0	0	0	8	1	1
L-6086-5	300	8	1	1	0	0	0	0	0	0	8	1	1
L-2266-0	1910	8	1	1	0	0	0	0	0	0	8	1	1
L-6182-0	1630	8	1	1	0	0	0	0	0	0	8	1	1
L-2266-11	1850	8	1	1	0	0	0	0	0	0	8	1	1
L-497	1920	8	1	1	0	0	0	0	0	0	8	1	1
L-2264-50	1720	28	8	8	21	3	3	22	4	4	71	15	15
L-6188-0	1533	28	8	8	12	2	2	22	4	4	62	14	14
L-4139-0	1310	0	0	0	12	2	2	22	4	4	34	6	6
L-4138-12	1425	0	0	0	12	2	2	22	4	4	34	6	6
L-4139-16	1325	0	0	0	3	1	1	0	0	0	3	1	1
L-61881-0	1325	0	0	0	3	1	1	0	0	0	3	1	1
L-6185-13	1310	0	0	0	3	1	1	22	4	4	25	5	5
L-2264-34	1555	0	0	0	3	1	1	0	0	0	3	1	1
R-503	1750	8	1	1	9	1	1	8	8	8	25	10	10

Table 10: Projected Increase in Traffic Volumes on Affected Roads during the Construction Stage

		Existing Traffic Conditions Without Development 2017			*Projected Opening Year **2019** using Tii Annual Growth Rates Without Development Traffic*			*Total Combined Works Traffic (Cumulative)*			*2019 Total Traffic Volumes – 2019 Projected Traffic + Cumulative Works Traffic*			*Percentage Change in Conditions Associated with Cumulative Works*			*% Road Capacity Used With addition of Cumulative Works Traffic*	
Road Label	Road 2-Way Capacity Based on conditions (PCUs/ Hr 2-way)	24Hr 2-Way AADT (PCUs)	AM Peak Hr 2-Way Flow (PCUS)	PM Peak Hr 2-Way Flow (PCUS)	24Hr 2-Way AADT (PCUs)	AM Peak Hr 2-Way Flow (PCUS)	PM Peak Hr 2-Way Flow (PCUS)	24Hr 2-Way AADT (PCUs)	AM Peak Hr 2-Way Flow (PCUS)	PM Peak Hr 2-Way Flow (PCUS)	24Hr 2-Way AADT (PCUs)	AM Peak Hr 2-Way Flow (PCUS)	PM Peak Hr 2-Way Flow (PCUS)	24Hr 2-Way AADT (PCUs)	AM Peak Hr 2-Way Flow (PCUS)	PM Peak Hr 2-Way Flow (PCUS)	*AM Peak Hour*	*PM Peak Hour*
L-2166-0	2000	665	69	63	684	71	65	67	18	18	751	89	83	10%	25%	28%	4.4	4.1
L-2156-	1500	977	77	80	967	79	82	8	1	1	975	80	83	1%	1%	1%	5.3	5.5
L-2157-5	1650	442	36	44	454	37	45	8	1	1	462	38	46	2%	3%	2%	2.3	2.8
L-6011-	150	92	12	13	95	12	13	8	1	1	103	13	14	9%	8%	8%	8.9	9.6
L-51853-	1350	1795	161	162	1831	157	196	16	2	2	1847	159	198	1%	1%	1%	11.8	14.7
L-2157-0	1810	850	80	67	1071	72	113	16	2	2	1087	74	115	2%	3%	2%	4.1	6.4
L-6011-0	1333	358	28	30	417	31	44	16	2	2	433	33	46	4%	7%	5%	2.5	3.5
L-95032-	150	48	2	1	49	2	1	8	1	1	57	3	2	16%	49%	97%	2.0	1.4
L-21141-	300	30	0	4	31	0	4	8	1	1	39	1	5	26%	N/A	24%	0.3	1.7
L-2114-0	1480	166	10	11	171	10	11	28	8	8	199	18	19	16%	78%	71%	1.2	1.3
L-6085-0	300	60	8	9	62	8	9	8	1	1	70	9	10	13%	12%	11%	3.1	3.4
L-6086-5	300	47	5	4	48	5	4	8	1	1	56	6	5	17%	20%	24%	2.0	1.7
L-2266-0	1910	305	13	26	314	13	27	8	1	1	322	14	28	3%	8%	4%	0.8	1.5
L-6182-0	1630	42	4	3	43	4	3	8	1	1	51	5	4	19%	24%	32%	0.3	0.3
L-2266-	1850	358	16	17	368	16	17	8	1	1	376	17	18	2%	6%	6%	0.9	1.0
L-497	1920	535	34	43	550	35	44	8	1	1	558	36	45	2%	3%	2%	1.9	2.4
L-2264-	1720	211	14	19	217	14	20	71	15	15	288	29	35	33%	104%	77%	1.7	2.0
L-6188-0	1533	63	2	8	65	2	8	62	14	14	127	16	22	96%	681%	170%	1.0	1.4
L-4139-0	1310	31	5	2	32	5	2	34	6	6	66	11	8	107%	117%	292%	0.9	0.6
L-4138-	1425	92	4	9	95	4	9	34	6	6	129	10	15	36%	146%	65%	0.7	1.1
L-4139-	1325	42	4	2	43	4	2	3	1	1	46	5	3	7%	24%	49%	0.4	0.2
L-61881-	1325	17	3	0	17	3	0	3	1	1	20	4	1	17%	32%	N/A	0.3	0.1
L-6185-	1310	13	0	1	13	0	1	25	5	5	38	5	6	187%	N/A	486%	0.4	0.5
L-2264-	1555	147	3	11	151	3	11	3	1	1	154	4	12	2%	32%	9%	0.3	0.8
R-503	1750	766	42	72	787	43	74	17	9	9	804	52	83	2%	21%	12%	3.0	4.7

A15.1.7.3 Evaluation of Traffic and Transport Modelling Results

A15.1.7.3.1 Road Capacity Impact:

Table 9 serves to demonstrate that the existing affected road network has more than adequate capacity to accommodate the worst case cumulative traffic associated with the development. It confirms that the existing volumes of traffic together with the cumulative works traffic will in all cases leave in excess of 95% of the traffic carrying reserve capacity available for each of the roads.

The increase in traffic associated with the Whole UWF Project will therefore have an imperceptible impact upon network capacity and operation, subject to adherence to traffic management measures at the works locations, which are included in the Traffic Management Plan.

A15.1.7.3.2 Road pavements impact

The pavements along haulage routes are not expected to be adversely impacted by construction traffic associated with the works. In any case high definition video surveys will be carried out both before and after the construction period, and any pavements which are inadvertently damaged by construction traffic will be repaired to the satisfaction of Tipperary County Council.

The pavements at road work locations, particularly at trenching locations will be impacted during road works, and as agreed with Tipperary County Council Roads Department, all sections of local roads subject to trenching works in the road pavement will be reinstated by full width strengthening, of the affected road, to 5 metres beyond the works area, on both sides. This reinstatement of trenching locations within road pavements is in accordance with the Tii Guidelines for the Opening, Backfilling and Reinstatement of Openings in Public Roads. This road reinstatement will ameliorate any impacts to road pavements, and therefore it is considered that no impacts to road pavements are likely to occur.

A15.1.7.3.3 Buried structures impact

During site investigations, all structures were subject to a photographic inspection, there were no visible signs of degradation of the structures, and no cracks or depressions in the road surfaces above. It is considered that these road structures are currently in good condition and will be capable of supporting all works and the small increased traffic loading associated with the construction works. At the 2 No. culverts at Haul Route Works locations, the 1m extension works will be carried out without affecting the integrity of these two structures. All structures will be monitored during the construction stage, and inspected following completion of the works to ensure integrity is maintained. No impact to buried structures is expected.

A15.1.7.3.4 Traffic impact

The effect on road users has been comprehensively and cumulatively assessed and there is expected to be an imperceptible effect on journey times or use of the road by road users due to the small increase in traffic loading and the available capacity on the roads (c.95%).

At road work locations, local road users will be accommodated through minimising the amount of road closures required by using stop-go systems, steel plating and through the use of appropriately sized machines to ensure the continued use of one lane of the road, in particular at Bealaclave.
At the 1 No. road closure in Baurnadomeeny, the road will be closed during off-peak hours, during school holidays and in consultation with the 8 No. local residents which use this road. Due to the small

number of road users at this location, combined with the scheduling of works outside of busy times, the short duration of the closure and the availability of an alternative route to the north, it is considered that the effect to road users on the L6085-0 at Baurnadomeeny will be imperceptible.

A15.1.7.3.5 Road Safety impact

The predicted small increases in traffic associated with the works, the provision of adequate sightlines at permanent site entrances, the use of flagmen at temporary entrances and the use of advance warning signage for entrances and road works will ensure the continued safe use of the road and it is expected that there will be no impact upon traffic safety.

A15.1.7.3.6 Pedestrians and cyclists impact

The presence of road works and increases in traffic volumes due to construction traffic is expected to have an imperceptible effect upon the continued safe progression and passage of pedestrians and cyclists on the affected roads, due to the very low usage of the roads by walkers and cyclists (CSO data, observations during site visits, traffic count survey results), the small increase in traffic volumes due to the works, the available capacity on the affected roads, and the imposition of speed limits on all vehicles delivering construction materials to works areas along the local road network.

A15.1.8 REQUIREMENT FOR MITIGATION MEASURES

There is no requirement for mitigation measures as no significant adverse effects are expected to the affected roads in the study area.

Project Design measures, described in Section A15.1.5.1 and the traffic management measures, described in the dedicated **Traffic Management Plan** in the Environmental Management Plans which accompanies the applications for the UWF Grid Connection, the UWF Related Works and the Upperchurch Windfarm.

The adherence to the Plan will be audited weekly by the Environmental Clerk of Works, and a Community Liaison Officer will inform local residences of upcoming construction schedules, in particular those relating to road works in their area

Appendix to Chapter 15: Material Assets - Roads

Appendix 15.2: FWD Testing

The data and descriptions in this appendix have informed Chapter 15: Material Assets (Roads) of the EIA Report.

The information presented in this Appendix 15.2 is outlined below and the relevant element(s) of the Whole UWF Project are also identified.

Appendix 12.1 Section	Section Heading	Relevant Individual Project Element
A-15.2.1	FWD Testing on UWF Grid Connection Local Roads	UWF Grid Connection
A-15.2.2	FWD Testing on UWF Related Works Local Roads	UWF Related Works

The Falling Weight Deflectometer (FWD) surveys were carried out by Milestone Pavement Technologies, who are an independent civil engineering firm who have been providing pavement evaluation services to the civil engineering industry for 20 years.

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A-15.2.2.5 FWD Section Maps with Chainages **Error! Bookmark not defined.**

A-15.2.1 FWD TESTING ON UWF GRID CONNECTION LOCAL ROADS

A-15.2.1.1 Introduction:

Falling Weight Deflectometer (FWD) surveys are carried out to assess the condition and load bearing capacity of road pavements.

Milestone Pavement Technologies were engaged by Ecopower Developments to carry out a FWD survey along the local roads associated with the UWF Grid Connection. In addition to measuring deflections, coring was carried out to determine pavement structure.

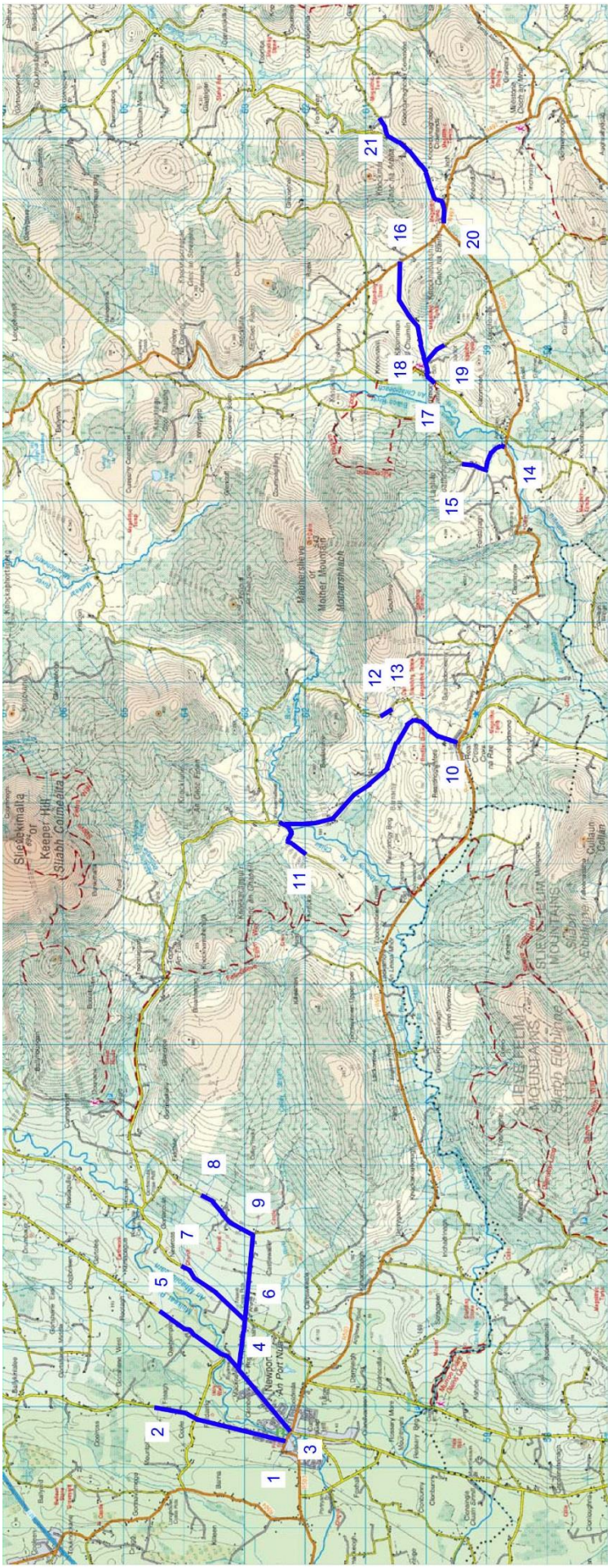
A-15.2.1.2 FWD Survey Overview

The survey took place on eleven road sections defined by start and end nodes as shown in Figure 1. Testing was carried out in one direction on road pavements up to and including 4.0m wide and in both directions on road pavements in excess of 4.0m. Details of these sections are shown in Table 1 and maps showing chainages for each section are contained in Section A-15.2.1.12.

Table 1: Section Details

Section		FWD Survey	Length Tested (m)
Start	Finish		
1	2	Both Directions	2500
3	5	Both Directions	2850
6	7	Both Directions	1400
9	8	1 Direction	1290
4	9	Both Directions	2270
11	10	1 Direction	4300
12	13	1 Direction	160
14	15	1 Direction	1240
16	17	Both Directions	2150
18	19	1 Direction	430
20	21	1 Direction	2200

Figure 1: Map of Survey Route (UWF Grid Connection)



A-15.2.1.3 FWD Survey Details

A-15.1.1.1 FWD Equipment and Data Collection

FWD testing was carried out in accordance with Appendix B of TII publication *AM-PAV-06050 Pavement Assessment Repair and Renewal Principles* and *'Guidelines on the Depth of Overlay to be used on Rural Regional and Local Roads'* (March 2014) issued by the D.T.T.A.S. The equipment used was a trailer mounted Primax FWD manufactured by Sweco. The 9 geophones mounted radially from the centre of the load plate were positioned as shown in Table 2.

Table 2: FWD Geophone Positions

Geophone Number	D1	D2	D3	D4	D5	D6	D7	D8	D9
Distance from centre of load(mm)	0	300	450	600	900	1200	1500	1800	2100

A load pulse is produced by dropping a known mass, and is transmitted to the pavement through the loading plate. The load cell measures the load imparted to the pavement surface and the geophones measure the pavement deflection in response to the load.

In this case the load level was set at 40kN to produce a load pulse similar to that produced by the moving wheel of a heavy goods vehicle. The load pulse was applied through a 300mm diameter plate which is a standard size plate for all FWD equipment. Deflections at each geophone were measured at a resolution of 1 micron. At each test point at least 3 drops were made, after an initial drop to settle the load plate.

Longitudinal spacing of measurements were generally at 50 metre intervals.

A-15.1.1.2 Coring

150mm diameter cores of the bound surface layer were cut from the pavement using a standard trailer version coring rig. Sub-base material was removed at each core location to get an indication of the depth and type of material.

A-15.2.1.4 FWD Survey Results

A-15.1.1.1 Pavement Condition based on FWD Results

The deflection bowl created by the FWD load pulse is influenced by the stiffness of the different pavement layers. Tables of measured deflections and Surface Curvature Index (SCI) provide information on pavement condition as follows:

D1: Indication of overall pavement performance

SCI: Indicates condition of upper pavement layers

D9: Indication of sub-grade condition

Guidance on the interpretation of deflection values is given in '*Guidelines on the Depth of Overlay to be used on Rural Regional and Local Roads (March 2014)*' as issued by the Department of Transport, Tourism and Sport, and this guidance is reproduced in Table 3 and Table 4. Tabulated deflection results contained in this report are highlighted in colour, based on the guidance.

Table 3: Central and SCI (D1-D2) Deflection Criteria (normalised to 40kN)

Central Deflection (D1)	SCI	Comment
<300	<150	Good load spreading ability
300-500	150-250	Good to poor load spreading ability
501-800	251-400	Poor to bad load spreading ability
>800	>400	Bad load spreading ability

Table 4: Outer Deflection Criteria (normalised to 40kN)

Outer Deflection (D9)	Comment
<15	Stiff subgrade
15-30	Stiff to moderate subgrade
31-45	Moderate to weak subgrade
>45	Weak subgrade

Report sections A-15.2.1.1 to A-15.2.1.11 contain tables of results for deflection values measured at each test point along each test section, and graphs of these values against distance.

Pavement condition can be considered based on sub-sections with deflections of similar magnitude deflection. A summary of the average deflection results for each sub-section is presented in Table 5.

Table 5: Average Deflection Values

Section	Chainage	Lane	D1	D1-D2	D9
1 to 2	0-150	Northbound	999	508	11
		Southbound	626	221	16
	150-850	Northbound	667	313	14
		Southbound	681	332	14
	850-2500	Northbound	965	401	19
		Southbound	988	447	18
3 to 5	0-975	Northbound	481	169	26
		Southbound	498	176	24
	975-2350	Northbound	711	302	27
		Southbound	707	286	30
	2350-2850	Northbound	608	231	39
		Southbound	756	312	41
6 to 7	0-450	Northbound	762	352	16
		Southbound	868	432	16
	450-1400	Northbound	491	199	10
		Southbound	414	173	11
9 to 8	0-450	Northbound	1133	538	8
	450-1290	Northbound	677	296	7
4 to 9	0-1100	Westbound	676	275	27
		Eastbound	724	322	25
	1100-1350	Westbound	385	200	10
		Eastbound	600	281	12
	1350-2270	Westbound	725	333	14
		Eastbound	707	328	13
10 to 11	0-1750	Southbound	1239	485	15
	1750-2800	Southbound	611	240	12
	2800-3150	Southbound	1091	491	7
	3150-4280	Southbound	589	253	13
12 to 13	0-160	Southbound	525	293	4
14 to 15	0-150	Southbound	1079	304	53
	150-1240	Southbound	539	310	5
16 to 17	0-850	Eastbound	1106	411	20
		Westbound	814	285	15
	875-1500	Eastbound	517	216	10
		Westbound	453	206	11
	1550-2150	Eastbound	1140	378	22
		Westbound	1062	394	19
18 to 19	0-430	Southbound	1165	469	11
20 to 21	0-1350	Eastbound	714	259	17
	1350-1800	Eastbound	1406	360	17
	1800-2200	Eastbound	577	276	7

The condition of the pavement could generally be described as follows:

- The pavement structure is weak with poor to bad load spreading ability on most sections.
- Many of the sections have excessive values highlighted in red. This normally indicates pavement failure.
- D9 values indicate stiff to moderate sub-grade support for most sections. Two sections, (3 to 5) and (14 to 15), have a number of D9 values that are very high suggesting a much weaker sub-grade.

A-15.1.1.2 Core Results

Table 7 contains details of core locations and pavement layer thicknesses determined from cores taken along each test section.

Table 7: Core Results

Section	Chainage	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
1 to 2	300	50mm DBM	40mm S.D.	120mm C.R.	Stoney Clay	---
	900	30mm S.D.	50mm DBM	60mm C.R.	+200mm Gravel/clay	
	1500	35mm S.D.	50mm C.R.	+200mm Gravel/clay		---
	2100	45mm S.D.	90mm C.R.	+200mm Gravel/clay		---
3 to 5	500	35mm DBM	65mm S.D.	140mm C.R.	Gravel/Clay	---
	950	30mm S.D.	50mm C.R.	25mm S.D.	Stone/Clay	---
	1450	40mm S.D.	80mm C.R.	30mm S.D.	Stone/Clay	---
	2000	35mm S.D.	70mm C.R.	35mm S.D.	Stone/Clay	---
6 to 7	200	35mm S.D.	95mm C.R.	Clay	---	---
	1000	20mm S.D.	120mm C.R.	10mm S.D.	110mm C.R.	Stone/Clay
9 to 8	300	20mm S.D.	130mm C.R.	Clay	---	---
	1000	20mm S.D.	110mm C.R.	Stone/Clay	---	---
4 to 9	550	25mm S.D.	70mm C.R.	30mm S.D.	70mm C.R.	Stone/Clay
	750	15mm S.D.	55mm C.R.	40mm S.D.	80mm C.R.	Stone/Clay
	1250	40mm S.D.	110mm C.R.	70mm DBM	Stone/Clay	---
	1900	25mm S.D.	35mm C.R.	25mm S.D.	60mm C.R.	Stone/Clay
11 to 10	550	22mm S.D.	60mm C.R.	70mm Shale	Clay	---
	1300	15mm S.D.	40mm C.R.	55mm Shale	Clay	---
	1850	20mm S.D.	60mm C.R.	50mm Shale	Clay	---
	2350	15mm S.D.	55mm Clay	Stone/Clay	---	---
	3050	15mm S.D.	40mm C.R.	Stone/Clay	---	---
	3700	25mm S.D.	50mm C.R.	---	---	---
12 to 13	80	20mm S.D.	100mm C.R.	Shale/Clay		
14 to 15	100	15mm S.D.	55mm Shale	Clay	---	---
	750	10mm S.D.	70mm Shale	Clay	---	---
16 to 17	250	40mm S.D.	80mm C.R.	+200mm C.R.	---	---
	650	30mm S.D.	110mm C.R.	115mm C.R.	Clay	---
	1300	55mm S.D.	55mm C.R.	+200mm C.R.	---	---
	1750	45mm S.D.	+300mm C.R.	---	---	---
18 to 19	220	15mm S.D.	45mm C.R.	25mm S.D.	55mm C.R.	Gravel/clay
20 to 21	200	40mm S.D.	30mm C.R.	80mm S.D.	110mm Shale	Clay
	700	35mm S.D.	45mm C.R.	30mm S.D.	80mm C.R.	Clay
	1300	45mm S.D.	40mm C.R.	25mm S.D.	60mm C.R.	Clay
	1750	50mm S.D.	230mm C.R.	Clay	---	---

S.D. = Surface Dressing C.R. = Crushed Rock DBM = Dense Bituminous Macadam

A-15.1.1.3 FWD Section 1 to 2: Tabulated Results and Graphs

Table A1: Section 1 to 2 Northbound values

Chainage	D1	D1-D2	D9
0	715	270	12
50	1079	528	13
100	1386	787	13
150	817	446	8
200	672	318	10
250	730	385	9
300	760	364	10
350	749	353	9
400	683	309	12
450	733	389	9
500	681	332	13
550	789	465	15
600	613	249	19
650	578	221	21
700	598	230	24
750	492	233	19
800	643	268	14
850	611	267	12
900	1366	650	16
950	779	360	17
1000	1336	621	28
1050	799	300	36
1100	794	404	19
1150	1001	369	30
1200	738	266	37
1250	1083	433	20

Table A2: Section 1 to 2 Southbound values

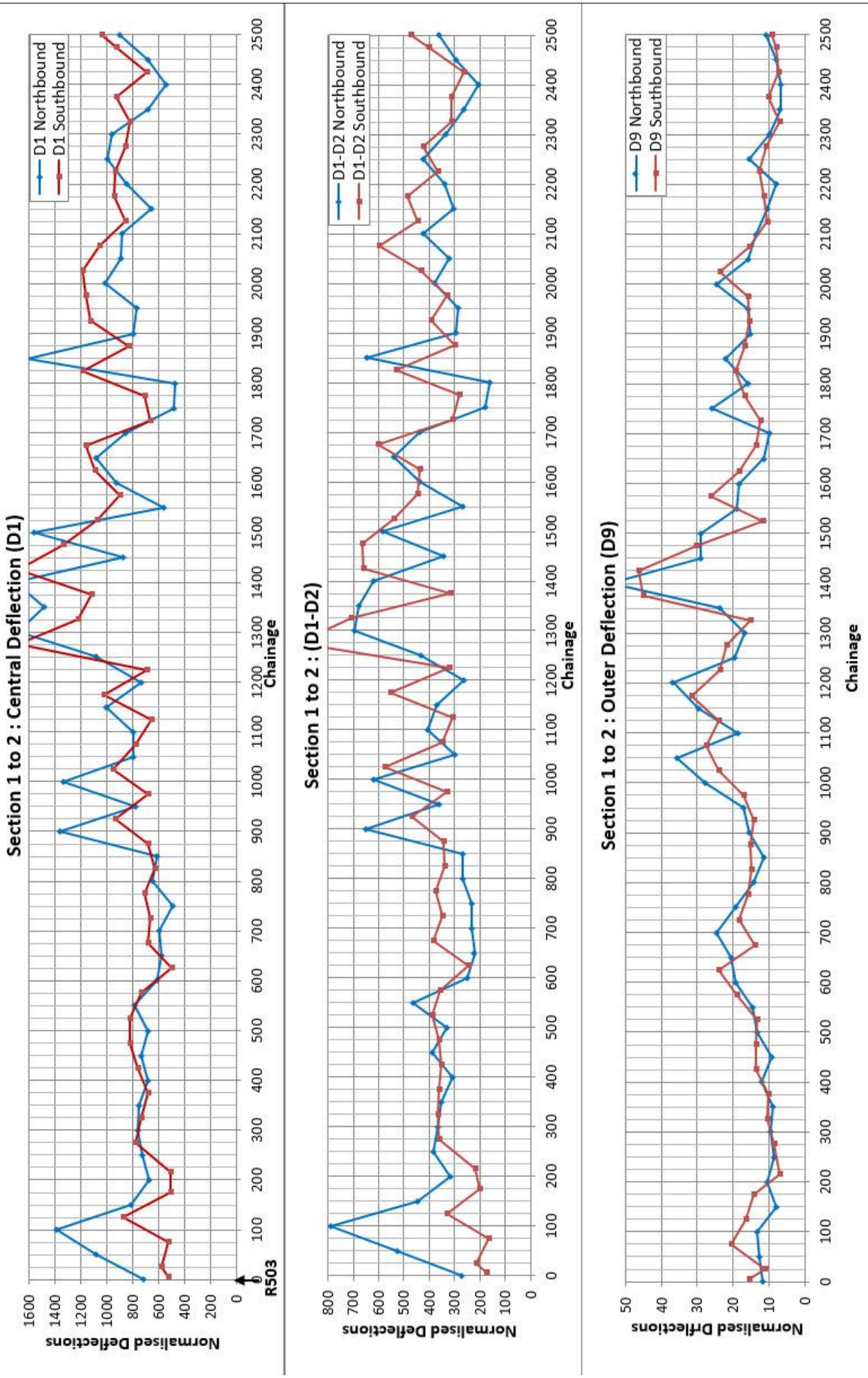
Chainage	D1	D1-D2	D9
5	528	174	16
25	582	216	11
75	523	163	21
125	870	332	17
175	512	203	14
215	511	218	7
275	775	363	9
325	736	366	10
375	682	360	10
425	759	354	14
475	819	361	14
525	822	388	13
575	737	355	19
625	499	244	24
675	678	382	14
725	663	347	18
775	707	375	16
825	633	338	15
875	686	345	15
925	937	467	14
975	682	332	17
1025	954	574	24
1075	776	350	27
1125	658	307	24
1175	1023	554	31
1225	687	322	24

Table A1: Section 1 to 2 Northbound (cont'd)

Chainage	D1	D1-D2	D9
1300	1684	695	17
1350	1485	678	24
1401	1709	620	54
1450	873	344	29
1500	1565	583	29
1550	561	267	19
1600	924	438	18
1650	1084	540	11
1700	854	436	10
1750	480	178	26
1800	475	162	16
1850	1612	647	22
1900	796	293	15
1950	770	287	16
2000	1017	381	25
2050	892	321	16
2100	884	425	14
2150	655	303	11
2200	849	338	8
2250	993	424	16
2300	962	335	10
2350	686	264	7
2400	542	205	7
2450	682	296	8
2500	902	360	11

Table A2: Section 1 to 2 Southbound (cont'd)

Chainage	D1	D1-D2	D9
1275	1684	917	22
1325	1219	710	15
1375	1122	318	45
1425	1688	659	46
1475	1340	665	30
1525	1078	540	12
1575	904	444	26
1625	1092	436	18
1675	1161	604	13
1725	663	309	12
1775	708	281	17
1825	1190	529	19
1875	829	301	17
1925	1125	393	16
1975	1158	330	16
2025	1185	433	24
2075	1054	598	15
2125	857	446	11
2175	943	486	11
2225	939	364	13
2275	856	423	11
2325	820	313	7
2375	928	312	10
2425	689	265	7
2475	926	402	8
2500	1040	471	9


Section 1 to 2 : Central Deflection (D1)
D1 Northbound
D1 Southbound
Normalised Deflections
Chainage
R503
Section 1 to 2 : (D1-D2)
D1-D2 Northbound
D1-D2 Southbound
Normalised Deflections
Chainage
Section 1 to 2 : Outer Deflection (D9)
D9 Northbound
D9 Southbound
Normalised Deflections
Chainage

A-15.1.1.4 FWD Section 3 to 5: Tabulated Results and Graphs

Table B1: Section 3 to 5 Northbound values

Chainage	D1	D1-D2	D9
0	426	138	25
50	540	178	26
100	604	251	33
150	64	3	31
200	791	274	40
250	507	188	9
300	408	138	12
350	694	271	9
400	473	176	14
450	565	233	17
500	434	161	24
550	434	158	21
600	685	296	16
650	490	191	23
700	281	74	24
750	326	85	34
800	307	76	32
850	544	193	33
900	586	194	38
950	452	108	49
1000	774	303	65
1050	1011	401	45
1100	867	368	40
1150	556	169	34
1200	538	214	16
1250	446	190	9
1300	543	221	12
1350	655	261	23
1400	650	231	29

Table B2: Section 3 to 5 Southbound values

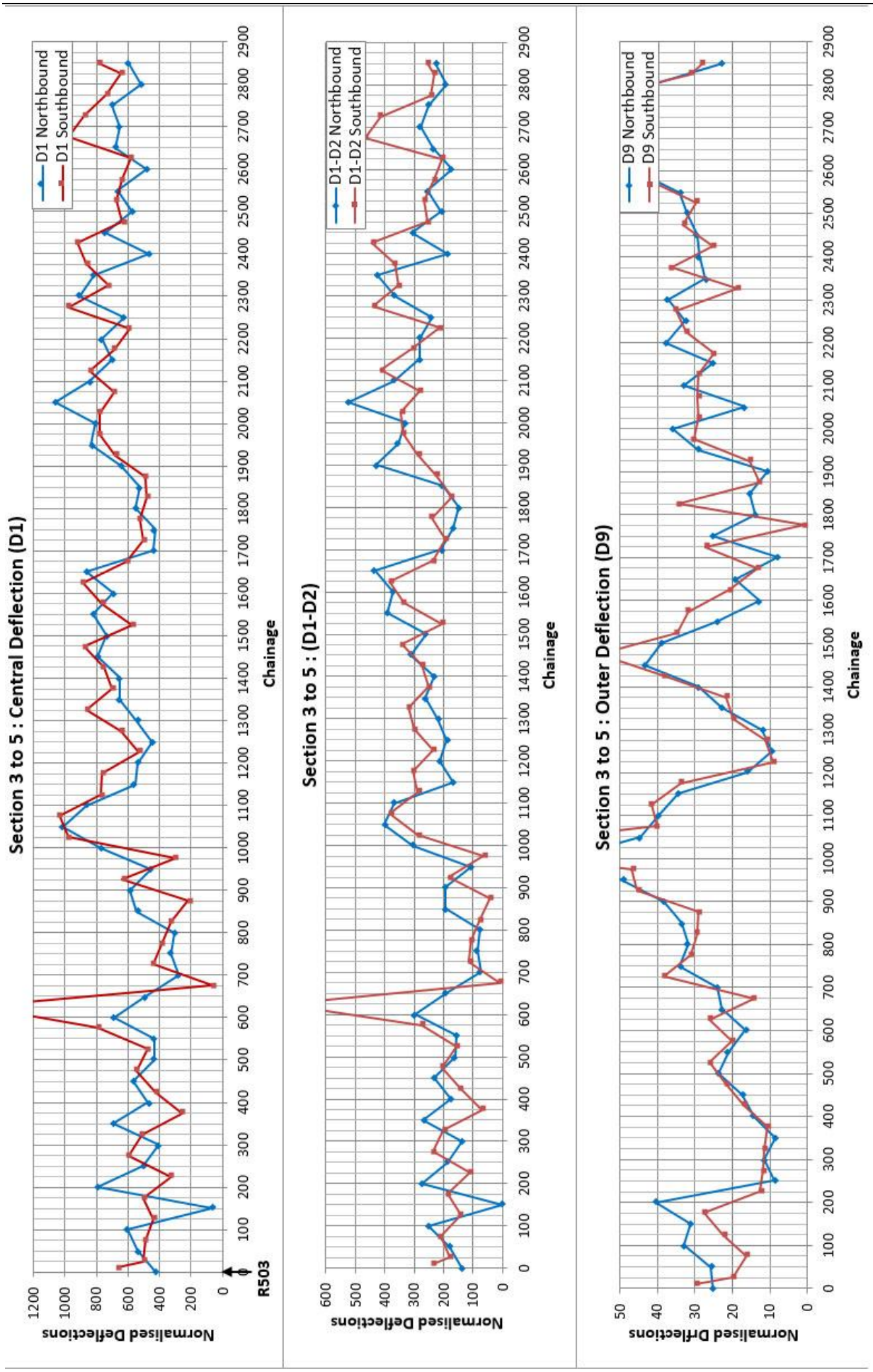
Chainage	D1	D1-D2	D9
10	666	235	30
25	501	178	20
75	489	211	16
125	438	141	22
175	502	187	28
225	329	111	13
275	595	236	12
325	510	200	12
375	255	71	11
425	428	142	17
475	546	207	22
525	478	157	26
575	791	273	20
625	1554	750	26
675	67	9	14
725	443	114	38
775	384	106	31
825	325	78	29
875	218	42	29
925	635	184	45
975	302	64	47
1025	977	287	91
1075	1036	383	40
1125	775	287	42
1175	764	305	34
1225	531	235	9
1275	648	300	11
1325	865	319	20
1375	700	249	22

Table B1: Section 3 to 5 Northbound (cont'd)

Chainage	D1	D1-D2	D9
1450	795	312	43
1500	737	260	39
1550	822	392	24
1600	693	371	13
1650	862	434	19
1700	440	209	8
1750	428	170	25
1800	553	150	14
1850	525	203	15
1900	648	430	11
1950	832	352	29
2000	808	329	36
2050	1060	523	17
2100	840	369	33
2151	703	280	25
2200	766	283	38
2250	626	241	33
2300	905	366	37
2350	814	426	27
2400	471	187	29
2450	742	306	29
2500	574	208	32
2550	668	253	34
2600	480	172	46
2650	682	235	57
2700	654	278	48
2750	702	249	47
2800	516	192	41
2850	592	227	23

Table B2: Section 3 to 5 Southbound (cont'd)

Chainage	D1	D1-D2	D9
1425	754	274	38
1475	875	341	55
1525	574	206	35
1575	762	336	32
1625	884	382	21
1675	613	236	13
1725	505	193	27
1775	523	240	1
1825	480	173	34
1875	491	223	13
1925	680	288	15
1975	780	338	30
2025	783	345	29
2075	685	281	29
2125	844	414	29
2175	687	306	25
2225	591	214	32
2275	979	438	35
2325	721	355	19
2375	867	365	36
2425	918	442	25
2475	636	253	33
2525	675	266	30
2575	637	231	42
2625	585	207	58
2675	977	467	53
2725	879	414	51
2775	734	244	54
2825	647	230	31
2850	787	255	28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D1 Northbound
D1 Southbound
Normalised Deflections
Chainage
R503
Section 3 to 5 : (D1-D2)
D1-D2 Northbound
D1-D2 Southbound
Normalised Deflections
Chainage
Section 3 to 5 : Outer Deflection (D9)
D9 Northbound
D9 Southbound
Normalised Deflections
Chainage

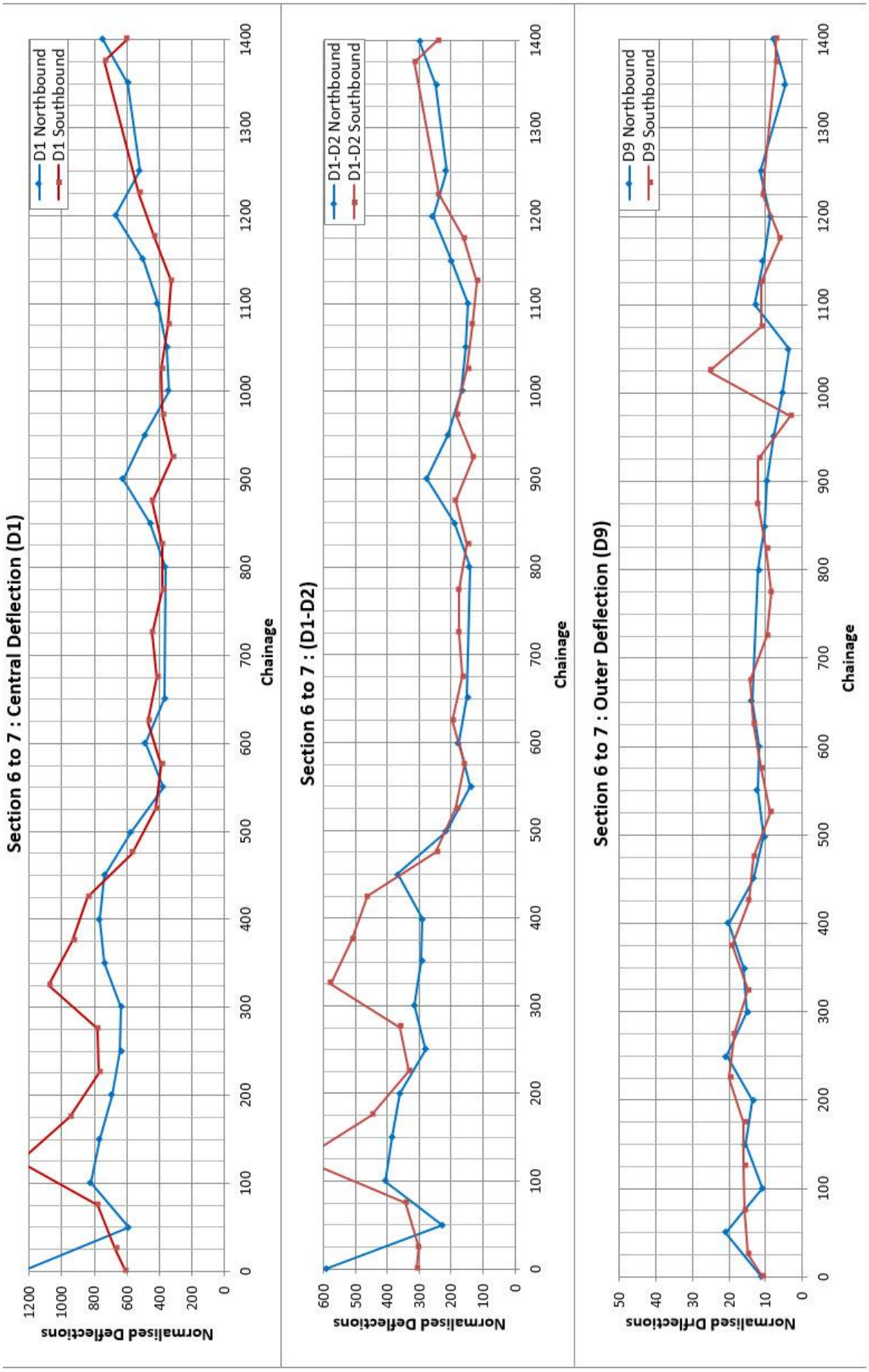
A-15.1.1.5 FWD Section 6 to 7: Tabulated Results and Graphs

Table C1: Section 6 to 7 Northbound values

Chainage	D1	D1-D2	D9
0	1237	592	11
50	588	227	21
100	822	407	11
150	766	384	16
200	693	361	13
250	640	282	21
300	637	314	15
350	737	293	16
400	767	293	20
450	736	368	13
499	576	215	10
550	372	140	12
600	486	176	12
651	364	151	14
800	363	141	12
850	456	190	10
900	624	276	10
950	494	212	8
1000	339	167	5
1050	351	154	4
1100	407	148	13
1150	496	199	11
1200	669	257	9
1251	519	215	11
1350	595	248	5
1400	748	300	8

Table C2: Section 6 to 7 Southbound values

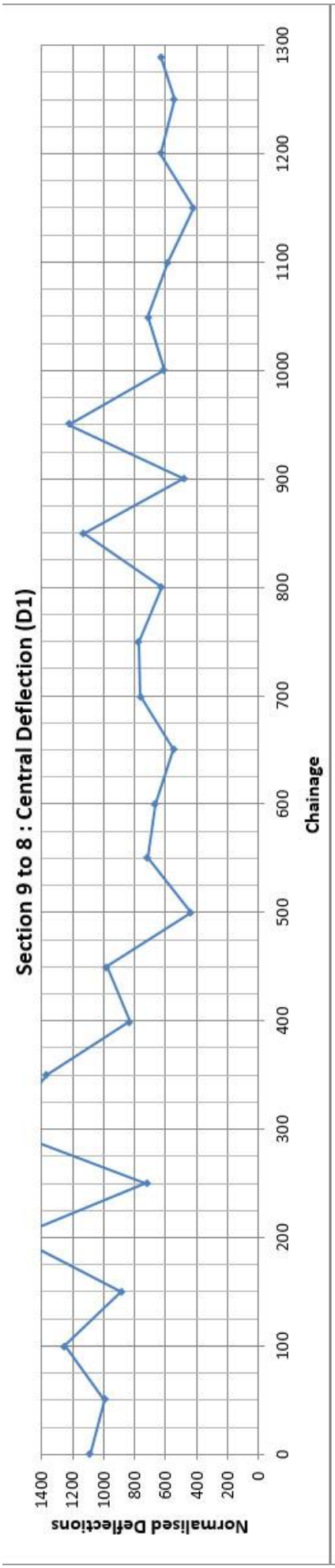
Chainage	D1	D1-D2	D9
0	610	309	11
25	667	301	15
75	783	342	16
125	1259	669	16
175	952	450	16
225	774	332	20
275	782	361	19
325	1079	579	15
375	935	511	19
425	839	463	15
475	565	249	13
525	425	185	9
575	388	159	11
625	471	195	13
675	413	166	14
725	441	177	10
774	379	175	9
825	383	150	10
875	441	186	12
925	319	129	12
974	381	185	3
1025	391	150	26
1075	346	135	11
1125	329	119	11
1175	430	163	6
1225	524	238	11
1375	742	314	7
1400	598	243	7


Section 6 to 7 : Central Deflection (D1)
D1 Northbound
D1 Southbound
Normalised Deflections
Chainage
Section 6 to 7 : (D1-D2)
D1-D2 Northbound
D1-D2 Southbound
Normalised Deflections
Chainage
Section 6 to 7 : Outer Deflection (D9)
D9 Northbound
D9 Southbound
Normalised Deflections
Chainage

A-15.1.1.6 FWD Section 9 to 8: Tabulated Results and Graphs

Table D1: Section 9 to 8 Northbound values

Chainage	D1	D1-D2	D9
0	1086	397	7
50	994	584	4
100	1246	797	14
150	888	524	7
200	1573	871	11
250	727	279	4
300	1644	560	25
350	1368	581	6
400	827	296	4
450	975	492	4
500	436	213	0
550	717	219	5
600	668	354	4
650	550	240	2
700	764	309	11
750	775	311	6
800	625	260	12
850	1123	469	4
900	482	222	2
950	1226	534	13
1000	610	294	2
1050	716	404	5
1100	586	248	9
1150	419	176	6
1200	632	267	19
1250	541	266	10
1290	634	250	16


Section 9 to 8 : Central Deflection (D1)
Normalised Deflections
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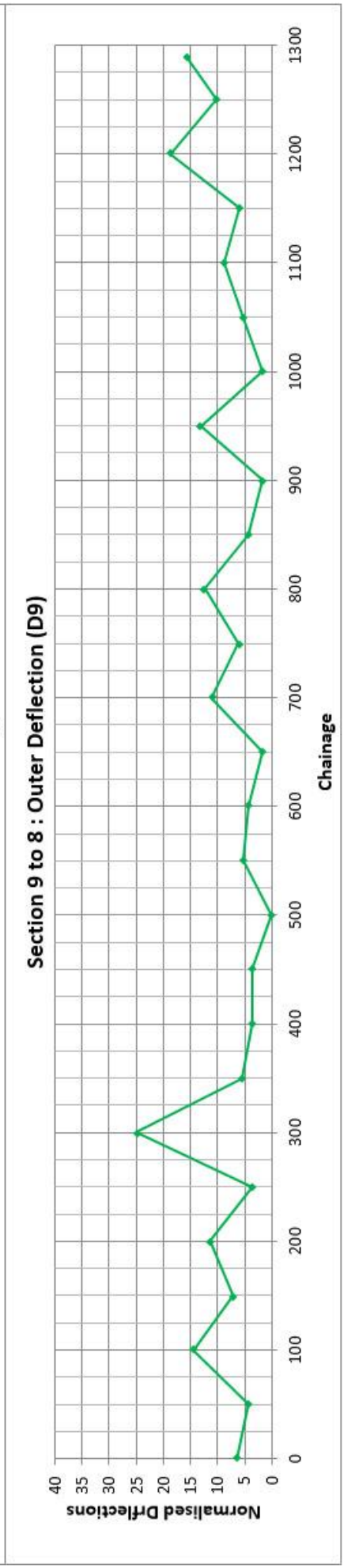
200
400
600
800
1000
1200
1400
Chainage
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300

Section 9 to 8 : (D1-D2)
Normalised Deflections
0
100
200
300
400
500
600
700
Chainage
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300


Section 9 to 8 : Outer Deflection (D9)
Normalised Drflections
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5
10
15
20
25
30
35
40
Chainage
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300

A-15.1.1.7 FWD Section 4 to 9: Tabulated Results and Graphs

Table E1: Section 4 to 9 Northbound values

Chainage	D1	D1-D2	D9
0	754	267	18
50	635	224	27
100	512	227	28
150	717	309	24
200	404	142	22
250	706	303	25
300	782	282	42
350	652	241	51
400	420	123	35
450	638	242	39
500	566	177	37
550	766	287	49
600	696	250	36
650	750	330	7
700	501	242	5
750	801	358	15
800	1007	410	26
850	753	278	26
900	798	378	41
950	564	229	18
1000	656	320	17
1050	549	263	17
1100	913	443	12
1150	414	262	3

Table E2: Section 4 to 9 Southbound values

Chainage	D1	D1-D2	D9
0	445	152	25
25	1460	826	17
75	840	349	28
125	396	155	26
175	599	285	18
225	608	322	18
275	588	227	40
325	698	290	46
375	638	218	42
425	671	259	35
475	707	286	50
525	754	330	30
575	366	138	18
625	282	130	1
675	670	350	3
725	843	333	23
775	1127	558	24
825	942	487	17
875	686	270	32
925	921	424	29
975	725	286	18
1025	868	416	26
1075	828	315	18
1125	488	246	0

Table E1: Section 4 to 9 Northbound (cont'd)

Chainage	D1	D1-D2	D9
1200	384	218	1
1250	359	151	15
1300	383	169	20
1350	1025	558	14
1400	952	545	3
1450	200	117	5
1500	847	371	15
1550	836	332	18
1600	619	245	21
1650	684	244	24
1700	636	262	25
1750	815	459	25
1800	527	238	22
1850	574	230	17
1900	693	318	15
1950	918	449	16
2000	658	303	6
2050	420	205	9
2100	727	314	15
2150	831	415	5
2200	744	323	9
2250	736	346	4
2270	1058	377	6

Table E2: Section 4 to 9 Southbound (cont'd)

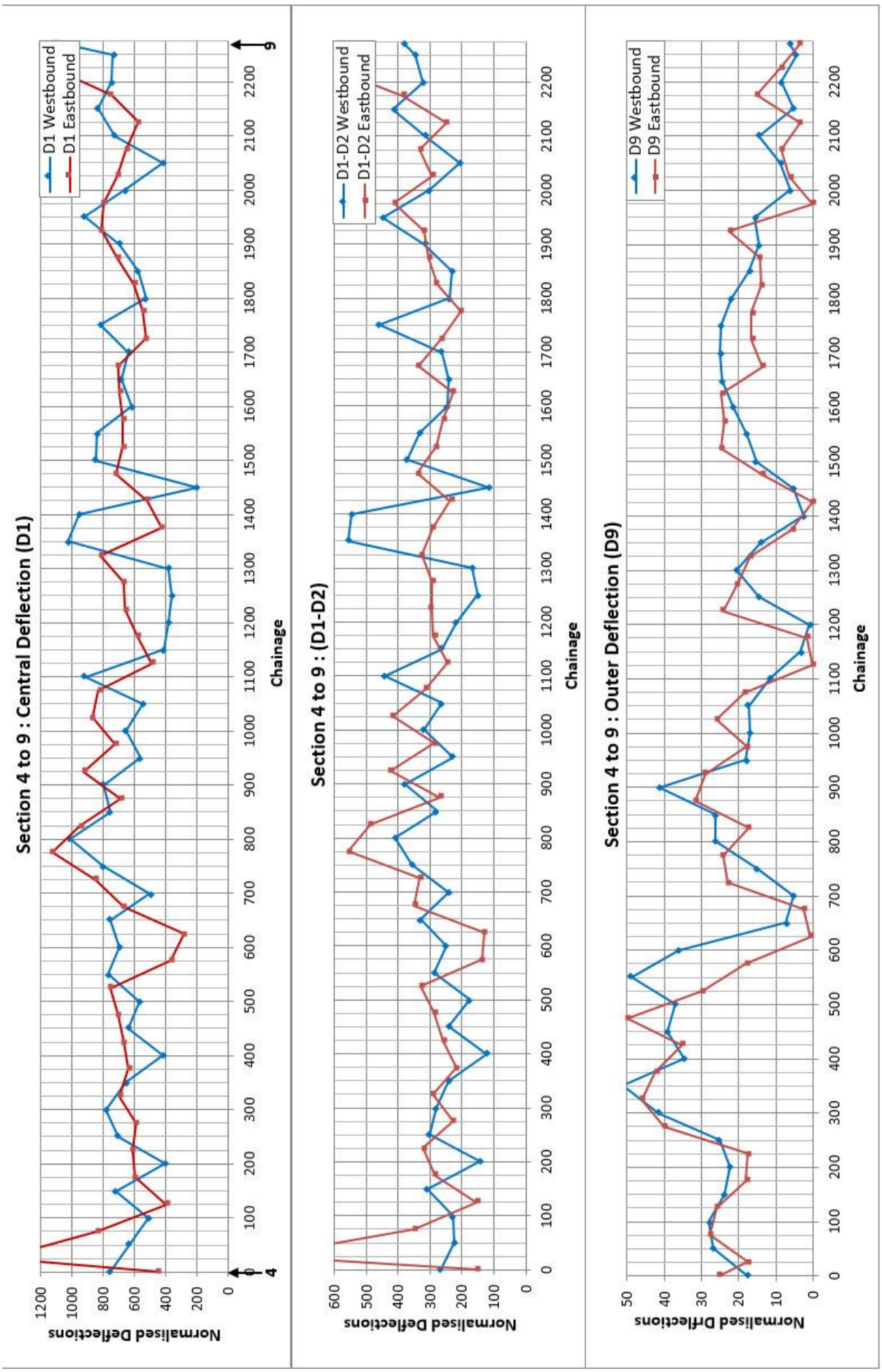
Chainage	D1	D1-D2	D9
1175	584	289	2
1225	660	295	24
1275	670	294	20
1325	815	326	17
1375	426	292	6
1425	521	237	0
1475	715	338	13
1525	672	279	25
1575	672	259	24
1625	696	227	25
1675	703	336	13
1725	527	262	17
1775	548	204	17
1825	604	278	14
1875	709	304	14
1925	807	319	23
1975	797	414	0
2025	713	295	6
2075	654	333	8
2125	574	250	3
2175	749	386	15
2225	1126	608	9
2270	1102	610	4

Table E1: Section 4 to 9 Northbound (cont'd)

Chainage	D1	D1-D2	D9
1200	913	443	12
1250	549	263	17
1300	656	320	17
1350	564	229	18
1400	798	378	41
1450	753	278	26
1500	1007	410	26
1550	801	358	15
1600	501	242	5
1650	750	330	7
1700	696	250	36
1750	766	287	49
1800	566	177	37
1850	638	242	39
1900	420	123	35
1950	652	241	51
2000	782	282	42
2050	706	303	25
2100	404	142	22
2150	717	309	24
2200	512	227	28
2250	635	224	27
2270	754	267	18

Table E2: Section 4 to 9 Southbound (cont'd)

Chainage	D1	D1-D2	D9
1175	828	315	18
1225	868	416	26
1275	725	286	18
1325	921	424	29
1375	686	270	32
1425	942	487	17
1475	1127	558	24
1525	843	333	23
1575	670	350	3
1625	282	130	1
1675	366	138	18
1725	754	330	30
1775	707	286	50
1825	671	259	35
1875	638	218	42
1925	698	290	46
1975	588	227	40
2025	608	322	18
2075	599	285	18
2125	396	155	26
2175	840	349	28
2225	1460	826	17
2270	445	152	25


Section 4 to 9 : Central Deflection (D1)
D1 Westbound
D1 Eastbound
Normalised Deflections
Chainage
4
9
Section 4 to 9 : (D1-D2)
D1-D2 Westbound
D1-D2 Eastbound
Normalised Deflections
Chainage
Section 4 to 9 : Outer Deflection (D9)
D9 Westbound
D9 Eastbound
Normalised Deflections
Chainage

A-15.1.1.8 FWD Section 10 to 11: Tabulated Results and Graphs

Table F1: Section 10 to 11 Deflection values

Chainage	D1	D1-D2	D9
0	441	170	2
50	576	205	6
100	313	100	7
150	1560	746	6
200	998	312	18
250	668	248	11
300	665	297	4
350	718	324	6
400	954	424	7
450	1569	663	11
500	863	228	22
550	558	287	3
600	2041	515	50
650	1143	289	35
700	927	512	4
750	1273	712	7
800	284	146	3
850	1388	994	4
900	3418	1435	27
950	1920	570	33
1000	1642	399	26
1050	1975	1389	10

Table F1: Section 10 to 11 values (cont'd)

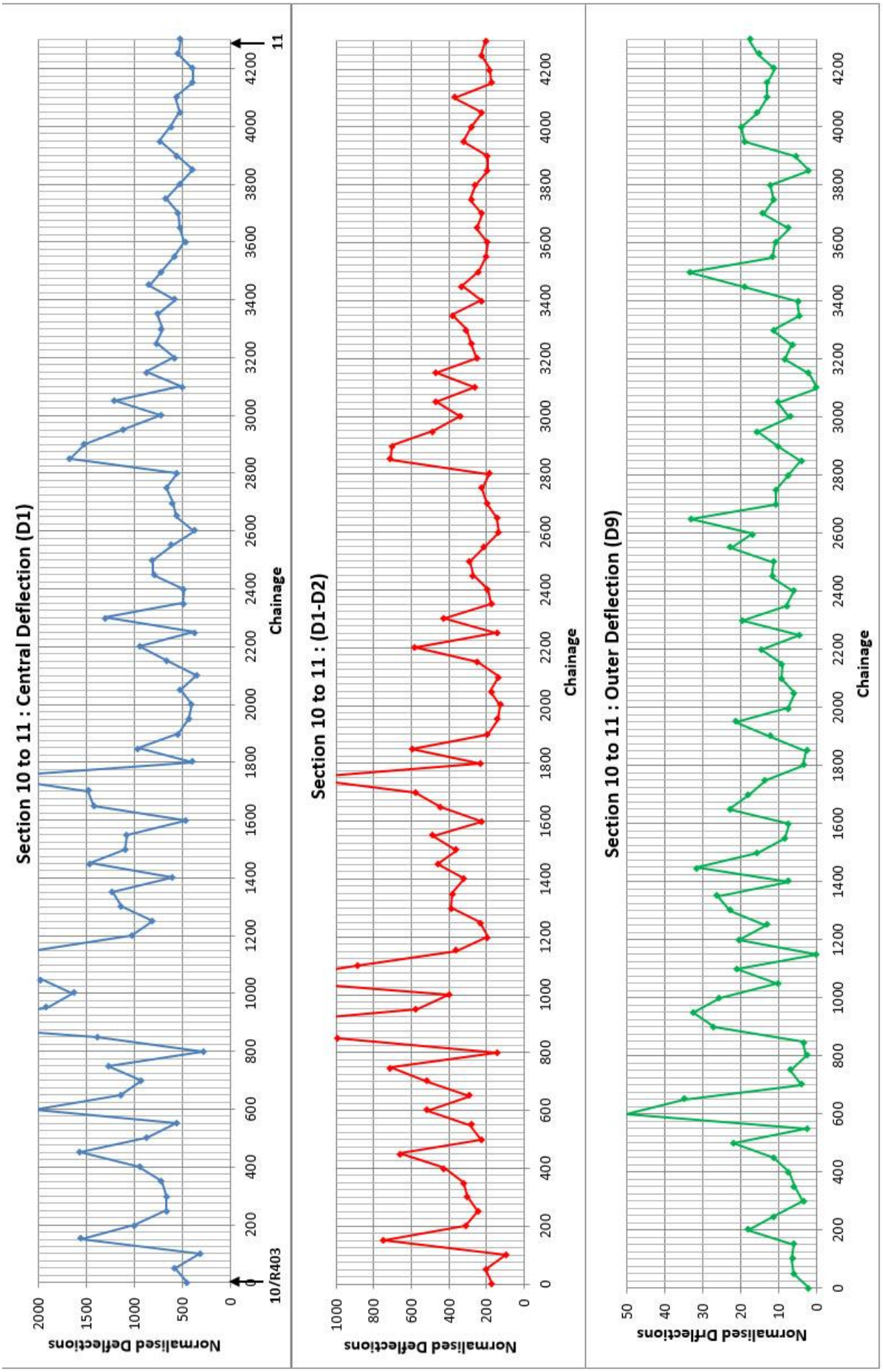
Chainage	D1	D1-D2	D9
1100	587	254	8
1150	876	464	2
1200	514	266	0
1250	1205	467	10
1300	724	343	7
1350	1124	486	16
1400	1519	705	10
1450	1674	708	4
1500	557	186	8
1550	667	224	11
1600	602	197	11
1650	557	148	33
1700	371	136	17
1750	614	209	23
1800	803	288	12
1850	802	271	12
1900	482	195	6
1950	491	176	8
2000	1304	424	20
2050	379	150	5
2100	946	581	15
2150	654	248	9

Table F1: Section 10 to 11 values (cont'd)

Chainage	D1	D1-D2	D9
2200	946	581	15
2250	379	150	5
2300	1304	424	20
2350	491	176	8
2400	482	195	6
2450	802	271	12
2500	803	288	12
2550	614	209	23
2600	371	136	17
2650	557	148	33
2700	602	197	11
2750	667	224	11
2800	557	186	8
2850	1674	708	4
2900	1519	705	10
2950	1124	486	16
3000	724	343	7
3050	1205	467	10
3100	514	266	0
3150	876	464	2
3200	587	254	8
3250	778	281	7

Table F1: Section 10 to 11 values (cont'd)

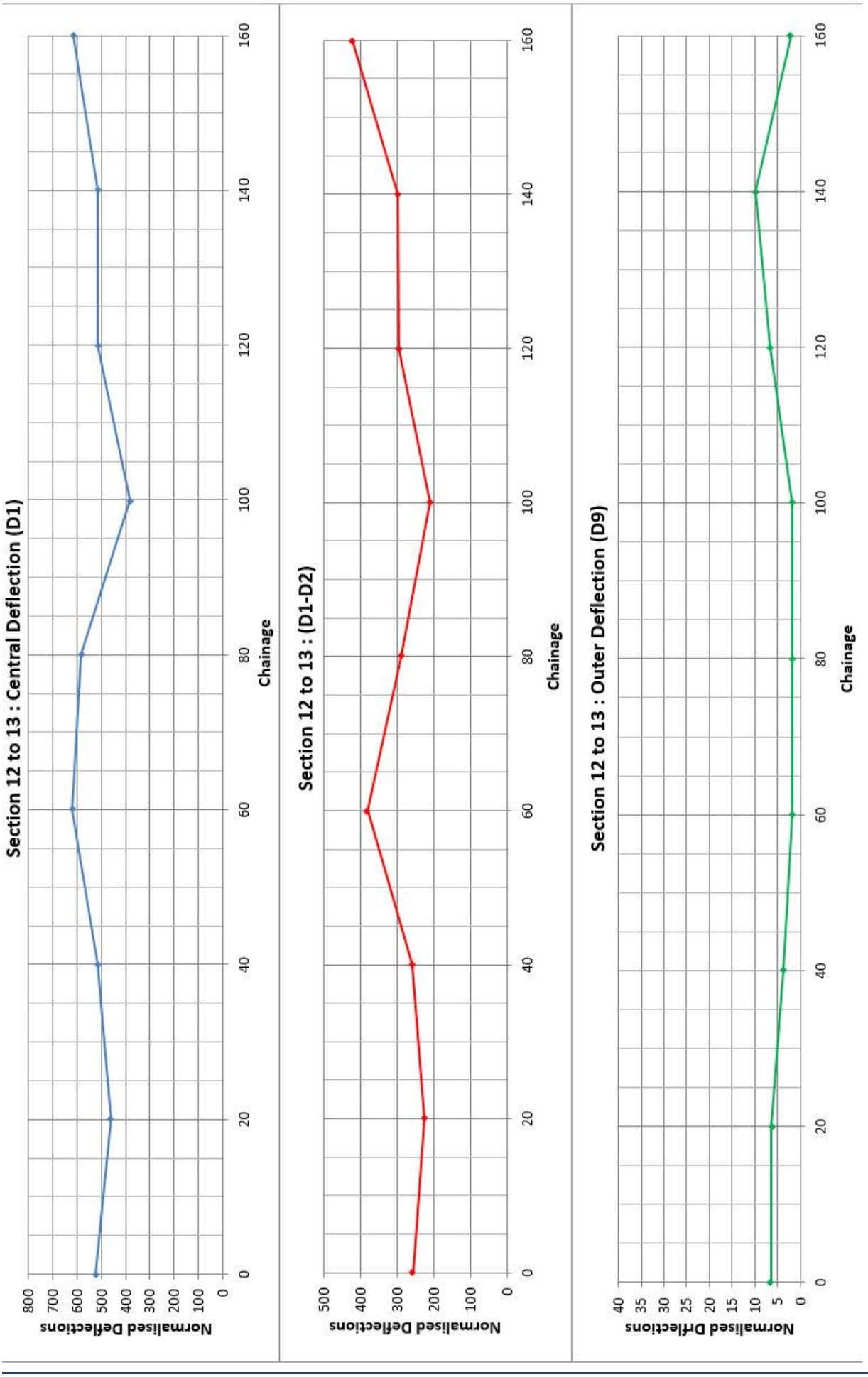
Chainage	D1	D1-D2	D9
3250	1975	1389	10
3300	1642	399	26
3350	1920	570	33
3400	3418	1435	27
3450	1388	994	4
3500	284	146	3
3550	1273	712	7
3600	927	512	4
3650	1143	289	35
3700	2041	515	50
3750	558	287	3
3800	863	228	22
3850	1569	663	11
3900	954	424	7
3950	718	324	6
4000	665	297	4
4050	668	248	11
4100	998	312	18
4150	1560	746	6
4200	313	100	7
4250	576	205	6
4280	441	170	2


Section 10 to 11 : Central Deflection (D1)
Normalised Deflections
Chainage
10/R403
11
Section 10 to 11 : (D1-D2)
Normalised Deflections
Chainage
Section 10 to 11 : Outer Deflection (D9)
Normalised Deflections
Chainage

A-15.1.1.9 FWD Section 12 to 13: Tabulated Results and Graphs

Table G1: Section 12 to 13 Deflection values

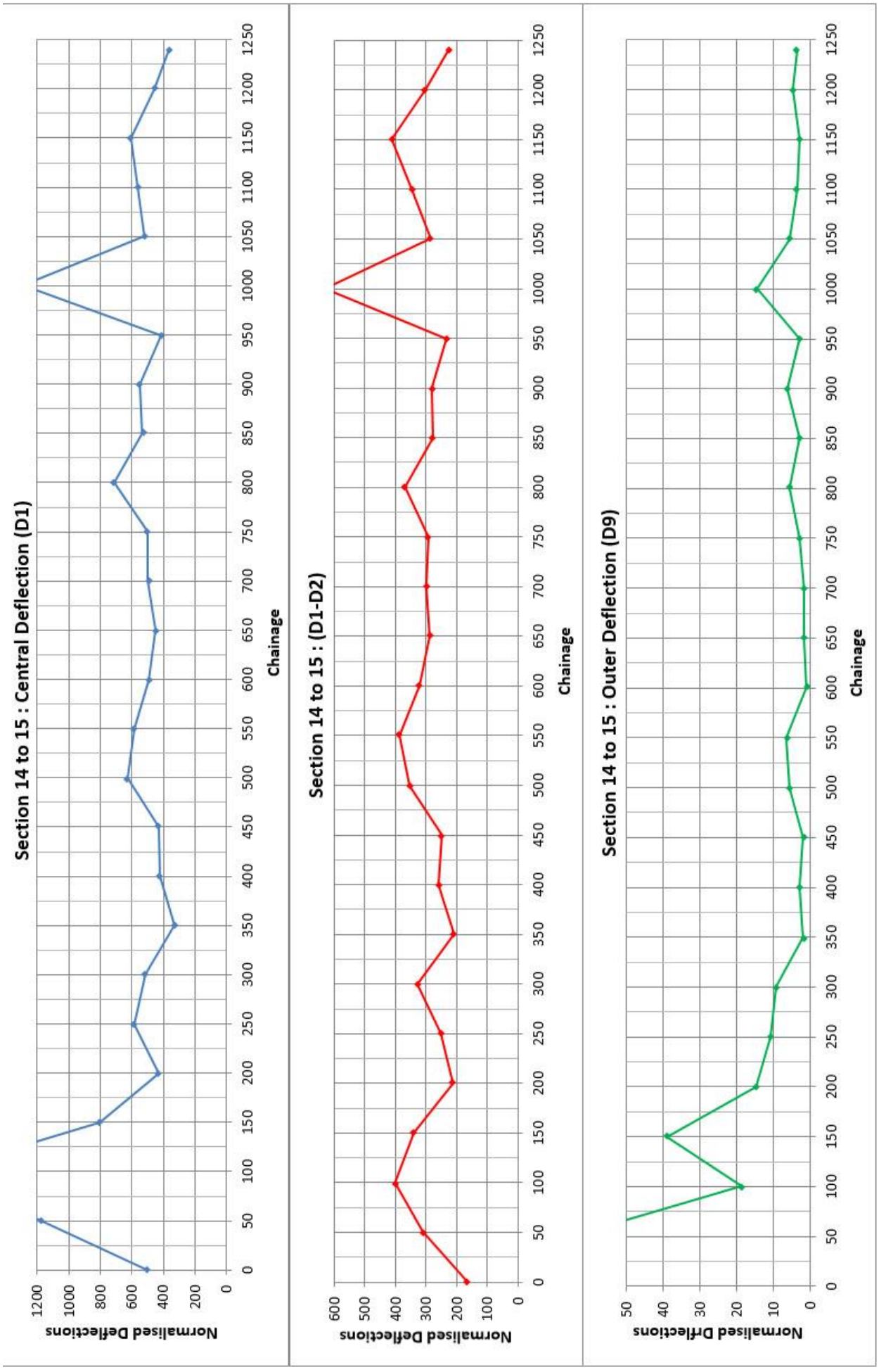
Chainage	D1	D1-D2	D9
0	523	256	6
20	461	224	6
40	517	258	4
60	621	381	2
80	582	290	2
100	382	210	2
120	515	294	7
140	513	299	10
160	615	420	2


Section 12 to 13 : Central Deflection (D1)
Normalised Deflections
0
100
200
300
400
500
600
700
800
Chainage
0
20
40
60
80
100
120
140
160
Section 12 to 13 : (D1-D2)
Normalised Deflections
0
100
200
300
400
500
Chainage
0
20
40
60
80
100
120
140
160
Section 12 to 13 : Outer Deflection (D9)
Normalised Drflections
0
5
10
15
20
25
30
35
40
Chainage
0
20
40
60
80
100
120
140
160

A-15.1.1.10 FWD Section 14 to 15: Tabulated Results and Graphs

Table H1: Section 14 to 1 Northbound values

Chainage	D1	D1-D2	D9
0	505	164	91
50	1179	310	65
100	1831	401	19
150	802	341	39
200	432	212	15
250	583	251	11
300	510	327	9
350	326	208	2
400	422	257	3
450	428	248	2
500	628	354	6
550	582	385	6
600	490	321	1
650	448	287	2
700	497	300	2
750	500	293	3
800	709	368	6
850	532	278	3
900	547	282	6
950	415	233	3
1000	1292	632	14
1050	518	284	6
1100	562	345	4
1150	605	413	3
1200	455	304	5
1240	366	228	4


Section 14 to 15 : Central Deflection (D1)
Normalised Deflections
Chainage
0
200
400
600
800
1000
1200
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
Section 14 to 15 : (D1-D2)
Normalised Deflections
Chainage
0
100
200
300
400
500
600
Section 14 to 15 : Outer Deflection (D9)
Normalised Deflections
Chainage
0
10
20
30
40
50

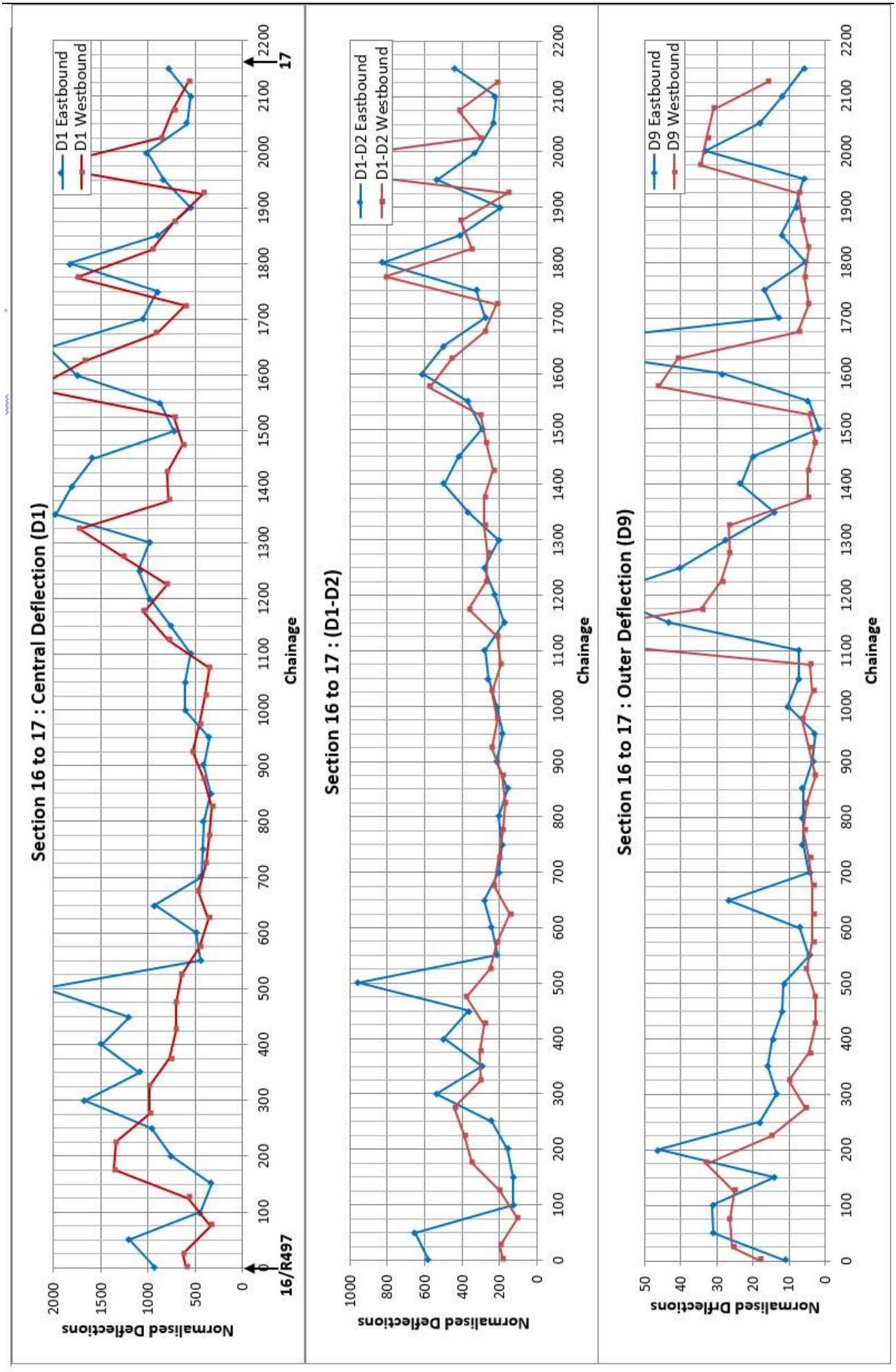
A-15.1.1.11 FWD Section 16 to 17: Tabulated Results and Graphs

Table J1: Section 16 to 17 Northbound values

Chainage	D1	D1-D2	D9
0	928	580	11
50	1198	653	31
100	446	128	31
150	329	125	14
200	755	155	46
250	958	240	18
300	1667	535	13
350	1090	292	16
400	1489	496	15
450	1202	365	12
500	2108	953	12
550	438	212	4
600	487	241	7
650	931	284	27
700	434	205	4
750	415	189	6
800	404	202	6
850	342	156	6
900	414	216	3
950	352	181	3
1000	602	215	10
1050	604	258	7
1100	548	279	7
1150	755	176	44
1200	984	224	62
1250	1097	282	40
1300	979	203	27
1350	1977	367	14
1400	1814	499	23
1450	1588	422	20
1500	727	296	2
1550	873	372	5
1600	1752	614	29
1650	2051	498	82
1700	1050	276	13
1750	899	323	17
1800	1834	831	6
1850	889	411	12
1900	544	196	8
1950	833	534	6
2000	1008	327	33
2050	584	237	18
2100	544	219	12
2150	783	435	6

Table J2: Section 16 to 17 Southbound values

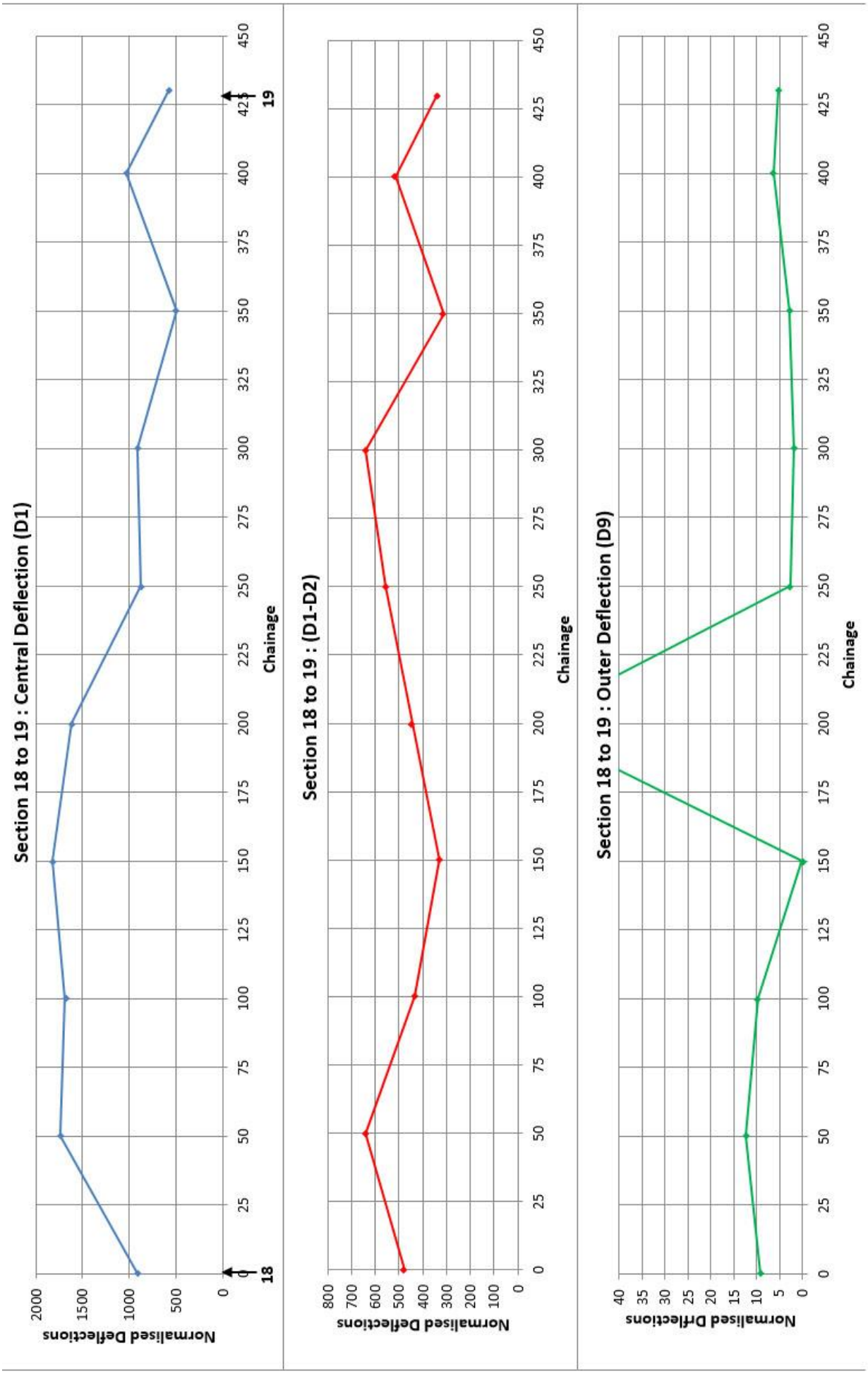
Chainage	D1	D1-D2	D9
0	594	184	18
25	628	197	26
75	332	105	26
125	571	202	25
175	1363	350	33
225	1335	389	15
275	980	443	5
325	986	301	10
375	769	303	4
425	698	280	3
475	698	376	3
525	642	254	5
575	458	209	4
625	355	145	3
675	465	231	3
725	387	206	4
775	350	180	6
825	324	171	5
875	407	188	3
925	524	242	4
975	450	213	6
1025	399	239	3
1075	348	192	4
1125	786	213	85
1175	1045	364	34
1225	797	268	29
1275	1263	267	27
1325	1725	281	27
1375	783	283	5
1425	796	235	5
1475	627	269	3
1525	720	303	4
1575	2211	574	46
1625	1671	461	41
1675	908	284	8
1725	605	218	5
1775	1757	810	6
1825	958	350	5
1875	725	409	6
1925	418	155	8
1975	2077	1412	35
2025	858	298	33
2075	732	421	31
2125	576	215	16


Section 16 to 17 : Central Deflection (D1)
D1 Eastbound
D1 Westbound
Normalised Deflections
Chainage
16/R497
17
Section 16 to 17 : (D1-D2)
D1-D2 Eastbound
D1-D2 Westbound
Normalised Deflections
Chainage
Section 16 to 17 : Outer Deflection (D9)
D9 Eastbound
D9 Westbound
Normalised Deflections
Chainage

A-15.1.1.12 FWD Section 18 to 19: Tabulated Results and Graphs

Table K1: Section 18 to 19 Northbound values

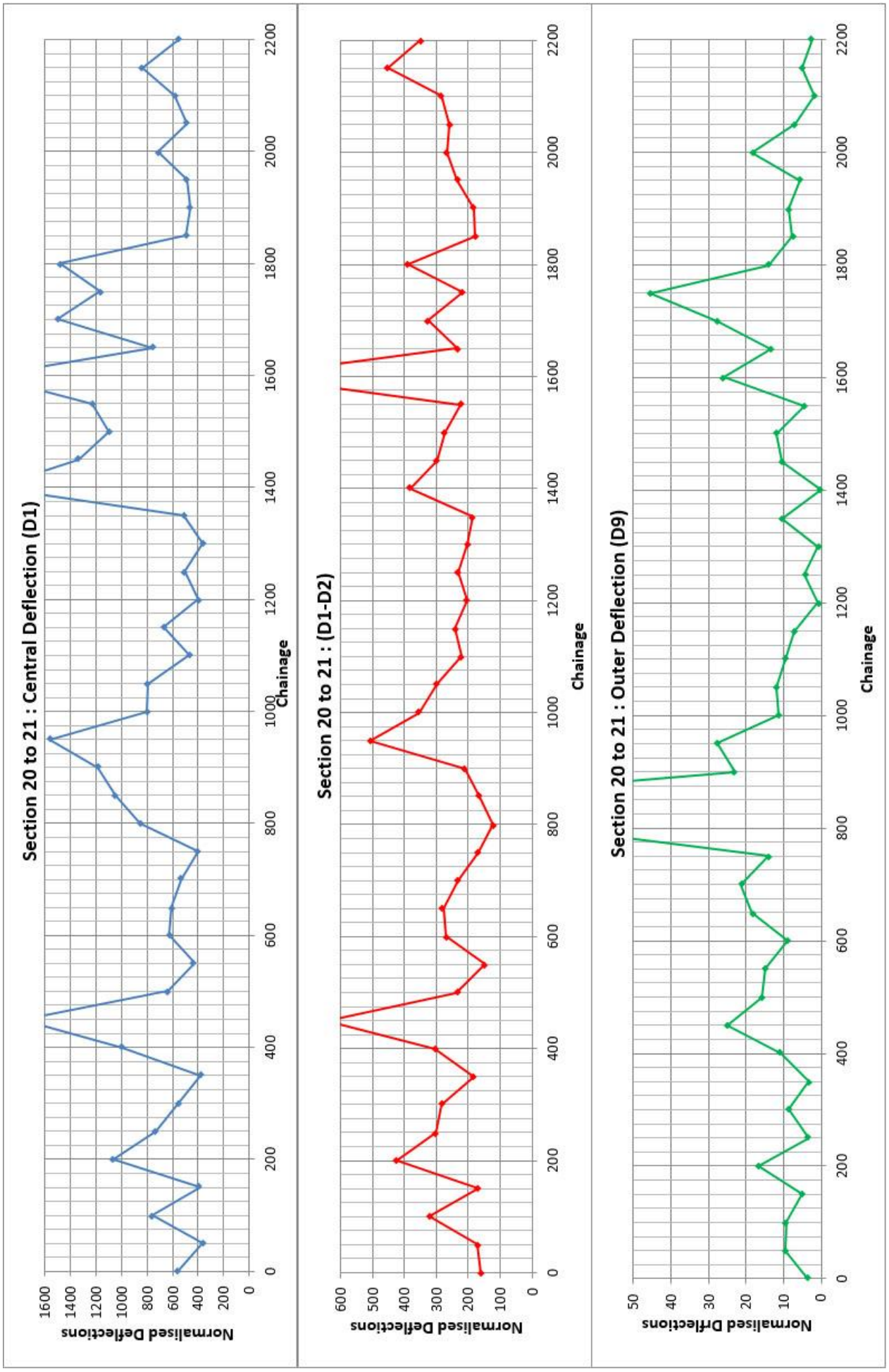
Chainage	D1	D1-D2	D9
0	911	476	9
50	1737	643	12
100	1684	433	10
150	1818	331	0
200	1614	446	61
250	876	557	3
300	907	639	2
350	493	314	3
400	1034	515	6
430	576	339	5


Section 18 to 19 : Central Deflection (D1)
Normalised Deflections
Chainage
18
19
Section 18 to 19 : (D1-D2)
Normalised Deflections
Chainage
Section 18 to 19 : Outer Deflection (D9)
Normalised Deflections
Chainage

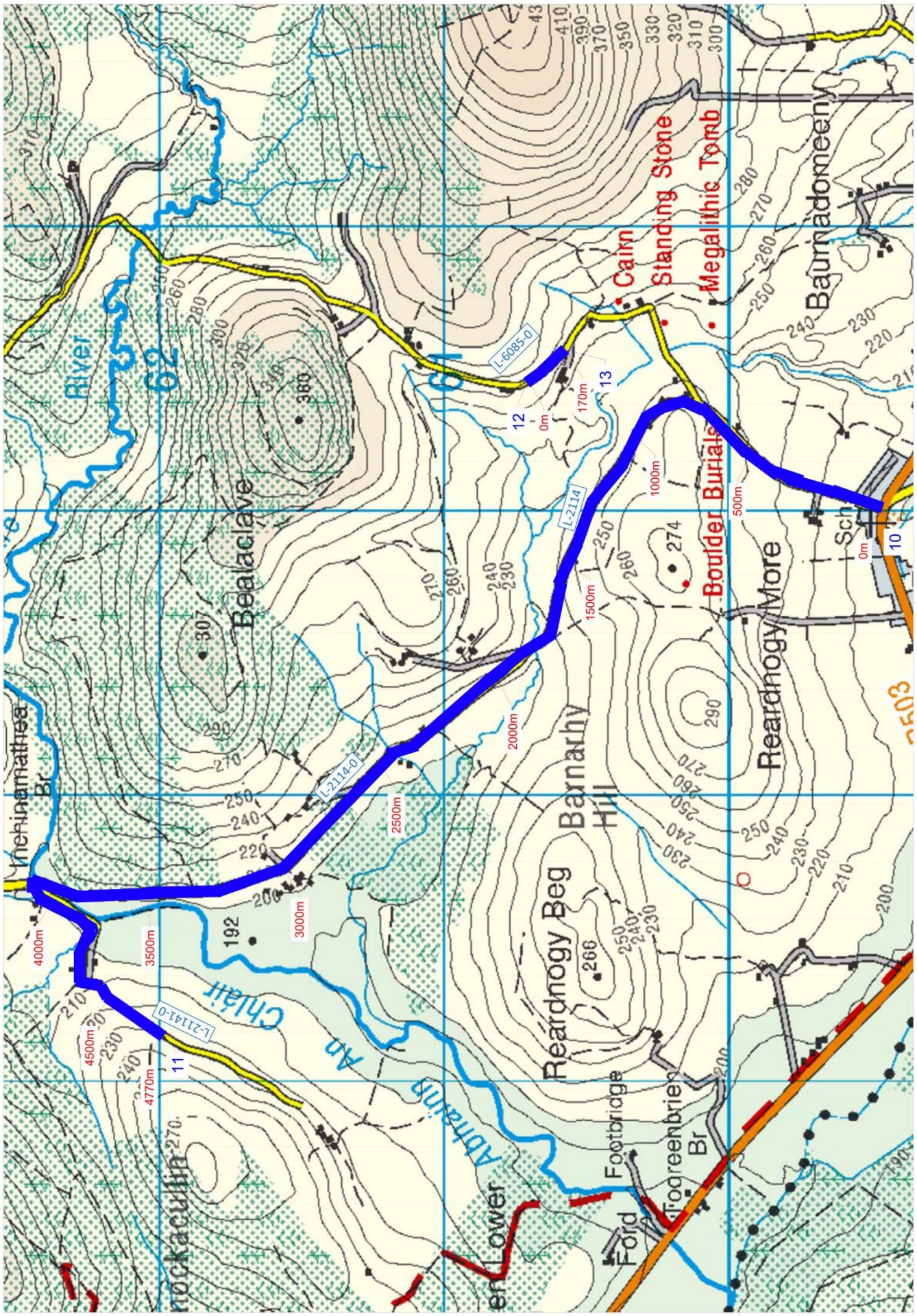
A-15.1.1.13 FWD Section 20 to 21: Tabulated Results and Graphs

Table L1: Section 20 to 21 Eastbound values

Chainage	D1	D1-D2	D9
0	559	160	4
50	365	171	10
100	762	322	9
150	386	169	5
200	1064	425	17
250	736	303	3
300	556	282	9
350	384	181	3
400	992	305	11
450	1786	643	25
500	637	238	16
550	430	147	15
600	630	271	9
650	609	278	18
700	535	233	21
750	401	169	14
800	858	121	73
850	1050	165	111
900	1184	212	23
950	1564	508	28
1000	802	355	11
1050	793	298	12
1100	466	222	10
1150	670	243	7
1200	397	204	1
1250	504	232	4
1300	363	203	1
1350	510	187	10
1400	2006	383	0
1450	1338	298	11
1500	1098	275	12
1550	1230	224	5
1600	2062	897	26
1650	756	234	13
1700	1506	325	28
1750	1169	216	45
1800	1486	390	14
1850	496	179	8
1900	465	182	9
1950	488	236	6
2000	711	267	18
2050	487	260	7
2100	580	285	2
2150	833	452	5
2200	555	352	3


Section 20 to 21 : Central Deflection (D1)
Normalised Deflections
Chainage
0
200
400
600
800
1000
1200
1400
1600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Section 20 to 21 : (D1-D2)
Normalised Deflections
Chainage
0
100
200
300
400
500
600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Section 20 to 21 : Outer Deflection (D9)
Normalised Drflections
Chainage
0
10
20
30
40
50
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200

A-15.2.1.5 FWD Section Maps with Chainages


Cairn
Standing Stone
Megalithic Tomb
Baurnadomeeny
Boulder Burials
Bealaclave
River
Inchinamathea Br
Barnarhy Hill
Reardnogy Beg
Reardnogy More
Footbridge
Ford
Lower
Abhainn An Chlair
L-6085-0
L-2114
L-2114-0
L-2114-0
12
13
11
10
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170m
1000m
500m
1500m
2000m
2500m
3000m
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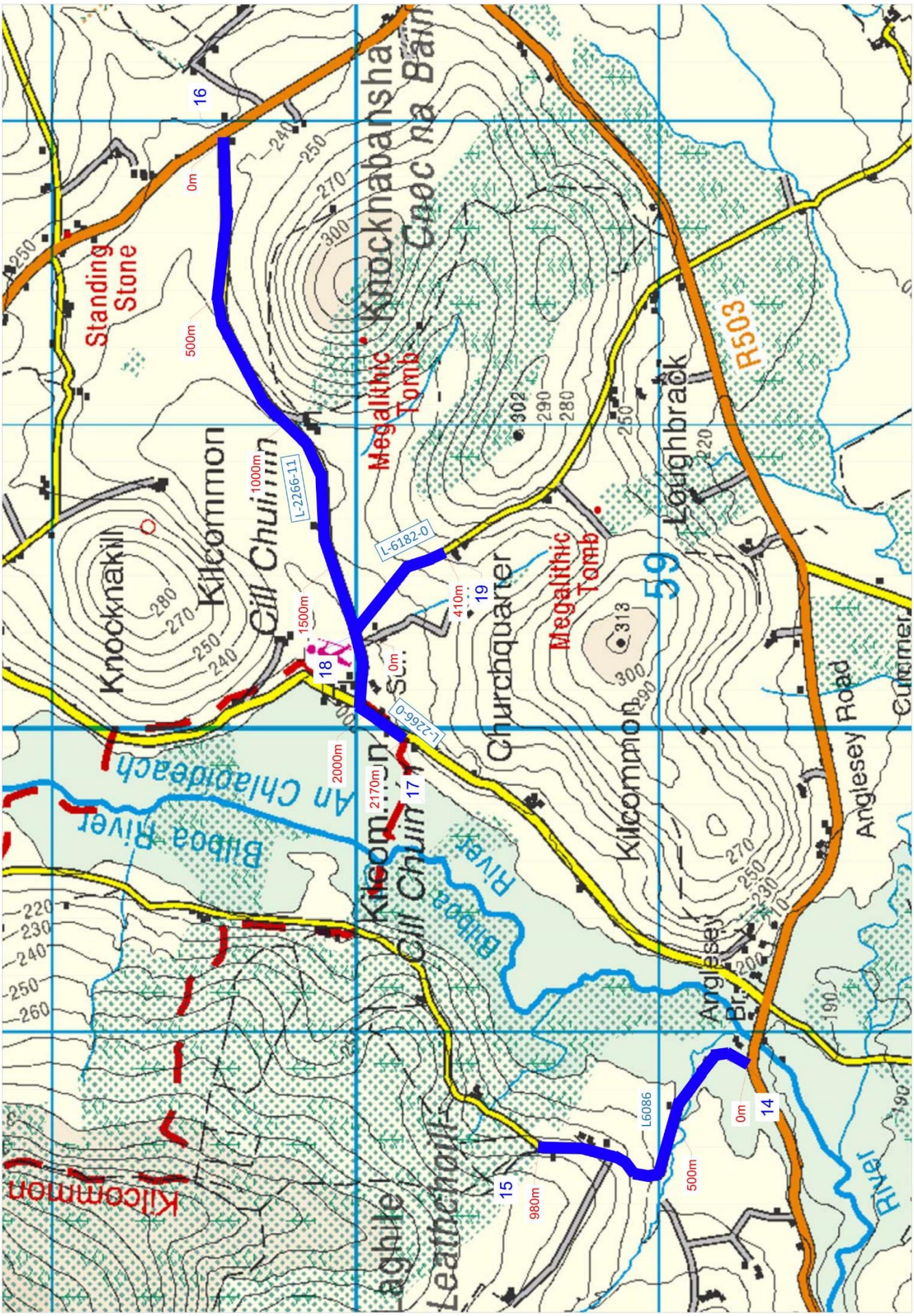
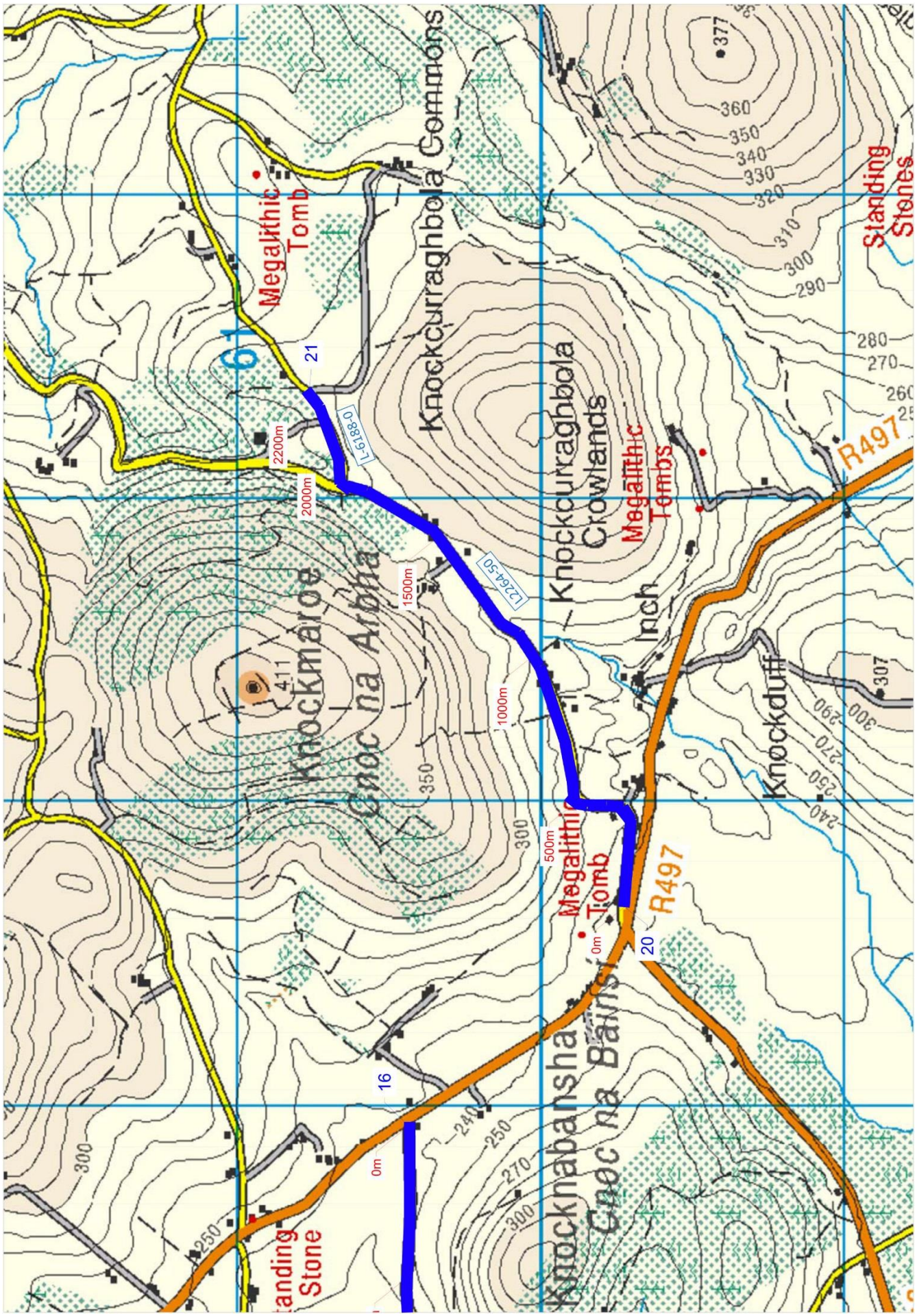
4000m
4500m
4770m


Standing Stone
Knocknabansha
Cnoc na Bain
Megalithic Tomb
Kilcommon
Cill Chuimin
Knocknakill
L-2266-11
L-6182-0
Churchquarter
Megalithic Tomb
R503
Loughbrack
Anglesey Road
Bilboa River
An Chlaoideach
Kilcommon
Cill Chuimin
Leathanaill
L6086
16
17
18
19
15
14
0m
500m
1000m
1500m
2000m
2170m
410m
980m


Megalithic Tomb
Knockcurraghbola Commons
Knockcurraghbola Crowlands
Megalithic Tombs
Standing Stones
R497
Knockmaroe
Cnoc na Arbha
411
Inch
Knockduff
307
Megalithic Tomb
R497
Knocknabansha
Cnoc na Bairnsi
Standing Stone
L6188-0
L2264-50
2200m
2000m
1500m
1000m
500m
0m
21
20
16
377
360
350
340
330
320
310
300
290
280
270
260
250
240

A-15.2.2 FWD TESTING ON UWF RELATED WORKS LOCAL ROADS

A-15.2.2.1 Introduction:

Falling Weight Deflectometer (FWD) surveys are carried out to assess the condition and load bearing capacity of road pavements.

Pavement Technologies were engaged by Ecopower Developments to carry out a FWD survey along the local roads associated with the Haul Route Works, which is part of the UWF Related Works. In addition to measuring deflections coring was carried out to determine pavement structure.

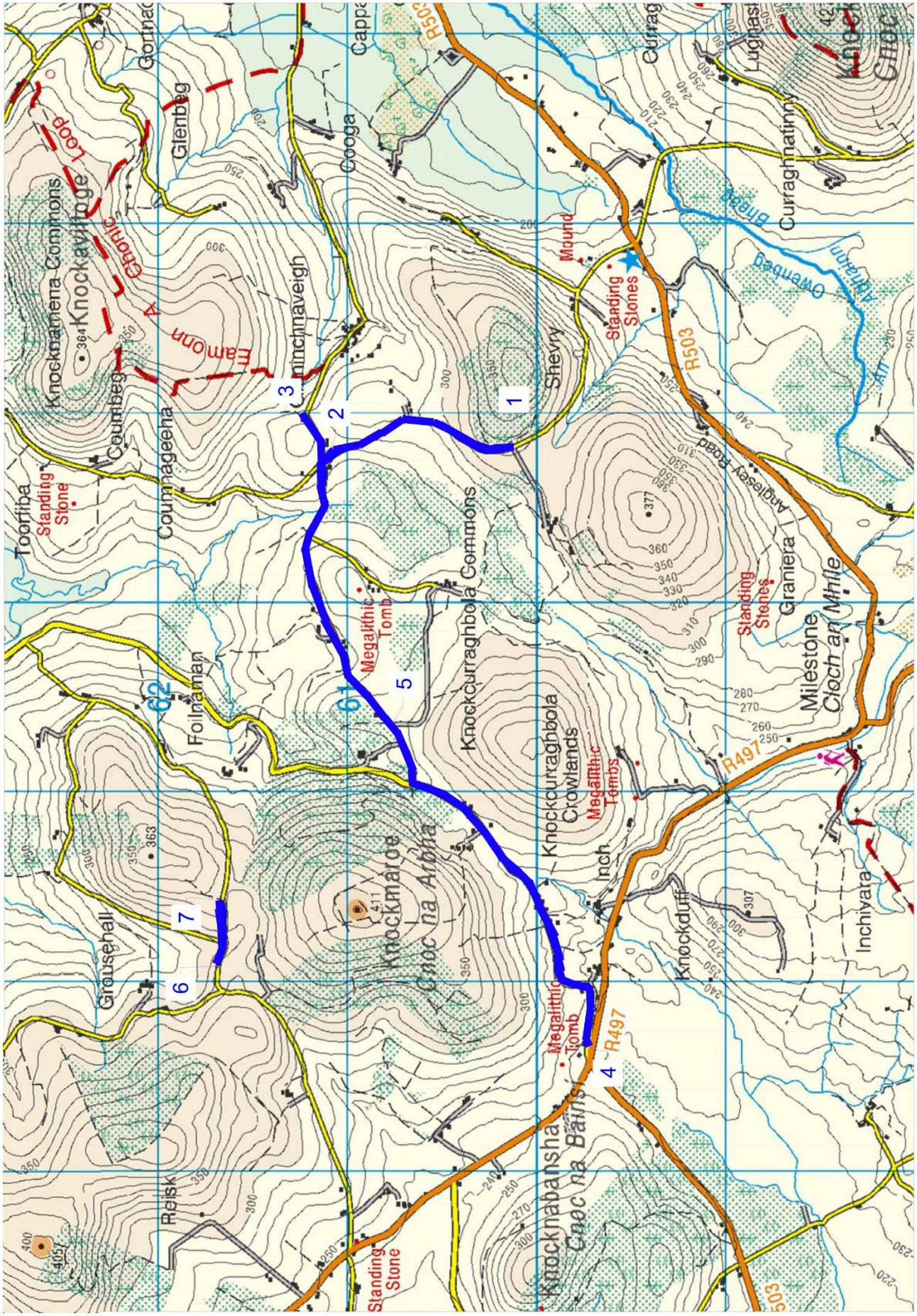
A-15.2.2.2 Survey Overview

The survey took place on five road sections defined by start and end points as shown in Figure 1. The length of each section is shown in Table 1 and maps detailing the chainages used are contained in report Section A-15.2.2.6.. As all of these road sections were narrow, testing was carried out in one direction only.

Table 1: Section Details

Section		Length Tested (m)
Start	Finish	
1	2	1400
2	3	450
5	2	1650
4	5	2200
6	7	400

Figure 1: Map of SurveyRoute (UWF Related Works)



A-15.2.2.3 FWD Survey Details

A-15.1.2.1 FWD Equipment and Data Collection

FWD testing was carried out in accordance with Appendix B of TII publication AM-PAV-06050 Pavement Assessment Repair and Renewal Principles and 'Guidelines on the Depth of Overlay to be used on Rural Regional and Local Roads' (March 2014) issued by the D.T.T.A.S. The equipment used was a trailer mounted Primax FWD manufactured by Grontmij. The 9 geophones mounted radially from the centre of the load plate were positioned as shown in Table 2.

Table 2: FWD Geophone Positions

Geophone Number	D1	D2	D3	D4	D5	D6	D7	D8	D9
Distance from centre of load(mm)	0	300	450	600	900	1200	1500	1800	2100

A load pulse is produced by dropping a known mass, and is transmitted to the pavement through the loading plate. The load cell measures the load imparted to the pavement surface and the geophones measure the pavement deflection in response to the load.

In this case the load level was set at 40kN to produce a load pulse similar to that produced by the moving wheel of a heavy goods vehicle. The load pulse was applied through a 300mm diameter plate which is a standard size plate for all FWD equipment. Deflections at each geophone were measured at a resolution of 1 micron. At each test point at least 3 drops were made, after an initial drop to settle the load plate.

Longitudinal spacing of measurements were generally at 50 metre intervals.

A-15.1.2.2 Coring

150mm diameter cores of the bound surface layer were cut from the pavement using a standard trailer version coring rig. Sub-base material was removed at each core location to get an indication of the depth and type of material.

A-15.2.2.4 FWD Survey Results

A-15.1.2.1 Pavement Condition based on FWD Results

The deflection bowl created by the FWD load pulse is influenced by the stiffness of the different pavement layers. Tables of measured deflections and Surface Curvature Index (SCI) provide information on pavement condition as follows:

D1: Indication of overall pavement performance

SCI: Indicates condition of upper pavement layers

D9: Indication of sub-grade condition

Guidance on the interpretation of deflection values is given in '*Guidelines on the Depth of Overlay to be used on Rural Regional and Local Roads (March 2014)*' as issued by the Department of Transport, Tourism and Sport, and this guidance is reproduced in Table 3 and Table 4. Tabulated deflection results contained in this report are highlighted in colour, based on the guidance.

Table 3: Central and SCI (D1-D2) Deflection Criteria (normalised to 40kN)

Central Deflection (D1)	SCI	Comment
<300	<150	Good load spreading ability
300-500	150-250	Good to poor load spreading ability
501-800	251-400	Poor to bad load spreading ability
>800	>400	Bad load spreading ability

Table 4: Outer Deflection Criteria (normalised to 40kN)

Outer Deflection (D9)	Comment
<15	Stiff subgrade
15-30	Stiff to moderate subgrade
31-45	Moderate to weak subgrade
>45	Weak subgrade

Report sections A-15.2.2.1 to A-15.2.2.6 contain tables of results for deflection values measured at each test point along each test section, and graphs of these values against distance.

Pavement condition can be considered based on sub-sections with deflections of similar magnitude deflection. A summary of the average deflection results for each sub-section is presented in Table 5.

Table 5: Average Deflection Values

Section	Chainage	Lane	D1	D1-D2	D9
1 to 2	0-900	Northbound	570	314	4
	900-1400	Northbound	1200	655	3
2 to 3	0-300	Eastbound	418	245	0
	300-450	Eastbound	564	287	7
5 to 2	0-800	Eastbound	608	328	3
	800-1400	Eastbound	910	517	4
	1400-1650	Eastbound	535	220	2
4 to 5	0-1350	Eastbound	714	259	17
	1350-1800	Eastbound	1406	360	17
	1800-2200	Eastbound	577	276	7
6 to 7	0-400	Eastbound	960	568	8

The condition of the pavement could generally be described as follows:

- D1 deflections indicate weak pavements on all sections with excessive values, highlighted in red, indicating failure. The exception to this is the sub-section of (2 to 3) from Chainage 0 to 300 which is significantly stronger.
- (D1-D2) values are very high indicating poor to bad load spreading ability in the upper layers.
- The sub-grade is generally stiff along all test sections based on D9 values.

A-15.1.2.2 Core Results

Table 6 contains locations and pavement layer thicknesses for cores taken along each test section.

Table 6: Core Results

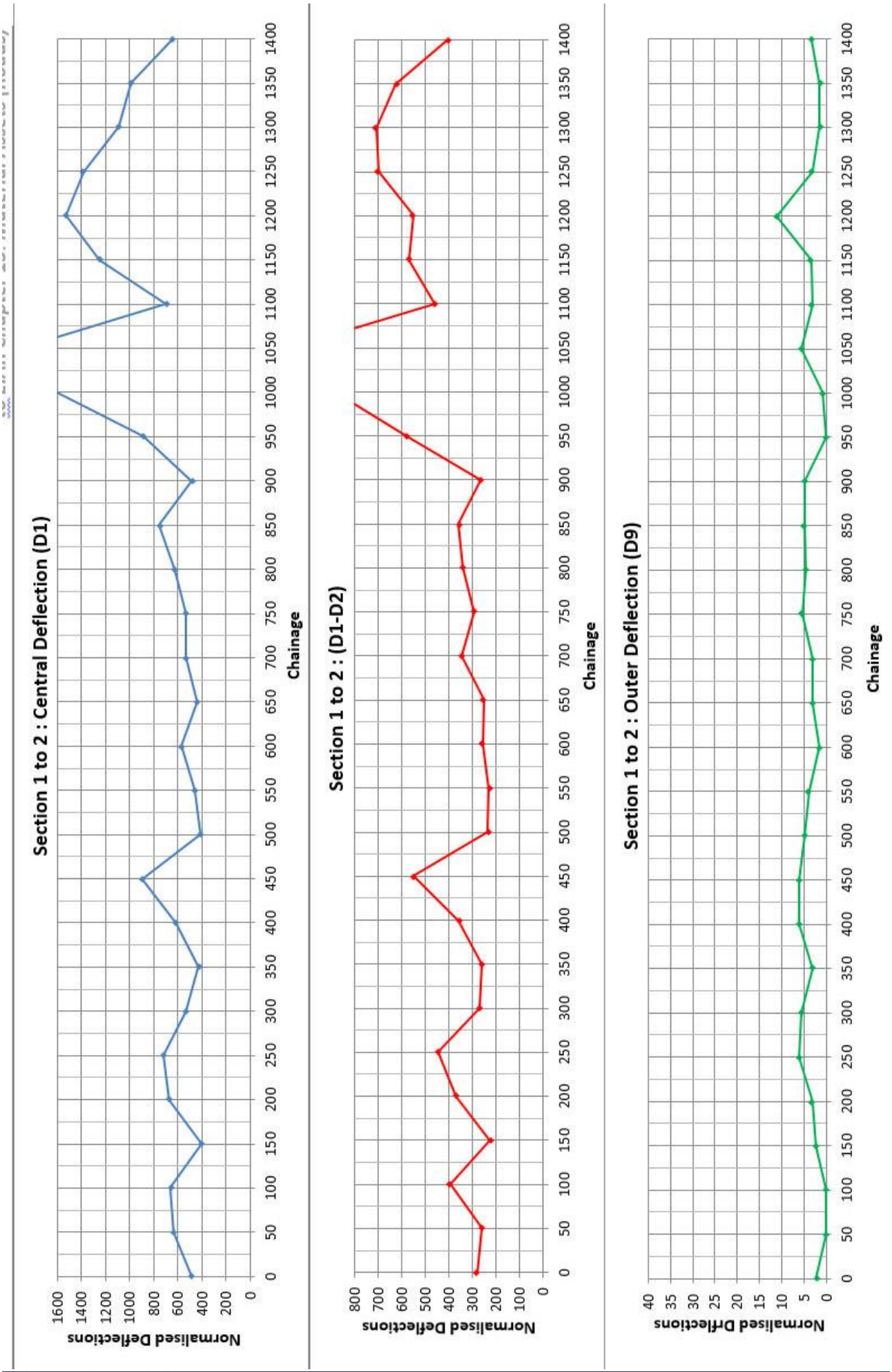
Section	Chainage	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
1 to 2	500	20mm S.D.	40mm C.R.	10mm S.D.	25mm C.R.	25mm S.D. on Clay
	1100	15mm S.D.	50mm C.R.	20mm S.D.	Clay	---
5 to 2	100	40mm S.D.	45mm C.R.	30mm S.D.	50mm C.R.	Clay
	650	30mm S.D.	50mm C.R.	25mm S.D.	25mm C.R.	Clay
	1100	35mm S.D.	40mm C.R.	30mm S.D.	40mm C.R.	Clay
4 to 5	200	40mm S.D.	30mm C.R.	80mm S.D.	110mm Shale	Clay
	700	35mm S.D.	45mm C.R.	30mm S.D.	80mm C.R.	Clay
	1300	45mm S.D.	40mm C.R.	25mm S.D.	60mm C.R.	Clay
	1750	50mm S.D.	230mm C.R.	Clay	---	---
6 to 7	350	10mm S.D.	125mm C.R.	10mm S.D.	Clay	---

S.D. = Surface Dressing *C.R. = Crushed Rock*

A-15.1.2.3 FWD Section 1 to 2: Tabulated Results and Graphs

Table A1: Section 1 to 2 Deflection Values

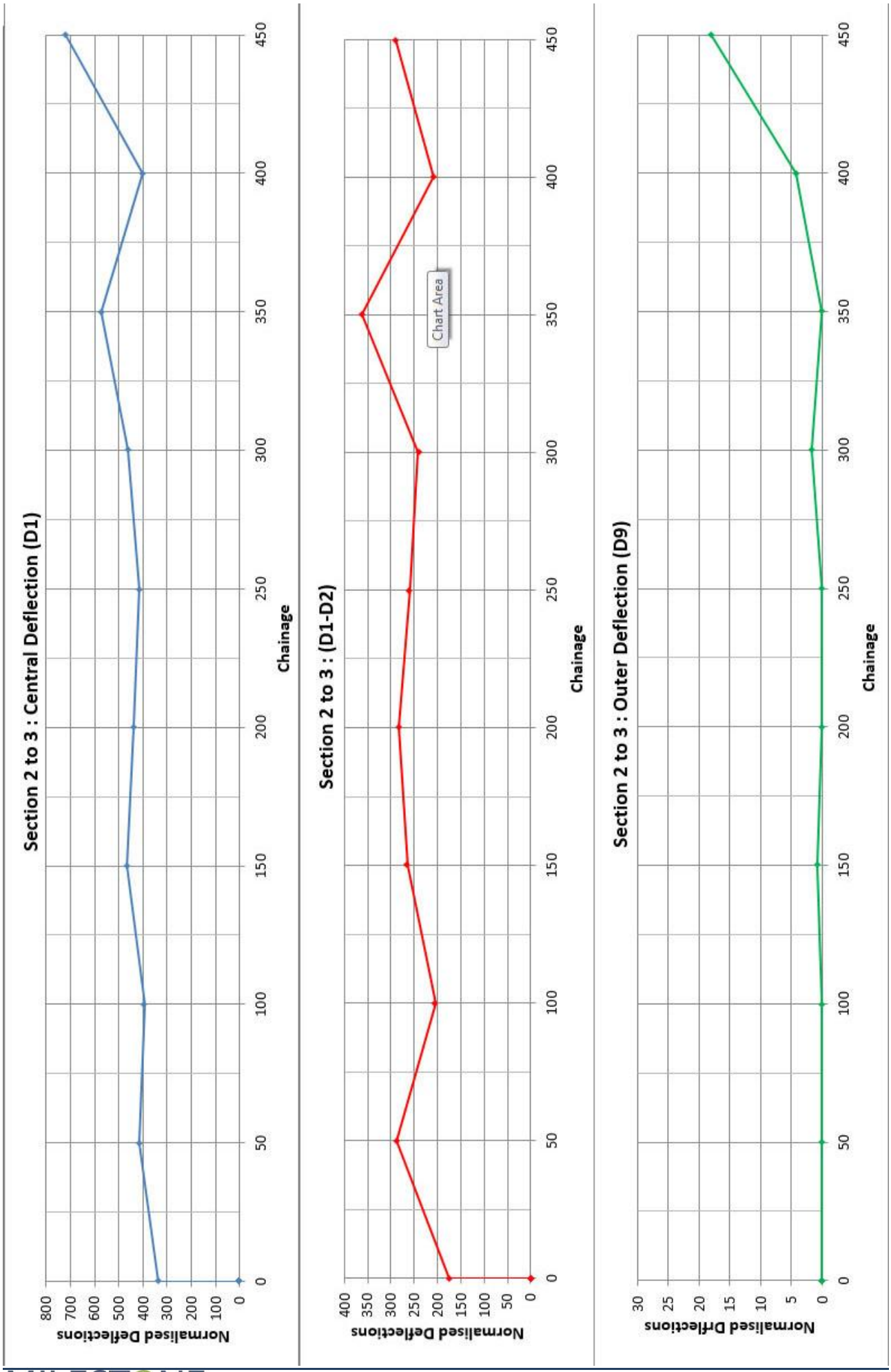
Chainage	D1	D1-D2	D9
0	486	280	2
50	637	259	0
100	658	394	0
150	404	224	2
200	674	371	3
250	718	445	6
300	528	266	6
350	425	257	3
400	613	358	6
450	892	548	6
500	410	234	5
550	458	230	4
600	566	257	2
650	438	251	3
700	528	347	3
750	528	290	5
800	625	340	5
850	754	357	5
900	483	263	5
950	890	579	0
1000	1603	887	1
1050	1918	1071	6
1100	697	460	3
1150	1250	569	3
1200	1531	551	11
1250	1384	698	3
1300	1090	708	2
1350	993	624	2
1400	646	399	3


Section 1 to 2 : Central Deflection (D1)
Normalised Deflections
Chainage
Section 1 to 2 : (D1-D2)
Normalised Deflections
Chainage
Section 1 to 2 : Outer Deflection (D9)
Normalised Deflections
Chainage

A-15.1.2.4 FWD Section 2 to 3: Tabulated Results and Graphs

Table B1: Section 2 to 3 Deflection values

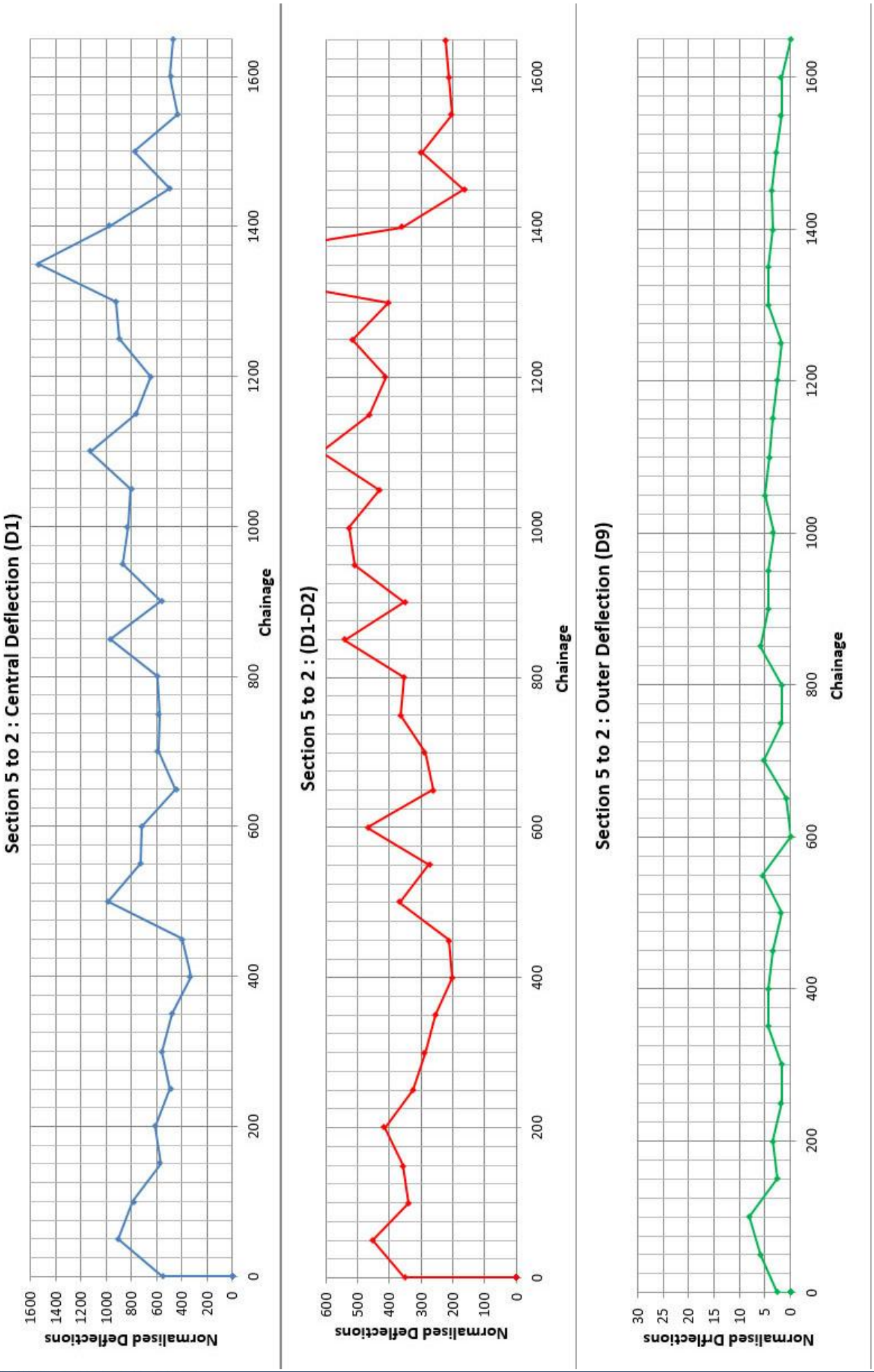
Chainage	D1	D1-D2	D9
0	337	175	0
50	414	288	0
100	394	205	0
150	468	264	1
200	440	283	0
250	414	260	0
300	461	241	2
350	573	361	0
400	400	209	4
450	719	290	18


Section 2 to 3 : Central Deflection (D1)
Normalised Deflections
Chainage
Section 2 to 3 : (D1-D2)
Chart Area
Normalised Deflections
Chainage
Section 2 to 3 : Outer Deflection (D9)
Normalised Deflections
Chainage

A-15.1.2.5 FWD Section 5 to 2: Tabulated Results and Graphs

Table C1: Section 5 to 2 Deflection values

Chainage	D1	D1-D2	D9
0	555	352	3
50	904	454	6
100	788	340	8
150	569	359	3
200	613	415	3
250	492	325	2
300	563	287	2
350	476	254	4
400	328	200	4
450	397	212	3
500	989	367	2
550	729	274	5
600	720	469	0
650	448	263	1
700	588	288	5
750	580	365	2
800	592	355	2
850	969	542	6
900	567	352	4
950	867	509	4
1000	829	527	3
1050	806	431	5
1100	1130	613	4
1150	766	463	3
1200	646	412	3
1250	896	515	2
1300	927	402	4
1350	1545	1077	4
1400	976	360	3
1450	499	165	4
1500	778	298	3
1550	433	202	2
1600	492	211	2
1650	471	224	0


Section 5 to 2 : Central Deflection (D1)
Normalised Deflections
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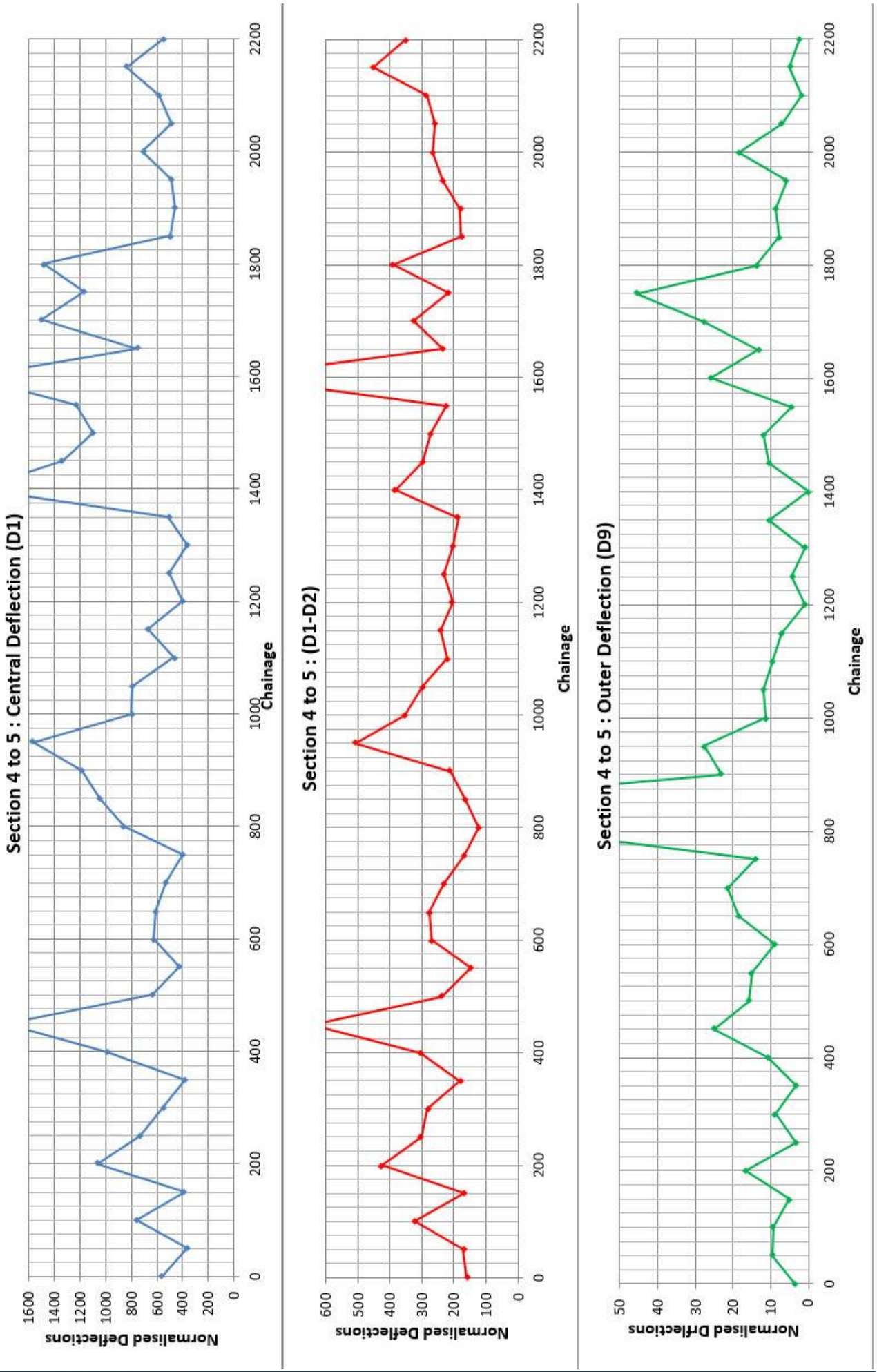
400
600
800
1000
1200
1400
1600
Section 5 to 2 : (D1-D2)
Normalised Deflections
Chainage
0
100
200
300
400
500
600
Section 5 to 2 : Outer Deflection (D9)
Normalised Drflections
Chainage
0
5
10
15
20
25
30

A-15.1.2.6 FWD Section 4 to 5: Tabulated Results and Graphs

Table D1: Section 4 to 5 Eastbound values

Chainage	D1	D1-D2	D9
0	559	160	4
50	365	171	10
100	762	322	9
150	386	169	5
200	1064	425	17
250	736	303	3
300	556	282	9
350	384	181	3
400	992	305	11
450	1786	643	25
500	637	238	16
550	430	147	15
600	630	271	9
650	609	278	18
700	535	233	21
750	401	169	14
800	858	121	73
850	1050	165	111
900	1184	212	23
950	1564	508	28
1000	802	355	11
1050	793	298	12
1100	466	222	10
1150	670	243	7
1200	397	204	1
1250	504	232	4
1300	363	203	1
1350	510	187	10
1400	2006	383	0
1450	1338	298	11
1500	1098	275	12
1550	1230	224	5
1600	2062	897	26
1650	756	234	13
1700	1506	325	28
1750	1169	216	45
1800	1486	390	14
1850	496	179	8
1900	465	182	9
1950	488	236	6
2000	711	267	18
2050	487	260	7
2100	580	285	2
2150	833	452	5
2200	555	352	3


Section 4 to 5 : Central Deflection (D1)
Normalised Deflections
Chainage
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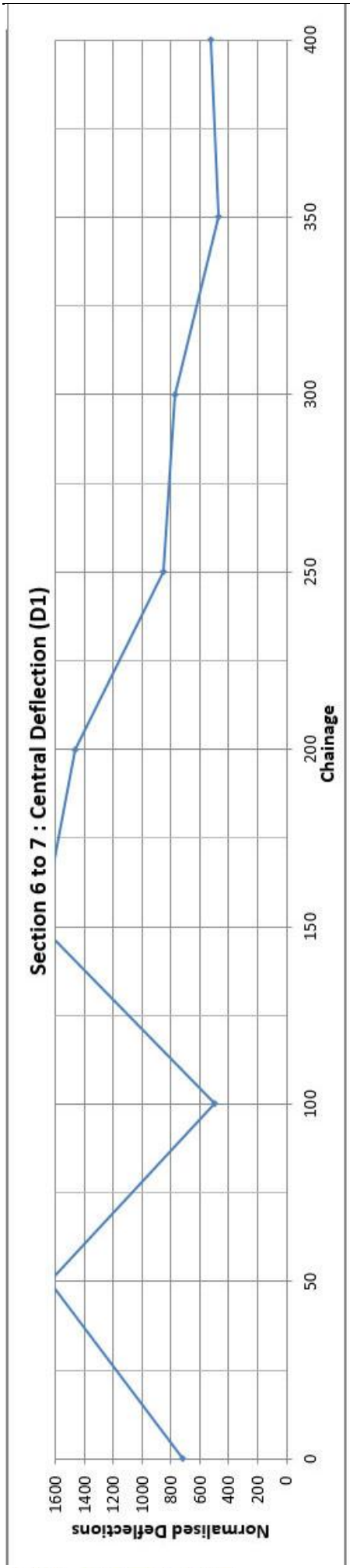
400
600
800
1000
1200
1400
1600
1800
2000
2200
Section 4 to 5 : (D1-D2)
Normalised Deflections
Chainage
0
100
200
300
400
500
600
Section 4 to 5 : Outer Deflection (D9)
Normalised Drflections
Chainage
0
10
20
30
40
50

A-15.1.2.7 FWD Section 6 to 7: Tabulated Results and Graphs

Table C1: Section 6 to 7 Deflection Values

Chainage	D1	D1-D2	D9
0	721	349	6
50	1642	1280	6
100	497	287	11
150	1694	1433	14
200	1466	308	21
250	849	428	9
300	776	484	2
350	473	253	1
400	524	290	1


Section 6 to 7 : Central Deflection (D1)
Normalised Deflections
Chainage
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800
1000
1200
1400
1600
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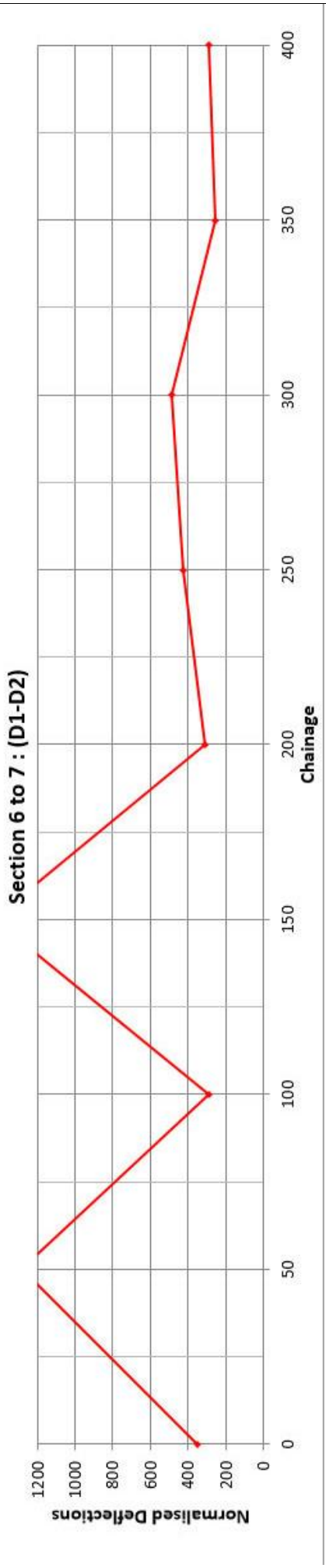
100
150
200
250
300
350
400


Section 6 to 7 : (D1-D2)
Normalised Deflections
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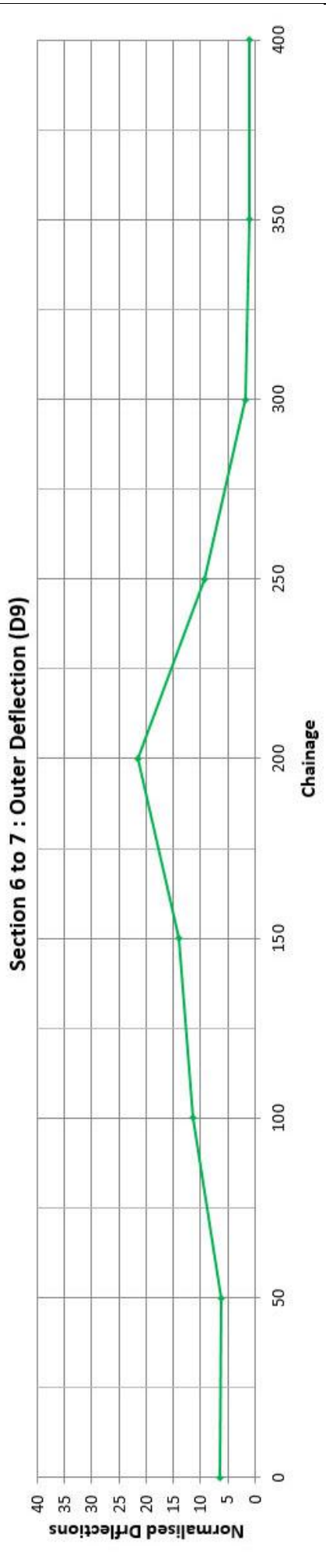
350
400


Section 6 to 7 : Outer Deflection (D9)
Normalised Drflections
Chainage
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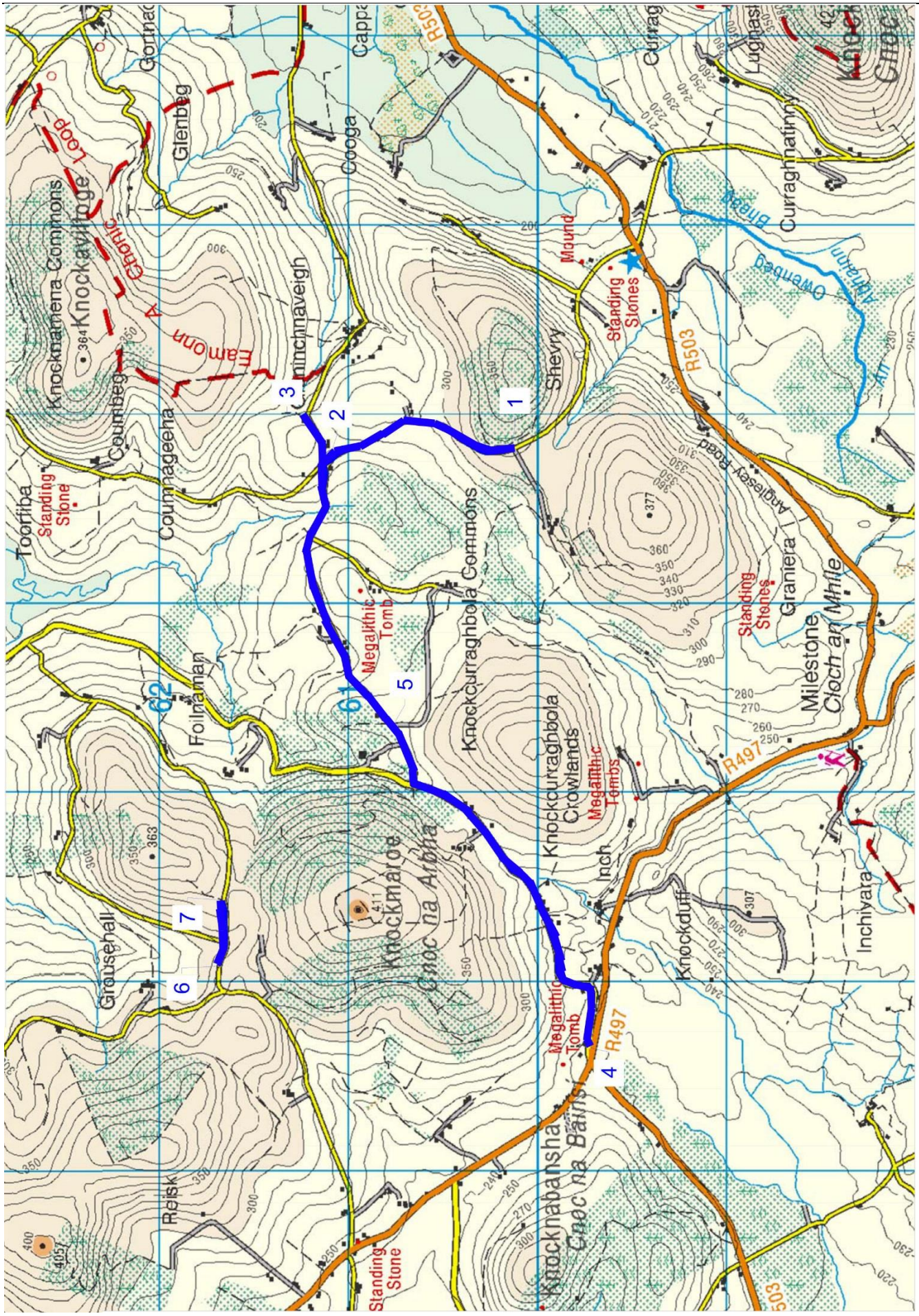
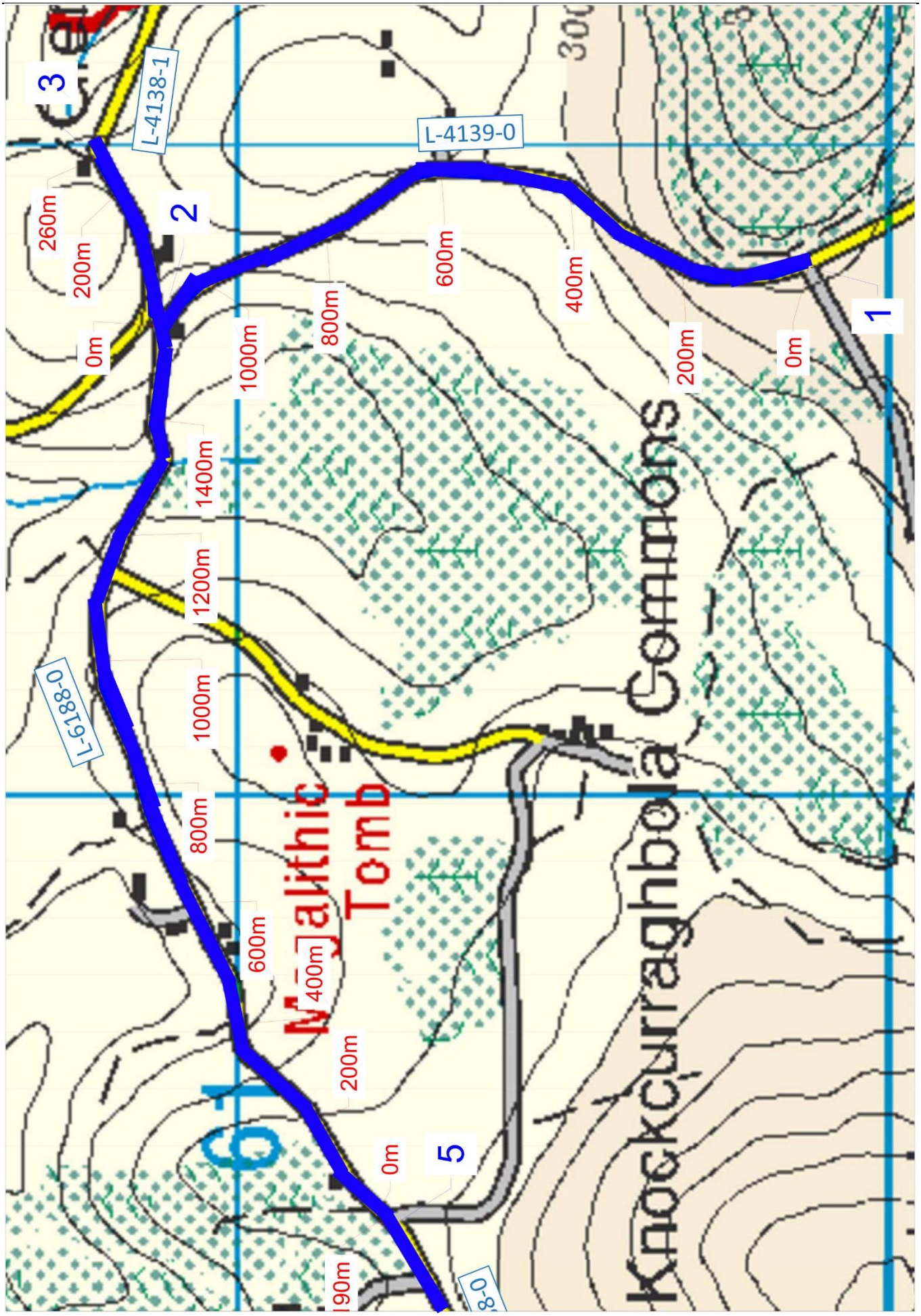
100
150
200
250
300
350
400


Knockavilloge
Knocknamena Commons
Coumbeg
Coumageena
Toorlira
Standing Stone
Glenbeg
Cooga
Crinchnaveigh
Sherry
Mound
Standing Stones
Curraghnatinny
Owenbeg
Abhainn
R503
Anglesey Road
Graniera
Milestone
Cloch an Mhile
Standing Stones
Megalithic Tomb
Knockcurraghbola Commons
Knockcurraghbola Crowlands
Megalithic Tomb
Foilnaman
Knockmaroe
Cnoc na Arbha
Inch
Knockduff
Inchiyata
R497
Megalithic Tomb
Grousehall
Reisk
Knocknabansha
Cnoc na Bains
Standing Stone
1
2
3
4
5
6
7
61
62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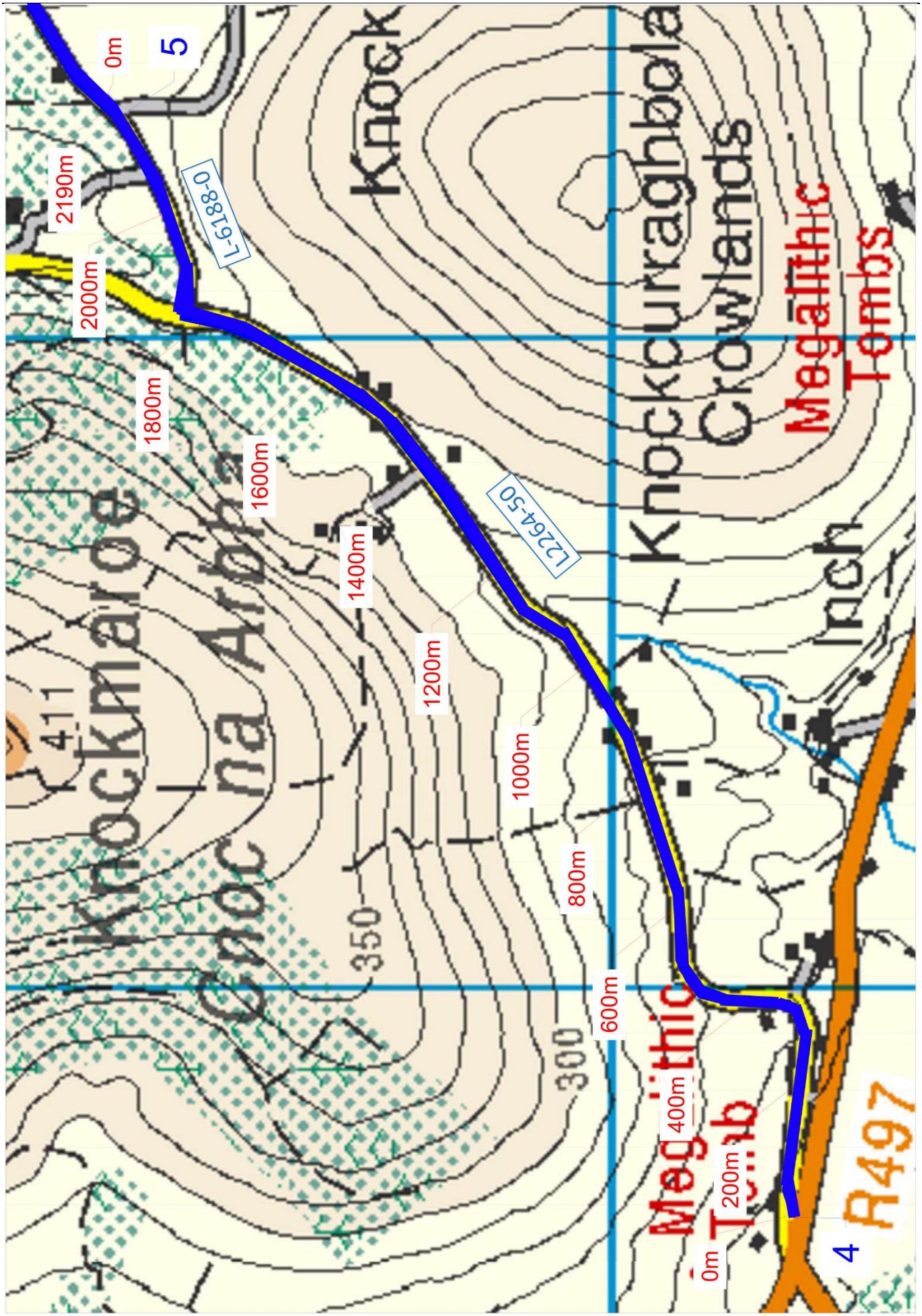
L-4139-0
L-6188-0
260m
200m
0m
1000m
800m
600m
400m
1400m
1200m
1000m
800m
600m
400m
200m
0m
200m
0m
Knockcurraghbola Commons
Tomb
1
2
3
5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5
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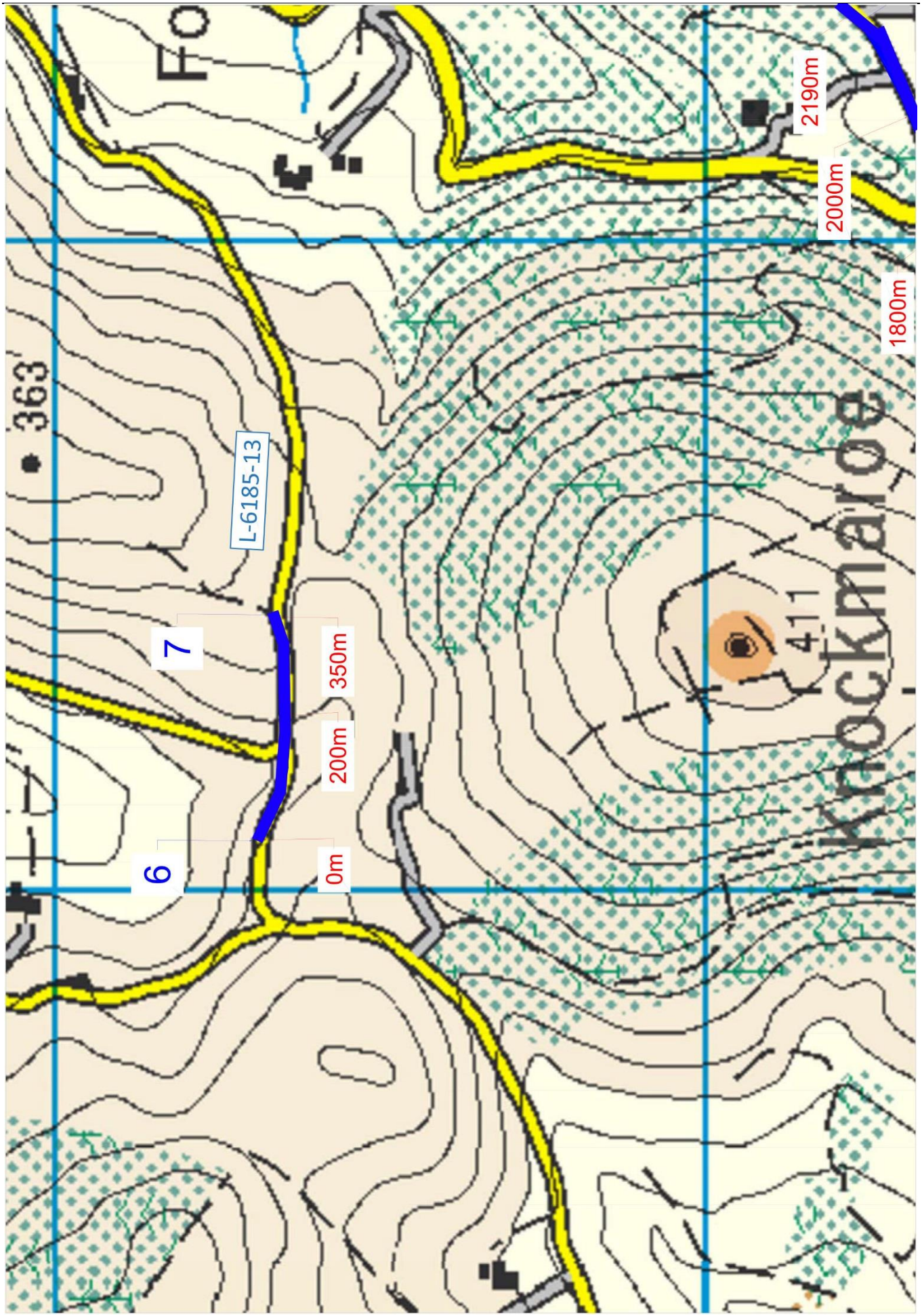
600m
400m
200m
0m
Knock
Knockcuraghbola
Crowlands
Megalithic
Tombs
Knockmaroe
Cnoc na Arbha
Inch
411
350
300
L2264-50
Megalithic
Tomb
4
R497


Fo
2190m
2000m
1800m
363
L-6185-13
7
350m
200m
6
0m
411
Knockmaroe

Appendix to Chapter 15: Material Assets - Roads

Appendix 15.3: Site Photographs

The data and descriptions in this appendix have informed Chapter 15: Material Assets (Roads) of the EIA Report.

The information presented in this Appendix 15.3 is outlined below and the relevant element(s) of the Whole UWF Project are also identified.

Appendix 15.3 Section	Section Heading	Relevant Individual Project Element
A-15.3.1	Photos of UWF Grid Connection roads and culverts	UWF Grid Connection
A-15.3.2	Photos of UWF Related Works roads and culverts	UWF Related Works

A-15.3 SITE PHOTOGRAPHS

A-15.3.1 PHOTOS OF UWF GRID CONNECTION ROADS AND CULVERTS

	UWF Grid Connection R1
	UWF Grid Connection R2

	UWF Grid Connection R3
	UWF Grid Connection R4

	UWF Grid Connection R5
	UWF Grid Connection R6

	UWF Grid Connection R7
	UWF Grid Connection R7

	UWF Grid Connection R8
	UWF Grid Connection R9

	UWF Grid Connection R10
	UWF Grid Connection R11

	UWF Grid Connection R12
	UWF Grid Connection R13

	UWF Grid Connection Material haulage routes – Bridge crossing on the L51853-0 at Rockvale
	UWF Grid Connection Material haulage routes – Bridge crossing on the L51853-0 at Rockvale

	UWF Grid Connection Material haulage **routes –** **Bridge crossing on the** L6011-0 at Castlewaller
	UWF Grid Connection Material haulage routes – Bridge crossing on the L6011-0 at Castlewaller

	UWF Grid Connection Material haulage routes – Bridge crossing on the L2114-0 at Bealaclave
	UWF Grid Connection Material haulage routes – Bridge crossing on the L2114-0 at Bealaclave

	UWF Grid Connection Material haulage routes – Bridge crossing on the L6086 -0 at Laghile
	UWF Grid Connection Material haulage routes – Bridge crossing on the 6086 -0 at Laghile

	UWF Grid Connection W38
	UWF Grid Connection W38

	UWF Grid Connection W39
	UWF Grid Connection W39

	UWF Grid Connection W40
	UWF Grid Connection W40

	UWF Grid Connection W41
	UWF Grid Connection WW41

	UWF Grid Connection W42
	UWF Grid Connection W42

	UWF Grid Connection W43 & W44
	UWF Grid Connection W43 & W44 Outflow

A-15.3.2 PHOTOS OF UWF RELATED WORKS ROADS AND CULVERTS

	UWF Related Works Internal Windfarm Cable Public Road Crossings RW1
	UWF Related Works Internal Windfarm Cable Public Road Crossings RW2

	UWF Related Works Internal Windfarm Cable Public Road Crossings RW3
	UWF Related Works Internal Windfarm Cable Public Road Crossings RW4 & RW5

	UWF Related Works Internal Windfarm Cable Public Road Crossings RW6
	UWF Related Works Internal Windfarm Cable Public Road Crossings RW7

	UWF Related Works Internal Windfarm Cable Public Road Crossings RW8
	UWF Related Works Internal Windfarm Cable Public Road Crossings RW9

	UWF Related Works Haul Route Works Bridge/Culvert Crossings WW1**2**
	UWF Related Works Haul Route Works Bridge/Culvert Crossings WW12

	UWF Related Works Haul Route Works Bridge/Culvert Crossings WW31
	UWF Related Works Haul Route Works Bridge/Culvert Crossings WW31

	UWF Related Works Haul Route Works Bridge/Culvert Crossings WW32
	UWF Related Works Haul Route Works Bridge/Culvert Crossings WW32

Appendix to Chapter 16: Cultural Heritage

Appendix 16.1: Detailed Cultural Heritage Desktop and Field Survey Results

The data and descriptions in this appendix have informed Chapter 16: Cultural Heritage of the EIA Report, in relation to noise emissions. The information presented in this Appendix 16.1 is outlined below and the relevant element(s) of the Whole UWF Project are also identified.

Appendix 16.1 Section	Section Heading	Relevant Individual Project Element
A-16.1.1	Archaeological and Historical Background	UWF Grid Connection & UWF Related Works UWF Replacement Forestry
A-16.1.2	Cultural Heritage Sites within the Study Areas	UWF Grid Connection UWF Related Works
A-16.1.3	Test Excavation Report - Castlewaller	UWF Grid Connection
A-16.1.4	Test Excavation Report – Knockmaroe	UWF Grid Connection
A-16.1.5	Test Excavation Report – Knockcurraghbola Common	UWF Related Works
A-16.1.6	Field Walking Description	UWF Grid Connection & UWF Related Works UWF Replacement Forestry

Appendix 16.1.1: Archaeological and Historical Background

A-16.1.1 Archaeological and Historical Background 2
A-16.1.1.1 General archaeological background 2
A-16.1.1.2 The Mesolithic Period (7000-4000BC) 2
A-16.1.1.3 The Neolithic Period (4000-2400BC) 3
A-16.1.1.4 The Bronze Age (2400-500BC) 4
A-16.1.1.5 The Iron Age (2400-500BC) 10
A-16.1.1.6 The Early Medieval Period (400-1100AD) 11
A-16.1.1.7 The Later Medieval Period (1179-1400AD) 12
A-16.1.1.8 The 'Age of Improvement' (17th-18th Century) 12
A-16.1.1.9 Early Modern Period (1850-Present) 12

A-16.1.1 Archaeological and Historical Background

A-16.1.1.1 General archaeological background

The Silvermine mountain range is a region with an extremely rich and diverse history of human settlement going back to prehistoric times. This is reflected in the archaeological record. This report focussed on cultural heritage sites within the Geographical Study Area – i.e. within construction works areas and in some cases, within 500m of construction works areas; and within 2km of any above ground structures associated with the project.

Within the study area there are 65 recorded monuments (RMPs). However if the scope is extended to the general landscape of the Silvermine Mountains this number rises dramatically to c.680 recorded monuments. These monuments date from the Neolithic through to post medieval and modern times. The monuments of Tipperary were surveyed in the early 1980s by the Archaeological Survey of Ireland. A review of prehistoric archaeology in Tipperary undertaken by Richard Raleigh (1985) highlighted the prehistoric richness of this North Tipperary region, while between 1992 and 1995 the North Munster Project of the Discovery Programme sought to understand settlement patterns over a vast 7000km^2 area that centred on the lower Shannon catchment (Grogan 1996). An Archaeological Inventory for County Tipperary was published in 2002 (see Farrelly and O'Brien 2002). In 1959, Michael O'Kelly from the Department of Archaeology, University College Cork, excavated one of the most visually impressive monuments in the region, the prehistoric Wedge tomb of Baurnadomeeny (RMP TN038-009), which is located 517m south of the proposed development area on the southeast face of Moherslieve (O'Kelly 1959; 1961). These works all formed the core of the desk study portion of this report.

A-16.1.1.2 The Mesolithic Period (7000-4000BC)

While there are no sites within the study area which can be directly attributed to this period, some 20km to the south of the study area, in the townland of Rathjordan, a small group of Early Mesolithic microliths were identified among the finds from an excavation of a ring barrow carried out in the 1940s (Woodman 1986, 10). A precise date for this material is impossible to ascertain other than it was most likely earlier than 6000 BC (Woodman 1986, 10). This might indicate that the wider region, in particular lower slopes of the western Silvermine Mountains, may have been a location for some of the earliest human settlement in the country.

A-16.1.1.3 The Neolithic Period (4000-2400BC)

The Neolithic period sees the first concrete evidence of human settlement in the study area. While people in the Neolithic were predominantly farmers and lived in rectangular or oval shaped wooden houses, it is their megalithic tombs and cairns which leave a lasting visual impression in the landscape. A court tomb at Shanballydesmond (RMP TN038-013), 2km south of the study area, is the oldest known Neolithic monument in Tipperary (Raleigh 1985). Excavations by Kelly in 1958 inside the tomb yielded six unburnt or cremated human remains and tools of flint and chert. The tomb itself sits at high point in the landscape overlooking the Bilboa River. Several other Megalithic Tombs have been identified within the study area where not enough remains to accurately attribute them to a specific period. While they are most likely later Wedge Tombs (see below), the possibility remains that they are earlier Neolithic examples.

Another probable Neolithic monument class is a cairn, and one such monuments lies within the study area. This cairn, located at Baurnadomeeny, (Site 68, TN038-007001), is located on the southwest of Mauherslieve and contains a cist burial (Site 69, TN038-007002)

Site 68 - Cairn and Site 69 - Cist from the north

A-16.1.1.4 The Bronze Age (2400-500BC)

The Bronze Age period is represented in the region area by several main site types: Wedge tombs, barrows, standing stones, stone circles/rows and fulachta fiadh. The tradition of megalithic tomb construction in the region continued through into this Early Bronze Age period with the construction of a number of wedge tombs. These tombs date to between 2300 and 2000 BC and are often associated with the Beaker pottery of the Early Bronze Age (Newman and Halpin 2000, 9). There are a total of seven examples of wedge tombs located within the study area (Site 67 *TN038-009*, Site 76 *TN039-014,* Site 77 *TN039-007*, and Site 82 *TN039-009*, Site 86 *TN039-008*, Site 88 *TN039-017* and Site 89 *TN039-016*). There are also three additional megalithic tombs (Site 85 TN039-050, Site 91 TN039-045 and Site 92 TN039-037) which have not been classified by the RMP, but most likely fall within this category. The most prominent and complete wedge tomb is located at Knockcurraghbola Commons and sits on the southern slopes of a small knoll (Site 82). It is situated within the study area, 97m northwest of the Internal Windfarm Cabling works. The tomb is 7m long and decreases in height and width from southwest to northeast.

Site 82 - Wedge Tomb, from east.

Another complex of four tombs – two of which are wedge tombs and two are possible wedge tombs – are located 1.5m southwest of the Knockcurraghbola Commons tomb (Site 88, 89, 91 and 92) are also in this townland. The first one is the most preserved of this group. These tombs were visited by the author as part of the field survey carried out for the archaeological assessment of the Upperchurch windfarm in 2012.

Site 88
Megalithic Tomb
(from NE)

Site 89
Megalithic Tomb
(from NE)

Site 91
Megalithic Tomb,
(from W)

Site 92
Megalithic Tomb
(from SE)

A series of test excavations in the vicinity of Site 86 - *Wedge Tomb*, which lies within close proximity to the route of the 110kV UGC (UWF Grid connection), were carried out by the author in preparation of this report. Nothing of archaeological significance was encountered during these works.

Site 85 Megalithic Tomb (from N)

Elsewhere, excavations at the Baurnadomeeny Wedge tomb (Site 67) by O'Kelly yielded 21 burials and a range of flint tools (Raleigh 1985). A distribution analysis of the tombs of the study area and the immediate surroundings of the Silvermine Mountains revealed that these types of burial monuments were not on the summits of hills like in the Neolithic but were more generally on lower lying, sloping land. The Wedge tombs are associated with a series of rivers and streams that ultimately flow into the River Shannon, with the exception of the Knockcurraghbola Commons group, which are at the juncture where streams flow to both the Bilboa River (and on to the Shannon) and the Turraheen River, which connects with the Suir River.

Site 67 - Wedge Tomb (from S)

The Middle Bronze Age period is represented in the study area by standing stones, stone rows and stone circles. There are at least 5 examples of standing stones (Site 66 TN038-008, Site 70 TN038-

011, Site 80 TN039-004002, Site 87 TN039-043, and Site 90 TN039-044), a stone circle (Site 79 TN039-004001), and a stone row (Site 83 TN039-052) from the study area. Distribution and viewshed analyses (carried out in 2012 by the author) of the standing stones within and adjacent to the study area show a striking pattern: they are overwhelmingly placed at positions which overlook the numerous rivers and streams.

Site 87
Standing Stone
(from NW)

Site 90
Standing Stone
(from N)

Test excavations were also carried out in the vicinity of Site 83 - *Stone Row* by the author in 2017 as part of this report

Site 83, Stone Row, from SE

A single fulacht fiadh, a type of Bronze Age site where water was heated for both domestic and ritual use, was identified within the development area (Site 84 TN039-051). This was located to the south of Site 83 - Stone Row in an area completely covered by dense mature forestry.

A-16.1.1.5 The Iron Age (2400-500BC)

Later burial monuments come in the form of barrows. There are three examples of this monument type in the development area (Site 31 TN031-071, Site 55 TN031-074 and Site 78 TN039-035). These burial mounds are generally dated to the Late Bronze and Early Iron Age but may be earlier.

No work has been carried out on any of the examples from within the study area to more accurately date these monuments. As with the earlier megalithic examples there is a high concentration of these monuments evident in the wider landscape of the development area. One example, a well preserved bowl-barrow (Site 31) is located *c.*400m from the southernmost extent of the development area.

Site 31 - Bowl Barrow from south

To make sense of the prehistoric site distribution patterns and the heavy concentration of prehistoric monuments in the upland region, Raleigh (1985) observed that mineral resources may have been an attraction for settlement. No mines are recorded in the study area; however there is a prehistoric copper mine c.2km south of the study area in Lackamore (TN038-020).

A-16.1.1.6 The Early Medieval Period (400-1100AD)

Occupation continued during the Early Medieval (c.400-1100 AD) period with a large concentration of ringforts to be found on the slopes of the Silvermine Mountains. Ringforts enclosed single farmsteads and are by far the most common medieval archaeological monument surviving in Ireland with over 47,000 examples having been identified across the island (Aalen et al. 2012, 45).

Although there are some examples dotted around the valleys in the Silvermine mountains, ringforts typically avoided upland areas. This monument type is more commonly found on flat ground and the lower slopes of river valleys. Within the study area there are a total of 12 ringforts. All bar one of these is located at the western extents of the development area.

In preparing this report, the author carried out excavations at Site 52 *Ringfort,* as the route of the 110kV UGC (UWF Grid connection) passes within close proximity of this monument. Nothing of archaeological significance was encountered in this area.

Location of Site 56 - Ringfort

There is also a cliff edge fort (Site 44 TN031-062) and an enclosure (Site 56 TN-31-078) within the study area which may be attributed to this period.

The Early Medieval period also saw the spread of Christianity across Ireland and many churches and monastic centres emerged during this period. The significance of holy wells and other sites of ritual significance, such as Ballaun Stones, can be traced back to this period. While it is unclear that any of the four medieval churches from the study area have their origins in this period, within the environs of the proposed development there are two holy wells (Site 5 TN031-010002 and Site-33 TN031-072) and a Ballaun Stone (Site 1, TN031-009) which may.

A-16.1.1.7 The Later Medieval Period (1179-1400AD)

The next significant archaeological period for the region followed the Anglo-Norman conquest in the late-12th century. During this period the western portion of the study area was part of the kingdom of Limerick. (Empey 1985, 76). It was conquered by 1206 and the previous Gaelic order was replaced by a new feudal regime that was organised on entirely different principles (Empey 1985, 76). The Anglo-Norman conquest had a massive impact on the landscape of Ireland. With the conquest came a new architecture of power in the form of great stone castles, cathedrals and churches. These great buildings were designed and located to assert the new-found dominance of the Anglo-Normans over the landscape, the people and their traditions. Within the broader landscape of the proposed development area there are a wide array of examples of Anglo-Norman buildings, from early motte and baileys through to the subsequent masonry castles and churches.

The four churches within the study area (Site 4, 30, 46 and 73), possibly dating from the medieval period, provide evidence for the Anglo-Norman encroachment into the locality. Within the broader region of the Silvermine Mountains there is greater evidence of this conquest, specifically the military aspect. The castles are situated at the foothills of the mountains overlooking the Clodiagh and Owenbeg rivers but not in the upland regions, which would have remained out of Norman influence. These frontier castles (for example Site 9, *tower house*) appear to defend a key routeway into the mountainous regions of North Tipperary.

A-16.1.1.8 The 'Age of Improvement' (17th-18th Century)

In the 17th-18th-centuries country estates known as demesnes emerged across the country. These had their origins in the "Age of Improvement". Demesnes consisted of designed landscapes which were usually enclosed by stone walls and were often entered through elaborate gate lodges and gateways. They often contained an area of managed woodland known as a wilderness; this included pathways for the gentry to stroll through. Trees were planted along the roads in the estate to create shelter belts and avenues along the approaches to the ‘Big House’. The houses formed the centrepiece of every demesne and were generally constructed in the Palladian style which drew on aspects of Classical Roman and Greek architecture.

Within the study area, a total of nine designed landscapes are shown on the first edition Ordnance Survey Maps. The Mountphilips 110kV Substation is located within the footprint of Mount Philips Demesne. Within the immediate vicinity of the substation site are two additional demesnes. These areas and their designed landscape features are described in Table 1 below. Practically all features associated with these sites within the vicinity of the development area are no longer extant.

A-16.1.1.9 Early Modern Period (1850-Present)

Agricultural farming and land improvement is evident across the majority of the study area. This is characterised by large scale land enclosure in upland areas and the presence of a significant number of lime kilns (69) and quarries (33) present in the study area.

In 1973, Ireland's accession to the E.E.C. (E.U.) and the subsequent effects of the Common Agricultural Policy (CAP) had far reaching consequences for the landscape. CAP promoted intensification and industrial-scale farming which was mainly responsible for the destruction of many of the field-boundaries marked on the first edition map of the development area. The land in the area is now a mix of improved agricultural grassland and wet grassland employed for pasture, though coniferous forest also makes up a sizeable proportion – c.30%.

APPENDIX 16.1.2 Cultural Heritage Sites within the Study Areas

A16.1.2 Cultural Heritage Sites within the Study Areas 2
A16.1.2.1 Cultural Heritage Sites within the UWF Grid Connection Study Area 4
A16.1.2.2 Cultural Heritage Sites within the UWF Related Works Study Area 35

A16.1.2 Cultural Heritage Sites within the Study Areas

The archaeological sites identified in the study area, along with a description, an impact evaluation and recommendations, are summarised in Table 1 (UWF Grid Connection Study Area) and Table 2 (UWF Related Works Study Area) below.

These sites were identified during both desktop studies and field walking surveys which were conducted in both 2016 and 2017. Desktop studies included a review of primary sources and secondary sources.

Primary sources included:

- Record of Monuments and Places
- Record of Protected Structures
- National Inventory of Architectural Heritage
- National Museum of Ireland Topographic Files
- All editions of the historic Ordnance Survey Maps (including the first edition 1841 and the second edition 1898 1:10560 maps)
- Other historic mapping, such as the Down Survey (1655) and the Griffith Valuation (1850).

Maps
First edition 1840 Ordnance Survey map sheet
Second edition 1900 Ordnance Survey map sheet
Griffith's Valuation maps and valuation report
Records of Monuments and Places (RMP) constraints maps

Aerial photographs
2000 Ordnance Survey orthophotography
2005 Ordnance Survey orthophotography
Google Earth
Bing maps aerial photos

Secondary sources:
DoEHLG, 1999, *Framework and Principles for the Protection of the Archaeological Heritage*, Dublin.

EPA, 2002, *Guidelines on the information to be contained in Environmental Impact Statements*, EPA, Dublin.

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O'Kelly, M. J. 1959. A court cairn at Shanballydesmond, County Tipperary, *Cork Archaeological Society Journal*, pp34-7.

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Raleigh 1985 The Archaeology of prehistoric Tipperary. In Nolan (ed) *Tipperary: History and Society*. Geography Publications, Dublin.

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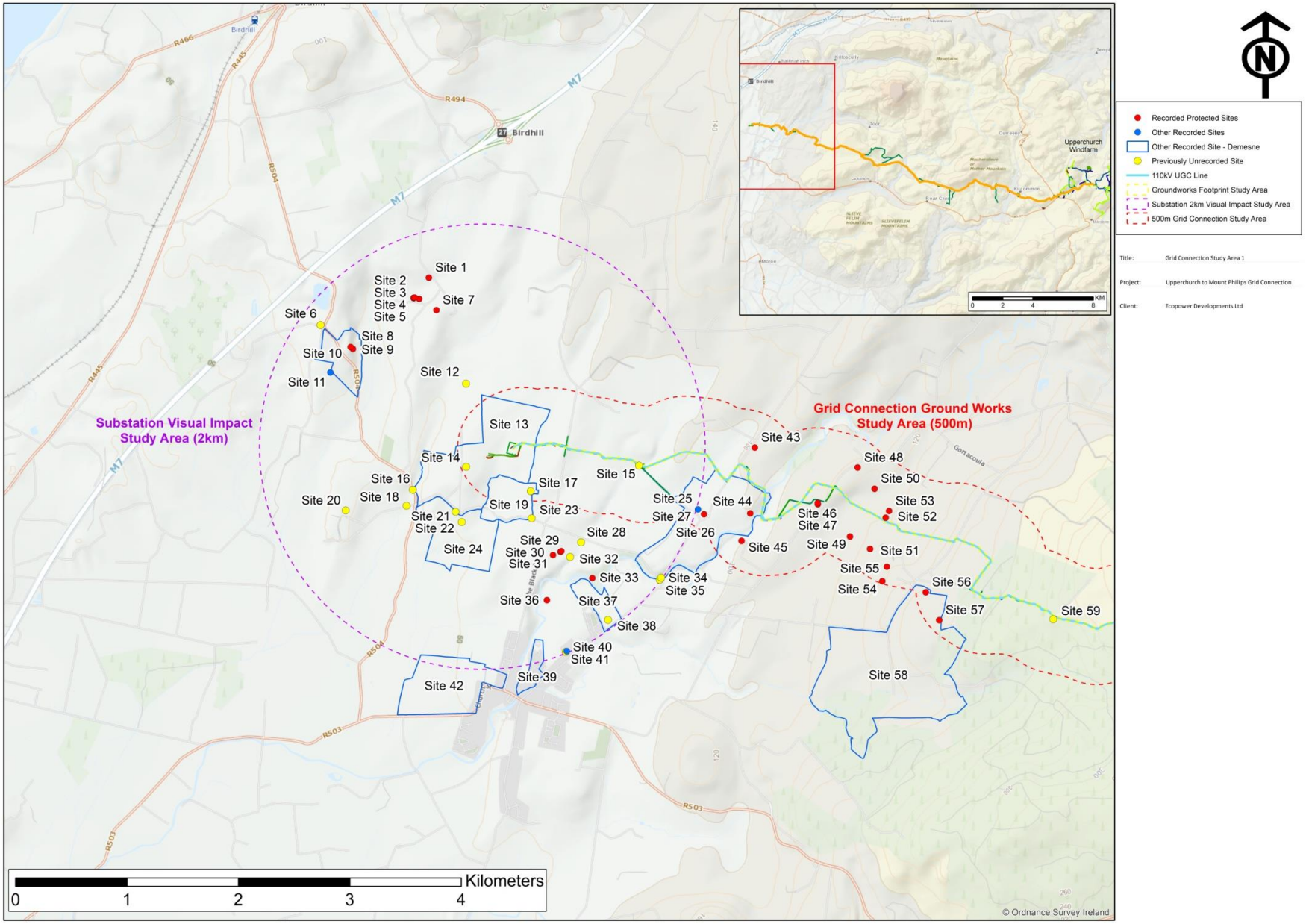
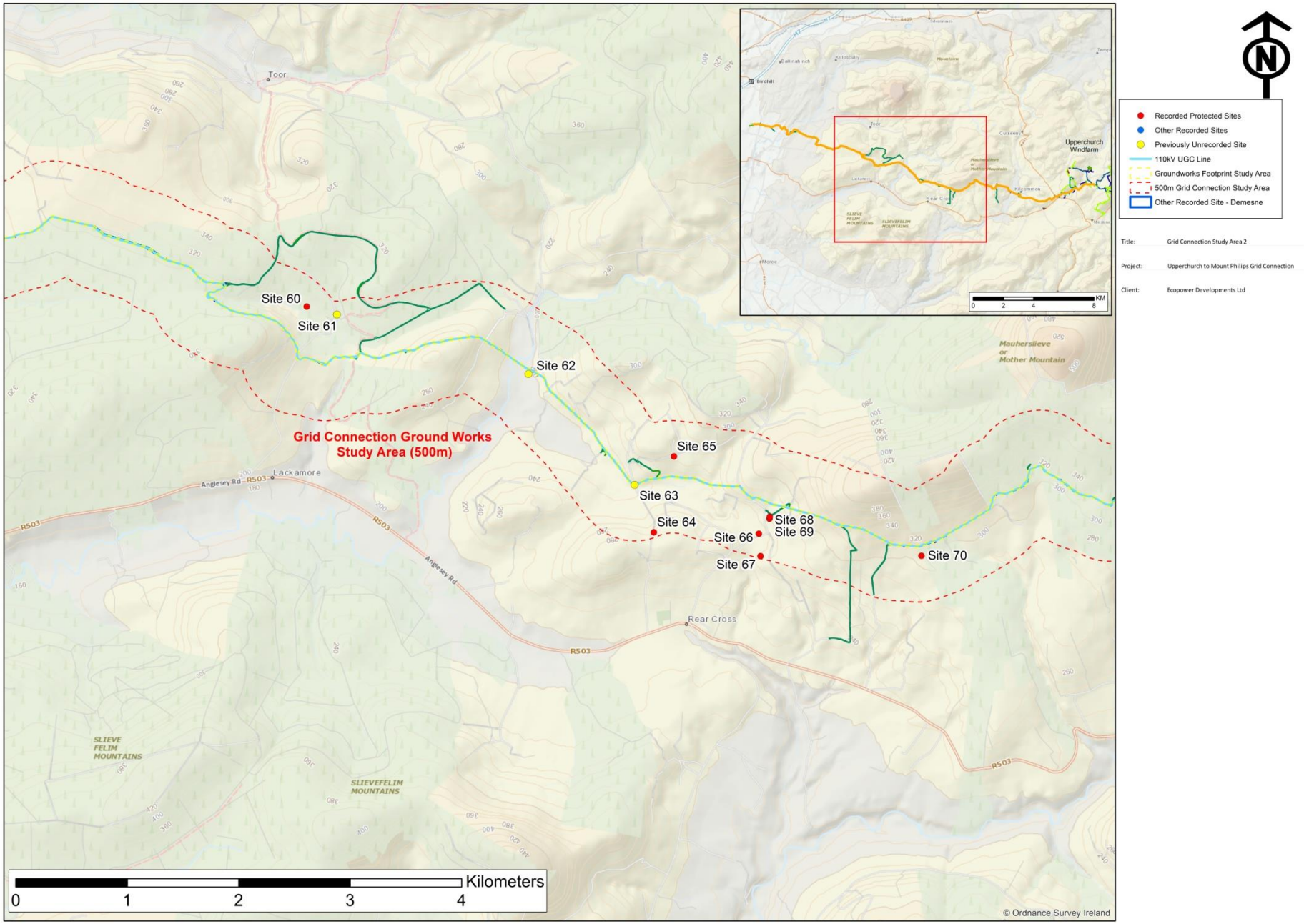
Waddell, J., (1998), *The Prehistoric Archaeology of Ireland*, Galway, Galway University Press.

A16.1.2.1 Cultural Heritage Sites within the UWF Grid Connection Study Area



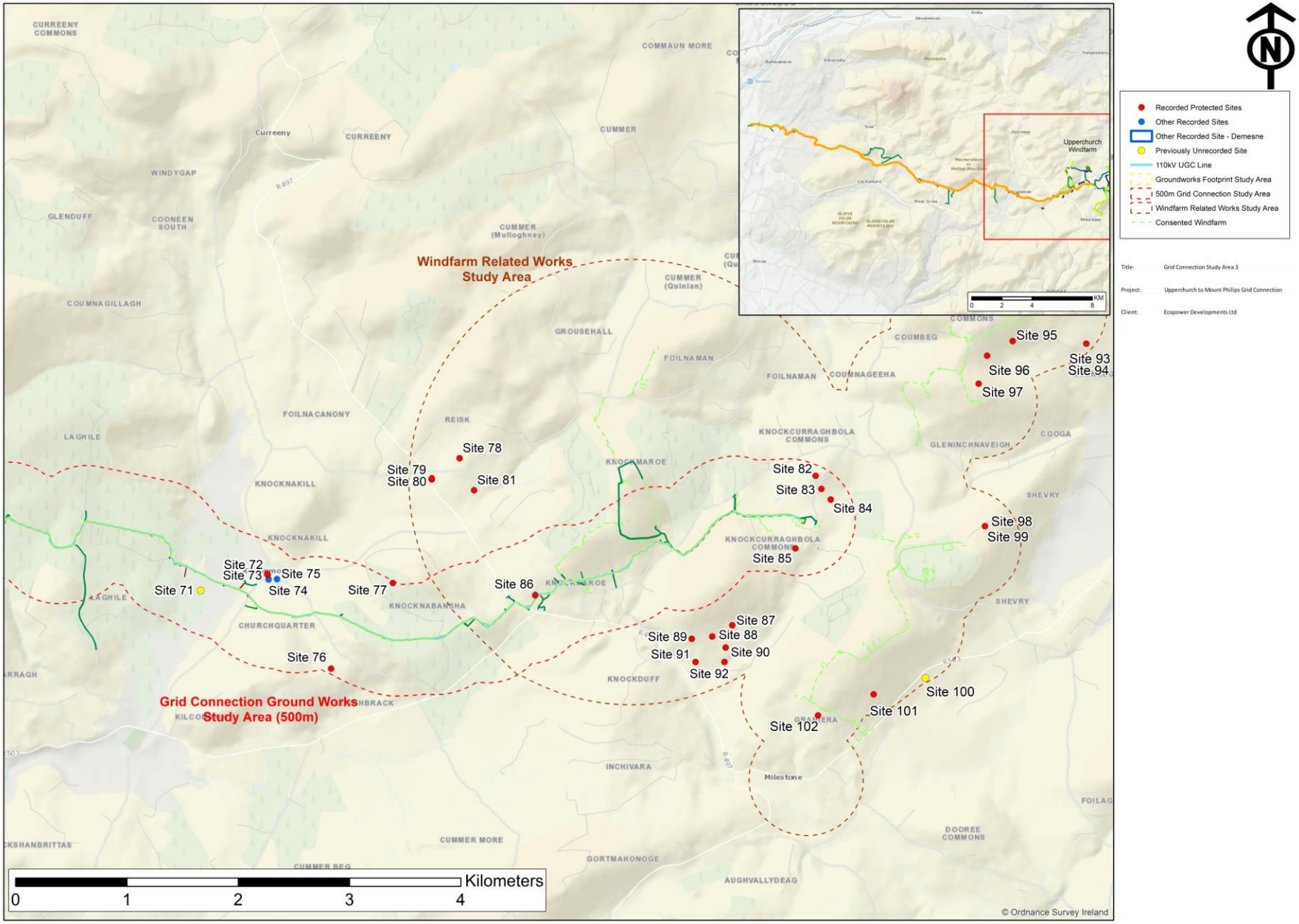
UWF Grid Connection Study Area Map 1 **(Larger scale map included in Tab 16 of Volume C3 EIA Report Figures)**

REFERENCE DOCUMENTS



REFERENCE DOCUMENTS

UWF Grid Connection Study Area Map 2(Larger scale map included in Tab 16 of Volume C3 EIA Report Figures)



UWF Grid Connection Study Area Map 3 (Larger scale map included in Tab 16 of Volume C3 EIA Report Figures)

REFERENCE DOCUMENTS

Table 1: Cultural Heritage Sites within the UWF Grid Connection Study Area

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
1	RMP	Recorded Protected Site	TN031-009----	Bullaun stone	571716	666067	Ballyard	Situated on a low SE-facing slope of rising ground in an upland area with a nearby stream to the SE and a church (TN031-010001) some 200m to the SW. Although at some distance this is possibly associated with the church site to the SW as there is a holy well called 'St Commaneth's Well' (TN031-010002) close to the church. A large earthfast boulder (dims. 2m x 0.9m x 0.65m) with two deep depressions (dims. 0.35m x 0.17m; 0.38m x 0.10m) and one shallow one on its upper surface.	1.64km to the NW	None	Avoidance
2	RMP	Recorded Protected Site	TN031-010004-	Font	571580	665888	Ballyard	An octagonal-shaped limestone stoup or font (TN037-046----) which rested on a four-clustered column is now located in the grounds of Newport RC church, originally came from the church (TN031-010001-) and graveyard (TN031-010003-) at Ballyard.	1.52km to the NW	None	Avoidance
3	RMP	Recorded Protected Site	TN031-010003-	Graveyard	571580	665884	Ballyard	Situated at the base of a W-facing slope with a stream immediately to the S, a holy well (TN031-010002-) to the SE and a bullaun stone (TN031-009----) to the NE. Present remains consist of a low rise of ground where the church (TN031-010001-) was located in the centre of a graveyard enclosed by a stone wall. Several architectural fragments are located in the SW sector of the graveyard and others are reused as grave surrounds. Berry (1904, 99-110) described the church as surviving to foundation level only measuring internally 60ft x 26ft (18m x 8.7m) with architectural fragments of a late medieval date scattered around the graveyard. An octagonal-shaped limestone stoup or font (TN031-010004-/TN037-046----) which rested on a four-clustered column is now located in the grounds of Newport RC church.	1.55km to the NW	None	Avoidance
4	RMP	Recorded Protected	TN031-01000	Church	571590	665889	Ballyard	Situated at the base of a W-facing slope with a stream immediately to the S, a holy well (TN031-010002-) to the SE and a bullaun stone	1.55km to the NW	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
		Site	1-					(TN031-009----) to the NE. Present remains consist of a low rise of ground where the church was located in the centre of a graveyard (TN031-010003-) enclosed by a stone wall. Several architectural fragments are located in the SW sector of the graveyard and others are reused as grave surrounds. Berry (1904, 99-110) described the church as surviving to foundation level only measuring internally 60ft x 26ft (18m x 8.7m) with architectural fragments of a late medieval date scattered around the graveyard. An octagonal-shaped limestone stoup which rested on a four-clustered column is now located in the grounds of Newport RC church.			
5	RMP	Recorded Protected Site	TN031-010002-	Ritual site - holy well	571630	665877	Ballyard	Situated at the base of a W-facing slope of rising ground with a church and graveyard (TN031-010001-) to the NW. A disused holy well originally enclosed by a drystone wall and now enclosed by a modern concrete surround with broken statues on a shelf to the N of the well.	1.55km to the NW	None	Avoidance
6	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	Smithy	570759	665625	Touknockane	A smithy is shown at this location on the 25 Inch edition of the Ordnance Survey (1905). It is shown as a cluster of farm buildings at a crossroads.	1.99km to the NW	None	Avoidance
7	RMP	Recorded Protected Site	TN031-011----	Ringfort - rath	571784	665776	Ballyard	Situated on the N-facing slope of an E-W ridge in an upland area overlooking a church (TN031-010) to NW. The present remains consist of a semicircular area (diam. 33m E-W) enclosed by an earth and stone bank (Wth 1.45m; int. H 0.4m ; ext. H 1.7m) visible from S through W through N to E, elsewhere destroyed with external fosse (Wth 3m; D 0.7m) visible at W only. Possible entrance gap at NE. Field fence intersects site at SE on a NE-SW axis.	1.35km to the NW	None	Avoidance
8	RMP	Recorded Protected	TN031-04800	Bawn	571014	665445	Cragg	Situated on rock outcrop in an upland area with extensive views. Described in the Civil Survey (1654-6) as 'the walls of a castle and a	1.66km to the NW	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
		Site	2-					Barbicon' (Simington 1934, vol. 2, 179). John Ryan is listed as proprietor in 1640 (ibid.). Present remains consist of a rectangular tower house (TN031-048001) three storeys high built with roughly coursed sandstone rubble with a high pronounced base-batter. Nineteenth-century outhouses now obscure a possible bawn area (TN031-048002) located to the N and W of the tower.			
9	RMP	Recorded Protected Site	TN031-04800 1-	Castle - tower house	571035	665428	Cragg	Situated on rock outcrop in an upland area with extensive views. Described in the Civil Survey (1654-6) as 'the walls of a castle and a Barbicon' (Simington 1934, vol. 2, 179). John Ryan is listed as proprietor in 1640 (ibid.). Present remains consist of a rectangular tower house (ext. dims. 8.7m N-S; 6.6m E-W; wall T 1.7m) three storeys high built with roughly coursed sandstone rubble with a high pronounced base-batter. There is good evidence of lime plaster on the internal faces of the walls of the tower house chambers. The external face of the S wall is destroyed and originally contained a round-arched rebated limestone doorway of which only one jambstone survives on the W side with evidence of a yett-hole. The main doorway led into a lobby protected by an overhead murder-hole. Access to spiral stairs (now destroyed) in the SW angle was via this lobby, with the main ground-floor barrel-vaulted chamber being reached via a round-arched limestone doorway in the N wall of the lobby. This chamber has a single-light flat-headed window set into the centre of the W, N and E walls with a brick fireplace inserted into the N end of the W wall. The first floor, which was accessed through a doorway in the centre of the S wall, had a wooden ceiling carried in the thickness of the wall. This floor was lit by single-light flat-headed windows set into the centre of the W, N and E walls. The second floor has a barrel-vaulted ceiling and is accessed from a round-arched limestone doorway in the centre of the S wall. In the NW angle there	1.63km to the NW	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								is a flat-headed doorway, now inaccessible, which probably led to a garderobe. Nineteenth-century outhouses now obscure a possible bawn area (TN031-048002-) located to the N and W of the tower.			
10	First Edition Ordnance Survey	Other Recorded Site	TN-58-R-711654	Demesne	570955	665348	Cragg	The extent of Cragg demesne is shown at this location on the first edition Ordnance Survey (1838).	1.49km to the NW	None	Avoidance
11	NIAH	Other Recorded Site	22403113	House	570832	665216	Cragg	Detached two-pile three-bay single-storey with dormer floor house, built c. 1880, with lower three-bay two-storey block to rear of west end. Gabled porch projection to middle bay and gabled ends with projecting chimneystacks to north elevation. Pitched slate roofs with decorative timber bargeboards with finials and cut limestone chimneystacks with single, paired and tripled round-profile chimneys. Rendered walls. Square-headed openings with single, double and paired one-over-one pane timber sash windows, latter with combined sills. U-plan layout of former stable blocks comprising L-plan single-storey blocks flanking central three-bay two-storey block, latter with integral segmental carriage arches and whole now converted to dwellings, with pitched slate roofs, gabled dormers and snecked dressed limestone walls. enclosing wall with gate piers. Limestone entrance gate piers with stone caps. Cragg House is significant for the architectural quality of its design and detailing. Its deliberate use of an asymmetrical form, with multiple pitched roofs and pairs of tall chimneystacks, provides an attractive composition, which is further enhanced by the quality of the outbuildings, and the buildings setting within a mature woodland garden.	1.59km to the NW	None	Avoidance
12	First	Previously	NA	Pond	572066	665098	Mountphil	Pond shown at this location on the first edition Ordnance Survey	654m to the	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
	Edition Ordnance Survey	Unrecorded Site					ips	(1838)	NW		
13	First Edition Ordnance Survey	Other Recorded Site	TN-59-R-721647	Demesne	572212	664459	Mountphilips	The extent of Mount Philips demesne is shown at this location on the first edition Ordnance Survey (1838).	0m	Indirect	Avoidance under supervision of monitoring archaeologist
14	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	House	572066	664351	Mountphilips	A house is shown at this location on the 25 Inch edition of the Ordnance Survey (1905). This appears to have been the main residence for Mount Philips Demesne (Site 13).	259m to the W	None	Avoidance
15	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	Ford	573616	664363	Oakhampton	A ford is shown at this location on the 25 Inch edition of the Ordnance Survey (1905).	10m to the S	None	Avoidance
16	First Edition Ordnance Survey	Previously Unrecorded Site	NA	Bridge	571588	664145	Mountphilips	Bridge shown at this location on the first edition Ordnance Survey (1838)	955m to the W	None	Avoidance
17	First Edition Ordna	Previously Unrecorded Site	NA	House	572645	664133	Coole	House shown at this location on the first edition Ordnance Survey (1838). This appears to have been the main residence for Coole Demesne (Site 19).	358m to the SE	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
	nce Survey										
18	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	Stepping Stones	571531	664002	Barna	Stepping stones is shown at this location on the 25 Inch edition of the Ordnance Survey (1905).	1.01km to the SW	None	Avoidance
19	First Edition Ordnance Survey	Previously Unrecorded Site	NA	Demesne	572433	664069	Coole	The extent of Coole demesne is shown at this location on the first edition Ordnance Survey (1838).	215m to the S	None	Avoidance
20	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	House	570985	663961	Killeen	A house is shown at this location on the 25 Inch edition of the Ordnance Survey (1905). It is referred to as "Killeen House" within a cluster of farm buildings.	1.53km to the SW	None	Avoidance
21	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	Lodge	571972	663948	Barna	The Gate Lodge for Barna Demesne is shown at this location on the 25 Inch edition of the Ordnance Survey (1905).	699m to the S	None	Avoidance
22	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	House	572027	663855	Barna	A house is shown at this location on the 25 Inch edition of the Ordnance Survey (1905). This appears to have been the main residence for Barna Demesne (Site 24).	740m to the SE	None	Avoidance
23	First Edition Ordnance	Previously Unrecorded Site	NA	Gate Lodge	572654	663889	Foildarrig	Gate Lodge at the entrance to Coole Demesne shown at this location on the first edition Ordnance Survey (1838)	593m to the S	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
	Survey										
24	First Edition Ordnance Survey	Other Recorded Site	TN-59-R-742638	Demesne	571977	663750	Barna	The extent of Barna demesne is shown at this location on the first edition Ordnance Survey (1838).	630m to the S	None	Avoidance
25	NIAH	Other Recorded Site	22403114	House	574131	663987	Oakhampton	Detached three-bay two-storey house, with projecting gabled central bay, built c. 1820, with earlier lower four-bay two-storey house, c. 1760, at right angles to rear. Pitched slate roofs, reconstructed to front block, with rendered chimneystacks and with stone eaves course to rear block. Exposed rubble sandstone walls with dressed quoins and voussoirs to openings. Square-headed openings with six-over-six pane timber sash windows and glazed timber door. Recent single- and two-storey additions to south gable. Courtyard to rear of house has detached six-bay two-storey stable block with pitched slate roof, exposed sandstone walls and square-headed openings with replacement timber windows and doors. Three-bay single-storey rubble sandstone outbuilding to south-east of house with integral carriage arches. Single-storey stone pavillion with hipped slate roof built c. 2000 connected to north-east of main block with flanking arched stone wall. Rubble limestone boundary walls with square-profile gate piers with plinths and flat caps, topped by carved stone eagles. Oakhampton House is significant for the architectural quality of its design and detailing. It is enhanced by the collection of outbuildings which form an enclosed courtyard behind the house. In the garden is a ringfort which the driveway circumnavigates.	369m to the S	None	Avoidance
26	First Edition		TN-59-R-	Demesne	574191	663857	Oakhampton	The extent of Oakhampton demesne is shown at this location on the first edition Ordnance Survey (1838).	0m	Indirect	Avoidance under

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
	Ordnance Survey		734629								supervision of monitoring archaeologist
27	RMP	Recorded Protected Site	TN031-061----	Ringfort - rath	574186	663943	Oakhampton	Situated on a rise of ground in an upland area in the front garden of Oakhampton House with a nearby cliff-edge fort (TN031-062) to the E. A raised circular platform (diam. 42m N-S) defined by a scarp (H 2-3m) with traces of a shallow external fosse best visible at S and a possible causewayed entrance at SE. A possible ringfort of platform type reused as a landscape feature. A cobblestone surface is visible underneath a yew tree in the S sector of the interior.	367m to the S	None	Avoidance
28	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	Stepping Stones	573098	663674	Foildarrig	A stepping stone is shown at this location on the 25 Inch edition of the Ordnance Survey (1905).	784m to the S	None	Avoidance
29	RMP	Recorded Protected Site	TN031-070002-	Children's burial ground	572906	663612	Foildarrig	Situated on an E-facing slope in an upland area with a bowl-barrow (TN031-071) to the SW. Described in the OS Namebooks (1840) as a place for 'still born infants or children dying without baptism'. No visible remains of any children's burial ground in the vicinity of the church site (TN031-070001).	915m to the S	None	Avoidance
30	RMP	Recorded Protected Site	TN031-070001-	Church	572898	663606	Foildarrig	This church site was located on an E-facing slope of rising ground overlooking a river with a nearby bowl-barrow (TN031-071) to the SW. The OS Letters describe the site as consisting of the wall-footings of a church which measures 5.7m N-S by 12m approx. E-W with a wall thickness of 1m (O'Flanagan 1930, vol. 2, 7). Described in the OS Namebooks (1840) as a children's burial ground (TN031-070002). No visible remains at ground level.	932m to the S	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
31	RMP	Recorded Protected Site	TN031-071----	Barrow - bowl-barrow	572831	663577	Foildarrig	Situated on flat, poorly drained land in an upland area with church site (TN031-070001) to NE. A round-topped mound (diam. 23m N-S; H 1.2m) enclosed by a wide, flat-bottomed fosse (Wth 7.5m; ext. D 0.4m) which was waterlogged at time of visit.	967m to the S	None	Avoidance
32	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	House	572999	663543	Foildarrig	Brook Lodge is shown at this location on the 25 Inch edition of the Ordnance Survey (1905).	956m to the S	None	Avoidance
33	RMP	Recorded Protected Site	TN031-072----	Ritual site - holy well	573184	663369	Foildarrig	Situated in a slight depression in undulating countryside with the nearby Mulkear River to the S. A disused holy well consisting of a natural spring (dims. 0.9m x 0.5m) with water flowing S towards the nearby river. According to a local landowner the well was known as St Bridget's Well (FitzPatrick 1985b, 160).	1.08m to the S	None	Avoidance
34	First Edition Ordnance Survey	Previously Unrecorded Site	NA	Mill	573803	663337	Rockvale	Mill shown at this location on the first edition Ordnance Survey (1838)	1.01km to the S	None	Avoidance
35	First Edition Ordnance Survey	Previously Unrecorded Site	NA	Bridge	573817	663356	Rockvale	Bridge shown at this location on the first edition Ordnance Survey (1838)	1.05km to the S	None	Avoidance
36	RMP	Recorded Protected Site	TN031-073----	Earthwork	572776	663172	Clonbealy	Situated on the W face of a low N-S ridge overlooking the Mulkear River to the W. Present remains consist of a roughly circular area covered in dense overgrowth with no evidence of an enclosing element. Rock outcrop protrudes from the surface of the interior. Of	1.36km to the S	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								doubtful antiquity; dense cover of vegetation makes detailed examination impossible.			
37	First Edition Ordnance Survey	Other Recorded Site	TN-59-R-734629	Demesne	573226	663147	Mackney (Bourke)	The extent of Fort Emil demesne is shown at this location on the first edition Ordnance Survey (1838).	1.247km to the S	None	Avoidance
38	First Edition Ordnance Survey	Previously Unrecorded Site	NA	House	573339	662976	Mackney (Bourke)	Fort Emil House shown at this location on the first edition Ordnance Survey (1838)	1.45km to the S	None	Avoidance
39	First Edition Ordnance Survey	Previously Unrecorded Site	NA	Demesne	572647	662556	Clonbealy	The extent of Rose Hill demesne is shown at this location on the first edition Ordnance Survey (1838).	1.73km to the S	None	Avoidance
40	First Edition Ordnance Survey	Previously Unrecorded Site	NA	School	572961	662690	Clonbealy	School shown at this location on the first edition Ordnance Survey (1838)	1.98km to the S	None	Avoidance
41	NIAH	Other Recorded Site	22311001	School	572954	662714	Clonbealy	Detached four-bay two-storey over basement former charter school, built c. 1820, with entrance porch. Later used as barracks and now a house. Pitched slate roof with rendered chimneystacks at gables. Rendered walls with render quoins. Replacement uPVC windows, set in square-headed openings to ground and first floors and segmental-	1.81km to the S	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								headed to basement and upper south gable. Porch has gabled roof with gable front and uPVC door approached by flight of curved steps. Rendered gate piers and wrought-iron entrance gate. Remnants of rubble garden walls. This former charter school forms part of a significant group with the surviving charter schools in Ireland. The building was later converted to use as a barracks, and has played a significant role in the social development and history of the area.			
42	First Edition Ordnance Survey	Previously Unrecorded Site	NA	Demesne	571873	662399	Newport	The extent of Newport demesne is shown at this location on the first edition Ordnance Survey (1838).	1.87km to the S	None	Avoidance
43	RMP	Recorded Protected Site	TN031-056----	Ringfort - rath	574643	664542	Oakhampton	Situated on a slight rise of ground in an upland area with a nearby ringfort (TN031-054) to the NE. A raised circular area (diam. 20m E-W) enclosed by a well-preserved earth and stone bank (Wth 2.2m; int. H 1.5m; ext. H 2.5m) with an entrance gap (Wth 4.8m) at E and possible traces of a shallow external fosse. This site may have been reused as a tree-ring in the nineteenth century.	237m to the N	None	Avoidance
44	RMP	Recorded Protected Site	TN031-062----	Cliff-edge fort	574601	663951	Oakhampton	Situated on a SE-facing slope of rising ground overlooking a steep-sided ravine with a river below. A raised circular area (diam.25.65m NW-SE; 29.45m NE- SW) enclosed by well-preserved flat-topped bank (Wth 3m; int. H 0.65m; ext. H 2m) reduced to a scarp at SE where the ravine forms a natural defence and a wide external fosse (Wth 3.5-5m; D 0.8m). No clear entrance feature visible - a gap in the bank (Wth 2m) at N may be the original entrance feature.	84m to the W	None	Avoidance
45	RMP	Recorded Protected Site	TN031-084----	House - indeterminate	574523	663704	Newross	No surface remains of any dwelling pre-1700 in area marked on 6" OS 6-inch map. Described in the OS field name books as New Ross Old house (O'Donovan et. al. 1840) which at that time had been replaced	283m to the S	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
				date				by a farmhouse and offices which were built on the site of the old house.			
46	RMP	Recorded Protected Site	TN031-063----	Church	575207	664045	Newross	Situated on the NW slope of a low hillock in an upland area. Listed in the ecclesiastical taxation of the Diocese of Cashel in 1302 (CDI, vol. 5, 281). A rectangular apse-ended nineteenth-century C of I church (ext. dims. 8.5m N-S; 21.6m E-W; wall T 0.75m) which contains two large barrel-vaulted mortuary vaults of nineteenth-century date. No other features are visible due to a dense cover of ivy on the walls of the church which is located in a large square-shaped graveyard (TN031-063002) containing eighteenth- and nineteenth-century headstones.	135m to the W	None	Avoidance
47	RMP	Recorded Protected Site	TN031-063001-	Graveyard	575208	664033	Newross	Situated on the NW slope of a low hillock in an upland area. Listed in the ecclesiastical taxation of the Diocese of Cashel in 1302 (CDI, vol. 5, 281). A rectangular apse-ended nineteenth-century C of I church (TN031-063001) which contains two large barrel-vaulted mortuary vaults of nineteenth-century date. No other features are visible due to a dense cover of ivy on the walls of the church which is located in a large square-shaped graveyard containing eighteenth- and nineteenth-century headstones.	135m to the W	None	Avoidance
48	RMP	Recorded Protected Site	TN031-058----	Ringfort - rath	575566	664362	Newross	Situated on high ground in an upland area overlooking a nearby ringfort (TN031-064) to the SE. A well-preserved ringfort consisting of a raised circular area (diam. 32m NW-SE) enclosed by an earthen bank (Wth 2.5-3.5m; int. H 0.2m; ext. H 1m) reduced to a scarp in places with a possible entrance gap (Wth 4m) at SE.	258m to the NE	None	Avoidance
49	RMP	Recorded Protected Site	TN031-068----	Ringfort - rath	575496	663742	Castlewaller	Situated on a slight rise of ground in an upland area. A circular area (diam. 18m N-S) enclosed by an earth and stone bank (Wth 1.2m; int. H 0.3m; ext. H 0.7-1.2m) with faint traces of a shallow external fosse visible at NW only and an entrance gap (Wth 3.5m) at ESE.	282m to the SW	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
50	RMP	Recorded Protected Site	TN031-064----	Ringfort - rath	575716	664172	Newross	Situated on flat poorly drained land in an upland area with nearby ringforts (TN031-058, TN031-066, TN031-067) to the NW and SE respectively. A raised circular area (diam. 27.5m N-S; 24.5m E-W) enclosed by an earthen bank (Wth 2.8m; int. H 0.7m; ext. H 1.2m) and an external fosse (Wth 2.3m; D 0.4m) which was waterlogged at the time of visit. The bank is destroyed at E by an intersecting field fence on an E-W axis. No entrance feature visible.	221m to the N	None	Avoidance
51	RMP	Recorded Protected Site	TN031-069----	Ringfort - rath	575676	663632	Castlewall er	Situated on the SW slope of an E-W ridge overlooking a stream to the W. A raised circular area (diam. 31m E-W) enclosed by a poorly preserved bank (Wth 2m; int. H 0.35m; ext. H 1.5m) reduced to a scarp in most places with a possible entrance gap (Wth 4m) at ESE. No visible trace of a fosse.	303m to the S	None	Avoidance
52	RMP	Recorded Protected Site	TN031-067----	Ringfort - rath	575816	663912	Castlewall er	Situated on the E-facing slope of a steep-sided ravine in an upland area with nearby ringforts (TN031-066, TN031-064) to NE and N respectively. A poorly preserved ringfort consisting of a circular area (diam. 22.5m NW-SE) enclosed by an earth and stone bank (Wth 2m; int. H 0.6m;ext. H 1.5-2.5m) reduced to a scarp at E with a wide flat-bottomed external fosse (Wth 2-3m; D 1.5m) destroyed at E and a possible outer bank now utilised as a field fence visible from S to W. No entrance feature visible.	28m to the NE	None	Avoidance
53	RMP	Recorded Protected Site	TN031-066----	Ringfort - rath	575846	663972	Castlewall er	Situated on the W-facing slope of a steep-sided ravine in an upland area with nearby ringforts (TN031-067, TN031-064) to the SW and NW respectively. It was not possible to inspect this site due to a dense cover of vegetation. An earlier field report (OPW 1957) describes the site as an oval-shaped area (diam. 40m N-S; 30m E-W) enclosed by an earth and stone bank (Wth 3m; int. H 0.65m; ext. H 1.7m) and external fosse (Wth 2m; D 0.6m) visible only at E and SW. No entrance feature visible.	94m to the S	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
54	RMP	Recorded Protected Site	TN031-076----	Ringfort - rath	575786	663342	Castlewaller	Situated on the NW-facing slope of an E-W ridge in an upland area with a nearby burial mound (TN031-074) to the NNE. A raised circular area (diam. NW-SE 22m approx.) enclosed by a bank (Wth 1.5m; int. H 0.6m; ext. H 1.5m) from E through S to W, elsewhere reduced to a scarp with destroyed entrance gap (Wth 2m) at SE.	522m to the S	None	Avoidance
55	RMP	Recorded Protected Site	TN031-074----	Barrow - mound barrow	575826	663472	Castlewaller	Situated on top of a hillock in an upland area with extensive views and overlooking nearby ringfort (TN031-076) to SSW. A conical-shaped flat-topped mound of earth and stone (H 1.2m; diam. top 5.4m) with stones protruding from the surface of the mound.	384m to the W	None	Avoidance
56	RMP	Recorded Protected Site	TN031-078----	Enclosure	576176	663242	Castlewaller	Situated on a N-facing slope of rising ground in an upland area. A circular area enclosed by an earth and stone bank (Wth 2m; int. H 0.6m; ext. H 0.5m). A dense cover of vegetation prevented examination of the interior.	433m to the W	None	Avoidance
57	RMP	Recorded Protected Site	TN031-081----	Ringfort - rath	576296	662992	Castlewaller	Situated on flat pasture at the base of an E-facing slope of rising ground in an upland area. A circular area (diam. 16m E-W) enclosed by an earthen bank (Wth 1m; int. H 0.5m; ext. H 0.8m) with an external fosse (Wth 1m; D 0.5m) visible from N to E to S only, with a causewayed entrance (Wth 1.3m) at E.	467m to the SE	None	Avoidance
58	First Edition Ordnance Survey	Other Recorded Site	TN-59-R-759624	Demesne	575877	662525	Castlewaller	The extent of Castlewaller demesne is shown at this location on the first edition Ordnance Survey (1838).	237m to the W	None	Avoidance
59	First Edition Ordnance	Previously Unrecorded Site	NA	Culley Rock	577335	662983	Castlewaller	"Culley Rock" shown at this location on the first edition Ordnance Survey (1838)	28m to the S	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
	Survey										
60	RMP	Recorded Protected Site	TN038-001----	Children's burial ground	580530	662348	Killeen (Killoscully Par.)	Situated on a natural hillock on the flat floodplains of a river valley in a mountainous region. A natural hillock which has been used as a children's burial ground as evidenced by low orthostats protruding from the surface of the mound (H 2m; 24m NW-SE; 14.5m NNE-SSW). Several orthostats appear to be aligned in rows orientated on a NNE-SSW axis.	334m to the NW	None	Avoidance
61	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	Ford	580816	662259	Knockacappul	A ford is shown at this location on the 25 Inch edition of the Ordnance Survey (1905).	388m to the N	None	Avoidance
62	First Edition Ordnance Survey	Previously Unrecorded Site	NA	Old Course	582534	661726	Bealaclave	"Old Course" shown at this location on the first edition Ordnance Survey (1838)	46m to the SE	None	Avoidance
63	First Edition Ordnance Survey	Previously Unrecorded Site	NA	Ford	583486	660732	Bealaclave	Ford shown at this location on the first edition Ordnance Survey (1838)	11m	Indirect	Avoidance under supervision of monitoring archaeologist
64	RMP	Recorded Protected Site	TN038-004----	Boulder-burial	583644	660323	Reardnogy More	Situated atop high ground on Barnarhu Hill in a mountainous region with extensive views in all directions and a possible stone circle site (TN038-005) to the SSW. A row of four boulders, one of which is prostrate, aligned E-W. All four boulder burials are resting on smaller	503m to the S	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								support-stones in typical boulder-burial arrangement. None of the stones penetrate the surface of the ground. The prostrate E stone is 0.7m x 0.95m x 0.4m and rests on three smaller support-stones. The second stone is 1m x 2.1m x 1.3m and also rests on small support-stones. The third stone is 0.8m x 0.9m x 0.8m and rests on three support-stones, two to the W and one to the E which creates a small chamber underneath the stone. The fourth stone is 1.1m x 1.6m x 1.3m and rests on three smaller stones. The overall length of the row is 10m with the gaps between the stones measuring from E to W 1.8m, 1.6m, 1.4m. (Rynne 1969, 90).			
65	RMP	Recorded Protected Site	TN038-002----	Cist	583824	661003	Bealaclave	Situated on a low rise of ground in an upland area. A small cist grave discovered during ploughing in 1963 by local farmer. The site consisted of an irregular shaped cist placed in an oval pit (D 0.3m). It was incompletely lined with several small stones with 3 possible capstones. A small quantity of cremated human bones were found at the bottom of the cist resting on a thick layer of charcoal (Rynne 1964, 89-93). Not visible at ground level.	174m to the N	None	Avoidance
66	RMP	Recorded Protected Site	TN038-008----	Standing stone	584586	660311	Baurnadomeeny	Situated on flat poorly drained land in an upland area with a wedge tomb (TN038-009) to the S and a cairn with a possible cist (TN038-007) to the NE. A tall erect orthostat (H 2.6m; dims. 0.65m x 0.4m) orientated on a WNW-ESE axis with no evidence of packing stones at its base. A modern road runs E-W immediately N of the stone.	306m to the S	None	Avoidance
67	RMP	Recorded Protected Site	TN038-009----	Megalithic tomb - wedge tomb	584601	660110	Baurnadomeeny	This well-preserved tomb, excavated in 1959 (O'Kelly 1960), is sited just below the summit of a hillock which forms the south-western spur of Mauherslieve. A gallery, 7.2m long, is centrally placed in a cairn, 15m to 16m in diameter, surrounded by a kerb of inward-sloping slabs. Between the kerb and the gallery there is an incomplete circle of stones, c.11m in diameter. Inside this there is an irregular arc	513m to the S	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								of large stones beyond the front half of the southern side of the gallery and another beyond the entire northern side. These formed the edge of an elaborate construction that enclosed the sides of the gallery. They link with a short, irregular double line of stones just in front of the gallery. A septal-stone divides the gallery into a short portico and a main chamber. The former, 2.15m long, narrows from 2.4m wide at the front to 2.1m at the septal-stone. Two sidestones form each of its sides and two low stones set end to end form a low sill at the front. There are incised lines, possibly anciently scored, on the inner face of the eastern orthostat at the northern side. Two pillar-like stones, one towards the front and the other towards the rear, stand on the main axis of the tomb and support the largest of three roof-slabs that partially roof the portico. A cist about 1m square is built against the southern side of the portico. The main chamber, 4.3m long and 1.25m wide at the septal-stone, lacks a backstone. Three sidestones form its S side, four the N side, and it is covered by four substantial roofstones. Pad-stones are interposed between some of the sidestones on the N side of the gallery and three such orthostats flank the S side. The excavation revealed a row of buttress-stones outside both lines of outer-walling. Twenty-one cremated burials were found at the site. Five were in the portico, one in the main chamber, twelve to the S of the tomb and three just outside the kerb at the SW. Among the few artifacts recovered at the site are some worked pieces of flint and chert, among them a plano-convex flint knife, and some pottery sherds which were associated with one of the burials. (De Valera and Ó Nualláin 1982, 84-6, No. 6)			
68	RMP	Recorded Protected Site	TN038-007001-	Cairn - unclassified	584681	660446	Baurnadomeeny	A low circular cairn (H 0.6m; diam. 14m) of loosely piled boulders with a large stone (1m x 2m) in the SE sector which may be the capstone of a cist (TN038-007002). It is situated on a SW-facing slope	157m to the S	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								of rising ground in an upland area with a nearby standing stone (TN038-008) to the SW.			
69	RMP	Recorded Protected Site	TN038-007002-	Cist	584684	660463	Baurnadomeeny	The low circular cairn (Site - 68) of loosely piled boulders with a large stone (1m x 2m) in the SE sector which may be the capstone of a cist.	128m to the S	None	Avoidance
70	RMP	Recorded Protected Site	TN038-011----	Standing stone	586044	660113	Baurnadomeeny	Situated on top of a NW-SE ridge on poorly drained bogland in mountainous area with extensive views. A tall rectangular slab which tapers at the top (H 2m; dims. 1.16m x 0.4m) orientated on a N-S axis. A large recumbent slab (dims. 1.55m x 1.3m x 0.2m) 1.6m to the N which appears to have been recently knocked down. If originally erect, it may have formed a stone pair.	94m to the S	None	Avoidance
71	25 Inch Ordnance Survey	Previously Unrecorded Site	NA	Footbridge	589521	659939	Churchquarter	A footbridge is shown at this location on the 25 Inch edition of the Ordnance Survey (1905).	172m to the S	None	Avoidance
72	RMP	Recorded Protected Site	TN039-006002-	Graveyard	590103	660103	Churchquarter	Situated on raised ground in a graveyard immediately N of Kilcommon RC church. The boundary wall of the graveyard along the N, E and W sides have been rebuilt. The ground level drops immediately NE of the N boundary wall and continues to fall gently to an adjacent river During a recent graveyard clean-up scheme, however, portion of an ogee-headed window was found (pers. comm. Richard O' Brien) which may indicate the presence of a medieval church.	212m to the N	None	Avoidance
73	RMP	Recorded Protected Site	TN039-006001-	Church	590108	660096	Churchquarter	The supposed site of the church depicted on the seventeenth-century Down Survey map is completely occupied by twentieth-century graveslabs. According to Gwynn and Hadcock the OS mistakenly identified Kilcommon, Kilnamanagh Upper Barony as the site of a	186m to the NE	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								Benedictine Priory, and points out that the founder's lands were in south Tipperary and that Orpen considered that Kilcommon, parish of Caher, is the site. This is taken as the correct identification. Brooks gives the date of foundation as c. 1200, with evidence that the priory continued until the reign of Edward III. It was probably abandoned soon after Glastonbury lost much of its property in Ireland in 1332 (Gwynn and Hadcock 1970, 107). During a recent graveyard clean-up scheme, however, portion of an ogee-headed window was found (pers. comm. Richard O' Brien) which may indicate the presence of a medieval church. Post-inventory note: Ogee-headed window not from Churchquarter graveyard but from Killea graveyard (29:6). See O'Brien, R. (2003) 'The Benedictine Priory of Kilcommon', Tipperary Historical Journal, 1-8.			
74	NIAH	Other Recorded Site	22403901	church/chapel	590117	660055	Churchquarter	Detached gable-fronted cruciform-plan church, built c. 1875, with four-bay nave, two-bay transepts and chancel and with lean-to sacristy to north-east. Pitched slate roof with decorative scalloped banding, cast-iron ridge-cresting and finials, cast-iron rainwater gutters supported on stone corbels and decorative cast-iron rainwater hoppers. Roughcast rendered walls with stepped cut limestone buttresses to corners. Chamfered cut limestone lancet windows, pointed to west walls of transepts, trefoil-headed elsewhere, and set into pointed arch recesses between buttresses in gable front, with stained glass to altar and centre of entrance gables, coloured elsewhere. Quatrefoil light over paired lancets in gables. Timber battened double doors set in pointed order arch with tympanum with hood moulding, quatrefoil detail and cross finial. Triangular-headed doorways to transepts. Interior has collared timber	157m to the NE	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								trusses with arched braces and struts and timber boarded ceiling, pointed arches to transepts, and sculpted marble reredos with crocketed pinnacles. Detached concrete bell tower with cast-iron bell. Graveyard and prayer garden to north			
75	NIAH	Other Recorded Site	22403902	presbytery/parochial/curate's house	590192	660058	Churchquarter	Detached three-bay two-storey house with lower two-storey return, built c. 1800. Hipped slate roof, pitched to return, with rendered chimneystacks and cast-iron rainwater goods. Rendered walls with dressed limestone quoins. Square-headed one-over-one pane timber sash windows and round-headed doorway with limestone block-and-start surround with panelled timber door with spoked fanlight. Return may be older than main block. Range of single-storey and lofted limestone outbuildings to rear (north) with pitched and lean-to slate and corrugated iron roofs.	226m to the NE	None	Avoidance
76	RMP	Recorded Protected Site	TN039-014----	Megalithic tomb - wedge tomb	590678	659253	Loughbrack	Situated on a level tract of wettish ground between Loughbrack and Knocknabansha Hills. Many gallery orthostats are missing but outer-walling, doubled at both sides, is well preserved and indicates a diminution in height and width towards the E. A large septal-stone at the W and adjoining it a long sidestone to the N and two alongside to the S remain of the gallery. The short surviving length of gallery is 1.3m wide. Immediately forward of the N end of the septal-stone there is a small transversely set stone. Almost 7m E of the septal-stone a transverse stone links the inner lines of the outer-walls. This stone may be part of the outer-walling though it could be the backstone of the gallery. The inner line of outer-walling at the S is represented by six stones. Outside and flanking the eastern half of this and extending further to the E there is an outer line of seven thin stones. Six stones of an inner line of outer-walling remain on the N side of the monument and there are four stones of an outer line. Just W of mid-length a further stone sits in the gap between these two	470m to the NE	None	Avoidance

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Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								lines. Opposed single stones extend the inner lines of outer-walling beyond the eastern transverse slab. A displaced slab lies between the surviving gallery sidestones and another rests against the eastern transverse stone. Low traces of a mound surround the structure. (De Valera and Ó Nualláin 1982, 90-01, No.11)			
77	RMP	Recorded Protected Site	TN039-007----	Megalithic tomb - wedge tomb	591232	660023	Knocknabansha	Situated in a small clearing in a plantation on the western slope of Knocknabansha Hill. It consists of the remains of a gallery aligned SW-NE, now 2.1m long and some 0.7m wide, formed by two opposed sidestones and a septal-stone outside the SW end of the more southerly sidestone may represent a doubling of the gallery wall. A slight depression in the ground extending about 1.5m beyond the E end of the structure may indicate that the gallery was originally longer. There are a number of displaced stones at the site. (De Valera and Ó Nualláin 1982, 89, No.8)	484m to the NE	None	Avoidance
78	RMP	Recorded Protected Site	TN039-035----	Barrow - ring-barrow	591832	661143	Reisk	Situated on the gentle SW-facing slope of a hill, in pasture. A circular site (12.8m N-S; 12.8m E-W) consisting of a central mound (diam. 4.8m; H 0.26m), a narrow, U-shaped fosse (W 1.7m; D 0.86m) and an outer bank (W 2m; ext. H 0.14m). The bank is steep-sided and the fosse is well defined with some rushes growing in it.	1.37km to the NW	None	Avoidance
79	RMP	Recorded Protected Site	TN039-004001-	Stone circle	591582	660963	Reisk	Situated in rough terrain on a small hillock, on a SW-facing slope, overlooking a valley. A stone circle not marked on the 1st ed. (1840) OS 6-inch map but depicted on the 2nd ed. (1905). There are no visible remains of the stone circle or of the standing stone (TN039-004002) also indicated at this location on the current 6-inch map.	1.31km to the N	None	Avoidance
80	RMP	Recorded Protected Site	TN039-004002-	Standing stone	591582	660953	Reisk	Situated in rough terrain on a small hillock on a SW-facing slope, overlooking a valley. A low standing stone (H 0.8m; dims. 0.85m x 0.2m) aligned NE-SW, sloping slightly to SW. The ground level has been built up with spoil and field clearance. A stone circle (TN039-	1.3km to the NW	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								004001), no longer evident, is also named on the map at this location.			
81	RMP	Recorded Protected Site	TN039-005----	Ringfort - rath	591963	660856	Reisk	Situated on a slight break in a S-facing slope in pasture. A denuded bivallate ringfort consisting of a circular area (diam. 34.5m N-S; 33m E-W) enclosed by a low bank (Wth 4m; int. H 0.13m; ext. H 1m), a U-shaped fosse (Wth 4m; D 0.43m) and outer bank (Wth 3.2m; ext. H 0.38m). Possible entrance in NE quadrant (Wth c. 2.5m) which appears to have been widened. The outer bank is not apparent along the NE quadrant - probably disturbed by adjacent NW-SE field boundary.	1.06km to the N	None	Avoidance
82	RMP	Recorded Protected Site	TN039-009----	Megalithic tomb - wedge tomb	595031	660986	Knockcurraghbola Commons	Situated on a hillock at the NE end of a low ridge. It consists of a long, narrow, partly roofed gallery closed at the SW by a septal-stone. Both sides of the gallery are flanked by outer-walling with the more westerly stone at either side set in advance of the septal-stone. These two stones would have served as the sides of a portico or, alternatively, represent a doubling of the portico sides since removed.The structure is 7m in overall length. The main chamber, open at its more easterly end, is 5.3m long and 1.2m wide at the septal-stone whence it narrows slightly towards the E.Two roofstones cover its forward end. There are five sidestones on the N side and three on the S side. There are six outer-wall stones to the N and four to the S. These are set close to the gallery walls and two of those to the N double as buttress-stones. Beyond the easternmost at the S there is a small stone which may be the butt of a taller one, probably another outer-wall stone. There are traces of a mound around the structure. A large retangular slab lies prostrate at the SW end of the gallery. (De Valera and Ó Nualláin 1982, 90, No.10)	97m to the W	None	Avoidance
83	RMP	Recorded Protected	TN039-052----	Stone row	595083	660868	Knockcurraghbola	Situated in pasture on SE facing slope of rising fround in upland area with good views of mountian valley to S and E, higher ground to N.	37m to the SE	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
		Site					Commons	Nearby wedge tomb (TN039-009) to NNW and fulacht fiadh (TN 039-051) to SE. Monument consists of two low limestone orthostats, aligned E-W, and 2.48m apart. Both stones are roughly triangular in shape with rectangular sections and the tops of the stones are tapering towards a point. The W stone measures 0.9m H; 0.58m x 0.21m. The E stone measures 0.8m H; 0.60m x 0.30m. Local landowner has no recollection that they were ever erected as scratching posts for livestock.			
84	RMP	Recorded Protected Site	TN039-051----	Fulacht fia	595166	660772	Knockcurraghbola Commons	Situated in wet marshy field in upland area with stream immediately to the S, field has recently been planted with conifer trees. Possible two stone row (TN039-052) and wedge tomb (TN039-009) to NW. During the planting of trees in this field a drainage ditch (Wth 0.70m; D 0.40m) was cut through the middle of the mound on an E-W axis revealing the burnt material of the monument. The monument consists of a large circular mound (diam. 16m N-S ; 20m E-W; H 1m) of burnt material with stream immediately to S of mound. No visible sign of any trough.	149m to the SE	None	Avoidance
85	RMP	Recorded Protected Site	TN039-050----	Megalithic tomb - unclassified	594849	660334	Knockcurraghbola Commons	Situated in upland region, in pasture with good panoramic views in all directions, view of Galtee More to the SW on a clear day. Good views of Wedge tomb (TN039-009) located 670m to N. A roughly rectangular chamber, 1m long by 0.85m wide and 0.3m high at the open SW end formed by four low upright stones with a large capstone (H 0.55m; L 2m; Wth 2m) sitting on top of the side stones. A second capstone may be a displaced roofstone from the SW end of the chamber. Not clear whether this is a megalicthic tomb or not however the arrangement of the capstone sitting on side stones forming a chamber suggests that it is a possible megalithic structure. It also has an impressive siting in the landscape with fine panoramic views of hilltops within this mountain region.	228m to the S	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
86	RMP	Recorded Protected Site	TN039-008----	Megalithic tomb - wedge tomb	592512	659913	Knockmaroe	Situated close to the foot of the S-facing slope of Knockmaroe Hill. The remains consist of a mound about 9m in diameter and 1m high with a hollow towards its western perimeter where there are three stones. One of these is an orthostat aligned WSW-ENE. This stone, which declines in height from W to E, may have formed part of a chamber side. Resting against the last is a large slab, possibly a displaced roofstone. A thin slab beneath this may have been detached from its underside. Some stones exposed at the edge of the hollow and at the perimeter of the mound are of uncertain origin. The scant remains seem to be those of a wedge tomb. (De Valera and Ó Nualláin 1982, 89, No.9)	21m to the W	None	Avoidance
87	RMP	Recorded Protected Site	TN039-043----	Standing stone	594282	659643	Knockcurraghbola Crownlands	Situated on a poorly drained S-facing slope of rising ground in an upland region. A narrow standing stone (H 1.25m; 0.25m x 0.2m) which is rectangular in plan with its long axis orientated N-S. The stone is unusually narrow and may have been erected as a scratching post.	775m to the SE	None	Avoidance
88	RMP	Recorded Protected Site	TN039-017----	Megalithic tomb - wedge tomb	594102	659543	Knockcurraghbola Commons	Sited 200m E of the a wedge tomb (TN039-016) and on the same S-facing slope. The scant remains consist of a septal-stone at the WSW, two sidestones of the more southerly side of the chamber and one of the opposite side. Another stone a little to the E of the last is somewhat loosely set and of uncertain origin. A small, low mound adjoins the S side of the chamber. The origin of a number of displaced stones at the site is uncertain. (De Valera and Ó Nualláin 1982, 91-2, No.12)	779m to the S	None	Avoidance
89	RMP	Recorded Protected Site	TN039-016----	Megalithic tomb - wedge tomb	593918	659522	Knockcurraghbola Commons	Sited on a S-facing slope in farmland. A narrow, SW-facing, wedge-shaped gallery flanked at either side by outer-walling survives. There are slight traces of a mound along the S side of the structure. The gallery, at least 4.2m long, is open at both ends. It narrows from 1m	55m to the S	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								wide at the SW to 0.65m at the NE and a diminution in the height of the gallery orthostats in the same direction is also indicated. Four orthostats survive along both sides of the gallery. Two of those on the S side have split into two or more separate uprights. Four outer-wall stones flank the S side of the gallery. The easternmost is set inside the line of the other three and adjoins the gallery wall. Six outer-wall stones flank the N side of the gallery, a number of them also split into separate uprights. Two transversely set stones seem to mark the end of this line of outer-walling. A number of partly concealed slabs lie to the W of the structure. (De Valera and Ó Nualláin 1982, 92, No.13)			
90	RMP	Recorded Protected Site	TN039-044----	Standing stone	594222	659443	Knockcurraghbola Commons	Situated on flat elevated pasture with good views in all directions. A triangular shaped standing stone (H 1.26m; 1m x 0.2m) which is rectangular in plan with its long axis orientated E-W.	958m to the SE	None	Avoidance
91	RMP	Recorded Protected Site	TN039-045----	Megalithic tomb - unclassified	593952	659313	Knockcurraghbola Commons	Situated on a low rise of ground overlooking a river valley in an upland region. A chamber, 1.35m long (SSE-NNW) is 0.85m wide at the open SSE end and narrows slightly towards the opposite end. It is formed by four low stones, one at the more westerly side, one at the NNW end, and there are two, a longer outer and shorter inner example, at the more easterly side. The shorter of the latter two stones is skewed so as to narrow the rear of the chamber. There is a largely concealed stone at the inner face of the last. The structural stones are relatively thin slabs and none rises more than 0.25m above ground level. This seems to be a large cist.	1.01km to the S	None	Avoidance
92	RMP	Recorded Protected Site	TN039-037----	Megalithic tomb - unclassified	594212	659313	Knockcurraghbola Commons	Sited just 200m S of wedge tomb (TN039-017) in a prominent position on a hillock in upland pasture. The remains are scant perhaps because of deliberate disturbance that may account for a subcircular depression measuring some 7m x 6m and at least 0.3m deep on top of the hillock. At the northern edge of the depression there is a low	1.08km to the SE	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								orthostat aligned WNW-ESE. It is 1.45m long, 0.15m thick and slopes from 0.65m high at its more westerly end to 0.15m at the opposite end. Some 0.5m S of this there is a prostrate slab 1.6m in maximum dimension while 5-7m to the SW there are three irregularly spaced stones, possibly representing a kerb. The diminution in height of the orthostat from W to E would suggest it could be the surviving remnant of the gallery side or outer-wall of a wedge tomb.			
93	RMP	Recorded Protected Site	TN040-046001	Enclosure	597461	662172	KNOCKNAMENA COMMONS	A large semicircular enclosure situated on a SE-facing slope of rising ground in an upland area overlooking a mountain valley with higher ground above the site to the N. Originally a circular enclosure, the present remains consist of a semicircular area (dims. 52m SE-NW; 60m E-W) enclosed by a bank (Wth 5m; int. H 0.25m; ext. H 0.7m) and external fosse (Wth 5m; D 0.3m) which survives from NW through N to SSE. The site is intersected by a road from SSE to S running along an E-W axis and from S to W by a field boundary aligned on a N-S axis. No entrance feature visible.	428m to the SE	None	Avoidance
94	RMP	Recorded Protected Site	TN040-046002	Ditch Barrow	596800	662195	KNOCKNAMENA COMMONS	Situated on a poorly drained SE-facing slope of rising ground in an upland area with a nearby enclosure (TN040-046001) 70m to the S. A low flat-topped mound (diam. 4.2m NE-SW; 4.4m E-W; H 0.45m) enclosed by a shallow water-logged fosse (Wth 2.4m; D 0.1m) with no evidence for an external bank.	428m to the SE	None	Avoidance
95	RMP	Recorded Protected Site	TN039-048	Ring Barrow	596570	662064	GLENBEG	Situated in pasture, on a SE-facing slope of rising ground in a mountainous region. Well preserved monument consisting of a raised circular area (diam. 4m N-S; 3.7m E-W; H 0.3m) with sunken depression (diam. 3m) on top of mound, defined by an inner fosse (Wth 1m; ext. D 0.2m) with the slightest traces of an outer bank, only visible in places. Overall diameter 8m N-S. Central depression may be due to collapsed cist in centre of mound.	136m to the S	None	Avoidance

REFERENCE DOCUMENTS

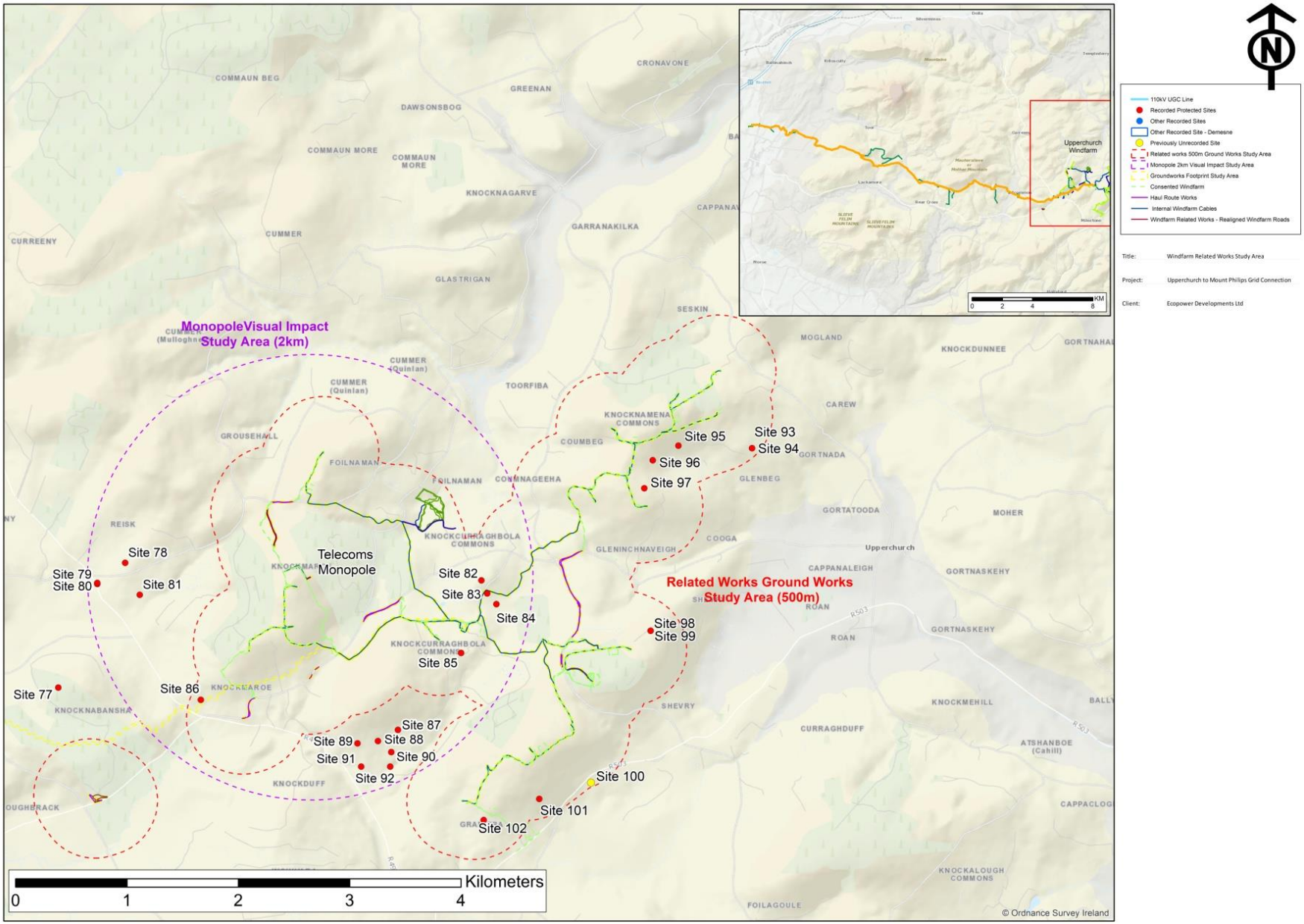
Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
96	RMP	Recorded Protected Site	TN039-047	Enclosure	596494	661813	KNOCKNAMENA COMMONS	Situated in pasture on E facing slope overlooking mountain valley in upland region, higher ground to W of enclosure. A roughly rectangular-shaped area (int. dims. 19m E-W; 20m N-S) enclosed by an earthen bank (Top Wth 1m; base Wth 2m; int. H 0.1m; ext. H 0.3m) with slight traces of an outer fosse, no entrance feature visible. Quarry in NE quadrant of enclosure. Possible linear field boundaries intersect enclosure along its S side. Possible summer grazing enclosure or booley site for upland grazing during the summer months.	180m to the S	None	Avoidance
97	RMP	Recorded Protected Site	TN039-046	Ring Barrow	596551	660533	KNOCKNAMENA COMMONS	Situated on top of high ground in upland region with good panoramic views in all directions. Much degraded monument consisting of a barely visible circular mound (diam. 8m N-S) enclosed by an inner fosse (Wth 2m; ext. D 0.2m) and slight traces of an outer bank (Wth 1m). A field boundary bisected the monument on a N-S axis. This field boundary has since been levelled. Monument is barely visible in the winter months and is probably not visible during the summer months.	136m to the E	None	Avoidance
98	RMP	Recorded Protected Site	TN039-038001	Ring Barrow	596015	659170	SHEVERY	Situated on a break in an E-facing slope in upland terrain, under pasture. Extensive views in all directions except upslope to SW. A circular area (diam. 11.5m N-S; 11.4m E-W) consisting of a central mound (diam. 4.6m N-S; 4.7m E-W; H 0.23m) enclosed by a water-logged fosse (Wth 1.6m; D 0.26m) and well-preserved outer bank (Wth 1.9m; H 0.3m), partially denuded in the SE quadrant. There are three stones embedded in the N half of the central mound which appear to be set on edge, possibly indicating the presence of a cist (TN039-038002).	239m to the NE	None	Avoidance
99	RMP	Recorded Protected Site	TN039-038002	Cist	595551	659023	SHEVERY	A circular ring-barrow (TN039-038001) consisting of a central mound enclosed by a water-logged fosse and well-preserved outer bank, partially denuded in the SE quadrant. There are three stones	239m to the NE	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								embedded in the N half of the central mound which appear to be set on edge, possibly indicating the presence of a cist.			
100	25 Inch Ordnance Survey		NA	House	595052	658833	GRANIERA	A house is shown at this location on the 25 Inch edition of the historic OS maps.	468m to the SE	None	Avoidance
101	RMP	Recorded Protected Site	TN039-028	Possible Field System	596551	660533	GRANIERA	Possible field system identified on GSI aerial photograph (April 1974, R.278/277). Old field drains situated on SE facing slope. Drain 1-1.6m wide but quite shallow. Modern, deep field drain further upslope. Not an ancient field system. Narrow trackway runs along side of hill, built into the slope. It is 1.8m wide and 0.6m above lower hill slope and below the upper hill slope.	328m to the SE	None	Avoidance
102	RMP	Recorded Protected Site	TN039-018	Megalithic Tomb - Unclassified	597461	662172	GRANIERA	Situated on an E-facing slope. An orthostat 1.2m high and aligned NE-SW, stands here. Another stone, probably but not certainly in situ, leans against its more southerly face. There are traces of a mound around the stones. The two stones might be the remnants of a megalithic tomb. (De Valera and Ó Nualláin 1982, 99, No.11)	169m to the S	None	Avoidance

REFERENCE DOCUMENTS

A16.1.2.2 Cultural Heritage Sites within the UWF Related Works Study Area



REFERENCE DOCUMENTS

UWF Related Works Study Map 1 (Larger scale map included in Tab 16 of Volume C3 EIA Report Figures)

Table 2: Cultural Heritage Sites within the Windfarm Related Works Study Area

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
78	RMP	Recorded Protected Site	TN039-035----	Barrow - ring-barrow	591832	661143	Reisk	Situated on the gentle SW-facing slope of a hill, in pasture. A circular site (12.8m N-S; 12.8m E-W) consisting of a central mound (diam. 4.8m; H 0.26m), a narrow, U-shaped fosse (W 1.7m; D 0.86m) and an outer bank (W 2m; ext. H 0.14m). The bank is steep-sided and the fosse is well defined with some rushes growing in it.	1.37km to the NW	None	Avoidance
79	RMP	Recorded Protected Site	TN039-004001-	Stone circle	591582	660963	Reisk	Situated in rough terrain on a small hillock, on a SW-facing slope, overlooking a valley. A stone circle not marked on the 1st ed. (1840) OS 6-inch map but depicted on the 2nd ed. (1905). There are no visible remains of the stone circle or of the standing stone (TN039-004002) also indicated at this location on the current 6-inch map.	1.31km to the N	None	Avoidance
80	RMP	Recorded Protected Site	TN039-004002-	Standing stone	591582	660953	Reisk	Situated in rough terrain on a small hillock on a SW-facing slope, overlooking a valley. A low standing stone (H 0.8m; dims. 0.85m x 0.2m) aligned NE-SW, sloping slightly to SW. The ground level has been built up with spoil and field clearance. A stone circle (TN039-004001), no longer evident, is also named on the map at this location.	1.3km to the NW	None	Avoidance
81	RMP	Recorded Protected Site	TN039-005----	Ringfort - rath	591963	660856	Reisk	Situated on a slight break in a S-facing slope in pasture. A denuded bivallate ringfort consisting of a circular area (diam. 34.5m N-S; 33m E-W) enclosed by a low bank (Wth 4m; int. H 0.13m; ext. H 1m), a U-shaped fosse (Wth 4m; D 0.43m) and outer bank (Wth 3.2m; ext. H 0.38m). Possible entrance in NE quadrant (Wth c. 2.5m) which appears to have been widened. The outer bank is not apparent along the NE quadrant - probably disturbed by adjacent NW-SE field boundary.	1.06km to the N	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
82	RMP	Recorded Protected Site	TN039-009----	Megalithic tomb - wedge tomb	595031	660986	Knockcurraghbola Commons	Situated on a hillock at the NE end of a low ridge. It consists of a long, narrow, partly roofed gallery closed at the SW by a septal-stone. Both sides of the gallery are flanked by outer-walling with the more westerly stone at either side set in advance of the septal-stone. These two stones would have served as the sides of a portico or, alternatively, represent a doubling of the portico sides since removed.The structure is 7m in overall length. The main chamber, open at its more easterly end, is 5.3m long and 1.2m wide at the septal-stone whence it narrows slightly towards the E.Two roofstones cover its forward end. There are five sidestones on the N side and three on the S side. There are six outer-wall stones to the N and four to the S. These are set close to the gallery walls and two of those to the N double as buttress-stones. Beyond the easternmost at the S there is a small stone which may be the butt of a taller one, probably another outer-wall stone. There are traces of a mound around the structure. A large retangular slab lies prostrate at the SW end of the gallery. (De Valera and Ó Nualláin 1982, 90, No.10)	97m to the W	None	Avoidance
83	RMP	Recorded Protected Site	TN039-052----	Stone row	595083	660868	Knockcurraghbola Commons	Situated in pasture on SE facing slope of rising fround in upland area with good views of mountian valley to S and E, higher ground to N. Nearby wedge tomb (TN039-009) to NNW and fulacht fiadh (TN 039-051) to SE. Monument consists of two low limestone orthostats, aligned E-W, and 2.48m apart. Both stones are roughly triangular in shape with rectangular sections and the tops of the stones are tapering towards a point. The W stone measures 0.9m H; 0.58m x 0.21m. The E stone measures 0.8m H; 0.60m x 0.30m. Local landowner has no recollection that they were ever erected as scratching posts for livestock.	37m to the SE	None	Avoidance
84	RMP	Recorded	TN039-	Fulacht fia	595166	660772	Knockcurr	Situated in wet marshy field in upland area with stream	149m to the	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
		Protected Site	051----				aghbola Commons	immediately to the S, field has recently been planted with conifer trees. Possible two stone row (TN039-052) and wedge tomb (TN039-009) to NW. During the planting of trees in this field a drainage ditch (Wth 0.70m; D 0.40m) was cut through the middle of the mound on an E-W axis revealing the burnt material of the monument. The monument consists of a large circular mound (diam. 16m N-S ; 20m E-W; H 1m) of burnt material with stream immediately to S of mound. No visible sign of any trough.	SE		
85	RMP	Recorded Protected Site	TN039-050----	Megalithic tomb - unclassified	594849	660334	Knockcurraghbola Commons	Situated in upland region, in pasture with good panoramic views in all directions, view of Galtee More to the SW on a clear day. Good views of Wedge tomb (TN039-009) located 670m to N. A roughly rectangular chamber, 1m long by 0.85m wide and 0.3m high at the open SW end formed by four low upright stones with a large capstone (H 0.55m; L 2m; Wth 2m) sitting on top of the side stones. A second capstone may be a displaced roofstone from the SW end of the chamber. Not clear whether this is a megalicthic tomb or not however the arrangement of the capstone sitting on side stones forming a chamber suggests that it is a possible megalithic structure. It also has an impressive siting in the landscape with fine panoramic views of hilltops within this mountain region.	228m to the S	None	Avoidance
86	RMP	Recorded Protected Site	TN039-008----	Megalithic tomb - wedge tomb	592512	659913	Knockmaroe	Situated close to the foot of the S-facing slope of Knockmaroe Hill. The remains consist of a mound about 9m in diameter and 1m high with a hollow towards its western perimeter where there are three stones. One of these is an orthostat aligned WSW-ENE. This stone, which declines in height from W to E, may have formed part of a chamber side. Resting against the last is a large slab, possibly a displaced roofstone. A thin slab beneath	21m to the W	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								this may have been detached from its underside. Some stones exposed at the edge of the hollow and at the perimeter of the mound are of uncertain origin. The scant remains seem to be those of a wedge tomb. (De Valera and Ó Nualláin 1982, 89, No.9)			
87	RMP	Recorded Protected Site	TN039-043----	Standing stone	594282	659643	Knockcurraghbola Crownlands	Situated on a poorly drained S-facing slope of rising ground in an upland region. A narrow standing stone (H 1.25m; 0.25m x 0.2m) which is rectangular in plan with its long axis orientated N-S. The stone is unusually narrow and may have been erected as a scratching post.	775m to the SE	None	Avoidance
88	RMP	Recorded Protected Site	TN039-017----	Megalithic tomb - wedge tomb	594102	659543	Knockcurraghbola Commons	Sited 200m E of the a wedge tomb (TN039-016) and on the same S-facing slope. The scant remains consist of a septal-stone at the WSW, two sidestones of the more southerly side of the chamber and one of the opposite side. Another stone a little to the E of the last is somewhat loosely set and of uncertain origin. A small, low mound adjoins the S side of the chamber. The origin of a number of displaced stones at the site is uncertain. (De Valera and Ó Nualláin 1982, 91-2, No.12)	779m to the S	None	Avoidance
89	RMP	Recorded Protected Site	TN039-016----	Megalithic tomb - wedge tomb	593918	659522	Knockcurraghbola Commons	Sited on a S-facing slope in farmland. A narrow, SW-facing, wedge-shaped gallery flanked at either side by outer-walling survives. There are slight traces of a mound along the S side of the structure. The gallery, at least 4.2m long, is open at both ends. It narrows from 1m wide at the SW to 0.65m at the NE and a diminution in the height of the gallery orthostats in the same direction is also indicated. Four orthostats survive along both sides of the gallery. Two of those on the S side have split into two or more separate uprights. Four outer-wall stones flank the S side of the gallery. The easternmost is set inside the line of the	55m to the S	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								other three and adjoins the gallery wall. Six outer-wall stones flank the N side of the gallery, a number of them also split into separate uprights. Two transversely set stones seem to mark the end of this line of outer-walling. A number of partly concealed slabs lie to the W of the structure. (De Valera and Ó Nualláin 1982, 92, No.13)			
90	RMP	Recorded Protected Site	TN039-044----	Standing stone	594222	659443	Knockcurraghbola Commons	Situated on flat elevated pasture with good views in all directions. A triangular shaped standing stone (H 1.26m; 1m x 0.2m) which is rectangular in plan with its long axis orientated E-W.	958m to the SE	None	Avoidance
91	RMP	Recorded Protected Site	TN039-045----	Megalithic tomb - unclassified	593952	659313	Knockcurraghbola Commons	Situated on a low rise of ground overlooking a river valley in an upland region. A chamber, 1.35m long (SSE-NNW) is 0.85m wide at the open SSE end and narrows slightly towards the opposite end. It is formed by four low stones, one at the more westerly side, one at the NNW end, and there are two, a longer outer and shorter inner example, at the more easterly side. The shorter of the latter two stones is skewed so as to narrow the rear of the chamber. There is a largely concealed stone at the inner face of the last. The structural stones are relatively thin slabs and none rises more than 0.25m above ground level. This seems to be a large cist.	1.01km to the S	None	Avoidance
92	RMP	Recorded Protected Site	TN039-037----	Megalithic tomb - unclassified	594212	659313	Knockcurraghbola Commons	Sited just 200m S of wedge tomb (TN039-017) in a prominent position on a hillock in upland pasture. The remains are scant perhaps because of deliberate disturbance that may account for a subcircular depression measuring some 7m x 6m and at least 0.3m deep on top of the hillock. At the northern edge of the depression there is a low orthostat aligned WNW-ESE. It is 1.45m long, 0.15m thick and slopes from 0.65m high at its more	1.08km to the SE	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								westerly end to 0.15m at the opposite end. Some 0.5m S of this there is a prostrate slab 1.6m in maximum dimension while 5-7m to the SW there are three irregularly spaced stones, possibly representing a kerb. The diminution in height of the orthostat from W to E would suggest it could be the surviving remnant of the gallery side or outer-wall of a wedge tomb.			
93	RMP	Recorded Protected Site	TN040-046001	Enclosure	597461	662172	KNOCKNAMENA COMMONS	A large semicircular enclosure situated on a SE-facing slope of rising ground in an upland area overlooking a mountain valley with higher ground above the site to the N. Originally a circular enclosure, the present remains consist of a semicircular area (dims. 52m SE-NW; 60m E-W) enclosed by a bank (Wth 5m; int. H 0.25m; ext. H 0.7m) and external fosse (Wth 5m; D 0.3m) which survives from NW through N to SSE. The site is intersected by a road from SSE to S running along an E-W axis and from S to W by a field boundary aligned on a N-S axis. No entrance feature visible.	428m to the SE	None	Avoidance
94	RMP	Recorded Protected Site	TN040-046002	Ditch Barrow	596800	662195	KNOCKNAMENA COMMONS	Situated on a poorly drained SE-facing slope of rising ground in an upland area with a nearby enclosure (TN040-046001) 70m to the S. A low flat-topped mound (diam. 4.2m NE-SW; 4.4m E-W; H 0.45m) enclosed by a shallow water-logged fosse (Wth 2.4m; D 0.1m) with no evidence for an external bank.	428m to the SE	None	Avoidance
95	RMP	Recorded Protected Site	TN039-048	Ring Barrow	596570	662064	GLENBEG	Situated in pasture, on a SE-facing slope of rising ground in a mountainous region. Well preserved monument consisting of a raised circular area (diam. 4m N-S; 3.7m E-W; H 0.3m) with sunken depression (diam. 3m) on top of mound, defined by an inner fosse (Wth 1m; ext. D 0.2m) with the slightest traces of an outer bank, only visible in places. Overall diameter 8m N-S. Central depression may be due to collapsed cist in centre of	136m to the S	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
								mound.			
96	RMP	Recorded Protected Site	TN039-047	Enclosure	596494	661813	KNOCKNAMENA COMMONS	Situated in pasture on E facing slope overlooking mountain valley in upland region, higher ground to W of enclosure. A roughly rectangular-shaped area (int. dims. 19m E-W; 20m N-S) enclosed by an earthen bank (Top Wth 1m; base Wth 2m; int. H 0.1m; ext. H 0.3m) with slight traces of an outer fosse, no entrance feature visible. Quarry in NE quadrant of enclosure. Possible linear field boundaries intersect enclosure along its S side. Possible summer grazing enclosure or booley site for upland grazing during the summer months.	180m to the S	None	Avoidance
97	RMP	Recorded Protected Site	TN039-046	Ring Barrow	596551	660533	KNOCKNAMENA COMMONS	Situated on top of high ground in upland region with good panoramic views in all directions. Much degraded monument consisting of a barely visible circular mound (diam. 8m N-S) enclosed by an inner fosse (Wth 2m; ext. D 0.2m) and slight traces of an outer bank (Wth 1m). A field boundary bisected the monument on a N-S axis. This field boundary has since been levelled. Monument is barely visible in the winter months and is probably not visible during the summer months.	136m to the E	None	Avoidance
98	RMP	Recorded Protected Site	TN039-038001	Ring Barrow	596015	659170	SHEVERY	Situated on a break in an E-facing slope in upland terrain, under pasture. Extensive views in all directions except upslope to SW. A circular area (diam. 11.5m N-S; 11.4m E-W) consisting of a central mound (diam. 4.6m N-S; 4.7m E-W; H 0.23m) enclosed by a water-logged fosse (Wth 1.6m; D 0.26m) and well-preserved outer bank (Wth 1.9m; H 0.3m), partially denuded in the SE quadrant. There are three stones embedded in the N half of the central mound which appear to be set on edge, possibly indicating the presence of a cist (TN039-038002).	239m to the NE	None	Avoidance
99	RMP	Recorded	TN039-	Cist	595551	659023	SHEVERY	A circular ring-barrow (TN039-038001) consisting of a central	239m to the	None	Avoidance

REFERENCE DOCUMENTS

Site No.	Source	Receptor Type	Ref No.	Class	Easting	Northing	Townland	Description	Distance to Construction Works Area Boundary	Impact	Recomm-endation
		Protected Site	038002					mound enclosed by a water-logged fosse and well-preserved outer bank, partially denuded in the SE quadrant. There are three stones embedded in the N half of the central mound which appear to be set on edge, possibly indicating the presence of a cist.	NE		
100	25 Inch Ordnance Survey		NA	House	595052	658833	GRANIERA	A house is shown at this location on the 25 Inch edition of the historic OS maps.	468m to the SE	None	Avoidance
101	RMP	Recorded Protected Site	TN039-028	Possible Field System	596551	660533	GRANIERA	Possible field system identified on GSI aerial photograph (April 1974, R.278/277). Old field drains situated on SE facing slope. Drain 1-1.6m wide but quite shallow. Modern, deep field drain further upslope. Not an ancient field system. Narrow trackway runs along side of hill, built into the slope. It is 1.8m wide and 0.6m above lower hill slope and below the upper hill slope.	328m to the SE	None	Avoidance
102	RMP	Recorded Protected Site	TN039-018	Megalithic Tomb - Unclassified	597461	662172	GRANIERA	Situated on an E-facing slope. An orthostat 1.2m high and aligned NE-SW, stands here. Another stone, probably but not certainly in situ, leans against its more southerly face. There are traces of a mound around the stones. The two stones might be the remnants of a megalithic tomb. (De Valera and Ó Nualláin 1982, 99, No.11)	169m to the S	None	Avoidance

REFERENCE DOCUMENTS

REFERENCE DOCUMENTS

APPENDIX 16.1.3
TEST EXCAVATION REPORT – CASTLEWALLER

Archaeological Assessment Report:
UWF Grid Connection, Test Excavations at Castlewaller townland, Co Tipperary

KILKENNY ARCHAEOLOGY
Archaeological Consultants

Client:
Ecopower Developments, Zetec House, Purcellsinch Business Park, Dublin Road, Kilkenny

Excavation Licence Reference:
16E0262

Licensed archaeologist:
Barry Fitzgibbon MA MIAI

Report authors:
Barry Fitzgibbon MA MIAI, Cóilin Ó Drisceoil MA MIAI and Philip Kenny

28th October 2016

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Document title	Archaeological Assessment Report: UW rid Connection, Test Excavations at Castlewaller townland, Co Tipperary
Client	Ecopower Developments, Zetec House, Purcellsinch Business Park, Dublin Road, Kilkenny
Document type	Archaeological Assessment
Excavation licence	16E0262
Planning reference	Pre planning
Licensed archaeologist	Barry Fitzgibbon MA MIAI
Contributing authors	Barry Fitzgibbon MA MIAI Cóilín O'Drisceoil MA MIAI
Issue number/date	**DRAFT FOR CLIENT REVIEW:** 28th October 2016
Document Issue Approval	Cóilín Ó Drisceoil MA MIAI

All recommendations and contents of this report are subject to the approval of the National Monuments Service of the Department of Arts, Heritage and Gaeltacht and the National Museum of Ireland.

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BARRY FITZGIBBON MA MIAI
Licenced archaeologist
28th October 2016

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16.1.3.1 INTRODUCTION

This report was commissioned by Ecopower Developments as a component of a Cultural Heritage Assessment for a future planning application to Tipperary County Council for the UWF Grid Connection. Application will be made for a 27.5km long grid connection route from the consented UWF Substation at Knockcurraghbola Commons, Upperchurch, County Tipperary to a proposed Mountphilips Substation at Mount Philips, County Tipperary. A Cultural Heritage Assessment of the route (Kilkenny Archaeology March 2016) identified that a section of the proposed route will pass within *c.*10m of Recorded Monument TN031-067 (Ringfort - Rath) at Castlewaller, Co Tipperary. This report presents the results of licenced test excavations along the proposed grid line at RMP TN031-067.

16.1.3.1.1 Assessment Methodology

Archaeological test excavations were conducted as per a method statement agreed with the National Monuments Service and licenced under the National Monuments Acts 1930-2004. The material contained within the document is based on the *Guidelines on the Information to be Contained in Environmental Impact Statements* (E.P.A. 2002, 2003), and conforms to the methodologies recommended in 'Framework and Principles for the Protection of the Archaeological Heritage' issued by the Dept. of Arts, Heritage, Gaeltacht and the Islands (1999). Section 3.6.6 of 'Framework and Principles for the Protection of the Archaeological Heritage' notes '*Environmental impact assessment should unless there are substantial grounds to show that it is not necessary, involve the carrying out of archaeological assessment including, where appropriate, test excavation'* (Dept. of Arts, Heritage Gaeltacht and the Islands 1999). All recommendations conform to the legislative frameworks of the *National Monuments Acts 1930-1994*, *Heritage Act 2000* and the *European Convention on the Protection of the Archaeological Heritage (ratified by Ireland 1997)*. The National Roads Authority's (NRA) G*uidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes* (2005) was also consulted because of its in-depth consideration of archaeological heritage as part of Environmental Impact Assessments (EIA).

16.1.3.1.2 Assessment Components

This assessment comprises a desk-based study and archaeological test excavations within the study area.

16.1.3.1.2.1 Desk-based study

The desk-top study employs a range of archival and documentary sources to provide an historical and archaeological account of the development area and its wider context. The sources utilised are listed in the bibliography below.

16.1.3.1.2.2 Archaeological test excavation

Archaeological test excavation is defined as: '*that form of archaeological excavation where the purpose is to establish the nature and extent of archaeological deposits and features present in a location which it is proposed to develop (though not normally to fully investigate those deposits or features) and allow an assessment to be made of the archaeological impact of the proposed development*' (*Framework and Principles for the Protection of the Archaeological Heritage* 1999, 27).

The archaeological testing methodology for the project was agreed with the Archaeological Licensing Section of the National Monuments Service and the National Museum of Ireland via a method statement. Testing was carried out 21st October 2016 and consisted of the mechanical excavation of three test trenches under excavation licence reference 16E0262. The primary aim of the testing was to discover if any subsurface archaeological remains existed within the proposed development area which would be negatively impacted upon by the proposed excavations for the gridline.

16.1.3.2 THE DEVELOPMENT

16.1.3.2.1 Development Proposal

It is proposed that the grid infrastructure associated with the 110kV UWF Grid Connection would be laid underground between the Consented UWF Substation at Upperchurch and a proposed Mountphilips Substation at Mount Philips. The length of the route is 27.5km and it is located along a mix of public roads, farm tracks, open farmland and existing forestry tracks.

16.1.3.2.2 Reason for archaeological intervention

A cultural heritage assessment of the grid route (Kilkenny Archaeology March 2016) recommended test excavations at RMP TN031-067 (Ringfort - Rath) at Castlewaller, Co Tipperary.

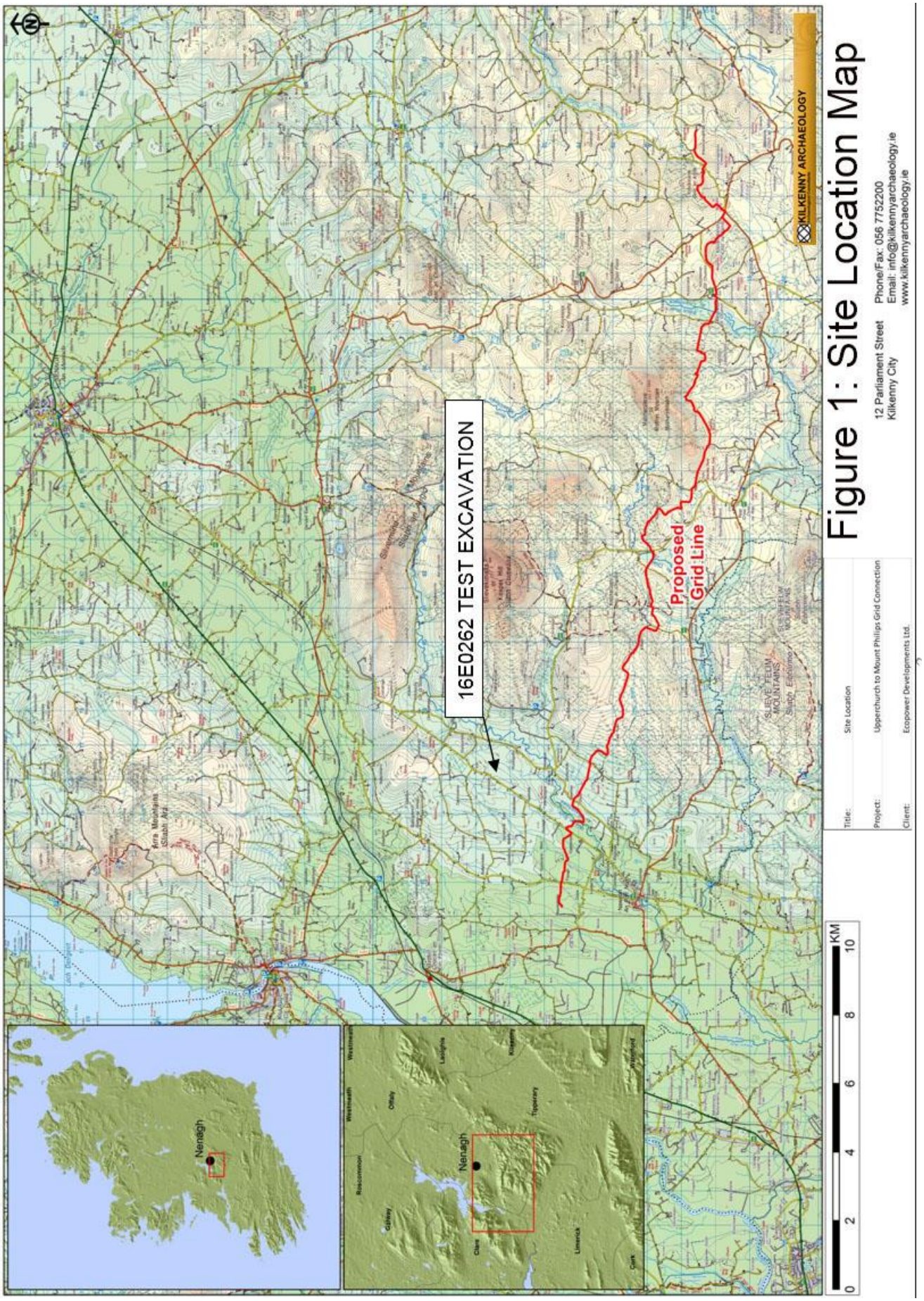


Figure 1: Site Location Map
KILKENNY ARCHAEOLOGY
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie
16E0262 TEST EXCAVATION
Proposed Grid Line
Title: Site Location
Project: Upperchurch to Mount Philips Grid Connection
Client: Ecopower Developments Ltd.
KM
0
2
4
6
8
10
Nenagh
Nenagh

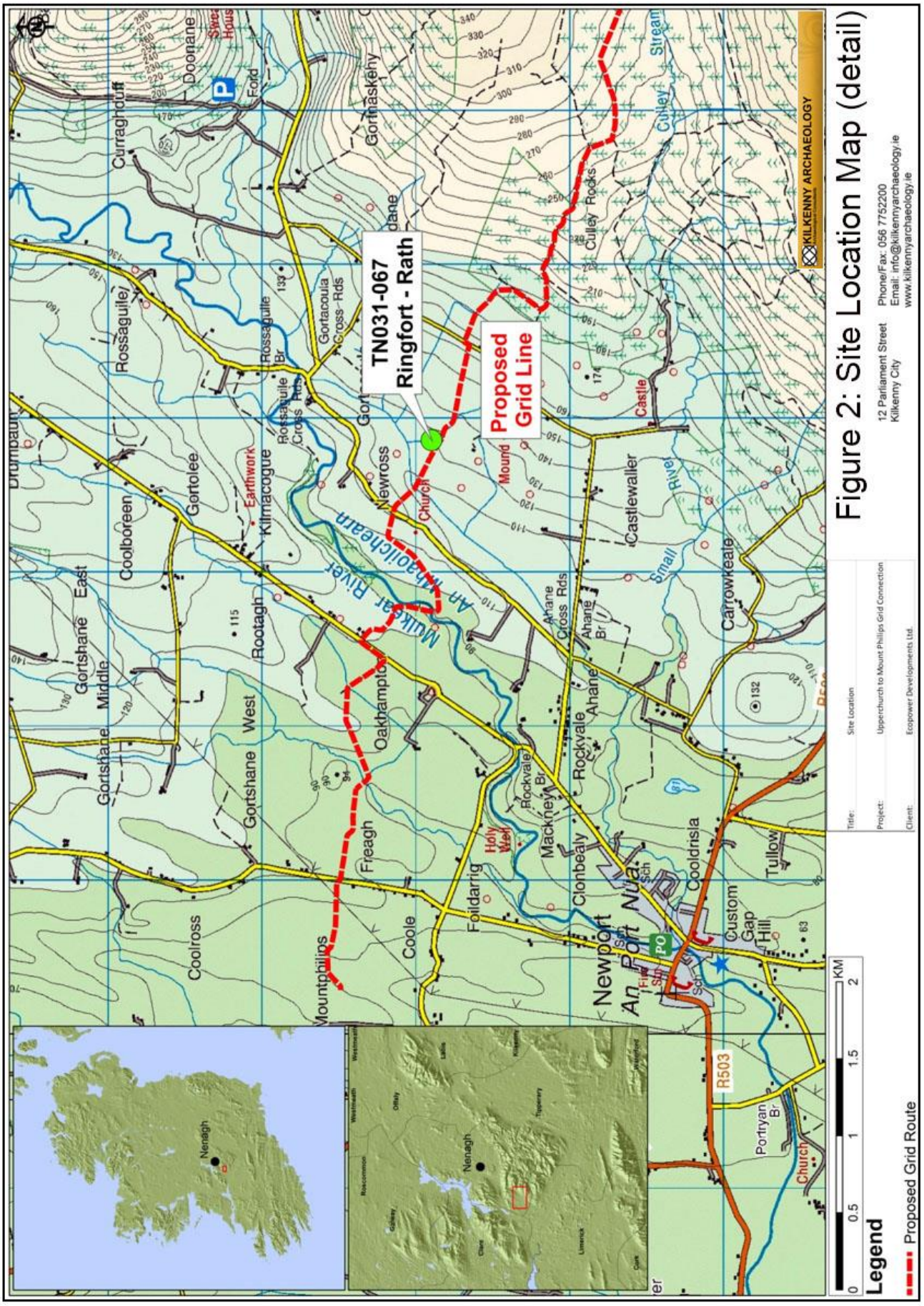


Figure 2: Site Location Map (detail)
TN031-067
Ringfort - Rath
Proposed
Grid Line
KILKENNY ARCHAEOLOGY
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie
Title: Site Location
Project: Upperchurch to Mount Phillips Grid Connection
Client: Ecopower Developments Ltd.
Legend
Proposed Grid Route
KM
0
0.5
1
1.5
2
Newport
An Port Nua
Castlewaller
Gortshane East
Gortshane Middle
Gortshane West
Rootagh
Coolboreen
Gortolee
Kilmacogue
Earthwork
Rossaguile
Rossaguile Br
Rossaguile Cross Rds
Gortacoula Cross Rds
Curraghduff
Doonane
Ford
Gortnaskehy
Culley Rocks
Culley Stream
Castle
Mound
Church
Newross
Oakhampton
Freagh
Coolross
Mountphilips
Coole
Foildarrig
Holy Well
Mackney
Rockvale
Rockvale Br
Clonbealy
Ahane
Ahane Cross Rds
Ahane Br
Carrowkeale
Small River
Cooldrisla
Custom Gap Hill
Tullow
R503
Portryan Br
Church
An Mhaoilchéasair River
Nenagh

16.1.3.3 ARCHAEOLOGICAL BACKGROUND

The proposed grid route for the UWF Grid Connection has been the subject of a comprehensive Cultural Heritage Assessment (Kilkenny Archaeology March 2016) and this section of the report thus focuses on the archaeological monument in the immediate vicinity of the test excavation area. Three ringforts are situated within 280m of the proposed grid line. Two are marked on the first edition Ordnance Survey map (1843) (Figure 3).

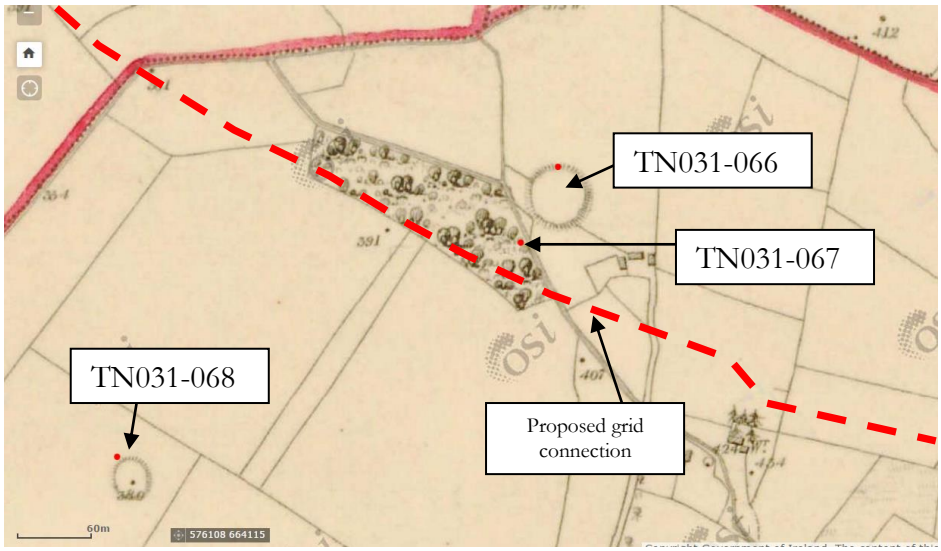


Figure 1: Recorded monuments in vicinity of proposed grid connection route, Castlewaller

Figure 2: Ringfort TN031-067 silted fosse from east

Figure 3: Ringfort TN031-067 south bank and silted fosse from east

TN031-067 is situated on the E-facing slope of a steep-sided ravine in an upland area with nearby ringforts (TN031-066, TN031-064) to NE and N respectively. It is a poorly preserved ringfort consisting of a circular area (diam. 22.5m NW-SE) enclosed by an earth and stone bank (Wth 2m; int. H 0.6m;ext. H 1.5-2.5m) reduced to a scarp at E with a wide flat-bottomed external fosse (Wth 2-3m; D 1.5m) destroyed at E and a possible outer bank now utilised as a field fence visible from S to W. No entrance feature is visible.

TN031-066 is located on the W-facing slope of a steep-sided ravine in an upland area with nearby ringforts (TN031-067, TN031-064) to the SW and NW respectively. It was not possible to inspect this site due to a dense cover of vegetation. An earlier field report (OPW 1957) describes the site as an oval-shaped area (diam. 40m N-S; 30m E-W) enclosed by an earth and stone bank (Wth 3m; int. H 0.65m; ext. H 1.7m) and external fosse (Wth 2m; D 0.6m) visible only at E and SW. No entrance feature visible. TN031-068 is located on a slight rise of ground in an upland area. A circular area (diam. 18m N-S) enclosed by an earth and stone bank (Wth 1.2m; int. H 0.3m; ext. H 0.7-1.2m) with faint traces of a shallow external fosse visible at NW only and an entrance gap (Wth 3.5m) at ESE.

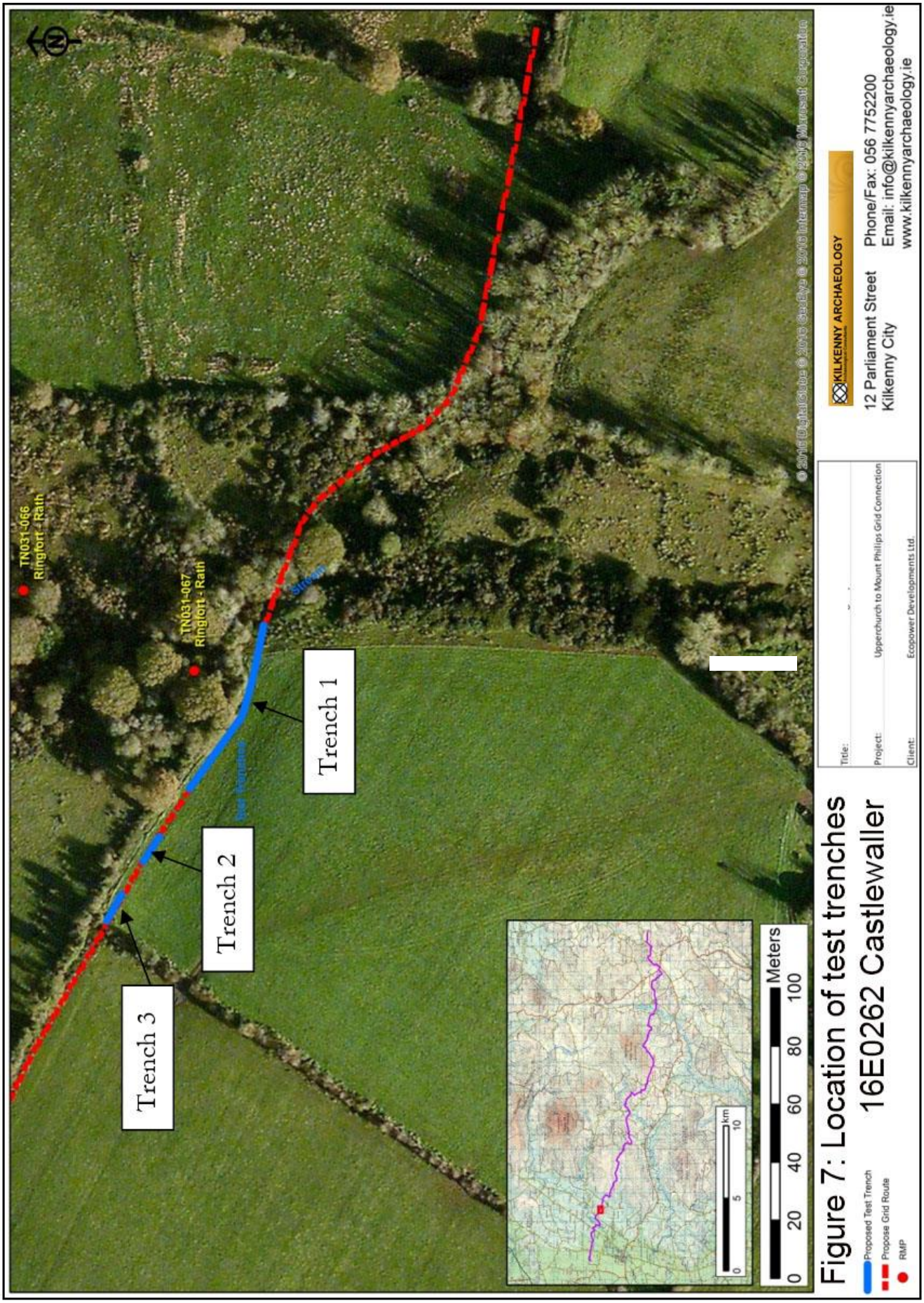
16.1.3.4 ARCHAEOLOGICAL TEST EXCAVATION RESULTS

Figure 4: Test excavations underway 21st October 2016, taken from south. Ringfort TN031-067 is in the background.

Test excavations were undertaken by mechanical excavator fitted with a 0.6m wide toothless bucket 21st October 2016 (Figure 6). The proposed grid line trench will be of the same width. Three trenches were excavated along the proposed grid line route to the level of the natural glacial substratum.

Test trench 1 was 50m long x 0.7m wide (Figures 8, 9). The topsoil was 0.9m depth at the east end of the trench over the glacial subsoil and 0.5m depth at the west end over the glacial subsoil. The latter was a light brownish grey boulder clay. Nothing of archaeological interest was noted.

Test trench 2 was 10m long x 0.7m wide (Figure 10). The topsoil was 0.45m depth over the glacial subsoil. The latter was a light brownish grey boulder clay. Nothing of archaeological interest was noted.


TN031-066
Ringfort - Rath
TN031-067
Ringfort - Rath
Trench 1
Trench 2
Trench 3
Meters
0 20 40 60 80 100
km
0 5 10
Figure 7: Location of test trenches
16E0262 Castlewaller
Proposed Test Trench
Propose Grid Route
RMP
KILKENNY ARCHAEOLOGY
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie
Title:
Project: Upperchurch to Mount Philips Grid Connection
Client: Ecopower Developments Ltd.

Test trench 3 was 9.5m long x 0.7m wide (Figure 11). The topsoil was 0.6m depth over the glacial subsoil. The latter was a light brownish grey boulder clay. Nothing of archaeological interest was noted.

Figure 5: Test-trench 1, from east

Figure 6: Test trench 1, from west

Figure 7: Test trench 2 from east

Figure 8: Test trench 3 from west

16.1.3.5 ARCHAEOLOGICAL IMPACT STATEMENT

16.1.3.5.1 Potential impact

Archaeological test excavations adjacent to RMP TN 031-067 *ringfort* uncovered nothing of archaeological potential. The proposed grid route trench at this location will have no archaeological impact.

16.1.3.5.2 Recommendations

The Cultural Heritage Assessment of the Upperchurch windfarm grid connection project has recommended that all groundworks during the construction of the development should be archaeologically monitored under licence from the National Monuments Service of the Department of Arts, Heritage and the Gaeltacht.

16.1.3.6 BIBLIOGRAPHY

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Records of Monuments and Places (RMP) constraints maps

Aerial photographs
2000 Ordnance Survey orthophotography
2005 Ordnance Survey orthophotography
Google Earth
Bing maps aerial photos

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APPENDIX - 16.1.4
TEST EXCAVATION REPORT – KNOCKMAROE

Archaeological Assessment Report:
110kV UWF Grid Connection, Test Excavations at Knockmaroe townland, Co Tipperary

KILKENNY ARCHAEOLOGY
Archaeological Consultants

Client:
Ecopower Developments, Zetec House, Purcellsinch Business Park, Dublin Road, Kilkenny

Excavation Licence Reference:
16E0261

Licensed archaeologist:
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Report authors:
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Document title	Archaeological Assessment Report: UW rid Connection Test Excavations at Knockmaroe townland, Co Tipperary
3 **Client**	Ecopower Developments, Zetec House, Purcellsinch Business Park, Dublin Road, Kilkenny
Document type	Archaeological Assessment
Excavation licence	16E0261
Planning reference	Pre planning
Licensed archaeologist	Barry Fitzgibbon MA MIAI
Contributing authors	Barry Fitzgibbon MA MIAI Cóilín O'Drisceoil MA MIAI
Issue number/date	**DRAFT FOR CLIENT REVIEW:** 28th October 2016
Document Issue Approval	Cóilín Ó Drisceoil MA MIAI

All recommendations and contents of this report are subject to the approval of the National Monuments Service of the Department of Arts, Heritage and Gaeltacht and the National Museum of Ireland.

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Licenced archaeologist
28th October 2016

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Figure 4: Location of TN039-008 Megalithic Tomb - Wedge Tomb on 20012 aerial photograph ..... **Error! Bookmark not defined.**

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Figure 7: Location of test trenches 16E0261 Knockmaroe **Error! Bookmark not defined.**

Figure 8: Test-trench 1, from north 11

Figure 9: Test trench 2, from north 11

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Figure 11: Test trench 4 from north 12

6.1.4.1 INTRODUCTION

This report was commissioned by Ecopower Developments as a component of a Cultural Heritage Assessment for a future planning application to An Bord Pleanála for the UWF Grid Connection. Application will be made for a 27.5km long grid connection route from the consented UWF Substation at Knockcurraghbola Commons, Upperchurch, County Tipperary to a proposed Mountphilips Substation at Mount Philips, County Tipperary. A Cultural Heritage Assessment of the route (Kilkenny Archaeology March 2016) identified that a section of the proposed route will pass within *c.*21m of Recorded Monument TN039-008 *Megalithic Tomb - Wedge Tomb*, at Knockmaroe, Co Tipperary. This report presents the results of licenced test excavations along the proposed grid line at RMP TN039-008.

6.1.4.1.1 Assessment Methodology

Archaeological test excavations were conducted as per a method statement agreed with the National Monuments Service and licenced under the National Monuments Acts 1930-2004. The material contained within the document is based on the *Guidelines on the Information to be Contained in Environmental Impact Statements* (E.P.A. 2002, 2003), and conforms to the methodologies recommended in 'Framework and Principles for the Protection of the Archaeological Heritage' issued by the Dept. of Arts, Heritage, Gaeltacht and the Islands (1999). Section 3.6.6 of 'Framework and Principles for the Protection of the Archaeological Heritage' notes '*Environmental impact assessment should unless there are substantial grounds to show that it is not necessary, involve the carrying out of archaeological assessment including, where appropriate, test excavation'* (Dept. of Arts, Heritage Gaeltacht and the Islands 1999). All recommendations conform to the legislative frameworks of the *National Monuments Acts 1930-1994*, *Heritage Act 2000* and the *European Convention on the Protection of the Archaeological Heritage (ratified by Ireland 1997)*. The National Roads Authority's (NRA) G*uidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes* (2005) was also consulted because of its in-depth consideration of archaeological heritage as part of Environmental Impact Assessments (EIA).

6.1.4.1.2 Assessment Components

This assessment comprises a desk-based study and archaeological test excavations within the study area.

6.1.4.1.2.1 Desk-based study

The desk-top study employs a range of archival and documentary sources to provide an historical and archaeological account of the development area and its wider context. The sources utilised are listed in the bibliography below.

6.1.4.1.2.2 Archaeological test excavation

Archaeological test excavation is defined as: '*that form of archaeological excavation where the purpose is to establish the nature and extent of archaeological deposits and features present in a location which it is proposed to develop (though not normally to fully investigate those deposits or features) and allow an assessment to be made of the archaeological impact of the proposed development*' (*Framework and Principles for the Protection of the Archaeological Heritage* 1999, 27).

The archaeological testing methodology for the project was agreed with the Archaeological Licensing Section of the National Monuments Service and the National Museum of Ireland via a method statement. Testing was carried out 21st October 2016 and consisted of the mechanical excavation of three test trenches under excavation licence reference 16E0261. The primary aim of the testing was to discover if any subsurface archaeological remains existed within the proposed development area which would be negatively impacted upon by the proposed excavations for the gridline.

6.1.4.2 THE DEVELOPMENT

6.1.4.2.1 Development Proposal

It is proposed that the grid infrastructure associated with the 110kV UWF Grid Connection would be laid underground between the Consented UWF Substation at Upperchurch and a proposed Mountphilips Substation at Mount Philips. The length of the route is 27.5km and it is located along a mix of public roads, farm tracks, open farmland and existing forestry tracks.

6.1.4.2.2 Reason for archaeological intervention

A cultural heritage assessment of the grid route (Kilkenny Archaeology March 2016) recommended test excavations at TN039-008 *Megalithic Tomb - Wedge Tomb*, Knockmaroe, Co Tipperary.

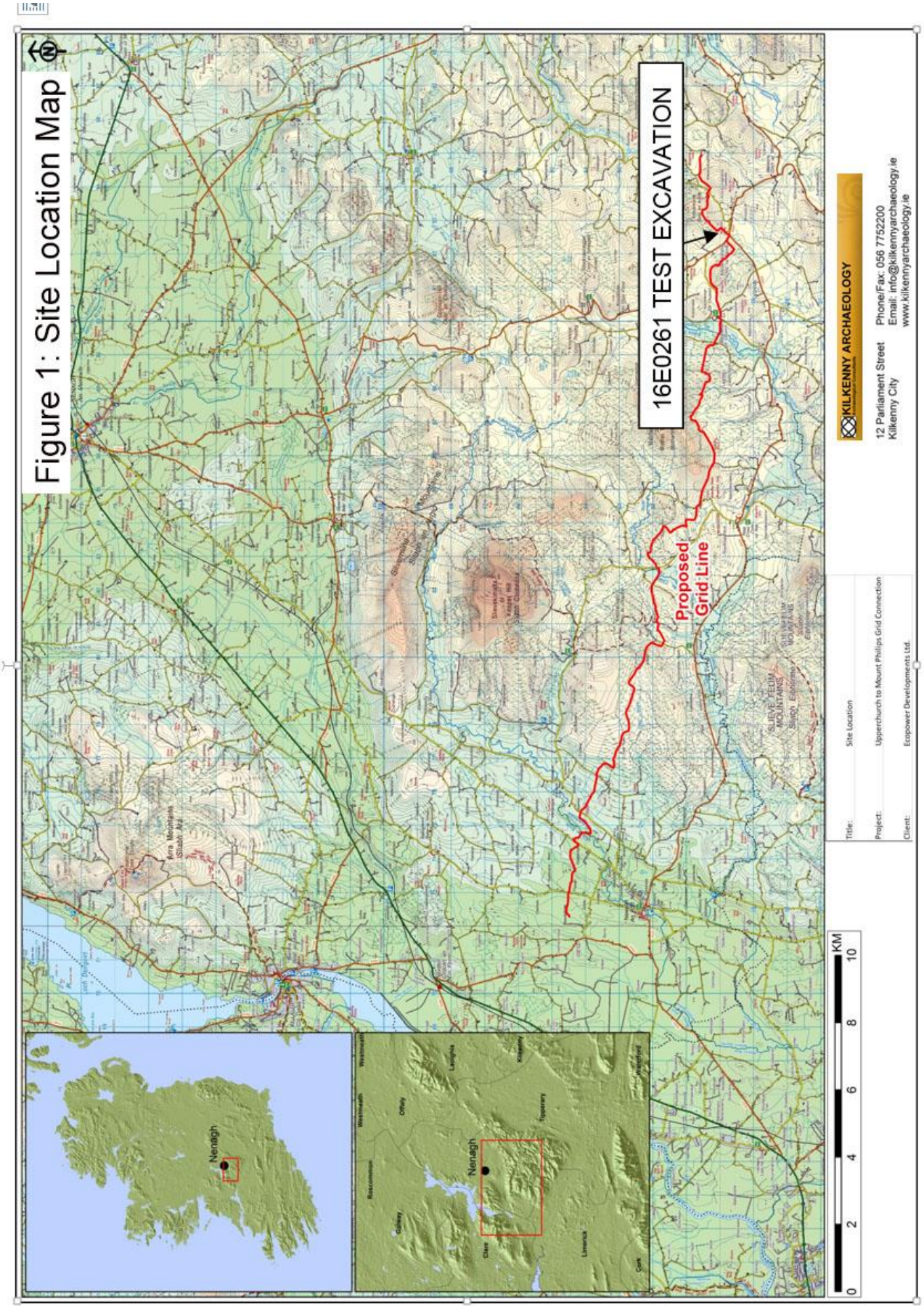
Figure 1: Site Location Map
16E0261 TEST EXCAVATION
Proposed Grid Line
KILKENNY ARCHAEOLOGY
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie
Title: Site Location
Project: Upperchurch to Mount Philips Grid Connection
Client: Ecopower Developments Ltd.
KM
0 2 4 6 8 10
Nenagh
Nenagh

Figure 2: Site Location (detail)
TN039-008
Megalithic Tomb
Wedge Tomb
Proposed
Grid Line
Knockmaroe
Conc an Arbha
Knockmaroe
Megalithic
Tomb
Knockcurraghbola
Crowlands
Megalithic
Tombs
Knockcurraghbola
Standing
Stone
Milestone
Cloch an
Gortmahonoge
Inchivara
Inch
Grousehall
Foilnanan
Reisk
Standing
Stone
Knocknabansha
Cnoc na Bainsi
Megalithic
Tomb
Loughbrack
R503
R497
Cummer
Cummer Br.
Anglesey
Road
Anglesey
Br.
Kilcommon
Cill Chuimin
Kilcommon
Cill Chuimin
Sch
PO
Churchquarter
Megalithic
Tomb
Knocknakill
Foilnacanony
Knockanrilly
Bilboa River
An Chlaoideach
River
Bilboa
Coonmore Br.
Cillin
Aughvaria
River
Nenagh
Legend
Proposed Grid Route
KM
0
0.5
1
1.5
2
KILKENNY ARCHAEOLOGY
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie
Title: Site Location
Project: Upperchurch to Mount Philips Grid Connection
Client: Ecopower Developments Ltd.

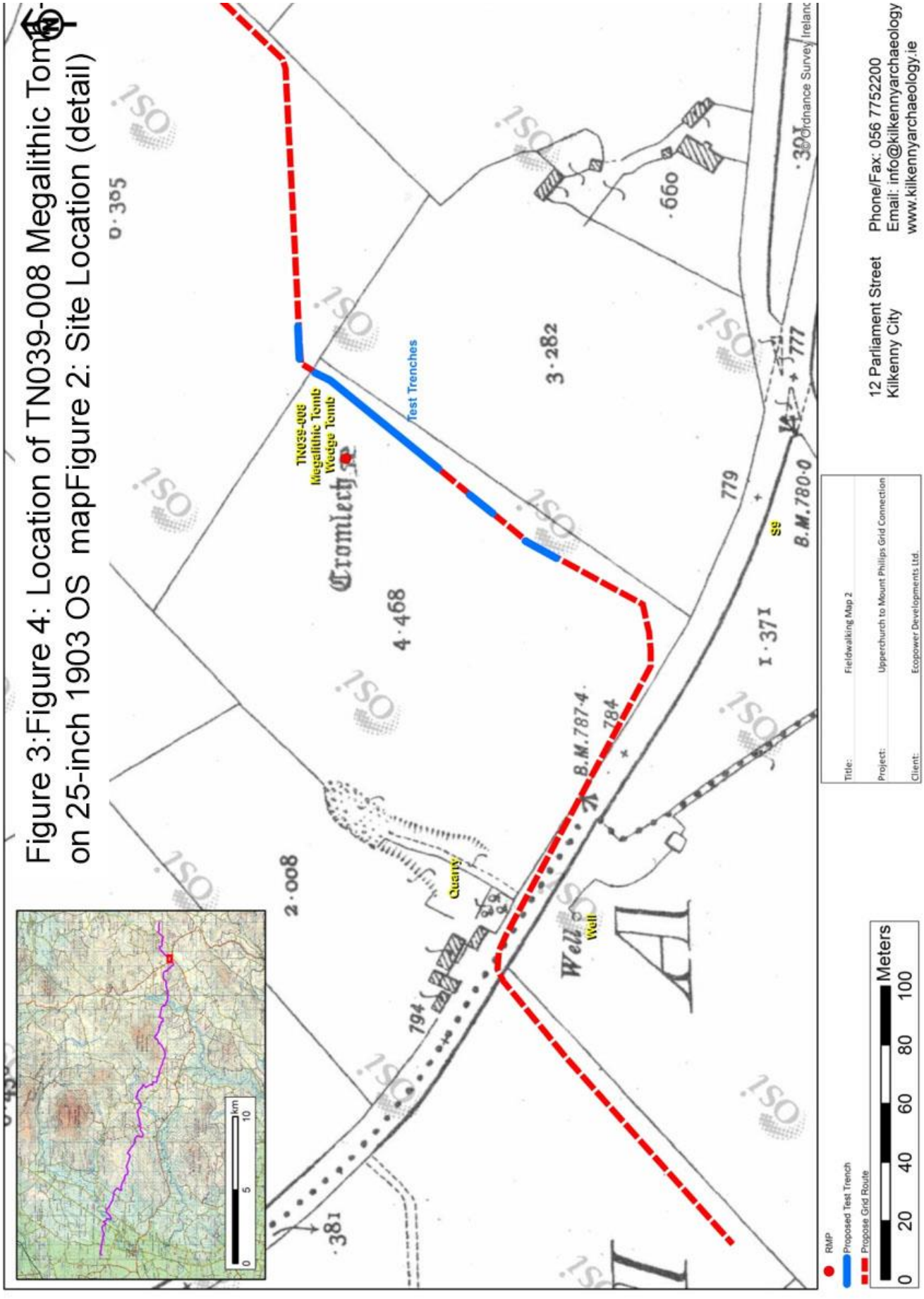
Figure 3:Figure 4: Location of TN039-008 Megalithic Tomb on 25-inch 1903 OS mapFigure 2: Site Location (detail)
TN039-008
Megalithic Tomb
Wedge Tomb
Test Trenches
Cromlech
Quarry
Well
Well
B.M.787·4
B.M.780·0
784
779
777
3·282
4·468
2·008
1·371
·660
·381
·394
·395
ISO
A1
Title: Fieldwalking Map 2
Project: Upperchurch to Mount Phillips Grid Connection
Client: Ecopower Developments Ltd.
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology
www.kilkennyarchaeology.ie
RMP
Proposed Test Trench
Propose Grid Route
Meters
0 20 40 60 80 100
km
0 5 10
© Ordnance Survey Ireland

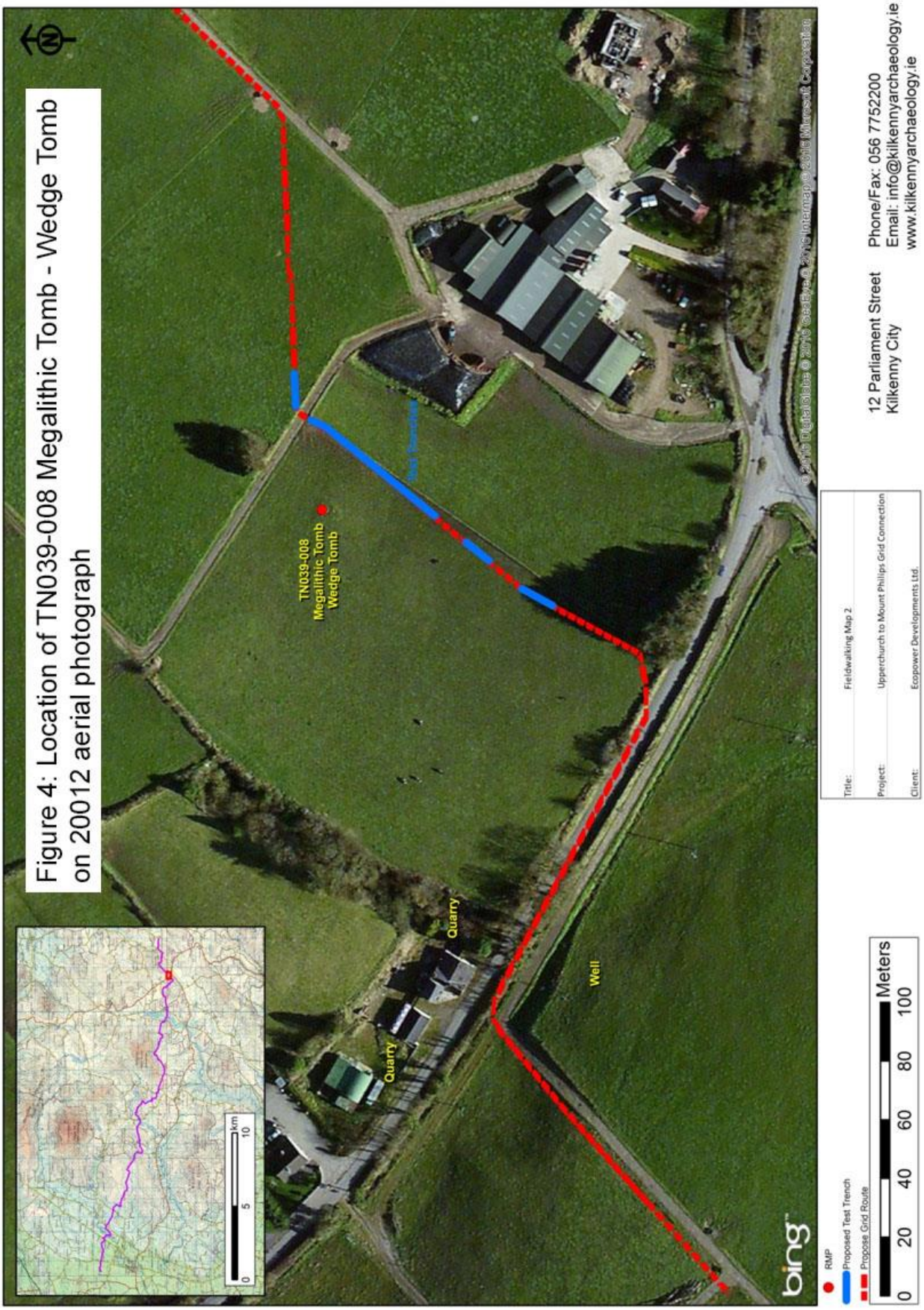
Figure 4: Location of TN039-008 Megalithic Tomb - Wedge Tomb on 20012 aerial photograph
TN039-008
Megalithic Tomb
Wedge Tomb
Quarry
Quarry
Well
bing
RMP
Proposed Test Trench
Propose Grid Route
0 20 40 60 80 100
Meters
km
0 5 10
Title: Fieldwalking Map 2
Project: Upperchurch to Mount Philips Grid Connection
Client: Ecopower Developments Ltd.
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie

6.1.4.3 ARCHAEOLOGICAL BACKGROUND

The proposed grid route for the UWF Grid Connection has been the subject of a comprehensive Cultural Heritage Assessment (Kilkenny Archaeology March 2016) and this section of the report thus focuses on the archaeological monument in the immediate vicinity of the test excavation area TN039-008 *Megalithic Tomb - Wedge Tomb*, at Knockmaroe, Co Tipperary (Figure 3).

The proposed development passes within c.21m of Recorded Monument TN039-008 Megalithic Tomb - Wedge Tomb (Figure 5). Wedge tombs were built between c.2300BC and 2000BC and are associated with the Early Bronze Age. There are several examples in the wider vicinity of the development area, including a particularly impressive wedge tomb excavated by Michael O'Kelly in 1959 in the nearby townland of Baurnadomeeny, which yielded 21 burials and a range of flint tools (O'Kelly 1959; 1960).

Figure 1: TN039-008 Megalithic Tomb - Wedge Tomb *from south*

TN039-008 wedge tomb is located close to the foot of the S-facing slope of Knockmaroe Hill. The remains consist of a mound about 9m in diameter and 1m high

with a hollow towards its western perimeter where there are three stones (De Valera and Ó Nualláin 1982, 89, No.9) (Figure 5). One of these is an orthostat aligned WSW-ENE. This stone, which declines in height from W to E, may have formed part of a chamber side. Resting against the last is a large slab, possibly a displaced roofstone. A thin slab beneath this may have been detached from its underside. Some stones exposed at the edge of the hollow and at the perimeter of the mound are of uncertain origin.

6.1.4.4 ARCHAEOLOGICAL TEST EXCAVATION RESULTS

Figure 2: Test excavations underway 21st October 2016, taken from north. TN039-008 Megalithic Tomb - Wedge Tomb *is in the foreground.*

Test excavations were undertaken by mechanical excavator fitted with a 0.6m wide toothless bucket 21st October 2016 (Figure 6). The proposed grid line trench will be of the same width. Four trenches were excavated along the proposed grid line route to the level of the natural glacial substratum (Figure 7).

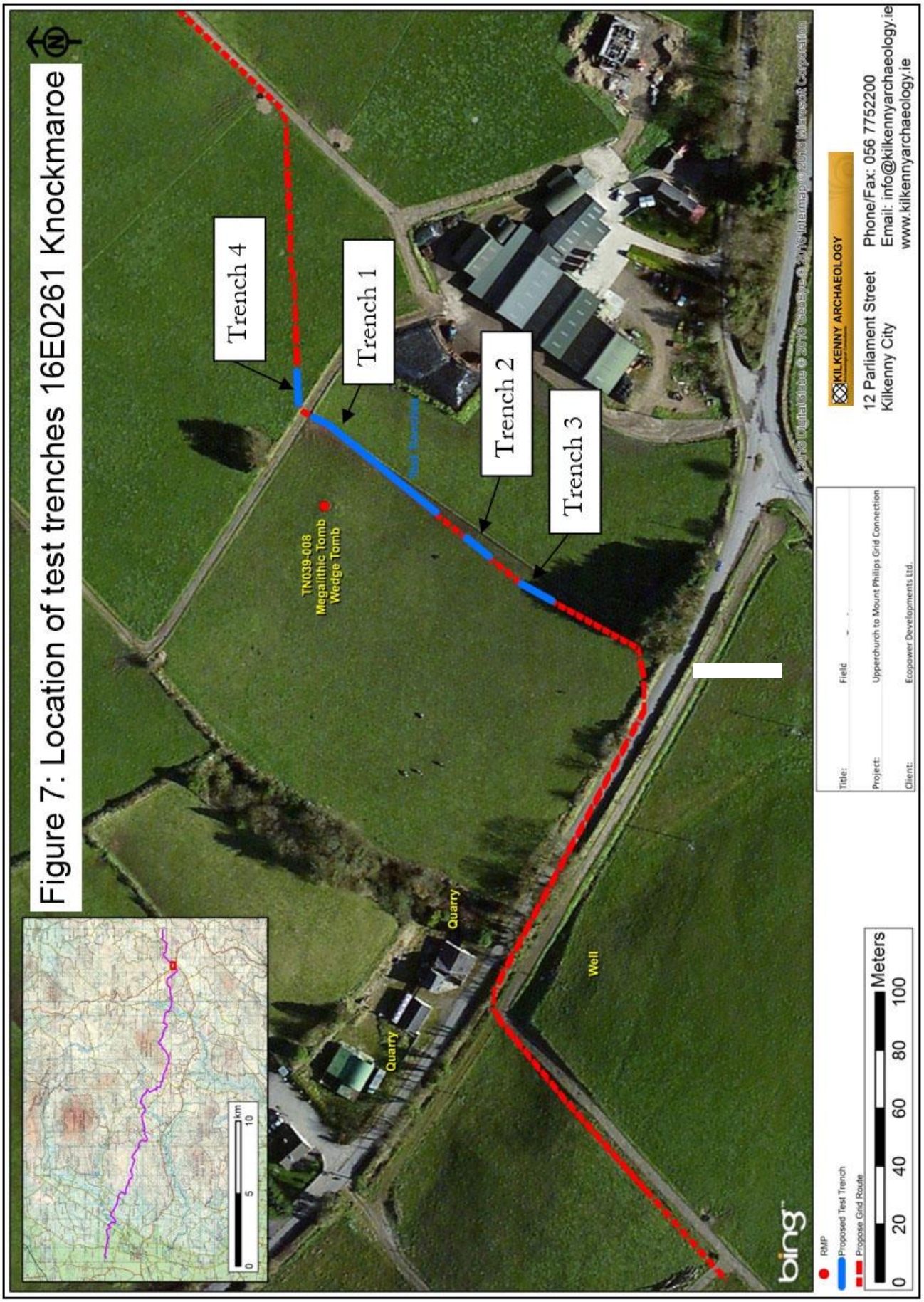
Figure 7: Location of test trenches 16E0261 Knockmaroe
Trench 4
Trench 1
Trench 2
Trench 3
TN039-008
Megalithic Tomb
Wedge Tomb
Quarry
Quarry
Well
KILKENNY ARCHAEOLOGY
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie
Title: Field
Project: Upperchurch to Mount Phillips Grid Connection
Client: Ecopower Developments Ltd
RMP
Proposed Test Trench
Propose Grid Route
0 20 40 60 80 100
Meters
bing

Figure 3: Test-trench 1, from north

Figure 4: Test trench 2, from north

Figure 5: Test trench 3 from north

Figure 6: Test trench 4 from north

Test trench 1 was 57m long x 0.8m wide (Figure 8). The topsoil was 0.3m depth over the glacial subsoil, a bright orange glacial substratum. The east edge of a backfilled field boundary ditch that is marked on the second edition OS map was noted intermittently along the west side of the trench (Figure 3). Nothing of archaeological interest was noted.

Test trench 2 was 10m long x 0.8m wide (Figure 9). The topsoil was 0.5m depth over the glacial subsoil. The field boundary noted in trench 1 was also noted at the north side of the trench. Nothing of archaeological interest was noted.

Test trench 3 was 10m long x 0.8m wide (Figure 10). The topsoil was 0.55m depth over the glacial subsoil. Nothing of archaeological interest was noted.

Test trench 4 was 9m long x 0.65m wide (Figure 11). The topsoil was 0.8m depth over the glacial subsoil. Nothing of archaeological interest was noted.

6.1.4.5 ARCHAEOLOGICAL IMPACT STATEMENT

6.1.4.5.1 Potential impact

Archaeological test excavations adjacent to RMP TN039-008 wedge tomb uncovered nothing of archaeological potential. The proposed UWF Grid Connection route trench at this location will therefore have no archaeological impact.

6.1.4.5.2 Recommendations

The Cultural Heritage Assessment of the UWF Grid connection has recommended that all groundworks during the construction of the development should be archaeologically monitored under licence from the National Monuments Service of the Department of Arts, Heritage and the Gaeltacht.

6.1.4.6 BIBLIOGRAPHY

Unpublished Primary Sources Consulted
Sites and Monuments Record (SMR) files held by the Archaeological Survey of Ireland
Topographical files of The National Museum of Ireland

Maps
First edition 1840 Ordnance Survey map sheet
Second edition 1900 Ordnance Survey map sheet
Griffiths's Valuation maps and valuation report
Records of Monuments and Places (RMP) constraints maps

Aerial photographs
2000 Ordnance Survey orthophotography
2005 Ordnance Survey orthophotography
Google Earth
Bing maps aerial photos

Secondary sources:
DeValera, R. and O Nuailláin, S., 1982, *Survey of the Megalithic Tombs of Ireland, Tipperary*, Government Publications.

DoEHLG, 1999, *Framework and Principles for the Protection of the Archaeological Heritage*, Dublin.

EPA, 2002, *Guidelines on the information to be contained in Environmental Impact Statements*, EPA, Dublin.

EPA, 2003, *Advice noted on current practice (in the preparation of Environmental Impact Statements),* EPA, Dublin.

Farrelly and O'Brien 2002 Archaeological Inventory of County Tipperary. Volume 1: North Tipperary. The Stationery Office, Dublin.

O'Kelly, M. J. 1959. A wedge shaped gallery grave at Baurnadomeeny, County Tipperary, preliminary notice in *North Munster Antiquarian Journal* 8: p62

O'Kelly, M. J. 1960. A wedge shaped gallery grave at Baurnadomeeny, County Tipperary, *Cork Archaeological Society Journal* 65: 85-115.

REFERENCE DOCUMENTS

APPENDIX 16.1.5
TEST EXCAVATION REPORT – KNOCKMAROE

Archaeological Assessment Report:

UWF Related Works,
Test Excavations at Knockcurraghbola Commons, Co Tipperary.

KILKENNY ARCHAEOLOGY
Archaeological Consultants

Client:
Ecopower Developments, Zetec House, Purcellsinch Business Park, Dublin Road, Kilkenny

Excavation Licence Reference:
17E0173

Licensed archaeologist:
Barry Fitzgibbon MA MIAI

Report authors:
Barry Fitzgibbon MA MIAI

06th July 2017

Kilkenny Archaeology
12 Parliament Street
Kilkenny City

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W. www.kilkennyarchaeology.ie

Document title	UWF Related Works, Test Excavations at Knockcurraghbola Commons, Co Tipperary.
Client	Ecopower Developments, Zetec House, Purcellsinch Business Park, Dublin Road, Kilkenny
Document type	Archaeological Assessment
Excavation licence	17E0173
Planning reference	Pre planning
Licensed archaeologist	Barry Fitzgibbon MA MIAI
Contributing authors	Barry Fitzgibbon MA MIAI
Issue number/date	06th July 2017

All recommendations and contents of this report are subject to the approval of the National Monuments Service of the Department of Arts, Heritage and Gaeltacht and the National Museum of Ireland.

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BARRY FITZGIBBON MA MIAI
Licenced archaeologist
06th July 2017

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16.1.5.1 INTRODUCTION

This report was commissioned by Ecopower Developments as part of a planning application to Tipperary County Council for works relating to UWF Related Works. The entirety of the Related Works is to be the subject of a comprehensive Cultural Heritage Assessment and this report will form part of that assessment.

The application will include underground Internal Windfarm Cables, Realigned Windfarm Roads at three locations, Haul Route Works comprising temporary widening of the public road in a number of locations and an 18m high wooden Telecom Relay Pole.

The Internal Windfarm Cables will involve the laying underground of electrical cables requiring a trench between the already Consented UWF Turbines and the already Consented UWF Substation. These trenches will be fully excavated. Initial scoping of the route (Kilkenny Archaeology March 2017) identified that a section of the Internal Windfarm Cable route will pass within the Zone of Notification for TN039-052 *Stone Row*, at Knockcurraghbola Commons, Co Tipperary. This report presents the results of licenced test excavations along the proposed line at RMP TN039-052.

16.1.5.1.1 Assessment Methodology

Archaeological test excavations were conducted as per a method statement agreed with the National Monuments Service and licenced under the National Monuments Acts 1930-2004. The material contained within the document is based on the *Guidelines on the Information to be Contained in Environmental Impact Statements* (E.P.A. 2002, 2003), and conforms to the methodologies recommended in 'Framework and Principles for the Protection of the Archaeological Heritage' issued by the Dept. of Arts, Heritage, Gaeltacht and the Islands (1999). Section 3.6.6 of 'Framework and Principles for the Protection of the Archaeological Heritage' notes '*Environmental impact assessment should unless there are substantial grounds to show that it is not necessary, involve the carrying out of archaeological assessment including, where appropriate, test excavation*' (Dept. of Arts, Heritage Gaeltacht and the Islands 1999). All recommendations conform to the legislative frameworks of the *National Monuments Acts 1930-1994*, *Heritage Act 2000* and the *European Convention on the Protection of the Archaeological Heritage (ratified by Ireland 1997)*. The National Roads Authority's (NRA) G*uidelines for the Assessment of Archaeological Heritage Impacts of*

National Road Schemes (2005) was also consulted because of its in-depth consideration of archaeological heritage as part of Environmental Impact Assessments (EIA).

16.1.5.1.2 Assessment Components

This assessment comprises a desk-based study and archaeological test excavations within the study area.

16.1.5.1.2.1 Desk-based study

The desk-top study employs a range of archival and documentary sources to provide an historical and archaeological account of the development area and its wider context. The sources utilised are listed in the bibliography below.

16.1.5.1.2.2 Archaeological test excavation

Archaeological test excavation is defined as: 'that form of archaeological excavation where the purpose is to establish the nature and extent of archaeological deposits and features present in a location which it is proposed to develop (though not normally to fully investigate those deposits or features) and allow an assessment to be made of the archaeological impact of the proposed development' (Framework and Principles for the Protection of the Archaeological Heritage 1999, 27).

The archaeological testing methodology for the project was agreed with the Archaeological Licensing Section of the National Monuments Service and the National Museum of Ireland via a method statement. Testing consisted of the mechanical excavation of two test trenches under excavation licence reference 17E0173. The primary aim of the testing was to discover if any subsurface archaeological remains existed within the Related Works area which would be negatively impacted upon by the excavations for the cable route.

16.1.5.2 THE DEVELOPMENT

16.1.5.2.1 Development Proposal

As part of a planning application for additional works related to the Consented Upperchurch Windfarm at Upperchurch, Co. Tipperary, permission is to be sought for the laying, underground Internal Windfarm Cables within the development area. This will require trenches from the already Consented Turbine locations to the already Consented Substation location, to be fully excavated. The cable ducts and backfill material are then to be placed in the cable trench.

16.1.5.2.2 Reason for archaeological intervention

A preliminary scoping report by Kilkenny Archaeology noted that a section of the Internal Windfarm Cables passes through the Zone of Notification for RMP TN039-052 *Stone Row.* In light of this, it was recommended that this portion of the proposed development be archaeologically tested in advance of the planning application.

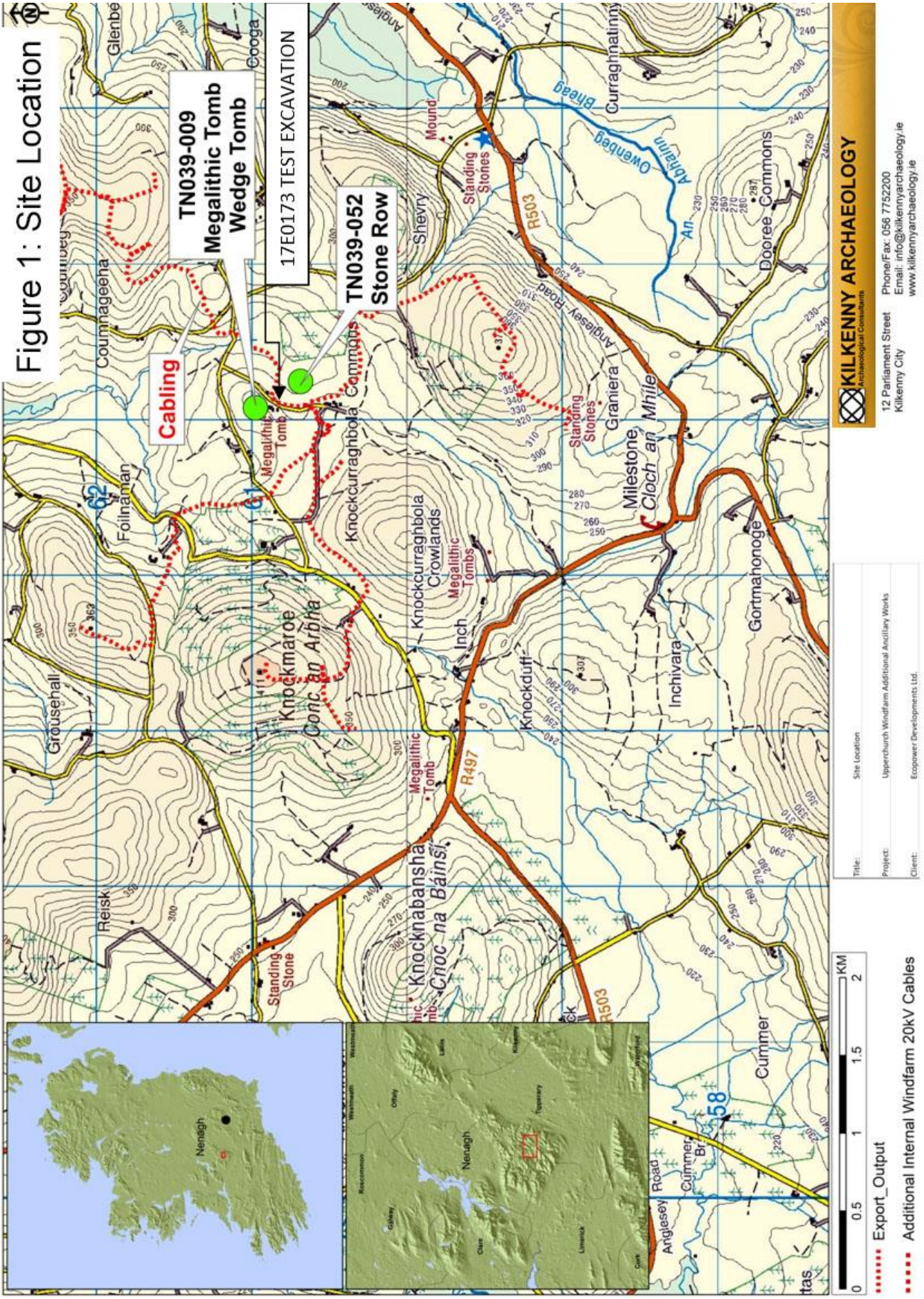
Figure 1: Site Location
TN039-009 Megalithic Tomb Wedge Tomb
17E0173 TEST EXCAVATION
TN039-052 Stone Row
Cabling
Megalithic Tomb
Standing Stones
Knockmaroe
Conc an Arbha
Knockcurraghbola Commons
Knockcurraghbola Crowlands
Megalithic Tombs
Knocknabansha
Cnoc na Bainsi
Megalithic Tomb
Standing Stone
Milestone
Cloch an Mhile
Graniera
Inchivara
Gortmahonoge
Knockduff
Inch
Shevry
Mound
Standing Stones
Curraghnatinny
Dooree Commons
Angliesey Road
R503
R497
Cummer
Cummer Br.
Road
Angliesey
Reisk
Grousehall
Foilnaman
Coumnageena
Glenbe
Cooga
Nenagh
KILKENNY ARCHAEOLOGY
Archaeological Consultants
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie
Title: Site Location
Project: Upperchurch Windfarm Additional Ancillary Works
Client: Ecopower Developments Ltd.
KM
0 0.5 1 1.5 2
Export_Output
Additional Internal Windfarm 20kV Cables

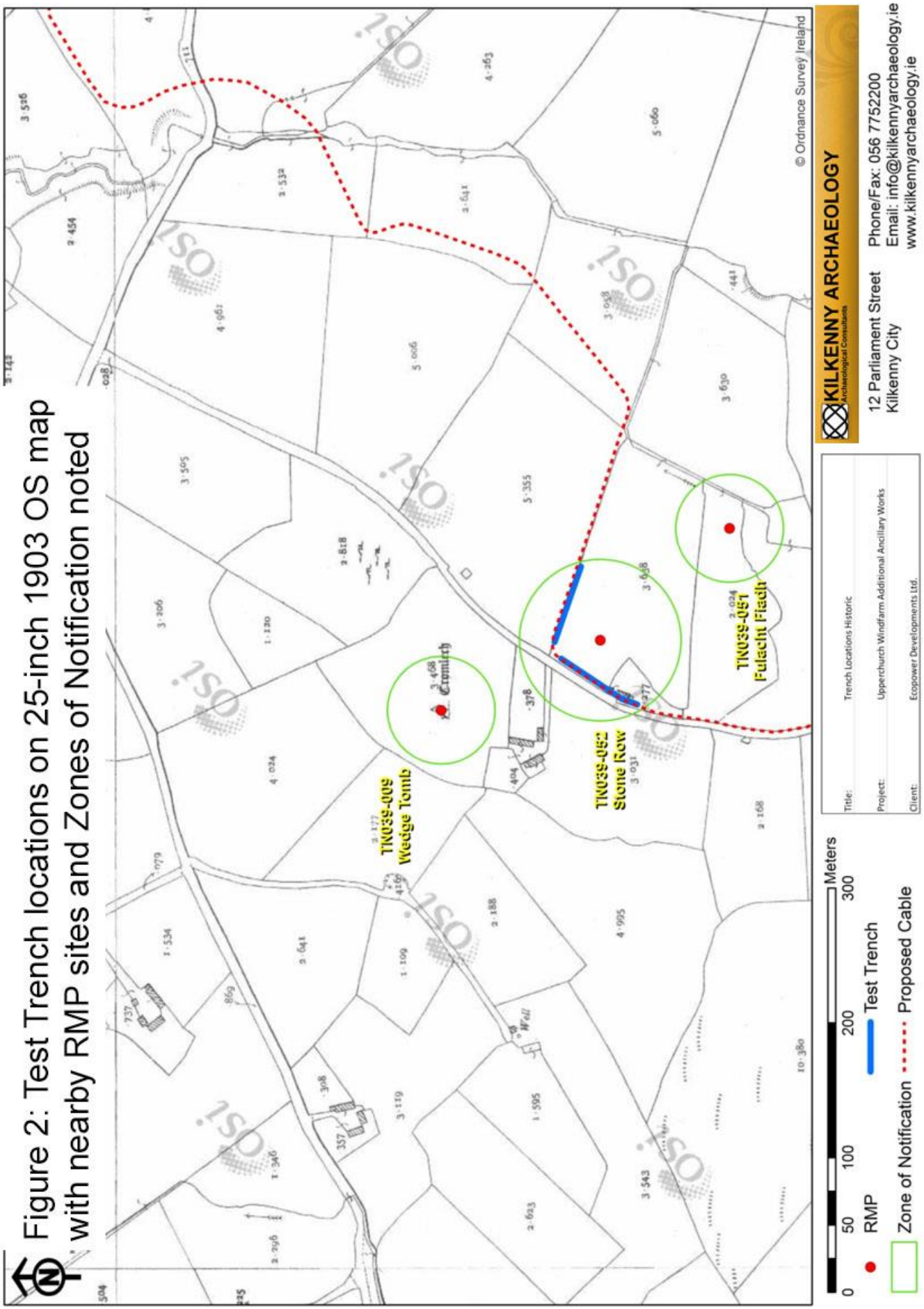
Figure 2: Test Trench locations on 25-inch 1903 OS map with nearby RMP sites and Zones of Notification noted
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TN038-009 Wedge Tomb
TN038-052 Stone Row
TN038-051 Fulacht Fiach
KILKENNY ARCHAEOLOGY
Archaeological Consultants
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie
Title: Trench Locations Historic
Project: Upperchurch Windfarm Additional Ancillary Works
Client: Ecopower Developments Ltd.
Meters
0 50 100 200 300
RMP
Test Trench
Zone of Notification
Proposed Cable

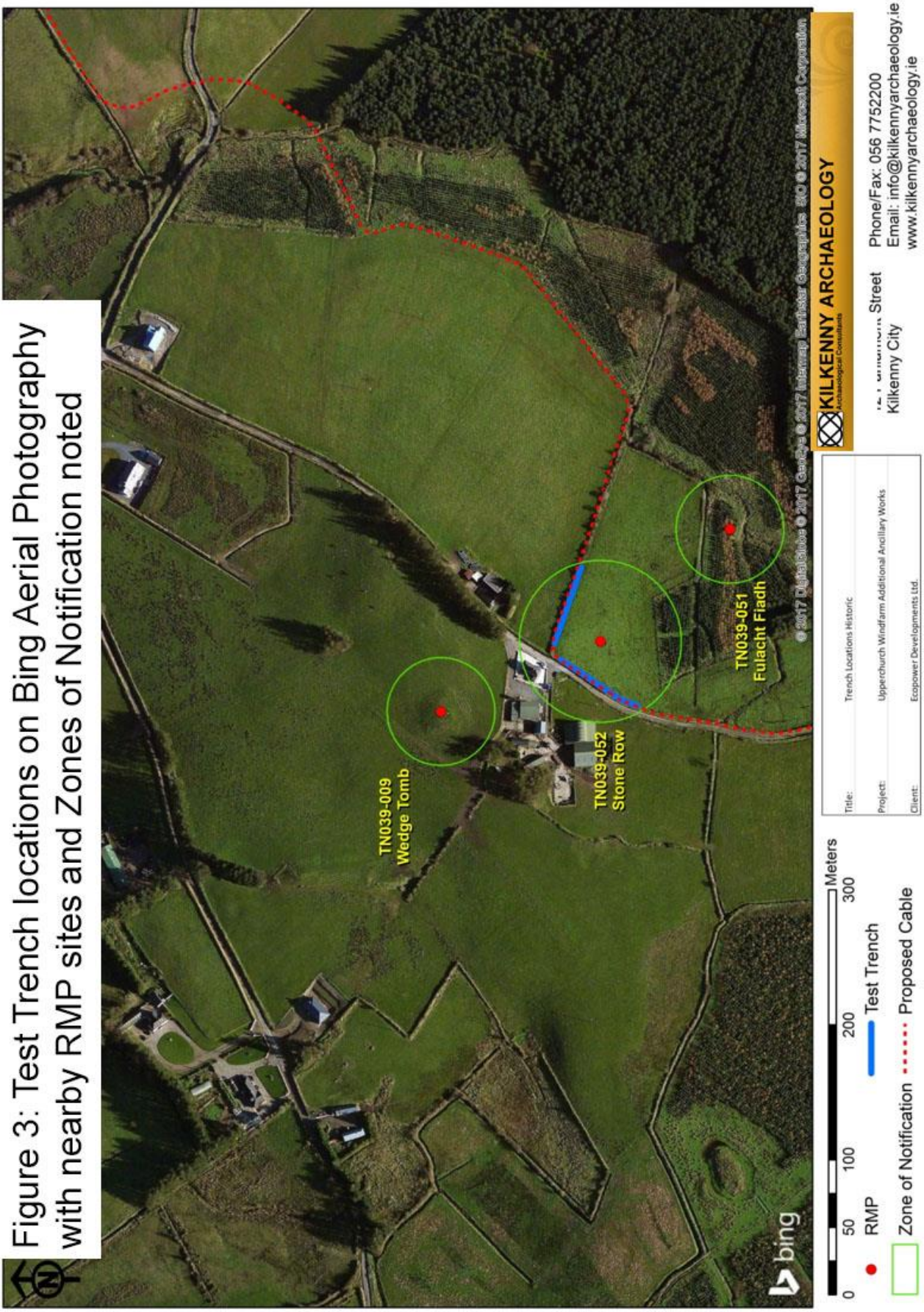

Figure 3: Test Trench locations on Bing Aerial Photography with nearby RMP sites and Zones of Notification noted

16.1.5.3 ARCHAEOLOGICAL BACKGROUND

The mountain ranges of northern Tipperary, centred around Moherslieve, the Silvermine Mountains and Slievefelim Mountains, is a region with an extremely rich and diverse history of human settlement going back to the Early Neolithic. This is reflected in the archaeological record with more than 300 RMPs in the vicinity, including a wide variety of impressive megalithic tombs. The monuments of Tipperary were surveyed in the early 1980s by the Archaeological Survey of Ireland. A review of prehistoric archaeology in Tipperary undertaken by Richard Raleigh (1985) highlighted the prehistoric richness of this North Tipperary region, while between 1992 and 1995 the North Munster Project of the Discovery Programme sought to understand settlement patterns over a vast 7000km^2 area that centred on the lower Shannon catchment (Grogan 1996).

The entirety of the UWF Grid Connection and UWF Related Works for the Upperchurch Windfarm is to be subject of a comprehensive Cultural Heritage Assessment and this report will form part of the assessment. This report focuses on the archaeological monument in the immediate vicinity of the test excavation area, TN039-052 *Stone Row*, at Knockcurraghbola Commons, Co Tipperary (Figure 6).

At this location the Internal Windfarm Cable passes within the Zone of Notification of Recorded Monument TN039-052 *Stone Row* (Figure 4, 5). Although a Stone Row is defined as a row of three or more stones erected in a line, this monument only comprises of two stones and as such may have been better described as a *Standing Stone - Pair*. Rows or Pairs are considered to have been aligned on various solar and lunar events and usually date to the Bronze Age (c. 2400-500 BC).

As mentioned above the monument has been described in detail by the RMP (Farrelly and O'Brien 2002). It is situated in a pasture with a moderate southeast facing slope of rising ground in upland area with good views of mountain valleys to south and east, with higher ground to north. The monument consists of two low limestone orthostats, aligned east-west, and 2.48m apart. Both stones are roughly triangular in shape with rectangular sections and the tops of the stones are tapering towards a point. The west stone measures 0.9m high; 0.58m x 0.21m wide. The east stone measures 0.8m high; 0.60m x 0.30m. A fulacht fiadh (TN 039-051) is located c.126m to the southeast and a wedge tomb (TN039-009) is located c.130m to the north-northwest. Both of these monuments also would have had their

origins during the Bronze Age, indicating that location may have held some significance during this period (See Figure 2 and Figure 3).

Figure 1: TN039-052 - Stone Row from south

Figure 2: TN039-052 - Stone Row from northwest

16.1.5.4 ARCHAEOLOGICAL TEST EXCAVATION RESULTS

Test excavations were undertaken by mechanical excavator fitted with a 0.9m wide toothless bucket. The Internal Windfarm Cable trench will be of the same width. Two trenches were excavated along the cable route to the level of the natural glacial substratum or bedrock.

Figure 3: Test excavations underway, taken from west.

Figure 7: Location of test trenches on Bing Aerial Photography 2012
TN039-009 Wedge Tomb
Trench 1
Trench 2
TN039-052 Stone Row
TN039-051 Fulacht Fiadh
bing
0 20 40 80 120 Meters
RMP
Test Trench
Zone of Notification
Proposed Cable
Title: Trench Locations Historic
Project: Upperchurch Windfarm Additional Ancillary Works
Client: Ecopower Developments Ltd.
12 Parliament Street
Kilkenny City
Phone/Fax: 056 7752200
Email: info@kilkennyarchaeology.ie
www.kilkennyarchaeology.ie

Figure 4: Trench 1 from the southeast

Figure 5: Trench 1 from the northeast

Figure 6: Trench 2 from the northeast

Figure 7: Trench 2 from the southwest. Spread of mixed demolition rubble visible in the foreground

Test trench 1 was 71m long x 0.95m wide (Figure 6, 7). The topsoil was 0.15m deep over the glacial subsoil, a bright orange glacial substratum. Patches of bedrock were visible throughout the trench, indicating that this subsoil is quite shallow. Nothing of archaeological interest was noted.

Test trench 2 was 72m long x 0.95m wide (Figure 10, 11). The topsoil was 0.2m deep over the glacial subsoil, where it was present. Otherwise the topsoil directly overlay bedrock. Towards the south of the trench, at the location of the present gate into the field, a spread of darker soil and stone was uncovered (Figure 11). This was most likely associated with the demolished building, shown at this location on the 25 inch map. The land owner confirmed

that this building was knocked within the last 40 years. No structural remains associated with the building appeared to survive. Nothing else of archaeological interest was noted.

16.1.5.5 ARCHAEOLOGICAL IMPACT STATEMENT

16.1.5.5.1 Potential impact

Archaeological test excavations adjacent to RMP TN039-052 - *Stone Row* uncovered nothing of archaeological potential. The Internal Windfarm Cable trench at this location will therefore have no archaeological impact.

16.1.5.5.2 Recommendations

It is recommended that all groundworks during the construction of the development should be archaeologically monitored under licence from the National Monuments Service of the Department of Arts, Heritage and the Gaeltacht.

16.1.5.6 BIBLIOGRAPHY

Unpublished Primary Sources Consulted
Sites and Monuments Record (SMR) files held by the Archaeological Survey of Ireland
Topographical files of The National Museum of Ireland

Maps
First edition 1840 Ordnance Survey map sheet
Second edition 1900 Ordnance Survey map sheet
Griffiths's Valuation maps and valuation report
Records of Monuments and Places (RMP) constraints maps

Aerial photographs
2000 Ordnance Survey orthophotography
2005 Ordnance Survey orthophotography
Google Earth
Bing maps aerial photos

Secondary sources:

DoEHLG, 1999, *Framework and Principles for the Protection of the Archaeological Heritage*, Dublin.

EPA, 2002, *Guidelines on the information to be contained in Environmental Impact Statements*, EPA, Dublin.

EPA, 2003, *Advice noted on current practice (in the preparation of Environmental Impact Statements),* EPA, Dublin.

Farrelly and O'Brien 2002 Archaeological Inventory of County Tipperary. Volume 1: North Tipperary. The Stationery Office, Dublin.

Grogan, E. 1994. The North Munster Project in Discovery Programme Report 4, p26-72. Royal Irish Academy, Dublin

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Appendix 16.1.6:
Field Walking Description

KILKENNY ARCHAEOLOGY
Archaeological Consultants

A16.1.6 FIELD WALKING DESCRIPTION 2
A16.1.6.1 FIELD WALKING DESCRIPTION - UWF GRID CONNECTION.....2
A16.1.6.2 FIELD WALKING DESCRIPTION - UWF RELATED WORKS.....69

A16.1.6 FIELD WALKING DESCRIPTION

A16.1.6.1 FIELD WALKING DESCRIPTION - UWF GRID CONNECTION

Figure 1: Fieldwalking Map 1 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

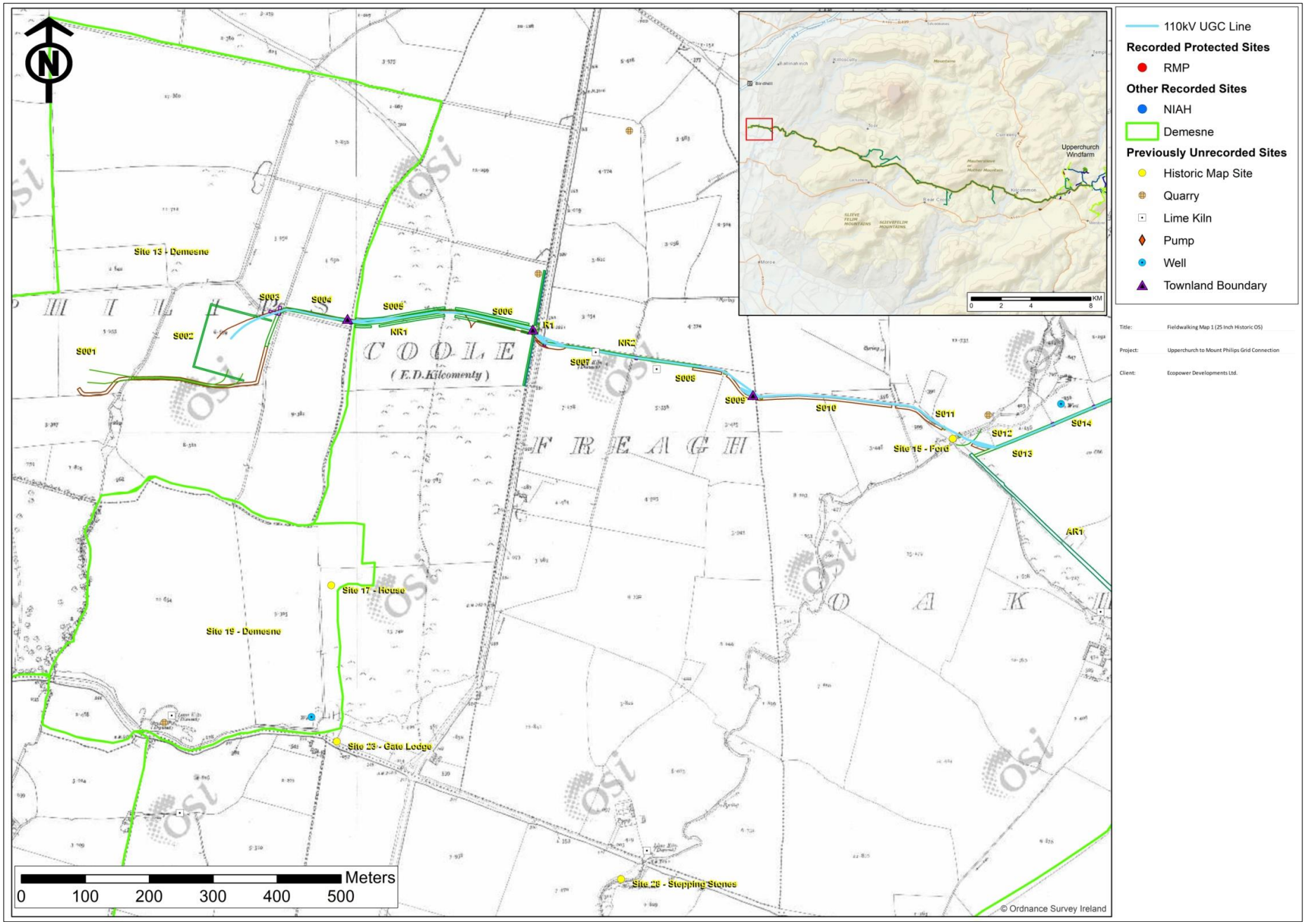


Figure 2: Fieldwalking Map 1 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S001

Figure 3: Section 001 from the east.

Section 001 comprises of a temporary access road and grid connection end mast cables connecting to the existing overhead mains in the field immediately west of the Mountphilips Substation. The field is a gently undulating, well-drained pasture with occasional reedy patches to the north. It is bound on all sides by trees. The development also passes over a small stream which runs along the eastern boundary (Figure 4). No features of archaeological significance were noted in the area.

Figure 4: Stream at eastern end of S001

S002

Figure 5: S002 from the east

Section 002 comprises of the site of the Mountphilips Substation, the termination point of the underground UWF Grid Connection and all associated works. It crosses a poorly-drained pasture with frequent reedy patches. A stream runs along the northern and then western boundaries. No features of archaeological significance were noted in the area.

S003

At this point the UWF Grid Connection crosses a small stream which runs through field boundary comprising of earthen bank and ditch lined with mature trees. No features of archaeological significance were noted in the area.

S004

Figure 6: S004 from the east

Section 004 of the UWF Grid Connection runs in a general easterly direction for a distance of c.103m. It runs long the southern boundary of a pasture field with some poorly drained patches. No features of archaeological significance were noted in the area.

S005/NR1

Figure 7: S005 from the east

At this point the UWF Grid Connection passes through a field boundary comprising of a bank and ditch with a narrow stream. This boundary would have originally served as the demesne (and townland) boundary for Mount Philips and into Coole townland. Section 005 of the UWF Grid Connection runs in a general easterly direction for a distance of 156m. It crosses a well drained agricultural pasture (S006) before exiting through an existing gateway. No features of archaeological significance were noted in the area.

S006

Section 006 of the UWF Grid Connection runs in a general easterly direction for a distance of 128m. It crosses a well drained agricultural pasture after which is emerged through a gateway on to a public road, R001, the townland boundary between Coole and Freagh. No features of archaeological significance were noted in the area.

R001

At this point the UWF Grid Connection crosses public road L-2166-0 before entering a field to the east. No features of archaeological significance were noted in the area.

S007/NR2

Figure 8: S007 from east

Section 007 of the UWF Grid Connection runs in a general easterly direction for a distance of c.128m. It follows the northern boundary of a poorly drained, reed covered pasture field. At the east end of the field the route passes through a hedge row and ditch with small stream. No features of archaeological significance were noted in the area.

S008

Section 008 of the UWF Grid Connection runs in a general easterly direction for a distance of 138m. It runs along the northern boundary of a well drained agricultural pasture. A *Limekiln* is shown as being located in this field on the historic editions of the Ordnance Survey, c. 20m south of the line of the UWF Grid Connection. There are no standing remains of said kiln visible nor was there any indication that the line of the UWF Grid Connection would impact any historic fabric.

S009

Section 009 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 60m. It crosses a poorly drained marshland before crossing a narrow stream, the townland boundary between Freagh and Oakhampton, and entering an area of thick cultivated forestry. No features of archaeological significance were noted in the area.

S010

Section 010 of the UWF Grid Connection runs in a general westerly direction for a distance of c.212m. It follows a narrow track way or firebreak through mature

cultivated forestry before crossing a narrow drain/stream. No features of archaeological significance were noted in the area.

S011

Section 011 of the UWF Grid Connection turns to the southeast and continues along an existing forestry track for a distance of c.115m. At this point is crosses a small stream in the vicinity of *Site 15 - Ford.* No obvious structural remains associated with the ford were noted in the area, nor were any other features of archaeological significance, although visibility was poor due to the thick covering of forestry in the area.

AR1

Access Road 1 follows an existing farm track along the southwestern boundary of a pair of poorly drained pasture fields. No features of archaeological significance were noted in the area.

S012

Section 012 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 153m. It crosses a poorly drained marshland before passing through a boundary of a ditch and a line of trees. No features of archaeological significance were noted in the area.

S013

Section 013 of the UWF Grid Connection continues in a northeasterly direction for a distance of 67m. It runs along the southern boundary of a poorly drained marshland. A spring or well is shown in along this route on the historic editions of the Ordnance Survey. No structural remains were noted during the field visit. No features of archaeological significance were noted in the area.

S014/NR3

Section 014 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 81m. It runs along the southern boundary of a well drained agricultural pasture. No features of archaeological significance were noted in the area.

Figure 9: Fieldwalking Map 2 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

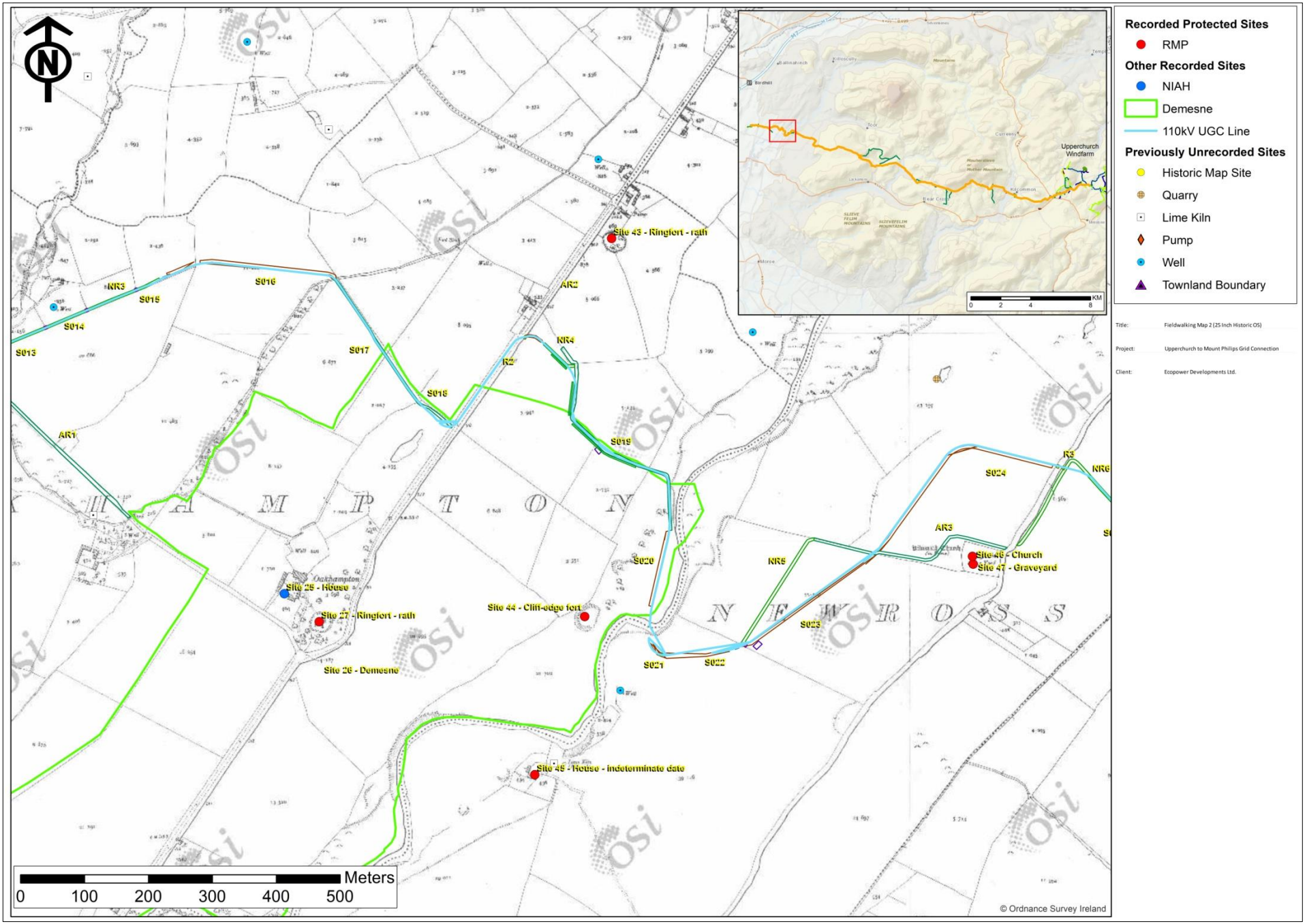


Figure 10: Fieldwalking Map 2 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S015

Section 015 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 101m. It runs along the southern boundary of a well drained agricultural pasture. No features of archaeological significance were noted in the area.

S016

Section 016 of the UWF Grid Connection runs in a general easterly direction for a distance of 228m. It passes through an undulating, well drained pasture field with a gentle west facing slope, after which it crosses a small stream. No features of archaeological significance were noted in the area.

S017

Section 017 of the UWF Grid Connection runs in a general south-easterly direction for a distance of c.144m. It follows an existing track way through a mix of poorly drained marshland, forestry and well drained agricultural pasture. The track passes though the boundary of Oakhampton demesne. No structural remains associated with this boundary are present along the route. No features of archaeological significance were noted in the area.

S018

Figure 11: S018 from the southeast

Section 018 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 148m. It follows and existing farm track along a well drained agricultural pasture before exiting onto the public road through a gate. No features of archaeological significance were noted in the area.

R002

Figure 12: R002 from the south

At this point the UWF Grid Connection runs in a northeasterly direction along the western verge of the public road for a distance of 177m before turning to the east again through a boundary of a ditch. No features of archaeological significance were noted in the area.

AR2

Access Road 2 follows an existing farm track around farm buildings. No features of archaeological significance were noted in the area.

S019/NR4

Figure 13: S019 from the west

Section 019 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 352m. It runs along the northeast boundary of a large, well-drained agricultural pasture, with a gentle southwest facing slope, subdivided by wire and post fencing. A portion of this route runs along the former boundary of *Site 26 - Oakhampton Demesne*. No features of archaeological significance were noted in the area.

S020

Section 020 of the UWF Grid Connection runs in a general southerly direction for a distance of c.126m. It crosses a well drained pasture on the banks of the Mucklear River before crossing the river and turning east. *Site 44 - Cliff Edge Fort* is located c.90m to the west. No features of archaeological significance were noted in the area.

S021

Section 021 of the UWF Grid Connection runs in a general southerly direction for a distance of 53m. It crosses a moderately well drained agricultural pasture with a gentle northwest facing slope. The field is bound to the north and east by the Newport (Mulkear) River, the townland boundary between Oakhampton and Newross, and on the other sides by a bank and ditch. No features of archaeological significance were noted in the area.

S022

Section 022 of the UWF Grid Connection runs in a general easterly direction for a distance of 124m. It crosses a well drained agricultural pasture with a gentle west

facing slope. The field is bound on all sides by a bank and ditch. No features of archaeological significance were noted in the area.

S023/NR5

Section 023 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 250m. It crosses a well drained agricultural pasture with a gentle west facing slope. The field is bound on all sides by a bank and ditch. No features of archaeological significance were noted in the area.

S024/AR3

Section 024 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 200m before turning eastwards and continuing for a further 146m. It crosses a well drained agricultural pasture with a gentle northwest facing slope before exiting through a boundary ditch and onto the public road. The field is bound on all sides by a bank and ditch. To the west is an area of cultivated forestry. In the southwest corner of this field are *Site 46- Church* and *Site 47 - Graveyard*. The UWF Grid Connection is located a minimum distance of 115m from the outer extent of the graveyard. An access road runs along the southern verges of this field, including along the edge of the outer extent of the graveyard where there is an existing private trackway. No other features of archaeological significance were noted in the area.

R003

At this point the UWF Grid Connection crosses public road L-2157-5 before entering a field to the east. No features of archaeological significance were noted in the area.

S025/NR6

Section 025 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 200m. It crosses a well drained agricultural pasture with a gentle northwest facing slope. The field is bound to the east by a small stream and on the other sides by a bank and ditch. The UWF Grid Connection exits through the east boundary which comprised of an earth and stone bank and acts as the townland boundary between Newross and Castlewaller. No features of archaeological significance were noted in the area.

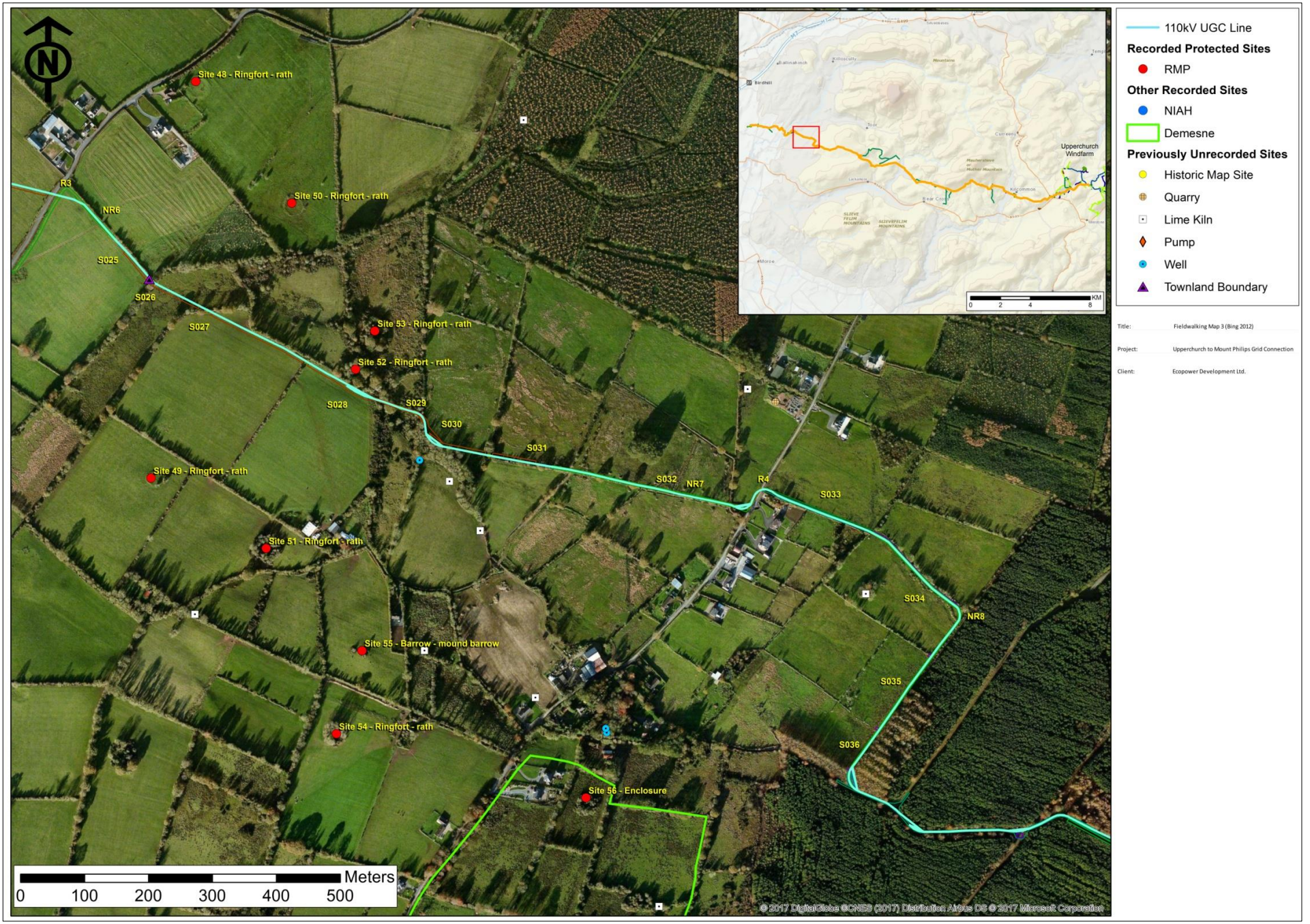


Figure 14: Fieldwalking Map 3 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

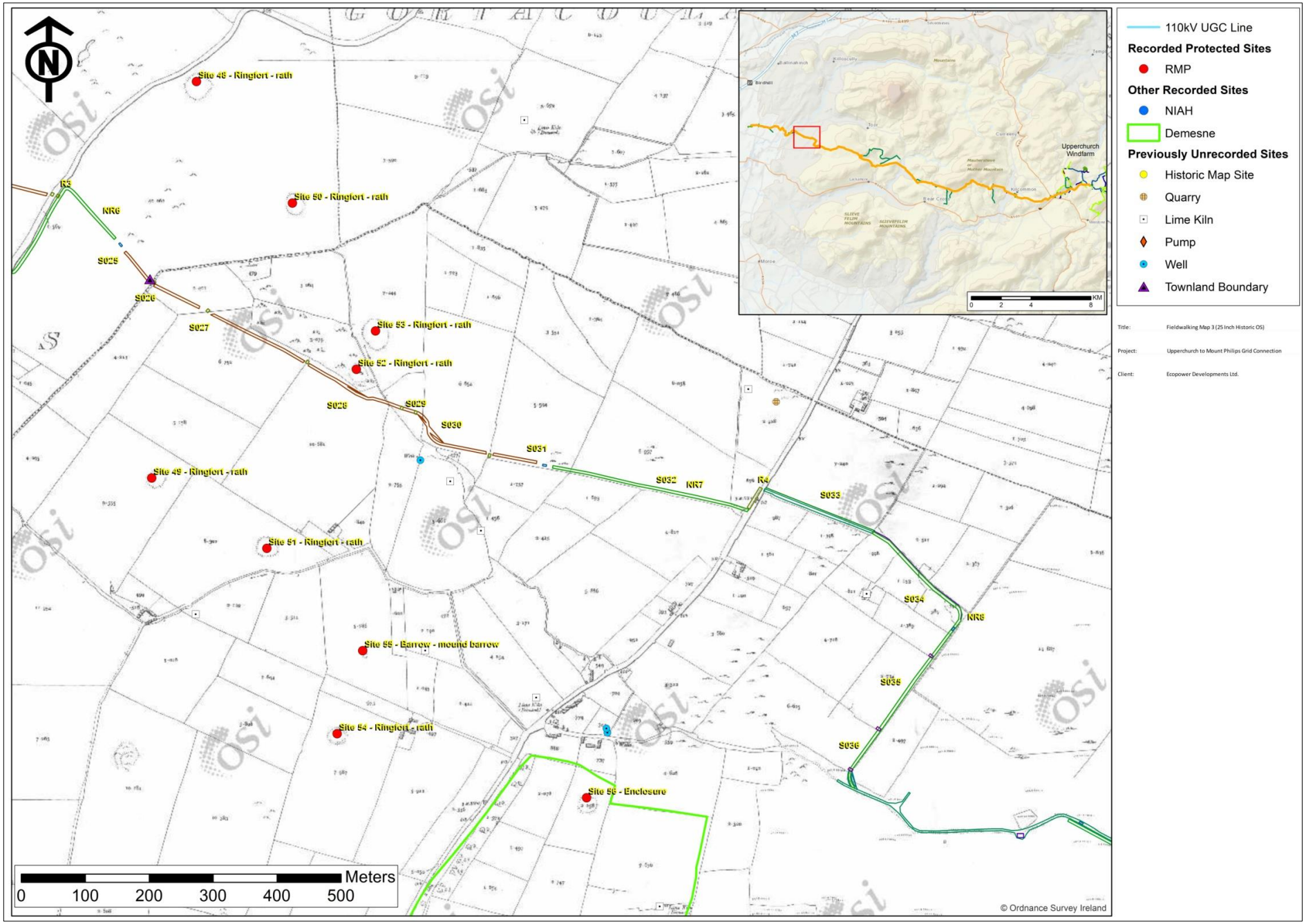


Figure 15: Fieldwalking Map 3 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S026

Section 026 of the UWF Grid Connection runs in a general south-easterly direction for a distance of c.80m. It crosses an area of poorly drained marshy ground. No features of archaeological significance were noted in the area.

S027

Section 027 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 175m. It crosses a well drained agricultural pasture with a gentle northwest facing slope. The field is bound on all sides by a bank and ditch. No features of archaeological significance were noted in the area.

S028

Section 028 of the UWF Grid Connection runs in a general south-easterly direction for a distance of c.135m. It runs long the northern boundary of an undulating, well drained, agricultural pasture with a gentle east facing slope. A stream runs along the northeastern boundary. *Site 52 - Ringfort* is immediately adjacent to this northern boundary and the UWF Grid Connection passes within the zone of notification for this RMP site. There are no obvious sign of the monument along the course of the UWF Grid Connection. Test excavations carried out by the author along the route of the UWF Grid Connection at this location revealed nothing of archaeological significance.

S029

At this point the UWF Grid Connection crosses a small stream. This stream is a tributary of the Small River, which in turn is a tributary of the Mucklear River. There is no evidence of a bridge or other structure at the crossing point. This section of the UWF Grid Connection runs through an area of natural woodland.

S030

Section 030 of the UWF Grid Connection runs in a general easterly direction for a distance of 126m. It runs along the southern boundary of a moderately well drained agricultural pasture. The field is on all sides by a bank, ditch and hedgerows. No features of archaeological significance were noted in the area.

S031

Section 031 of the UWF Grid Connection runs in a general easterly direction for a distance of 132m. It crosses a field of poorly drained marshland. The field is bound all sides by a bank and ditch. No features of archaeological significance were noted in the area.

S032/NR7

Section 032 of the UWF Grid Connection runs in a general easterly direction for a distance of 332m. It crosses a poorly drained agricultural pasture with a gentle northwest facing slope. The field was bound on all sides by ditches and hedgerows. No features of archaeological significance were noted in the area.

R004

At this point the UWF Grid Connection crosses public road L-6011-10 before entering a farm gate to the east. No features of archaeological significance were noted in the area.

S033

Section 033 of the UWF Grid Connection runs in a general easterly direction for a distance of 182m. It runs along an existing farm track which is along the southern boundary of a moderately well drained agricultural pasture. The field is bound on all sides by a hedgerows and ditches. No features of archaeological significance were noted in the area.

S034/NR8

Section 034 of the UWF Grid Connection runs in a general southeasterly direction along the northern boundary of a moderately well drained before turning south along the eastern boundary for a total distance of 268m. The field is bound to the east by the mature cultivated forestry and on all other sides by a bank and ditch. The First Edition Ordnance Survey shows a Lime Kiln located in this field c.93m southwest of the UWF Grid Connection. The area is overgrown and the extent to which this site survives was difficult to ascertain during the field visit. No other features of archaeological significance were noted in the area.

S035

Section 035 of the UWF Grid Connection runs in a general southwesterly direction for a distance of 144m along the eastern boundary of a moderately well drained pasture with occasional, poorly-drained reed covered patches. The field is bound to the east by the mature cultivated forestry and on all other sides by a bank and ditch. No features of archaeological significance were noted in the area.

S036

Section 036 of the UWF Grid Connection runs in a general southerwesterly direction for a distance of 79m along the eastern boundary of a moderately well-drained pasture with occasional, poorly-drained reed covered patches. The field is bound to the east by the mature cultivated forestry and on all other sides by a bank and ditch. No features of archaeological significance were noted in the area.

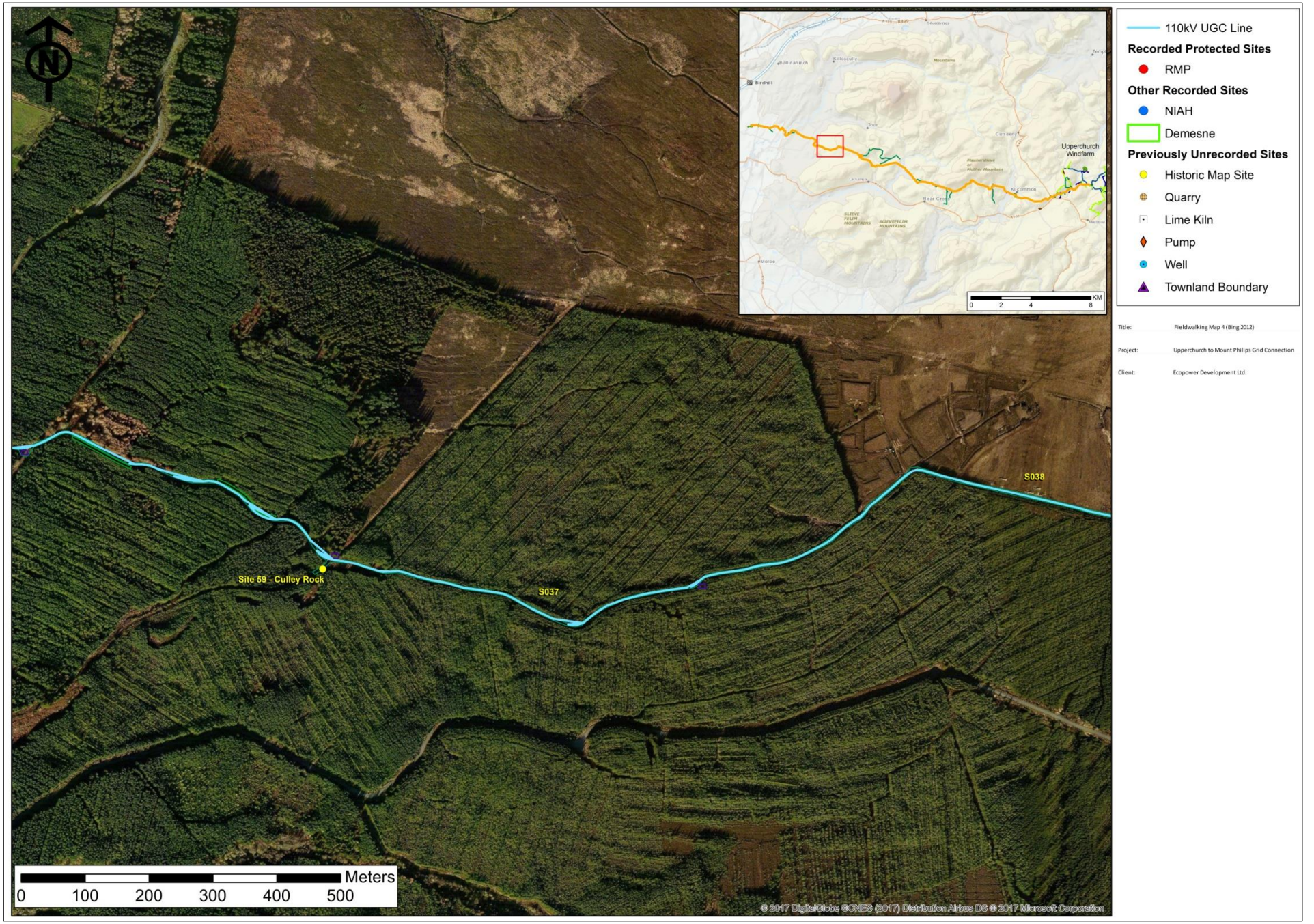


Figure 16: Fieldwalking Map 4 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

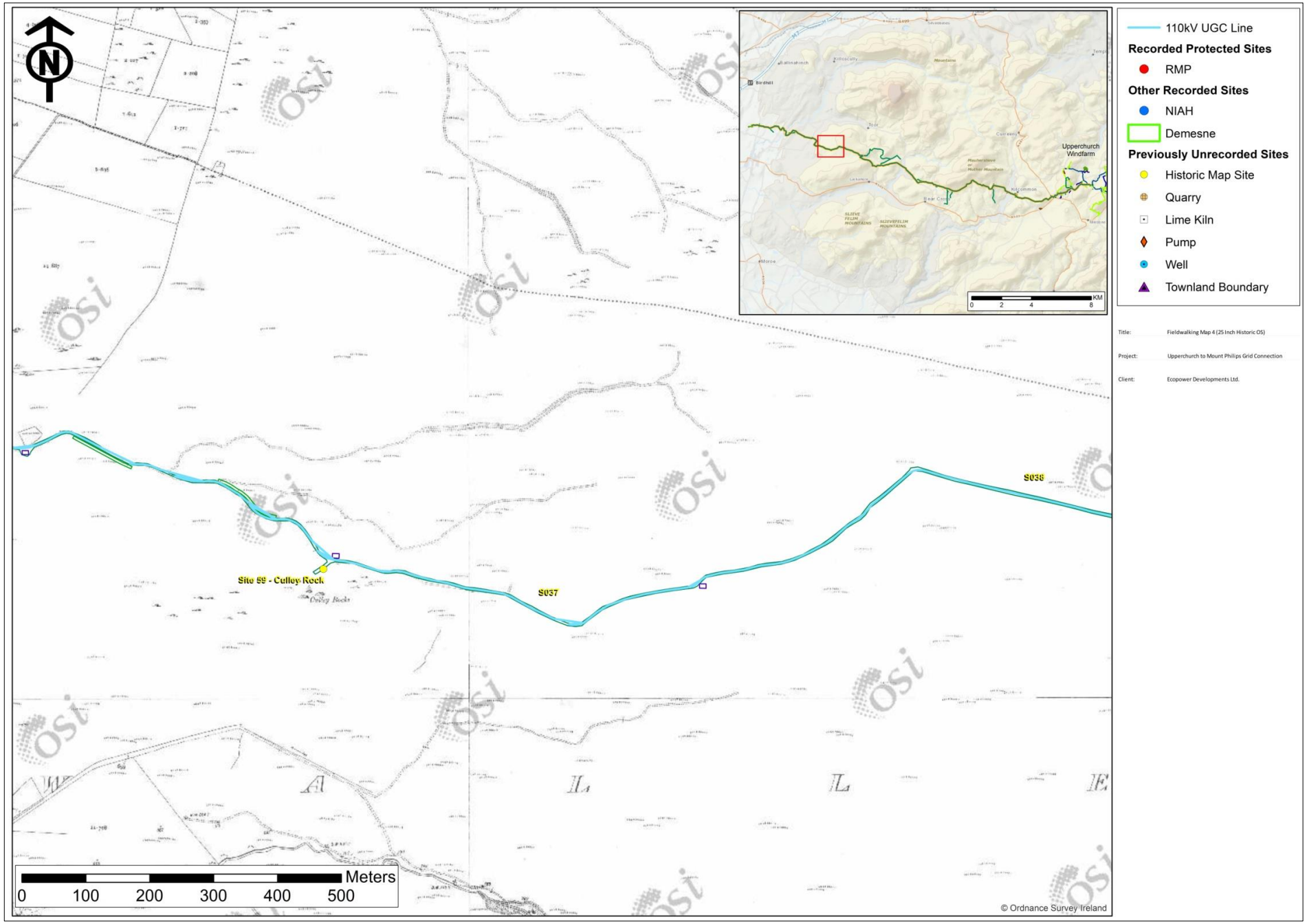


Figure 17: Fieldwalking Map 4 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S037

Section 037 of the UWF Grid Connection runs in a general easterly direction for a distance of 1.73km. It runs along an existing forestry road through an area of mature cultivated forestry. No features of archaeological significance were noted in the area.

S038

Section 038 of the UWF Grid Connection runs in a general easterly direction for a distance of 498m. It runs along an existing forestry road to the north of an area of mature cultivated forestry. No features of archaeological significance were noted in the area.

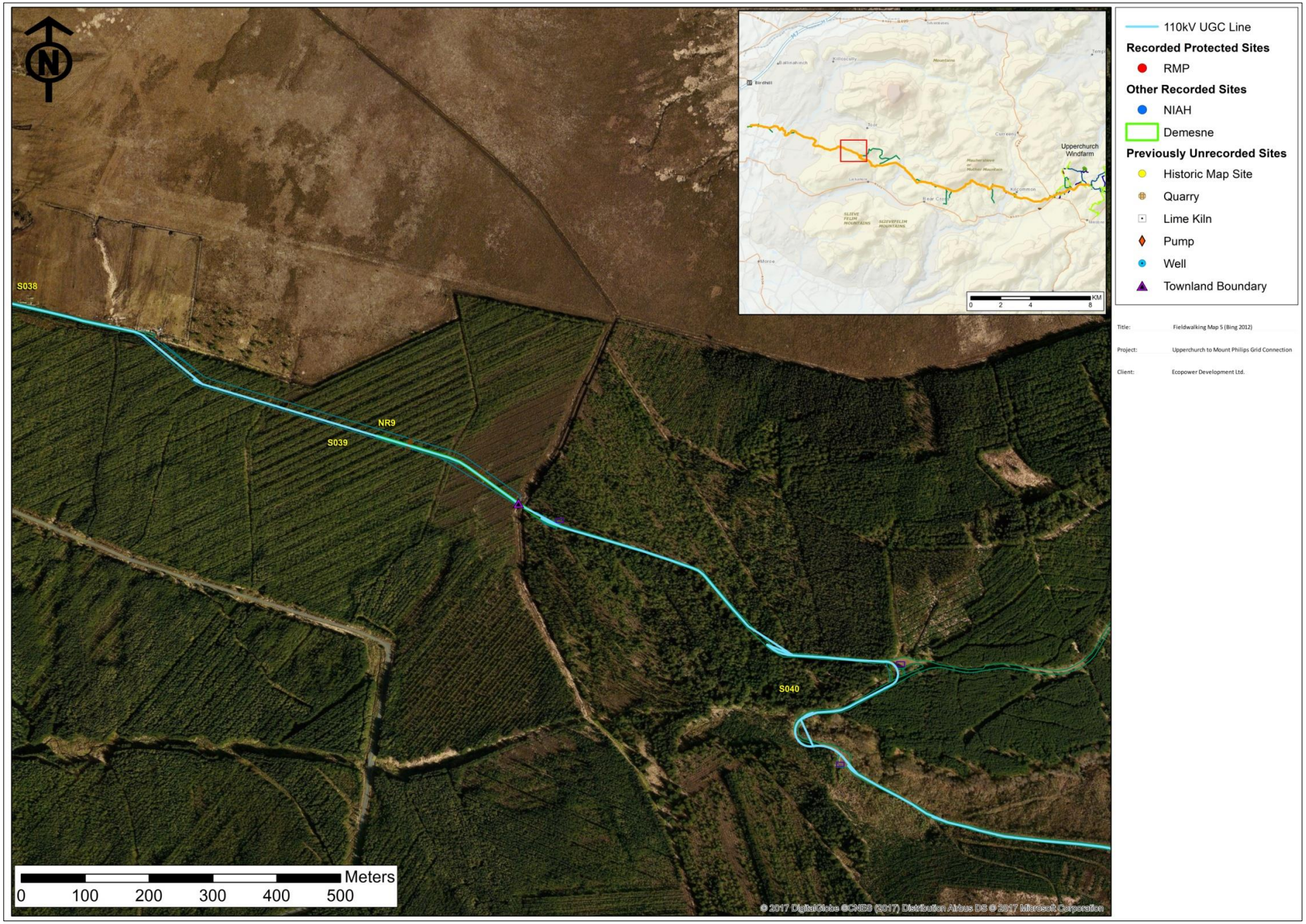


Figure 18: Fieldwalking Map 5 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

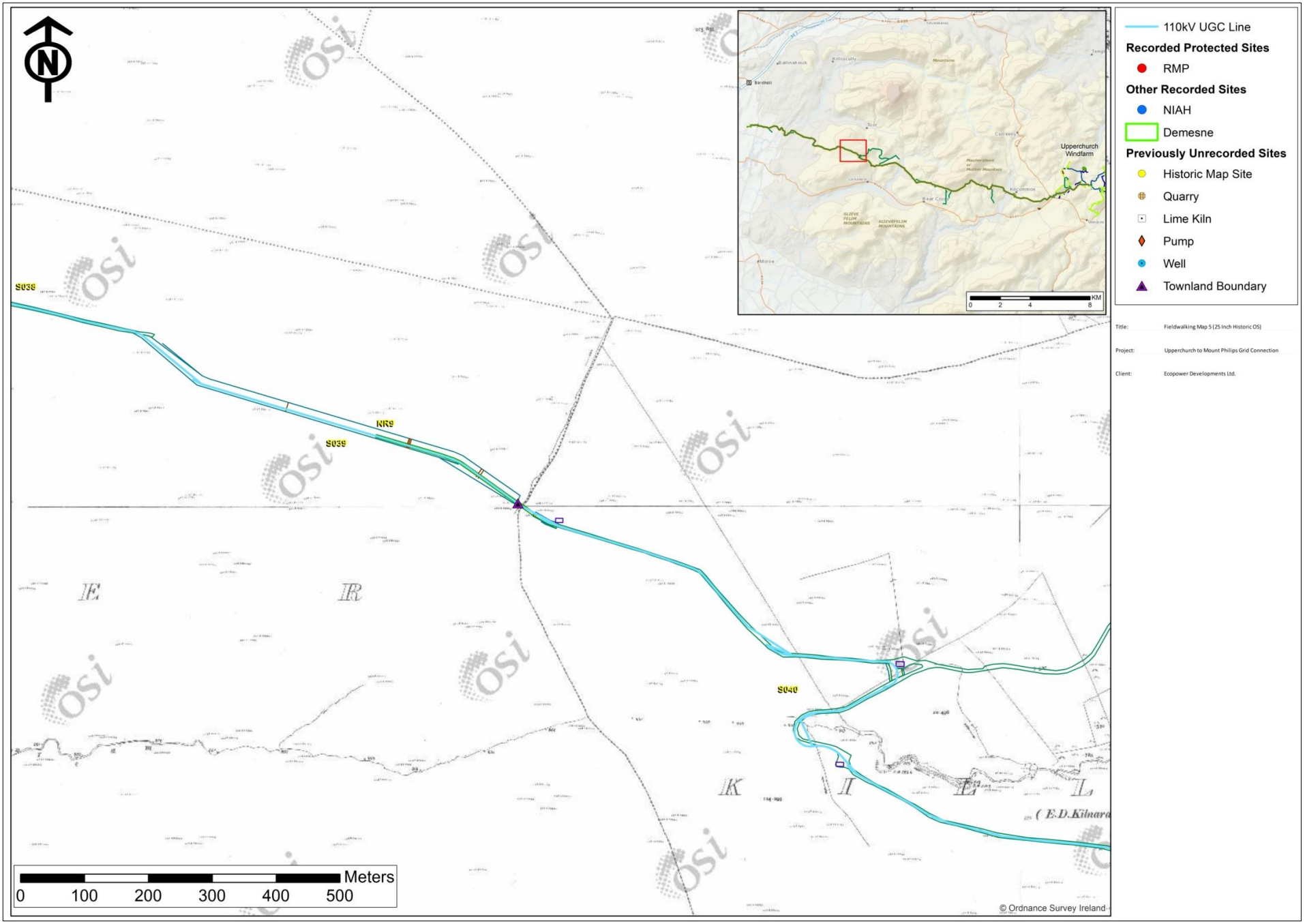


Figure 19: Fieldwalking Map 5 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S039/NR9

Section 039 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 730m. It runs through an area of mature cultivated forestry. At the eastern extent of this section the route passes over the townland boundary between Castlewaller and Killeen. No structural remains relating to this townland or any other features of archaeological significance were noted in the area.

S040

Section 040 of the UWF Grid Connection runs in a general easterly direction for a distance of 1.77km. It runs along existing forestry roads through an area of mature cultivated forestry. No features of archaeological significance were noted in the area.

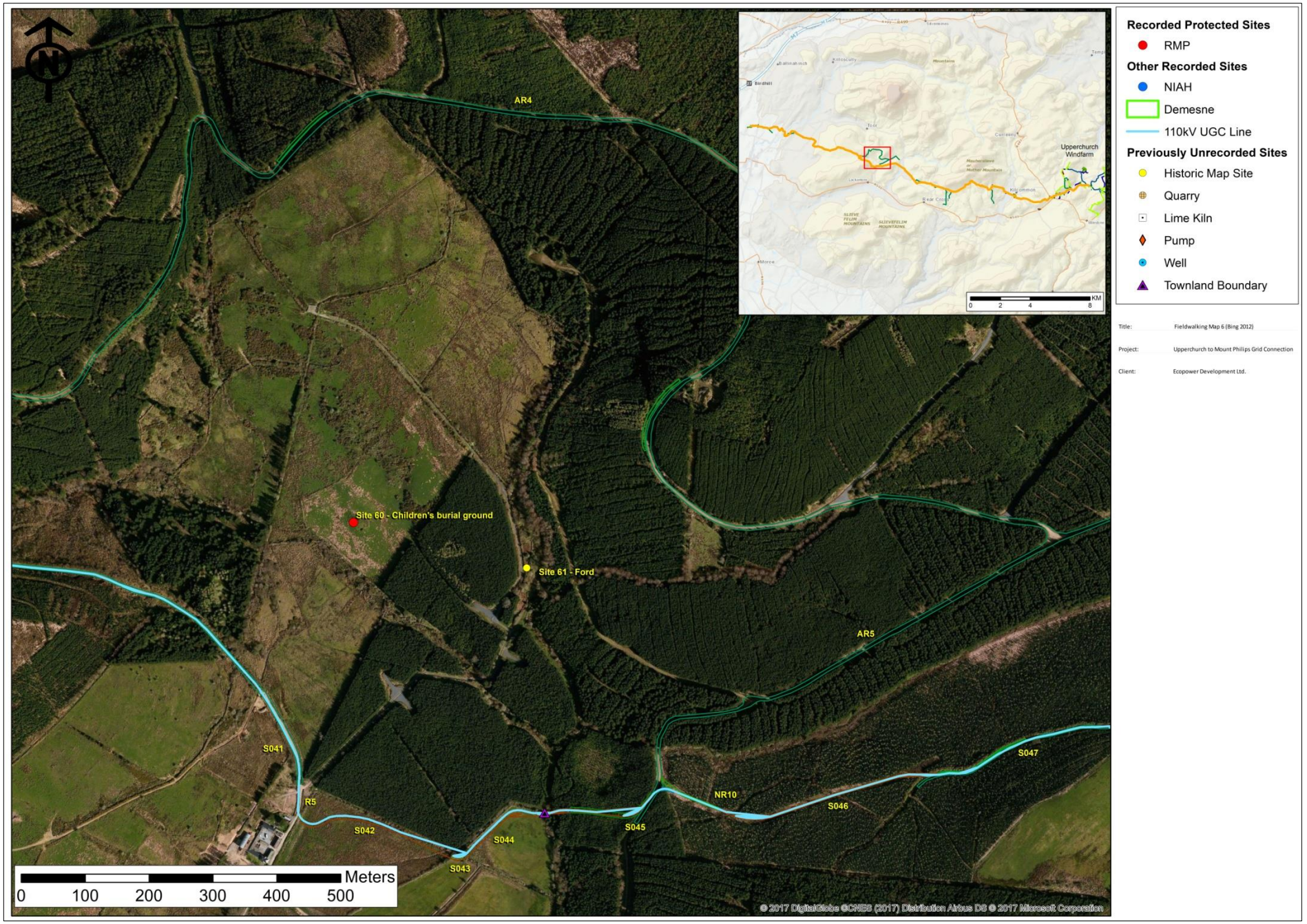


Figure 20: Fieldwalking Map 6 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

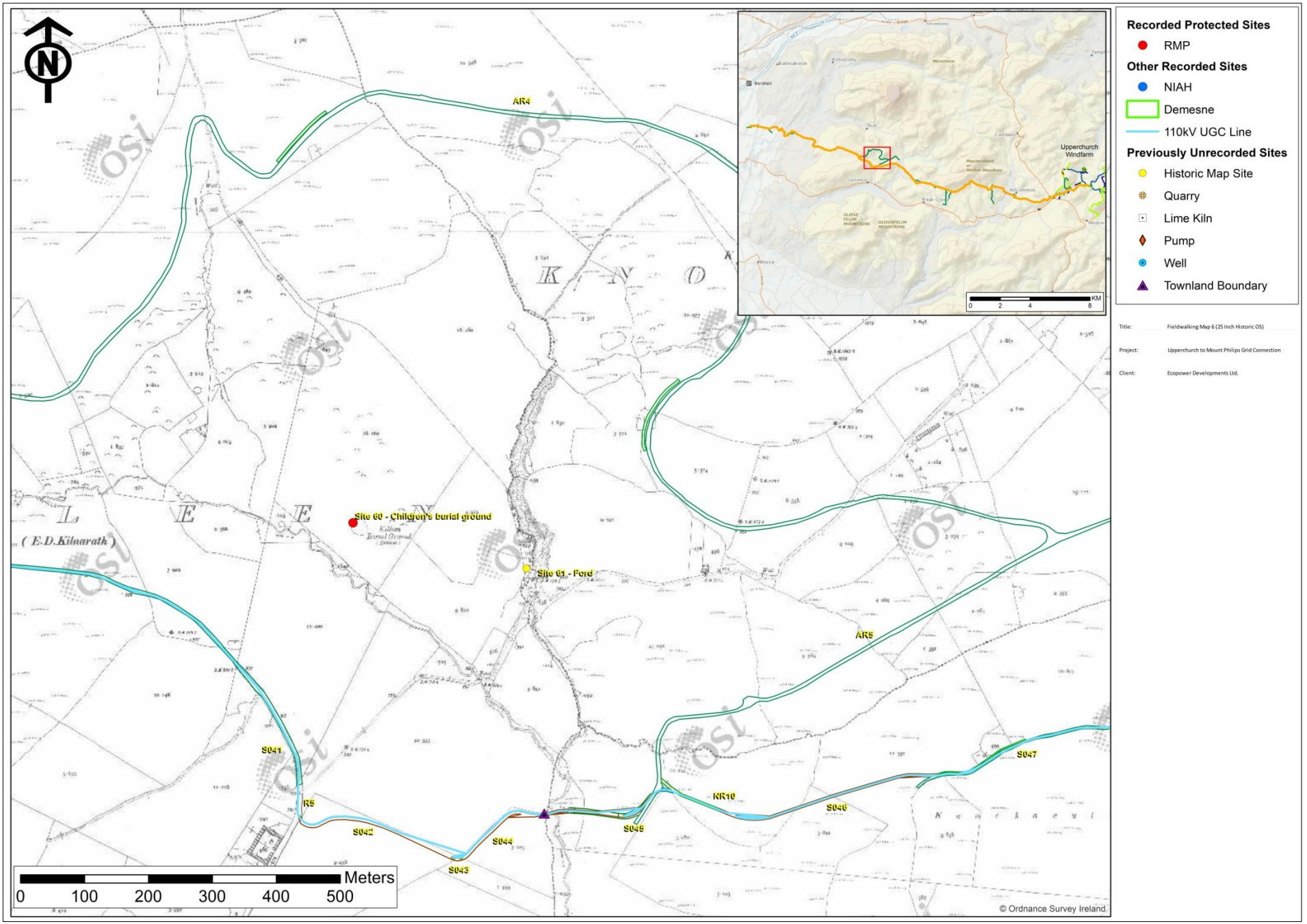


Figure 21: Fieldwalking Map 6 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S041
Section 041 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 182m along an existing farm track. No features of archaeological significance were noted in the area.

AR4, 5 and 6
These access roads follow existing forestry roads through an area of mature cultivated forestry. No features of archaeological significance were noted in the area.

R005
At this point the UWF Grid Connection runs along public road L-95032-8 before entering a field to the east. No features of archaeological significance were noted in the area.

S042
Section 042 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 259m. It crosses a poorly drained agricultural pasture. To the north is an area of mature cultivated forestry. No features of archaeological significance were noted in the area.

S043
Section 043 of the UWF Grid Connection runs in a general northeasterly direction through the northern most corner of a moderately well drained pasture field. The field is bound on all sides by a hedge and ditch. No features of archaeological significance were noted in the area.

S044
Section 044 of the UWF Grid Connection runs in a general north and then east direction for a distance of c.157m. This section runs along the west and northern verge of a well drained agricultural pasture with a gentle east facing slope. At the eastern end of this section the UWF Grid Connection passes over a small stream. No features of archaeological significance were noted in the area.

S045
Section 045 of the UWF Grid Connection runs in a general easterly direction for a distance of 181m along an existing forestry firebreak. Along this section of the route it crosses the townland boundary between Killeen and Knockacullin. No features of archaeological significance were noted in the area.

S046/NR10
Section 046 of the UWF Grid Connection crosses an existing forestry road (AR5) and runs in a general easterly direction for a distance of 445m along an existing forestry firebreak. No features of archaeological significance were noted in the area.

S047

Section 047 of the UWF Grid Connection runs in a general easterly direction for a distance of 384m along an existing forestry road. No features of archaeological significance were noted in the area.

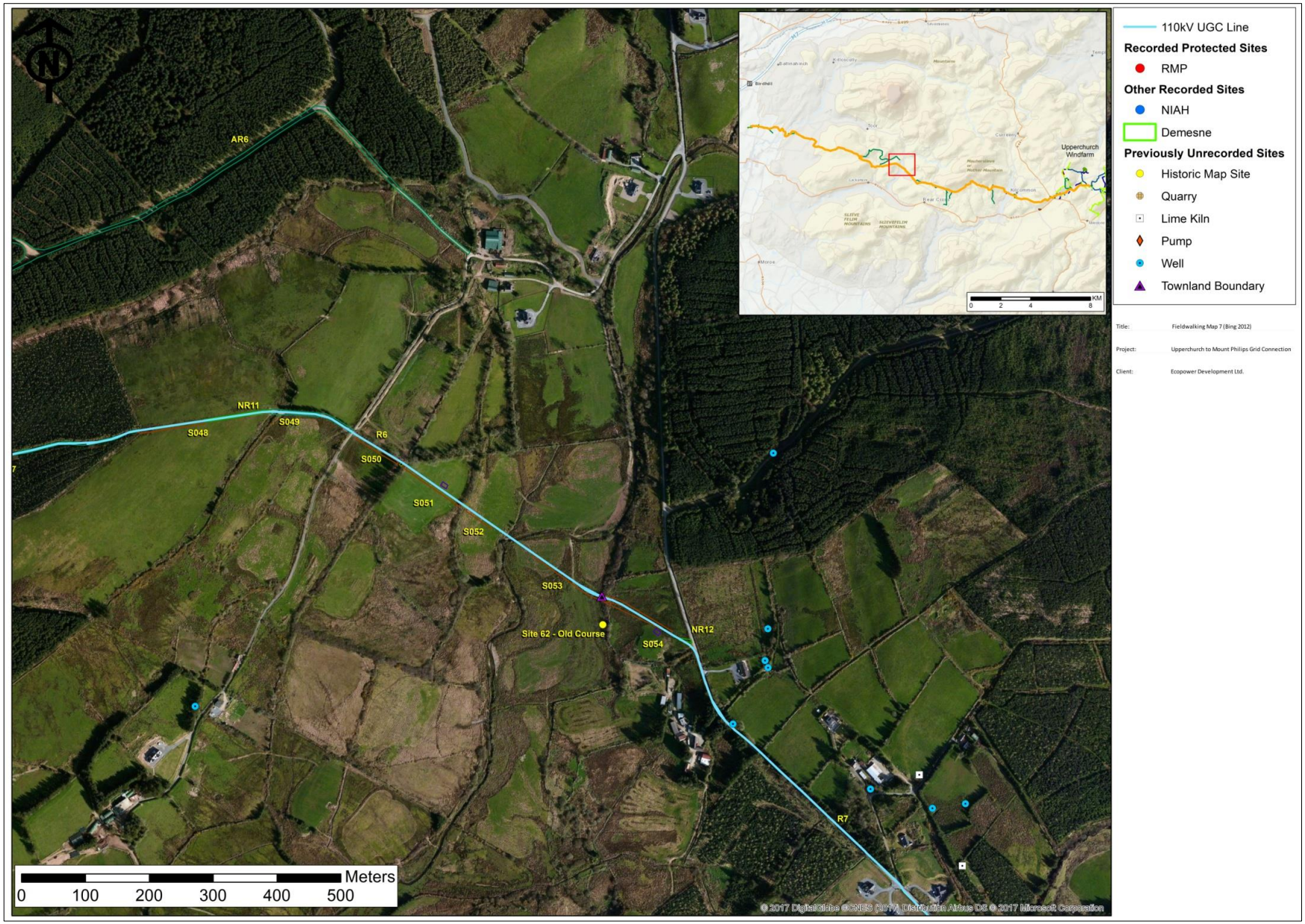


Figure 22: Fieldwalking Map 7 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

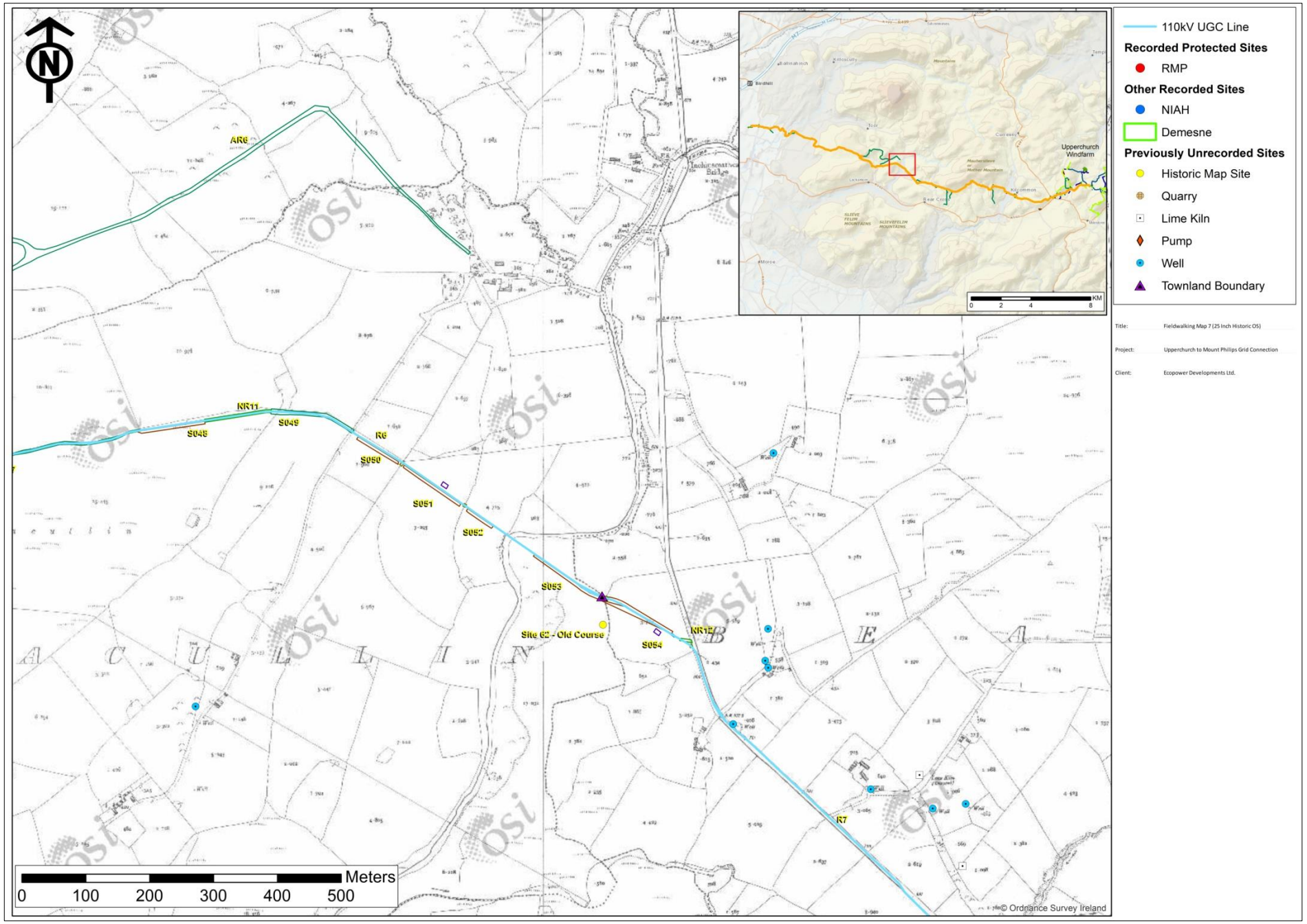


Figure 23: Fieldwalking Map 7 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S048/NR11

Section 048 of the UWF Grid Connection runs in a general easterly direction for a distance of 219m. It crosses a well drained agricultural pasture with a gentle northwest facing slope. No features of archaeological significance were noted in the area.

S049

Section 049 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 123m along an existing farm track through a well drained pasture before emerging and crossing a public road. No features of archaeological significance were noted in the area.

R006

At this point the UWF Grid Connection crosses the public road L-21141-0 before entering a field to the east. No features of archaeological significance were noted in the area.

S050

Section 050 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 88m. It crosses a moderately well drained agricultural pasture with a gentle east facing slope. The field is bound on all sides by ditch and hedges. No features of archaeological significance were noted in the area.

S051

Section 051 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 113m. It crosses a moderately well drained agricultural pasture with a gentle east facing slope. No features of archaeological significance were noted in the area.

S052

Section 052 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 91m. It crosses a poorly drained pasture with a moderate east facing slope. At the eastern extent of this section the UWF Grid Connection crosses the river Clare. No features of archaeological significance were noted in the area.

S053

Section 053 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 173m. It crosses a poorly drained pasture with a moderate west facing slope. At the eastern end of the section the UWF Grid Connection passes over the old course of the river Clare (*Site 62*), the townland boundary between Knockacullin and Bealaclave, as marked on the first edition Ordnance Survey. No features of archaeological significance were noted in the area.

S054/NR12

Section 054 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 157m. It crosses a poorly drained pasture with a gentle northwest

facing slope before joining a public road on the east boundary. No features of archaeological significance were noted in the area.

R007

At this point the UWF Grid Connection runs along public road L-2114-0 for a distance of 1.28km. Ditches and hedgerows run alongside the road. A well is show at the roadside on the 25 Inch Edition Ordnance Survey but no evidence of any surviving structure was visible during the field visit. At the south-eastern extent of this section the route turns eastwards and enters an adjoining field gate. No features of archaeological significance were noted in the area.

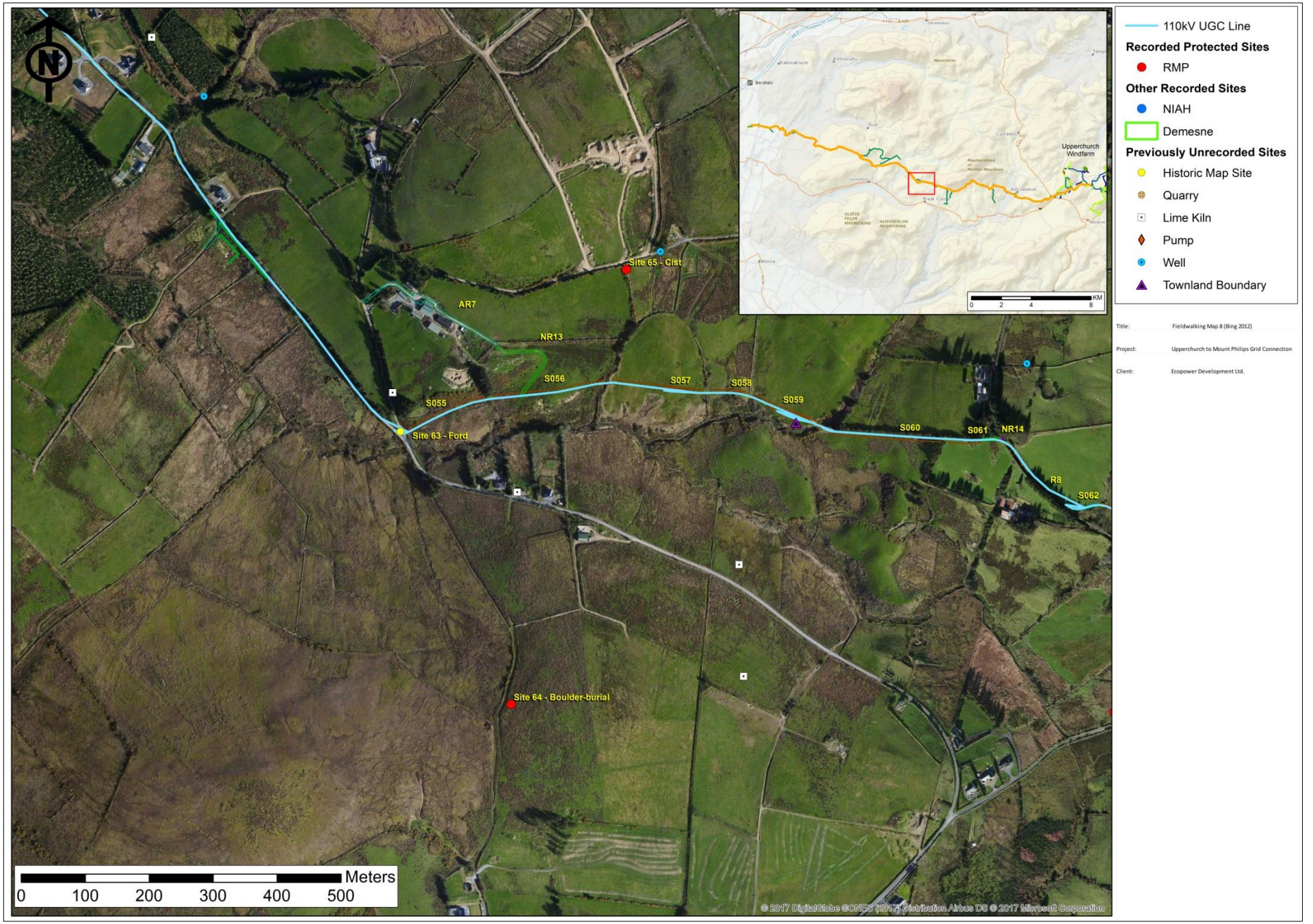


Figure 24: Fieldwalking Map 8 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

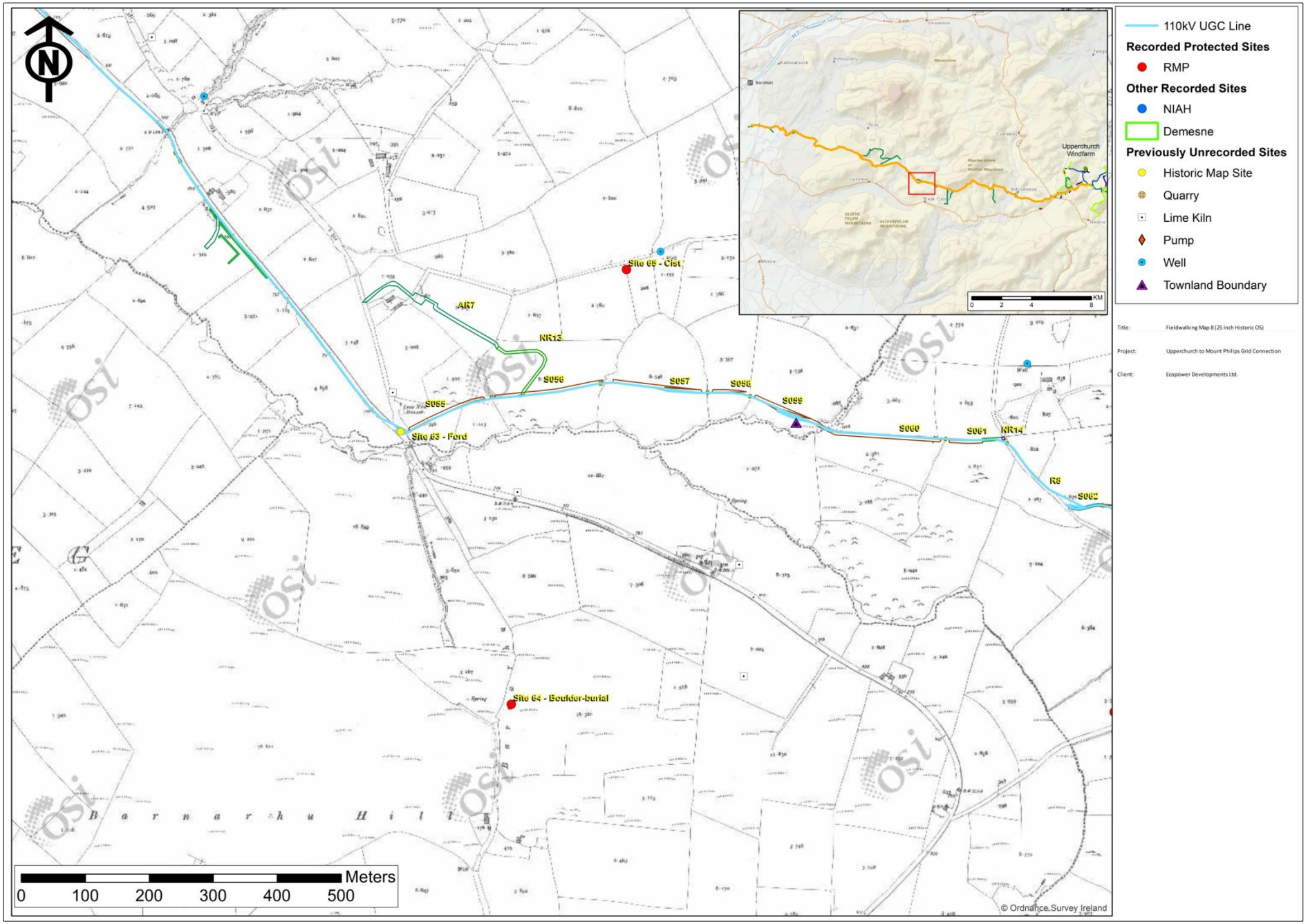


Figure 25: Fieldwalking Map 8 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S055
Section 056 of the UWF Grid Connection runs in a general easterly direction for a distance of 145m. It crosses an area of poorly drained marshland with a moderate south facing slope. No features of archaeological significance were noted in the area.

S056/NR13/AR6
Section 056 of the UWF Grid Connection runs in a general easterly direction for a distance of 180m. It crosses an area of moderately well-drained pasture with a gentle south facing slope. No features of archaeological significance were noted in the area.

S057
Section 057 of the UWF Grid Connection runs in a general easterly direction for a distance of 158m. It crosses a moderately well drained agricultural pasture with a gentle south facing slope. No features of archaeological significance were noted in the area.

S058
Section 058 of the UWF Grid Connection runs in a general easterly direction for a distance of 70m. It crosses a poorly drained agricultural pasture with frequent reedy patches and earth and stone boundaries. To the south a narrow stream runs east to west. No features of archaeological significance were noted in the area.

S059
Section 059 of the UWF Grid Connection runs in a general easterly direction for a distance of 118m. It crosses a moderately poorly drained agricultural pasture with frequent reedy patches and earth and stone boundaries. To the south a narrow stream runs east to west. This stream acts as a townland boundary between Bealaclave and Buarnadomeen. No features of archaeological significance were noted in the area.

S060
Section 060 of the UWF Grid Connection runs in a general easterly direction for a distance of 201m. It crosses a poorly drained pasture with a gentle south facing slope. No features of archaeological significance were noted in the area.

S061/NR14
Section 061 of the UWF Grid Connection runs in a general easterly direction for a distance of 97m. It crosses a moderately well drained agricultural pasture with a gentle south facing slope. The field is bound on all sides by a bank and ditch. At the eastern extent of this section the route joins up with the public road R008. No features of archaeological significance were noted in the area.

R008
At this point the UWF Grid Connection runs along public road L-6085-0 for a distance of 160m. Ditches and hedgerows run alongside the road. At the south-eastern extent

of this section the route turns eastwards and enters an adjoining field. No features of archaeological significance were noted in the area.

S062

Section 062 of the UWF Grid Connection runs along the southern boundary of a well drained agricultural pasture. The field is bound on all sides by a bank and ditch. No features of archaeological significance were noted in the area.

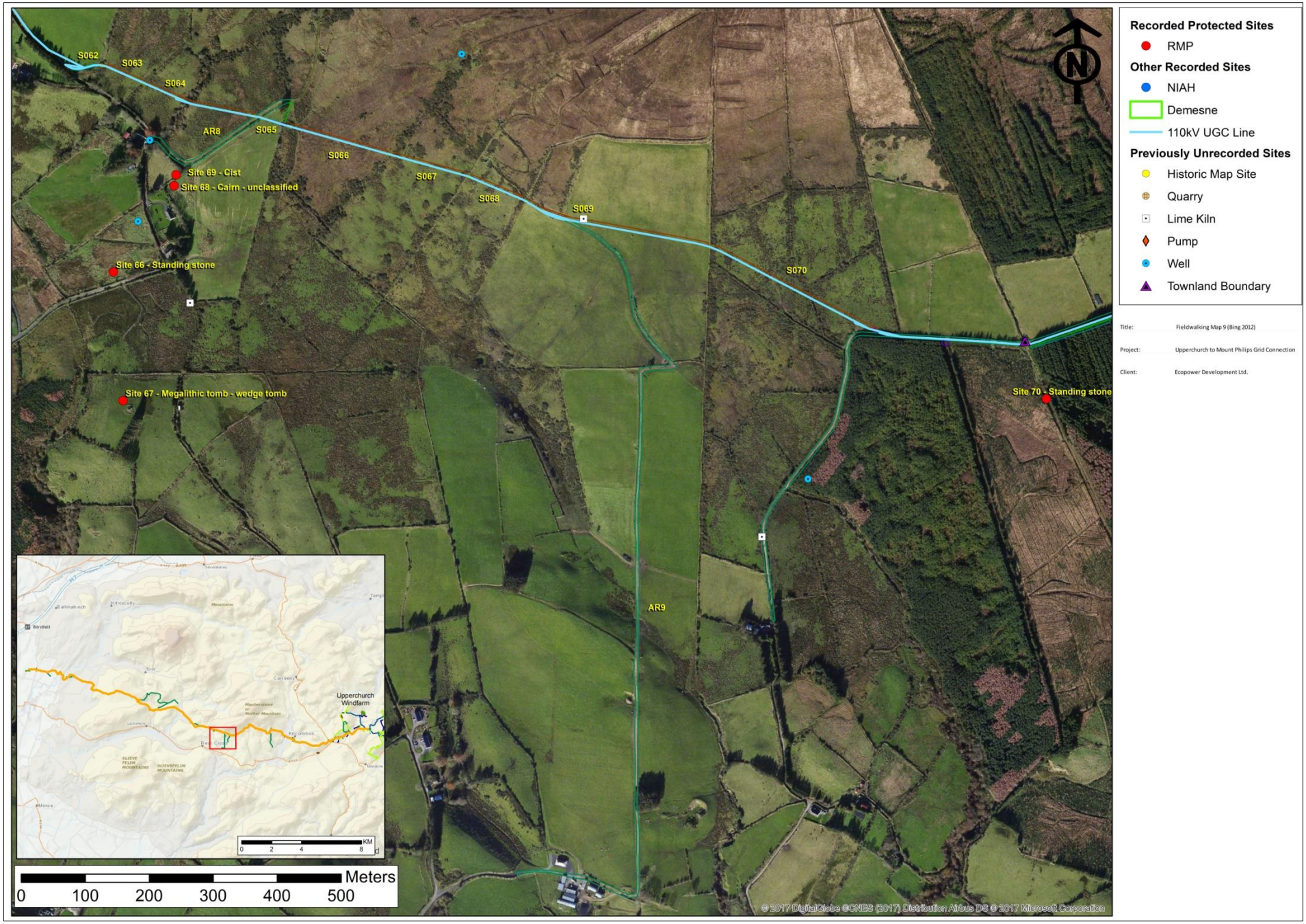
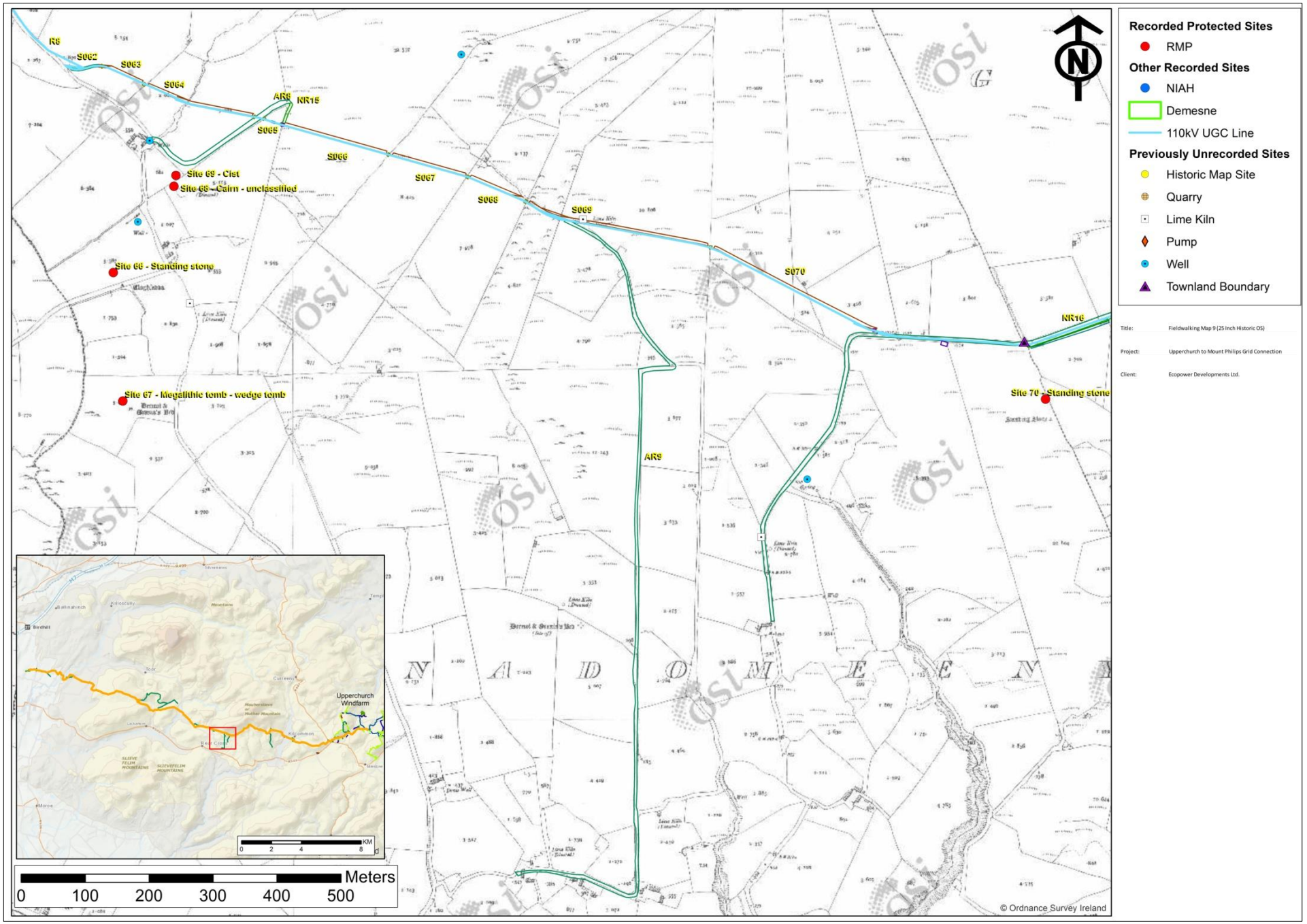


Figure 26: Fieldwalking Map 9 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS



REFERENCE DOCUMENTS

Figure 27: Fieldwalking Map 9 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S063

Section 063 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 142m. It crosses a poorly drained agricultural pasture with a gentle southwest facing slope. The field is bound on all sides by bank and ditch and to the east by wire and post fencing. No features of archaeological significance were noted in the area.

S064

Section 064 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 116m. It crosses a poorly drained agricultural pasture with a gentle southwest facing slope. The field is bound on all sides by bank and ditch. It is also subdivided by wire and post fencing. No features of archaeological significance were noted in the area.

S065/AR8/NR15

Section 065 of the UWF Grid Connection runs in a general easterly direction for a distance of 38m. It crosses a moderately well agricultural pasture with a gentle southwest facing slope. The field is bound on all sides by bank and ditch. No features of archaeological significance were noted in the area.

S066

Section 066 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 173m. It crosses a poorly drained marshland with a moderate south-west facing slope. The field is bound on all sides by earth and stone bank and ditch. It is also subdivided by wire and post fencing. No features of archaeological significance were noted in the area.

S067

Section 067 of the UWF Grid Connection runs in a general south easterly direction for a distance of 127m. It crosses a poorly drained agricultural pasture with a moderate southwest facing slope. No features of archaeological significance were noted in the area.

S068

Section 068 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 102m. It crosses a poorly drained agricultural pasture with a moderate southwest facing slope. No features of archaeological significance were noted in the area.

S069

Section 069 of the UWF Grid Connection runs in a general easterly direction for a distance of 299m. It crosses a well drained agricultural pasture with a moderate south-facing slope. The field is bound on all sides by an earth and stone bank and ditch. A lime kiln is shown on the 25 Inch Ordnance Survey c.10m to the south of this section. No other features of archaeological significance were noted in the area.

AR9

Access Road 9 runs in a general northerly direction along an existing farm road. No features of archaeological significance were noted in the area.

S070

Section 070 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 289m. It crosses a poorly drained marshland with a moderate south facing slope. Several drains, possibly representing former field boundaries, as shown on the 25 Inch Ordnance Survey run across this section of the UWF Grid Connection. No features of archaeological significance were noted in the area.

S071/NR16

Section 071 of the UWF Grid Connection runs in a general easterly direction for a distance of 960m. It follows an existing farm/forestry track. A large area of cultivate forestry is located to the south of this road. To the north is an area of field and marshland. The road passes through the townland boundary between Buarnadomeen and Goulmore. *Site 70 - Standing Stone* is located c.87m south of the UWF Grid Connection. The area in which it is located is covered in mature cultivated forestry and the exact site of the stone could not be ascertained. No features of archaeological significance were noted along the route of the UWF Grid Connection.

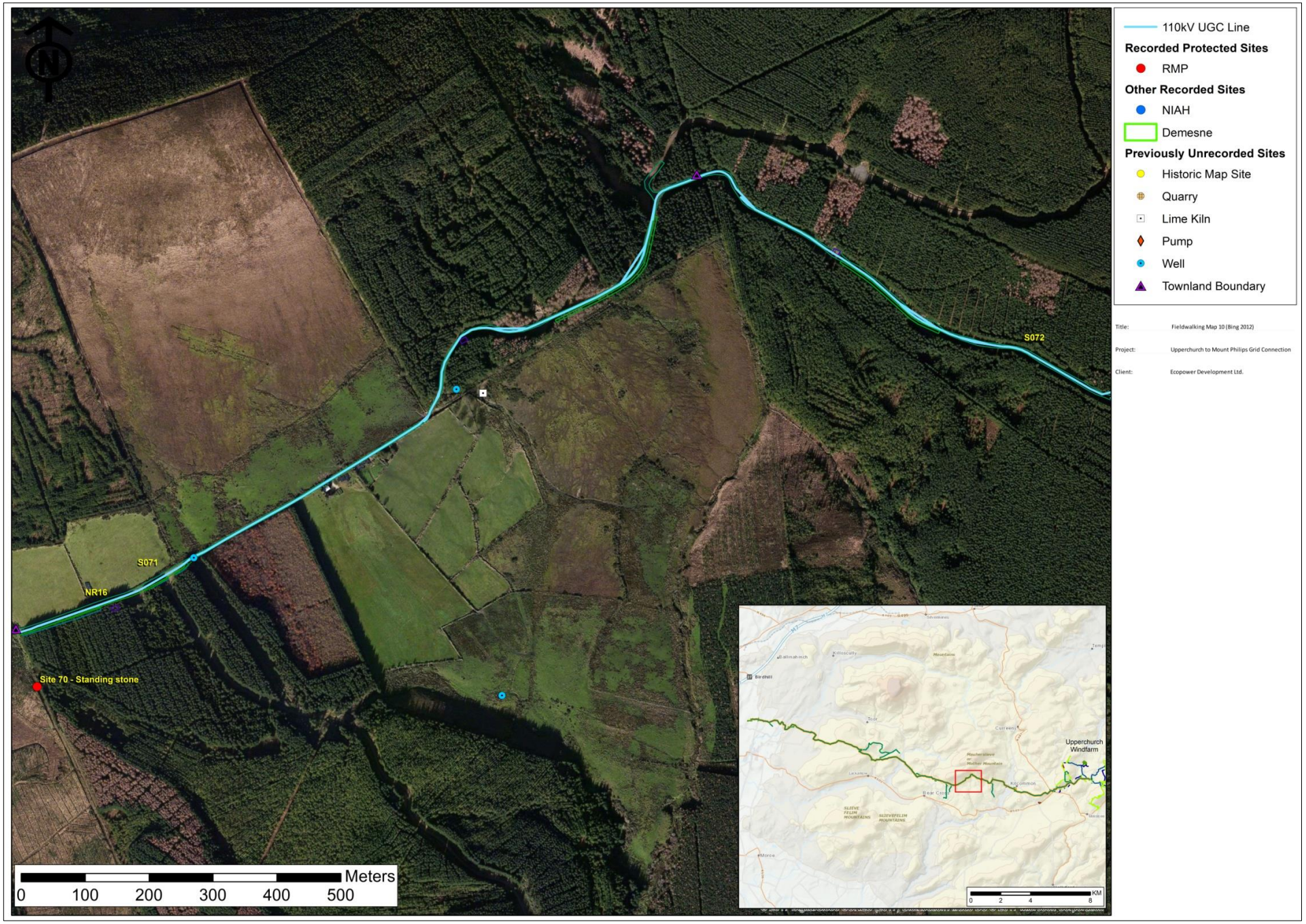


Figure 28: Fieldwalking Map 10 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

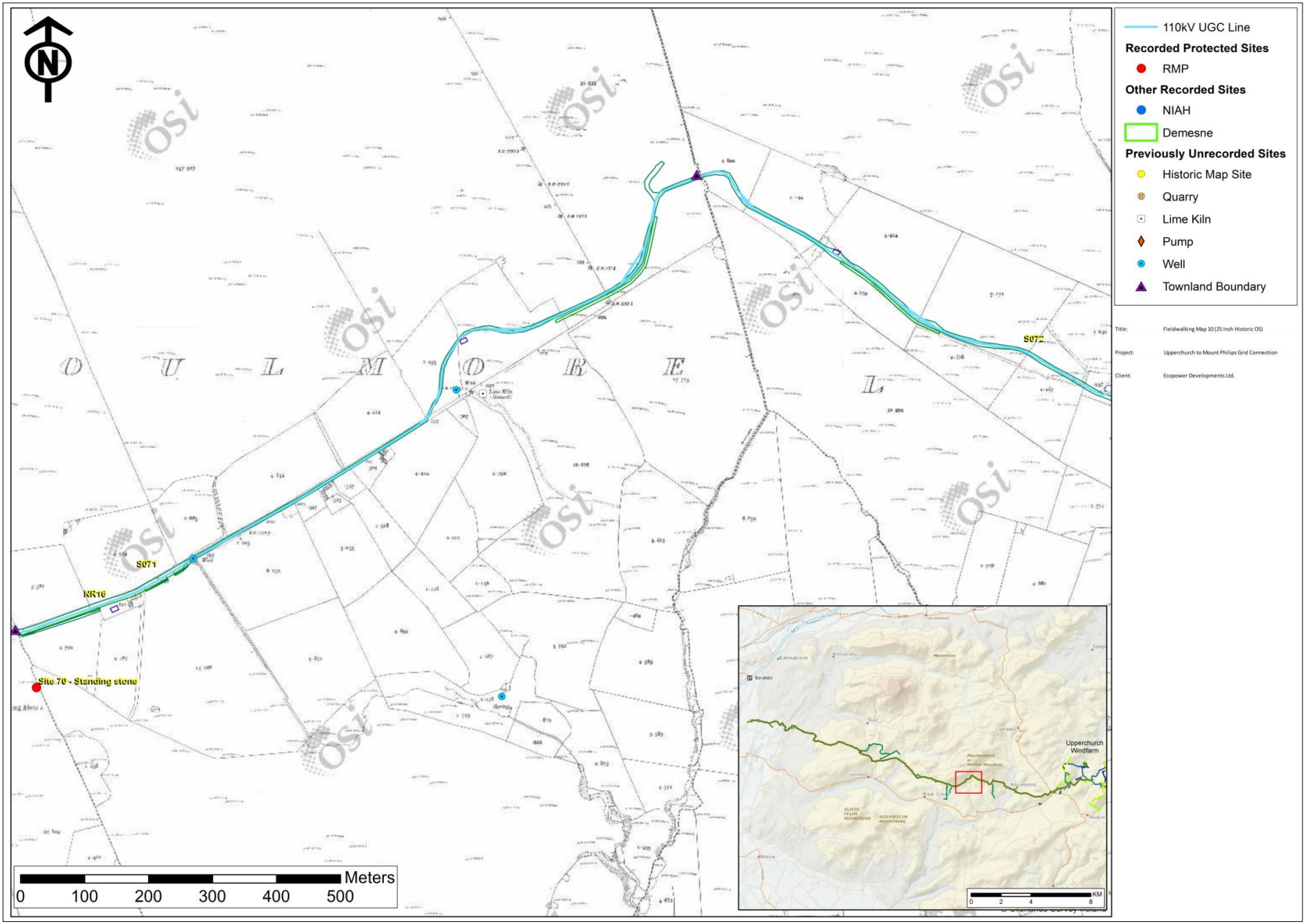


Figure 29: Fieldwalking Map 10 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S072/NR17

Section 072 of the UWF Grid Connection runs in a general easterly direction for a distance of 2.38km along an existing forestry track. The track passes by the townland boundary between Goulmore and Laghile. No features of archaeological significance were noted in the area.

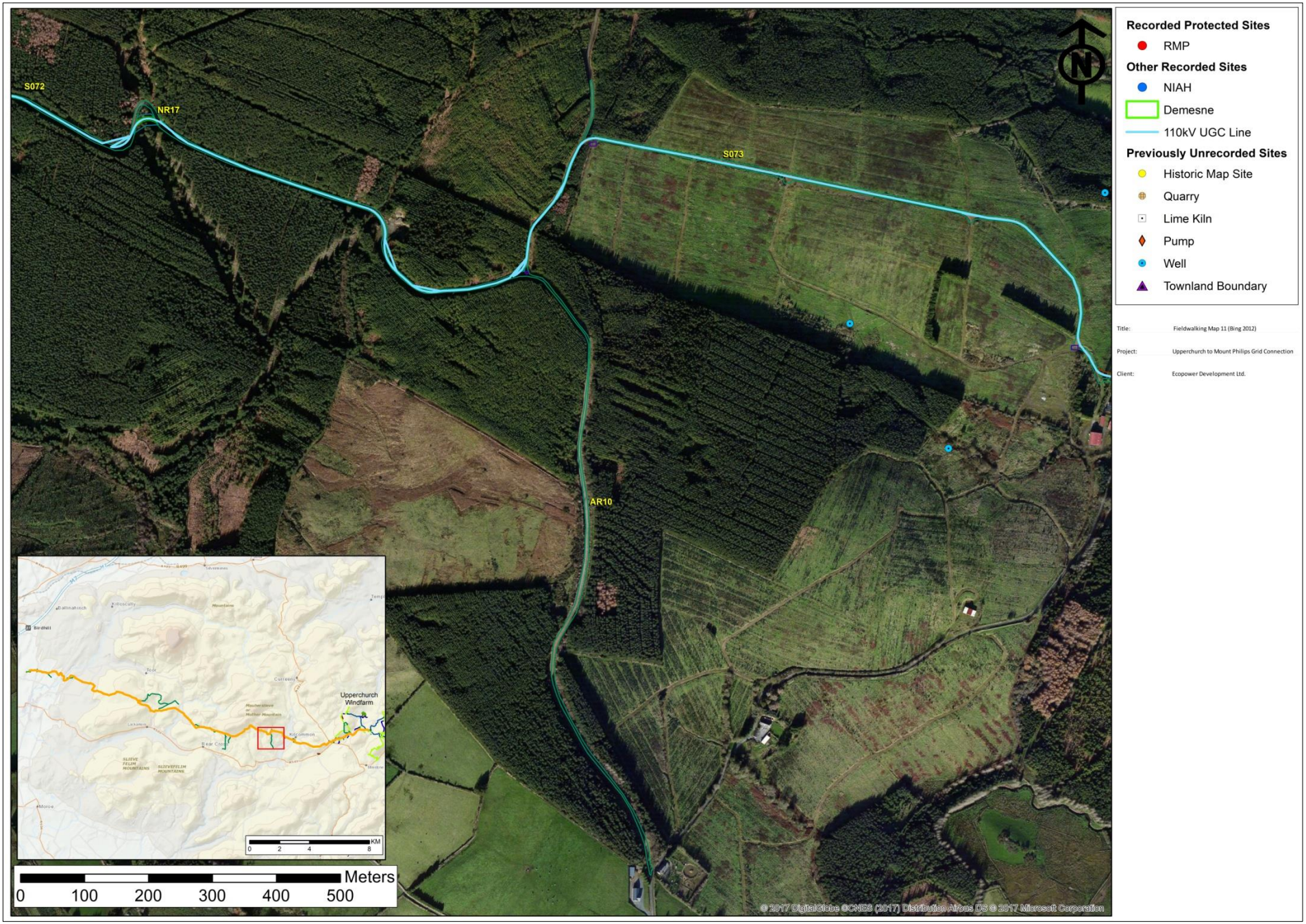


Figure 30: Fieldwalking Map 11 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

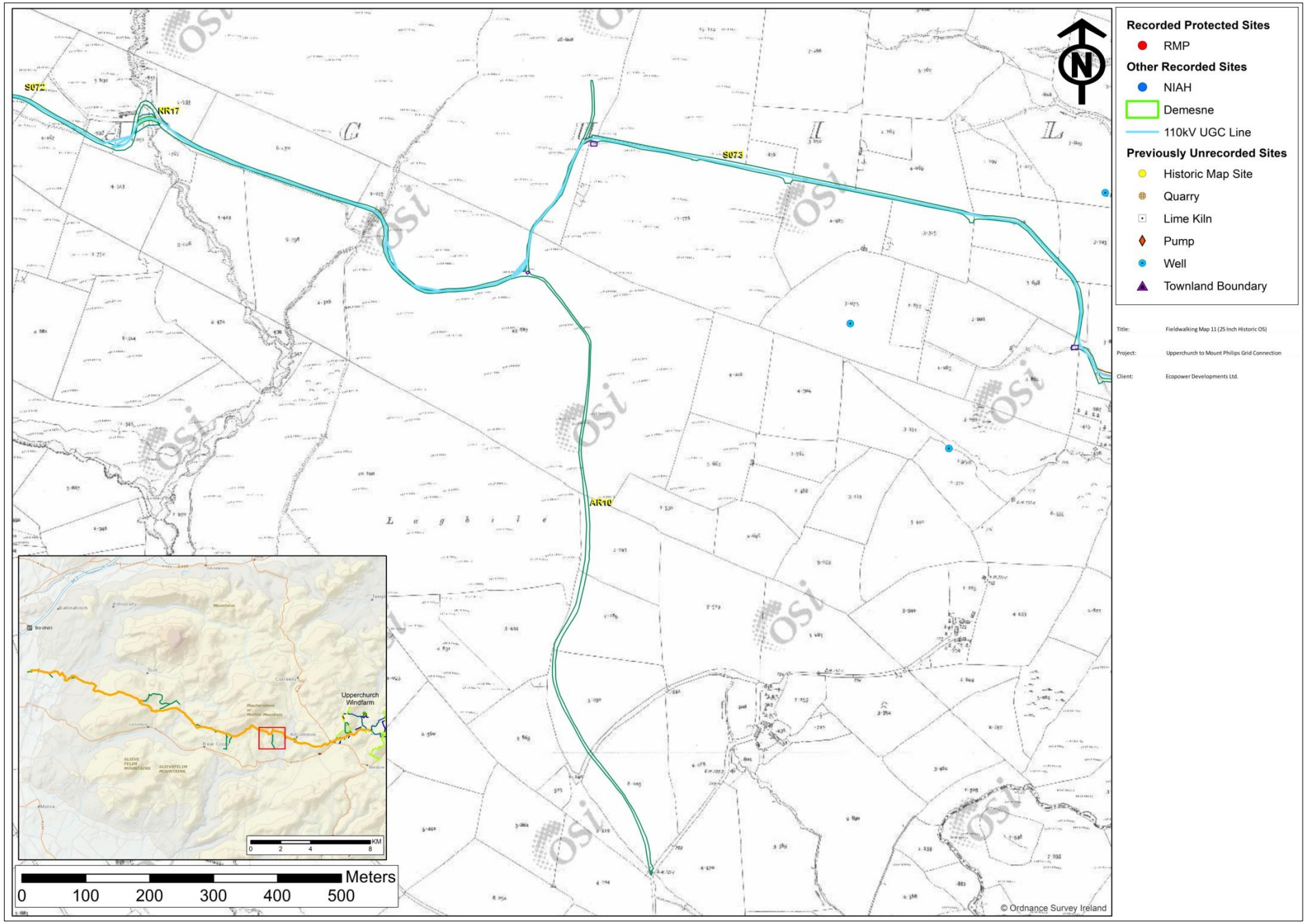


Figure 31: Fieldwalking Map 11 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

AR10

Access Road 10 runs along an existing forestry path in a northerly direction through an area of dense mature forestry. No features of archaeological significance were noted in the area.

S073

Figure 32: S073 from the southeast

Section 073 of the UWF Grid Connection runs in a general easterly direction for a distance of 1021m along an existing forestry track. The route is surrounded by recently felled and young forestry. No features of archaeological significance were noted in the area.

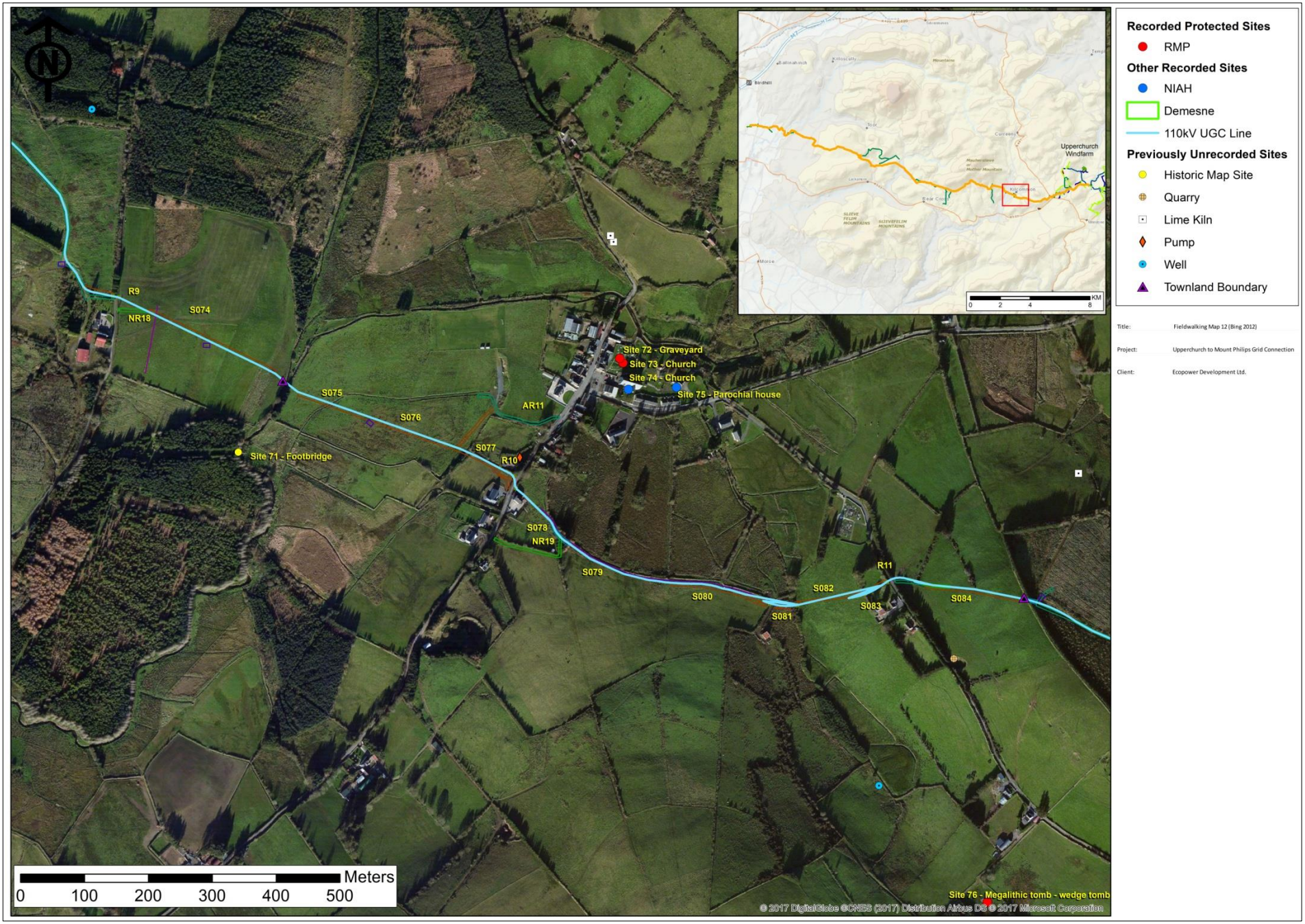


Figure 33: Fieldwalking Map 12 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

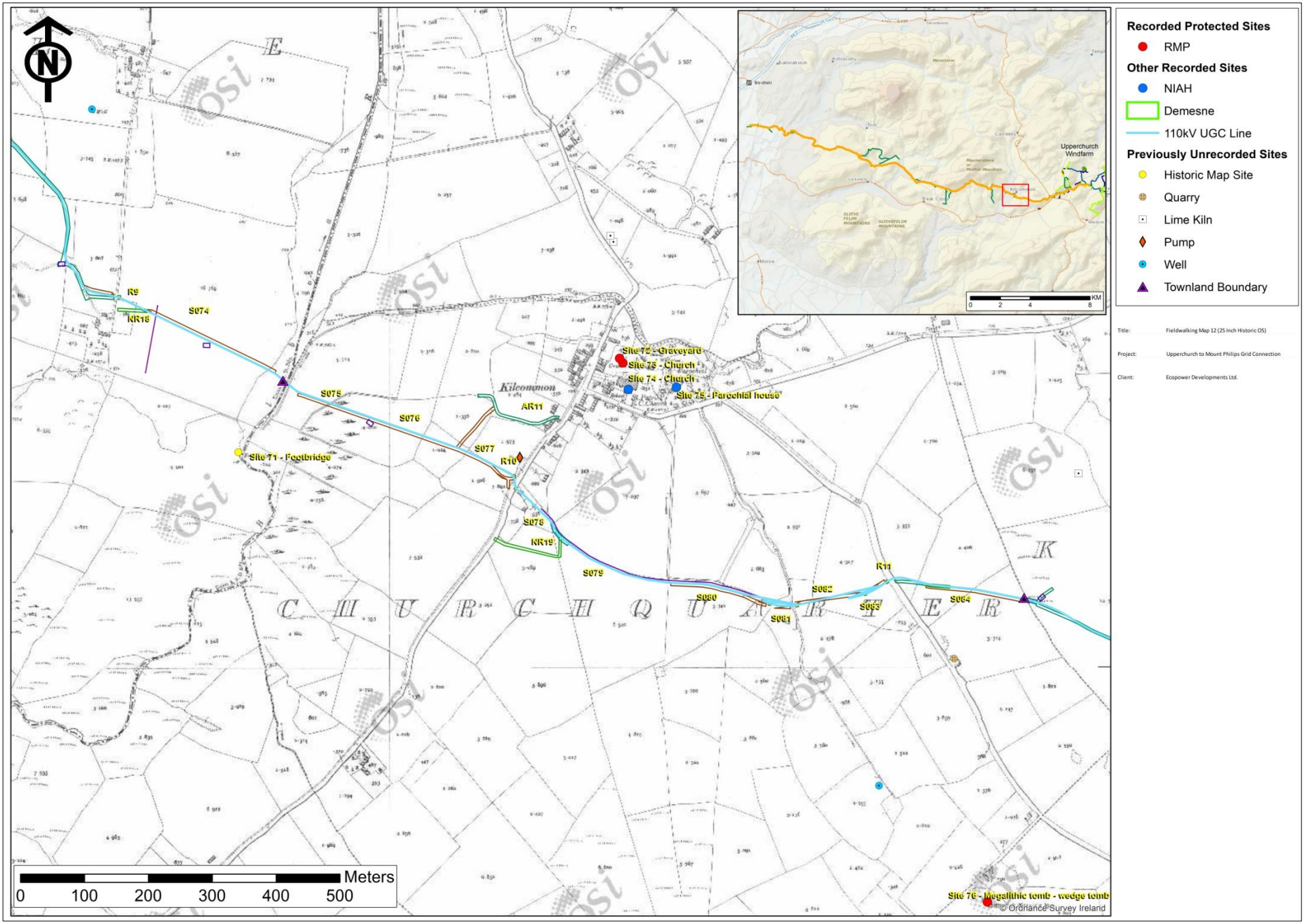


Figure 34: Fieldwalking Map 12 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

R009

At this point the UWF Grid Connection crosses the public road L-6086-5. No features of archaeological significance were noted in the area.

Figure 35: S074 from the west

S074/NR18

Section 074 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 302m. It crosses a well drained agricultural pasture with a gentle east facing slope. The pasture has been subdivided by wire and post fencing. No features of archaeological significance were noted in the area.

S075

At this point the UWF Grid Connection crosses the Bilboa River (which acts as the townland boundary between Laghile and Churchquarter) and runs in a general southeasterly direction for a distance of 61m. It crosses a moderately well drained agricultural pasture with a gentle easting facing slope. No features of archaeological significance were noted in the area.

S076

Section 076 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 230m. It crosses two narrow drains in an otherwise well drained agricultural pasture. No features of archaeological significance were noted in the area.

AR11

Access Road 11 passes through a flat pasture to the west of Kilcommon village. No features of archaeological significance were noted in the area.

Figure 36: S077 from the east

S077

Section 077 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 81m. It crosses an area of open ground to the north of a residential property before emerging onto public road L-2266-0. No features of archaeological significance were noted in the area.

R010

At this point the UWF Grid Connection crosses the public road L-2266-0 to the south of Kilcommon. No features of archaeological significance were noted in the area.

S078

Section 078 of the UWF Grid Connection runs in a general south-easterly direction before turning easterly for a distance of 110m. It crosses a moderately well drained agricultural pasture with a gentle south facing slope. The field is bound on all other sides by a combination of hedgerows, stone and earth banks, and ditches. No features of archaeological significance were noted in the area.

NR19/S079

Section 079 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 170m. It crosses a moderately well drained agricultural pasture with a gentle northwest facing slope. The field is bound on all other sides by a combination of hedgerows, stone and earth banks, and ditches. No features of archaeological significance were noted in the area.

S080

Section 080 of the UWF Grid Connection runs in a general south-easterly direction for a distance of 163m. It runs along the northern boundary of a well drained agricultural pasture with a gentle northwest facing slope. The field is bound to the north by a drain and on all other sides by a bank and ditch. No features of archaeological significance were noted in the area.

S081

Section 081 of the UWF Grid Connection runs in a general easterly direction for a distance of 39m. It crosses an area of poorly drained marshland with a gentle east facing slope. The field is bound by hedgerows and ditches. No features of archaeological significance were noted in the area.

S082

Section 082 of the UWF Grid Connection runs in a general easterly direction for a distance of 104m. It crosses a well drained agricultural pasture with a gentle east facing slope. The field is bound on all sides by earth and stone banks, hedgerows and ditch. No features of archaeological significance were noted in the area.

S083

Section 083 of the UWF Grid Connection runs in a general easterly direction for a distance of 41m. It crosses an area of well drained grassland north of a modern farmyard. No features of archaeological significance were noted in the area.

R011

At this point the UWF Grid Connection crosses the public road L-6182-0 before entering a pasture field to the east. No features of archaeological significance were noted in the area.

S084

Section 084 of the UWF Grid Connection runs in a general easterly direction for a distance of 215m. It crosses a well drained agricultural pasture with a gentle northwest facing slope. At the eastern extent of this section is passes through the townland boundary between Churchquarter and Knocknabansha. The boundary comprises of an earth and stone bank. No features of archaeological significance were noted in the area.

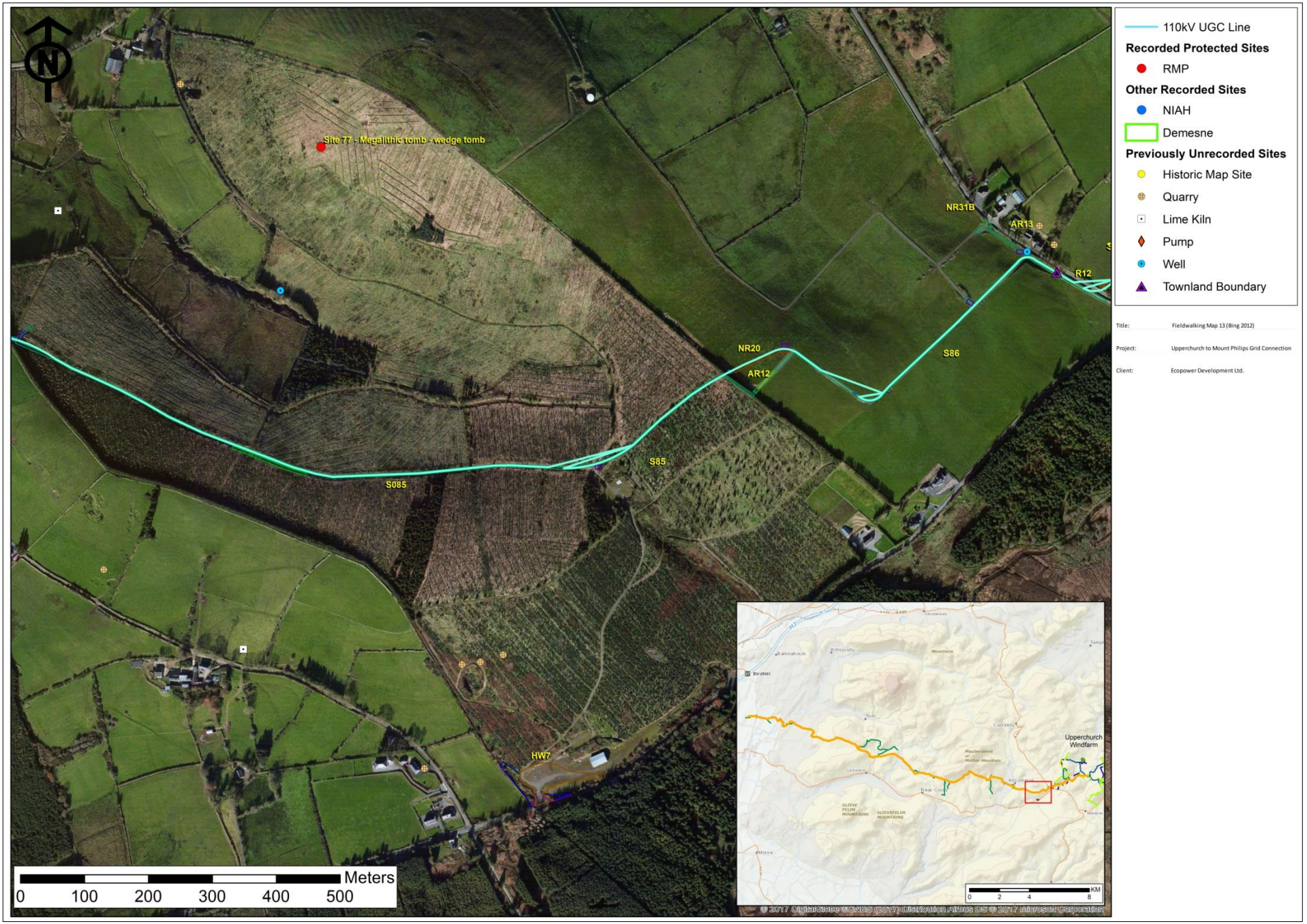


Figure 37: Fieldwalking Map 13 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

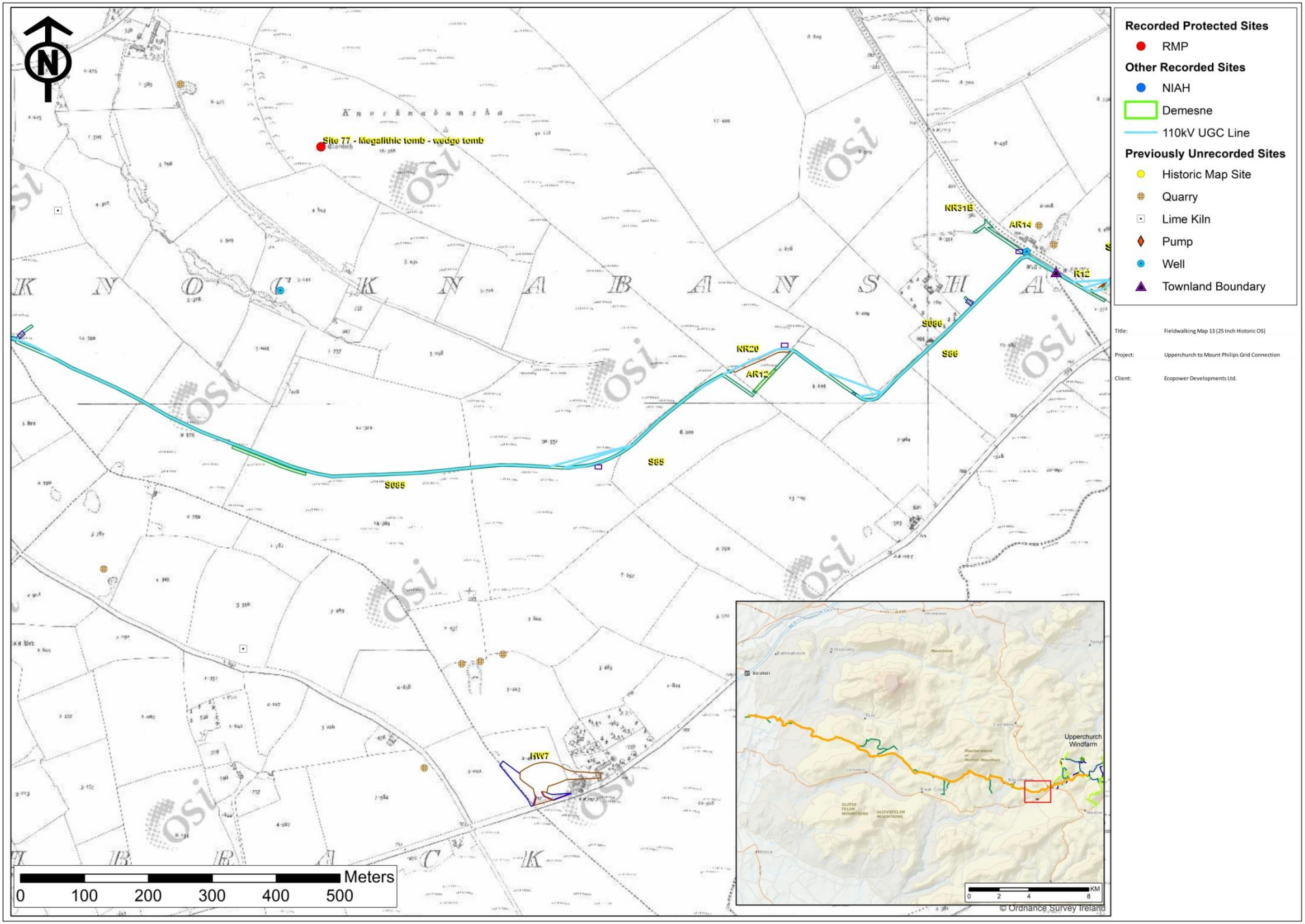


Figure 38: Fieldwalking Map 13 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

S085

Section 085 of the UWF Grid Connection runs in a general easterly direction for a distance of 1.22m. It runs along a forestry track in an area of thick cultivated forestry. No features of archaeological significance were noted in the area.

Figure 39: S086 from the southeast.

S086/AR12/NR20/AR13

Section 086 of the UWF Grid Connection runs in a general north-easterly direction for a distance of 680m. It crosses a mix of open grassland and farm tracks through a well drained agricultural pasture with a gentle east facing slope. The field is bound to the east by a ditch and hedgerows. A spring or well was noted on the historic maps as feeding into this ditch. At the eastern extent of this section the route passes through the townland boundary between Knocknabansha and Knockmaroe. No features of archaeological significance were noted in the area.

Figure 40: R012 from the south.

R012

At this point the UWF Grid Connection crosses the public road R-497 before entering a pasture field to the east. No features of archaeological significance were noted in the area.

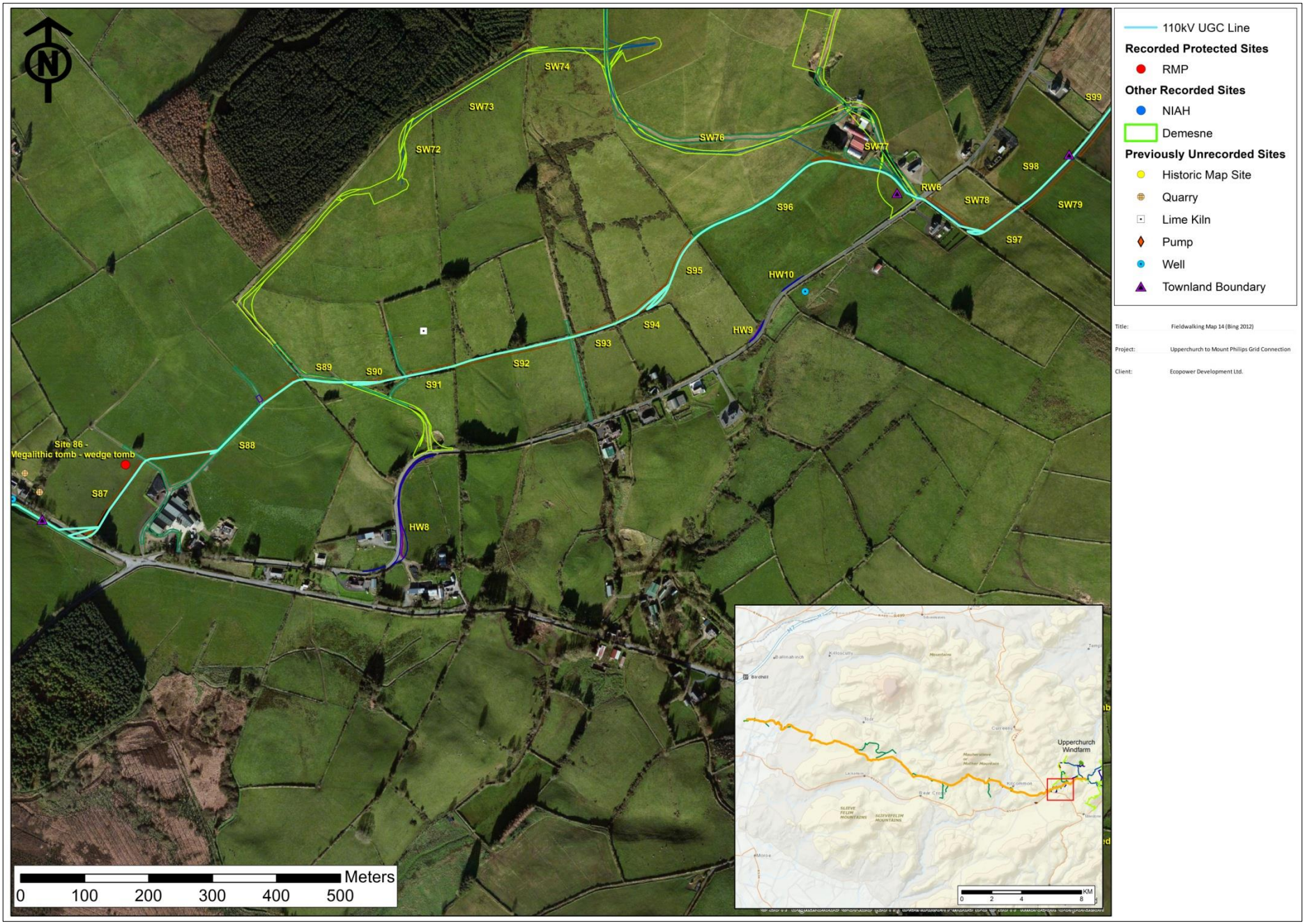


Figure 41: Fieldwalking Map 14 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

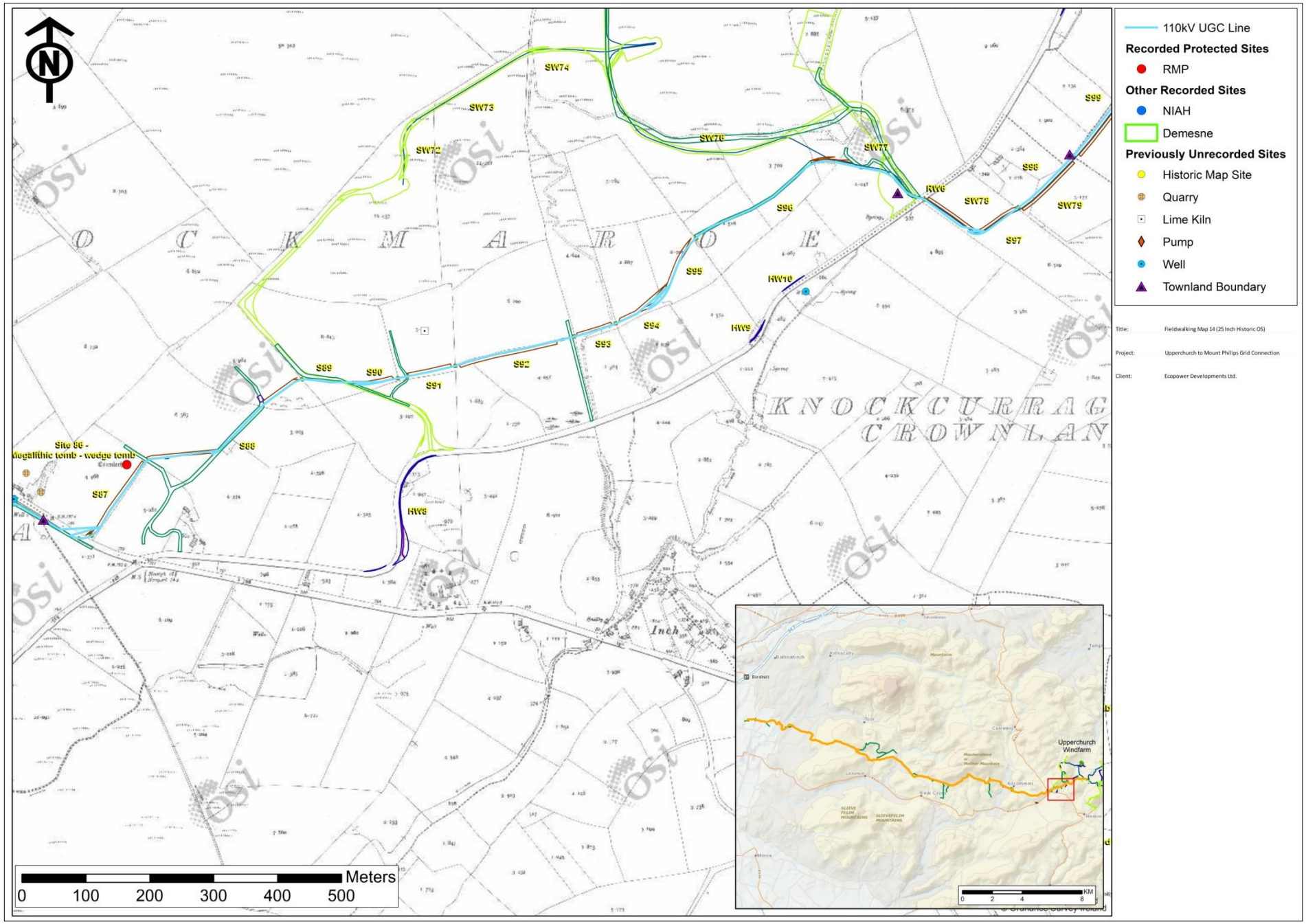


Figure 42: Fieldwalking Map 14 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

Figure 43: S087 from the north.

S087

Section 087 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 154m. It crosses a moderately well drained agricultural pasture with a moderate west facing slope. The field is bound to the west by earth and stone bank and hedgerows and on all over sides by wire and post fencing. *Site 86 - Megalithic Tomb - Wedge Tomb* is located c.20 to the west of this section. As such the development passes through the Zone of Notification for this monument. This section was subject to preplanning archaeological test excavations carried out by the author, which uncovered no evidence of previously unknown subsurface archaeological features. No other features of archaeological significance were noted in the area.

S088/NR21

Section 088 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 287m. It crosses a mix moderately well drained agricultural pasture and existing farm tracks with a moderate south/southwest facing slope. No features of archaeological significance were noted in the area.

AR14

This operational phase access road runs through an existing farmyard. No features of archaeological significance were noted in the area.

S089

Section 089 of the UWF Grid Connection runs in a general easterly direction for a distance of 85m. It crosses a well drained agricultural pasture with a south facing slope. No features of archaeological significance were noted in the area.

S090
Section 090 of the UWF Grid Connection runs in a general easterly direction for a distance of 77m. It crosses a well drained agricultural pasture with a south facing slope. No features of archaeological significance were noted in the area.

S091
Section 091 of the UWF Grid Connection runs in a general easterly direction for a distance of 80m. It crosses a well drained agricultural pasture with a south facing slope. The field is bound on all sides by an earth and stone bank and ditch. No features of archaeological significance were noted in the area.

S092/NR22/AR15
Section 092 of the UWF Grid Connection runs in a general easterly direction for a distance of 189m. It crosses a well-drained agricultural pasture, subdivided with wire and post fencing and a gentle northwest facing slope. No features of archaeological significance were noted in the area.

S093
Section 093 of the UWF Grid Connection runs in a general easterly direction for a distance of 72m. It crosses a well drained agricultural pasture with a gentle south facing slope. No features of archaeological significance were noted in the area.

S094
Section 094 of the UWF Grid Connection runs in a general easterly direction for a distance of 85m. It crosses a well drained agricultural pasture with a gentle south facing slope. No features of archaeological significance were noted in the area.

S095
Section 095 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 104m. It crosses a well drained agricultural pasture with a northwest south facing slope. No features of archaeological significance were noted in the area.

Figure 44: S096 from the south.

S096

Section 096 of the UWF Grid Connection runs in a general easterly direction for a distance of 403m. It runs along an existing farm track which crosses a well drained agricultural pasture with a steep south facing slope. A modern farmyard lies to the east. No features of archaeological significance were noted in the area.

R013

Figure 45: R013 from the south

At this point the UWF Grid Connection crosses the public road L-2264-50 before entering a pasture field to the southeast. This road acts as the townland boundary between Knockmaroe and Knocknacurraghbola Crownlands. No features of archaeological significance were noted in the area.

S097

Section 097 of the UWF Grid Connection runs in a general southeasterly direction for a distance of 100m and then turns northeast. It crosses a well drained agricultural pasture with a northwest facing slope. No features of archaeological significance were noted in the area.

S098

Section 098 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 88m. It crosses a well drained agricultural pasture with a northwest facing slope. At the eastern extent the route passes through the townland boundary between Knocknacurragh Crownlands and Knocknacurraghbola Commons. No features of archaeological significance were noted in the area.

S099

Section 099 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 163m. It crosses a well drained agricultural pasture with a gentle northwest facing slope. The field is bound on all sides by an earth and stone bank and ditch. No features of archaeological significance were noted in the area.

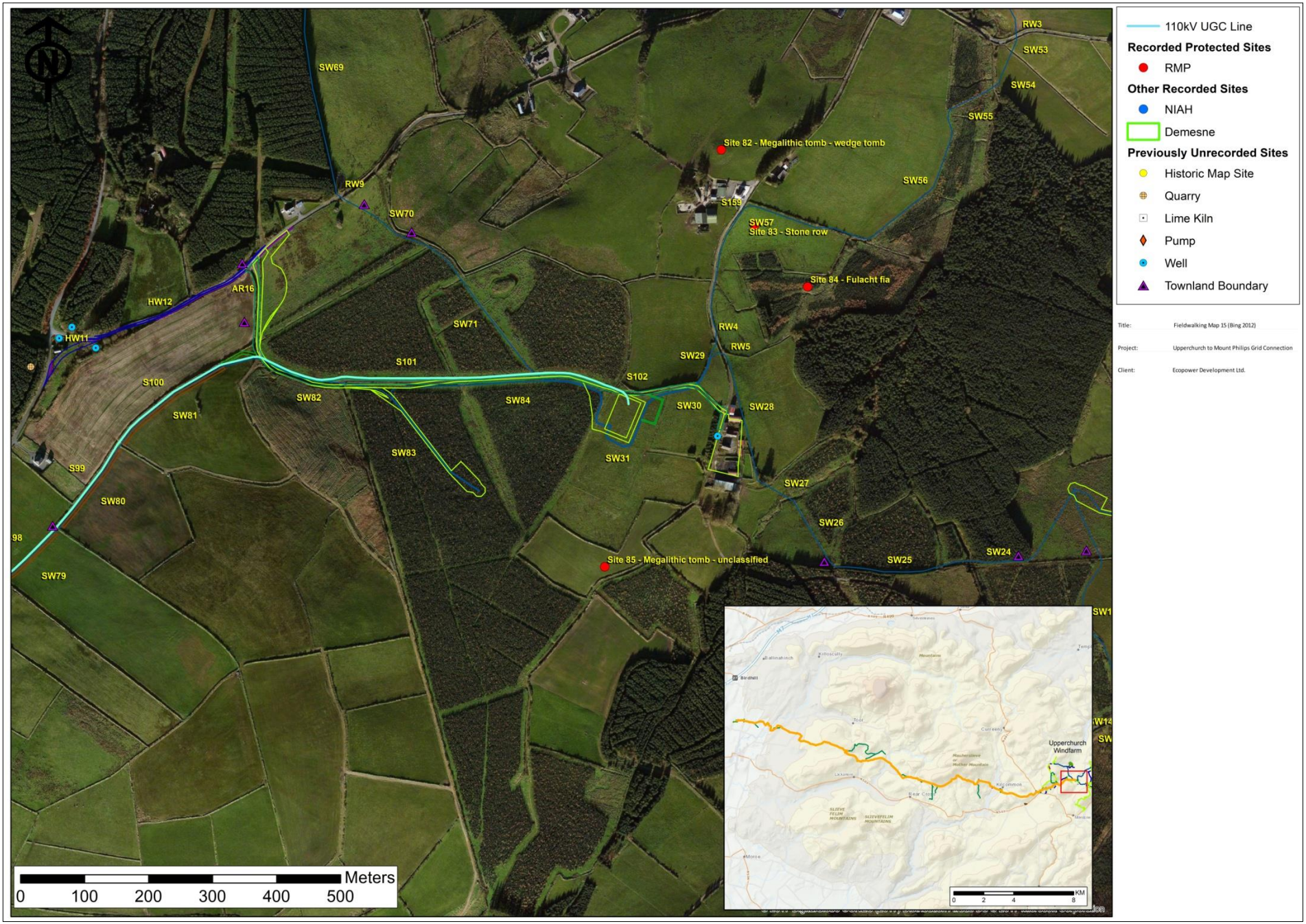


Figure 46: Fieldwalking Map 15 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

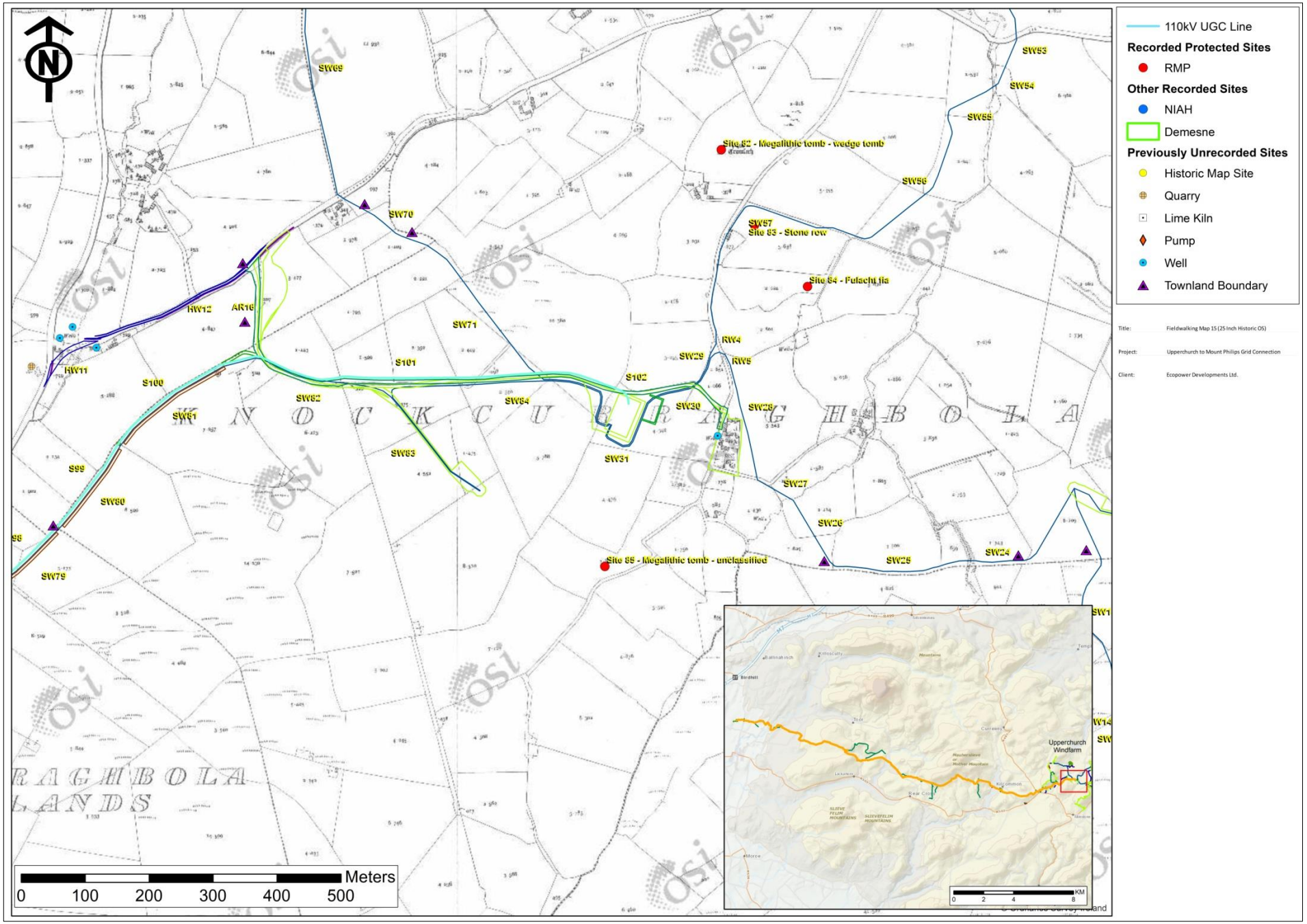


Figure 47: Fieldwalking Map 15 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

Figure 48: S100 from the east.

S100/NR23

Section 100 of the UWF Grid Connection runs in a general northeasterly direction for a distance of 262m. It crosses a well drained agricultural pasture with a northwest facing slope. The field is bound on all sides by an earth and stone bank and ditch. No features of archaeological significance were noted in the area.

Figure 49: S101 from the west

S101

Section 101 of the UWF Grid Connection runs in a general easterly direction for a distance of 561m. It follows the route of an existing farm and forestry track through an area of mature cultivated forestry. No features of archaeological significance were noted in the area.

Figure 50: S102 and the site of the Upperchurch Substation from the northeast.

S102

The site of the Upperchurch substation is located in the northwest corner of a well drained, gently undulating pasture. The UWF Grid Connection enters the Upperchurch substation from the north. No features of archaeological significance were noted in the area.

A16.1.6.2 FIELD WALKING DESCRIPTION - UWF RELATED WORKS

INTERNAL WINDFARM CABLES

SW1-SW12 (Figure 51-54)

These sections of the UWF Related Works occur within the footprint of Upperchurch Windfarm. There will be no additional works in this area beyond those assessed in the 2013 EIS, when this section was previously walked by the author. Nothing of archaeological significance was noted at this time.

SW13 (Figure 53-54)

Section SW13 of the Internal Windfarm Cable route runs in a general northerly direction for a distance of 37m. It runs along the verge of an open, poorly drained, pasture containing a section of the Upperchurch Windfarm before crossing a narrow farm track. No features of archaeological significance were noted in the area.

SW14 (Figure 53-54)

Section SW14 of the Internal Windfarm Cable route crosses a narrow farm track, which is defined by low earthen banks and wire and post fencing. No features of archaeological significance were noted in the area.

SW15 (Figure 53-54)

Section SW15 of the Internal Windfarm Cable route runs in a general northerly direction for a distance of 263m before crossing a low earthen boundary to the north. The boundary acts as a townland boundary between the townlands of Shevry and Knockcurraghbola Commons. The route runs along the western boundary of an undulating pasture. To the immediate west is an area of dense mature cultivated forestry. No features of archaeological significance were noted in the area.

SW16 (Figure 53-54)

Section SW16 of the Internal Windfarm Cable route runs in an easterly direction, along the line of the Realigned Windfarm Road RWR1, through an area of young cultivated forestry before turning in a northerly direction for a total distance of 270m. No features of archaeological significance were noted in the area.

SW17-SW19 (Figure 53-54)

These sections of the UWF Related Works occur within the footprint of the Upperchurch Windfarm. There will be no additional works in this area beyond those assessed in the 2013 EIS, when this section was previously walked by the author. Nothing of archaeological significance was noted at this time.

SW20 (Figure 53-54)

Section SW20 of the Internal Windfarm Cable route runs in a general northerly direction for a distance of 27m along a forestry firebreak before emerging into an open pasture. No features of archaeological significance were noted in the area.

SW21 (Figure 53-54)

Section SW21 of the Internal Windfarm Cable route runs in a general westerly direction and cuts across the corner of a well-drained open pasture with a moderate north facing slope. The eastern boundary of this pasture acts as the townland boundary between Shevry and Knockcurraghbola Commons. The boundary is a low earthen bank topped with wire and post fencing. No features of archaeological significance were noted in the area.

SW22 (Figure 53-54)

Section SW22 of the Internal Windfarm Cable route runs in a general westerly direction for a distance of 273m. It crosses a well-drained pasture with a moderate north facing slope. A portion of this section follows the foot print of the permitted windfarm. No features of archaeological significance were noted in the area.

RW1 (Figure 53-54)

At this point the Internal Windfarm Cable route crosses the public road, L-4139-0, before entering a pasture field to the west. No features of archaeological significance were noted in the area.

SW23 (Figure 53-54)

Section SW23 of the Internal Windfarm Cable route runs along the footprint of the consented windfarm in an open in a general westerly direction for a distance of 217m before branching to the south, along SW15, and southwest, towards SW24. It crosses a well-drained pasture with a moderate north facing slope. No features of archaeological significance were noted in the area.

SW24 (Figure 53-54)

Section SW24 of the Internal Windfarm Cable route runs in a general westerly direction for a distance of 90m. It runs through an area of mature cultivated forestry. No features of archaeological significance were noted in the area.

SW25 (Figure 53-54)

Section SW25 of the Internal Windfarm Cable route runs in a general westerly direction for a distance of 212m. It follows the route of a forestry track through an area of mature cultivated forestry. No features of archaeological significance were noted in the area.

SW26 (Figure 53-54)

SW26 of the Internal Windfarm Cable route runs in a general northwesterly direction for a distance of 132m. It passes through a poorly drained marshland in a hollow between two hills. The northernmost portion of this section crosses a shallow brook. No features of archaeological significance were noted in the area.

SW27 (Figure 53-54)

Section SW27 of the Internal Windfarm Cable route runs in a general northwesterly direction for a distance of 44m. It passes through a poorly drained marshland with a

gentle southeast facing slope. No features of archaeological significance were noted in the area.

SW28 (Figure 53-54)

Section SW28 of the Internal Windfarm Cable route runs in a general northerly direction for a distance of 218m. It runs along the eastern side of a complex of modern farm buildings before turning to the west and crossing a narrow laneway (RW5). The boundaries are low earth and stone banks. No features of archaeological significance were noted in the area.

RW5 (Figure 53-54)

At this point the Internal Windfarm Cable route crosses the public road, L-61881-0, before entering a pasture field to the west. No features of archaeological significance were noted in the area.

SW29 (Figure 53-54)

Section SW29 of the Internal Windfarm Cable route runs in a general southerwesterly direction for a distance of 66m. It passed through a well-drained pasture with a moderate east facing slope. No features of archaeological significance were noted in the area.

SW30-SW31 (Figure 53-54)

These sections of the UWF Related Works occur within the footprint of the Upperchurch Windfarm. There will be no additional works in this area beyond those assessed in the 2013 EIS, when this section was previously walked by the author. Nothing of archaeological significance was noted at this time.

SW32-SW50 (Figure 53-58)

These sections of the UWF Related Works occur within the footprint of the Upperchurch Windfarm. There will be no additional works in this area beyond those assessed in the 2013 EIS, when this section was previously walked by the author. Nothing of archaeological significance was noted at this time.

SW51 (Figure 53-58)

Section SW51 of the Internal Windfarm Cable route runs in a general southwesterly directions for a distance of 458m. It starts after crossing the townland boundary between Coumnageeha / Gleninchnaveigh / Knockcurraghbola Commons and follows eastern and southern boundaries of a large, poorly drained, pasture at the peak of a small hill. No features of archaeological significance were noted in the area.

RW2 (Figure 53-58)

At this point the Internal Windfarm Cable route crosses the public road before entering a pasture field to the west. No features of archaeological significance were noted in the area.

SW52 (Figure 53-58)

Section SW52 of the Internal Windfarm Cable route runs in a general southwesterly direction for a distance of 179m. It follows the northern and western boundary of an open pasture with a moderate south facing slope. No features of archaeological significance were noted in the area.

RW3 (Figure 53-58)

At this point the Internal Windfarm Cable route crosses the public road, L-6188-0, before entering a pasture field to the south. The boundaries are moderately sized earth and stone banks. No features of archaeological significance were noted in the area.

SW53 (Figure 53-58)

Section SW53 of the Internal Windfarm Cable route runs in a general southerly direction for a distance of 23m across the northern corner of an open well drained pasture with a moderate southeast facing slope. The boundaries are earth and stone banks. There is a large drain at the southern extent of this section. No features of archaeological significance were noted in the area.

SW54 (Figure 53-58)

Section SW54 of the Internal Windfarm Cable route runs in a general southerly direction for a distance of 52m through a well-drained pasture with a moderate southeast facing slope. No features of archaeological significance were noted in the area.

SW55 (Figure 53-58)

Section SW55 of the Internal Windfarm Cable route runs in a general southwesterly direction for a distance of 90m. It passes over an area of poorly drained marshland and along a forestry firebreak in a section of young cultivated forestry. No features of archaeological significance were noted in the area.

SW56 (Figure 53-58)

Section Sw56 of the Internal Windfarm Cable route runs in a general southerly direction for a distance of 256m along the eastern boundary of a large, well-drained pasture at the bottom of a steep east facing slope before crossing through an earth and stone bank into a field to the west. No features of archaeological significance were noted in the area.

SW57 (Figure 53-58)

Section SW57 of the Internal Windfarm Cable route runs along the northern and western boundaries of a large pasture field with a moderate to steep east facing slope. This field contains both Site 83 - *Stone Row* and Site 84 - *Fulacht Fiadh*. Site 84 is under an area of mature cultivated forestry. Test excavations were carried out by the author along this stretch of the Internal Windfarm Cable route and no features of archaeological interest were uncovered.

RW4 (Figure 53-58)

At this point the Internal Windfarm Cable route crosses the public road, L-61881-0, before entering a pasture field to the west. No features of archaeological significance were noted in the area.

SW58-SW59 (Figure 59-60)

These sections of the UWF Related Works occur within the footprint of the Upperchurch Windfarm. There will be no additional works in this area beyond those assessed in the 2013 EIS, when this section was previously walked by the author. Nothing of archaeological significance was noted at this time.

SW60 (Figure 59-60)

Section SW60 of the Internal Windfarm Cable route runs in a general southerly direction for a distance of 78m. It starts after crossing the townland boundary between Grousehall and Foilnaman and follows the route of an existing farm on the western boundary of an open pasture. No features of archaeological significance were noted in the area.

RW7 (Figure 59-60)

At this point the Internal Windfarm Cable route crosses the public road, L-6185-13. The boundaries of the road comprise of earth and stone banks. No features of archaeological significance were noted in the area.

SW61 (Figure 59-60)

Section 163 of the Internal Windfarm Cable route runs in a general easterly and then southeasterly direction for a distance of 367m. It runs along the northern boundary of a well-drained pasture with a moderate south facing slope. At the eastern section the route passes over an earthen bank and drain. No features of archaeological significance were noted in the area.

SW62 (Figure 59-60)

Section SW62 of the Internal Windfarm Cable route runs in a general south-easterly direction for a distance of 190m. It follows the line of a drain running down slope in the same direction before crossing an earth and stone bank into a neighbouring pasture. No features of archaeological significance were noted in the area.

SW63 (Figure 59-60)

Section SW63 of the Internal Windfarm Cable route runs in a general south-easterly direction for a distance of 98m along the northeast boundary of a well-drained pasture with a moderate east facing slope. It follows the line of a drain and bank before turning east and into a neighbouring pasture. No features of archaeological significance were noted in the area.

SW64 (Figure 59-60)

Section SW64 of the Internal Windfarm Cable route runs in a general northeasterly direction for a distance of 85mm. It crosses a well-drained pasture with a moderate

east facing slope. At its eastern extent it crosses an earth and stone boundary onto a farm track adjacent to a modern residential building. No features of archaeological significance were noted in the area.

SW65 (Figure 59-60)

Section SW65 of the Internal Windfarm Cable route runs follows a modern farm track for distance of 100m. No features of archaeological significance were noted in the area.

SW66 (Figure 59-60)

Section SW66 of the Internal Windfarm Cable route follows the southern boundary of an open green field for a distance of 48m. No features of archaeological significance were noted in the area.

RW8 (Figure 61-62)

At this point the Internal Windfarm Cable route crosses the public road, L-2264-34, which acts as the townland boundary between Foilnaman and Knockcurraghbola Commons, before entering a pasture field to the east. No features of archaeological significance were noted in the area.

SW67 (Figure 61-62)

Section SW67 of the Internal Windfarm Cable route runs in a general southeasterly direction for a distance of 135m. Initially it passes through an area of moderately well drained pasture and then into an area of poorly drained marshland at the base of a moderate south facing slope. At the end of this section the route passes over a shallow drain and low bank. No features of archaeological significance were noted in the area.

SW68 (Figure 61-62)

Section SW68 of the Internal Windfarm Cable route runs in a general southerly direction for a distance of 52m. It passes through an area of poorly drained marshland. At the southern extent it crosses an earth and stone field boundary. No features of archaeological significance were noted in the area.

SW69 (Figure 61-62)

Section SW69 of the Internal Windfarm Cable route runs in a general southerly direction for a distance of 376m. It follows the western boundary of an open green field. At the southern extent it leaves the field through an existing farm gate and crosses the public road. No features of archaeological significance were noted in the area.

RW9 (Figure 61-62)

At this point the Internal Windfarm Cable route crosses the public road, L-6188-0, before entering a pasture field to the south. No features of archaeological significance were noted in the area.

SW70 (Figure 61-62)

Section SW70 of the Internal Windfarm Cable route runs in a general south-easterly direction for a distance of 160m. It crosses a mix of poorly drained marshland and along a forestry track through mature cultivated forestry. No features of archaeological significance were noted in the area.

SW71 (Figure 61-62)

Section SW71 of the Internal Windfarm Cable route runs in a general south-easterly direction for a distance of 260m travels along a forestry track through mature cultivated forestry. No features of archaeological significance were noted in the area.

SW72-SW76 (Figure 63-64)

These sections of the UWF Related Works occur within the footprint of the Upperchurch Windfarm. There will be no additional works in this area beyond those assessed in the 2013 EIS, when this section was previously walked by the author. Nothing of archaeological significance was noted at this time.

SW77 (Figure 63-64)

Section SW77 crosses 70m of an agricultural pasture before running adjacent to UWF Grid Connection Section S97. The grid connection run in a general easterly direction for a distance of 230m. A modern farmyard lies to the east. No features of archaeological significance were noted in the area.

RW6 (Figure 63-64)

At this point the UWF Grid Connection crosses the public road L-2264-50, UWF Grid Connection crossing point R13, before entering a pasture field to the southeast. This road acts as the townland boundary between Knockmaroe and Knockcurraghbola Crownlands. No features of archaeological significance were noted in the area.

SW78 (Figure 63-64)

Section SW78 runs adjacent to UWF Grid Connection Section S97; it runs in a general southeasterly direction for a distance of 100m and then turns northeast. It crosses a well-drained agricultural pasture with a northwest facing slope. No features of archaeological significance were noted in the area.

SW79 (Figure 63-64)

Section SW79 runs adjacent to UWF Grid Connection Section S98; it runs in a general northeasterly direction for a distance of 88m. It crosses a well-drained agricultural pasture with a northwest facing slope. At the eastern extent the route passes through the townland boundary between Knockcurraghbola Crownlands and Knockcurraghbola Commons. No features of archaeological significance were noted in the area.

SW80 (Figure 63-64)

Section SW80 runs adjacent to UWF Grid Connection Section S99; it runs in a general northeasterly direction for a distance of 163m. It crosses a well-drained agricultural pasture with a gentle northwest facing slope. The field is bound on all sides by an

earth and stone bank and ditch. No features of archaeological significance were noted in the area.

SW81 (Figure 65-66)

Section SW81 runs adjacent to UWF Grid Connection Section S100; it runs in a general northeasterly direction for a distance of 262m. It crosses a well-drained agricultural pasture with a northwest facing slope. The field is bound on all sides by an earth and stone bank and ditch. No features of archaeological significance were noted in the area.

S82 (Figure 65-66)

Section SW82 runs adjacent to UWF Grid Connection Section S101; it follows the route of an existing farm and forestry track, for 140m, through an area of mature cultivated forestry before crossing to the southern side of the existing farm track for 90m. No features of archaeological significance were noted in the area.

S83 (Figure 65-66)

Section SW83 runs through an area of mature cultivated forestry in a southeasterly direction for 230m. No features of archaeological significance were noted in the area.

S84 (Figure 65-66)

Section SW84 follows the route of an existing farm and forestry track, for 340m, through an area of mature cultivated forestry before turning south and then east before entering the Upperchurch Windfarm Substation. No features of archaeological significance were noted in the area.

HAUL ROUTE WORKS

HW1 – HW2 (Figure 53-54)

Minor road widening works are to be carried out along the route of the L-4139-0 road as part of the overall program of haul route works. The road sides are banked by earth and stone banks, beyond which are patches of mature cultivated forestry and poorly drained pasture fields. No features of archaeological interest were noted at any of the locations marked for widening

HW3 – HW4 (Figure 53-54)

Minor road widening works are to be carried out along the route of the L-4139-0 road as part of the overall program of haul route works. The road sides are banked by earth and stone banks, beyond which are patches of mature cultivated forestry and poorly drained pasture fields. No features of archaeological interest were noted at any of the locations marked for widening.

HR5 (Figure 53-54)

New road works are to be carried out across a pasture field and existing farm yard in a general north direction for 180m between the L-4139-0 and the L-4138-12 as part of the overall program of haul route works. The road sides are banked with by earth and stone banks topped with hedgerows. No features of archaeological significance were noted in the area.

HR6 (Figure 53-54)

Minor road widening works are to be carried out along the route of the L-4138-12 road as part of the overall program of haul route works. The road sides are banked with by earth and stone banks topped with hedgerows. No features of archaeological interest were noted at any of the locations marked for widening.

HR7 (Figure 37-38)

HR7 is an open yard site with no features of archaeological significance noted in the area.

HR8-HR10 (Figure 63-64)

Minor road widening works are to be carried out along the route of the L-2264-50 road as part of the overall program of haul route works. The road sides are banked with by earth and stone banks topped with hedgerows. No features of archaeological interest were noted at any of the locations marked for widening.

HW11 (Figure 65-66)

New road works are to be carried out across a pasture field in a general northeasterly direction for 82m between the L-2264-50 and the L-6188-0 as part of the overall program of haul route works. The road sides are banked with by earth and stone banks topped with hedgerows. No features of archaeological significance were noted in the area.

HR12 (Figure 65-66)

Minor road widening works are to be carried out along the route of the L-6188-0 road as part of the overall program of haul route works. The road sides are banked with by earth and stone banks topped with hedgerows. No features of archaeological interest were noted at any of the locations marked for widening.

HR13 (Figure 59-60)

Minor road widening works are to be carried out along the route of the L-6185-13 road as part of the overall program of haul route works. The road sides are banked with by earth and stone banks topped with hedgerows. No features of archaeological interest were noted at any of the locations marked for widening.

REALIGNED WINDFARM ROADS

RWR1 (Figure 53-54)

Section RWR1 of the Realigned Windfarm Roads runs in a westerly direction, along the line of the Internal Windfarm Cable SW16, through an area of young cultivated forestry for a total distance of 270m. No features of archaeological significance were noted in the area.

RWR2 (Figure 59-60)

Section RWR3 of the Realigned Windfarm Roads runs in a northerly direction, through a well-drained agricultural pasture, along an existing farm track and through another well drained agricultural pasture for a total distance of 350m. RWR3 crosses the townland boundary between Knockmaroe and Grousehall. No features of archaeological significance were noted in the area.

RWR3 (Figure 59-60)

Section RWR2 of the Realigned Windfarm Roads runs in a northeasterly direction, through a well-drained agricultural pasture with a south facing slope for a total distance of 30m. No features of archaeological significance were noted in the area.

UWF REPLACEMENT FORESTRY

UWF Replacement Forestry (Figure 61-62)

The replacement forestry is due to be planted over 3 open, poorly drained pasture fields. The fields are bound by a combination of mature cultivated forestry, streams and earth and stone banks. No features of archaeological significance were noted in the area.

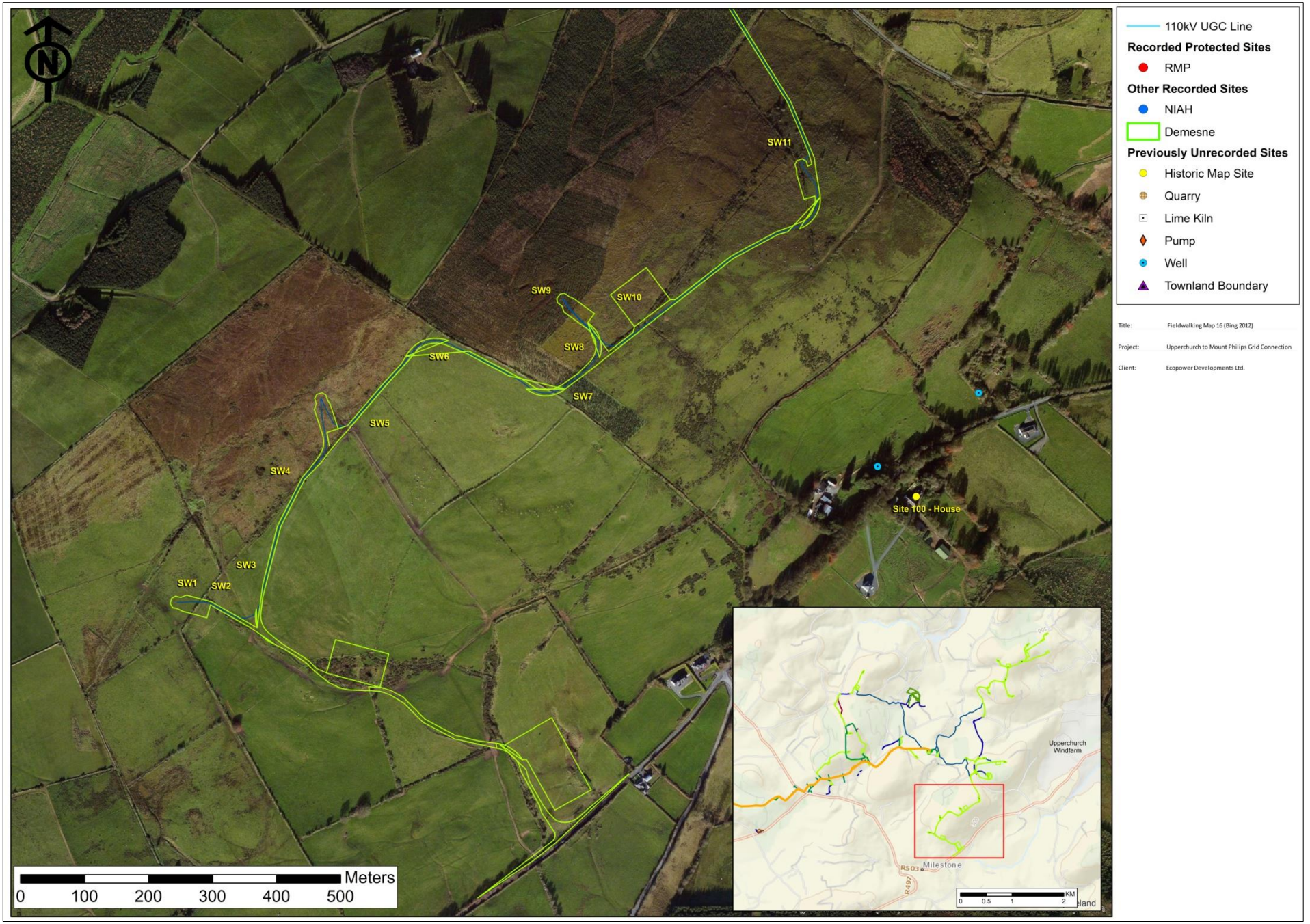


Figure 51: Fieldwalking Map 16 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

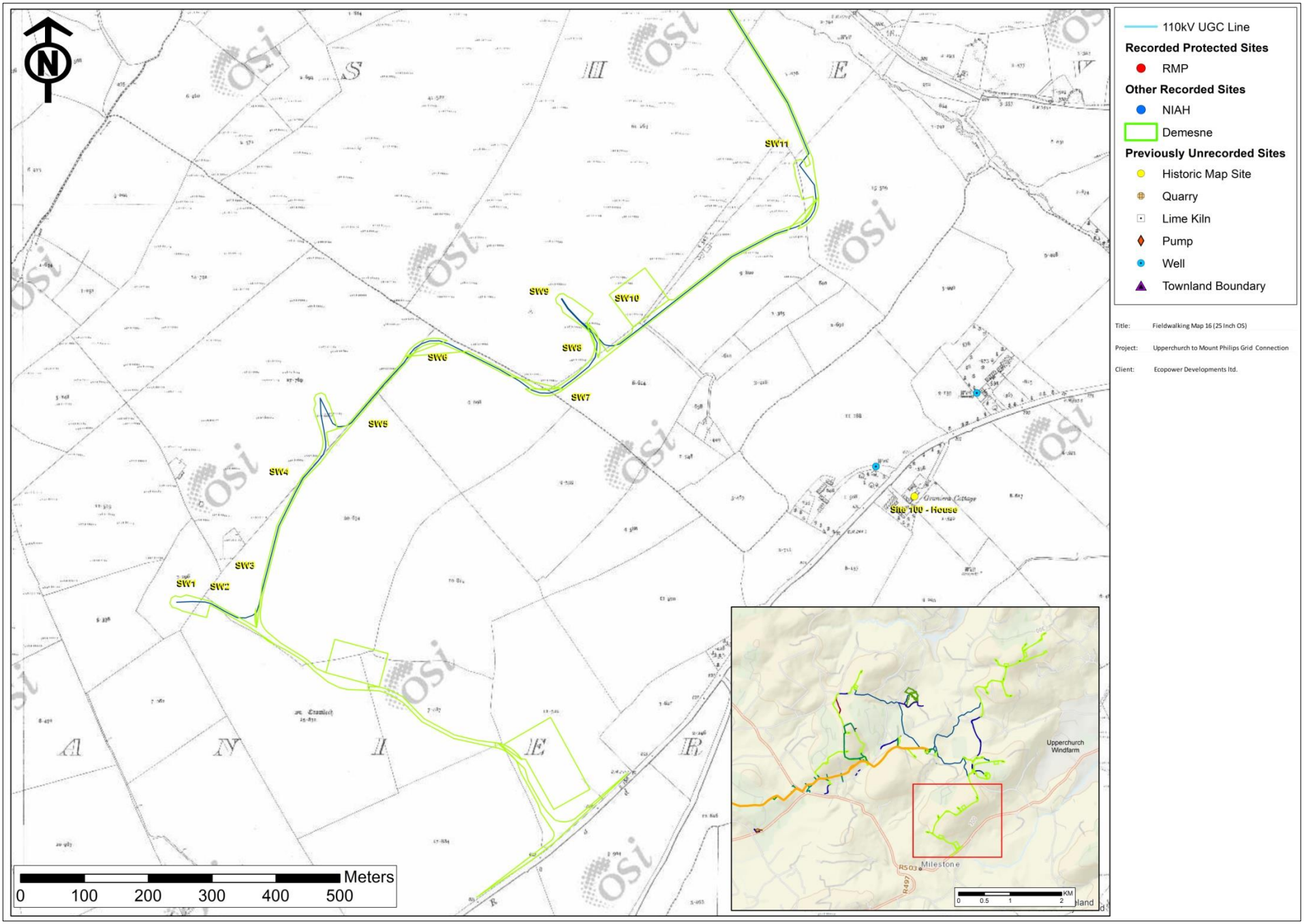


Figure 52: Fieldwalking Map 16 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

Figure 53: Fieldwalking Map 17 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

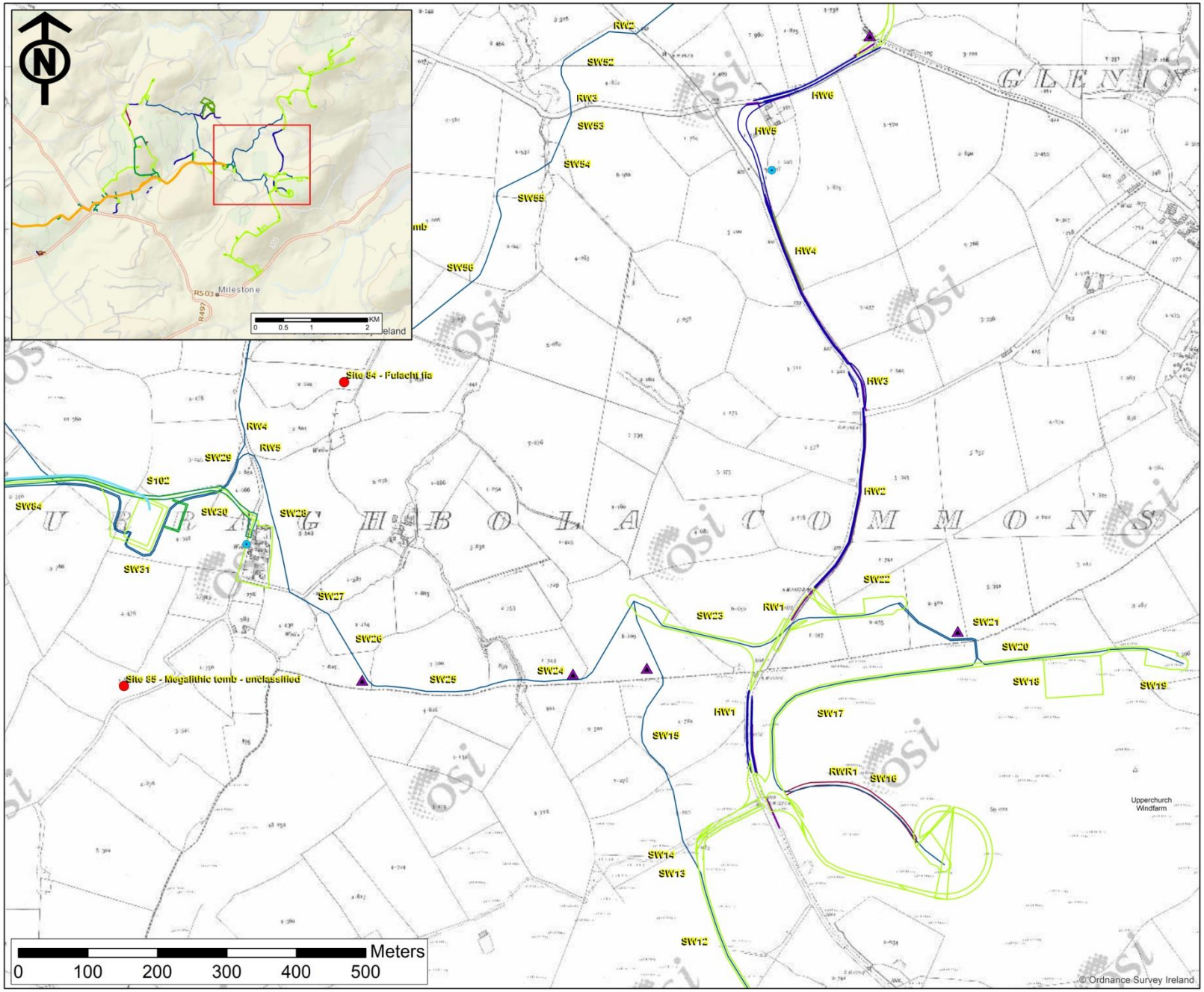


Figure 54: Fieldwalking Map 17 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

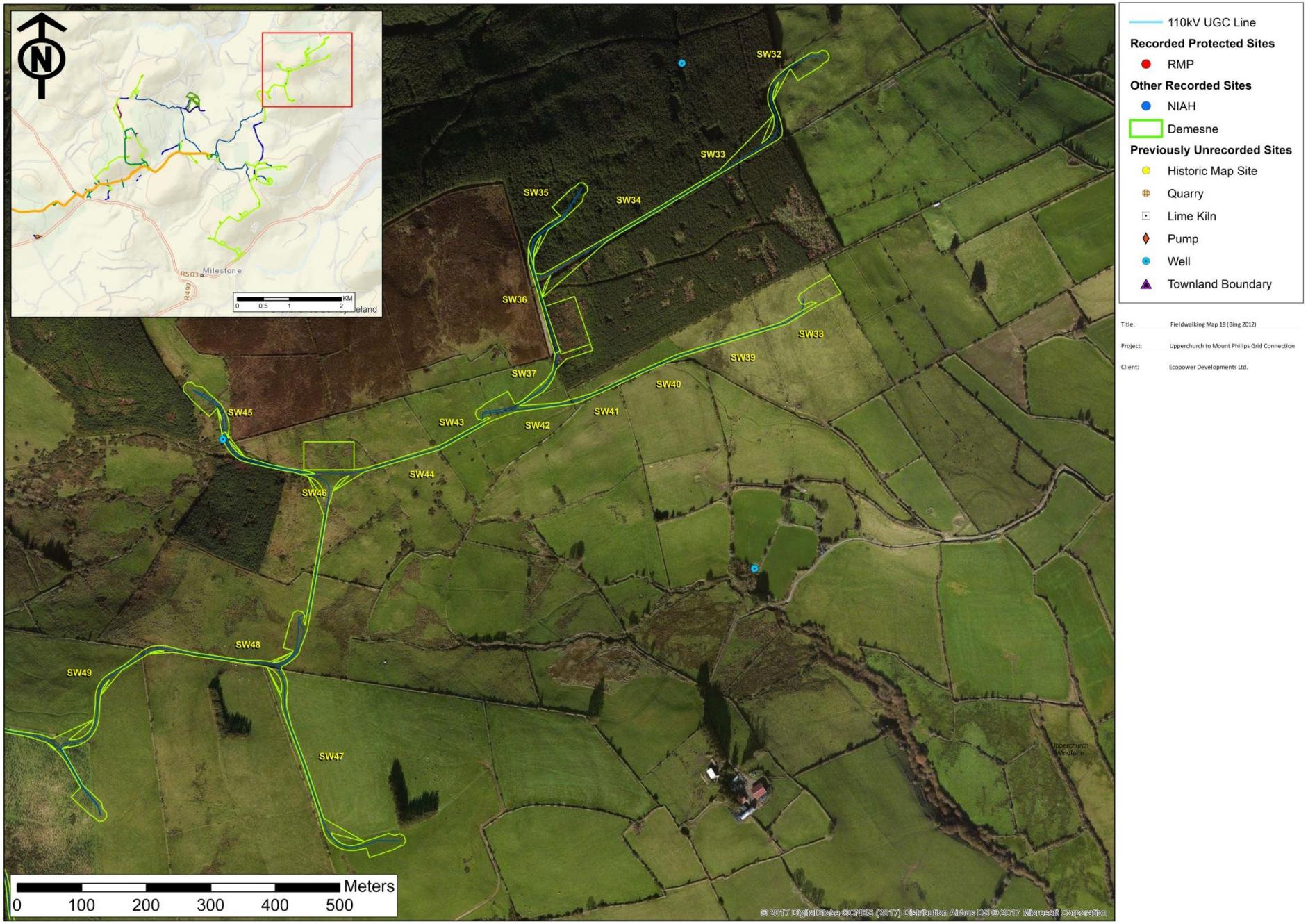


Figure 55: Fieldwalking Map 18 on Bing Aerial Photography 2012

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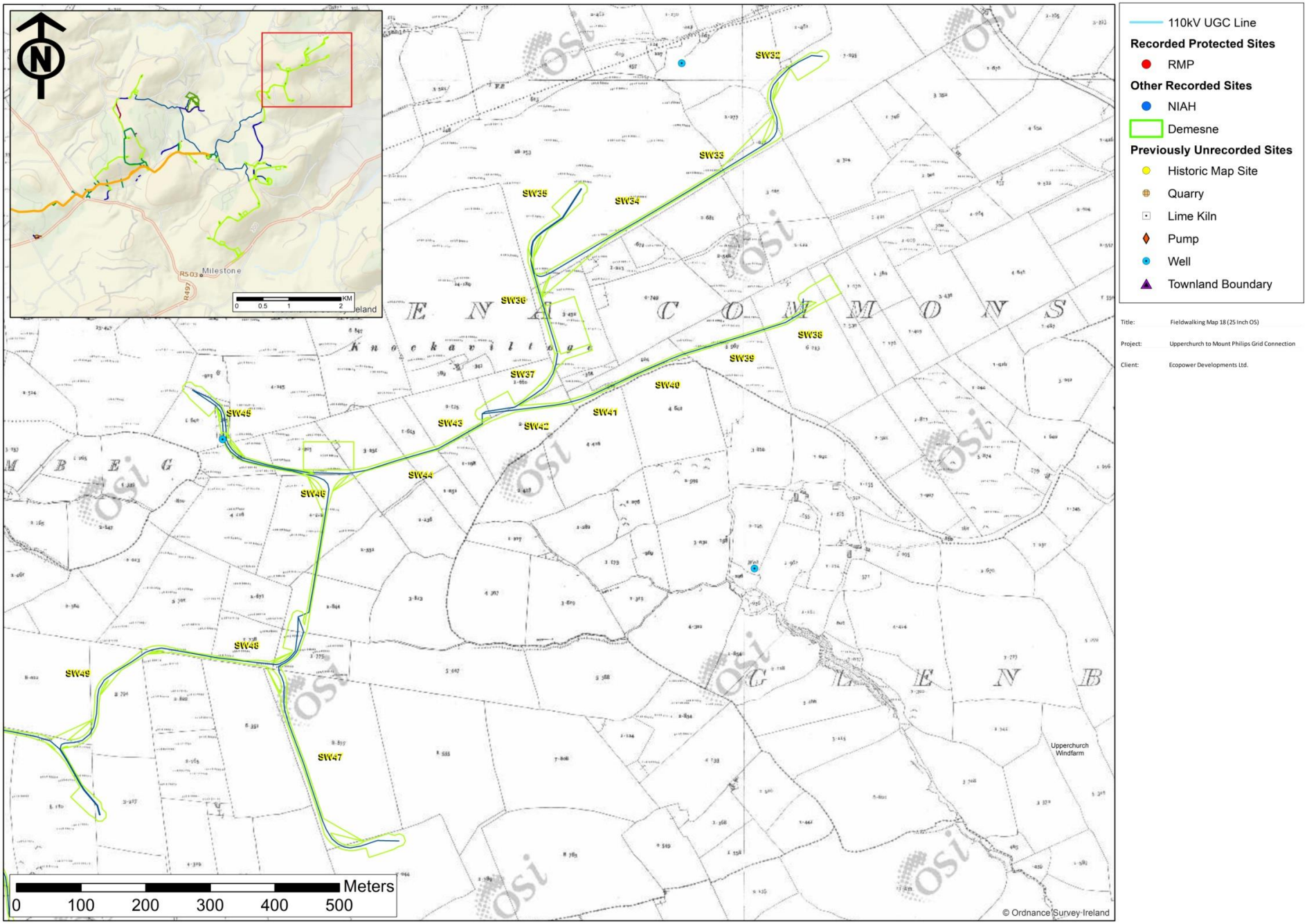

Figure 56: Fieldwalking Map 18 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

Figure 57: Fieldwalking Map 19 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

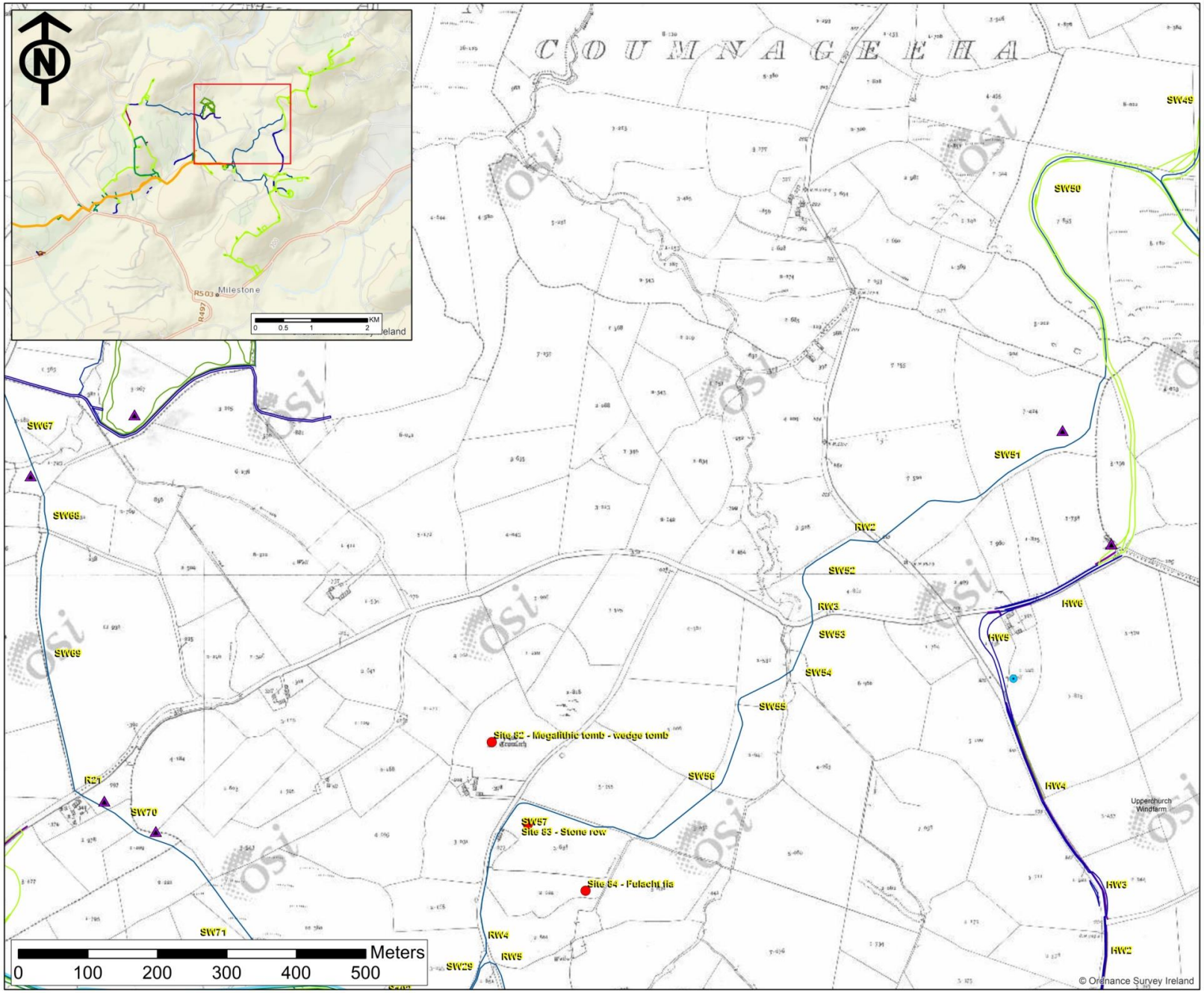

Figure 58: Fieldwalking Map 19 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

Figure 59: Fieldwalking Map 20 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

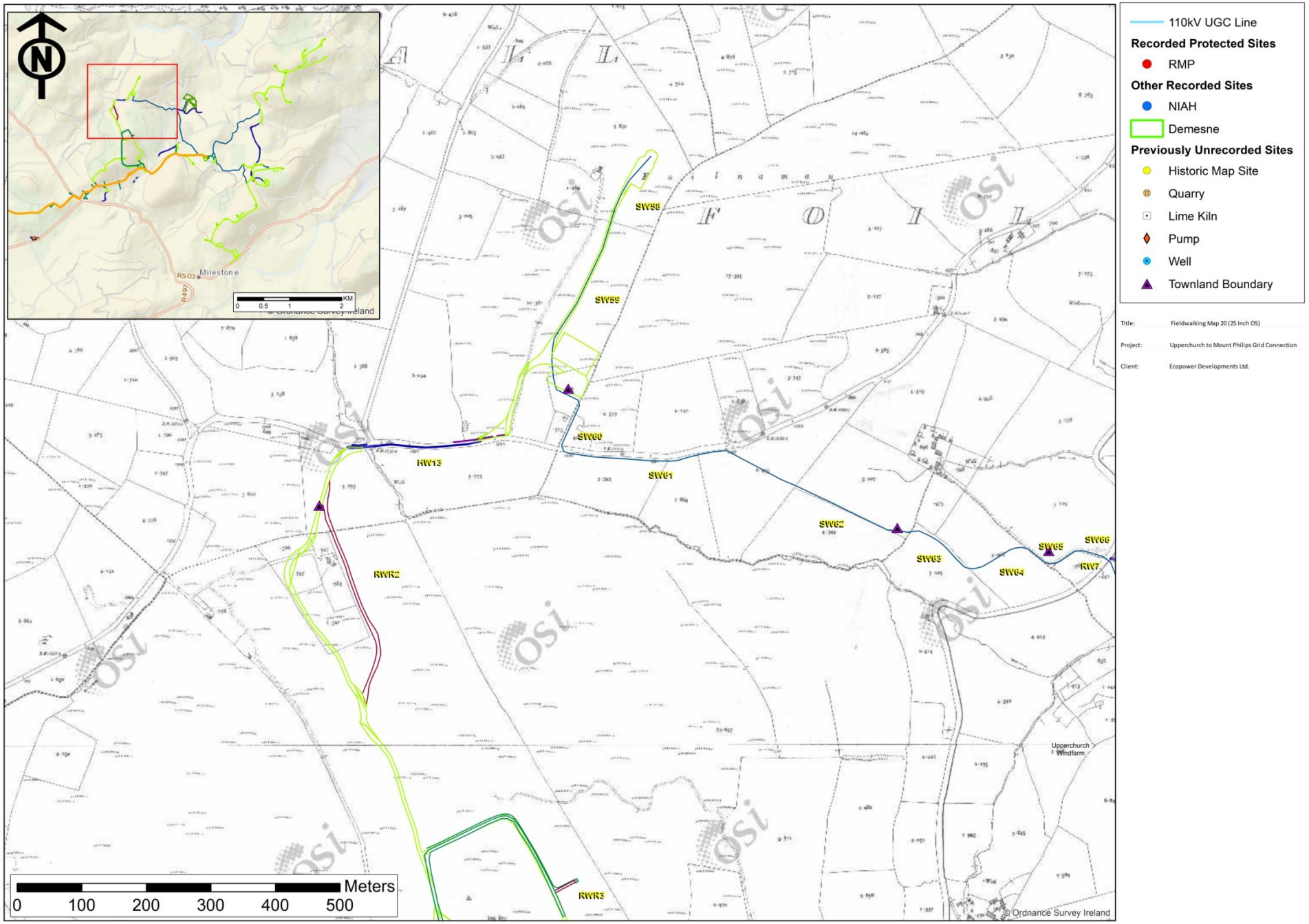

Figure 60: Fieldwalking Map 20 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

Figure 61: Fieldwalking Map 21 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

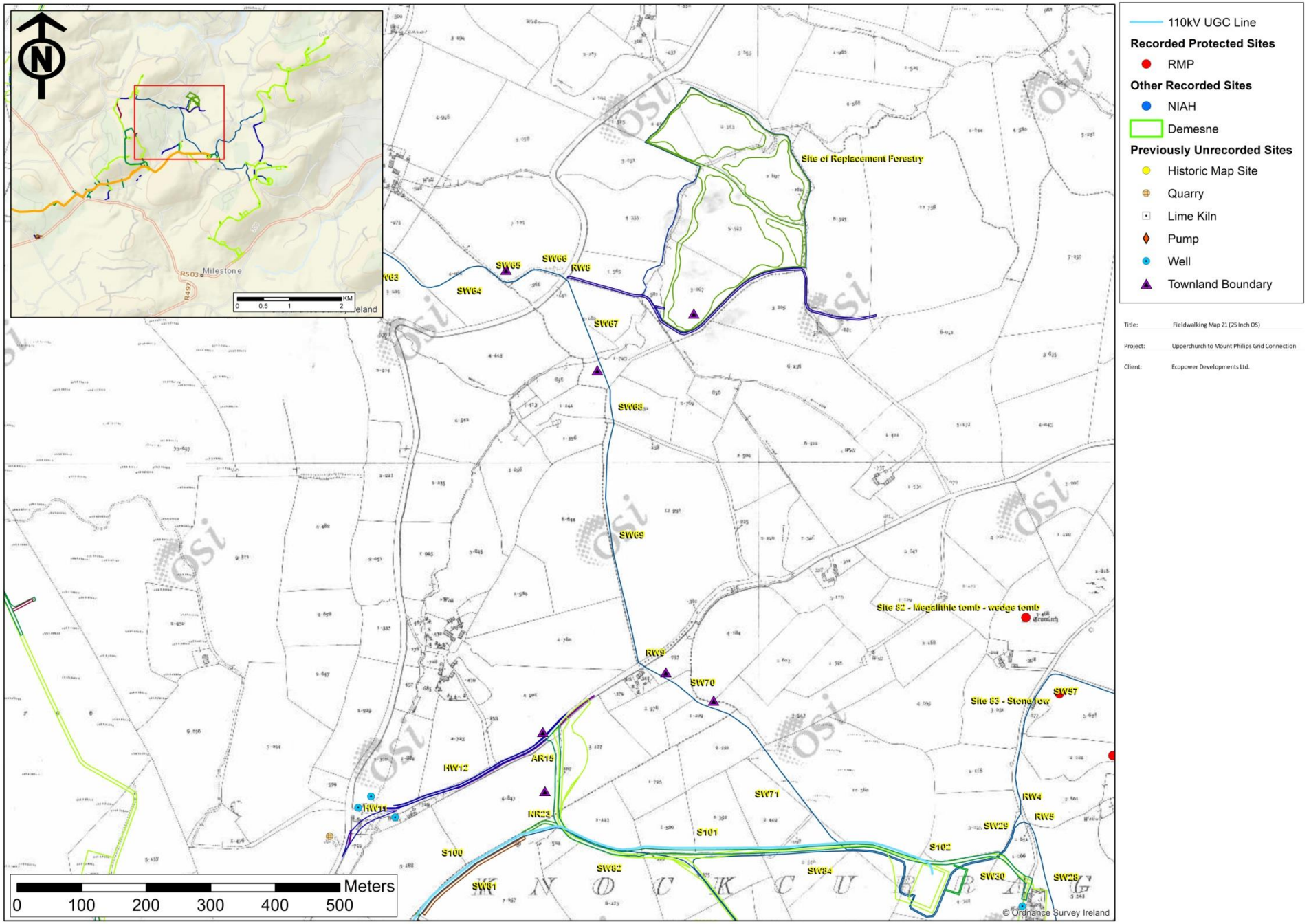

Figure 62: Fieldwalking Map 21 on 25 Inch Ordnance Survey 1905

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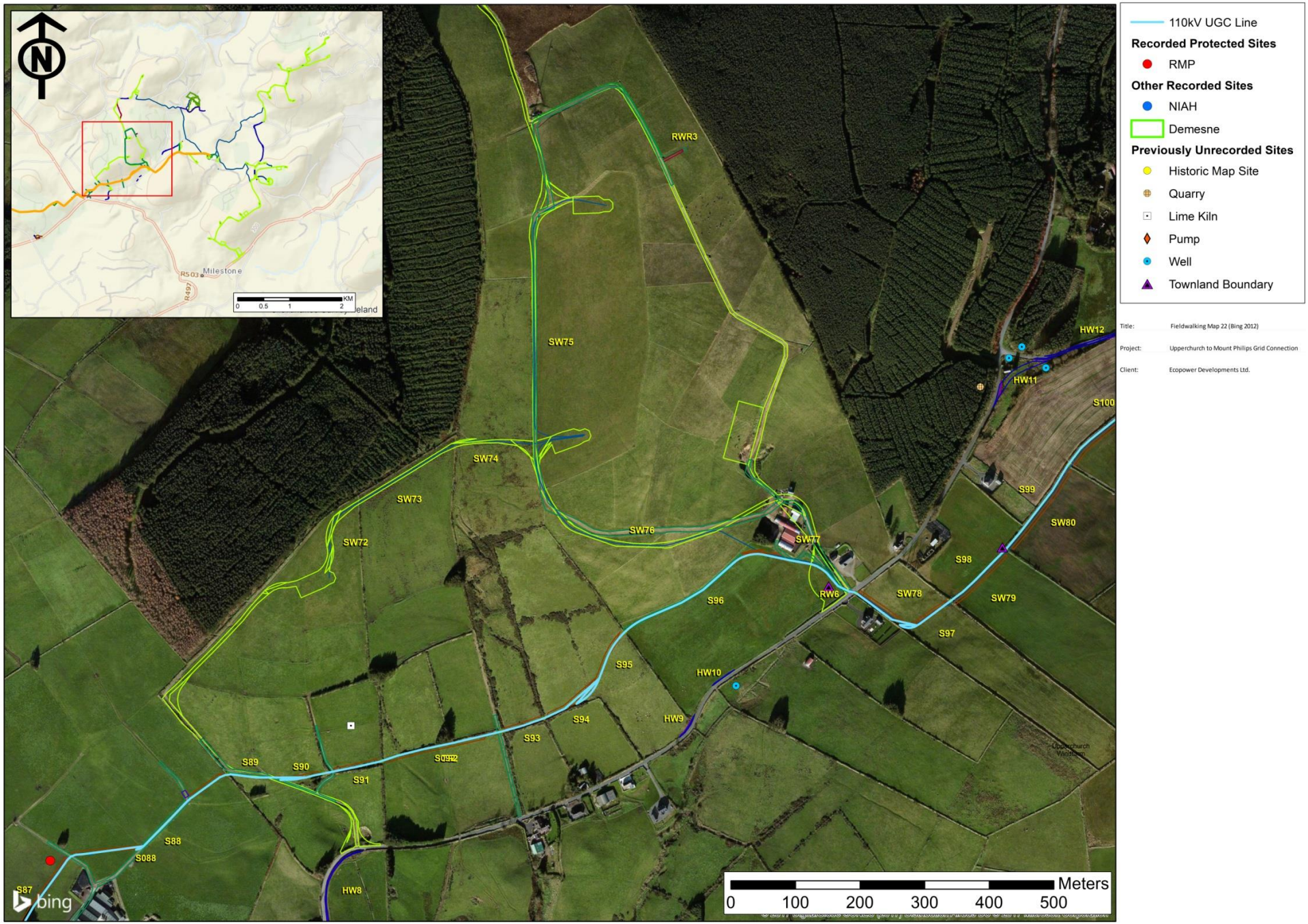


Figure 63: Fieldwalking Map 22 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

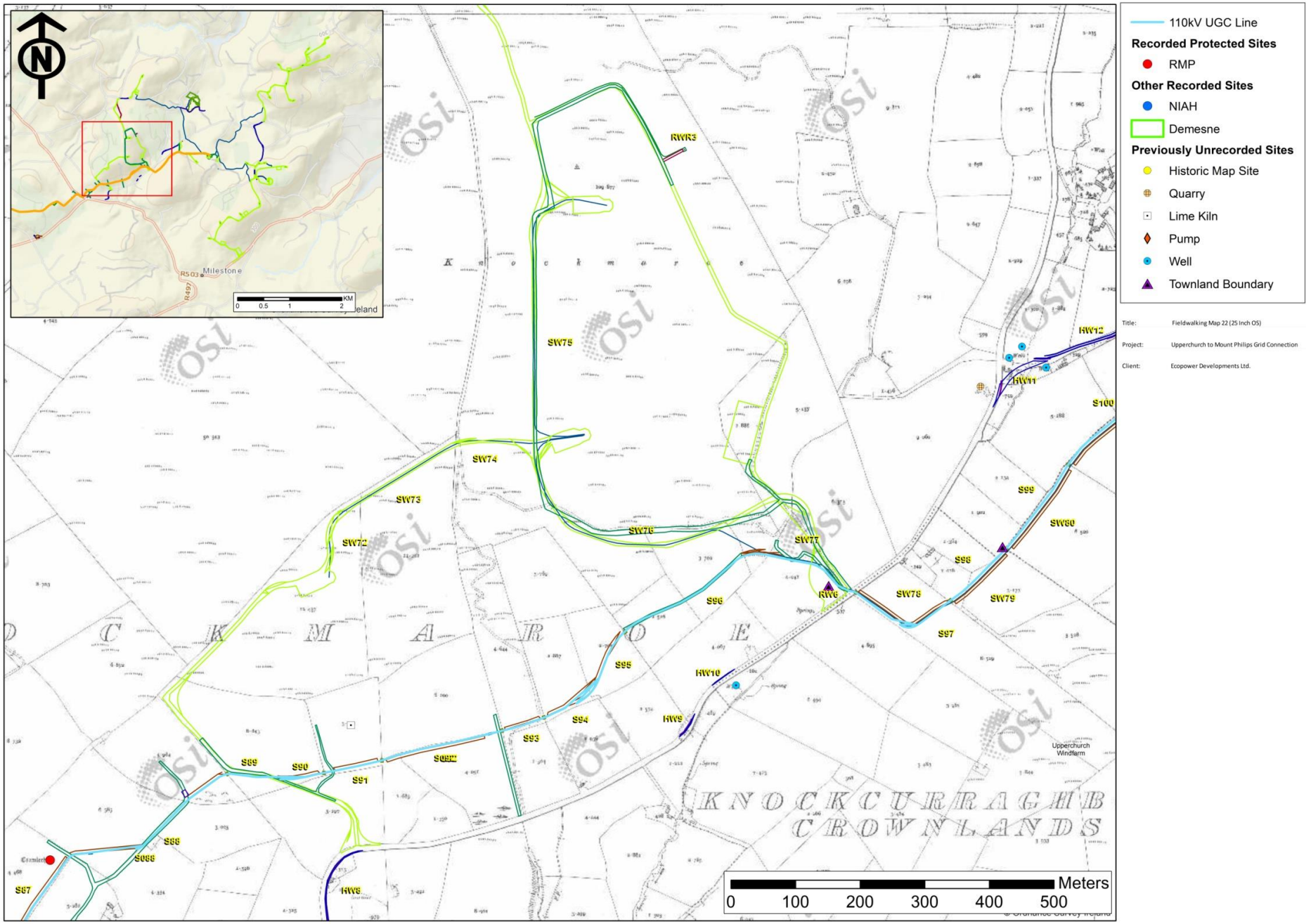


Figure 64: Fieldwalking Map 22 on 25 Inch Ordnance Survey 1905

REFERENCE DOCUMENTS

Figure 65: Fieldwalking Map 23 on Bing Aerial Photography 2012

REFERENCE DOCUMENTS

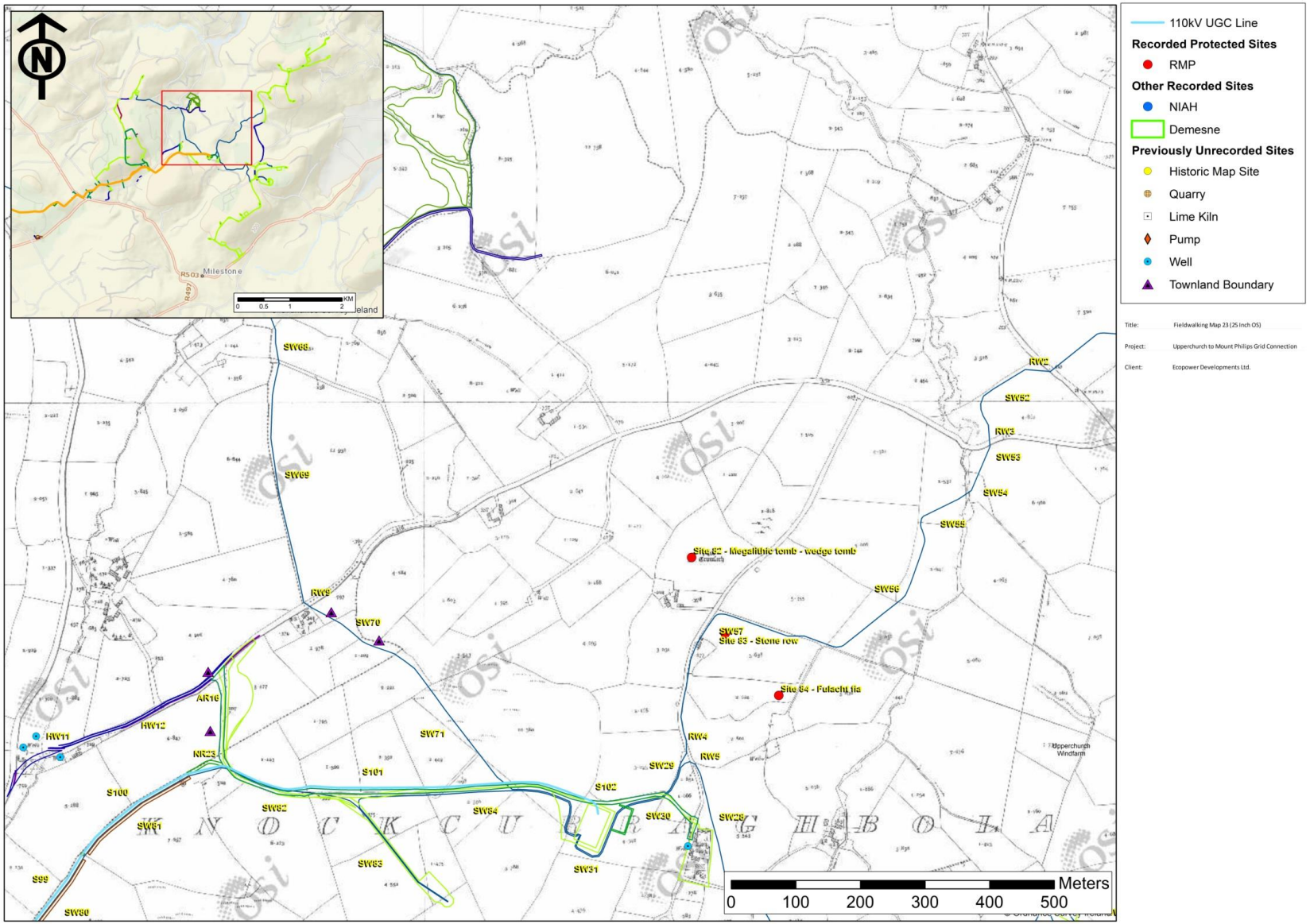


Figure 66: Fieldwalking Map 23 on 25 Inch Ordnance Survey 190

REFERENCE DOCUMENTS

REFERENCE DOCUMENTS

Appendix to Chapter 17: Landscape

Appendix 17.1: Landscape

The data and descriptions in this appendix have informed Chapter 17: Landscape of the EIA Report, in relation to landscape character and visual amenity. The information presented in this Appendix 17.1 is outlined below and the relevant element(s) of the Whole Windfarm Project are also identified.

Appendix 17.1 Section	**Section Heading**	**Relevant Individual Project Element**
A-17.1.1	Contextual Photographs of the Study Area	UWF Grid Connection & UWF Related Works
A-17.1.2	ZTV No.1 :Theoretical Visibility of the Mountphilips Substation within the 2km Study Area	UWF Grid Connection
A-17.1.3	ZTV No.2: Telecom Relay Pole within the 2km Study Area	UWF Related Works

The surveys and modelling described in this appendix has been undertaken in accordance with the reference documents as appropriate in 17.1.6 of Chapter 17.

A-17.1.1 Contextual Photographs of the Study Area

Image 1 - Portion of Grid Connection study area (UWF Grid Connection – temporary site entrance E4) in the townlands of Oakhampton within LCA12 'River Shannon – Newport'

Image 2 - Portion of Grid Connection study area (UWF Grid Connection – near road crossing R4) in the townlands of Castlewaller on border between LCA12 'River Shannon – Newport' and LCA18 – 'Silvermines – Rearcross'

Image 3 - Portion of UWF Grid Connection study area (UWF Grid Connection – near temporary site entrance E14) view towards the townlands of Knockacullen within LCA18 – 'Silvermines – Rearcross'

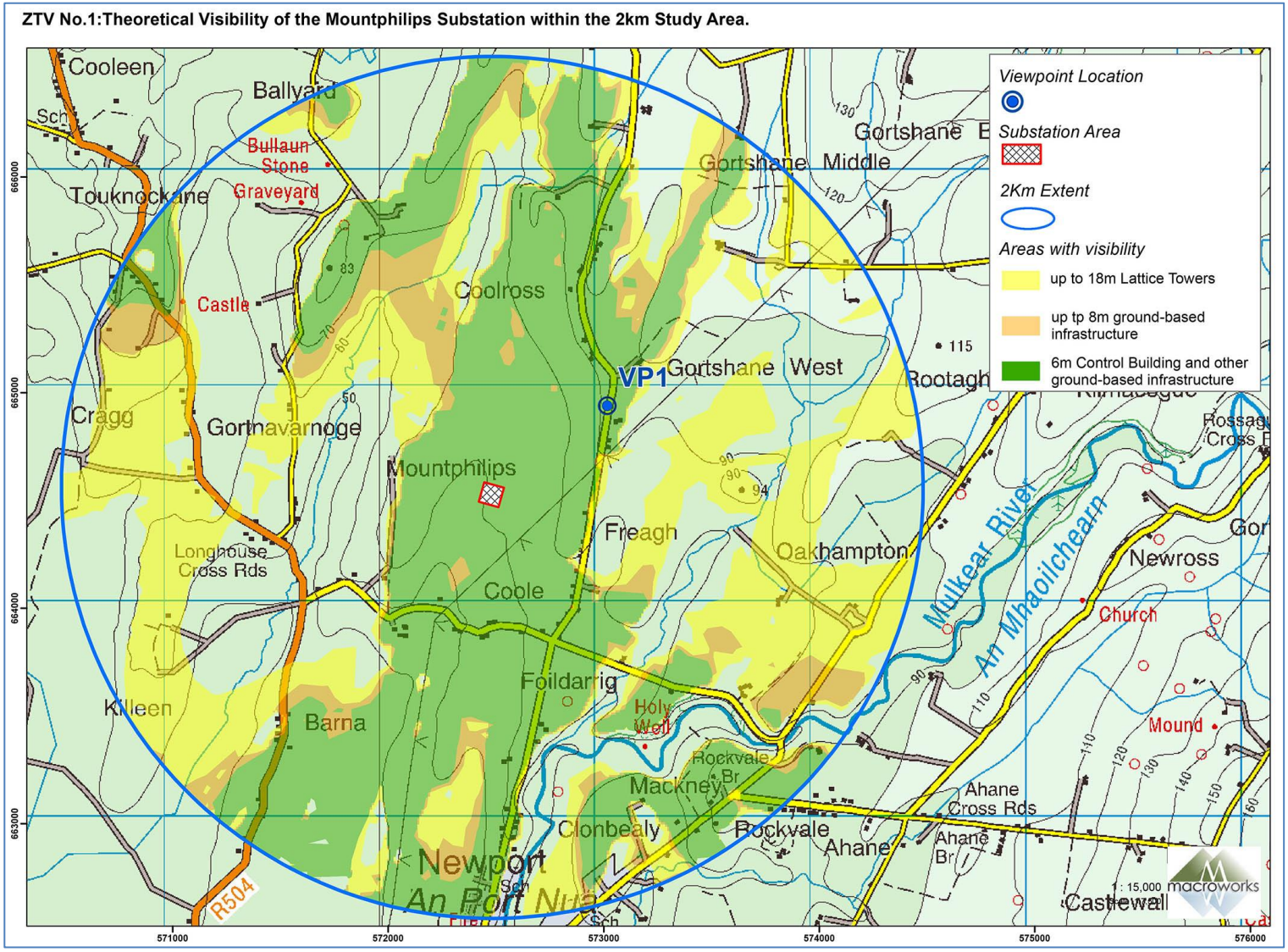
Image 4 - Portion of Grid Connection study area (UWF Grid Connection – near road crossing R10) at Village of Kilcommon on border between LCA18 – 'Silvermines – Rearcross' and LCA17 – 'Upperchurch, Kilcommon & Hollyford Mountain Mosaic'

Image 5 - Portion of UWF Grid Connection study areas (UWF Grid Connection – near road crossing R12) in townland of Knocknabansha within LCA17 – 'Upperchurch, Kilcommon & Hollyford Mountain Mosaic'

A-17.1.2 ZTV No.1: Theoretical Visibility of the Mountphilips Substation within the 2km Study Area

The Zone of Theoretical Visibility (ZTV) map below indicated from where in the surrounding landscape of the study area the Mountphilips Substation is potentially visible in a 'bare-ground' scenario and does not take account of screening by existing vegetation and buildings.

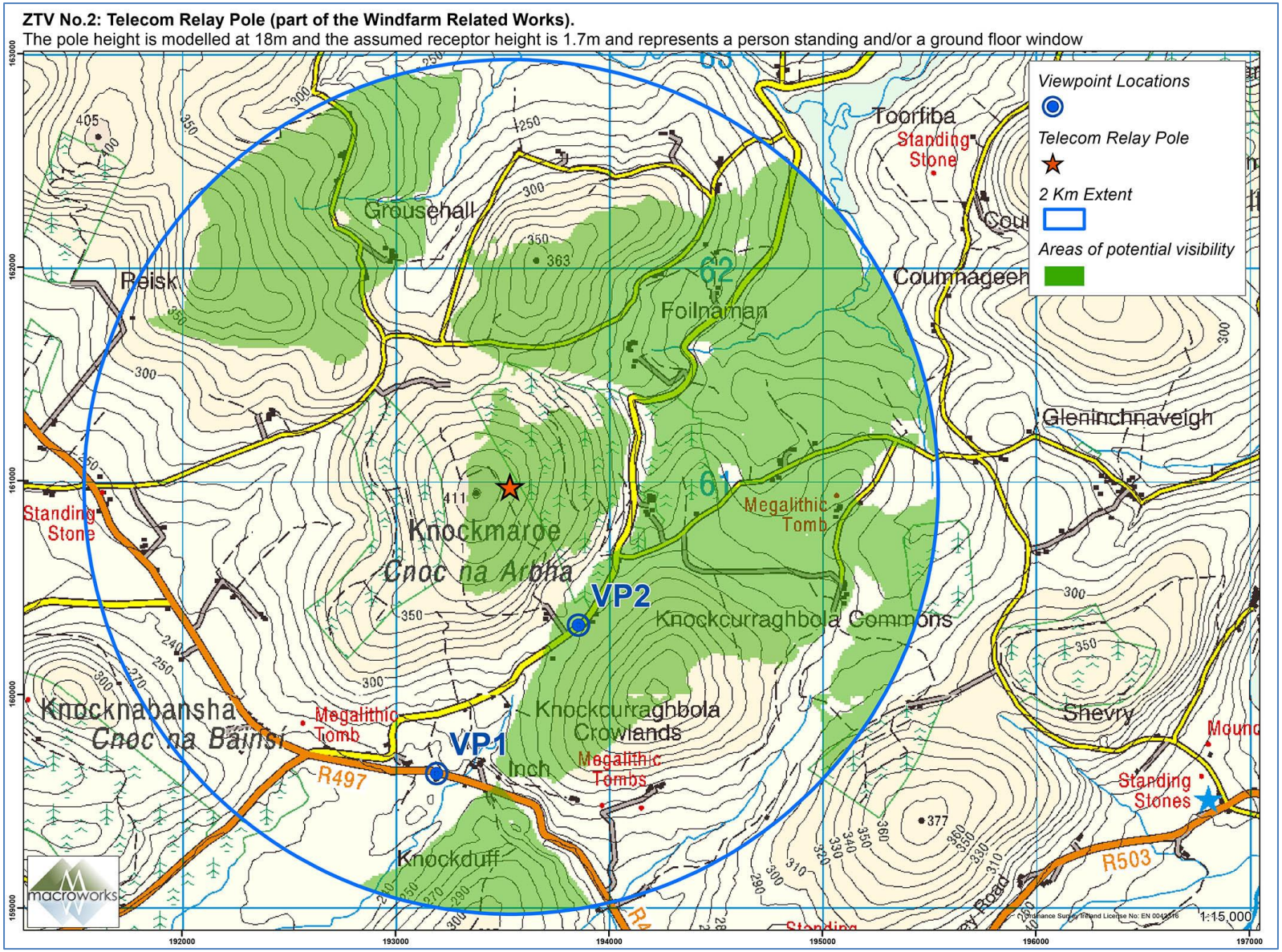
ZTV No.1:Theoretical Visibility of the Mountphilips Substation within the 2km Study Area.



A-17.1.3 ZTV No.2: Telecom Relay Pole within the 2km Study Area

The Zone of Theoretical Visibility (ZTV) map below indicated from where in the surrounding landscape of the study area the top of the Telecom Relay Pole is potentially visible in a 'bare-ground' scenario and does not take account of screening by existing vegetation and buildings.

ZTV No.2: Telecom Relay Pole (part of the Windfarm Related Works).
The pole height is modelled at 18m and the assumed receptor height is 1.7m and represents a person standing and/or a ground floor window



Appendix to Chapter 18: Interaction of the Foregoing

No Appendices for Chapter 18

Appendix to Chapter 19: Monitoring Arrangements

No Appendices for Chapter 19

Appendix to Chapter 20: Executive Summary

No Appendices for Chapter 20