LAND PLANNING & DESIGN

Environmental Impact Assessment Report

Volume 2 - Updated Maps and Appendices response to Request for Further Information for An Bord Pleanala dated 6th February 2019

Comhairle Contae Átha Cliath Theas
South Dublin County Council

CUNNANE STRATTON REYNOLDS
LAND PLANNING & DESIGN

~~July 2017~~ December 2019

Prepared by **Cunnane Stratton Reynolds** in Association with

CATHAL CRIMMINS

VEON

fel Forest Enterprises Ltd.

ROD ROUGHAN & O'DONOVAN

Introduction

This report – Volume 2 of the EIAR – presents the maps and appendices provided as supplementary information to the various chapters of Volume 1 – the Main Report.

The sections of this report (Volume 2) are numbered in accordance with the chapters of Volume 1. (Not all chapters of the main report have supplementary information).

Each section of this report is comprised of two sub-sections, one for maps and one for appendices. (Not all sections have both maps and appendices; they may include only one or the other).

Chapter 1 Introduction

Supplementary Information

Chapter 1 Introduction

Maps

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Kilometers
0 0.250.5 1 1.5 2

Site Context

Site

South Dublin County Boundary

CUNNANE STRATTON REYNOLDS
LAND PLANNING & DESIGN

Dublin Office
3 Molesworth Place
Tel: 01 6610419
Email: info@csrlandplan.ie

Project:	Date:	June 2017
The Dublin Mountains Project Hell Fire Club & Massy's Wood South Dublin	Scale:	1:50,000 @A3
	Drawn:	CL
	Checked:	RB
Drawing: Site Context Map	Drawing No:	Map 1.1

Chapter 2 Existing Environment

Supplementary Information

Chapter 2 Existing Environment

Maps

Zoning Objectives

- Site Boundary
- County Boundary
- Objective RES — *To protect and/or improve residential amenity*
- Objective RES-N — *To provide for new residential communities in accordance with approved area plans*
- Objective REGEN — *To facilitate enterprise and/or residential-led regeneration*
- Objective DC — *To protect, improve and provide for the future development of District Centres*
- Objective LC — *To protect, improve and provide for the future development of Local Centres*
- Objective EE — *To provide for enterprise and employment related uses*
- Objective OS — *To preserve and provide for open space and recreational amenities*
- Objective HA (LV, DV, DM) — *To protect and enhance the outstanding natural character and amenity of the Liffey Valley, Dodder Valley and Dublin Mountains areas*
- Objective RU — *To protect and improve rural amenity and to provide for the development of agriculture*

*Note: Legend reflects zoning objectives visible on map at current scale only

0 0.25 0.5 1 1.5 2 Kilometers

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Project: The Dublin Mountains Project Hell Fire Club & Massy's Wood South Dublin	Date:	June 2017
	Scale:	1:25,000 @A3
	Drawn:	CL
	Checked:	RB
Drawing: Zoning Objectives	Drawing No:	Map 3.1

Chapter 5 Population and Human Health

Supplementary Information

Chapter 5 Population and Human Health

Maps

Electoral Divisions

Electoral Divisions

	<all other values>

CSOED

	03001	*Ballinascorney*
	03003	*Bohernabreena*
	03011	*Edmondstown*
	03012	*Firhouse-Ballycullen*
	03014	*Firhouse Village*
	03035	*Tallaght-Kiltipper*
	03037	*Millbrook*
	03038	*Oldbawn*
	05069	*Tilbradden*
	Site	

0 0.5 1 2 3 4 Kilometers

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3 Molesworth Place
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Email: info@csrlandplan.ie

Project:	Date:	June 2017
The Dublin Mountains Project Hell Fire Club & Massy's Wood South Dublin	Scale:	1:75,000 @A3
	Drawn:	CL
	Checked:	RB
Drawing: Electoral Divisions	Drawing No:	Map 5.1

Kilometers
0 0.250.5 1 1.5 2

Schools within 5 km Radius

- Site
- All Schools
- 5km Radius From Massy's Woods and Hell Fire Woods

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LAND PLANNING & DESIGN

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Project:	Date:	June 2017
The Dublin Mountains Project Hell Fire Club & Massy's Wood South Dublin	Scale:	1:50000 @A3
	Drawn:	CL
	Checked:	RB
Drawing: Schools within 5km of Site	Drawing No:	Map 5.2

Chapter 5 Population and Human Health

Appendices

Age Group of Population 2011 to 2016 by Electoral Division, Statistical Indicator and Census Year			
		2011	2016
03001 Ballinascorney, South Dublin			
	Persons of all ages (Number)	804	921
	Persons aged 0-4 years (Number)	92	91
	Persons aged 5-12 years (Number)	86	129
	Persons aged 13-18 years (Number)	66	56
	Persons aged 19-24 years (Number)	47	67
	Persons aged 25-44 years (Number)	277	299
	Persons aged 45-64 years (Number)	162	181
	Persons aged 65-69 years (Number)	32	36
	Persons aged 70 years and over (Number)	42	62
03003 Bohernabreena, South Dublin			
	Persons of all ages (Number)	4,592	4,496
	Persons aged 0-4 years (Number)	508	321
	Persons aged 5-12 years (Number)	615	673
	Persons aged 13-18 years (Number)	308	395
	Persons aged 19-24 years (Number)	331	263
	Persons aged 25-44 years (Number)	1,552	1,357
	Persons aged 45-64 years (Number)	914	1,042
	Persons aged 65-69 years (Number)	104	159
	Persons aged 70 years and over (Number)	260	286
03011 Edmondstown, South Dublin			
	Persons of all ages (Number)	5,712	5,757
	Persons aged 0-4 years (Number)	466	412
	Persons aged 5-12 years (Number)	674	709
	Persons aged 13-18 years (Number)	488	462
	Persons aged 19-24 years (Number)	460	451
	Persons aged 25-44 years (Number)	1,713	1,577
	Persons aged 45-64 years (Number)	1,440	1,538
	Persons aged 65-69 years (Number)	158	232
	Persons aged 70 years and over (Number)	313	376
03012 Firhouse-Ballycullen, South Dublin			
	Persons of all ages (Number)	7,773	8,230
	Persons aged 0-4 years (Number)	709	682
	Persons aged 5-12 years (Number)	1,101	1,076
	Persons aged 13-18 years (Number)	765	786
	Persons aged 19-24 years (Number)	618	686
	Persons aged 25-44 years (Number)	2,531	2,484
	Persons aged 45-64 years (Number)	1,817	2,131
	Persons aged 65-69 years (Number)	105	195
	Persons aged 70 years and over (Number)	127	190
03014 Firhouse Village, South Dublin			
	Persons of all ages (Number)	11,648	12,214
	Persons aged 0-4 years (Number)	1,218	1,088
	Persons aged 5-12 years (Number)	1,579	1,708
	Persons aged 13-18 years (Number)	910	1,073

	Persons aged 19-24 years (Number)	808	812
	Persons aged 25-44 years (Number)	4,392	3,994
	Persons aged 45-64 years (Number)	2,208	2,668
	Persons aged 65-69 years (Number)	237	399
	Persons aged 70 years and over (Number)	296	472
03035 Tallaght-Kiltipper, South Dublin			
	Persons of all ages (Number)	8,068	8,478
	Persons aged 0-4 years (Number)	873	799
	Persons aged 5-12 years (Number)	1,235	1,303
	Persons aged 13-18 years (Number)	677	791
	Persons aged 19-24 years (Number)	664	599
	Persons aged 25-44 years (Number)	3,022	3,014
	Persons aged 45-64 years (Number)	1,388	1,559
	Persons aged 65-69 years (Number)	104	231
	Persons aged 70 years and over (Number)	105	182
037 Tallaght-Millbrook, South Dublin			
	Persons of all ages (Number)	3,290	3,386
	Persons aged 0-4 years (Number)	215	197
	Persons aged 5-12 years (Number)	254	295
	Persons aged 13-18 years (Number)	185	186
	Persons aged 19-24 years (Number)	241	207
	Persons aged 25-44 years (Number)	896	897
	Persons aged 45-64 years (Number)	816	710
	Persons aged 65-69 years (Number)	356	309
	Persons aged 70 years and over (Number)	327	585
038 Tallaght-Oldbawn, South Dublin			
	Persons of all ages (Number)	4,527	4,579
	Persons aged 0-4 years (Number)	271	275
	Persons aged 5-12 years (Number)	348	404
	Persons aged 13-18 years (Number)	293	273
	Persons aged 19-24 years (Number)	421	312
	Persons aged 25-44 years (Number)	1,419	1,393
	Persons aged 45-64 years (Number)	1,231	1,094
	Persons aged 65-69 years (Number)	263	394
	Persons aged 70 years and over (Number)	281	434
069 Tibradden, Dún Laoghaire-Rathdown			
	Persons of all ages (Number)	786	1111
	Persons aged 0-4 years (Number)	64	62
	Persons aged 5-12 years (Number)	76	101
	Persons aged 13-18 years (Number)	45	264
	Persons aged 19-24 years (Number)	42	47
	Persons aged 25-44 years (Number)	249	279
	Persons aged 45-64 years (Number)	130	161
	Persons aged 65-69 years (Number)	26	29
	Persons aged 70 years and over (Number)	154	168

Population Density and Area Size 2011 to 2016 by Electoral Division, Census Year and Statistical Indicator						
	Population - 2011	Population - 2016	Actual change since previous census	Percentage change since previous census	Population density (persons per sq km)	Area (sq km)
03001 Ballinascorney, South Dublin	804	921	117	14.6	38.3	24.05
03003 Bohernabreena, South Dublin	4592	4496	-96	-2.1	103.6	43.39
03011 Edmondstown, South Dublin	5712	5757	45	0.8	1361.7	4.23
03012 Firhouse-Ballycullen, South Dublin	7773	8230	457	5.9	2897.4	2.84
03014 Firhouse Village, South Dublin	11648	12214	566	4.9	5080.4	2.4
03035 Tallaght-Kiltipper, South Dublin	8068	8478	410	5.1	5136.2	1.65
03037 Tallaght-Millbrook, South Dublin	3290	3386	96	2.9	5324.6	0.64
03038 Tallaght-Oldbawn, South Dublin	4527	4579	52	1.1	3146.7	1.46
05069 Tibradden, Dún Laoghaire-Rathdown	786	1111	325	41.3	83.3	13.34

Fáilte Ireland
National Tourism Development Authority

TOURISM FACTS 2015

September 2016

Issued By:

Research & Evaluation
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All estimates are based on information from the CSO's Country of Residence Survey (CRS), Passenger Card Inquiry (PCI) Survey and Household Travel Survey (HTS), NISRA's Northern Ireland Passenger Survey (NIPS), NISRA's Continuous Household Survey (CHS), Fáilte Ireland's Survey of Overseas Travellers (SOT), Port Survey of Holidaymakers, Accommodation Occupancy Survey, Visitor Attractions Survey, Domestic Omnibus Survey, and SouthWestern Tourism Services (Register of Accommodation).

Tourism Ireland is responsible for marketing the Island of Ireland overseas. Information on Tourism Ireland's marketing activities and the performance of overseas tourism to the island of Ireland is available on www.tourismireland.com/corporate/

TOURISM FACTS 2015

Expenditure by tourists visiting Ireland (including receipts paid to Irish carriers by foreign visitors) was estimated to be worth €6 billion in 2015, this represents growth of 16% on 2014. Combining spending by international tourists with the money spent by Irish residents taking trips here, total tourism expenditure in 2015 was estimated to be €7.7 billion.

Overseas tourist visits to Ireland in 2015 grew by 13.1% to 8.0 million. Short haul markets, Britain and Mainland Europe recorded respective growth of 11.3% and 15.7%. North America and other long haul markets also performed very strongly, increasing by 12.9% and 11.7% respectively.

Britain remains our biggest source market for overseas tourists, representing 41.6% of all such visits. The next biggest source market is Mainland Europe, which accounts for 35.8% of international volume. Some 16.1% of overseas tourists come from North America. The balance, 6.4%, comes from other long haul markets.

Economic benefits

In 2015, out-of-state tourist expenditure amounted to €4.6 billion. With a further €1.3 billion spent by overseas visitors on fares to Irish carriers, foreign exchange earnings were €6 billion. Domestic tourism expenditure amounted to €1.7 billion, making tourism a €7.7 billion industry.

Government earned estimated revenue of €1.8 billion through taxation of tourism, of which €1.3 billion came from foreign tourism. In 2015 the tourism industry accounted for 3.5% of all tax revenue.

In 2015 the value of exported goods and services was estimated at €295.4 billion of which €6 billion can be directly attributed to tourism, accounting for 2.0% of export earnings. Being largely service based, tourism goods have low import content in comparison to other exports.

Total out-of-state and domestic tourism expenditure of €7.7 billion in 2015 represented 4.0% of GNP in revenue terms.

Because tourism is characterised by the fact that consumption takes place where the service is available and tourism activity is frequently concentrated in areas which lack an intensive industry base, it is credited with having a significant regional distributive effect.

Direct employment in the tourism and hospitality industry

The Central Statistics Office's official count of direct employment in 'Accommodation and food service activities', a category which includes hotels, restaurants, bars, canteens and catering, was 139,900 in 2015 (7.1% of total employment). This estimate of employment is based on the CSO Household Survey and the jobs identified are defined as 'the respondent's main job' and include both full-time and part-time.
Source: CSO Quarterly National Household Survey

Drawing on an alternative approach, an estimate of all jobs in the tourism and hospitality industry based on past Fáilte Ireland surveys of businesses (full-time, part-time, seasonal/casual and not confined to 'main' job) indicates total employment in the sector at approximately 220,000. This estimate includes an additional category of tourism services and attractions which is not covered by the CSO.

Tourism Numbers 2012 – 2015

Where did Ireland's tourists come from?

Numbers (000s)	2012	2013	2014	2015
Britain	**2,722**	**2,870**	**3,007**	**3,346**
Mainland Europe	**2,247**	**2,346**	**2,490**	**2,880**
France	*384*	*409*	*420*	*471*
Germany	*437*	*466*	*535*	*609*
Italy	*240*	*226*	*246*	*304*
Spain	*239*	*249*	*274*	*322*
Netherlands	*137*	*148*	*151*	*174*
Belgium	*82*	*95*	*99*	*121*
Denmark	*42*	*51*	*55*	*66*
Sweden	*70*	*72*	*60*	*64*
Switzerland	*78*	*73*	*84*	*105*
Austria	*46*	*51*	*57*	*53*
Norway	*48*	*50*	*50*	*58*
Poland	*159*	*152*	*140*	*161*
All Other Europe	*284*	*306*	*318*	*373*
North America	**940**	**1,039**	**1,146**	**1,294**
USA	*833*	*924*	*1,005*	*1,129*
Canada	*107*	*115*	*140*	*165*
Rest of World	**378**	**431**	**462**	**516**
Australia, New Zealand & Other Oceania	*158*	*192*	*191*	*205*
Other Areas	*219*	*240*	*271*	*312*
Total Overseas	**6,286**	**6,686**	**7,105**	**8,036**
Northern Ireland[1]	1,299	1,572	1,708	1,492
Total out-of-state	**7,585**	**8,258**	**8,813**	**9,528**
Domestic trips[2]	8,291	8,413	8,991	9,125

Source surveys are designed to measure area of residence groupings (bold figures). Figures in italics are indicative of approximate overall market size but do not provide a sufficient level of precision to accurately reflect absolute market size or trends over time.

Source: CSO/Fáilte Ireland/TSB, NISRA

1 Revised by NISRA May 2015

2 2012-2015 domestic data revised due to new methodological approach by CSO, August 2016

Tourism Revenue 2012 – 2015

How much money did they spend?

Revenue (€m)	2012	2013[3]	2014	2015
Britain	**857.9**	**890.9**	**926.7**	**1,017.9**
Mainland Europe	**1,060.5**	**1,228.2**	**1,301.2**	**1,555.3**
North America	**745.7**	**829.0**	**940.3**	**1,199.7**
Other Overseas	**291.6**	**367.7**	**428.1**	**492.6**
TOTAL OVERSEAS	**2,955.8**	**3,315.7**	**3,596.4**	**4,265.3**
Northern Ireland[4, 5]	292.3	304.5	334.4	351.2
TOTAL OUT-OF-STATE	**3,248.1**	**3,620.3**	**3,930.7**	**4,616.5**
Carrier receipts[6]	856.0	976.0	1,166.0	1,322.0
Overseas same-day visits	34.0	35.0	41.0	38.0
TOTAL FOREIGN EXCHANGE EARNINGS	**4,138.1**	**4,631.3**	**5,137.7**	**5,976.5**
Domestic trips[7]	1,514.2	1,533.0	1,713.5	1,725.3
TOTAL TOURISM REVENUE	**5,652.3**	**6,164.3**	**6,851.2**	**7,701.8**

Source surveys are designed to measure area of residence groupings (bold figures).
Source: CSO/Fáilte Ireland/TSB NISRA/Central Bank of Ireland

Revenue – some useful figures

Per diems – spend per person per day

Overseas tourists	€68
Overseas holidaymakers	€89
Domestic overnight trips	€73

For every euro spent on tourism (domestic and overseas), 23c is generated in tax.

Employment – some useful figures

Every €1mn of tourist expenditure helps to support 29 tourism jobs.
1,000 additional tourists support 14 jobs in the tourism industry.

3 Revised March 2014
4 NISRA GBP: Northern Ireland resident expenditure data provided in STℰ from 2009 onwards. Euro exchange rate 2015-0.72585 Source: Central Bank of Ireland
5 2012,2013 Revised by NISRA May 2015
6 2012 carrier receipts revised March 2014, 2013 and 2014 revised March 2016
7 2012-2015 domestic data revised due to new methodological approach by CSO, August 2016

Regional Visits and Revenue 2015

Where did tourists go in 2015?

Numbers (000s) ***Revenue (€m)***	**Britain**	**Mainland Europe**	**North America**	**Other Areas**	**All Overseas**	**Northern Ireland[8,9]**	**Domestic Trips**
Dublin	1,594	1,987	980	376	4,937	391	1,599
	322.9	*657.3*	*457.0*	*289.0*	*1,726.2*	*81.6*	*263.8*
East & Midlands	431	341	109	41	922	223	1,319
	116.7	*119.0*	*62.0*	*26.0*	*323.7*	*52.4*	*216.5*
South-East	298	290	215	73	876	46	1,318
	90.8	*84.1*	*55.0*	*29.0*	*258.9*	*9.6*	*258.1*
South-West	632	808	490	174	2,104	94	1,746
	191.3	*333.5*	*209.0*	*58.0*	*791.8*	*48.8*	*389.6*
Shannon	302	419	342	85	1148	n/a	890
	88.6	*99.2*	*144.0*	*35.0*	*366.8*	*n/a*	*138.6*
West	331	690	436	133	1,590	146	1,482
	101.6	*203.9*	*229.0*	*40.0*	*574.5*	*53.8*	*315.1*
North-West	302	239	110	43	694	591	771
	105.9	*58.2*	*43.0*	*17.0*	*224.1*	*104.9*	*143.7*

Source: CSO/Fáilte Ireland NISRA/Central Bank of Ireland

Overseas Tourists in 2015

How did overseas tourists spend their money in Ireland?

Breakdown of spend in Ireland (%)	**Total**	**Britain**	**Mainland Europe**	**North America**	**Rest of World**
Bed & board	31	28	33	32	27
Other food & drink	33	39	31	32	32
Sightseeing/entertainment	7	6	8	7	8
Internal transport	13	13	12	14	12
Shopping	14	12	14	13	18
Miscellaneous	2	2	2	3	2

When did they arrive?

Seasonality (%)	**Total**	**Britain**	**Mainland Europe**	**North America**	**Rest of World**
January-March	18	20	17	13	16
April	8	8	9	7	7
May	10	9	10	10	9
June	10	8	10	14	10
July	11	10	11	13	12
August	12	11	12	12	12
September	9	9	9	11	10
October-December	23	25	22	20	24

Source: Fáilte Ireland estimates based on CSO

8 Source: NISRA GBP; Euro exchange rates 2015 – 0.72585 Source: Central Bank of Ireland

9 Shannon n/a– insufficient survey response level to support an estimate

How did they arrive/depart?

(%)	Total	Britain	Mainland Europe	North America	Rest of World
Air					
From Britain	37	74	5	22	32
From Mainland Europe	37	1	87	18	28
Transatlantic	11	1	1	56	2
Asia/Middle East	2	-	-	-	29
Sea					
From Britain	9	17	3	2	6
From Mainland Europe	1	*	3	-	-
Via N. Ireland	3	7	1	1	4

Source: CSO (indicates less than 0.5 percent)*

Where did they stay? (distribution of bednights)

(%)	Total	Britain	Mainland Europe	North America	Rest of World
Hotels	19	23	14	28	16
Guesthouses/B&Bs	6	4	8	7	3
Self-catering	23	10	25	25	32
Caravan & camping	1	1	2	*	*
Hostels	3	1	4	3	3
Friends/relatives	26	54	18	21	22
Other	22	7	29	16	24
Source: SOT					
Nights (Million)	62.5	16.4	26.7	11.8	7.6
Source (CSO)					

(indicates less than 0.5 percent)*

What activities did they engage in?

	Overseas Participants (000s)
Hiking/cross country walking	1,674
Cycling	355
Golf	198
Angling	163
Equestrian	75

What was their main reason for visiting Ireland?

(000s)	Total	Britain	Mainland Europe	North America	Rest of World
Holiday	4,036	1,254	1,612	926	243
Visit friends/relatives	2,374	1,412	591	201	169
Business	1,273	618	469	115	72
Other	353	61	209	51	32

Source: CSO and NISRA

In 2015, less than 3 in ten (29%) of those coming to Ireland to visit friends/relatives were born in Ireland.

Overseas Holidaymakers 2015

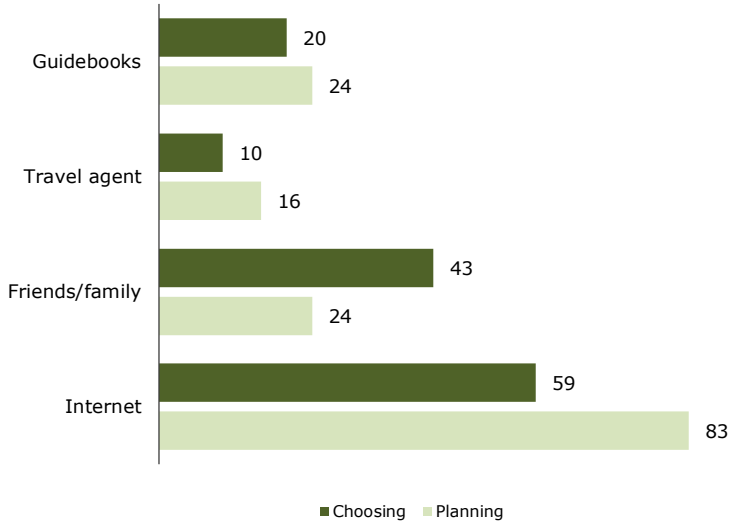
Holidaymakers in this section are defined as tourists who stated that their primary purpose for visiting Ireland was a holiday.

What was the total number of holidaymakers in 2015?

Holidaymakers (000s)	2010	2011	2012	2013	2014	2015
Britain	896	961	941	979	1,057	1,254
Mainland Europe	971	1,041	1,120	1,227	1,314	1,612
North America	546	591	634	718	803	926
Rest of World	137	167	184	220	219	243
Total	2,549	2,760	2,879	3,144	3,393	4,036

Source: CSO and NISRA

Sources of information for choosing/planning a holiday in Ireland (%)



Source: Fáilte Ireland's Port Survey of Holidaymakers 2015

How did they arrange their holiday?

(%)	Total	Britain	Mainland Europe	North America	Rest of World
Package*	16	10	14	24	15
Independent	84	90	86	76	85

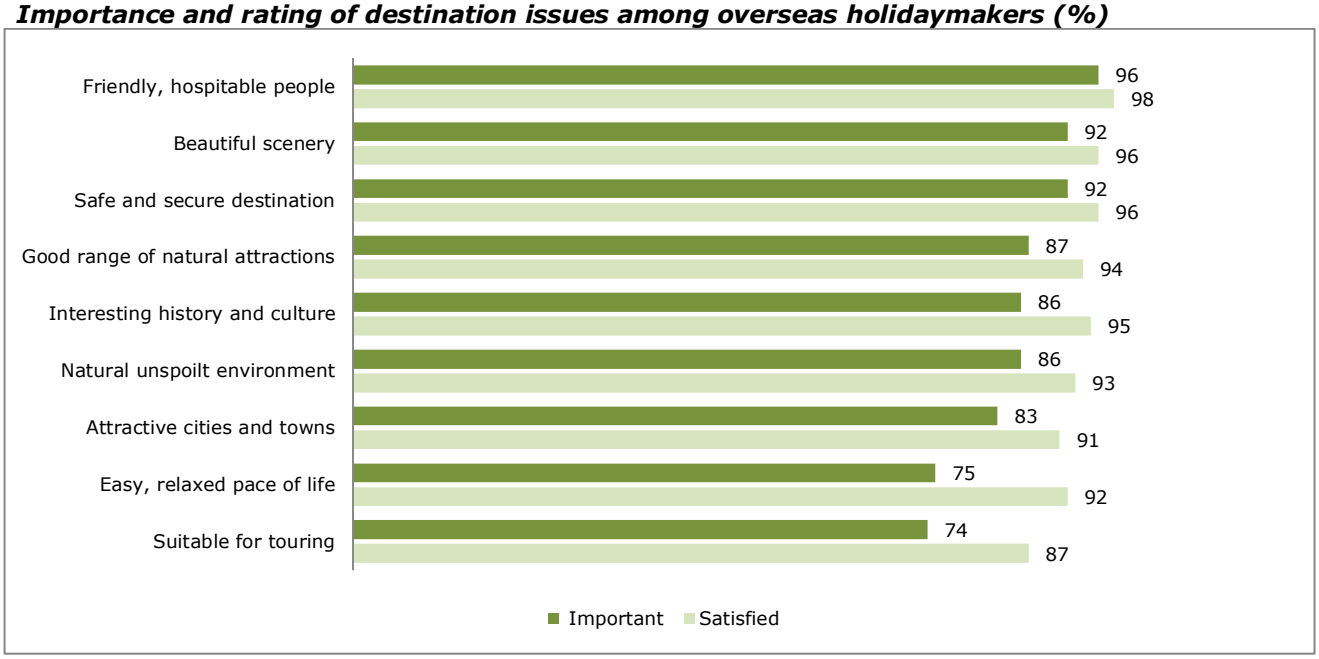
** Prepaid an inclusive price for fares to/from Ireland and at least one other element of the holiday.*
Source: Fáilte Ireland's Survey of Overseas Travellers

What were the characteristics of holidaymakers to Ireland (%)?

Experience of Ireland		Use of car		Age		Social class		Party composition	
First visit	61	Car brought	12	Under 25 years	21	Managerial/professional (AB)	28	Alone	21
Repeat	37	Car hired	32	25-34 years	24	White collar (C1)	55	Couple	43
Irish-born	2	Car not used	56	35-44 years	13	Skilled worker (C2)	13	Family	14
				45+ years	43	Unskilled worker (DE)	3	Other adult group	22

Source: Fáilte Ireland's Survey of Overseas Travellers

Importance and rating of destination issues among overseas holidaymakers (%)



Source: Fáilte Ireland's Port Survey of Overseas Holidaymakers 2015

Domestic Tourism in 2015[10]

Domestic trips (000s) by purpose of travel

	2012	2013	2014	2015
Holiday trips	4,036	4,073	4,436	4,658
- *Long (4+ nights)*	*918*	*1,088*	*1,144*	*1,078*
- *Short (1-3 nights)*	*3,118*	*2,985*	*3,292*	*3,580*
Visiting friends/relatives trips	2,765	2,988	2,918	2,921
Business trips	350	364	453	407
Other trips	1,140	988	1,184	1,138
Total trips	**8,291**	**8,413**	**8,991**	**9,125**

Source: CSO Household Travel Surveys 2012-2015

Domestic expenditure (€m) by purpose of travel

	2012	2013	2014	2015
Holiday trips	876.2	947.2	992.8	1,070.4
- *Long (4+ nights)*	*311.9*	*395.2*	*385.6*	*394.2*
- *Short (1-3 nights)*	*564.3*	*552.0*	*607.1*	*676.2*
Visiting friends/relatives trips	289.6	284.8	327.0	296.5
Business trips	80.5	84.2	110.3	98.0
Other trips	268.0	216.8	283.4	260.4
Total expenditure	**1,514.2**	**1,533**	**1,713.5**	**1,725.3**

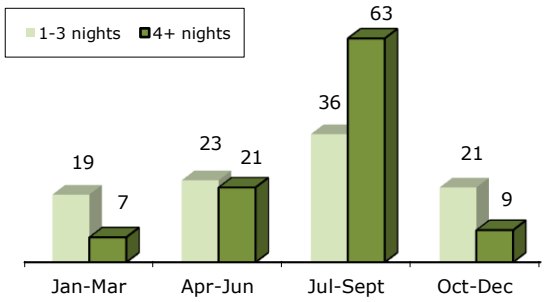
Source: CSO Household Travel Surveys 2012-2015

Accommodation bednights domestic holidaymakers (%)

	2012	2013	2014	2015
Hotels	37	34	34	35
Guesthouse/B&Bs	3	3	4	4
Caravan/camping	12	15	14	7
Self-catering	20	22	23	22
Holiday home	12	15	12	19
Friends/relatives	13	10	13	10
Other	2	1	1	3

Source: CSO Household Travel Surveys 2012-2015

Seasonality of holidaymakers (%) 2015 by length of stay



Source: CSO Household Travel Survey 2015

10 2012-2015 domestic data revised due to new methodological approach by CSO, August 2016

Activities engaged in by domestic holidaymakers (%)

Houses/castles	26
Hiking/walking	23
National parks	22
Gardens	21
Visits to spas	20
Watersports (excluding swimming)	18
Heritage/ interpretive centres	18
Monuments	16
Museums/art galleries	15
Cycling	7
Golf	7
Angling	4
Attending horse racing	3
Equestrian pursuits	1

Source: Fáilte Ireland Domestic Omnibus 2015

The Tourism Product

Accommodation in 2015

	Premises	**Rooms**
Hotels	798	56,240
Guesthouses	226	2,835
Bed and Breakfasts*	1,324	5,568
Self-Catering (group scheme only - units)	3,346	n/a
Hostels (beds)	110	7,989
Caravan & camping (pitches)	93	5,312

Source: SouthWestern Tourism Services
** includes specialist and pub accommodation*

Accommodation occupancy in 2015

	%
Hotel Room Occupancy	70
Guesthouse Room Occupancy	61
B&Bs Room Occupancy	40
Hostels Bed Occupancy	64
Group Scheme Self-Catering Bed Occupancy	30
Caravan and Camping Bed Occupancy	24

Source: Fáilte Ireland Occupancy Surveys

Attendance at popular visitor attractions in Ireland 2015

Top Fee-Charging Attractions			Top Free Attractions		
Name of Attraction	**County**	**2015**	**Name of Attractions**	**County**	**2015**
Guinness Storehouse	Dublin	1,498,124	The National Gallery of Ireland	Dublin	718,637
Cliffs of Moher Visitor Experience	Clare	1,251,574	National Botanic Gardens	Dublin	553,348
Dublin Zoo	Dublin	1,105,005	Irish Museum of Modern Art	Dublin	485,702
National Aquatic Centre	Dublin	991,554	National Museum of Ireland - Archaeology, Kildare St	Dublin	457,057
Book of Kells	Dublin	767,996	Doneraile Wildlife Park	Cork	432,180
Tayto Park	Meath	750,000	Farmleigh	Dublin	410,076
St Patrick's Cathedral	Dublin	532,042	Science Gallery at Trinity College Dublin	Dublin	409,891
Fota Wildlife Park	Cork	436,386	Newbridge Silverware Museum of Style Icons	Kildare	350,000
Blarney Castle	Cork	400,000	Chester Beatty Library	Dublin	343,929
Bunratty Castle & Folk Park	Clare	341,685	National Museum of Ireland - Natural History, Merrion St	Dublin	320,528
Kilmainham Gaol	Dublin	326,635	National Museum of Ireland - Decorative Arts & History, Collins Barracks	Dublin	295,820
Rock of Cashel	Tipperary	300,749	Holy Cross Abbey	Tipperary	210,000
Kylemore Abbey & Garden	Galway	300,000	Connemara National Park	Galway	190,753
Castletown House & Parklands	Kildare	297,691	Dublin City Gallery The Hugh Lane	Dublin	190,000
Kilkenny Castle	Kilkenny	282,588	Sliabh Liag Cliffs	Donegal	185,760
Old Jameson Distillery	Dublin	282,056	Crawford Art Gallery	Cork	175,902
Powerscourt House & Gardens	Wicklow	249,475	Galway City Museum	Galway	174,556
Dublin Castle	Dublin	231,178	Drumcliffe Church & Audio Visual Presentation	Sligo	160,000
Christ Church Cathedral	Dublin	195,888	Malin Head Viewing Point	Donegal	154,760
The House of Waterford Crystal	Waterford	177,000	Nicholas Mosse Pottery	Kilkenny	125,000
Glenveagh Castle and Grounds	Donegal	170,797	National Museum of Ireland - Country Life, Turlough Park	Mayo	119,839

Source: Fáilte Ireland Visitor Attraction Survey 2015

Fáilte Ireland
National Tourism Development Authority

Regional tourism performance in 2015

October 2016

Issued By:

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Please note: tourists and holidaymakers can visit more than one county or region during one trip, therefore the sum of visits/holidays to regions and counties add up to more than the national total.

Regional distribution of overseas markets in 2015

REGION		Britain	Mainland Europe	North America	Other Areas	Total
Dublin	Tourists (000s)	1,594	1,987	980	376	4,937
	Tourist Revenue (€mn)	322.9	657.3	457.0	289.0	1,726.2
	Holidaymakers (000s)	678	1,176	777	210	2,841
East & Midlands	Tourists (000s)	431	341	109	41	922
	Tourist Revenue (€mn)	116.7	119.0	62.0	26.0	323.7
	Holidaymakers (000s)	114	207	66	17	404
South East	Tourists (000s)	298	290	215	73	876
	Tourist Revenue (€mn)	90.8	84.1	55.0	29.0	258.9
	Holidaymakers (000s)	116	210	187	44	557
South West	Tourists (000s)	632	808	490	174	2,104
	Tourist Revenue (€mn)	191.3	333.5	209.0	58.0	791.8
	Holidaymakers (000s)	298	604	410	116	1,428
Shannon	Tourists (000s)	302	419	342	85	1,148
	Tourist Revenue (€mn)	88.6	99.2	144.0	35.0	366.8
	Holidaymakers (000s)	107	324	275	54	760
West	Tourists (000s)	331	690	436	133	1,590
	Tourist Revenue (€mn)	101.6	203.9	229.0	40.0	574.5
	Holidaymakers (000s)	145	533	355	87	1,120
North West	Tourists (000s)	302	239	110	43	694
	Tourist Revenue (€mn)	105.9	58.2	43.0	17.0	224.1
	Holidaymakers (000s)	104	190	84	25	403

Overseas tourists (000s) to counties in 2015

County	Total	Britain	Mainland Europe	North America	Other Areas
Dublin	4,938	1,593	1,987	980	376
Carlow	62	31	23	7	1
Kilkenny	267	52	107	85	23
Tipperary (South)	133	46	45	29	12
Waterford	263	79	81	80	24
Wexford	221	113	63	30	15
Cork	1,449	505	565	266	113
Kerry	1,026	166	415	347	97
Clare	597	110	221	220	46
Limerick	537	166	200	134	37
Tipperary(North)	51	27	15	6	4
Offaly (West)	10	6	4	1	0
Galway	1,354	243	621	373	117
Mayo	302	79	121	85	17
Roscommon	50	23	11	11	4
Cavan	144	93	25	17	9
Donegal	289	84	126	55	24
Leitrim	57	29	16	8	3
Monaghan	65	45	10	6	4
Sligo	186	62	86	30	9
Kildare	214	113	71	19	10
Laois	57	31	17	6	3
Longford	30	15	10	3	2
Louth	125	62	44	13	5
Meath	134	58	48	20	9
Wicklow	248	95	112	32	10
Offaly (East)	38	19	14	4	1
Westmeath	116	55	42	15	4

- *"*" indicates less than 1,000.*
- *Total visits to region are less than the sum of visits to the counties because overseas tourists can visit more than one county.*
- *Data is based on three-year rolling averages.*

Overseas tourist revenue (€mn) by county in 2015

County	Total	Britain	Mainland Europe	North America	Other Areas
Dublin	1,726	323	657	457	289
Carlow	32	10	14	8	1
Kilkenny	45	14	14	12	5
Tipperary (South)	41	15	14	8	4
Waterford	75	23	24	16	12
Wexford	65	29	18	12	7
Cork	558	137	254	126	40
Kerry	234	54	79	83	18
Clare	127	30	29	60	9
Limerick	212	47	61	80	24
Tipperary (North)	25	11	9	4	2
Offaly (West)	2	2	*	*	-
Galway	475	69	174	197	34
Mayo	80	25	26	26	4
Roscommon	20	8	4	6	2
Cavan	50	27	7	10	6
Donegal	83	32	24	22	5
Leitrim	15	9	3	2	1
Monaghan	25	18	4	2	1
Sligo	51	20	20	6	4
Kildare	89	30	33	20	6
Laois	18	10	4	3	1
Longford	8	5	2	*	*
Louth	36	13	10	9	3
Meath	44	15	18	8	3
Wicklow	82	22	36	15	9
Offaly (East)	12	5	3	3	1
Westmeath	36	16	14	5	1

- *"*" indicates less than €1mn.*
- *Data is based on three-year rolling averages.*

Irish residents' trips by county

Number of trips (000s) by the main county visited, 2012 - 2015

	2012	***2013***	***2014***	***2015***
Total domestic – trips (000s) [1]	**8,291**	**8,413**	**8,991**	**9,125**
Cavan and Leitrim	196	242	179	234
Clare	388	347	388	410
Cork	944	902	973	967
Donegal	300	313	329	314
Dublin	1,642	1,525	1,639	1,599
Galway	720	834	916	895
Kerry	708	823	862	779
Kildare and Carlow	250	228	253	306
Kilkenny	197	291	200	228
Laois and Offaly	155	169	205	193
Limerick	188	271	253	257
Louth and Monaghan	110	148	197	142
Mayo	385	458	524	463
Meath	184	182	183	208
Roscommon and Longford	156	97	137	160
Sligo	242	207	223	263
Tipperary	202	184	161	217
Waterford	304	273	317	285
Westmeath	177	167	187	209
Wexford	575	518	603	679
Wicklow	267	234	259	315

[1] Data is published at county level above a threshold of 150,000 trips for most recent year. Data is amalgamated below this threshold.
Source: Central Statistics Office Household Travel Survey, 2012-2015

Irish residents' trip expenditure by county

Expenditure by main county visited, 2012- 2015

	2012	***2013***	***2014***	***2015***
Total domestic expenditure (€million)	**1,514.2**	**1,533.0**	**1,713.5**	**1,725.3**
Cavan and Leitrim	30.3	39.5	24.9	39.5
Clare	88.1	87.2	83.2	101.2
Cork	180.3	150.9	171.3	171.0
Donegal	73.0	67.8	89.2	75.7
Dublin	273.5	267.2	283.7	263.8
Galway	143.4	150.7	201.0	194.1
Kerry	171.6	200.7	198.4	202.8
Kildare and Carlow	35.1	24.9	30.4	39.9
Kilkenny	28.5	36.1	24.0	30.1
Laois and Offaly	19.0	20.5	27.9	24.8
Limerick	25.2	37.4	39.2	32.1
Louth and Monaghan	15.2	18.7	30.5	24.3
Mayo	84.5	109.6	118.6	93.3
Meath	28.6	20.7	20.3	23.6
Roscommon and Longford	19.0	19.0	26.8	28.2
Sligo	39.1	42.2	43.0	61.2
Tipperary	29.6	22.8	27.7	37.5
Waterford	63.8	51.2	73.7	62.3
Westmeath	18.2	19.6	20.8	28.2
Wexford	109.1	111.9	140.2	140.0
Wicklow	39.1	34.6	38.6	51.7

Source: Fáilte Ireland's own estimates based on CSO Household Travel Survey, 2015

Profile of overseas tourists by region in 2015

Main reason for visit (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Holiday	58	44	64	68	66	70	58
Business	15	9	7	9	10	5	7
Visiting friends/relatives	22	44	27	19	21	20	33
Other	5	3	3	4	2	4	2

Month of departure (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
January-March	18	14	10	12	11	9	9
April	8	8	8	6	5	6	6
May	10	8	9	10	9	9	7
June	11	9	12	12	11	12	10
July	11	13	16	12	14	14	16
August	11	15	16	15	15	18	21
September	10	11	10	11	11	12	12
October-December	22	21	18	22	23	19	20

Route of entry (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Air from Britain	36	38	26	35	34	23	26
Air from Mainland Europe	45	35	27	37	30	40	31
Transatlantic Air	12	10	17	16	22	21	14
Asia/Middle East Air	2	1	3	1	1	1	3
Sea from Britain	5	14	22	8	9	11	19
Sea from Mainland Europe	1	2	4	3	3	4	6

Accommodation used (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Hotel	53	27	38	41	42	34	32
Guesthouse/B&B	7	12	17	24	17	24	19
Rented	4	3	4	7	6	6	2
Caravan & camping	*	2	3	2	3	3	5
Hostel	8	2	1	6	4	9	3
Friends/relatives	22	53	31	24	26	22	32
Other	5	5	5	5	5	7	8

Accommodation bednights (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Hotel	24	10	13	17	19	13	14
Guesthouse/B&B	3	4	5	12	6	10	11
Rented	26	12	16	23	27	28	4
Caravan & camping	*	1	1	2	2	1	2
Hostel	4	1	*	3	1	4	2
Friends/relatives	20	49	39	22	29	24	44
Other	23	23	26	21	16	20	23

Other regions visited (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Dublin		28	43	41	40	54	45
East & Midlands	6		12	8	8	10	15
South East	7	10		18	18	16	14
South West	16	17	42		38	38	28
Shannon	9	9	24	22		21	22
West	16	16	29	29	28		39
North West	5	8	9	7	10	13	

Experience of Ireland (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Irish born	8	25	17	11	10	10	18
On first visit	47	25	38	42	44	48	29
Repeat	45	50	45	48	46	42	53

Party composition (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Travelling alone	54	56	38	40	43	41	42
Couple	23	25	35	35	32	33	35
Family	8	9	15	13	12	13	12
Other adult party	15	10	11	13	14	14	11

Social class (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Managerial/professional (AB)	31	30	32	41	27	29	26
White collar (C1)	55	51	48	45	57	55	53
Skilled worker (C2)	11	14	15	11	14	12	15
Unskilled worker (DE)	3	5	5	3	2	3	5

Age (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Under 19 years	7	7	7	8	6	9	7
19-24 years	17	11	8	11	14	14	9
25-34 years	25	20	19	21	21	21	18
35-44 years	15	15	13	13	14	12	11
45-54 years	17	18	16	16	16	17	17
55-64 years	12	15	20	18	16	15	19
65+ years	7	14	18	14	13	12	19

Profile of overseas holidaymakers by region in 2015

Month of departure (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
January-March	13	4	4	6	4	4	4
April	6	6	6	7	4	5	5
May	10	11	8	9	8	10	9
June	14	17	16	17	16	16	14
July	13	22	20	14	17	17	21
August	14	18	18	19	16	19	20
September	12	13	15	14	18	16	16
October-December	18	11	12	16	17	14	10

Route of entry (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Air from Britain	28	18	13	23	19	17	15
Air from Mainland Europe	46	47	26	38	34	42	36
Transatlantic Air	18	13	31	23	30	25	19
Asia/Middle East Air	1	1	1	1	1	1	1
Sea from Britain	5	16	21	10	10	9	16
Sea from Mainland Europe	1	6	8	6	6	6	11

Accommodation used (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Hotel	63	44	49	45	49	43	42
Guesthouse/B&B	13	30	29	38	29	36	31
Rented	4	3	5	7	6	4	3
Caravan & camping	1	7	7	5	7	5	9
Hostel	13	5	3	7	7	10	3
Friends/relatives	3	10	5	5	2	3	4
Other	4	4	3	5	4	5	9

Regional tourism performance in 2015

Accommodation bednights (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Hotel	56	31	32	31	33	30	24
Guesthouse/B&B	11	20	20	26	21	31	32
Rented	8	8	15	13	17	9	5
Caravan & camping	1	5	8	7	8	5	9
Hostel	13	4	2	6	4	7	2
Friends/relatives	6	28	17	7	5	5	7
Other	5	4	6	10	12	13	21

Other regions visited (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Dublin		60	69	60	63	72	64
East & Midlands	8		19	13	14	14	22
South East	14	28		29	31	27	23
South West	31	48	74		63	56	48
Shannon	18	29	44	35		33	41
West	30	41	55	45	48		64
North West	8	20	14	12	18	19	

Experience of Ireland (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Irish born	1	2	4	2	1	1	2
On first visit	69	54	62	61	65	64	48
Repeat	30	44	33	37	33	36	51

Party composition (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Travelling alone	21	20	13	16	14	19	17
Couple	42	46	56	51	50	49	52
Family	13	11	14	16	17	14	15
Other adult party	24	22	17	16	19	18	15

Social class (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Managerial/professional (AB)	26	28	33	35	27	30	28
White collar (C1)	58	52	51	51	58	55	56
Skilled worker (C2)	13	14	13	11	14	12	13
Unskilled worker (DE)	3	5	3	2	1	2	3

Age (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Under 19 years	7	6	6	7	6	8	6
19-24 years	16	9	6	9	11	10	9
25-34 years	26	20	19	21	20	21	17
35-44 years	13	13	10	10	12	12	9
45-54 years	17	20	16	15	17	17	21
55-65 years	13	19	24	21	18	18	21
65+ years	9	13	19	16	16	14	17

Gender (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Male	41	43	45	50	47	43	44
Female	59	57	55	50	53	57	56

Marital status (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Married/living as married	53	63	69	68	64	63	67
Single/widowed/divorced/ separated	47	37	31	31	36	37	33

Dependent children (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Yes	17	19	16	18	19	19	20
No	83	81	84	82	81	81	80

Use of car (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Car brought/borrowed	5	23	24	16	14	15	28
Car hired	28	55	49	54	59	53	47
Car not used	66	22	27	31	26	32	25

Whether travelling on a package (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Package	17	18	25	23	26	22	28
Independent	83	82	75	77	74	78	72

Value for Money (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Good	61	65	57	61	49	55	60
Fair	33	30	39	36	43	39	35
Poor	5	4	4	3	7	5	5

Profile of domestic tourists by region in 2015

Trips and revenue	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Domestic trips (000s)	1,599	1,319	1,318	1,746	890	1,482	771
Proportion of all domestic trips (%)	18	14	14	19	10	16	8
Domestic revenue (€m)	264	217	258	390	139	315	144

Purpose of trip (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Holiday	34	47	69	60	41	55	48
Visiting friends/relatives	37	34	23	27	40	31	38
Business	9	5	2	4	5	3	2
Other	20	14	5	9	14	12	12

Timing of domestic trips (%)	Dublin	East & Midlands	South East	South West	Shannon	West	North West
January-March	21	18	17	18	19	19	21
April-June	27	22	26	24	21	23	22
July-September	26	35	40	35	39	36	37
October-December	26	25	17	23	21	21	20

Accommodation capacity by region in 2015

Approved room capacity	Dublin	East & Midlands	South East	South West	Shannon	West	North West
Hotels							
5*	1,684	535	248	930	255	232	96
4*	8,610	3,429	2,786	4,729	1,877	3,028	2,474
3*	7,425	1,943	2,123	3,717	2,999	3,093	2,281
2*	728	273	232	276	376	332	289
1*	84	101	54	40	32	116	34
Other	-			-		-	-
Total Hotels	**18,531**	**6,281**	**5,443**	**9,692**	**5,539**	**6,801**	**5,174**
Guesthouses and B&Bs	850	830	1,075	2,490	1,024	1,559	833
Total Paid Serviced	**19,381**	**7,111**	**6,518**	**12,182**	**6,563**	**8,360**	**6,007**
Self-catering (registered)*	48	80	182	1,303	506	260	218
Hostels**	3,039	412	285	1,700	777	1,349	511

** Self-catering registered figures are units (e.g.houses)*
*** Hostel figures are beds available.*

Notes

Note 1: Holidaymakers are defined as tourists who stated that their main reason for visiting Ireland was a holiday.

Note 2: Approved Room Capacity is supplied by by SouthWestern Tourism Services (Register of Accommodation)

Note 3: In the tables, * means less than 0.5%, - means 0%.

Note 4: Estimates are based on information from the CSO's Country of Residence Survey (CRS), Passenger Card Inquiry (PCI) and Household Travel Survey, NISRA's Northern Ireland Passenger Survey (NIPS) and Continuous Household Survey (CHS) and Fáilte Ireland's Survey of Overseas Travellers.

Definition of tourism regions

Dublin	
Dublin County	
East & Midlands	
Kildare	Laois
Longford	Louth
Meath	Wicklow
Offaly (East)	Westmeath
South East	
Carlow	Kilkenny
Tipperary (South)	Waterford
Wexford	
South West	
Cork	Kerry
Shannon	
Clare	Limerick
Tipperary (North)	Offaly (West)
West	
Galway	Mayo
Roscommon	
North West	
Cavan	Donegal
Leitrim	Monaghan
Sligo	

TOURISM FACTS 2016

Preliminary

June 2017

Issued By:

Research & Evaluation
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All estimates are based on information from the CSO's Country of Residence Survey (CRS), Passenger Card Inquiry (PCI) Survey and Household Travel Survey (HTS), NISRA's Northern Ireland Passenger Survey (NIPS), NISRA's Continuous Household Survey (CHS), Fáilte Ireland's Survey of Overseas Travellers (SOT), Port Survey of Holidaymakers, Accommodation Occupancy Survey, Visitor Attractions Survey, Domestic Omnibus Survey, and SouthWestern Tourism Services (Register of Accommodation).

Tourism Ireland is responsible for marketing the Island of Ireland overseas. Information on Tourism Ireland's marketing activities and the performance of overseas tourism to the island of Ireland is available on www.tourismireland.com/corporate/

TOURISM FACTS 2016

Overseas tourist visits to Ireland in 2016 grew by 8.8% to 8.742 million. Short haul markets, Britain and Mainland Europe recorded respective growth of 8.5% and 7.7%. North America market also performed very strongly, increasing by 14.2%.

Britain remains our biggest source market for overseas tourists, representing 41% of all such visits. The next biggest source market is Mainland Europe, which accounts for 36% of international volume. Some 17% of overseas tourists come from North America. The balance, 6%, comes from other long haul markets.

Tourism Numbers 2013 – 2016 (*preliminary*)

Where did Ireland's tourists come from?

Numbers (000s)	2013	2014	2015	2016
Britain	**2,870**	**3,007**	**3,346**	**3,632**
Mainland Europe	**2,346**	**2,490**	**2,880**	**3,102**
France	*409*	*420*	*471*	*494*
Germany	*466*	*535*	*609*	*624*
Italy	*226*	*246*	*304*	*326*
Spain	*249*	*274*	*322*	*370*
Netherlands	*148*	*151*	*174*	*222*
Belgium	*95*	*99*	*121*	*127*
Denmark	*51*	*55*	*66*	*64*
Sweden	*72*	*60*	*64*	*59*
Switzerland	*73*	*84*	*105*	*107*
Austria	*51*	*57*	*53*	*58*
Norway	*50*	*50*	*58*	*50*
Poland	*152*	*140*	*161*	*176*
All Other Europe	*306*	*318*	*373*	*427*
North America	**1,039**	**1,146**	**1,294**	**1,477**
USA	*924*	*1,005*	*1,129*	*1,294*
Canada	*115*	*140*	*165*	*183*
Rest of World	**431**	**462**	**516**	**531**
Australia, New Zealand & Other Oceania	*192*	*191*	*204*	*206*
Other Areas	*240*	*271*	*312*	*325*
Total Overseas	**6,686**	**7,105**	**8,036**	**8,742**
Northern Ireland[1]	1,572	1,708	1,492	1,358
Total out-of-state	**8,258**	**8,813**	**9,528**	**10,100**
Domestic trips[2]	8,413	8,991	9,125	9,282

Source surveys are designed to measure area of residence groupings (bold figures). Figures in italics are indicative of approximate overall market size but do not provide a sufficient level of precision to accurately reflect absolute market size or trends over time.

Source: CSO/Fáilte Ireland/TSB, NISRA

1 Revised by NISRA May 2015

2 2012-2015 domestic data revised due to new methodological approach by CSO, August 2016

Tourism Revenue 2013 – 2016 (*preliminary*)

How much money did they spend?

Revenue (€m)	2013[3]	2014	2015	2016
Britain	**890.9**	**926.7**	**1,017.9**	**1,109.8**
Mainland Europe	**1,228.2**	**1,301.2**	**1,555.3**	**1,657.5**
North America	**829.0**	**940.3**	**1,199.7**	**1,337.4**
Other Overseas	**367.7**	**428.1**	**492.6**	**533.3**
TOTAL OVERSEAS	**3,315.7**	**3,596.4**	**4,265.3**	**4,638.0**
Northern Ireland[4, 5]	304.5	334.4	338.2	366.9
TOTAL OUT-OF-STATE	**3,620.3**	**3,930.7**	**4,603.5**	5004.9
Carrier receipts[6]	976.0	1,166.0	1,322.0	1,479.0
Overseas same-day visits	35.0	41.0	38.0	48.0
TOTAL FOREIGN EXCHANGE EARNINGS	**4,631.3**	**5,137.7**	**5,963.5**	**6,531.9**
Domestic trips[7]	1,533.0	1,713.5	1,725.3	1,776.1
TOTAL TOURISM REVENUE	**6,164.3**	**6,851.2**	**7,688.8**	**8,308.0**

Source surveys are designed to measure area of residence groupings (bold figures).
Source: CSO/Fáilte Ireland/TSB NISRA/Central Bank of Ireland

Revenue – some useful figures

Per diems – spend per person per day

Overseas tourists	€68
Overseas holidaymakers	€89
Domestic overnight trips	€71

3 Revised March 2014

4 NISRA GBP: Northern Ireland resident expenditure data provided in ST£. 2016 Euro exchange rate 0.81948 Source: Central Bank of Ireland

5 2013 Revised by NISRA May 2015 2015 revised 2016

6 2013 and 2014 revised March 2016

7 2012-2015 domestic data revised due to new methodological approach by CSO, August 2016

Regional Performance 2016

Where did tourists go in 2016? (EUROSTAT NUTS 3 REGIONS, see pg 12)

Numbers (000s) ***Revenue (€m)***	**Britain**	**Mainland Europe**	**North America**	**Other Areas**	**All Overseas**	**Northern Ireland**	**Domestic Trips**
Dublin	1,893	2,231	1,169	394	5,687	310	1,406
	368	*764*	*496*	*347*	*1,975*	*106*	*272*
Mid East[8]	241	234	108	7	590	37	704
	68	*99*	*65*	*18*	*251*	*14*	*123*
Midlands[9]	128	64	28	70	289	18	401
	31	*25*	*13*	*2*	*72*	*6*	*66*
South East	358	290	227	71	946	67	1,355
	112	*73*	*56*	*32*	*273*	*25*	*233*
South West	593	772	591	122	2,079	84	2,006
	200	*280*	*317*	*52*	*849*	*38*	*401*
Mid West	377	401	357	80	1,215	9	817
	102	*133*	*120*	*36*	*390*	*2*	*170*
West	350	733	479	114	1,675	155	1,591
	110	*191*	*210*	*33*	*543*	*54*	*329*
Border	360	263	144	47	815	679	1,001
	120	*92*	*60*	*13*	*286*	*123*	*183*

Source: CSO/Fáilte Ireland NISRA/Central Bank of Ireland

Overseas Tourists in 2016

How did overseas tourists spend their money in Ireland?

Breakdown of spend in Ireland (%)	**Total**	**Britain**	**Mainland Europe**	**North America**	**Rest of World**
Bed & board	33	29	34	34	33
Other food & drink	34	40	33	32	32
Sightseeing/entertainment	6	5	7	6	7
Internal transport	12	12	12	13	11
Shopping	12	11	12	13	14
Miscellaneous	2	2	2	2	3

8 Caution – small sample sizes in individual market areas

9 Caution – small sample sizes in individual market areas

When did they arrive?

Seasonality (%)	Total	Britain	Mainland Europe	North America	Rest of World
January-March	19	22	18	13	17
April	8	9	9	6	6
May	9	8	10	10	8
June	10	8	10	12	10
July	11	9	12	13	12
August	12	11	12	12	12
September	9	9	9	11	10
October-December	22	23	21	23	23

Source: Fáilte Ireland estimates based on CSO

How did they arrive/depart?

(%)	Total	Britain	Mainland Europe	North America	Rest of World
Air					
From Britain	38	75	5	21	32
From Mainland Europe	38	1	88	22	30
Transatlantic	10	1	1	53	2
Asia/Middle East	2	-	-	-	28
Sea					
From Britain	8	16	3	2	5
From Mainland Europe	1	-	2	-	-
Via N. Ireland	3	6	1	2	4

Source: CSO (indicates less than 0.5 percent)*

Where did they stay? (distribution of bednights)

(%)	Total	Britain	Mainland Europe	North America	Rest of World
Hotels	18	22	13	31	11
Guesthouses/B&Bs	7	6	9	10	3
Self-catering	25	11	27	20	45
Caravan & camping	1	1	1	*	*
Hostels	3	1	5	4	2
Friends/relatives	25	49	19	21	19
Other	21	10	26	14	20
Source: SOT					
Nights (Million)	67.9	17.7	28.9	13.2	8.1
Source (CSO)					

(indicates less than 0.5 percent)*

What activities did they engage in?

	Overseas Participants (000s)
Hiking/cross country walking	2,077
Cycling	399
Golf	193
Angling	131
Equestrian	98

What was their main reason for visiting Ireland?

(000s)	Total	Britain	Mainland Europe	North America	Rest of World
Holiday	4,406	1,423	1,699	1,041	242
Visit friends/relatives	2,613	1,518	684	233	178
Business	1,338	633	487	139	79
Other	385	58	232	64	32

Source: CSO and NISRA

In 2016, just under one third (31%) of those coming to Ireland to visit friends/relatives were born in Ireland.

Overseas Holidaymakers 2016

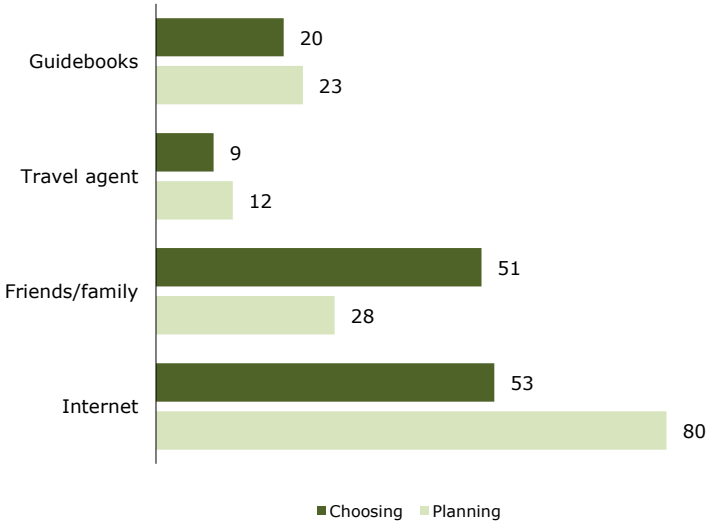
Holidaymakers in this section are defined as tourists who stated that their primary purpose for visiting Ireland was a holiday.

What was the total number of holidaymakers in 2016?

Holidaymakers (000s)	2011	2012	2013	2014	2015	2016
Britain	961	941	979	1,057	1,254	1,423
Mainland Europe	1,041	1,120	1,227	1,314	1,612	1,699
North America	591	634	718	803	926	1,041
Rest of World	167	184	220	219	243	242
Total	2,760	2,879	3,144	3,393	4,036	4,406

Source: CSO and NISRA

Sources of information for choosing/planning a holiday in Ireland (%)



Source: Fáilte Ireland's Port Survey of Holidaymakers 2016

How did they arrange their holiday?

(%)	Total	Britain	Mainland Europe	North America	Rest of World
Package*	17	6	15	28	16
Independent	83	94	85	72	84

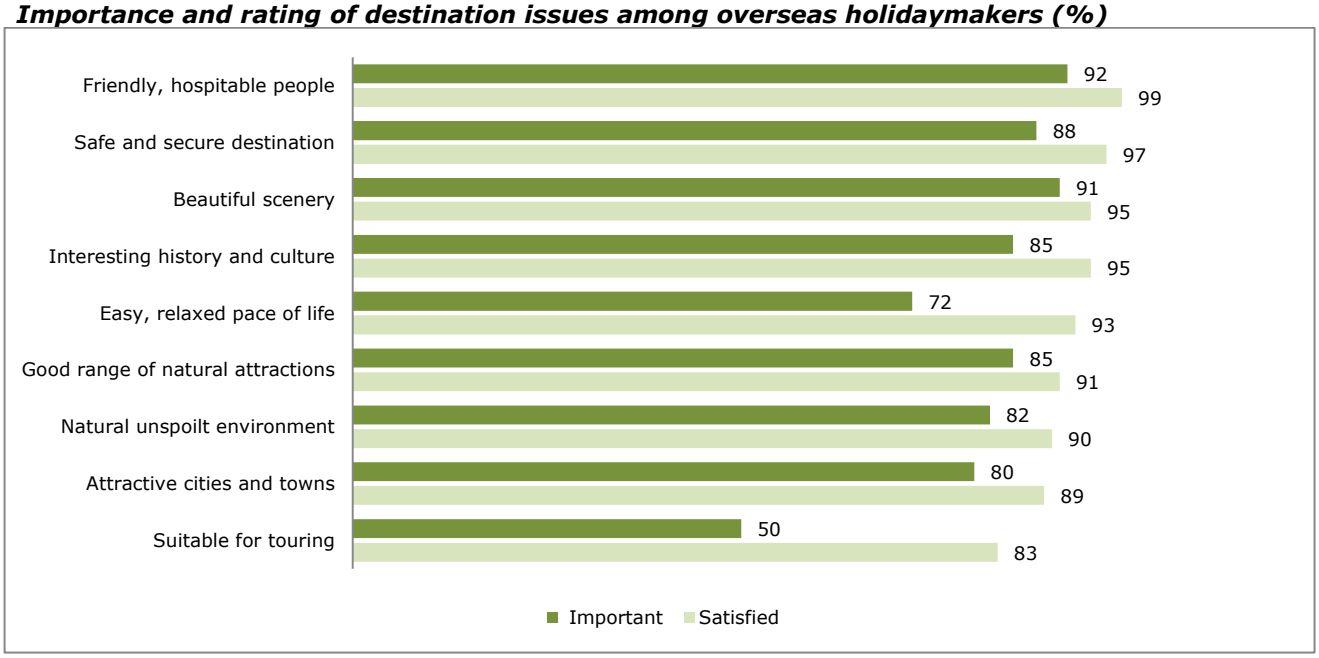
** Prepaid an inclusive price for fares to/from Ireland and at least one other element of the holiday.*
Source: Fáilte Ireland's Survey of Overseas Travellers

What were the characteristics of holidaymakers to Ireland (%)?

Experience of Ireland		Use of car		Age		Social class		Party composition	
First visit	64	Car brought	11	Under 25 years	22	Managerial/professional (AB)	30	Alone	19
Repeat	36	Car hired	31	25-34 years	24	White collar (C1)	57	Couple	42
Irish-born	1	Car not used	58	35-44 years	13	Skilled worker (C2)	10	Family	15
				45+ years	40	Unskilled worker (DE)	3	Other adult group	23

Source: Fáilte Ireland's Survey of Overseas Travellers

Importance and rating of destination issues among overseas holidaymakers (%)



Source: Fáilte Ireland's Port Survey of Overseas Holidaymakers 2016

Domestic Tourism in 2016[10]

Domestic trips (000s) by purpose of travel

	2013	2014	2015	2016
Holiday trips	4,073	4,436	4,658	4,830
- *Long (4+ nights)*	*1,088*	*1,144*	*1,078*	*1,144*
- *Short (1-3 nights)*	*2,985*	*3,292*	*3,580*	*3,686*
Visiting friends/relatives trips	2,988	2,918	2,921	3,032
Business trips	364	453	407	425
Other trips	988	1,184	1,138	994
Total trips	**8,413**	**8,991**	**9,125**	**9,282**

Source: CSO Household Travel Surveys 2013-2016

Domestic expenditure (€m) by purpose of travel

	2013	2014	2015	2016
Holiday trips	947.2	992.8	1,070.4	1,123.9
- *Long (4+ nights)*	*395.2*	*385.6*	*394.2*	*418.4*
- *Short (1-3 nights)*	*552.0*	*607.1*	*676.2*	*705.5*
Visiting friends/relatives trips	284.8	327.0	296.5	294.5
Business trips	84.2	110.3	98.0	104.7
Other trips	216.8	283.4	260.4	253.0
Total expenditure	**1,533**	**1,713.5**	**1,725.3**	**1,776.1**

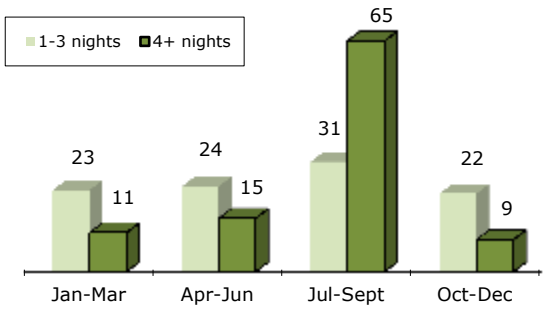
Source: CSO Household Travel Surveys 2013-2016

Accommodation bednights domestic holidaymakers (%)

	2013	2014	2015	2016
Hotels	34	34	35	28
Guesthouse/B&Bs	3	4	4	4
Caravan/camping	15	14	7	*n.a.*
Self-catering	22	23	22	15
Holiday home	15	12	19	9
Friends/relatives	10	13	10	34
Other	1	1	3	11

Source: CSO Household Travel Surveys 2013-2016

Seasonality of holidaymakers (%) 2016 by length of stay



Source: CSO Household Travel Survey 2016

10 2012-2015 domestic data revised due to new methodological approach by CSO, August 2016

Activities engaged in by domestic holidaymakers (%)

Hiking/walking	25
Houses/castles	24
National parks	23
Visits to spas	20
Heritage/ interpretive centres	20
Gardens	19
Watersports (excluding swimming)	19
Monuments	18
Museums/art galleries	14
Cycling	8
Golf	6
Angling	3
Attending horse racing	3

Source: Fáilte Ireland Domestic Omnibus 2016

The Tourism Product

Accommodation in 2016

	Premises	**Rooms**
Hotels	798	56,757
Guesthouses	203	2,584
Bed and Breakfasts	1,257	5,078
	Premises	**Beds**
Self-Catering (units)	3,143	16,694
Hostels	92	7,503
Welcome Standard	177	6,656
Caravan & camping (pitches)	92	5,333

Source: Capita

Accommodation occupancy in 2016

	%
Hotel Room Occupancy	72
Guesthouse Room Occupancy	66
B&Bs Room Occupancy	49
Hostels Bed Occupancy	66
Self-Catering Bed Occupancy	39
Caravan and Camping Bed Occupancy	24

Source: Fáilte Ireland Accommodation Survey

Attendance at popular visitor attractions in Ireland 2016

Top Fee-Charging Attractions			Top Free Attractions		
Name of Attraction	**County**	**2016**	**Name of Attractions**	**County**	**2016**
Guinness Storehouse	Dublin	1,647,408	The National Gallery of Ireland	Dublin	755,577
Cliffs of Moher Visitor Experience	Clare	1,427,166	Irish Museum of Modern Art	Dublin	584,856
Dublin Zoo	Dublin	1,143,908	National Botanic Gardens	Dublin	583,539
National Aquatic Centre	Dublin	1,037,992	Doneraile Wildlife Park	Cork	480,000
Book of Kells	Dublin	890,781	National Museum of Ireland - Archaeology, Kildare St	Dublin	479,261

Source: Fáilte Ireland Visitor Attraction Survey 2016

NUTS 3 Region	County
Dublin	Dublin City & County
South East	Carlow Kilkenny Tipperary (South) Waterford Wexford
South West	Cork Kerry
West	Galway Mayo Roscommon
Mid East	Kildare Meath Wicklow
Midland	Laois Longford Offaly Westmeath
Mid West	Clare Limerick Tipperary (North)
Border	Cavan Donegal Leitrim Monaghan Sligo Louth

Chapter 6 Biodiversity

Supplementary Information

Supplementary Appendix S1

Merlin Survey Reports

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Ornithological Survey Report

Merlin (Falco columbarius) survey of the Dublin Mountains

for Roughan O'Donovan, Consulting Engineers

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Version Control

Version	Date	Changes	Confidentiality	Prep	Rev	Auth
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Final	29/10/2019		Not confidential		Client	AL

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Staff of ROD assisted with fieldwork and Patrick O'Shea advised and assisted with location of VPs.

John Lusby provided comments on findings. The cover image of a Merlin over moorland was provided by Tim Melling for sole use within this report (all other rights reserved)

Field Investigations and Data

Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work. Where any data supplied by the client or from other sources may have been used it has been assumed that the information is correct. No responsibility can be accepted by Alan Lauder Consulting for inaccuracies in the data supplied by any other party.

Declaration of Compliance

"The information which we have prepared and provided is true and has been prepared and provided in a manner consistent with the Chartered Institute of Ecology and Environmental Management's Code of Professional Conduct. We confirm that the opinions expressed within this document are our true and professional *bona fide* opinions."

Third Party Disclaimer

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Contents

1. Background

This report details fieldwork undertaken to determine the presence, status and distribution of breeding Merlin in the Dublin Mountains in relation to the development of a proposed Dublin Mountains Visitor Centre.

The need for the survey arises from a request for further information from An Bord Pleanála (Ref. 06S JA0040) to "undertake additional bird surveys in optimal conditions…"

2. Methodology

2.1 Survey Methods

2.1.1 General Approach

The general approach to fieldwork was similar to that used within the National Merlin Survey 2018 (IRSG/BWI 2018[1]) and which is based on or derived from, standard published methods for Merlin within the UK and from studies within Ireland which have helped refine methods for this difficult to detect, near cryptic, species (Hardy et al 2013[2], Norris et al 2009[3], Lusby et al 2011[4]).

This survey, with a more localised focus than the national survey and many Irish studies, allowed for an approach which, within reason, maximised the likelihood of detection of Merlin while also collecting all information relating to Merlin activity observed in the area and which would inform the an assessment of the likelihood of detection and the suitability of the area for breeding.

The general approach consisted of fieldwork carried out by skilled and experienced field observers, to determine presence and location of breeding Merlin by carrying out timed and focused vantage point watches within all areas of suitable habitat within the study area, undertaking detailed searches of open ground and perches for any signs or prey remains from Merlin kills and recording the presence of prey species, conflict species and the presence of hooded crow (which can give rise to nest sites).

2.1.2 Survey Area

This area was defined by the client but not mapped and takes consideration of the likely zone of impact of the proposed Dublin Mountains Visitor Centre and the presence of suitable Merlin nesting habitat.

The likely zone of impact was defined as the entire area within 5 km of the proposed development, and, the Glendoo Brook downstream as far as The Liffey Estuary Lower transitional waterbody as far as the North Bull and Poolbeg Lighthouses. The likely zone of impact covers the trails leading into the Wicklow Mountain SPA, from the Hellfire Wood car park, to a distance of at least 5 km i.e. a 10 km round trip.

The area consists of upland ground with a mix of open ground habitats, mainly heather moorland and blanket bog, and forestry cover. At lower altitude the area is bounded by a range of agricultural habitats, mainly improved or semi-improved grassland.

Figure 1 illustrates VP locations within the study area with the outer VPs and their viewsheds (Appendix 3) roughly equivalent to the outer boundary.

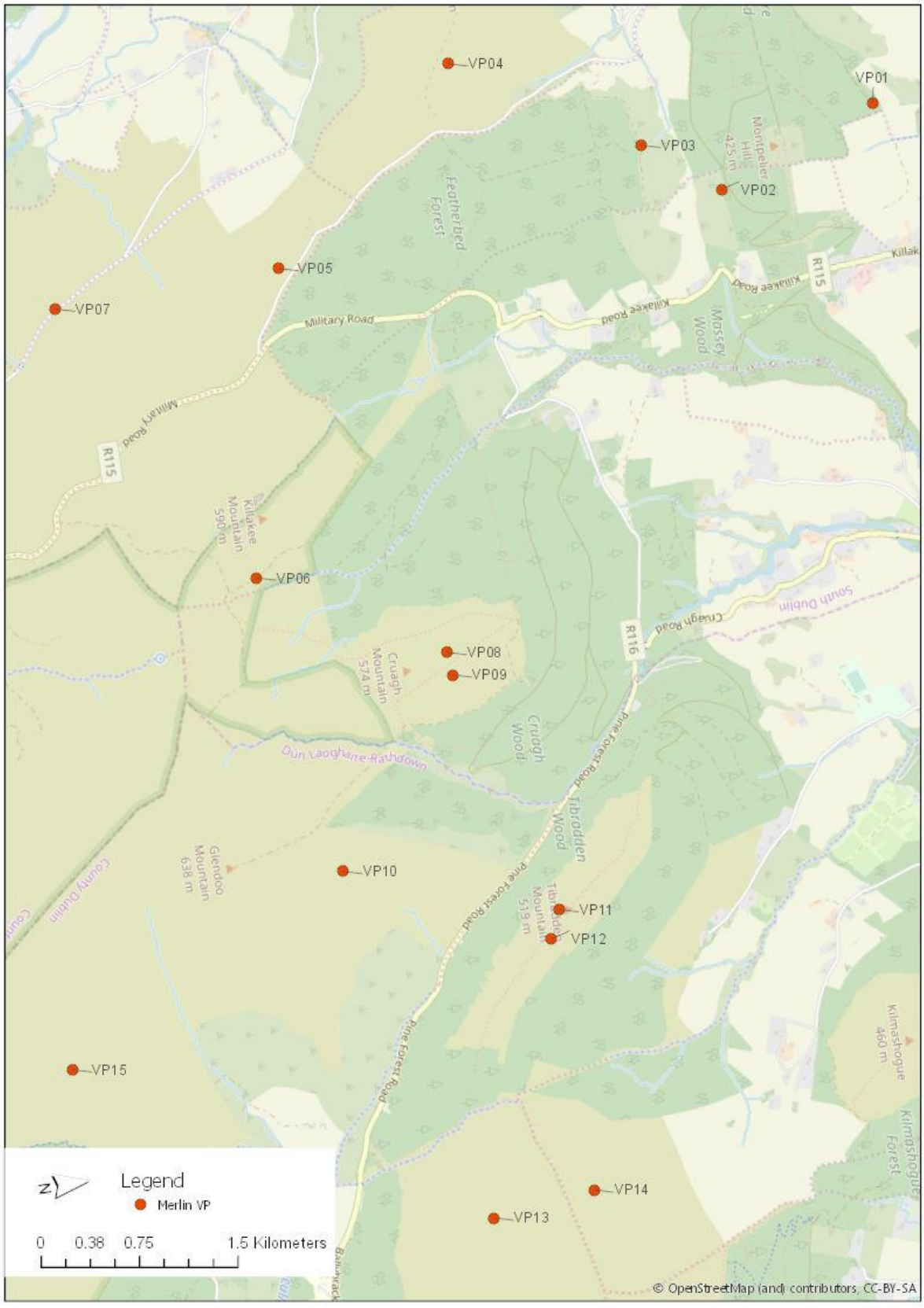

Figure 1 Merlin VP locations

2.1.3 Vantage point selection

The locations of all vantage points are shown in Figure 1.

Each vantage point was selected initially from a map search and then through ground truthing to ensure all areas of apparently suitable Merlin breeding habitat was able to be observed from at least one vantage point within 1.5 kilometres. This is similar to the National Merlin Survey, where vantage points were also located at a maximum distance of 1.5 km from the area of potentially suitable breeding habitat which was being watched. This increased confidence of recording Merlin which may be associated with that habitat where being more distant can potentially further reduce detection of this small fast flying falcon (author's pers obs).

The approximate viewshed of all VPs extending to 1.5 km radius in a, roughly, 180-degree arc is shown in Appendix 3.

Suitable Merlin nesting habitat is well defined by the National Merlin Survey 2018 guidelines and in summary consists of:

- Trees adjacent to, or in close proximity to unenclosed lands particularly moors and heathland. Plantation edges, notably those plantations aged between 31 to 40 years but also forests as young as 11 years and over 50 years in age are possible (Lusby et al. 2017[4]).
- Trees in open woodland, shelter belts, copses, tree lines, wooded islands on inland lakes and isolated trees in open upland areas provided there is a suitable stick nest available
- Merlin may also nest on the ground in moorland where heather is 30 – 70 cm high typically on sloping ground.

A typical view from a Vantage point is illustrated in figures 2 and 3, showing key features within the observer's view

2.1.4 Vantage point watches

Vantage Point (VP) watches are commonly used in surveys of raptors where occurrence or detectability can be low and thus long periods of focussed observation are necessary to detect presence and behaviour types to enable the breeding status of a species to be determined. Locating vantage points within Merlin breeding habitat enables observations to be targeted at this species. These vantage points are not necessarily ideal for observations of other species though additional helpful records of other bird species in the area can be collected incidentally. Hardey, 2013[2] and the National Merlin Survey 2018[1] used 3 hours as the minimum recommended viewing period noting that observations prior 1000h or after 1600h were of highest value. Lusby *et al*. 2011[5] indicates that there was no significant variation in detection rate through daylight hours.

Figure 2 View from VP3 – overlooking distant forest edge and moorland – the lower grassland creating a mosaic with the heather is less typical for Merlin but the moorland abutting the forest is more suitable

Figure 3 View from VP 14 – suitable Merlin breeding habitat on the mature forest edge, adjacent to high quality moorland

In this study, surveyors were given the following guidance for carrying out vantage point watches:

- Four visits to each VP through the season, wherever possible these to be roughly evenly spaced each month from April to July. Where this was not possible due to logistics or weather, weighting the preference for visits to before 15 May or after 15 June was also acceptable as this provided the highest chance of detectability of any occupied Merlin nesting areas as it coincides with the periods of greatest visibility of breeding Merlin (Lusby *et al.* 2011[5], Lusby *et al. 2017*[4]*)*

- Six-hour VP watches were carried out ideally starting early morning or ending late evening – midday watches were acceptable where this was not possible due to e.g. weather
- Plot all Merlin activity on maps and forms provided - the purpose is to record breeding evidence therefore heights and detailed timings are not needed while notes on breeding behaviour and flight lines are most important
- Record other raptor sightings (on form provided)
- Record a complete list of all bird species encountered during the VP (on form provided) indicating the code for breeding evidence

The recording forms used are shown at Appendix 2.

As noted in the last bullet point, field surveyors were asked to record a list of all species seen or heard within the viewshed, or very close to, each VP including coding for breeding evidence. The aim of this was to ascertain the general composition of the bird community within the area with a view to identifying the presence of:

- Key Merlin prey species
- Species whose old nests are known to be used by Merlin
- Species which may be mobbed by breeding Merlin
- Species which may be antagonistic to Merlin
- Species of high conservation priority which may not have been located by other surveys

2.1.5 Searching for signs of Merlin

Merlin typically leave a range of signs such as prey remains and pluckings on perches within close proximity of nests, most often within c. 300 m. Perches are usually located on boulders, fence posts, hummocks and less commonly on branches. They are usually in open ground.

Observers were asked to search all open ground within 300 m. of potential breeding habitat (forest edge) for signs of Merlin. Spending approximately 1-2 hours after each visit or on a separate day, searching suitable perches such as rocks, fence posts and tree stumps.

Observers were asked to record the location and type of remains to assist with ascertaining whether these were from Merlin or from other raptor species.

2.2 Survey Team

2.2.1 Personnel (Non-ROD staff)

Non-ROD personnel selected for the project had high levels of Merlin, general raptor and VP survey experience.

Personnel were given survey technique training in advance of survey commencement to ensure consistent survey standards and were mentored throughout by AL.

The staff listed carried out all survey work at Vantage points 7-15

Alan Lauder (AL): Project manager and Fieldwork
Alan is a professional ornithologist and nature conservation specialist with over 30 years' experience working across state and non-governmental wildlife and conservation organisations in the UK and

Ireland and more recently in commercial ornithological services. He has extensive experience of a wide range of ornithological research, survey and monitoring techniques, is a skilled field worker as well as being experienced in habitat and wildlife management projects. As a senior level leader and manager in a range of organisations he developed extensive skills and experience in the management of large-scale ornithological research and survey programs, project, organisational and strategic development, communications and policy.

His specific raptor experience is extensive. He was the organiser of the 2001/2002 UK National Peregrine Survey, steering group member on the 2017 Irish National Peregrine Survey, Steering group member and local organiser (Wicklow) for the Irish National Merlin Survey 2018 and has been involved in raptor surveying and research both in Scotland and more recently in Ireland over a 35 year period including; membership of Tayside Raptor Study Group in the 1990s, involvement with co-ordinating raptor license reporting for SNH in the 1990s, initiating the Scottish Raptor Monitoring scheme in 2000 with the BTO, lead on raptor conservation projects in S&W Scotland for RSPB in 2002-2008 and oversight of BirdWatch Ireland raptor survey programs from 2008-2013 including those for Merlin. Alan continues active field involvement with raptor studies, particularly Peregrines, Ravens and Merlin in County Wicklow.

John Lusby (JL) – Fieldworker and methods advice
John is an experienced raptor ecologist with specialisms in Barn Owl, Kestrel and Merlin and an extensive publishing record on Irish Merlin. He was lead organiser of the National Merlin Survey 2018 and has been BirdWatch Ireland's lead officer on Merlin studies.

Hannah Keogh (HK) - Fieldworker
Hannah is a professional field ornithologist and has wide experience of bird survey techniques. She has participated in many VP-based bird surveys for renewable energy projects and has been a participant in national Merlin and Peregrine surveys.

2.2.2 ROD Staff

Staff from ROD carried out all survey work for Vantage Points 1-6.

Patrick O'Shea (POS)-Fieldworker

Patrick O'Shea is an ecologist with experience in bird surveying for infrastructure projects including VP surveys. Patrick carried out the 2018 Merlin survey for the Dublin Mountains Visitor Centre and was a participant in the national Peregrine Survey.

Mike Bailey (MB)- Fieldworker

Mike is an ecologist with a background in raptor research. Mike has coordinated and carried out bird surveys including monitoring for development projects in Africa, the UK and Ireland.

3. Results & analysis

3.1 Duration and coverage of fieldwork

Table 1 shows the dates of survey work at all VPs. In a few cases survey visits were cut short due to changing weather making conditions unsuitable for survey work and the deficit in hours was added on alternative days as close as possible to the original date – these are not contained in the table but are held in original data files. This ensured that a minimum of 24 VP survey hours were carried out at each VP through the season.

A map of VP locations is contained at Figure 1.

Table 1 Dates of survey work at all Vantage Points

	Visit dates				
Vantage Point	Visit 1	Visit 2	Visit 3	Visit 4	additional visits
1	25/04/2019	30/05/2019	25/06/2019	25/07/2019	
2	03/04/2019	03/05/2019	07/06/2019	05/07/2019	
3	29/04/2019	31/05/2019	27/06/2019	26/07/2019	
4	29/04/2019	28/05/2019	17/06/2019	16/07/2019	
5	26/04/2019	28/05/2019	18/06/2019	10/07/2019	
6	02/05/2019	31/05/2019	20/06/2019	24/07/2019	
7	25/04/2019	15/05/2019	16/06/2019	27/07/2019	
8	19/04/2019	01/06/2019	30/06/2019	23/07/2019	07/06/2019
9	29/04/2019	30/05/2019	30/06/2019	23/07/2019	
10	01/05/2019	24/05/2019	16/06/2019	15/07/2019	
11	29/04/2019	08/06/2019	22/06/2019	18/07/2019	
12	01/05/2019	07/06/2019	04/07/2019	13/07/2019	
13	04/05/2019	22/06/2019	12/07/2019	17/07/2019	
14	10/05/2019	21/06/2019	13/07/2019	18/07/2019	27/07/2019
15	15/05/2019	28/05/2019	13/07/2019	27/07/2019	

Additional visits were carried out at VPs 8 and 14 as a single Merlin was seen at VP 8 and signs of Merlin were detected at VP 14 both warranting follow up visits to ensure detection of Merlin was high

3.2 Merlin records

Only one sighting of a Merlin was obtained during the fieldwork. This was at VP 8 and is detailed in Table 2 below:

Table 2 Merlin sightings

Date	Time	Duration (s)	VP#	No. birds	Age	Sex	Activity	Comments	Observer	Breeding evidence?
01/06/2019	09:45	15	8	1	Adult	M	F	Rapid flight to and over Cruagh Wood (to SW)	HK	Habitat

This record is coded as H for breeding evidence. This equates to a sighting of a single bird during the breeding season in suitable 'habitat' and is classed as "possible" breeding. This is plotted in Figure 4 below.

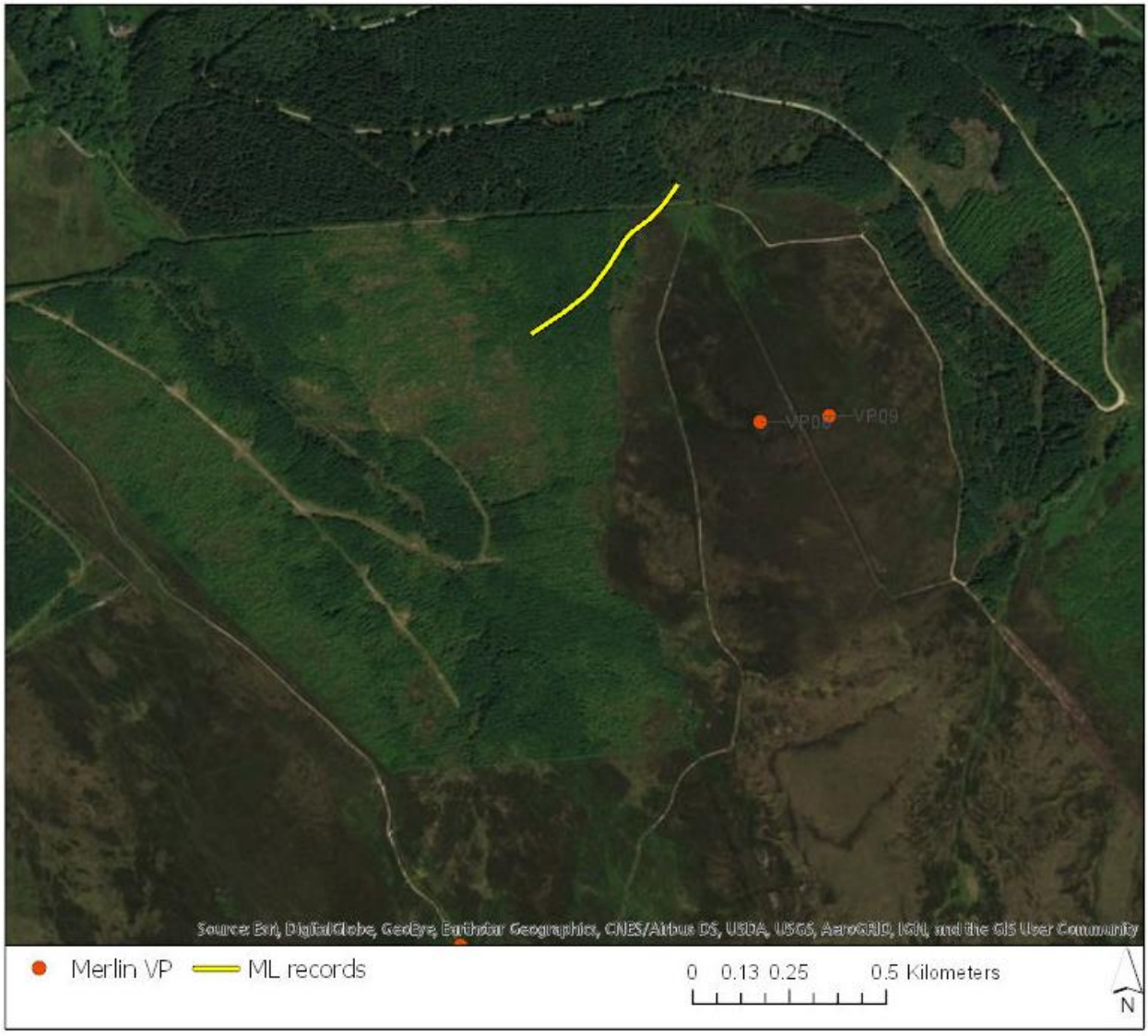

Figure 4 Location and track of Merlin sighting

3.3 Other raptors

Fieldworkers recorded the incidence of raptor occurrence at all VPs and a summary of all records is contained at table 3.

This table shows the occurrence of 4 raptor species. All VPs showed some level of raptor presence, with the commonest raptor present being Buzzard but with frequent sightings of Sparrowhawk and Kestrel. In a few cases frequent or near continual, observations of common species were seen during VP watches.

The incidence and behaviour of these other raptors indicate all species were common breeders within or close to the survey area.

One sighting of an adult male Hen Harrier was recorded. No Hen Harrier are known to nest in the Wicklow or Dublin Mountains and the timing of this sighting suggests it was either a non-breeder or potentially a failed breeder from elsewhere. Records of non-breeding Hen Harrier in the Wicklow and Dublin mountains are not unusual during the summer months (author pers. obs.).

Table 3 Raptor sightings summary at all VPs

Date	VP#	visit	Species	No. sightings in VP	Min. no. birds	Max. no. bird	Activity seen	Status/comments	Breeding evidence
25/04/2019	1	1	no birds	0	0				
30/05/2019	1	2	no birds	0	0				
29/06/2019	1	3	Buzzard	7	1	5	H		H
12/07/2019	1	4	Buzzard	1	1	1	D, F	agitated calls over forest	A
12/07/2019	1	4	Kestrel	5	2	3	H	pair hunting	P
03/04/2019	2	1	Buzzard	3	1	3	F	soaring/flying	D
03/04/2019	2	1	Kestrel	2	1	2	F	flying	H
03/04/2019	2	1	Sparrowhawk	1	1	1	F	female flying	H
03/05/2019	2	2	Buzzard	2	2	2	F, D		H
03/05/2019	2	2	Kestrel	1	1	1	F		H
07/06/2019	2	3	no birds	0	0				
05/07/2019	2	4	no birds	0	0				
29/04/2019	3	1	Buzzard	3	2	3	F		H
31/05/2019	3	2	Buzzard	3	1	3	F,H		H
17/06/2019	3	3	Kestrel	1	1	1	F, H		H
26/07/2019	3	4	Buzzard	2	1	2	H, F		H
26/07/2019	3	4	Kestrel	2	2	3	F		P
26/07/2019	3	4	Sparrowhawk	2	1	2	F		H
29/04/2019	4	1	Kestrel	1	1	1	H	hunting over clear fell	H
30/05/2019	4	2	Kestrel	2	1	1	H		H
28/05/2019	4	2	no birds	0	0				
17/06/2019	4	3	no birds	0	0				
16/07/2019	4	4	Buzzard	1	1	1	P	heard only	H
16/07/2019	4	4	Kestrel	4	2	4	H	fledged young	FL
26/04/2019	5	1	Buzzard	4	1	4	H	hunting	H
26/04/2019	5	1	Kestrel	4	2	5	H	flying and hunting	P
28/05/2019	5	2	Buzzard	2	1	2	F		H
14/06/2019	5	3	Buzzard	1	1	1	F		H
14/06/2019	5	3	Kestrel	6	1	4	H, F		H
18/06/2019	5	3	Kestrel					included in 14/06	
10/07/2019	5	4	Kestrel	4	2	3	H		P
02/05/2018	6	1	Buzzard	1	2	2	D	soaring display	D

Date	VP#	visit	Species	No. sightings in VP	Min. no. birds	Max. no. bird	Activity seen	Status/comments	Breeding evidence
02/05/2018	6	1	Kestrel	7	1	4	H	hunting	H
31/05/2019	6	2	no birds	0	0				
20/06/2019	6	3	no birds	0	0				
24/07/2019	6	4	no birds	0	0				
25/04/2019	7	1	Buzzard	20	2	2	F, P, H	soaring display	P
25/04/2019	7	1	Kestrel	1	1	1	H	male	H
15/05/2019	7	2	Buzzard	2	1	2	H		H
15/05/2019	7	2	Kestrel	1	1	1	H		H
16/06/2019	7	3	Buzzard	1	2	2	D	soaring	P
16/06/2019	7	3	Kestrel	1	2	2	H	2x male	H
27/07/2019	7	4	Buzzard	4	3	4	F	Newly fledged young	FL
19/04/2019	8	1	no birds	0	0				
01/06/2019	8	2	Hen Harrier	1	1	1	F	mobbed	H
30/06/2019	8	3	no birds	0	0				
27/07/2019	8	4	Buzzard	2	1	2	F	soaring	H
27/07/2019	8	4	Sparrowhawk	1	1	1	F	juvenile	H
07/06/2019	8	addn	no birds	0	0			Raven only	
29/04/2019	9	1	no birds	0	0				
30/05/2019	9	2	no birds	0	0				
30/06/2019	9	3	no birds	0	0			Raven only	
23/07/2019	9	4	no birds	0	0			Raven only	
01/05/2019	10	1	no birds	0	0			Raven only	
24/05/2019	10	2	Kestrel	2	1	2	H, F		H
16/06/2019	10	3	no birds	0	0			Raven only	
15/07/2019	10	4	no birds	0	0			Raven only	
29/04/2019	11	1	Kestrel	2	1	2	H	male	H
29/04/2019	11	1	Sparrowhawk	1	1	1	F	Flying over forest	H
08/06/2019	11	2	Buzzard	1	1	1	F		H
08/06/2019	11	2	Kestrel	2	2	2	H	pair hunting	P
08/06/2019	11	2	Sparrowhawk	1	1	1	F		F
22/06/2019	11	3	Buzzard	2	1	2	F, H		H
18/07/2019	11	4	Sparrowhawk	1	1	1	F	juvenile	H
01/05/2019	12	1	Buzzard	3	4	5	H, F		P
01/05/2019	12	1	Kestrel	4	1	4	H, F	male only	H
07/06/2019	12	2	no birds	0	0				
04/07/2019	12	3	Buzzard	1	1	1	F, H		H
13/07/2019	12	4	Buzzard	1	1	1	F, H		H
13/07/2019	12	4	Kestrel	3	2	3	F, H	Incl. at least 1 juv.	H
04/05/2019	13	1	Buzzard	1	1	1	P		H
04/05/2019	13	1	Kestrel	1	1	1	H		H
22/06/2019	13	2	Buzzard	1	1	1	F	heard only	H
12/07/2019	13	3	no birds	0	0			Raven only	
17/07/2019	13	4	Buzzard	1	1	1	F		H
17/07/2019	13	4	Kestrel	1	1	1	H		H
17/07/2019	13	4	Sparrowhawk	1	1	1	F, S	briefly soaring	H
10/05/2019	14	1	Kestrel	1	1	1	FF	carrying prey	FF
21/06/2019	14	2	Kestrel	8	2	4	F, H		P
13/07/2019	14	3	Kestrel	1	1	1	H		H
18/07/2019	14	4	Buzzard	1	1	1	H		H
27/07/2019	14	addn	no birds	0	0				
15/05/2019	15	1	Kestrel	2	1	2	H		H

Date	VP#	visit	Species	No. sightings in VP	Min. no. birds	Max. no. bird	Activity seen	Status/comments	Breeding evidence
28/05/2019	15	2	no birds	0	0			Raven only	
13/07/2019	15	3	Kestrel	1	1	2	D	alarming/mobbing	P
27/07/2019	15	4	no birds	0	0				

3.4 Bird community of the survey area

The cumulative seasonal lists, frequency occurrence[a] and highest recorded breeding evidence for each species on each VP is shown in Table 4.

The species shown in table 4 are ranked in order of frequency of occurrence across the survey season at all VPs with the most frequently recorded first. From this list, the frequency occurrence and the breeding evidence recorded for each species the bird community at and around each VP area is characterised and the following key findings are noted:

The bird community is typical of upland areas, forestry, scrub and upland marginal grassland.

Key Merlin prey species are small and medium sized passerines, notably those frequenting open ground and forest edge and in this study Meadow Pipit and Skylark were recorded on most VPs and these are commonly found as major prey items in Merlin diet in Ireland (Fernandez-Bellon & Lusby, 2011[6]).

A wide range of other small passerines represented at some level in Merlin diet were seen commonly including Swallow, Song Thrush and Chaffinch.

Upland waders were only represented by Snipe, and these were seen on only three VPs. Snipe are a regular prey species taken by Merlin and can make up a large portion of the biomass recorded in diet studies[6].

Hooded Crow, the primary provider of old nests that are subsequently used by Merlin were common.

Raptors such as Buzzard and Kestrel and corvids, including Raven, were common. These are typically species which are mobbed by Merlin where they occur within their territories, though the level of response can vary considerably[2, 5, 7]. Kestrels were seen in nearly 40% of VPs and antagonistic or competitive interactions are often seen between Kestrel and Merlin where they are in close proximity (author pers. obs., K.D. Shaw pers comm.).

[a] Frequency of the species recorded across all visits (range 0-4)

Table 4 Frequency occurrence and breeding evidence for all species (except Merlin) at all VPs

	VP1		VP2		VP3		VP4		VP5		VP6		VP7		VP8		VP9		VP10		VP11		VP12		VP13		VP14		VP15		%
Species	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**F**	**B**	**occurrence**
Meadow Pipit	3	FF	1	H	2	T	4	ON	4	FF	4	FF	4	FL	4	FF	4	T	4	A	4	FF	3	D	4	FF	3	FF	4	FF	86.7
Chaffinch	3	FL	4	T	2	T	1	S	3	T	3	T	2	T	4	T	2	H	3	S	4	T	4	T	4	T	4	T	1	H	73.3
Woodpigeon	2	f	3	H	4	P	3	H	3	P	1	H	1	H	3	H	2	H	3	H	4	H	3	FL	4	P	4	T	3	H	71.7
Hooded Crow	2	P	4	P	2	P	2	H	4	P			3	P	3	P	1	P			3	FL	4	H	4	FL	4	T	3	H	65.0
Blackbird	2	T	3	A	4	T	1	H	1	T	2	T	1	H	2	S			2	T	4	FF	4	T	4	P	1	H	3	S	56.7
Raven	2	H	2	f	3	f	4	P	4	P	1	f	1	f	2	P			1	T	4	H	3	H	3	H	2	H	3	H	58.3
Wren	2	T	3	T	2	T			3	T			4	T			2	S	1	S	3	T	3	T	3	T	3	T	1	S	50.0
Swallow	1	f	2	f	4	P	1	f	1	f	1	f	3	ON	1	f	2	f	2	f	1	H	4	H	3	f	2	f	3	f	51.7
Skylark	2	T			1	S	4	T	3	T	4	T	3	T	2	P	3	T	3	T			1	S	3	ON	3	ON	3	T	58.3
Mistle Thrush	2	FL	1	A					1	FF			1	H			1	S	2	H	4	FL	3	FL	3	FL	3	P	3	FL	40.0
Robin	1	S	3	FL	1	H			1	S	1	S					1	S	1	H	3	T	3	T	3	T	3	T	1	S	36.7
Willow Warbler	2	T	3	T					3	FF	1	S	2	T	1	S					3	T	4	T	1	H	3	T	2	S	41.7
Coal Tit	2	T	3	T	4	T			2	H			1	S	2	T			1	S	2	FL	3	FL	1	H	1	H			36.7
Song Thrush	3	P	4	P	2	T	1	H	3	FF	1	S	1	H	1	S					1	FL	2	T	1	S	2	T			36.7
Jay	2	T	4	FL	2	T	1	H	1	P					1	H					4	FL	2	A	2	T	2	A			35.0
Swift	1	f	1	f			1	f	1	f	1	f			1	f	1	f	2	f	1	f	4	f	2	f	3	f	2	f	35.0
Buzzard	2	H	1	D	2	H	1	f	3	H	1	P	4	FL							2	H	3	P	3	H	1	H			38.3
Kestrel			1	H	2	P	2	FL	2	H	1	H	2	H					1	H	2	H	2	FL	2	H	3	H	2	H	36.7
Jackdaw	1	H	2	f	3	H	1	f	3	P											1	H	2	f	2	f	1	f	2	H	30.0
Magpie	1	H	3	P	3	H	1	H	1	P									1	P	1	f	2	H	2	H	2	H			28.3
Red Grouse											2	A			2	T	1	H	3	P			3	T	3	T	3	T	1	H	30.0
Lesser Redpoll													2	P	1	H					4	P	2	H	3	H	3	T			25.0
Dunnock	2	T	2	P															1	S	3	T	1	S	1	S	1	H			18.3
Great Tit			3	P	1	S									1	H	1	H			2	FL	1	FL	2	T					18.3
Siskin													2	H							3	P	3	H			4	T			20.0
Mallard	1	F	3	f	1	f			1	f	1	f	1	F									1	f			1	f			16.7
LBB Gull			1	f	2	f			2	f			1	f							2	f			2	f					16.7
Goldcrest			1	H																	2	T	3	T	2	T	1	H			15.0

Table 4 Frequency occurrence and breeding evidence for all species (except Merlin) at all VPs

	VP1		VP2		VP3		VP4		VP5		VP6		VP7		VP8		VP9		VP10		VP11		VP12		VP13		VP14		VP15		%
Bullfinch			1	P																	2	P	3	FL	1	H	2	P			15.0
Blackcap			1	S																	4	T	2	T	1	S					13.3
Goldfinch			1	H									1	f									1	f	2	H	3	T			13.3
Pheasant	3	T			2	H													1	S											10.0
Sparrowhawk			1	H	1	H															3	H			1	H					10.0
Blue Tit	1	H	2	T	1	H																	1	H	1	FL					10.0
Chiffchaff			3	T	2	H									2	S															11.7
Cuckoo											1	H	1	H	2	S	1	H	2	H									1	S	13.3
Whitethroat			2	T																					3	T					8.3
House Martin			1	f									1	H							1	f	1	f	1	f	1	f			10.0
Herring Gull	1	f	1	f			1	f	1	f											1	f									8.3
Stonechat							3	P	1	T	1	H	2	FL			1	S											1	H	15.0
Linnet	2	P	1	P			1	H					1	H																	8.3
Long-tailed Tit			2	P	1	H																									5.0
Starling	1	H											1	H					1	f					1	f					6.7
Greenfinch			1	f																			1	f			1	f			5.0
Feral Pigeon	1	f			1	f											1	f													5.0
Grey Heron			1	f	1	F																									3.3
Rook									1	f																			1	H	3.3
Snipe							1	H					1	D											1	H					5.0
Wheatear													2	T													1	FL			5.0
Sand Martin													1	f																	1.7
Grey Wagtail													1	H																	1.7
Hen Harrier															1	H															1.7
Grt Spt Woodpecker															1	f															1.7

3.5 Prey remains and other signs

Searches for prey remains were carried out across all VP viewsheds in suitable habitat as described in the methods section.

No prey remains were found within viewshed search areas but one old set of “pluckings” (>1 month and possibly significantly older) was found on a rock perch at approximately O 17602 21950 and was thought to be “likely Merlin” (J. Lusby pers comm.).

This site is c. 1.5 km east of the nearest part of the study area.

No other signs suspected to be of Merlin were found despite extensive and regular searching.

This is relatively close to the location of the single sighting and given the age of the remains may relate to the same time period.

No other signs or prey remains were found which indicated the presence of Merlin.

4. Discussion & conclusions

4.1 Status of Breeding Merlin in the Dublin Mountains in 2019

Merlin are known to breed in the wider upland massif of the Wicklow and Dublin Mountains[8] and are listed as a qualifying feature of the SPA which encompasses much of this area. The areas covered by VPs in our study were selected on the basis of the guidance from the National Merlin Survey 2018[1] regarding selecting survey areas based on habitat characteristics of recognised Merlin breeding sites. Areas of unsuitable habitat were excluded.

In 372 hours of fieldwork across all suitable Merlin breeding habitat within the study area only one Merlin sighting was obtained. This short view of a male bird flying rapidly over and through forest and forest edge was indicative of hunting and showed no notable behaviours to indicate local breeding. A single set of pluckings of prey which were likely to have come from a Merlin "kill" were found on an area of forest edge/open ground approximately 1.5 km east of the study area. These were thought to be old and though found in July are likely to have originated in June or perhaps before that, possibly around the time of the Merlin sighting at VP8.

Merlin typically defend areas close to the nest as nest territories (up to perhaps around 0.8 km radius) but are known to hunt much more widely, distances of 5-10 km and potentially further are thought to be not uncommon, to provision the female and young on a nest[2]. It is reasonable to conclude, given the lack of Merlin sightings across the study area, that the male bird seen in the single sighting event is likely to have originated from a nest which is likely to be a significant distance away.

There are known historical breeding sites to the southern fringes of the Dublin mountains at Glencree and Prince William Seat[8], neither of which are in the study area described in Section 2.1.2 of this report. It is not known whether these have been occupied in recent years. But are within relevant "hunting" distance of the sighting. There were also at least 2 active territories in 2 5-km squares to the south west of the study area (at Kippure and Coronation Plantation areas) during the 2018 National Merlin Survey (unpublished data per IRSG[b]) and these are within 8 - 10 km of the location of the sighting noted in our study which is also within a feasible foraging range for Merlin.

5. Conclusions

The Dublin Mountains contain a range of habitats which can be utilised by Merlin, including forest edge for nesting and suitable upland open ground for hunting. This study attempted to locate the presence of breeding Merlin in the study area described in Section 2.1.2. The approach used standard methods as applied in other studies in Ireland but these were enhanced, by longer observation times, to provide an increased likelihood of locating any breeding birds of this difficult to observe species. In addition, the survey team included highly experienced Merlin fieldworkers to ensure any Merlin sightings could be readily detected and followed up.

Only one sighting was obtained and this is likely to have been a bird foraging from a nest elsewhere, potentially up to 10 km away from the study area. Given the lack of other sightings and no signs

[b] Irish Raptor Study Group

within the study area and the intensity of survey effort, it is reasonable to conclude that Merlin did not breed within the study area in 2019.

The habitat across the study area remains apparently suitable for Merlin and the bird community offers opportunities both for nests (from crows, Sparrowhawks etc) and for potentially adequate prey opportunities with typical prey species seen in most areas. The lack of traditional sites in the area, as noted by McElheron, 2005[8] and the relatively young age of the forests bordering onto moorland ground may at least partly explain the absence of Merlin in the area at the current time though there may be other factors including prey density factors, inter-specific competition (e.g. with Sparrowhawk and Peregrine) or potentially subtle habitat issues, among others, which may be implicated.

APPENDIX 1 - References

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[6] Fernandez-Bellon, D. and Lusby, J. 2011. The feeding ecology of Merlin *Falco columbarius* during the breeding season in Ireland, and an assessment of current diet analysis methods. *Irish Birds* 9:2, 159-164.

[7] Ratcliffe, D. 1997. *The Raven*. T & A.D. Poyser

[8] McElheron, A. 2005. *Merlins of the Wicklow Mountains*. Currach Press, Dublin

APPENDIX 2 – recording forms

Merlin Survey – VP Recording

VP		Date		Start time		End Time	

Sheet no.	
Total sheets	

Merlin records

Map code	No. birds	Age (if known)	Sex (M/F/U)	Time (24h)	Duration (sec)	Activity (record all applicable) F: Flying P:perched D: display H: hunting M:mobbing N: nest material FF: carrying food ON: visiting occupied nest	Comments (record anything of significance, behavioural notes, interactions with other species, location notes in relation to perches or forest areas used etc.)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Merlin Signs searching

Mark area searched on map		Start time		Duration	

Locate and mark each site of remains found and photograph (in situ) and collect remains (bags provided - mark with date and grid ref)

map code	perch type (rock, post, hummock, other)	Age of signs (Fresh/ up to 1 Mth old/ >1 mth OLD)	remains (Feathers, Mammal, Invertebrates, Pellets)	Grid Ref (10 fig)	Notes/comments	Collected ? (Y/N) - mark bag with date and map code	Photo? (Y/N)
A							
B							
C							
D							
E							

Additional Raptor records - record all additional raptors seen on this form

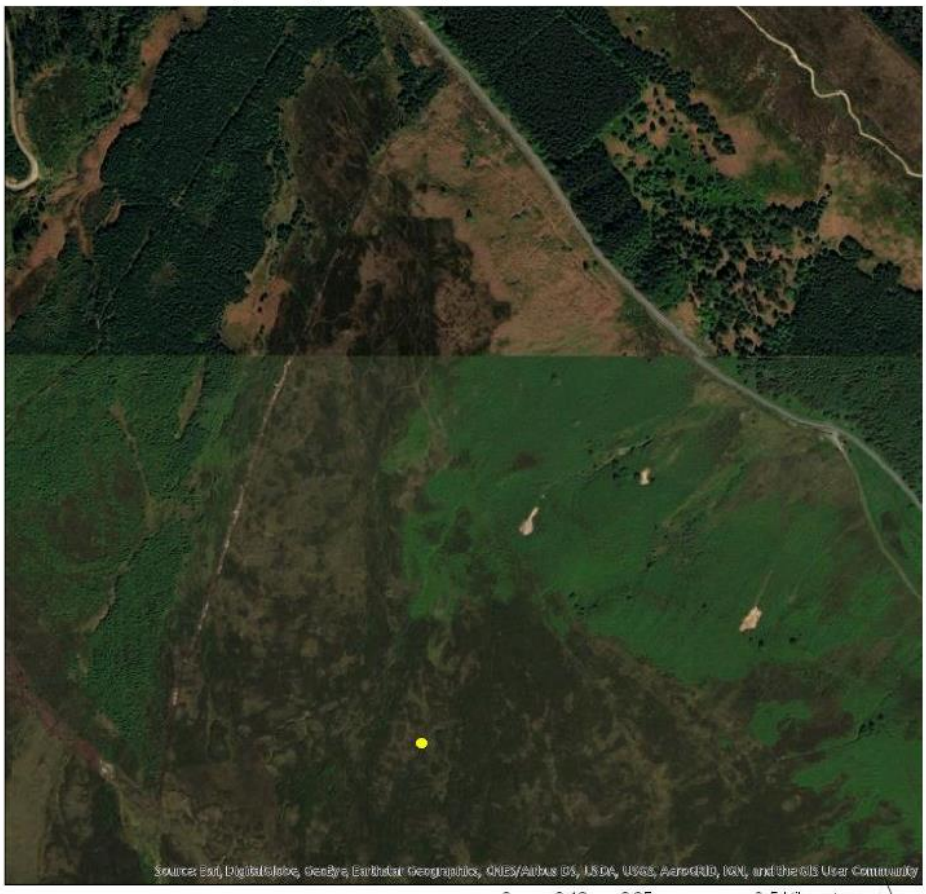
BTO code	No. birds	Age (if known)	Sex (M/F/U)	Time (24h)	Duration (sec)	Activity (record all applicable)	Comments

Office use only					
chk		scan		data	

VP species list - record all species seen or heard from the VP and breeding evidence or "✓" for "present – unknown status"

Species List					
BTO Code	Max. breed code	BTO Code	Max. breed code	BTO Code	Max. breed code

VP 10 Glendoo N(looking W – N- NE)



Date		Start time		End Time	
Observer					
Notes on VP location					

Hour	1	2	3	4	5	6	Notes
Wind Force							
Wind Dir.							
Vis.							
Precip'n							
Cloud (%)							

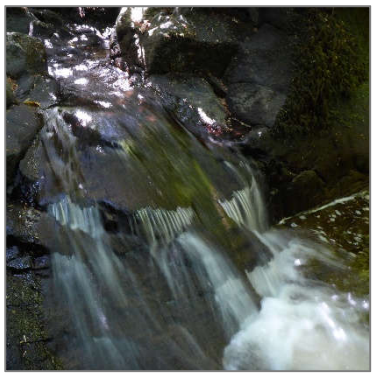
Sightings summary, disturbance events, comments:

Weather codes:	1	2	3	4	5
Wind Force	Use Beaufort scale (1-5 - no surveying above force 5)				
Wind Direction	Use compass points (N, NNE, NE, ENE, E etc.)				
Visibility	<500m	0.5-1km	1-2km	>2km	
Precipitation	None/ dry	Drizzle/ mist	Light/ short showers	Heavy/ long showers	Persistent rain (no survey in prolonged rain)

APPENDIX 3 VP Approximate viewshed arcs

Supplementary Appendix S2

Bryophyte Survey Report



Blackthorn Ecology

ROUGHAN & O'DONOVAN

MASSY'S WOOD AND MOUNTPELIER HILL

BRYOPHYTE SURVEY

1ST NOVEMBER 2019

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TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

Blackthorn Ecology has been appointed by Roughan & O'Donovan to carry out a bryophyte survey of Massy's Wood and Montpellier Hill (the Hellfire Club) to inform an Environmental Impact Assessment Report (EIAR) for the proposed Dublin Mountains Visitors' Centre. The need for the survey arises from a request for further information from An Bord Pleanála (Ref. 06S JA0040) to "undertake additional surveys/monitoring… of vegetation and habitats, protected species including bats and otter, and chemical substances and freshwater invertebrates…".

1.2 About the Authors

This report has been prepared by Dr George F. Smith and Dr Joanne Denyer.

Dr Smith has extensive experience in botanical surveys and Ecological Impact Assessment. He is an experienced bryologist and the British Bryological Society (BBS) Regional Recorder for Offaly and Westmeath. Dr Smith is a Chartered Ecologist and a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM), the chief professional society in Ireland for ecological professionals, and as such, he is bound by their Code of Professional Conduct.

Dr Denyer has significant expertise in bryology and has carried out numerous bryophyte surveys, including assessments of rare and protected species. She is the BBS Regional Recorder for Wicklow and Kildare and a former member of the BBS Council. Dr Denyer is a full member of CIEEM, and as such, she is bound by their Code of Professional Conduct.

2 METHODS

A desk survey was carried out to review any previous records (prior to 2015) held by the BBS for the site and the hectad (10 km grid square) O12 in which the study site is located. The results of this review were used to target rare and protected species that have the potential to occur in the site. These species were specifically searched for during the field surveys.

A field survey of Massy's Wood was carried out on 14th May 2019, and a field survey of Montpellier Hill was conducted on 15th August 2019. All moss and liverwort species found were recorded. Species that could not be identified confidently in the field were collected for later identification under the microscope. Where required, difficult specimens were referred to BBS specialist referees for examination.

The field survey focused on areas that would be developed as part of the Dublin Mountains Visitors' Centre project and locations where visitor numbers would be expected to increase. In Massy's Wood, these areas included the canopy walkway site, the walking trails, the walled gardens and the ice house. At Montpellier Hill, the survey focused on the visitors' centre site and associated paths and infrastructure, the location of the expanded car park, walking trails and the Hellfire Club. The field survey also ensured that all habitat and microhabitat types favoured by bryophytes were searched, such as the river, shaded banks, conifer and broadleaved woodland, footpaths, stone walls, etc.

3 RESULTS

3.1 Historical Records

3.1.1 Site Records

There was a total of 423 records of 215 bryophyte taxa from hectad O12 prior to 2015.

These historical records included three mosses protected under the Flora (Protection) Order 2015: *Bryum uliginosum, Bryum intermedium* and *Brachydontium trichodes*. *Bryum uliginosum* was recorded in 1879 in a "Glen near Killakee, Co. Dublin" and could thus have been from the river glen at Massy's Wood. *Bryum intermedium* was recorded in 1854 from "Kilakee" and could thus have also been from the study area. *Brachydontium trichodes* was recorded in 1863 from "Kelly's Glen", which is outside the study area.

None of the historical records were unambiguously from the study area. There are records of 28 species from hectad O12 prior to 2019 that are poorly localised, but may have been recorded from the study area. These are listed in Table 1 along with their conservation status according to the Red List (Lockhart et al., 2012a), the locality of the record, and the year (or probable year range) recorded. Notes are also provided on the habitat preferences of rare and threatened bryophytes as detailed by Lockhart *et al.* (2012b). Overall, seven Red List mosses may have been recorded from the study area in the past.

Table 1. Historical records potentially from the study area

Species	Red List	Habitat	Locality	Year
Liverworts				
Bazzania trilobata	LC[1]		Killakee Glen	1894
Cephalozia catenulata	LC		Killakee Glen	1876
Leiocolea turbinata	LC		Dublin,nr	1830
Mylia taylorii	LC		Dublin Mts	1989
Pleurozia purpurea	LC		Dublin Mts	1876
Saccogyna viticulosa	LC		Killakee Glen	1878
Mosses				
Bryum alpinum	LC		Dublin Mts	1915
Bryum intermedium	FPO, Endangered	Unshaded, open, moist, basic soil	Kilakee	1854
Bryum radiculosum	LC		Killakee	1852
Bryum uliginosum	FPO, Endangered	Moist open calcareous sites such as dune slacks, stream banks and lake shores	Glen near Killakee, Co. Dublin	1829-1879

[1] LC = Least Concern; FPO = Flora (Protection) Order

Species	Red List	Habitat	Locality	Year
Campylostelium saxicola	Endangered	Shaded humid, moderately acid rock. Often on N-facing slopes or near streams.	Dublin Mountains	1812-1848
Dicranodontium denudatum	LC		Dublin Mts	1915
Fissidens incurvus	LC		Killakee	1865
Grimmia orbicularis	Vulnerable	Calcareous stone or mortar, usually unshaded	Dublin, nr	1898
Gymnostomum aeruginosum	LC		Killakee Glen	1878
Microbryum rectum	LC		Dublin,nr	1813
Orthotrichum rivulare	Near Threatened	Periodically inundated zone beside rivers, usually on rock or bark	Kilakee	1857
Oxystegus tenuirostris	LC		Dublin Mts	1872
Palustriella commutata s.str.	LC		Killakee Glen	1853
Pterigynandrum filiforme	Regionally Extinct	Tends to occur on base-rich rocks in open upland sites. Rarely can occur on tree roots.	Killakee Glen	1829-1879
Pterogonium gracile	LC		Killakee Glen	1878
Racomitrium ericoides	LC		Kilakee	1850
Rhabdoweisia fugax	Vulnerable	Moderately dry crevices in acid rock, often in woodland and on boulders near lakes/ waterfalls	Dublin Mountains	1812-1848
Sphagnum contortum	LC		Dublin Mts	1854
Sphagnum cuspidatum	LC		Dublin Mts	1858
Sphagnum squarrosum	LC		Dublin Mts	1864
Taxiphyllum wissgrillii	LC		Killakee	1868
Tortula subulata	LC		Dublin Mt	1854

3.1.2 Assessment

The only species listed in the historical records in Table 1 that was also recorded during field surveys (Appendix A) was *Palustriella commutata*, a species of calcareous wetlands, such as fens and tufa-springs. This suggests that very few or none of the records in Table 1 was in actuality from the study area. Most records suggest very different habitat types that those found in the study area, such as upland peatlands (e.g. *Pleurozium purpureum* and *Sphagnum cuspidatum*), fen/flush (e.g. *Sphagnum contortum*), and base-rich outcroppings (e.g. *Gymnostomum aeruginosum* and *Pterogonium gracile*).

None of the Red List species in Table 1 were recorded during the field survey (Appendix A). *Bryum intermedium, B. uliginosum* and *Pterigynandrum filiforme* are species of open base-rich ground or rocks, which does not occur in the study area, and thus they are highly unlikely to be present.

The walled gardens have calcareous mortar in many places; however, shading and ivy encroachment was quite heavy, outcompeting most bryophytes. Thus, *Grimmia orbicularis* is highly unlikely to be present.

Suitable habitat for *Campylostelium saxicola* and *Orthotrichum rivulare* is present, especially in the upper ravine. There is also suitable habitat for *Rhabdoweisia fugax*, particularly by the river. None of these species was recorded during the field survey. Although their presence in the study area is very unlikely, it cannot be completely ruled out.

3.2 Field Survey

A total of 136 bryophytes were recorded during the field surveys, including 29 liverworts and 107 mosses. A complete list of species recorded is presented in Appendix A.

3.2.1 Species of Conservation Interest

The most notable findings of the survey are:

- One moss listed on the Flora (Protection) Order 2015
- Four Red List mosses, two ranked Vulnerable and two ranked Near Threatened (Lockhart et al., 2012a, Lockhart et al., 2012b)
- Two species not previously recorded in Co. Dublin
- Five species not recorded in Co. Dublin since 1959
- 49 species considered rare in Co. Dublin
- 34 species considered occasional in Co. Dublin

Protected and Red List species

Orthotrichum stramineum is protected under the Flora (Protection) Order 2015 and is Vulnerable in the Red List. It was recorded on trees in the vicinity of the proposed canopy walkway. It is an epiphyte on the bark of ash, beech, elder, sycamore and willow trees, and several of its Irish sites are near watercourses or woodland edges (Lockhart et al., 2012b).

The Vulnerable *Plagiothecium laetum* was recorded on rotting wood under gorse in a young conifer plantation on Montpellier Hill near the site of the proposed visitors' centre. It is a species of tree bases and deadwood in Britain; in Ireland, however, the three recent records have been from Sitka spruce plantations (Lockhart et al., 2012b). It is probably under-recorded (Lockhart et al., 2012b).

The Near Threatened *Platyhypnidium lusitanicum* was recorded for the first time from Co. Dublin during this survey from the upper ravine of the Massy's Wood river. It is rare but widespread nationally and is found in base-poor, rocky, fast-flowing streams and rivers (Lockhart et al., 2012b, Blockeel et al., 2014).

The Near Threatened *Heterocladium wulfsbergii* was also recorded along the upper ravine of the Massy's Wood river. It typically occurs in the flood zone of fast-flowing rivers in woodlands and ravines. It is probably under-recorded (Lockhart et al., 2012b, Blockeel et al., 2014).

None of the rare, threatened or protected species listed in Table 1 were recorded from the field survey despite searching in areas of potential habitat. Few other species listed in Table 1 were recorded in the field survey, indicating that localities of most of the historic records are not likely to be in the study area.

County distribution

Many of the species considered rare in a Co. Dublin context are in fact widespread and even common in a national context. Their rarity in Dublin is frequently a result of the urban and lowland habitats that dominate much of the county. For example, the moss *Hookeria lucens* and the liverwort *Calypogeia fissa* are species of acid, often peaty, soils that are uncommon in limestone-dominated Dublin, but are frequent in neighbouring Wicklow. Several widespread epiphytes are considered rare in a Dublin context, such as *Isothecium alopecuroides*, *Ulota phyllantha* and *Radula complanata*, due mainly to the rarity of woodland in the county, lower humidity and perhaps also poorer air quality. As Massy's Wood and Mountpelier Hill provide habitat and environmental conditions that are uncommon in the county, it is unsurprising that the site is important for bryophyte diversity in a Dublin context.

Hookeria lucens: rare in Co. Dublin, frequent throughout Ireland on acid soils

3.2.2 Habitats

Woodlands

Massy's Wood showing patchy cover of bryophytes concentrated around the base of a mature tree

Within the broadleaved and mixed woodlands in Massy's Wood and Mountpelier Hill, the most frequently occurring bryophytes were typically large pleurocarpous mosses, including *Eurhynchium striatum, Brachythecium rutabulum, Kindbergia praelonga* and *Oxyrrhynchium hians*. The large acrocarp *Mnium hornum* was also common. On the bases of trees and boulders, *Hypnum cupressiforme* var. *cupressiforme* and *Isothecium myosuroides* were relatively abundant. Deadwood supported the liverwort *Lophocolea bidentata*. In damper areas in Massy's Wood, *Plagiomnium rostratum* was common, whereas *Hypnum jutlandicum*, a typical heathland species, was frequent in the drier, more acidic conifer forests of Montpelier Hill. Bryophyte abundance on the forest floor was rather patchy due to several factors, including trampling and poaching by deer and humans and in places shading.

Epiphytes were frequent though not abundant, and were found particularly on smaller broadleaved trees, branches and twigs. The most frequently occurring species included the liverworts *Metzgeria furcata* and *Frullania dilatata* and the mosses *Hypnum andoi* and *H. cupressiforme* var. *resupinatum*.

Walled garden in Massey's Wood

Stonework

The stonework in the walled gardens in Massy's Wood and elsewhere provided habitat for a range of generally calcicolous small mosses, including *Rhychostegiella tenella, Tortula muralis, Bryum capillare, Didymodon rigidulus* and *Bryoerythrophyllum recurvirostrum*. A stone bridge in Massy's Wood supported quantities of the liverwort *Lejeunea cavifolia*. Exposed granite boulders on Mountpelier Hill provided a very different habitat and were characterised mainly by *Racomitrium* species and also *Polytrichum juniperinum*.

River

Massy's Wood river with well-developed bryophyte community on instream boulders

The river supported a well-developed bryophyte community typical of upland, base-poor, rocky and fast-flowing rivers. Among the most frequent aquatic species were the mosses *Platyhypnidium riparioides* and *Dichodontium pellucidum* and the liverworts *Scapania undulata* and *Chiloscyphus polyanthos*. *Hyocomium armoricum* was more abundant in the sheltered upper ravine. On rocks in the river and on damp riversides, *Thamnobryum alopecurum* and *Rhizomnium punctatum* were common.

Paths and bare soil

Footpaths, forestry tracks and disturbed ground provided good habitat for a range of smaller, less competitive bryophytes. Small acrocarps, such as *Barbula unguiculata*, *B. convoluta* var. *convoluta*, *Didymodon insulanus* and *Bryum argenteum* were frequent. The liverworts *Solenostoma gracilllimum* and *Nardia scalaris* were characteristic of bare ground by forest roads on Mountpelier Hill.

Ctenidium molluscum and other calcicole bryophytes on limestone surfaced forest road, Mountpelier Hill

The influence of limestone gravel used to surface forest roads was evident in the presence of the lime-loving *Ctenidium molluscum*, *Ditrichum gracile* and *Trichostomum crispulum*. Seepage areas by forestry tracks provided habitat for species of damp calcareous ground, such as *Philonotis fontana* and *Bryum pseudotriquetrum*.

Sheltered soil banks by tracks in Massy's Wood supported such typical species as *Fissidens taxifolius* and *Plagiothecium* species. More open banks, especially on Mountpelier Hill, supported *Pogonatum urnigerum* and *P. aloides*.

Grassland

Grasslands are hostile environments for most bryophytes, as only the larger, more competitive species can persist. In damp grasslands especially around the Hellfire Club,

Pseudoscleropodium purum, Calliergonella cuspidata and *Rhytidiadelphus squarrosus* were characteristic.

Tufa springs

Three tufa-forming features were recorded in Massy's Wood, and their locations are provided in Table 2 below. These habitats correspond to the priority Habitats Directive Annex I habitat '*petrifying springs (7220)'.

Tufa-forming seepage zone below track in Massy's Wood

The best developed and most sensitive feature is a tufa-forming cascade immediately below the track that flows in the direction of the river. It originates from two springs emerging from the sides of forestry drains above the track. There is some tufa formation in the drains, which join a short distance downhill and are culverted under the track. A range of characteristic bryophytes occurred here, including *Cratoneuron filicinum*, *Palustriella comutata*, and the thallose liverwort *Pellia endiviifolia*.

A tufa-forming seepage zone was noted on the east bank of the river; however, it was poorer in bryophyte cover and species because of dense shading by cherry laurel.

A third spring was recorded in the upper ravine. It was similar to the first with the addition of the typical tufa-forming moss *Eucladium verticillatum*.

Table 2. Tufa spring locations

Feature	IG Eastings	IG Northings
tufa cascade below path	312595	223832
-- drain source 1	312580	223820
-- drain source 2	312569	223829
tufa seepage on east riverbank	312508	223466
tufa spring in upper ravine	312399	222562

4 EVALUATION

4.1 Conservation Value

CIEEM guidance on Ecological Impact Assessment (Chartered Institute of Ecology and Environmental Management, 2018) recommends evaluating the importance of an ecological feature according to a geographic scale. According to commonly used ranks in Ireland (Local, County, National and International), the bryophyte flora of the study area would rank towards the upper end of **County Value** for biodiversity.

This value is appropriate due to the relatively species-rich bryophyte flora mainly resulting from the diversity of habitats and microhabitats present. One of these is the Habitats Directive priority habitat 'petrifying springs (7220)'. A significant proportion of the species present are rare in Co. Dublin. These include four Red List species of national significance, one of which (*Orthotrichum stramineum*) is also protected under the Flora (Protection) Order 2015. It is an offence under Section 21 the Wildlife Act 1976, as amended, to damage any specimens of protected plants or their habitat.

It could be argued that the site is of National value for biodiversity, given the numbers of Red List species present. Two of them, however, are at the lowest ranking of Near Threatened. In addition, the only species for which the study area appears to support a significant proportion of the national population is *Plagiothecium laetum*. The Mountpelier Hill site represents one of only six Irish records and one of four recent records. It is likely, however, that this species is under-recorded in Ireland as it is easy to overlook. Furthermore, south Co. Dublin and north Co. Wicklow appears to represent the stronghold of the species in Ireland. Therefore, a ranking of County Value is the most appropriate.

4.2 Mitigation

In the light of the proposed Dublin Mountains Visitors' Centre, mitigation measures are recommended here to reduce or eliminate negative impacts of the project on bryological biodiversity.

4.2.1 Massy's Wood

- The population of *Orthotrichum stramineum* is in the vicinity of the proposed canopy walkway. To safeguard it and to comply with legal protection,
  - A pre-construction survey should be carried out to better define its abundance and distribution on site.
  - Plants in the vicinity of the walkway should be temporarily marked and protected from damage during construction.

    - The plant should be protected from potential damage by visitors by routing them away from populations using marked walking routes and unobtrusive barriers, such as wooden fencing.
- *Platyhypnidium lusitanicum* and *Heterocladium wulfsbergii* do not require special mitigation measures as no development is planned in or near the upper ravine in Massy's Wood.
- The tufa-forming cascade adjacent to the path should be protected from construction works and any path upgrades in the area should not negatively affect the habitat itself or its hydrology, including the source springs.
- Modifications or disturbance to the banks of the river in Massy's Wood should be kept to a minimum, as this represents good quality bryophyte habitat with the (unlikely) potential to support additional rare species.

4.2.2 Mountpelier Hill

- *Plagiothecium laetum* is located in the vicinity of the proposed path to the visitors' centre. To safeguard it,
    - A pre-construction survey should be carried out to better define its abundance and distribution on site.
    - The path should be routed to avoid its populations.
    - Temporary fencing should be erected to exclude construction traffic from the vicinity of the plants.
    - The plant should be protected from potential damage by visitors by routing them away from populations using marked walking routes and unobtrusive barriers, such as wooden fencing.

4.2.3 General Measures

- In general, development of the visitors' centre, paths and other infrastructure should practice good construction site management. Areas for stockpiling materials and for machine traffic should be tightly controlled so as to minimise the disturbance footprint on the site. Clearance of vegetation, deadwood, rocks, etc. should be carried out only where required and not out of a desire for tidiness. This will help conserve the overall biodiversity of bryophytes (and other species) on site.
- Interpretive material at the visitors' centre should highlight the value of the site for biodiversity of mosses and liverworts and help visitors understand the value of bryophytes.

5 REFERENCES

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APPENDIX A SPECIES RECORDED ON SITE

The mosses and liverworts recorded during the 2019 field surveys are listed in the table below. Nomenclature follows the BBS *Checklist* (British Bryological Society, 2009). In addition to the species name, the following information is provided:

- **Red List:** indicates if the species is included in the Red List of bryophytes (Lockhart et al., 2012a). FPO = listed under Flora (Protection) Order 2015; NT = Near Threatened; VU = Vulnerable.
- **NVCR/De-bracket: "**NVCR" indicates that the species is a new vice-county record, i.e. it has been recorded from Co. Dublin for the first time during this survey. "De-bracket" indicates that this is the first record of the species with a voucher specimen from Co. Dublin since 1959.
- **Grid refs:** provides Irish Grid references of rare species or species collected.
- **Massy's Wood / Mountpelier:** indicate if the species was recorded in Massy's Wood, on Mountpelier Hill or both.
- **Distribution within site:** gives notes on the frequency and habitat of the species within the study area.
- **Distribution nationally:** gives an indication of how widespread the species is nationally, based on the *Atlas of British and Irish Bryophytes* (Blockeel et al., 2014).
- **Distribution within Co. Dublin:** indicates the frequency with which the species has been recorded in Co. Dublin. Species with 3 or fewer recent records are identified as *Rare*. Species with less than 10 recent records are identified as *Occasional*.

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Liverworts								
Aneura pinguis					x	In calcareous spring/ seepage areas	Widespread	Widespread

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Calypogeia arguta					x	Occasional in woodland	Widespread (except midlands area)	**Rare:** Only 3 records from Co. Dublin (Fernhill, 2018; Seahan Mt, 2007; Killakee Mt, 1969).
Calypogeia fissa				x		Occasional in woodland	Widespread	**Rare:** Only 3 recent records from Co. Dublin (Fernhill 2018; Lower Lough Bray & Cruagh Mt, 2007) and 1 historic record.
Calypogeia muelleriana					x	Occasional in woodland	Widespread	Occasional: <10 records for Co. Dublin
Cephalozia bicuspidata				x	x	Occasional in woodland	Widespread	Occasional: <10 records for Co. Dublin
Chiloscyphus polyanthos				x		Frequent in river		**Rare**: Only 1 recent record from Co. Dublin (Glenasmole, 2011) and 2 historic records**.**
Conocephalum conicum s.str.				x		Occasional on riverbank	Widespread	Occasional: <10 records for Co. Dublin
Diplophyllum albicans				x	x	Occasional to frequent in forestry and upland area	Widespread	Widespread
Frullania dilatata				x	x	Frequent epiphyte	Widespread	Widespread
Jungermannia sp.			O 11163 23641		x	Rare on forestry track	n/a	n/a

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Leiocolea badensis		NVCR	O 11163 23641 & O 12773 24068	x	x	Soil in crevice of old wall in woodland (MW) and forestry track (MH)	Widespread (except south-west)	**Rare**: These are the first records for Co. Dublin.
Lejeunea cavifolia				x		Locally abundant on stonework of bridge in lower woodland	Widespread (except midlands area)	**Rare**: Only recorded from 1 other site in Co. Dublin (Mt Merion Wood, 1967)
Lepidozia reptans				x		Occasional on rotting wood in woodland	Widespread (except midlands area)	**Rare:** Only 2 records from Co. Dublin (Lower Lough Bray, 2010; Slievenabawnoge, 1959)
Lophocolea bidentata				x	x	Frequent on rotting wood	Widespread	Widespread
Lophocolea heterophylla					x	Rare on rotting wood in forestry	Widespread	Occasional: <10 records for Co. Dublin
Lunularia cruciata				x		Occasional to frequent on riverbank	Widespread	Widespread
Metzgeria furcata				x	x	Frequent epiphyte	Widespread	Occasional: <10 records for Co. Dublin
Metzgeria violacea				x	x	Occasional epiphyte	Widespread	Occasional: <10 records for Co. Dublin
Nardia scalaris					x	Frequent on exposed acid soil by upland forestry tracks	Widespread (except midlands area)	Occasional: <10 records for Co. Dublin

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Pellia endiviifolia				x	x	Occasional to frequent on riverbank and in calcareous spring areas	Widespread	Widespread
Pellia epiphylla				x	x	Occasional in woodland and on riverbank	Widespread	Occasional: <10 records for Co. Dublin
Pellia neesiana				x		Rare on riverbank in upper ravine		**Rare**: Only 2 records from Co. Dublin (Glenasmole, 2011; Ben of Howth, 1975).
Plagiochila asplenioides				x		Rare to occasional in woodland, usually near riverbank	Widespread	**Rare**: Only 1 recent record from Co. Dublin (Dingle Glen, 2017) and 1 historic record recorded.
Plagiochila porelloides				x		Rare to occasional in woodland, usually near riverbank	Widespread	**Rare**: Only 2 records from Co. Dublin (Dingle Glen, 2017; Glenasmole, 2014).
Radula complanata					x	Occasional epiphyte	Widespread	**Rare**: Only 3 recent records from Co. Dublin (Fernhill, 2018; Dingle Glen, 2017; Killakee Mountain, 2007) and 1 historic record.
Riccardia multifida					x	Rare in flushed area by upland forestry track		**Rare**: Only 2 recent records from Co. Dublin (Howth, 2007 & 2010) and 1 historic record recorded (also from Howth).

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Scapania nemorea				x		Occasional in woodland	Widespread	**Rare**: Only 3 recent records for Co. Dublin (Howth, 2019; Fernhill, 2018; Dingle Glen, 2017) and 1 historic record.
Scapania undulata				x		Frequent in river	Widespread	Occasional: <10 records for Co. Dublin
Solenostoma gracillimum					x	Frequent on exposed acid soil by upland forestry tracks		**Rare**: Only 2 records from Co. Dublin (Ballycorus, 2008; Killakee Mountain, 1969).
Mosses								
Amblystegium serpens				x	x	Occasional to frequent within woodland	Widespread	Widespread
Atrichum undulatum				x	x	Occasional in woodland	Widespread	Occasional: <10 records for Co. Dublin
Barbula convoluta var. *convoluta*					x	Occasional on disturbed soil	Widespread	Widespread
Barbula unguiculata				x	x	Occasional on disturbed soil	Widespread	Widespread
Brachythecium rivulare				x		Occasional in wetland areas	Widespread	Widespread
Brachythecium rutabulum				x	x	Frequent in woodland and grassland	Widespread	Widespread
Bryoerythrophyllum recurvirostrum				x		Occasional on stonework/ walls	Widespread	Occasional: <10 records for Co. Dublin
Bryum argenteum					x	Occasional on paths/ road edges	Widespread	Widespread

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Bryum capillare				x	x	Occasional on stonework/ walls	Widespread	Widespread
Bryum pallens					x	Occasional on soil	Widespread	**Rare**: Only 2 records from Co. Dublin (Malahide, 1988; Killakee Mountain, 1969).
Bryum pseudotriquetrum					x	Occasional on damp forestry tracks	Widespread	Widespread
Bryum sp.					x	Rare at edge of car park	n/a	n/a
Calliergonella cuspidata				x	x	Occasional in damp grassland	Widespread	Widespread
Campylopus flexuosus				x	x	Occasional in upland forestry	Widespread	Occasional: <10 records for Co. Dublin
Campylopus introflexus					x	Occasional in upland forestry	Widespread	Widespread
Ceratodon purpureus				x	x	Occasional on disturbed acid soil	Widespread	Widespread
Cirriphyllum piliferum				x		Occasional in woodland	Widespread	Occasional: <10 records for Co. Dublin
Cratoneuron filicinum				x	x	Occasional in woodland and springs	Widespread	Widespread
Cryphaea heteromalla				x	x	Occasional epiphyte	Widespread	Occasional: <10 records for Co. Dublin
Ctenidium molluscum				x	x	Occasional on forestry tracks	Widespread	**Rare**: Only 2 records from Co. Dublin (Dalkey Quarry, 2010; Phoenix Park, 1988).

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Dichodontium pellucidum s.str.				x		Frequent in river	Widespread (except midlands area)	**Rare**: Only 1 record from Co. Dublin (Seahan Mountain, 2007).
Dicranella heteromalla				x	x	Occasional in upland forestry	Widespread	Widespread
Dicranum scoparium				x	x	Occasional in woodland	Widespread	Widespread
Didymodon fallax					x	Occasional on forestry tracks	Widespread	Widespread
Didymodon insulanus				x	x	Occasional on disturbed soil	Widespread	Widespread
Didymodon luridus					x	Occasional in car-park	Widespread (except north)	**Rare**: Only 2 records from Co. Dublin (Dalkey Quarry, 2010; Phoenix Park, 1988).
Didymodon rigidulus				x	x	Occasional on stonework/ walls	Widespread	Widespread
Ditrichum gracile					x	Occasional on forestry tracks	Widespread (except south-west)	**Rare**: Only 1 recent record from Co. Dublin (Dalkey Quarry, 2010) and 1 historic record.
Eucladium verticillatum				x		Occasional in calcareous seepage/ spring areas	Widespread	Widespread
Eurhynchium striatum				x	x	Frequent in woodland	Widespread	Occasional: <10 records for Co. Dublin

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Fissidens bryoides var. *bryoides*				x			Widespread	**Rare:** Only 3 records from Dublin (Fernhill, 2018; Kilmashogue Mountain, 2007; Phoenix Park, 1988).
Fissidens taxifolius				x	x	Occasional on soil in woodland	Widespread	Widespread
Fontinalis squamosa				x				**Rare**: Only 1 record from Co. Dublin (Killakee Mountain, 1969)
Grimmia trichophylla					x	Occasional on boulders in open upland areas	Frequent in upland areas	Frequent in upland areas
Heterocladium heteropterum var. *flaccidum*				x		Occasional on banks of river in ravine	Occasional in woodlands and ravines.	**Rare**: Only 1 record from Co. Dublin (Dingle Glen, 2017). There are only 4 records for Co. Wicklow (3 post-1950) and no records from other adjacent counties.
Heterocladium heteropterum var. *heteropterum*				x		Occasional on banks of river in ravine		**Rare**: Only 1 recent record from Co. Dublin (Lower Lough Bray, 2019) and 1 historc record
Heterocladium wulfsbergii	NT		O 12570 22311	x		Rare on banks of river in upper ravine	Occasional in woodlands and ravines.	**Rare**: Only 1 record from Co. Dublin (Upper Dodder Valley, 1962).
Homalia trichomanoides		De-bracket (but not collected)		x		Occasional on wall/ bank	Widespread	**Rare**: Only 1 historic record from Co. Dublin (Dundrum, 1840).

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Homalothecium sericeum					x	Occasional on trees and boulders	Widespread	Widespread
Hookeria lucens				x		Occasional on riverbank	Widespread	**Rare**: Only 1 record from Co. Dublin (Killakee Mountain, 1969)
Hygrohypnum luridum		De-bracket	O 120 237		x	Rare in car park	Widespread	**Rare**: This is the first recent record for Co. Dublin
Hylocomium splendens					x	Occasional in open upland area	Widespread	Occasional: <10 records for Co. Dublin
Hyocomium armoricum				x		Occasional to frequent on boulders in upper river	Widespread (except midlands area)	**Rare**: Only 2 records from Co. Dublin (Seahan Mountain, 2007; Killakee Mountain, 1969)
Hypnum andoi				x	x	Frequent on trees	Widespread	Widespread
Hypnum cupressiforme var. *cupressiforme*				x	x	Frequent on trees and boulders	Widespread	Widespread
Hypnum cupressiforme var. *resupinatum*				x	x	Frequent on trees	Widespread	Widespread
Hypnum jutlandicum					x	Frequent in forestry	Widespread	Widespread
Isothecium alopecuroides		De-bracket	O12139 23793	x	x	Occasional in woodland	Widespread	**Rare**: Only 3 records in Co. Dublin (Fernhill, 2018; Dingle Glen, 2017; Sandyford, 1946)
Isothecium myosuroides				x	x	Frequent on trees and boulders	Widespread	Occasional: <10 records for Co. Dublin
Kindbergia praelonga				x	x	Frequent on boulders, trees and soil	Widespread	Widespread

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Microeurhynchium pumilum (syn. *Oxyrrhynchium pumilum*)			O 124 232 (and O125237 in 2018)	x		On soil on riverbank	Widespread but less frequent in midlands	**Rare**: Only 1 recent record from Co. Dublin from this site (Massy's Wood, 2018) and 2 historic records
Mnium hornum				x	x	Occasional to frequent in woodland	Widespread	Widespread
Mnium stellare		De-bracket	O 12506 23482	x		Boulder in upper ravine	Occasional, rarer in east	**Rare**: This is the first record for Co. Dublin post 1938.
Neckera complanata				x		Occasional epiphyte	Widespread	**Rare:** Only 3 records from Dublin (Fernhill, 2018; Ardgillan Demesne, 2010; Phoenix Park, 1988).
Neckera pumila				x	x	Occasional epiphyte	Widespread	**Rare**: Only 1 record from Co. Dublin (Killakee Mountain, 1969)
Oligotrichum hercynicum					x			**Rare**: Only 2 records from Co. Dublin (Seahan Mountain, 2007; Kilmashogue Mountain, 2007)
Orthodontium lineare				x	x	Occasional on logs	Widespread	Occasional: <10 records for Co. Dublin
Orthotrichum affine				x	x	Occasional epiphyte	Widespread	Occasional: <10 records for Co. Dublin
Orthotrichum cupulatum					x	Occasional on stonework		**Rare**: Only 1 recent record from Co. Dublin (Killakee Mountain, 1969) and 1 historic record

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Orthotrichum lyellii				x		Occasional epiphyte		**Rare**: Only 1 record from Co. Dublin (Killakee Mountain, 1969)
Orthotrichum stramineum	VU, FPO		O12214 23553	x		Occasional epiphyte	**Rare** but recent records suggest this species is spreading	**Rare**: Only 1 record from Co. Dublin (Fernhill, 2018)
Oxyrrhynchium hians				x	x	Frequent in woodland	Widespread	Widespread
Palustriella commutata				x		In calcareous spring/ seepage areas	Widespread	Widespread
Philonotis fontana					x	Occasional in seepage areas by foresty tracks	Widespread	**Rare**: Only 3 records from Co. Dublin (Seahan Mountain, 2007; Ballyboghil, 2003; Killakee Mountain, 1969)
Plagiomnium rostratum				x		Frequent in woodland	Widespread	Occasional: <10 records for Co. Dublin
Plagiomnium undulatum				x		Occasional in woodland	Widespread	Widespread
Plagiothecium laetum	VU		O 12049 23669		x	One location on rotting wood under gorse in conifer plantation	**Rare**: Only 5 records for Ireland (2 pre-1950)	**Rare**: Only 1 record from Co. Dublin (Killakee Mountain, 1969)
Plagiothecium nemorale				x		Occasional on soil in woodland	Widespread	**Rare**: Only 3 ecords from Dublin (Fernhill, 2018; Dingle Glen, 2017; Ardgillan Demesne, 2010).

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Plagiothecium succulentum			O 12830 24037	x		Occasional on soil in woodland	Widespread	**Rare**: Only 1 record from Co. Dublin (Glencullen, 2013)
Plagiothecium undulatum				x	x	Occasional in woodland	Widespread	Widespread
Platyhypnidium lusitanicum	NT	NVCR	O 1249 2242	x		Occasional in river in upper ravine	Occasional (absent from midlands)	**Rare**: This is the first record for Co. Dublin.
Platyhypnidium riparioides				x		Frequent in river	Widespread	Widespread
Pleuridium acuminatum				x	x	Occasional on disturbed soil	Widespread	**Rare**: Only 2 records from Co. Dublin (Fernhill, 2018; Ballycorus, 2008)
Pogonatum aloides				x	x	Occasional on exposed soil banks	Widespread	Occasional: <10 records for Co. Dublin
Pogonatum urnigerum					x	Occasional on exposed soil banks	Widespread	**Rare:** Only 3 recent records from Dublin (Fernhill, 2018; Kilmashoge Mt & Seahan Mt, 2007) and 1 historic record.
Pohlia melanodon				x		Occasional in woodland	Widespread	Widespread
Polytrichastrum formosum				x	x	Occasional in woodland	Widespread	Widespread
Polytrichum commune					x	Occasional in upland areas	Widespread	Widespread
Polytrichum juniperinum					x	Occasional on soil and boulders in upland areas	Widespread	Occasional: <10 records for Co. Dublin

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Pseudoscleropodium purum					x	Occasional in damp grassland	Widespread	Widespread
Pseudotaxiphyllum elegans				x	x	Occasional in woodland	Widespread	Occasional: <10 records for Co. Dublin
Racomitrium aciculare				x	x	Occasional on boulders in upland area and in river	Widespread	Occasional: <10 records for Co. Dublin
Racomitrium fasciculare					x	Occasional on exposed boulders	Widespread	Occasional: <10 records for Co. Dublin
Racomitrium heterostichum s.str.					x	Occasional on exposed boulders	Widespread	Occasional: <10 records for Co. Dublin
Racomitrium obtusum					x	Occasional on exposed boulders	Not mapped separately from *R. heterostichum*	Not mapped separately from *R. heterostichum*
Rhizomnium punctatum				x		Frequent in and by river	Widespread	Occasional: <10 records for Co. Dublin
Rhynchostegiella tenella				x	x	Occasional on stonework	Widespread	Widespread
Rhynchostegiella teneriffae		De-bracket	O 12492 23267	x		Boulder in stream	Occasional in north and south (absent in midlands and rare in east)	**Rare**: This is the first record for Co. Dublin post 1872.
Rhynchostegium murale				x		Rare on stonework	Occasional	**Rare**: Only 2 records from Co. Dublin (Firhouse, 1988; Pheonix Park, 1993)

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Rhytidiadelphus loreus				x	x	Occasional in upper ravine (MW) and upland foresty (HF)	Widespread	Occasional: <10 records for Co. Dublin
Rhytidiadelphus squarrosus				x	x	Occasional in grassland and by paths	Widespread	Widespread
Rhytidiadelphus triquetrus				x	x	Occasional in woodland	Widespread	Occasional: <10 records for Co. Dublin
Schistidium crassipilum					x	Occasional on stonework	Widespread	Widespread
Sciuro-hypnum plumosum				x		Occasional in upper river	Widespread	**Rare:** Only 3 recent records from Dublin (Glenasmole 2011; Druid's Glen, 2010) and 1 historic record.
Sphagnum denticulatum					x	Occasional in seepage areas by upland forestry tracks	Widespread	Occasional: <10 records for Co. Dublin
Syntrichia montana					x	Occasional on stonework	Widespread	Occasional: <10 records for Co. Dublin
Tetraphis pellucida				x		Occasional in woodland	Widespread (except in midlands)	Occasional: <10 records for Co. Dublin
Thamnobryum alopecurum				x		Frequent in and by river	Widespread	Occasional: <10 records for Co. Dublin
Thuidium tamariscinum				x	x	Occasional in woodland	Widespread	Widespread

Species	Red List	NVCR/ De-bracket	Grid refs	Massy's Wood	Mount-pelier	Distribution within site	Distribution nationally	Distribution within Co. Dublin
Tortula muralis				x	x	Occasional on stonework	Widespread	Widespread
Trichostomum crispulum				x	x	Occasional on forestry tracks	Widespread	**Rare**: Only 2 recent records for Co. Dublin (Howth, 2007; Donabate, 2006) and 1 historic record.
Ulota bruchii				x	x	Occasional epiphyte	Widespread	Widespread
Ulota crispa s.l.				x		Occasional epiphyte	n/a	n/a
Ulota phyllantha					x	Occasional epiphyte	Widespread	**Rare**: Only 3 recent records for Co. Dublin (Killiney Hill, 2010; Ardgillan Demesne, 2010; Seahan Mountain, 2007)
Weissia sp.			O 12586 22314	x		Occasional on soil in crevices of old stone wall	n/a	n/a
Zygodon conoideus				x		Occasional epiphyte		**Rare**: Only 2 recent records for Co. Dublin (Seahan Mountain, 2007; Howth, 2007)
Zygodon viridissimus var. *viridissimus*				x		Occasional epiphyte	Widespread	Occasional: <10 records for Co. Dublin

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Supplementary Appendix S3

Water Quality Survey Assessment

Water Quality Assessment
Killakee Stream,
Massy's Wood,
Co. Dublin

Version: 30th October 2019

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TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

The purpose of this investigation was to assess the biological and chemical water quality of the Killakee Stream in Massy's Wood, near Killakee Mountain, Co. Dublin. This report was prepared as part of the assessment of the proposed Dublin Mountains Visitor Centre. A proposed drainage outfall is located on this stream. The need for the survey arises from a request for further information from An Bord Pleanála (Ref. 06S JA0040) to "*undertake additional surveys/ monitoring during optimal conditions, inter alia, of…. chemical substances and freshwater invertebrates upstream and downstream of the surface water discharge point in Glendoo Brook*."

1.2 Killakee Stream Overview

The Killakee stream rises approximately 250 m upstream of the proposed drainage outfall location. stream flows into the Glendoo Brook (also known as the River Jamestown 09 EPA code: 09J05). This 3rd order watercourse then flows through Massy's Wood to join the River Owendoher (EPA code: 09O01), continuing north to its confluence with the River Dodder (EPA code: 09D01). From here the 5th order River Dodder flows north-east before turning north and flowing into the 6th order River Liffey in Dublin City upstream of where it flows into the sea.

This Killakee stream is not registered as an EPA watercourse, presumably due to its small size. The Glendoo Brook (River Jamestown 09) from its source, including the site, to where it flows into the River Liffey is rated an "at risk" water body and is rated "Moderate" Water Framework Directive status 2010-2015 at the site. There has been no EPA Q-values assigned on the Glendoo Brook. According to the EPA the Owendoher_10 water body is at Moderate Status with physical habitat modifications listed as being a significant pressure.

2. METHODOLOGY

2.1 Site Location

The two study sites (Site 1 and 2) are located on the section of the Killakee stream which flows through Massy's Wood. A bridge on the walking trail through the wood crosses the stream. Much of the stream is overgrown and inaccessible. Site 1 is located approximately 200 m downstream of the proposed drainage outfall and Site 2 is approximately 100 m upstream of the proposed drainage outfall.

2.2 Biological Assessments

Semi-quantitative sampling of freshwater invertebrates was undertaken at the two sites listed using kick sampling as described in Appendix 1, Toner *et al.*, 2005. Sampling was carried out on the 28th of August 2019 which is within the optimum survey period (June-October) when flows are likely to be relatively low and water temperatures highest. Surveys during this period are likely, therefore, to coincide with the worst conditions to be expected in those reaches affected by waste inputs (Appendix 1, Toner *et al.*, 2005).

The biological sampling procedure followed at each site involved the use of a D-shaped hand net (mesh size 0.5 mm; 350 mm diameter) which was submerged on the riverbed with its mouth directed upstream. The substrate upstream of the net was then kicked for one minute to dislodge invertebrates,

which were subsequently caught in the net. This was repeated at three points along/across the watercourse. Stone washings were also undertaken over a further 1-minute period to ensure a representative sample of the fauna present at each site was collected. This involves selecting stones from the river and brushing/washing any invertebrates off into a tray.

All three samples of invertebrates from each substation were combined and live sorted on the riverbank for 20 minutes. Identification was undertaken on site, with any unknown specimens fixed in alcohol for later identification in the laboratory.

Following the kick sampling the macroinvertebrate data collected was then used to determine the Quality rating of the stream. The Quality Rating (Q) System (Appendix 1, Toner *et al.*, 2005) is the standard biotic index which is used by the EPA. Invertebrates are categorised into one of five arbitrary 'Indicator Groups' as follows: Group A, the sensitive forms, Group B, the less sensitive forms, Group C, the tolerant forms, Group D, the very tolerant forms and Group E, the most tolerant forms.. Further details on the Q-rating system and its relationship to the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009) are provided in Appendix 1.

2.3 Water Sampling

Water samples (1.5 L from each study site) were also taken from Sites 1 and 2 on the 28th of August 2019. Chemical analysis of rivers can be undertaken at any time of year (Appendix 1, Toner *et al.*, 2005). The water sampling was timed to coincide with normal flows in the river. During sampling appropriate measures to prevent contamination from other sources was undertaken and all sampling equipment had been thoroughly cleaned. Samples were labelled and placed in a cooler box and were promptly delivered to the laboratory (BHP Laboratories Ltd) for analysis.

3. RESULTS

3.1 Macroinvertebrates and Biological Water Quality

The abundance categories (fair, scarce, common etc.), outlined in Appendix 1 of Toner *et al.* (2005) have been assigned based on the percentage frequency of occurrence in each sample. Macroinvertebrate results are presented in Table 1 with biotic indices presented in Table 2.

3.1.1 Site 1

At this site, located downstream of the bridge in Massy's Wood, a total of 15 macroinvertebrate groups were recorded. No Group A pollutant 'sensitive' macroinvertebrates were found. The only Group B 'less sensitive' macroinvertebrate to be recorded at the site was the cased caddis fly larvae *Sericostoma personatum*, which was present in scarce/few numbers. In total 9 Group C 'tolerant' macroinvertebrates were recorded at Site 1. Blackfly larvae (Simulidae) were found to be dominant at the site. Two of the Group C macroinvertebrates were common; *Gammarus duebeni* and *Hydrospyche* sp. Green chironomids occurred in small numbers. The abundance of the remaining Group C macroinvertebrates was categorised as scarce/few for each Corixidae, *Elmis* sp., *Polycentropus* sp., *Caenis* sp.

There were 4 Group D 'very tolerant' macroinvertebrates recorded at the site. One of these groups was leeches (Hirudinea), which were present in fair numbers. Small numbers of *Asellus aquaticus* were present. Both Lumbricidae and *Baetis rhodani* were recorded as scarce/few. There were also small numbers of the Group E 'most tolerant' bloodworm *(Chironomous* sp.) found at this site.

Site 1 was given a Q-rating of 3, indicating 'moderately polluted' and a 'Poor' WFD status (See Appendix 1).

3.1.2 Site 2

Similar to Site 1 no Group A macroinvertebrates were found. The only Group B macroinvertebrate to be recorded at the site was the cased caddis fly larvae *Sericostoma personatum*, present in scarce/few numbers. Fair numbers of blackfly larvae (Simulidae), a Group C macroinvertebrate, were present at the site. There were small numbers of two other Group C macroinvertebrate; Green chironomid and *Gammarus duebeni.* Four other Group C macroinvertebrates were recorded at the site in scarce/few numbers; *Elmis* sp., *Philopotamidae, Sericostoma personatum* and *Hydropsyche* sp.

There were three Group D macroinvertebrates found at Site two during sampling. There was scarce/few *Baetis rhodani* present, small numbers of *Asellus aquaticus,* and *Hirudinea* species (Glossiphonidae) were dominant. Significant numbers of horsehair worms were also found spawning in the upstream sampling site. The abundance of the pollutant tolerant group; Gordiidae; was categorised as common.

The upstream Site 2 was also allocated a Q-value of 3, indicating moderately polluted and a 'Poor' water quality status.

3.2 Chemical Water Quality

Table 3 and Table 4 below present the results of the chemical water sample tests carried out in the laboratory (BHP Laboratories Ltd.) for samples taken at Site 1 and Site 2 respectively.

3.2.1 Site 1

The Alkalinity at Site 1 was 99 mg/l and indicates 'moderate' alkalinity and 'soft' water. At Site 1 Biological Oxygen Demand (BOD) was 0.3 mg/l; this level is low and meets 'High' status in the European Communities Environmental Objectives (Surface Waters) Regulations (2009). The Chemical Oxygen Demand (COD) recorded for the Site 1 samples is also not of concern at a level of < 15 mg/l. Total Dissolved Solids (TDS) at Site 1 was found to be 180 mg/l. Natural TDS levels range from 25 mg/l to 250 mg/l. Total Suspended Solids (TSS) in the water samples from Site 1 was found to be low, at < 5 mg/l. The Orthophosphate level at Site 1 of 0.02 mg/l is low and within High Status limits. The level of Total Phosphorus, however, was relatively high at 0.67 mg/l. The Nitrate level at Site 1 was 3.4 mg/l which is a normal level. Nitrite was below the level of detection. Overall, chemical water quality is assessed as unsatisfactory due to the elevated level of Total Phosphorus.

3.2.2 Site 2

The Alkalinity at Site 2 was 94 mg/l and again indicates 'moderate' alkalinity and 'soft' water. At Site 2 BOD was 0.4 mg/l this level is low and meets 'High' status standards in the European Communities Environmental Objectives (Surface Waters) Regulations (2009). The COD recorded for the Site 2 samples is also not of concern at a level of < 15 mg/l. TDS at Site 2 was found to be 248 mg/l. Natural TDS levels range from 25 mg/l to 250 mg/l. TSS in the water samples from Site 1 was found to be low at 11 mg/l (limit value is 25 mg/l). The Orthophosphate level at Site 2 of 0.031 mg/l is low and meets all Good Status limits (SWR, 2009). The level of Total Phosphorus was 0.29 mg/l which is slightly elevated. The Nitrate level at Site 2 was again 3.4 mg/l which is a normal level. Nitrite was below the level of detection. Overall, chemical water quality is assessed as unsatisfactory due to a slightly elevated level of Total Phosphorus.

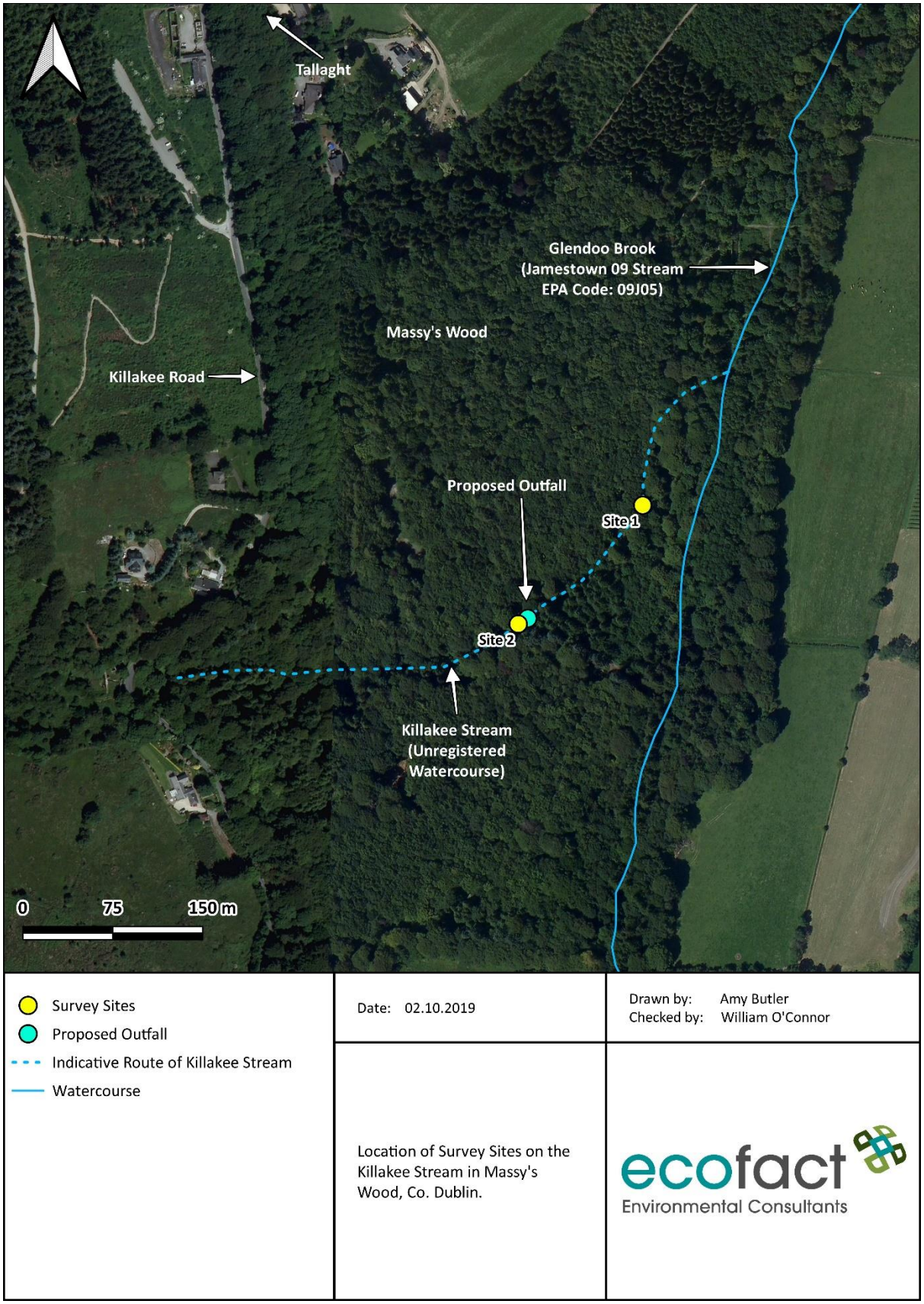


Figure 1 Location of the aquatic ecology survey locations and proposed discharge location.

Table 1 Results of the on-site macroinvertebrate survey at the two survey sites on the Killakee Stream in Massy's Wood in August 2019.

	Pollution Sensitivity Group	Site 1	Site 2
SEGMENTED WORMS (Clitellata, Oligochaeta)			
Aquatic earthworm (Lumbricidae)	D	Scarce/Few	
LEECHES (Hirudinea)			
Glossiphonidae	D	Fair Numbers	Dominant
CRUSTACEANS (Crustacea)			
Amphipods (Amphipoda, Gammaridae)			
Freshwater shrimp *Gammarus duebeni*	C	Common	Small Numbers
Isopods (Isopoda, Asellidae)			
Hog louse *Asellus aquaticus*	D	Small Numbers	Small Numbers
MAYFLIES (Uniramia, Ephemeroptera)			
Baetidae			
Baetis rhodani	D	Scarce/Few	Scarce/Few
White midges (Caenidae)			
Caenis sp	C	Scarce/Few	
CASELESS CADDIS FLIES (Trichoptera)			
Grey flags (Hydropsychidae)			
Hydropsyche sp.	C	Common	Scarce/Few
Trumpet-net Caddisflies (Polycentropodidae)			
Polycentropus sp.	C	Scarce/Few	Scarce/Few
Philopotamidae	C		Scarce/Few
CASED CADDIS FLIES (Tricoptera)			
Sericostomatidae			
Black caperer *Sericostoma personatum*	B	Scarce/Few	Scarce/Few
TRUE FLIES (Diptera)			
Blackfly larvae (Simulidae)	C	Dominant	Fair Numbers
Chironomidae			
Green chironomid	C	Small Numbers	Small Numbers
Bloodworm *Chironomous sp.*	E	Small Numbers	Scarce/Few
BEETLES (Coleoptera)			
Riffle beetles (Elmidae)			
Elmis sp.	C	Scarce/Few	Scarce/Few
BUGS (Hemiptera)			
Corixidae	C	Scarce/Few	
HORSEHAIR WORMS (Nematomorpha)			
Gordioidea			
Gordiidae	D		Common
Family diversity		**14**	**13**
Note. Scarce/Few = <1%, Small numbers = <5%, Fair numbers = 5-10%, Common = 10-20% Numerous = 25-50%, Dominant = 50-75% and Excessive = >75%			

Table 2 Water quality at the two survey sites on the Killakee stream in Massy's Wood in August 2019.

Site	Site 1	Site 2
Number of Families	14	13
Q-Value	Q3	Q3
Q-Status	Moderately polluted	Moderately polluted
WFD status	Poor	Poor

Table 3 Results of the laboratory chemical assessment for the water sample taken from Site 1.

Site 1	Units	Results	Date Analysed	Method
Wet Chemistry				
Alkalinity (as $CaCO_3$)	mg/L	99	09/09/2019	BHP AC 095
Biological Oxygen Demand	mg/L	0.3	04/09/2019	BHP AC 005
Chemical Oxygen Demand	mg/L	<15	03/09/2019	BHP AC 006
OrthoPhosphate (as P)	mg/L	0.02	04/09/2019	BHP AC 095
Total Phosphorus (as P)	mg/L	**0.67**	05//09/2019	BHP AC 095
Total Dissolved Solids	mg/L	**180**	03/09/2019	BHP AC 011
Total Suspended Solids	mg/L	**<5**	03/09/2019	BHP AC 012
Metals				
Arsenic	mg/L	<0.0001	08/09/2019	1450
Cadmium	mg/L	<0.005	09/09/2019	BHP AC 129
Copper	mg/L	<0.025	18/09/2019	BHP AC 129
Iron	mg/L	0.068	09/09/2019	BHP AC 129
Zinc	mg/L	0.028	09/09/2019	BHP AC 129
Ion Chromotography				
Nitrate (as NO_3)	mg/L	3.4	02/09/2019	BHP AC 019
Nitrite (as NO_2)	mg/L	<0.05	02/09/2019	BHP AC 019

Table 4 Results of the laboratory chemical assessment for the water sample taken from Site 2.

Site 2	Units	Results	Date Analysed	Method
Wet Chemistry				
Alkalinity (as $CaCO_3$)	mg/L	94	09/09/2019	BHP AC 095
Biological Oxygen Demand	mg/L	0.4	04/09/2019	BHP AC 005
Chemical Oxygen Demand	mg/L	<15	03/09/2019	BHP AC 006
OrthoPhosphate (as P)	mg/L	0.031	04/09/2019	BHP AC 095
Total Phosphorus (as P)	mg/L	**0.29**	05//09/2019	BHP AC 095
Total Dissolved Solids	mg/L	**248**	03/09/2019	BHP AC 011
Total Suspended Solids	mg/L	**11**	03/09/2019	BHP AC 012
Metals				
Arsenic	mg/L	<0.0001	08/09/2019	1450
Cadmium	mg/L	<0.005	09/09/2019	BHP AC 129
Copper	mg/L	<0.025	18/09/2019	BHP AC 129
Iron	mg/L	0.19	09/09/2019	BHP AC 129
Zinc	mg/L	<0.025	09/09/2019	BHP AC 129
Ion Chromotography				
Nitrate (as NO_3)	mg/L	3.4	02/09/2019	BHP AC 019
Nitrite (as NO_2)	mg/L	<0.05	02/09/2019	BHP AC 019

4. CONCLUSION

A total of two sites were sampled on the Killakee Stream in August 2019. Biological and chemical water quality assessments were carried out at each site. This was undertaken to gain an understanding of the baseline conditions of the Killakee Stream to inform the planning application for the proposed Dublin Mountains Visitor Centre, which included an outfall into this stream. The Killakee stream is not registered by the EPA, and it rises c. 250 m upstream of the outfall location.

The current biological water quality monitoring results indicate that the Killakee stream is Moderately Polluted. Both sites were assigned an EPA Q Rating of Q3, which corresponds to 'Poor Status'. Family diversity at Site 1 and Site 2 was 14 and 13 respectively. It was not considered that the macroinvertebrate population at the site was very diverse. No Class A species were recorded at either site. Pollution tolerant indicators were the majority recorded at these sites. Both of the sites were noted to show siltation impacts as well as debris from fallen vegetation.

The current chemical water quality monitoring results indicate unsatisfactory chemical water quality due to elevated Total Phosphorus levels. It is noted that this is just a one-off chemical water quality sample, so any exceedances are taken to indicate unsatisfactory conditions.

Overall, the current results indicate that the Killakee stream is currently affected by background water quality issues and there is evidence of pressures on aquatic ecology. The source of this water quality pressure is unknown. This is a very small stream and is not of aquatic ecological significance. No fish were recorded during the survey and it is unlikely that fish would occur due to the small size of the stream. However, salmonids will be present in downstream areas.

REFERENCES

EPA (2001) Parameters of Water Quality; interpretation and standards.

EPA (2011) Integrated Water Quality Report – South East Ireland.

European Communities Environmental Objectives (Surface Waters) Regulations 2009. S.I. 272 of 2009.

Toner, P., Bowman, K., Clabby, K., Lucey, J., McGarrigle, M, Concannon, C., Clenaghan, C., Cunningham, P., Delaney, J., O' Boyle, S., MaCarthaigh, M., Craig, M., and Quinn, R. (2005) *Water Quality in Ireland 2001-2003*. Environmental Protection Agency, Wexford.

PLATES

Plate 1 Walking trail in Massy's Wood crossing the Killakee stream.

Plate 2 View downstream from bridge. Stream hidden by heavy vegetation and trees.

Plate 3 Stream flowing through debris from surrounding vegetation and trees.

Plate 4 Collecting water samples at Site 1.

Plate 5 Kick sampling at Site 1.

Plate 6 Kick sample analysed at Site 1.

Plate 7 Water after aggravation of sediment during kick sampling at Site 1.

Plate 8 Site 2: Large rocks and branches placed across stream, possibly used as a crossing point for visitors using the forest trail.

Plate 9 Collecting water samples at Site 2.

Plate 10 Kick sampling at Site 2.

Plate 11 Kick sample taken from Site 2.

Plate 12 Horsehair worms spawning (present in kick sample from Site 2).

APPENDIX 1 BIOTIC INDICES

Table A1.1 Biological River Quality Classification (Q-Values).

'Q' value	Community Diversity	Water Quality	Condition*	Status	Quality
Q5	High	Good	Satisfactory	Unpolluted	Class A
Q4	Reduced	Fair	Satisfactory	Unpolluted	Class A
Q3	Much Reduced	Doubtful	Unsatisfactory	Slightly Polluted	Class B
Q2	Low	Poor	Unsatisfactory	Moderately Polluted	Class C
Q1	Very Low	Bad	Unsatisfactory	Seriously Polluted	Class D

* *'Condition' refers to the likelihood of interference with beneficial or potential beneficial use.*

The connection between the Q-rating system and the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009) is given in Table A1.2 below.

Table A1.2 Water Framework Directive (WFD) ecological status classification and corresponding Q-rating.

Ecological status classification	Corresponding Q-rating
High	Q5, Q4-5
Good	Q4
Moderate	Q3-4
Poor	Q3, Q2-3
Bad	Q2, Q1

Supplementary Appendix S4

Survey Transect Routes

Massy's Estate Transect Routes

Legend

- Breeding Bird Transect
- Bat Transect
- Squirrel Transect

N

0 75 150 300 Meters

Montpelier Hill Transect Routes

Legend

- Breeding Bird Transect
- Squirrel Transect
- Montpelier Hill Bat Transect

N

0 75 150 300 Meters

Supplementary Appendix S5

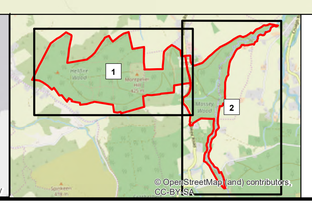
Protected Species Habitats and Camera Track Locations

N

0 125 250 500 Meters

Legend

- Red Squirrel Sighting
- Squirrel Drey
- Chewed Cones
- Pine Marten Sighting
- Tufa Spring
- Pine Marten Scat
- Otter Spraint
- P. laeutum (Bryophyte)
- Camera Traps
- O. stramineum (Bryophyte)



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DUBLIN MOUNTAINS VISITOR CENTRE

PROTECTED SPECIES, HABITATS AND CAMERA TRAP LOCATIONS

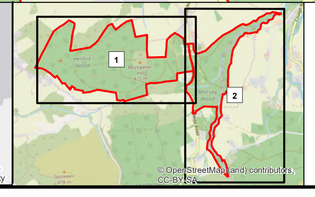
SHEET 1 OF 2

N

0 125 250 500 Meters

Legend

- Red Squirrel Sighting
- Squirrel Drey
- Chewed Cones
- Pine Marten Sighting
- Tufa Spring
- Pine Marten Scat
- Otter Spraint
- P. laeutum (Bryophyte)
- Camera Traps
- O. stramineum (Bryophyte)



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DUBLIN MOUNTAINS VISITOR CENTRE

PROTECTED SPECIES, HABITATS AND CAMERA TRAP LOCATIONS

SHEET 2 OF 2

Supplementary Appendix S6

Higher Plant List

Massy's Estate		Hell Fire Club	
Common Name	**Latin Name**	**Common Name**	**Latin Name**
Ash	*Fraxinus excelsior*	Ash	*Fraxinus excelsior*
Beech	*Fagus sylvatica*	Beech	*Fagus sylvatica*
Bramble	*Rubus fruticosus agg.*	Billberry	*Vaccinium myrtillus*
Broad Buckler-fern	*Dryopteris dilatata*	Bird's-foot Trefoil	*Lotus corniculatus*
Broad-leaved Dock	*Rumex obtusifolius*	Black Medic	*Medicago lupulina*
Brooklime	*Veronica beccabunga*	Bracken	*Pteridium aquilinum*
Bugle	*Ajuga reptans*	Bramble	*Rubus fruticosus agg.*
Burdock	*Arctium minus*	Burdock	*Arctium minus*
Cherry Laurel	*Prunus laurocerasus*	Larch	*Larix decidua*
Cleavers	*Galium aparine*	Cat's-ear	*Hypochaeris radicata*
Common Chickweed	*Stellaria media*	Cock's-foot	*Dactylis glomerata*
Common Dog Violet	*Viola riviniana*	Colt's-foot	*Tussilago farfara*
Common Figwort	*Scrophularia nodosa*	Common Knapweed	*Centaurea nigra*
Common Haircap	*Polytrichum commune*	Common Sorrel	*Rumex acetosa*
Common Knapweed	*Centaurea nigra*	Common Spotted Orchid	*Dactylorhiza fuchsii*
Common Sorrel	*Rumex acetosa*	Common vetch	*Vicia sativa*
Cow Parsley	*Anthriscus sylvestris*	Creeping Bent	*Agrostis stolonifera*
Creeping Bent	*Agrostis stolonifera*	Creeping Buttercup	*Ranunculus repens*
Creeping Buttercup	*Ranunculus repens*	Creeping Thistle	*Cirsium arvense*
Cypress	*Cupressus sp.*	Cuckoo Flower	*Cardamine pratensis*
Dandelion	*Taraxacum officinale*	Daisy	*Bellis perennis*
Early Dog Violet	*Viola reichenbachiana*	Dandelion	*Taraxacum officinale*
Elder	*Sambucus nigra*	Dougals Fir	*Pseudotsuga menziesii*
Enchanter's Nightshade	*Circaea lutetiana*	Downy Birch	*Betula pubescens*
False Wood-brome	*Brachypodium sylvaticum*	Elder	*Sambucus nigra*
Field Forget-me-not	*Myosotis arvensis*	Eyebright	*Euphrasia officinalis*
Field Horsetail	*Equisetum arvense*	Fairy Flax	*Linum catharticum*

Massy's Estate		Hell Fire Club	
Common Name	**Latin Name**	**Common Name**	**Latin Name**
Flowing Current	*Ribes sanguineum*	False Oat-Grass	*Arrhenatherum elatius*
Foxglove	*Digitalis purpurea*	Common Figwort	*Scrophularia nodosa*
Fuchsia	*Fuchsia magellanica*	Foxglove	*Digitalis purpurea*
Germander Speedwell	*Veronica chamaedrys*	Germander Speedwell	*Veronica chamaedrys*
Greater Plantain	*Plantago major*	Gorse	*Ulex europaeus*
Ground Elder	*Aegopodium podagraria*	Greater Stitchwort	*Stellaria holostea*
Hard Fern	*Blechnum spicant*	Groundsel	*Senecio vulgaris*
Hart's Tongue	*Asplenium scolopendrium*	Hawthorn	*Crataegus monogyna*
Hart's-tongue Fern	*Phyllitis scolopendrium*	Hazel	*Corylus avellana*
Hedge Woundwort	*Stachys sylvatica*	Heath Bedstraw	*Galium saxatile*
Herb Robert	*Geranium robertianum*	Heath Milkwort	*Polygala serpyllifolia*
Himalayan Honeysuckle	*Leycesteria formosa*	Heath Speedwell	*Veronica officinalis*
Hogweed	*Heracleum sphondylium*	Heather	*Calluna vulgaris*
Holly	*Ilex aquifolium*	Herb Robert	*Geranium robertianum*
Horse Chestnut	*Aesculus hippocastanum*	Himalayan Honeysuckle	*Leycesteria formosa*
Ivy	*Hedera helix*	Hogweed	*Heracleum sphondylium*
Ivy-leaved Toadflax	*Cymbalaria muralis*	Holly	*Ilex aquifolium*
Lady Fern	*Athyrium filix-femina*	Ivy	*Hedera helix*
Larch	*Larix decidua*	Ivy-leaved Toadflax	*Cymbalaria muralis*
Lesser Celandine	*Ficaria verna*	Lady's Bedstraw	*Galium verum*
Lords-and-ladies	*Arum maculatum*	Lesser Hawkbit	*Leontodon taraxacoides*
Male Fern	*Dryopteris filix-mas*	Lesser Stitchwort	*Stellaria graminea*
Marsh Thistle	*Cirsium palustre*	Lousewort	*Pedicularis sylvatica*
Meadow buttercup	*Ranunculus acris*	Male fern	*Dryopteris filix-mas*
Nettle	*Urtica dioica*	Marsh Thistle	*Cirsium palustre*
Pendulous Sedge	*Carex pendula*	Meadow Buttercup	*Ranunculus acris*
Pendunculate Oak	*Quercus robur*	Montbretia	*Crocosmia crocosmiiflora*

Massy's Estate		Hell Fire Club	
Common Name	**Latin Name**	**Common Name**	**Latin Name**
Perennial Ryegrass	*Lolium perenne*	Mouse-ear Hawkweed	*Hieracium pilosella*
Pignut	*Conopodium majus*	Nettle	*Urtica dioica*
Prickly Sow Thistle	*Sonchus asper*	Pendunculate Oak	*Quercus robur*
Primrose	*Primula vulgaris*	Perrenial Ryegrass	*Lolium perenne*
Ragwort	*Jacobaea vulgaris*	Polypody	*Polypodium vulgare*
Red Clover	*Trifolium pratense*	Prickly Sow Thistle	*Sonchus asper*
Remote Sedge	*Carex remota*	Primrose	*Primula vulgaris*
Rhododenron	*Rhododendron ponticum*	Purple Toadflax	*Linaria purpurea*
Rosebay Willowherb	*Chamaenerion angustifolium*	Ragwort	*Jacobaea vulgaris*
Sanicle	*Sanicula europaea*	Red Clover	*Trifolium pratense*
Sessile Oak	*Quercus patrea*	Red Fescue	*Festuca rubra*
Short-fruited Willowherb	*Epilobium obscurum*	Rosebay Willowherb	*Chamaenerion angustifolium*
Silver Birch	*Betula pendula*	Rowan	*Sorbus aucuparia*
Snowberry	*Symphoricarpos albus*	Self-heal	*Prunella vulgaris*
Soft Rush	*Juncus effusus*	Bell Heather	*Erica cinerea*
Soft Shield Fern	*Polystichum setiferum*	Sessile Oak	*Quercus petraea*
Sticky Mouse-ear	*Cerastium glomeratum*	Ribwort Plantain	*Plantago lanceolata*
Sweet Chestnut	*Castanea sativa*	Silver Birch	*Betula pendula*
Sycamore	*Acer pseudoplatanus*	Sitka Spruce	*Picea sitchensis*
Tutsan	*Hypericum androsaemum*	Slender St. John's-wort	*Hypericum pulchrum*
Veriagated Yellow Archangel	*Lamium galeobdolon*	Smooth Sowthistle	*Sonchus oleraceus*
Wavy Bittercress	*Cardamine flexuosa*	Soft Brome	*Bromus hordeaceus*
White Clover	*Trifolium repens*	Soft Rush	*Juncus effusus*
Wood Avens	*Geum urbanum*	Spear Thistle	*Cirsium vulgare*
Wood Fescue	*Festuca altissima*	Sticky Mouse-ear	*Cerastium glomeratum*
Wood Rush	*Luzula sylvatica*	Sweet Chestnut	*Castanea sativa*
Wood Sorrel	*Oxalis acetosella*	Yarrow	*Achillea millefolium*

Massy's Estate		**Hell Fire Club**	
Common Name	**Latin Name**	**Common Name**	**Latin Name**
Wood Speedwell	*Veronica montana*	Timothy	*Phleum pratense*
Woodruff	*Galium odoratum*	Tormentil	*Potentilla erecta*
Wych Elm	*Ulmus glabra*	Western Gorse	*Ulex galii*
Yellow Pimperenelle	*Lysimachia nemorum*	White Clover	*Trifolium repens*
Yew	*Taxus baccata*	Wild Migionette	*Reseda lutea*
Yorkshire Fog	*Holcus lanatus*	Wood Avens	*Geum urbanum*
		Wood Sage	*Teucrium scorodonia*
		Wood Speedwell	*Veronica montana*
		Yorkshire Fog	*Holcus lanatus*

Supplementary Appendix S7

Vegetation Survey Results

Quadrats- Massy's Wood	18th June 2019										
Common Name	**Latin Name**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Ash	*Fraxinus excelsior*		5		3		5		5	10	5
Beech	*Fagus sylvatica*	4		8	9	1	9	10	10		
Bramble	*Rubus fruticosus agg.*		9	6		4					
Broad Leaved Dock	*Rumex obtusifolius*										2
Bugle	*Ajuga reptans*						1				
Cherry Laurel	*Prunus laurocerasus*						7				
Cleavers	*Galium aparine*	4			2					4	
Common Haircap	*Polytichum Communis*				3	1		1			
Common Knapweed	*Centaurea nigra*										3
Common Sorrel	*Rumex acetosa*	3									3
Creeping Bent	*Agrostis stolonifera*				2		5			4	3
Creeping Buttercup	*Ranunculus repens*	3					4			2	5
Cypress	*Cupressus sp.*					5					
Dandelion	*Taraxacum majus*				1						
Enchanter's Nightshade	*Circaea lutetiana*		4	4	2						
Field Horsetail	*Equisetum arvense*										8
Germander Speedwell	*Veronica chamaedrys*						3		2		
Greater Plantain	*Plantago major*	3									3
Hard Fern	*Blechnum spicant*			3	3		2				
Harte's Tongue	*Asplenium scolopendrium*									2	
Hedge Woundwort	*Stachys sylvatica*	5									4
Herb Robert	*Geranium robertianum*		9	5	4	5	4			4	
Hogweed	*Heracleum sphondylium*	4									
Holly	*Ilex aquifolium*					2			3		
Horse Chestnut	*Aesculus hippocastanum*								5		
Ivy	*Hedera helix*	5	3				2		4	4	

Quadrats- Massy's Wood	18th June 2019										
Common Name	**Latin Name**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Lady Fern	*Athyrium filix-femina*					2			3		
Larch	*Larix decidua*				5						
Male Fern	*Dryopteris filix-mas*		3			4				4	
Marsh Thistle	*Cirsium palustre*										2
Nettle	*Urtica dioica*	5					5			4	4
Pendunculate Oak	*Quercus robur*			4				5			4
Perennial Rye Grass	*Lolium perenne*										3
Pignut	*Conopodium majus*								4		
Red Clover	*Trifolium pratense*										2
Remote Sedge	*Carex remota*	3								3	
Sanicle	*Sanicula europaea*	3	3				2		5		
Short fruited Willowherb	*Epilobium obscurum*	3	3								
Snowberry	*Symphoricarpos albus*	5									
Soft Rush	*Juncus effusus*					2					
Sticky Mouse Ear	*Cerastium glomeratum*								2		
Sweet Chestnut	*Castanea sativa*		10								
Sycamore	*Acer pseudoplatanus*	10	5			4	7		5	5	
Wavy Bittercress	*Cardamine flexuosa*								2		
White Clover	*Trifolium repens*										4
Wood Avens	*Geum urbanum*	6	3	3	1					2	
Wood Fescue	*Festuca altissima*	5		4							
Wood Rush	*Luzula sylvatica*					5	4	1	8		
Wood Sorrel	*Oxalis acetosella*			5	4	3		4		1	
Wood Speedwell	*Veronica montana*		3						3		
Woodruff	*Galium odoratum*									2	
Wych Elm	*Elmus glabra*										6

Quadrats- Massy's Wood	18th June 2019										
Common Name	**Latin Name**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Yellow Pimperenelle	*Lysimachia nemorum*						4		2	2	
Yew	*Taxus baccata*								2		
Yorkshire Fog	*Holcus lanatus*					7					2

Quardrat	Notes	ITM X	ITM Y
Q1	By the entrance to Massy's in front of Gate Lodge on the west side of the path. Woodland edge habitat.	712050	723864
Q2	On the slope close to Kilakee road in an area domiated by tall sweet chestnut trees 1.2m diameter. Sycamore is present within 10m of the road. Young ash form the understorey 3-8m tall. Open woodland with a sparse understory and a field layer<0.5m high. Bare ground makes up 20% of quadrat.	712118	723581
Q3	After path crossoads about half-way to bridge. The area is partially shaded by beach and represent the typical flora in the middle part of Massy's. under the beech tree the ground is bare and make up 20% of the quadrat. Oxalis grows in the shade where other species cannot, but it is outcompeted in the clearing.	712238	723607
Q4	25m below bridge on path to be formalised. Representative of more shaded area of middle woodland. Bare ground 70%.	712288	723443
Q5	Above badger sett in Masssy among standing cypress trees. The standing dead trees have a lot of woodpecker holes. The quadrat in a clearing where cypress trees formally grew. Wood rush domiates.	712151	723267
Q6	Along proposed link path in a small area not completely cover by laurel. The clearing may exist because of seepage from the road. The flora is representative of the are pre laurel invasion.	712081	723446
Q7	SW corner of main block of densely growing beech trees with occasional oak. Approx. location where link path turns down the hill.	712152	723196
Q8	eastern corner of Massy's wood where big beech tree fell down and was remove in 2017/2018. It borders a field and there is a lot of light getting in.	712469	723319
Q9	young planted woodland on eastern side of wood. Laurel is invading the woodland from the Glendoo Brook (east) side. Most of the ash trees are 15cm diameter, with some scattered twice this size. Thinning is probably overdue.	712497	723949
Q10	downstream of most downstream bridge on left bank.	712818	724090

Montpelier Hill Quadrats- Heath	2nd July 2019					
Common Name	**Latin Name**	**1**	**2**	**3**	**4**	**5**
Bare Ground	n/a	5	4	4	4	4
Bell Heather	*Erica cinerea*		3	1	5	5
Bramble	*Rubus fruticosus agg.*	3	2		3	
Cat's Ear	*Hypochaeris radicata*	2	1			
Cock's Foot	*Dactylis glomerata*	2		1	3	2
Colts Foot	*Tussilago farfara*		3			
Common Knapweed	*Centaurea nigra*	3		4		
Dwarf Gorse	*Ulex galii*	9	10	9	8	9
False Oat Grass	*Arrhenatherum elatius*	1				1
Heath bedstraw	*Galium saxatile*				3	3
Heath Milkwort	*Polygala serpyllifolia*	1				
Heath speedwell	*Veronica officinalis*	2		2		
Lancelote Plantain	*Plantago lancelota*		1			
Red Fescue	*Festuca rubra*	3	3	3	2	
Slender St. John's Wort	*Hypericum pulchrum*	1	1	1	3	1
Tormentil	*Potentilla erecta*	1	3	3	2	2
Wood Sage	*Teucrium scorodonia*	5	3	3	3	
Wood speedwell	*Veronica montana*			3		

Montpelier Quadrat No.	ITM X	ITM Y
1	710899	723364
2	710883	723365
3	710872	723367
4	710861	723368
5	710851	723368

Heath Habitat Conservation Assessment: Montpelier Hill					
Question:					
Number of bryophyte or non-crustose lichen species present, excluding Campylopus spp. and Polytrichum spp. ≥ 3	F	F	F	F	F
Number of positive indicator species present ≥ 2 (Appendix VI)	F	P	P	P	P
Siliceous heaths: cover of positive indicator species ≥ 50% (Appendix VI)	P	P	P	P	P
Proportion of dwarf shrub cover composed of Myrica gale, Salix repens, Ulex gallii collectively < 50%	F	F	F	F	F
Cover of the following weedy negative indicator species: Cirsium arvense, C. vulgare, Ranunculus repens, large Rumex species (except R. acetosa), Senecio jacobea, Urtica dioica collectively < 1%	P	P	P	P	P
Cover of non-native species < 1%	P	P	P	P	P
Cover of non-native species < 1% (local vicinity)	F	F	F	F	F
Cover of scattered native trees and scrub < 20% (local vicinity)	F	F	F	F	F
Cover of Pteridium aquilinum < 10% (local vicinity)	P	P	P	P	P
Cover of Juncus effusus < 10% (local vicinity)	P	P	P	P	P
Senescent proportion of Calluna vulgaris cover < 50%	N/A	N/A	N/A	N/A	N/A

Last complete growing season's shoots of ericoids and Empetrum nigrum showing signs of browsing collectively < 33% (Assess a minimum of 10 shoots distributed across the plot)	N/A	P	P	P	P
No signs of burning inside boundaries of sensitive areas (local vicinity)	P	P	P	P	P
Outside boundaries of sensitive areas, all growth phases of Calluna vulgaris should occur throughout, with ≥ 10% of cover in mature phase (local vicinity)	N/A	N/A	N/A	N/A	N/A
Cover of disturbed bare ground < 10%	F	P	P	P	P
Cover of disturbed bare ground < 10% (local vicinity)	F	F	F	F	F
Total fail	**7**	**5**	**5**	**5**	**5**

Supplementary Appendix S8

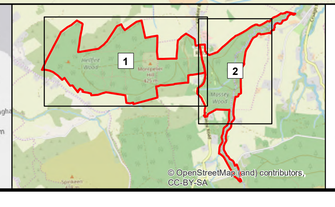
Bat Activity Survey Reports

N

0 125 250 500 Meters

Bat Species

- Brown long-eared bat
- Common pipistrelle
- Leisler's bat
- Myotis spp.
- Soprano pipistrelle



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DUBLIN MOUNTAINS VISITOR CENTRE

BAT RECORDS SHEET 1 OF 2

N

0 75 150 300 Meters

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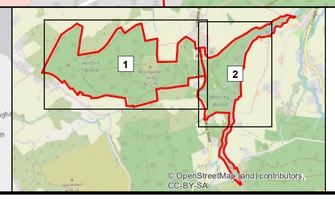
Bat Species

- Brown long-eared bat
- Common pipistrelle
- Leisler's bat
- Myotis spp.
- Soprano pipistrelle



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DUBLIN MOUNTAINS VISITOR CENTRE

BAT RECORDS SHEET 2 OF 2

Supplementary Appendix S9

Walker Survey Report

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Dublin Mountains Visitor Centre

Walker Survey Report

December 2019

ROD
ROUGHAN & O'DONOVAN

DUBLIN MOUNTAINS VISITOR CENTRE

Walker Survey Report

TABLE OF CONTENTS

1. INTRODUCTION

Roughan & O'Donovan was appointed by South Dublin County Council to provide environmental and engineering services for the proposed Dublin Mountains Visitor Centre.

The planning application for the development included an Environmental Impact Assessment Report (EIAR) and Screening for Appropriate Assessment Report which were submitted to An Bord Pleanála in July 2017.

In the letter dated the 6th February 2019 (Ref 06S.JA0040), An Bord Pleanála requested further information in relation to the impacts of the development, particularly in relation to the impact of increased visitor numbers using the proposed visitor centre as a new starting point for the Dublin Mountains Way, which leads into the nearby European sites, and the impacts that the increased number of users might have on the European sites.

In order to assess the impact of increased visitor access on the surrounding environment, including the Wicklow Mountains SPA, the Wicklow Mountains SAC and the Glenasmole Valley SAC, ROD commissioned walker surveys in 2017 and 2019. The Dublin Mountains Partnership provided data on car park usage in the Dublin Mountains. All available data has been compiled in this report for ease of reference by An Bord Pleanála.

The visitor data is presented and discussed in this report, particularly in relation to the existing patterns of usage and the potential changes in the patterns of usage that may occur as a result of increased visitor numbers using the proposed visitor centre.

To avoid repetition, the project and site descriptions, which are detailed in the EIAR and Natura Impact Statement, are not reiterated in this report.

2. SOURCES OF INFORMATION

2.1 Dublin Mountains Partnership Visitor Monitoring (Nomad)

Visitor Monitoring was carried out by Nomad Traffic Counting Systems (Nomad, hereafter) on behalf of the Dublin Mountains Partnership at eight car parks in the Dublin Mountains. As set out in Table 1, below, monitoring commenced at half of the sites in July 2015 and at the remainder of sites in July 2017 and used a mix of vehicle and pedestrian counters. Using data collected between the date of the installation of the respective counters and the 30th of June 2019, Nomad Traffic Counting Systems produced a summary report. The full report is presented in Appendix A to this report.

Table 1. Visitor Monitoring Sites (Nomad)

Monitoring site	Counter type	Date of installation of counter
Barnaslingan	Pedestrian	08/07/2015
Cruagh Wood	Pedestrian	08/07/2015
Hell Fire Wood	Vehicle	08/07/2015
Ticknock	Vehicle	08/07/2015
Kilmashogue Forest	Pedestrian	01/07/2017
Glenasmole	Pedestrian	01/07/2017
Rathmichael Woods	Pedestrian	01/07/2017
Kiltipper Park	Pedestrian	01/07/2017

2.2 2017 Walker Survey (Abacus)

A previous survey of walker numbers was conducted by Abacus from the 3rd to the 6th of November 2017. The survey sites were selected to establish how well used the trails are which link the Hell Fire Club car park, Cruagh Wood and the Dublin Mountains Way towards the Glenasmole Valley. Counters were placed at the following locations:

- The south end of Massy's Estate, 100m north of the Cruagh Road. This is the trail that links the proposed development to the Dublin Mountains Way.
- The Cruagh Wood Car Park - Counters were placed at the two pedestrian exits leading into Cruagh Wood from the car park.
- Killakee Wood (also known as 'the Featherbeds Forest') - 550m west of the Old Military Road, where the Dublin Mountains Way passes through felled conifer plantation.
- Piperstown Local Road - West of Killakee Wood along the Dublin Mountains Way towards the Glenasmole Valley SAC.

A map showing the survey locations is presented in Appendix B to this report.

2.3 2019 Walker Survey (Traffinomics)

Following the request for further information from An Bord Pleanala in February 2019 fresh walker surveys were carried out by Traffinomics at 12 sites over 3 months in Summer 2019 coincident with other ecological surveys at selected sites across the recreational forests in the Dublin Mountains at the northern edge of the Wicklow Mountains Special Protection Area for birds. The surveys were carried out over four days per month in June (7^{th} - 10^{th}), July (5^{th} - 8^{th}) and August (9^{th} - 12^{th}) 2019. The surveys involved visitor counts using cameras and a car park traffic survey to record the dwell times of vehicles as an indicator for the typical duration of visits. The aim of the surveys was to collect data on the durations of visits and the level of visitor use at the Hell Fire Club, Massy's Estate, Cruagh Wood and on the interconnecting paths leading from the proposed development towards the Natura 2000 Sites. The 12 locations were as follows:

- Three cameras were placed at the Hell Fire Club at the footpath 2 exits from the car park and close to the summit on the eastern side where several approach paths intersect;
- Three cameras were placed in Massy's Estate near the entrance from Killakee Road, at the upper bridge over the Glendoher Brook, and on the Dublin Mountains Way Link trail that leaves the southern end of the wood at Cruagh Road;
- Four cameras were placed in Cruagh Wood, one at the Dublin Mountains Way trail exit onto Cruagh Road, one at the forest road exit from the car park, and two along the paths at the southern edge of the forest leading into the Wicklow Mountains SAC and SPA at Cruagh Mountain; and
- Two cameras were placed along the Military Road, where walking trails leave the road heading northeast towards Cruagh and Glendoo Mountains.

A map showing the survey locations is provided in Appendix C to this report.

3. RESULTS

3.1 Dublin Mountains Partnership Visitor Monitoring (Nomad)

A summary of the results obtained for the car parks nearest to the proposed development is shown in Table 2, below. The full report for these data is provided in Appendix A to this document.

Table 2. Average visitor numbers at car parks surveyed 2015/2017 - 2019

Car Park	Survey Period	Counter type	Distance (km)*	Average Visitor Numbers		
				Monthly	Weekly	Daily
Hell Fire Club	07/2015 – 06/2019	Vehicle	0.2	7,355	1,688	241
Cruagh	07/2015 – 06/2019	Pedestrian	1.1	2,723	625	89
Glenasmole	07/2017 – 06/2019	Pedestrian	2.4	2,313	531	76
Kilmashogue	07/2017 – 06/2019	Pedestrian	3.2	1,816	417	60
Ticknock	07/2015 – 06/2019	Vehicle	4.8	16,768	3,848	550
*Approx. linear distance from proposed Visitor Centre						

3.2 2017 Walker Survey (Abacus)

The 2017 walker surveys were undertaken at 4 locations on, or adjacent to, the Dublin Mountains Way where it traverses across the mountains in close proximity to the Natura 2000 sites. These surveys sought to quantify the scale of walker activity in relation to the proximity to the main access point at Cruagh Wood car park which is the closest of the recreational forests to the SPA on Cruagh Mountain. The survey at Massy's Estate was located at the southern extremity of the forest where a trail links to the Dublin Mountains Way on Cruagh Road. This provided an indication of the number of walkers that make linked trips between the lower forest at Massy's Estate and the higher forest at Cruagh.

A summary of the results is presented in Table 3, below. The figures refer to 'movements' recorded, where a movement is a single person; horse or mountain bike passing a counter.

Table 3. Total daily movements at sites surveyed in November 2017

Site	Daily Total Movements				Total	%
	Friday 03/11/2017	Saturday 04/11/2017	Sunday 05/11/2017	Monday 06/11/2017		
Massy's Estate	34	50	54	11	149	7%
Cruagh	178	540	1,057	82	1,857	88%
Killakee	11	21	44	13	89	4%
Piperstown	0	10	9	0	19	1%
Total	223	621	1,164	106	2,114	100%
%	11%	29%	55%	5%	100%	

In total, 2,114 movements were recorded at the survey sites between the 3rd and the 6th of November 2017. Cruagh Wood car park was the busiest location, accounting for 88% of the total number of movements recorded across all days. Sunday was the busiest day overall, accounting for 55% of the movements during the four-day survey period. The data obtained

indicate that weekend days (Saturday and Sunday) are notably busier than weekdays at the sites in question.

The maximum daily number of movements recorded west of Massy's Estate on the Dublin Mountains Way were 44 at Killakee Wood / Featherbeds Forest and 10 at the Local Road in Piperstown. (Where a person does a looped walked, two movements will be triggered).

The 2017 walker surveys show that very few walkers stray beyond the limits of the recreational forest along the Dublin Mountains Way. Those surveys did not however cover the trails leading from Cruagh Wood out onto the open mountain and into the SPA south of the forest. The later surveys in 2019 were more extensive and fill that information gap.

3.3 2019 Walker Survey (Traffinomics)

At each site between two and twelve movements were recorded as indicated on the site maps. A movement is a single person; horse or mountain bike passing a camera. It can be assumed that the vast majority of visitors will trigger a camera at a car park twice; once on the beginning of a walk, and once again when returning to their vehicle. Furthermore, once in the woodlands, a visitor may trigger multiple cameras. As such, the overall number movements is not representative of the total number of visitors, but rather of relative intensity of use at each survey location. Plate 1 below illustrates how movements are recorded. The site locations and movements are presented in a drawing in Appendix C to this report. The summary of the results is presented in Table 4, below, and should be read in conjunction with Appendix C.

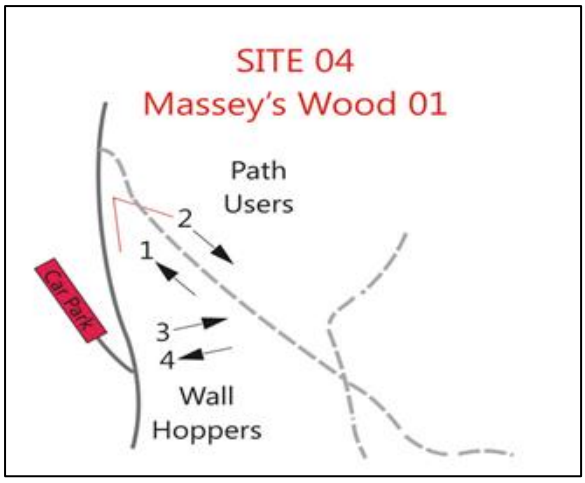


Plate 1. Movements at Site 04 Massy's Wood 01.

Table 4. Total movements at sites surveyed in 2019

Site No.	Site Name	Total Movements (over 4 days)			Total over 12 Days	Average per Day
		7th – 10th June	5th – 8th July	9th – 12th August		
1	Hellfire 01 Car Park	1,887	2,143	1,490	5,520	460
2	Hellfire 02 Car Park	2,445	2,639	1,860	6,944	579
3	Hellfire 03 Summit	1,338	1,497	1,029	3,864	322
4	Massy's 01 NW Entrance	741	1,051	856	2,648	220
5	Massy's 02 Glendoo Brook Bridge	512	577	468	1,557	130
6	Massy's 03 South	194	235	113	542	45
7	Cruagh Wood 01 DMW West	110	143	75	328	27
8	Cruagh Wood 02 Car Park	1,559	1,578	1,393	4,530	378
9	Cruagh Wood 03 NW Mountain	84	66	53	203	17
10	Cruagh Wood 04 NE Mountain	410	500	258	1,168	97
11	Military Road 01	25	26	7	58	5
12	Military Road 02	141	102	17	260	22
Overall Total		**9,446**	**10,557**	**7,619**	**27,622**	**2,300**
Totals at Main Entrances (Sites 1, 2, 4 & 8)					***19,642***	***1,636***

Review and Assessment of 2019 Walker Surveys

A. Hell Fire Wood

Hell Fire Wood is by far the busiest location for visitors with 1,039 average daily movements recorded at the two footpaths leading from the car park into the forest. This is 2.75 times higher than the number of movements recorded at Cruagh Wood car park.

B. Massy's Estate

The results show that 220 average daily movements occurred at the entrance to Massy's Estate (Site No. 4) compared to 45 average daily movements recorded at Site No. 6 at the southern end of Massy's Estate leading to Cruagh Wood. This indicates that 80% of visitors to Massy's Estate do not venture through to the southern exit at Cruagh Road.

C. Cruagh Wood

The average daily movement of 27 at Site No. 7 where the Dublin Mountains Way exits from Cruagh Wood onto Cruagh Road at the western edge was 7% of the total number of movements (378) recorded at Site No. 8 at Cruagh Wood car park. This shows that people linking between Cruagh Wood and Massy's Estate are a small minority of the overall number who visit Cruagh.

D. Interactions between Hell Fire Club, Massy's Estate and Cruagh Wood

The survey figures indicate low interactions between Massy's Estate and Cruagh Wood along the Glendoo Brook trail that links the two forests.

The combined number of average daily movements recorded at Hell Fire Club and Massy's Estate at the Killakee Road (Sites 1,2 & 4) accesses was 1,259 of which 17.5% was at Massy's Estate. This figure indicates the degree of interaction between the two adjoining recreational forests, with 1 in 6 of the combined visitors entering Massy's Estate from the Killakee Road side.

With 80% of visitors remaining in Massy's Estate it may be postulated that 1 in 35 (<3%) of visitors to the Hell Fire Club car park (or who park on Killakee Road) may venture further through Massy's Estate to Cruagh Wood, and perhaps all the way to Cruagh Mountain, over a walking distance of 3.2km.

E. Visitors to Cruagh Mountain and the SPA

The results from Site No. 9 and Site No. 10 show that on average 114 people per day visited Cruagh Mountain from the two access points at the southern edge of Cruagh Wood. This represents 30% of the number of visitors recorded at the car park. Therefore, 70% of visitors to Cruagh Wood remain within the forest and presumably circulate along the forest roads.

Detailed movements at the two access points are presented in Tables 5 and 6, below. There are informal paths at these locations that link Cruagh Wood to the uplands, including the Wicklow Mountains SAC and SPA. Along the most direct path leading to the Natura 2000 Sites (Site No. 9) 203 movements were recorded. The main path walked by most people follows the edge of the forest linking the two survey locations, and forming a loop walk that travels adjacent to the boundary of the SPA but does not enter any Natura 2000 site. The movements are broken down in Table 5, below.

At Site 9 over the 12 days survey period, a daily average of 3 people walked into Cruagh Wood from the direction of Cruagh Mountain (Movement 1), and 3 people walked out of Cruagh Wood towards the uplands (Movement 2). In the same period, 3 people followed the forest perimeter path south-east towards Cruagh Mountain (Movement 3), and 8 people walked in the opposite direction (Movement 4).

Table 5. Site No. 9 (Cruagh Wood Northwest) total movements over 12 days

Movement	1	2	3	4	Total
June	14	21	8	41	84
July	13	5	9	39	66
August	12	8	15	18	53
Total	**39**	**34**	**32**	**98**	**203**
Daily Average	**3**	**3**	**3**	**8**	**17**

Significantly more traffic was recorded at Site No. 10, 1,168 no. over 12 days, with an average of 97 people per day. This site is at a junction where the main mountain access track from the

east meets the forest perimeter path from the north, a trail from Cruagh Mountain to the west, and another the trail heading southeast towards Glendoo Mountain.

Plate 2. Site 10: Cruagh Wood Southeast Access Point onto Cruagh Mountain

Plate 3. Site 10: View west onto Cruagh Mountain – Forest Perimeter Trail on right

Table 6. Site No. 10 (Cruagh Wood Southeast) total movements

Movement	1	2	3	4	5	6	7	8	9	10	11	12	Total
June	90	15	12	15	25	4	2	9	20	14	58	146	410
July	130	20	7	31	28	4	10	10	30	24	85	120	499
August	69	1	3	6	15	0	1	2	4	4	29	125	259
Total	**289**	**36**	**22**	**52**	**68**	**8**	**13**	**21**	**54**	**42**	**172**	**391**	**1,168**
Daily Average	**24**	**1.5**	**2**	**4**	**6**	**<1**	**1**	**2**	**4**	**4**	**14**	**33**	**97**

680 of the 1,169 movements recorded at Site No. 10 refer to two movements - movement 1 and 12 - which indicate a looped walk from Cruagh Wood along the conifer plantation edge, turning into the forest at the junction. Movements 3, 4, 5, 6, 7 and 11 travel from the junction into or out from Cruagh Mountain (and the Natura 2000 Sites). These movements can be translated as 207 people (17 per day on average) walking towards Cruagh Mountain (movements 3, 7, 11) and 128 people (11 per day on average) walking down from Cruagh Mountain (movement 4, 5, 6) during the survey period.

The total number of people entering and exiting the trails leading into upland habitats, including the Wicklow Mountains SAC and SPA, from Cruagh Wood are presented in Table 7, below. In summary, the data from Sites No. 9 and 10 show that the number of movements entering the uplands and the Wicklow Mountains SAC and SPA is 273 over the full survey period (23 per day on average). For comparison, there are 2,475 movements entering Cruagh Wood from Sites 7 and 8 during the same period. These figures show that 11% of visitors to Cruagh Wood go beyond the forest boundary onto the open mountain within the SAC and SPA.

Table 7. Total walkers entering and exiting the Wicklow Mountain SAC/SPA.

	Site 9 (Cruagh Wood 03)	Site 10 (Cruagh Wood 04)	12 Days Total	Daily Average
Into SAC/SPA	66	207	**273**	**23**
Out of SAC/SPA	137	128	**265**	**22**

Interpretation of the Walker Surveys

The survey data has shown that only a very small number of people who visit the 3 recreational forests in the Glendoher Valley of the Dublin Mountains (Hell Fire, Massy's and Cruagh Woods) venture further and onto the open mountain areas within the SAC and SPA. The daily average number of visitors to the 3 forests was 1,636 people, of which 23 people per day visited the upper mountain area, which is 1.4% of the total. It was not possible to record how many of these people, if any at all, started their trip from Hell Fire Club car park, but it is unlikely that any walkers came from that far away.

The proposed visitor centre at Hell Fire Club has been forecast to attract up to 300,000 visitors per year (821 per day spread over the full 7 days of the week), which is approximately 3 times the current number of visitors (current daily average: 241). The average daily increase in visitors will therefore be 580 people. The walker survey data shows that if the current visitor

patterns are applied, then perhaps 3% of these additional visitors may venture through Massy's Estate to Cruagh Wood, which would amount to 20 people per day.
Furthermore, if the typical 11% proportion of walkers who go onto the open mountain from Cruagh Wood is applied (which seems quite unlikely given the cumulative distance of over 6km for the round trip from Hell Fire Club), then perhaps two of the additional visitors may reach the SAC and SPA area on Cruagh Mountain per day. Hypothetically therefore the number of people walking on the upper mountain could increase from just 23 per day to 25 per day on average.

Car Parking Surveys

The car park survey was carried out at the Hell Fire Club car park and at the Cruagh Wood car park on Saturday the 10th August 2019. The survey recorded the numbers of vehicles entering and exiting the site and used number plates to determine the dwell time. The vehicle types and dwell times for vehicles are presented in Tables 8 and 9, below.

Table 8. Summary of vehicle types – Hell Fire Club and Cruagh Car Parks.

Location	Total Entries/ Exits	Car	LGV	Bus
Hell Fire Club Car Park	161	154	6	1
Cruagh Car Park	97	96	1	0

Table 9. Vehicle dwell times – Hell Fire Club and Cruagh Car Parks.

Dwell Time	Hell Fire Club Car Park	Cumulative %	Cruagh Car Park	Cumulative %
0 - 15 Mins	19	12%	12	12%
15 - 30 Mins	7	16%	5	17%
30 - 45 Mins	23	30%	7	25%
45 - 60 Mins	34	51%	27	52%
1 - $1^{1/4}$ hr	28	69%	26	79%
$1^{1/4}$ hr - $1^{1/2}$ hr	20	81%	8	88%
$1^{1/2}$ hr - $1^{3/4}$ hr	10	88%	4	92%
$1^{3/4}$ hr - 2hr	3	89%	6	98%
2hr - 3hr	11	96%	2	100%
3hr - 4hr	6	100%	0	-
Total	**161**		**97**	

The dwell times of vehicles at the car parks show that visits are generally short, with approximately 50% of visits lasting under 1 hour in both car parks. This number increases at a similar rate, with 89% and 98% of visits being less than 2 hours in Massy's Estate and Cruagh Wood, respectively. This information tallies with the recorded small number of walker movements at the southern boundary of the forest and indicates that most walkers travel the relatively short circuit along the forest trails which can be completed in less than 2 hours rather than venturing into the uplands including the European designated sites.

4. EXISTING WAYMARKED TRAILS

Coillte lists a number of waymarked trails at the Hell Fire Club, Massy's Estate and Cruagh Wood. The trails at the Hell Fire Club and in Massy's Estate begin at the Hell Fire Club car park and the entrance to Massy's Estate from the R115. The trails in Cruagh Wood begin in the Cruagh Wood Car Park. The trails are described in Table 10, below.

Table 10. Waymarked Trails at the Hell Fire Club, Massy's Estate and Cruagh Wood.

Site	Trail Name	Distance; Time
Hell Fire Club	Forest Loop	5.5km; 1.5 hours
Hell Fire Club	Montpellier Loop	4km; 1 hour
Massy's Estate	Riverside Walk	6km; 2 hours
Massy's Estate	Nature Trail	1.5km; 45 mins
Massy's Estate	Mountain Access Trail	2.5km; 45 mins (one way)
Massy's Estate	Cruagh Slí na Sláinte	5km; 1 hour

The Dublin Mountains Way is a 42km long trail from Shankill to Tallaght through the Dublin Mountains. From the east, the Dublin Mountains Way travels from Tibradden Mountain through Cruagh Wood and along Cruagh Road and the Military Road briefly before entering Killakee Wood / Featherbeds Forest and continuing on local roads to Bohernabreena. There is a link between the Dublin Mountains Way and the proposed development through Massy's Estate.

5. EXISTING TRAIL CONDITIONS

Th walking trails in the Dublin Mountains as shown in the following photographs are a mix of forest roads, maintained walking trails and informal paths. The trails which border Cruagh Wood are maintained and in good condition. The trails leading to the summit of Cruagh Mountain and further afield towards the Glendoo and Killakee Mountains are informal and narrow, with some localised erosion from rainfall. There was no evidence of significant erosion or excessive widening as a result of footfall. Recent fire damage was evident on the northern slope of Glendoo Mountain and the southern slope of Killakee Mountain close to the Old Military Road. The photographs below show a selection of the trails.

Plate 4. The western path leading from Cruagh Wood to the Cruagh Mountain, close to Site No. 9 in the 2019 walker surveys.

Plate 5. The path leading north-west along the southern boundary of Cruagh Wood, close to Site No. 10 in the 2019 walker surveys.

Plate 6. The path descending Cruagh Mountain northward. The Hell Fire Club can be seen in the background.

Plate 7. The western trail from Cruagh Wood looking towards Killakee Mountain to the south. Which skirts to the west of the summit of Cruagh Mountain (to the left).

Plate 8. The trail leading eastward from Killakee Mountain beside the Military Road to Glendoo Mountain in the background.

Plate 9. The reservoir service road alongside the upper Glenasmole Reservoir, Bohernabreena, which forms part of the Dublin Mountains Way.

6. ASSESSMENT

Access to the Dublin Mountains in Glendoher by walkers is almost entirely from the car parks at Hell Fire Club and Cruagh Wood. The survey data show that the typical visits are short in duration (<2 hours) and do not allow enough time for the vast majority of the visitors to travel beyond the waymarked trails at the Hell Fire Club, Massy's Estate and Cruagh Wood and into the European designated sites.

The number of people observed walking on Cruagh Mountain within the SAC and SPA was very low at weekends, and almost nil during weekdays. As noted separately in the ecological surveys, there appears to be no evidence of disturbance to wildlife being caused by the very low level of human presence on the mountain.

The link between Massy's Estate and Cruagh Wood is not well used, and people accessing Cruagh Wood from Massy's Estate make up a very small proportion of the overall number of visitors. It is evident that walkers currently park at the Cruagh Wood Car Park rather than the Hell Fire Club car park to access Cruagh Woods and Cruagh Mountain. This is a small car park with approximately 35 parking spaces.

The low usage of the trail leading south from Massy's Estate and the 2017 survey figures for the Dublin Mountains Way at Killakee indicates that there is virtually no link by walkers between Massy's Estate and the Glenasmole Valley (SAC) at 8km walking distance to the southwest.

The EIAR for the proposed development states that the proposed visitor centre will lead to a three-fold increase in visitors to the Hell Fire Club and Massy's Estate. The visitor profile will change from the existing, largely local visitors to include a higher proportion of international and domestic tourists. It is likely that the additional visitor activity will focus entirely on the Hell Fire Club and Massy's Estate. It is very unlikely that these new visitors will extend their walk very significantly to access the wider higher Dublin Mountains area further south via the single linking trail through Massy's Estate.

Based on the current visitor patterns as observed in the walker surveys, it may be postulated that the large increase in visitor numbers expected at the proposed visitor centre at Hell Fire Club could lead to a very small increase in walkers at Cruagh Mountain of just 2 additional visitors per day. The impact of such a very small increase in terms of adverse effects on the qualifying interests of the SAC and SPA will be nil.

7. CONCLUSION

Based on the data obtained during several surveys, including the detailed visitor surveys in 2019, a number of conclusions can be drawn:

a) There is one link trail, although not well used, between the Hell Fire Club car park and Cruagh Wood that could enable visitors at the proposed visitor centre to extend their activity as far as Cruagh Mountain to the south within the Wicklow Mountains SAC and SPA.
b) At both the Hell Fire Club and Cruagh Wood, visitors tended to stay for a short period of time, with half of the visitors staying less than one hour, and almost all staying less than two hours.
c) Based on the dwell times at both car parks, there are very few visitors that stay for enough time to venture far into the uplands.
d) In Cruagh Wood, the majority of visitors do not enter the heath habitats on the open mountain, and it appears that the walks alongside and through Cruagh Wood are the most popular.
e) A three-fold increase in visitor numbers at the Hell Fire Club is highly unlikely to result in a significant increase in visitor numbers accessing Cruagh Wood or the Natura 2000 Sites through the existing trail network.

APPENDIX A
DMP Visitor Monitoring

Visitor Monitoring Report

Dublin Mountains Partnership

01/07/2015 to 30/06/2019

Dublin Mountains Partnership

NOMAD

Site Id	Site	Type	Calibration Factor
1007A	Barnaslingan	pedestrian	1
1013A	Cruagh	pedestrian	0.5
1024A	Hellfire	vehicle	1.25
1051A	Ticknock	vehicle	2.5
0023A	Kilmashogue Forest TOTAL	pedestrian	0.5
0024C	Glenasmole TOTAL	pedestrian	0.5
0025A	Rathmichael Woods TOTAL	pedestrian	0.5
0026A	Kiltipper Park TOTAL	pedestrian	0.5

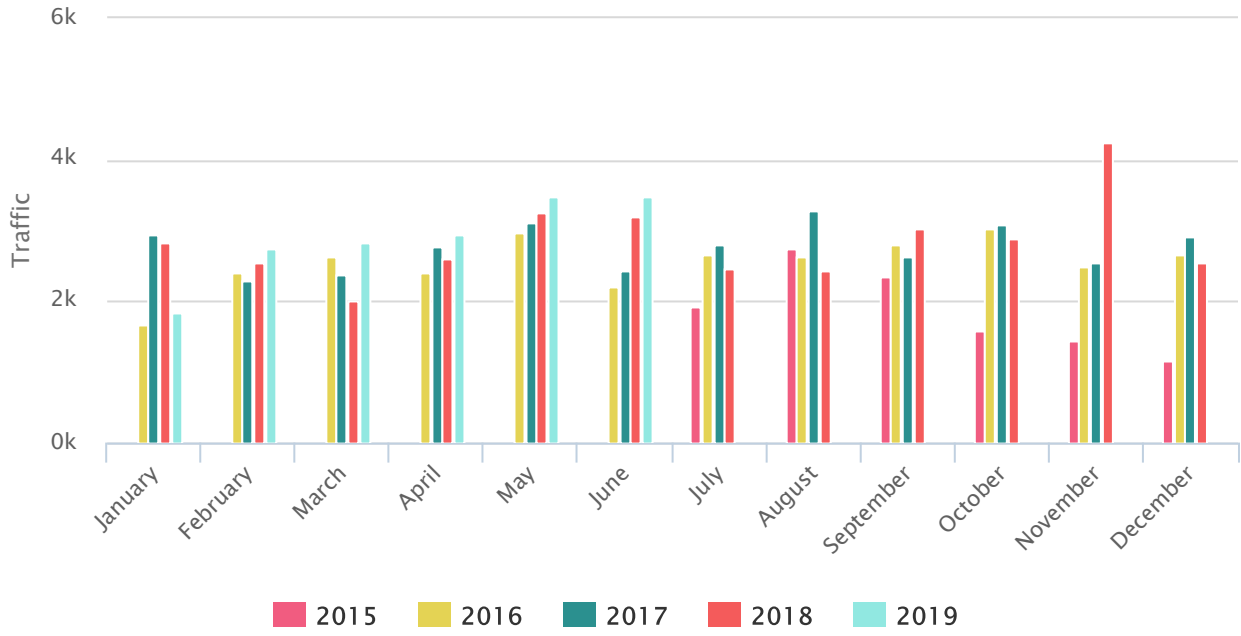
Barnaslingan 1007A

Data Summary

	Barnaslingan
Total Traffic for Period	126,367
Monthly Average	2,651
Weekly Average	608
Daily Average	87
Busiest day of the year	2018-11-26
Busiest day of the week	Sunday
Busiest hour of the day	14
Device Type	pedestrian
Installation Date	2015-07-08
Site ID	1007
Calibration Factor	1
GPS Co-ordinates	,

Totals for each month of the year

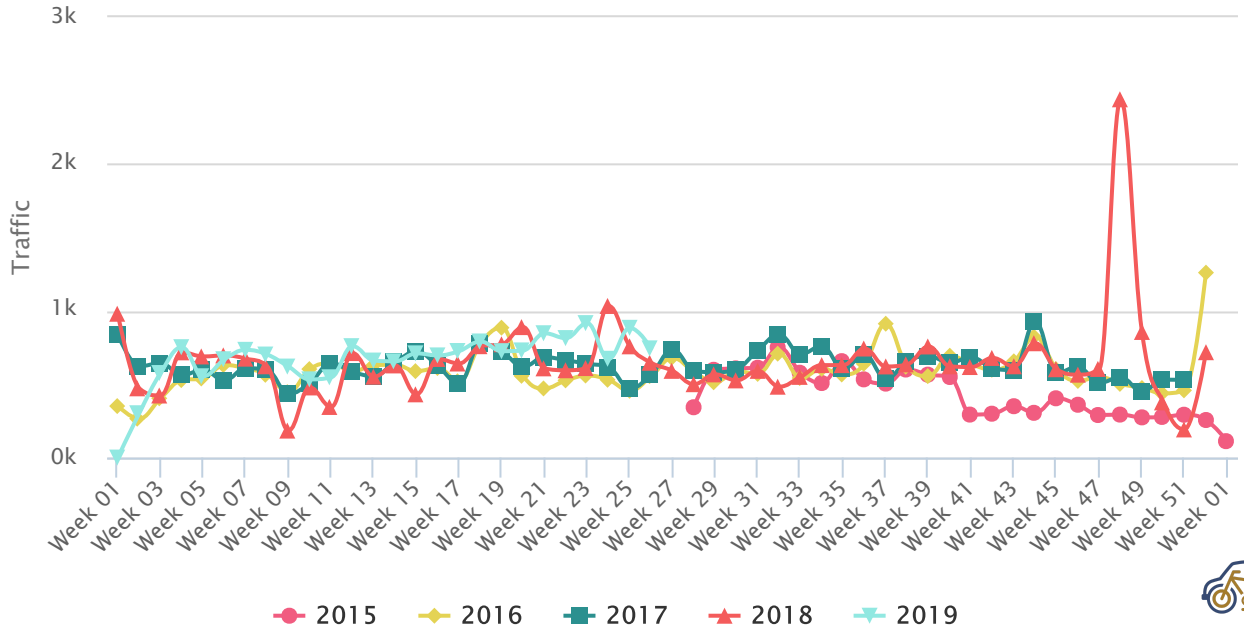
1st July 2015 to 30th June 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015							1,932	2,753	2,335	1,587	1,452	1,150
2016	1,660	2,401	2,641	2,405	2,967	2,216	2,651	2,632	2,811	3,026	2,484	2,651
2017	2,941	2,287	2,390	2,764	3,118	2,430	2,812	3,281	2,641	3,076	2,547	2,922
2018	2,837	2,557	2,007	2,610	3,265	3,199	2,458	2,446	3,030	2,889	4,246	2,538
2019	1,835	2,755	2,820	2,933	3,484	3,495						

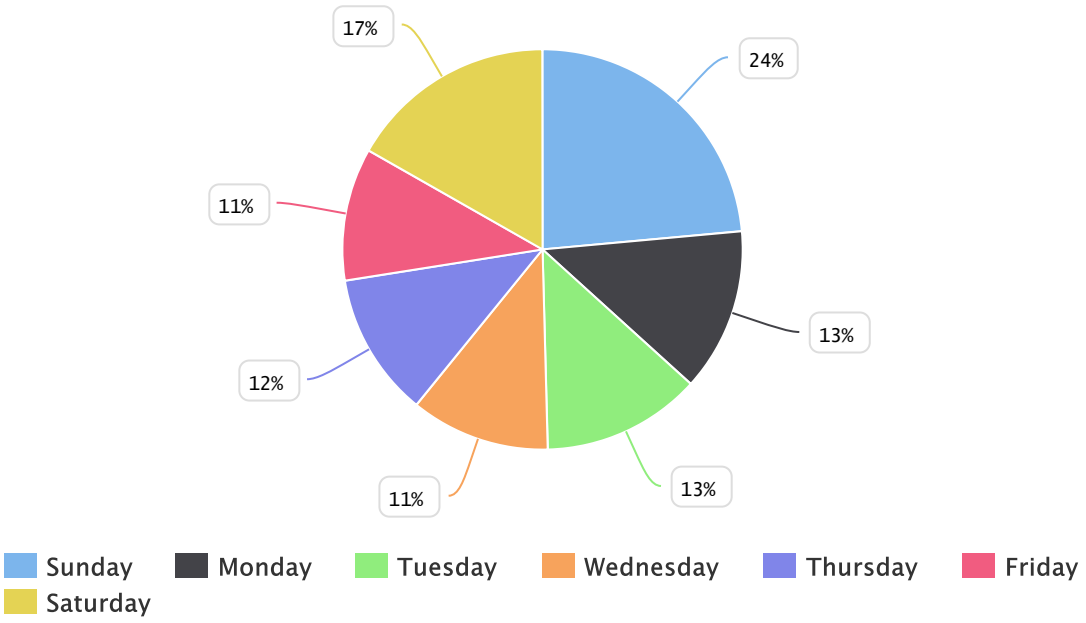
Weekly Totals

1st July 2015 to 30th June 2019



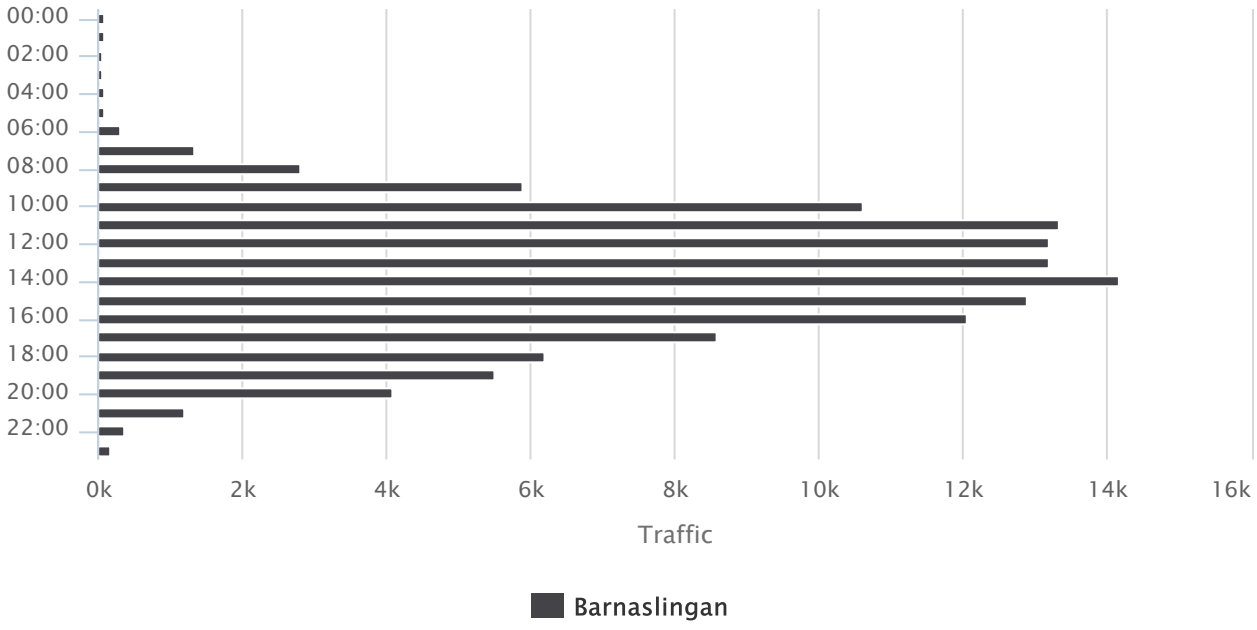
Totals for each day of the week

1st July 2015 to 30th June 2019



Totals for each hour of the day

1st July 2015 to 30th June 2019



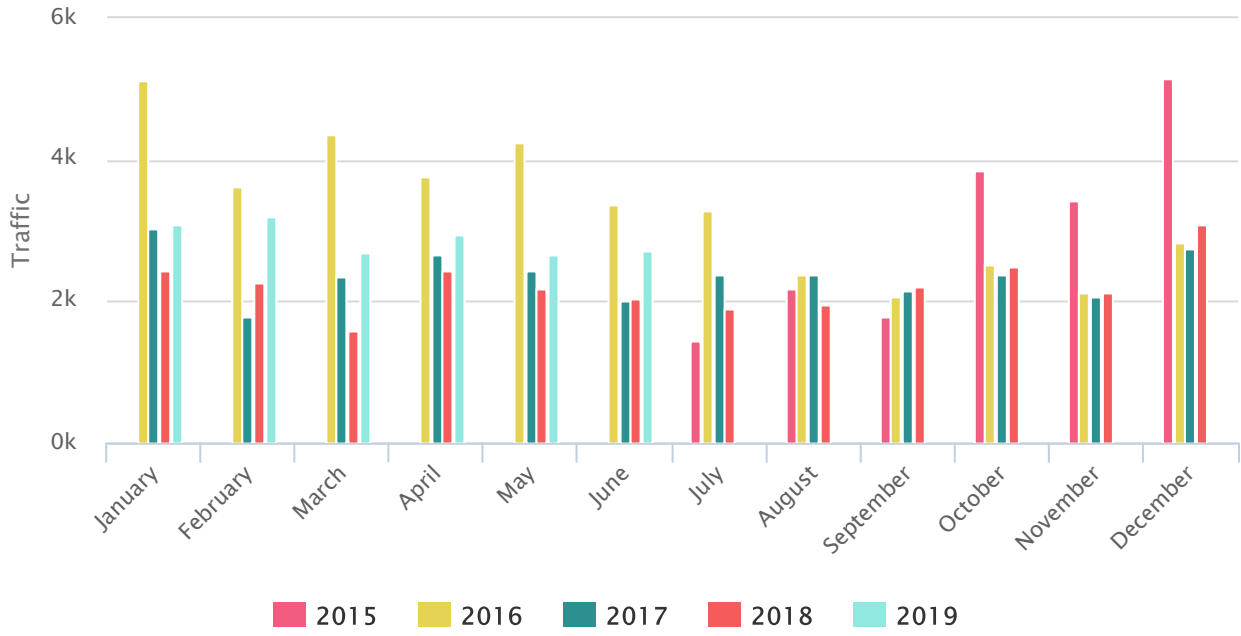
Cruagh 1013A

Data Summary

	Cruagh
Total Traffic for Period	129,804
Monthly Average	2,723
Weekly Average	625
Daily Average	89
Busiest day of the year	2015-12-27
Busiest day of the week	Sunday
Busiest hour of the day	12
Device Type	pedestrian
Installation Date	2015-07-08
Site ID	1013
Calibration Factor	0.5
GPS Co-ordinates	,

Totals for each month of the year

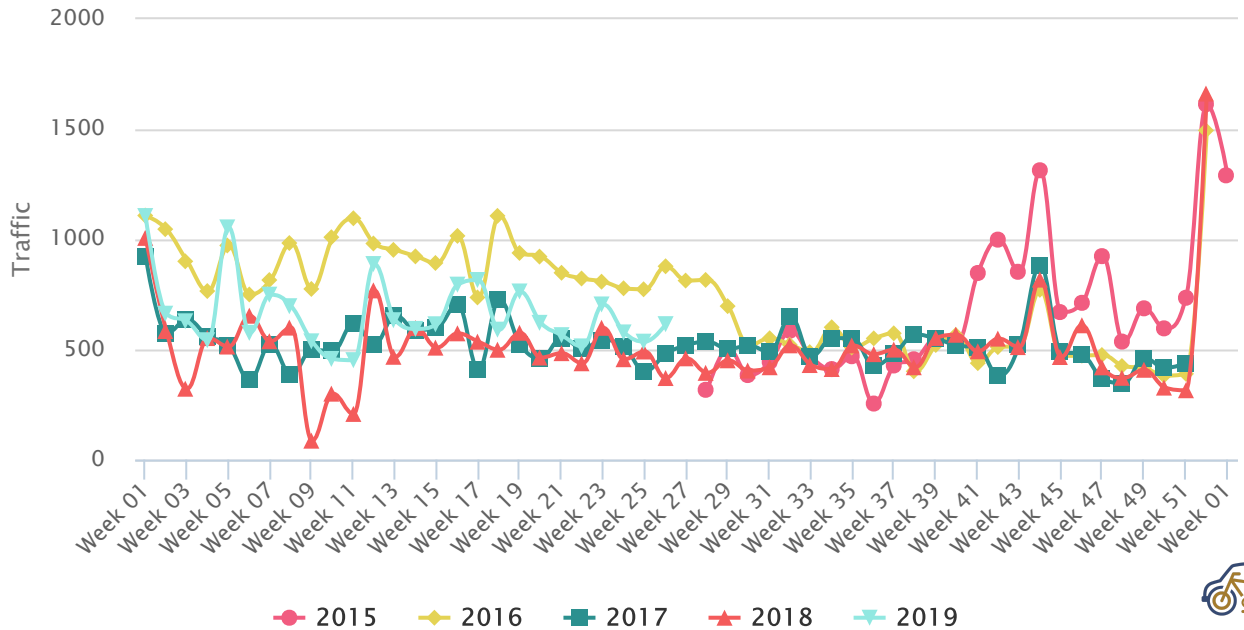
1st July 2015 to 30th June 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015							1,441	2,177	1,795	3,840	3,423	5,153
2016	5,112	3,611	4,348	3,753	4,245	3,380	3,292	2,390	2,054	2,510	2,109	2,832
2017	3,024	1,779	2,359	2,665	2,445	2,005	2,385	2,385	2,145	2,390	2,076	2,741
2018	2,432	2,257	1,592	2,438	2,172	2,041	1,903	1,942	2,210	2,477	2,109	3,091
2019	3,074	3,205	2,703	2,933	2,662	2,710						

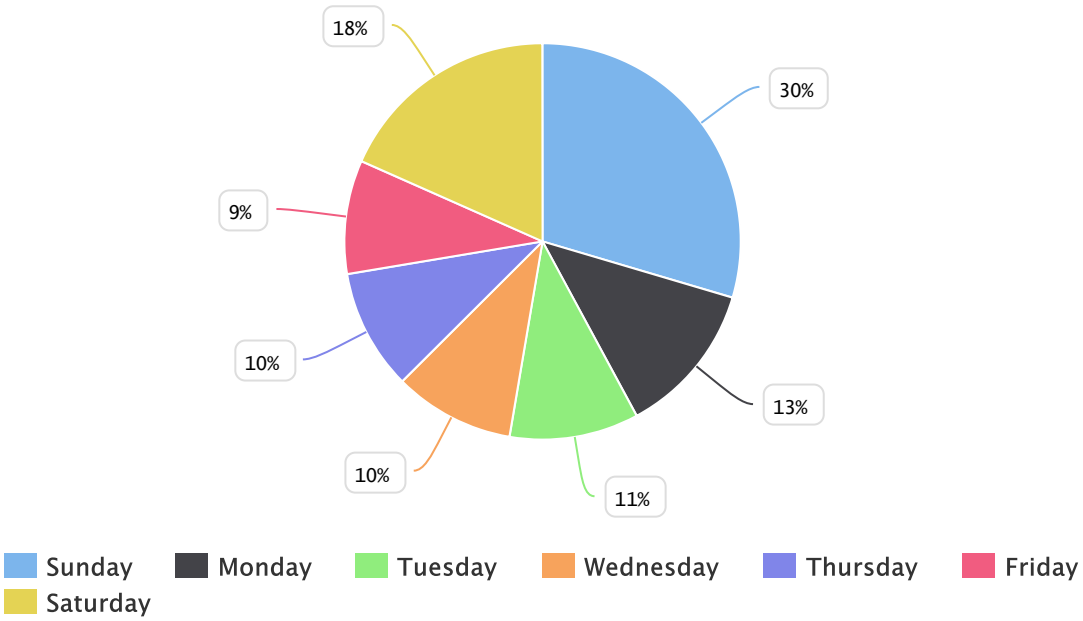
Weekly Totals

1st July 2015 to 30th June 2019



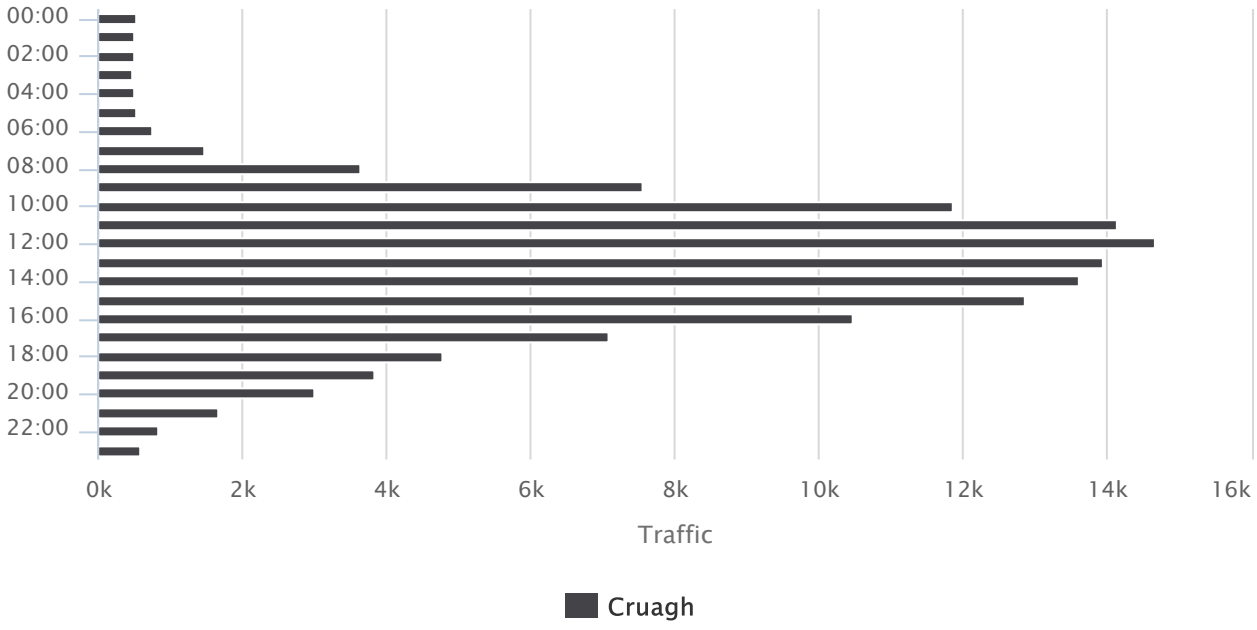
Totals for each day of the week

1st July 2015 to 30th June 2019



Totals for each hour of the day

1st July 2015 to 30th June 2019



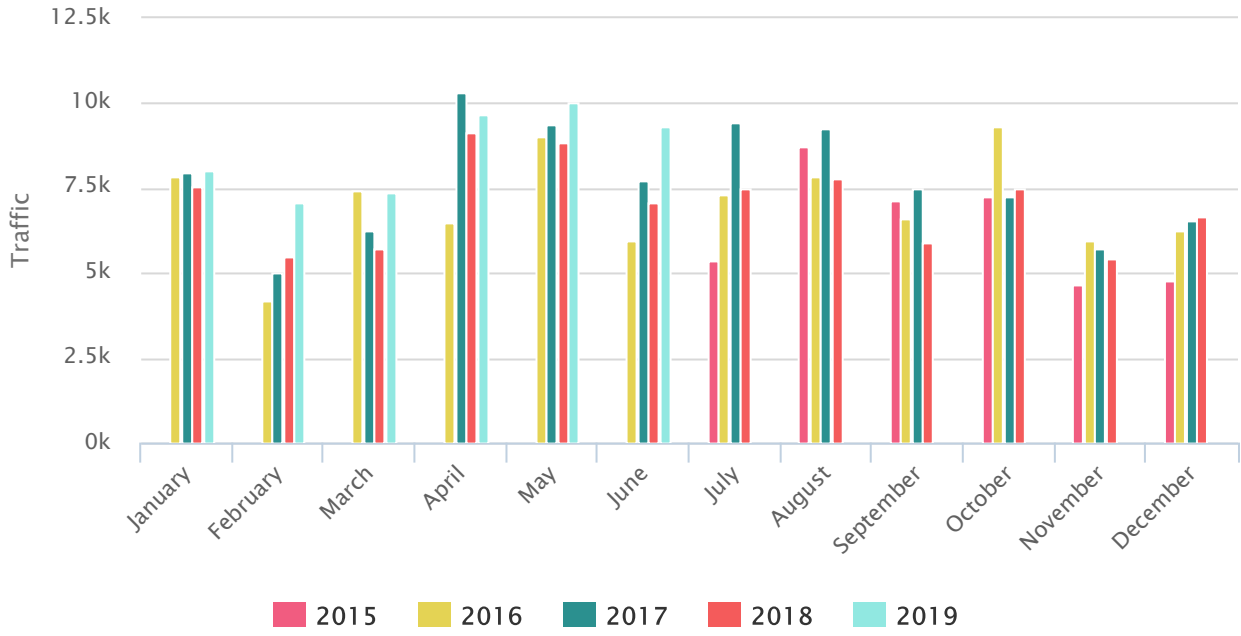
Hellfire 1024A

Data Summary

	Hellfire
Total Traffic for Period	350,629
Monthly Average	7,355
Weekly Average	1,688
Daily Average	241
Busiest day of the year	2019-04-22
Busiest day of the week	Sunday
Busiest hour of the day	14
Device Type	vehicle
Installation Date	2015-07-08
Site ID	1024
Calibration Factor	1.25
GPS Co-ordinates	,

Totals for each month of the year

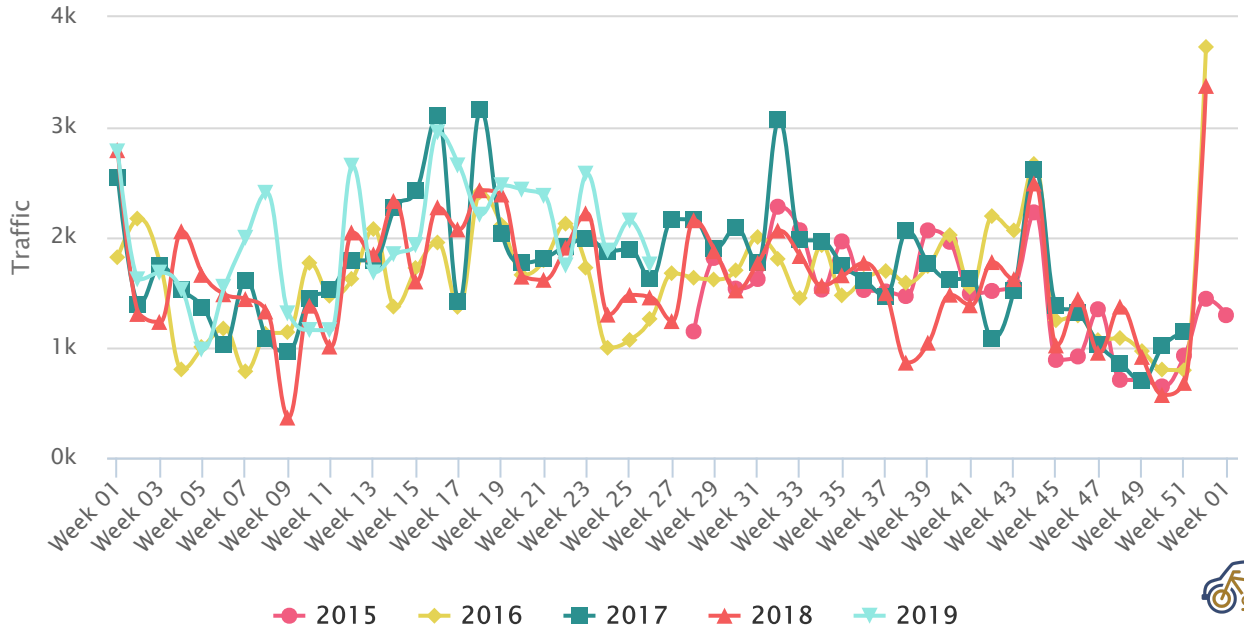
1st July 2015 to 30th June 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015							5,376	8,708	7,135	7,279	4,684	4,748
2016	7,838	4,158	7,443	6,489	9,031	5,934	7,305	7,865	6,583	9,323	5,960	6,253
2017	7,969	5,036	6,261	10,328	9,390	7,709	9,461	9,278	7,511	7,234	5,740	6,554
2018	7,570	5,460	5,740	9,145	8,821	7,064	7,488	7,800	5,881	7,513	5,428	6,656
2019	8,031	7,080	7,388	9,671	10,028	9,289						

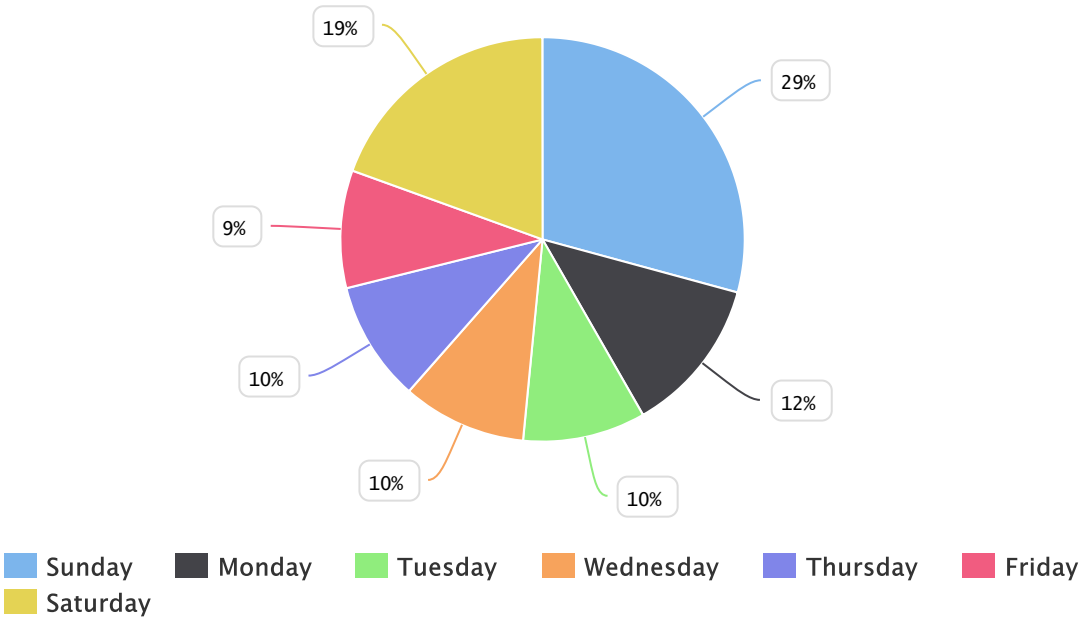
Weekly Totals

1st July 2015 to 30th June 2019



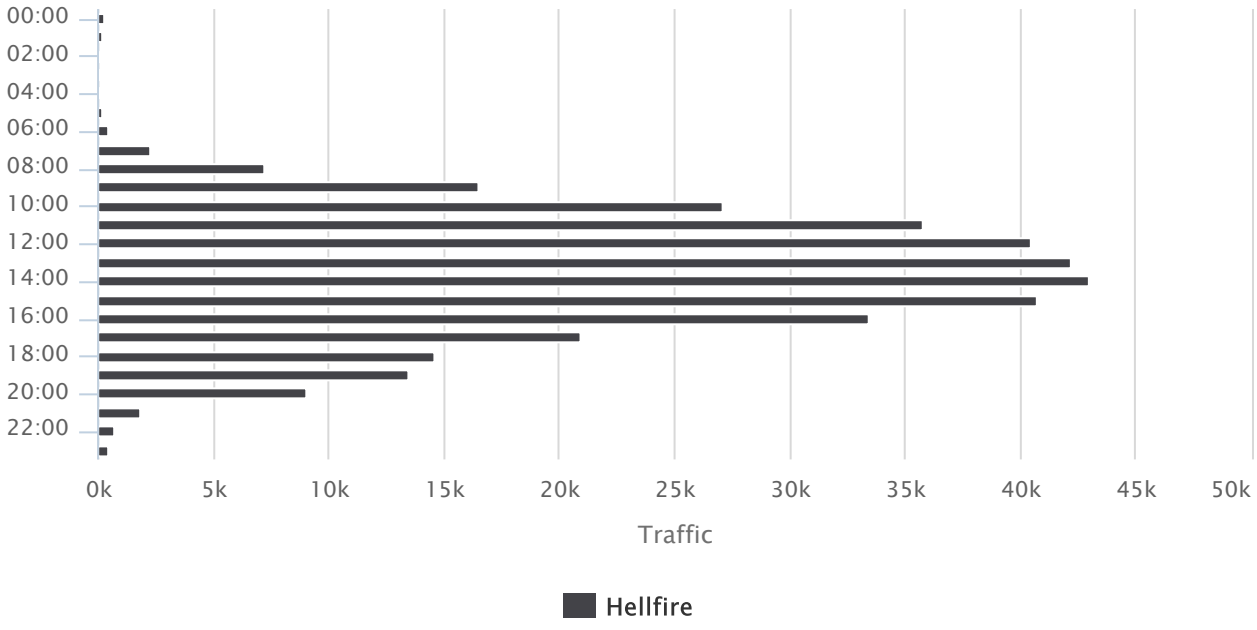
Totals for each day of the week

1st July 2015 to 30th June 2019



Totals for each hour of the day

1st July 2015 to 30th June 2019



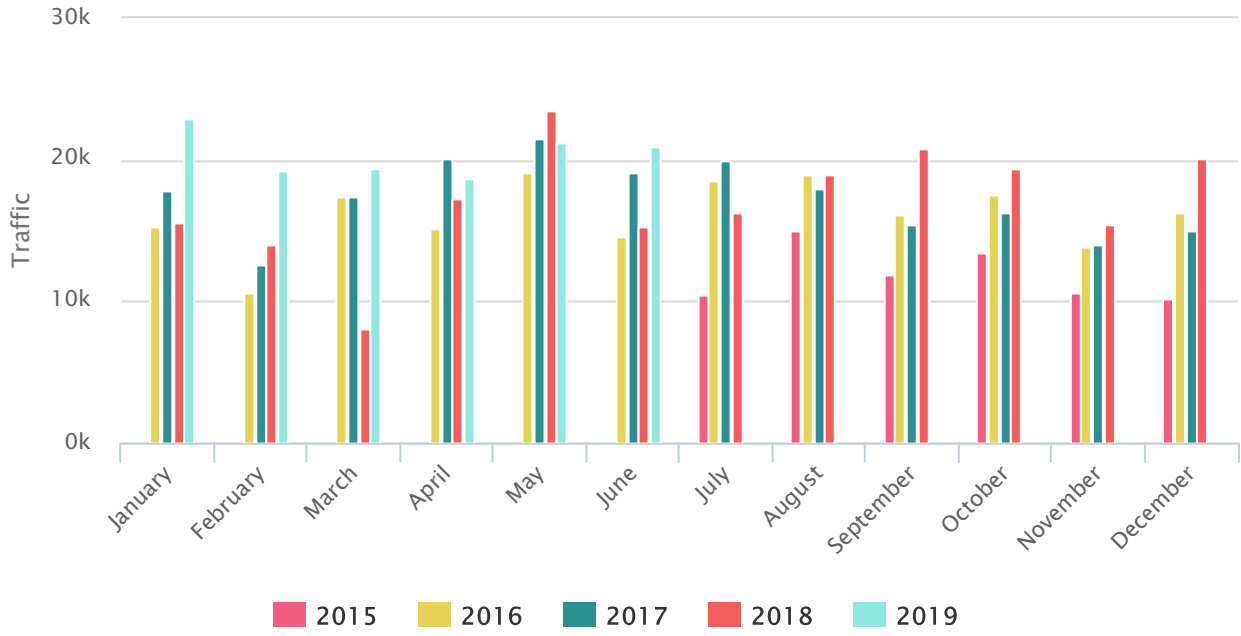
Ticknock 1051A

Data Summary

	Ticknock
Total Traffic for Period	799,373
Monthly Average	16,768
Weekly Average	3,848
Daily Average	550
Busiest day of the year	2019-03-24
Busiest day of the week	Sunday
Busiest hour of the day	11
Device Type	vehicle
Installation Date	2015-07-08
Site ID	1051
Calibration Factor	2.5
GPS Co-ordinates	,

Totals for each month of the year

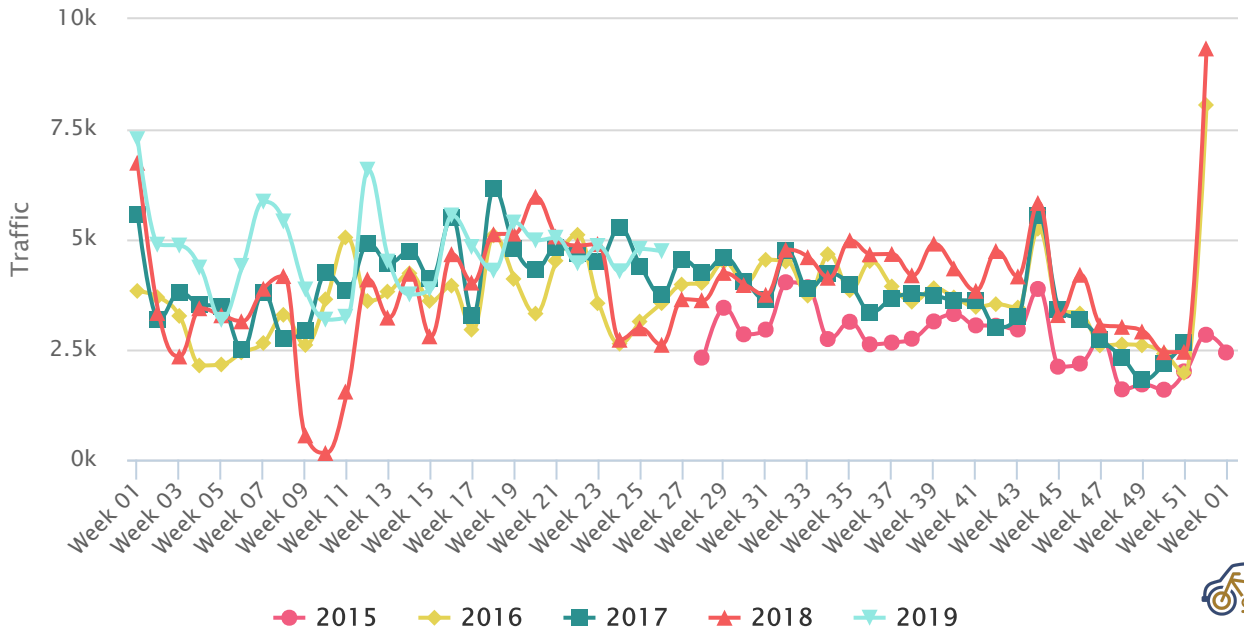
1st July 2015 to 30th June 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015							10,523	15,063	11,940	13,413	10,558	10,200
2016	15,350	10,645	17,468	15,150	19,135	14,530	18,518	18,998	16,203	17,555	13,923	16,238
2017	17,770	12,600	17,370	20,050	21,570	19,128	19,895	17,960	15,430	16,278	14,005	14,938
2018	15,505	14,025	8,120	17,203	23,550	15,265	16,328	19,008	20,773	19,343	15,455	20,055
2019	22,870	19,280	19,420	18,668	21,180	20,930						

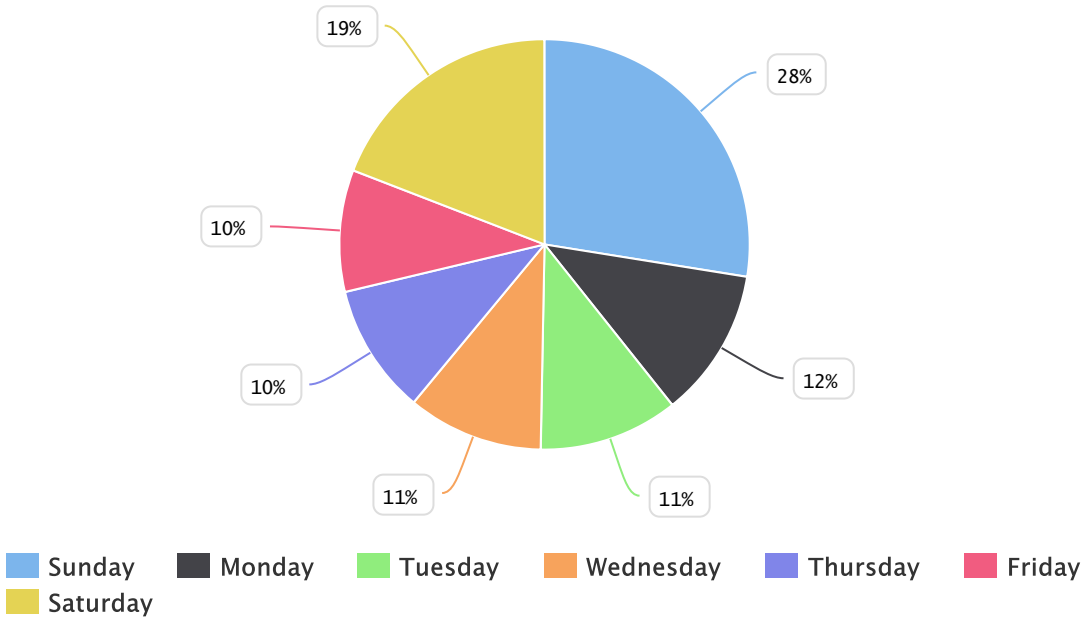
Weekly Totals

1st July 2015 to 30th June 2019



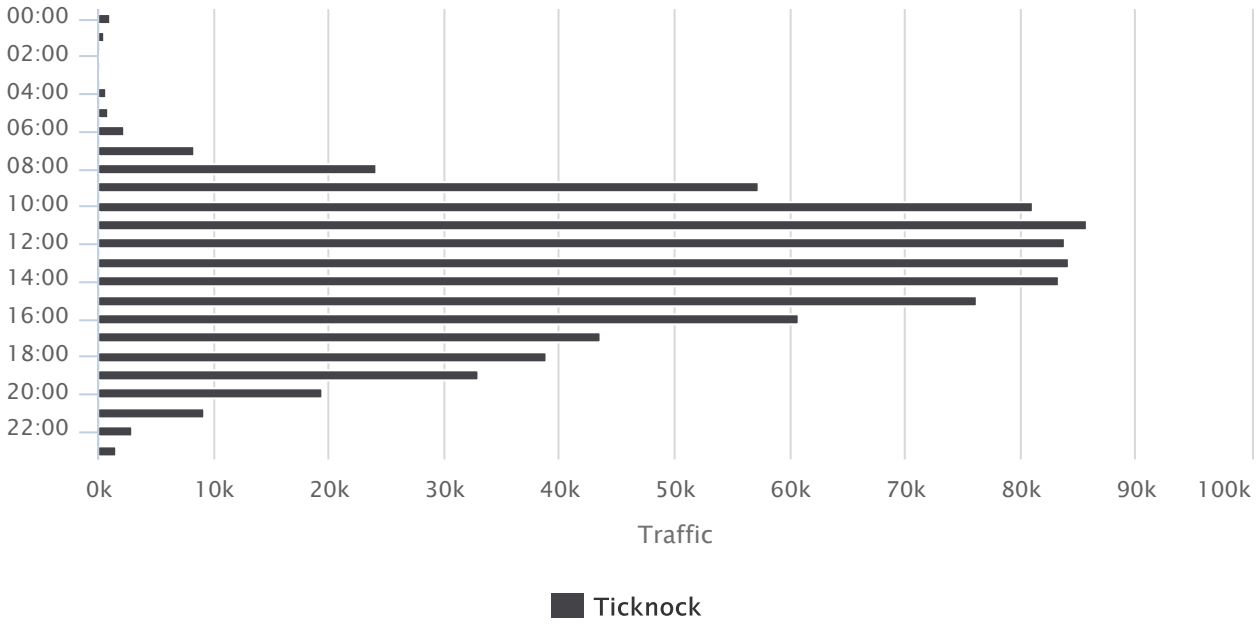
Totals for each day of the week

1st July 2015 to 30th June 2019



Totals for each hour of the day

1st July 2015 to 30th June 2019



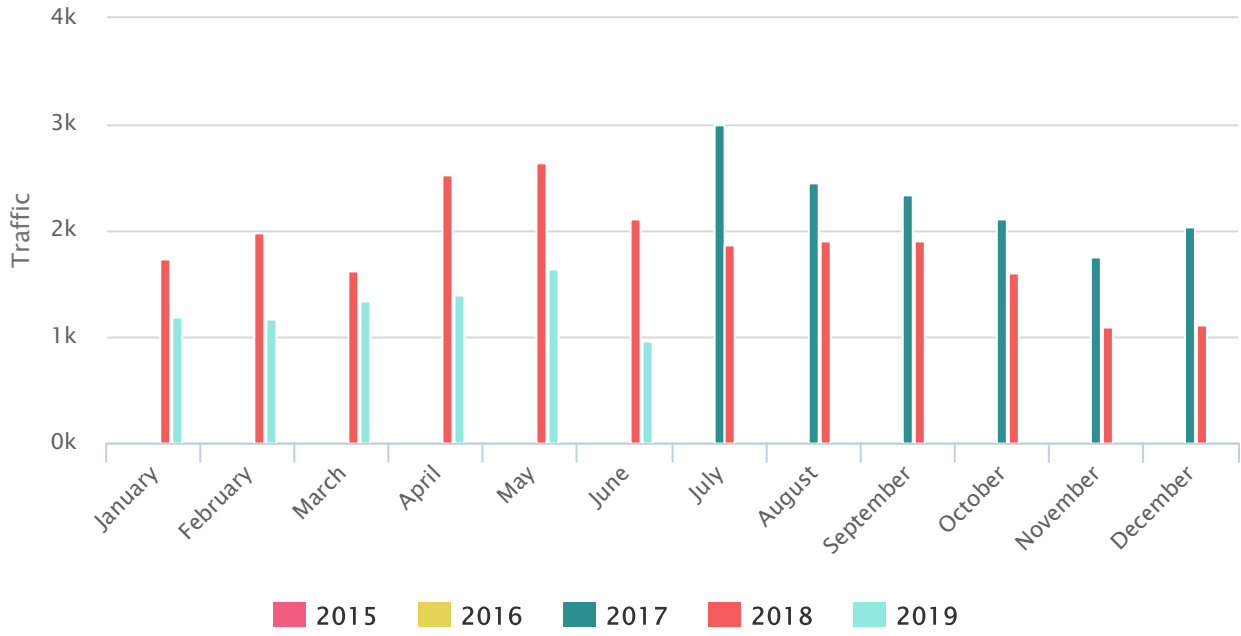
Kilmashogue Forest TOTAL 0023A

Data Summary

	Kilmashogue Forest TOTAL
Total Traffic for Period	43,472
Monthly Average	1,816
Weekly Average	417
Daily Average	60
Busiest day of the year	2017-12-26
Busiest day of the week	Sunday
Busiest hour of the day	11
Device Type	pedestrian
Installation Date	2017-07-01
Site ID	0023
Calibration Factor	0.5
GPS Co-ordinates	,

Totals for each month of the year

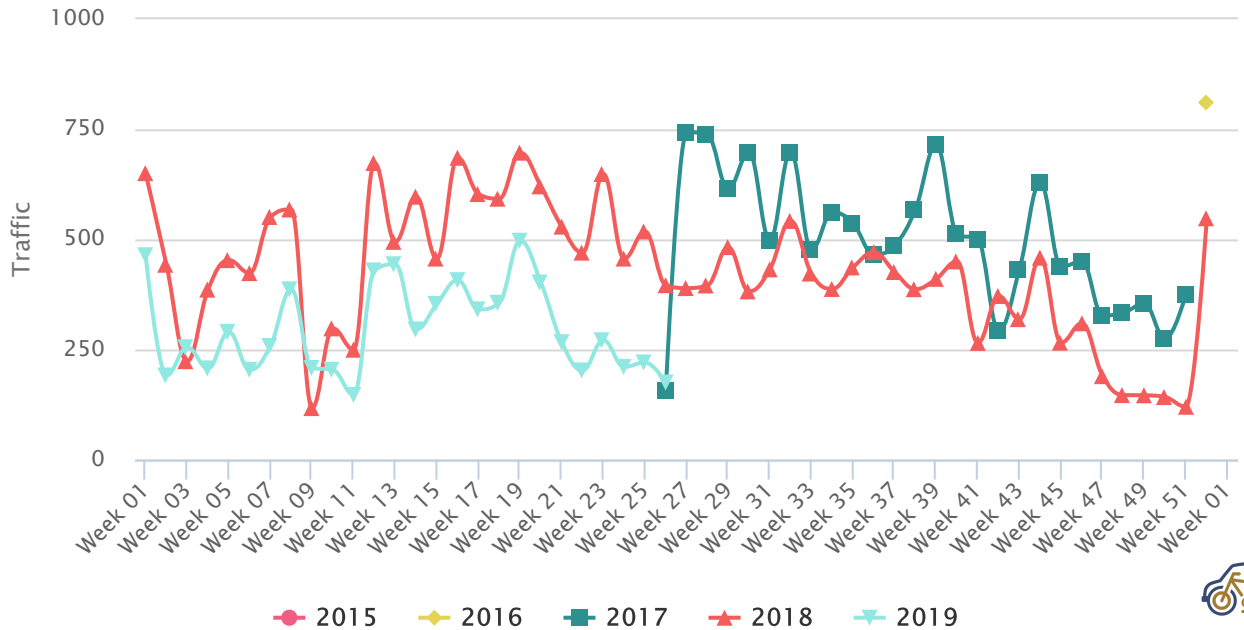
1st July 2015 to 30th June 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015												
2016												
2017							3,003	2,447	2,339	2,110	1,755	2,038
2018	1,742	1,975	1,621	2,523	2,636	2,118	1,869	1,901	1,907	1,598	1,101	1,107
2019	1,182	1,173	1,333	1,401	1,634	964						

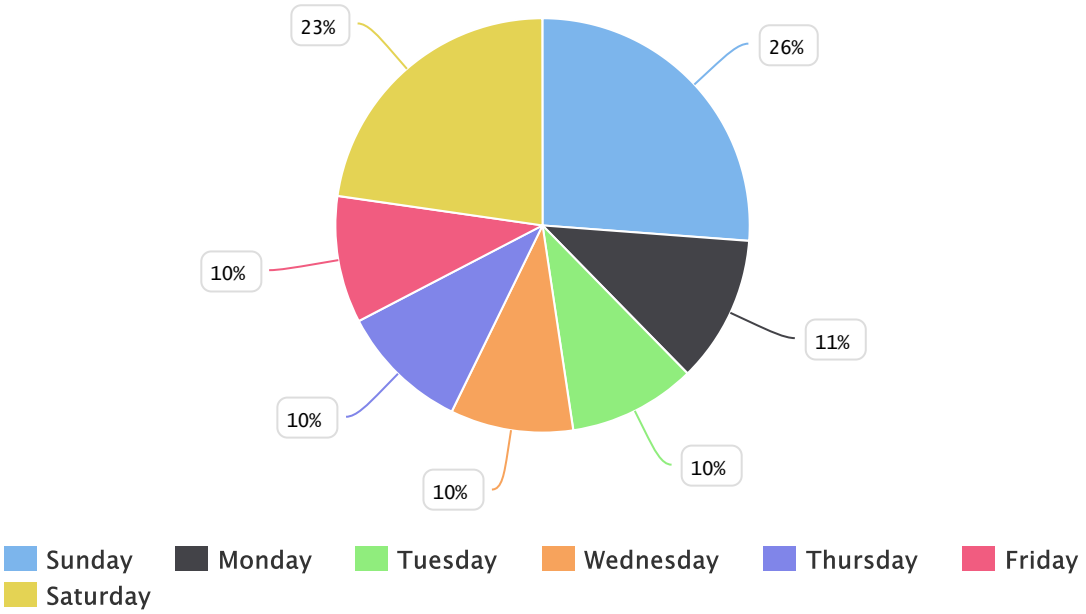
Weekly Totals

1st July 2015 to 30th June 2019



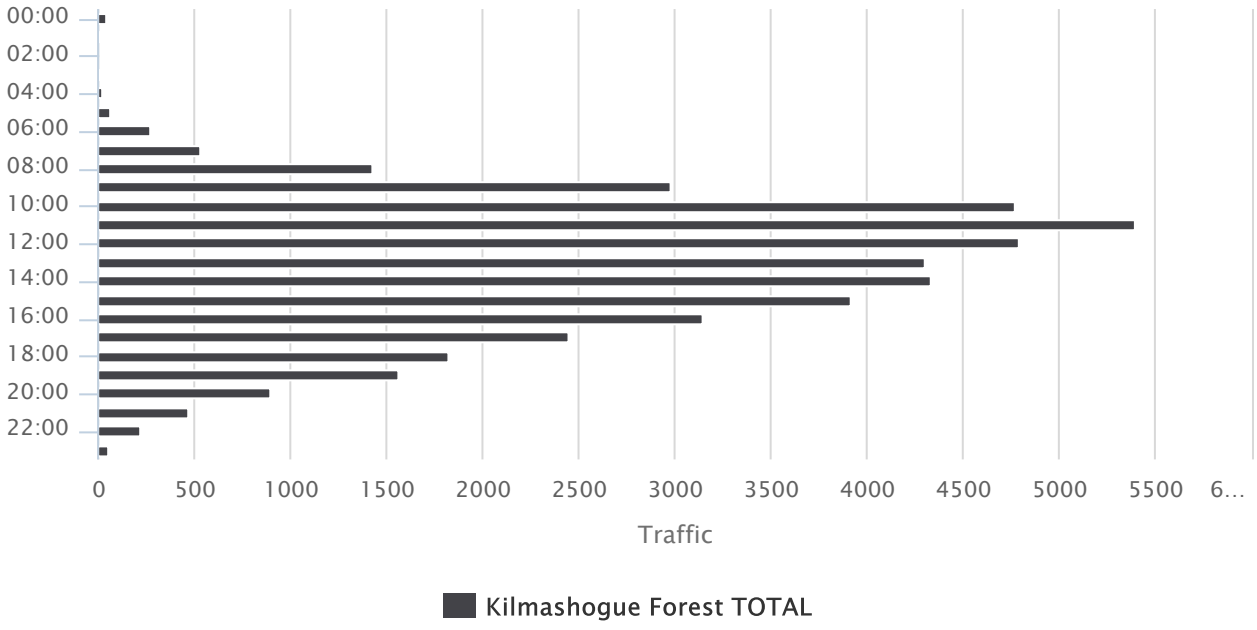
Totals for each day of the week

1st July 2015 to 30th June 2019



Totals for each hour of the day

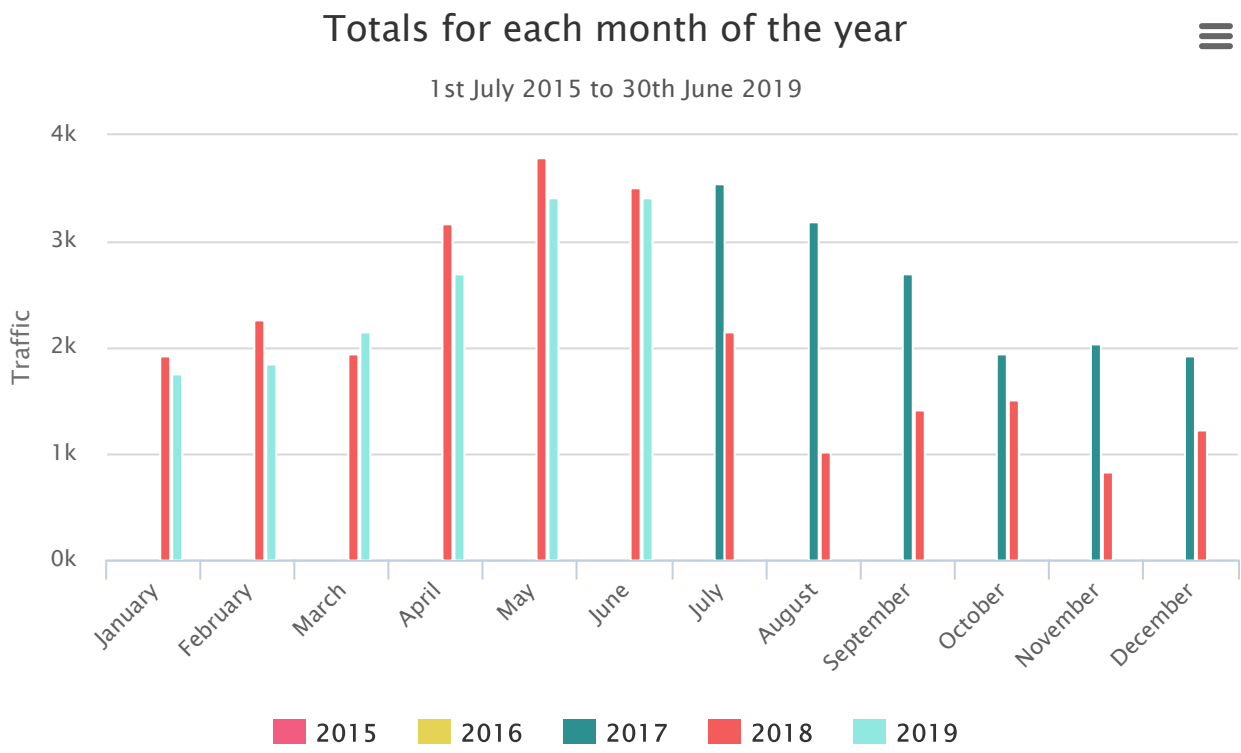
1st July 2015 to 30th June 2019



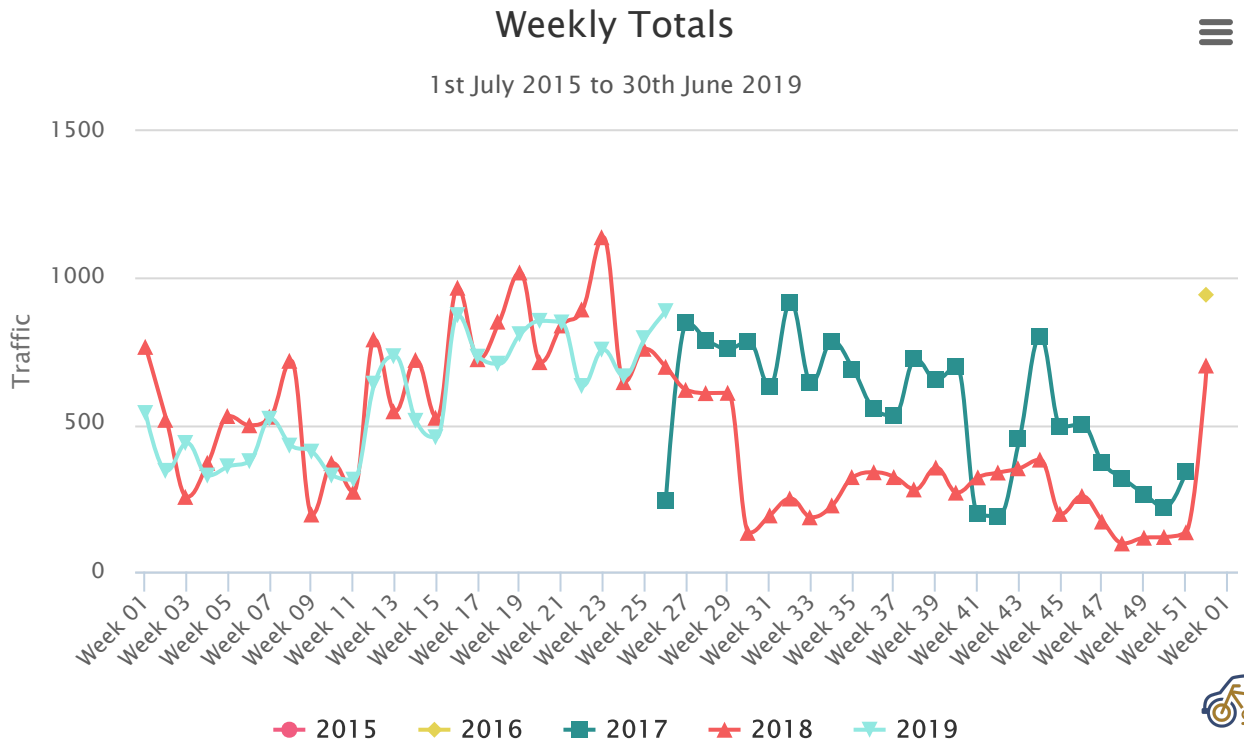
Glenasmole TOTAL 0024C

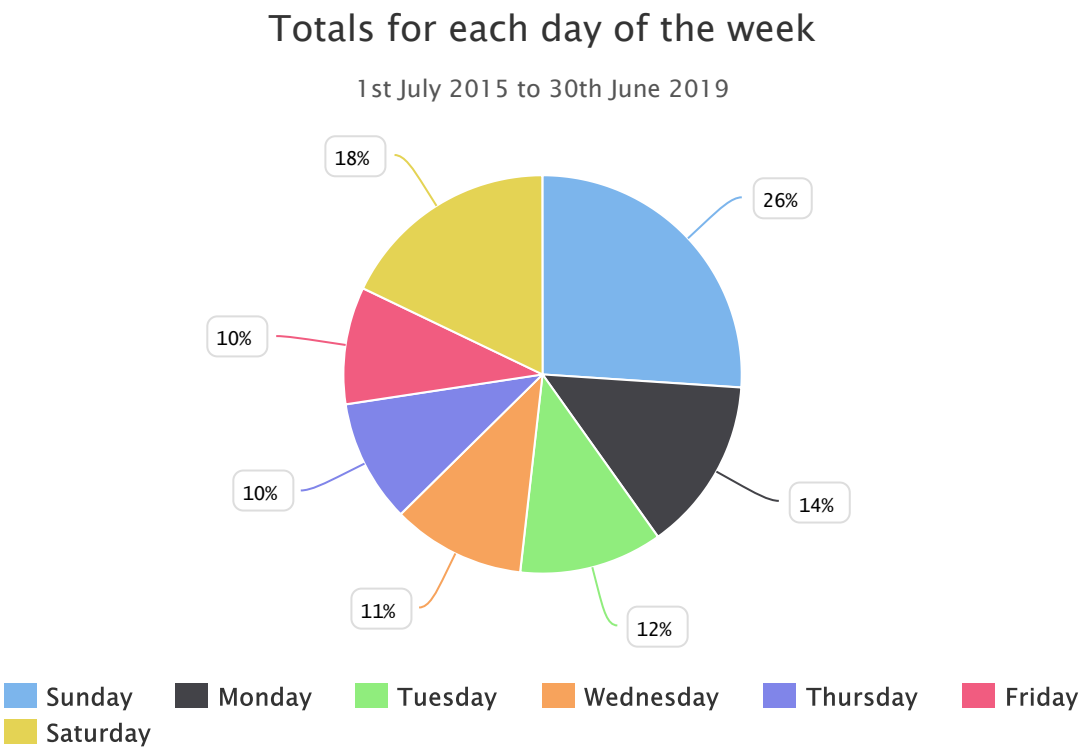
Data Summary

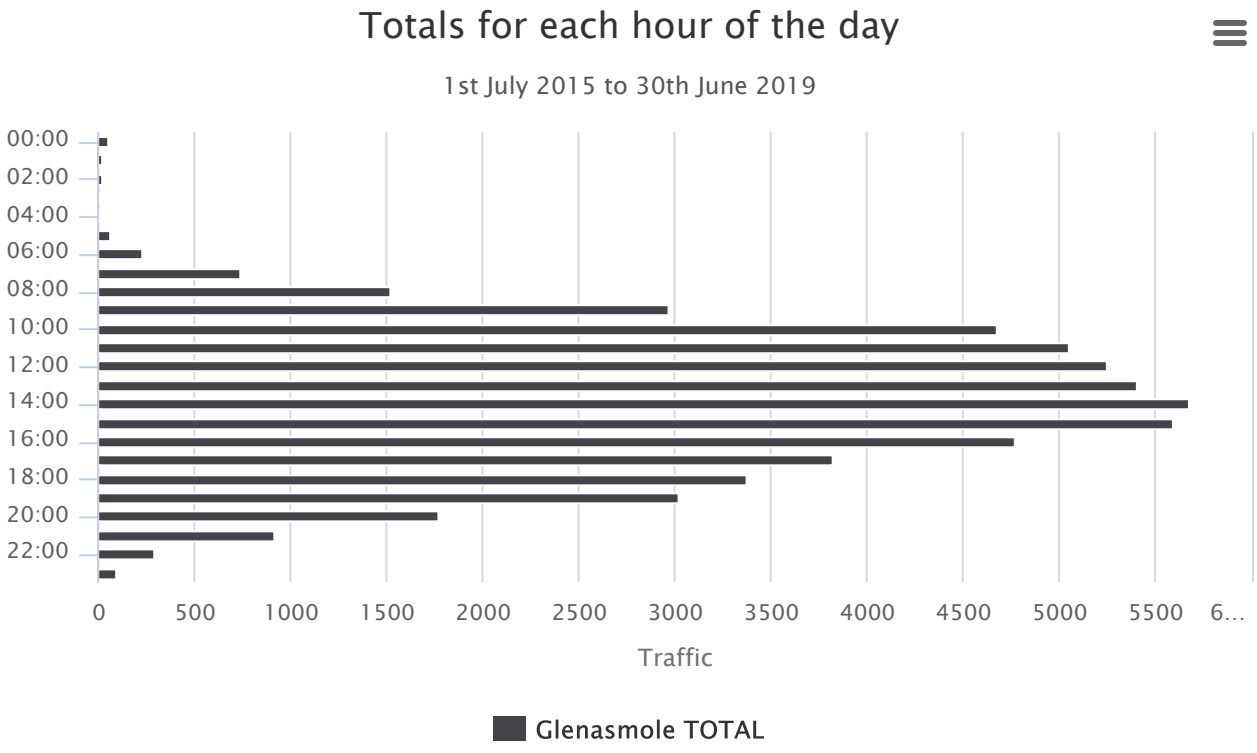
	Glenasmole TOTAL
Total Traffic for Period	55,352
Monthly Average	2,313
Weekly Average	531
Daily Average	76
Busiest day of the year	2018-05-27
Busiest day of the week	Sunday
Busiest hour of the day	14
Device Type	pedestrian
Installation Date	2017-07-01
Site ID	0024
Calibration Factor	0.5
GPS Co-ordinates	,



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015												
2016												
2017							3,539	3,184	2,704	1,938	2,043	1,928
2018	1,928	2,264	1,941	3,167	3,798	3,501	2,150	1,010	1,412	1,504	833	1,229
2019	1,759	1,853	2,143	2,701	3,409	3,421						



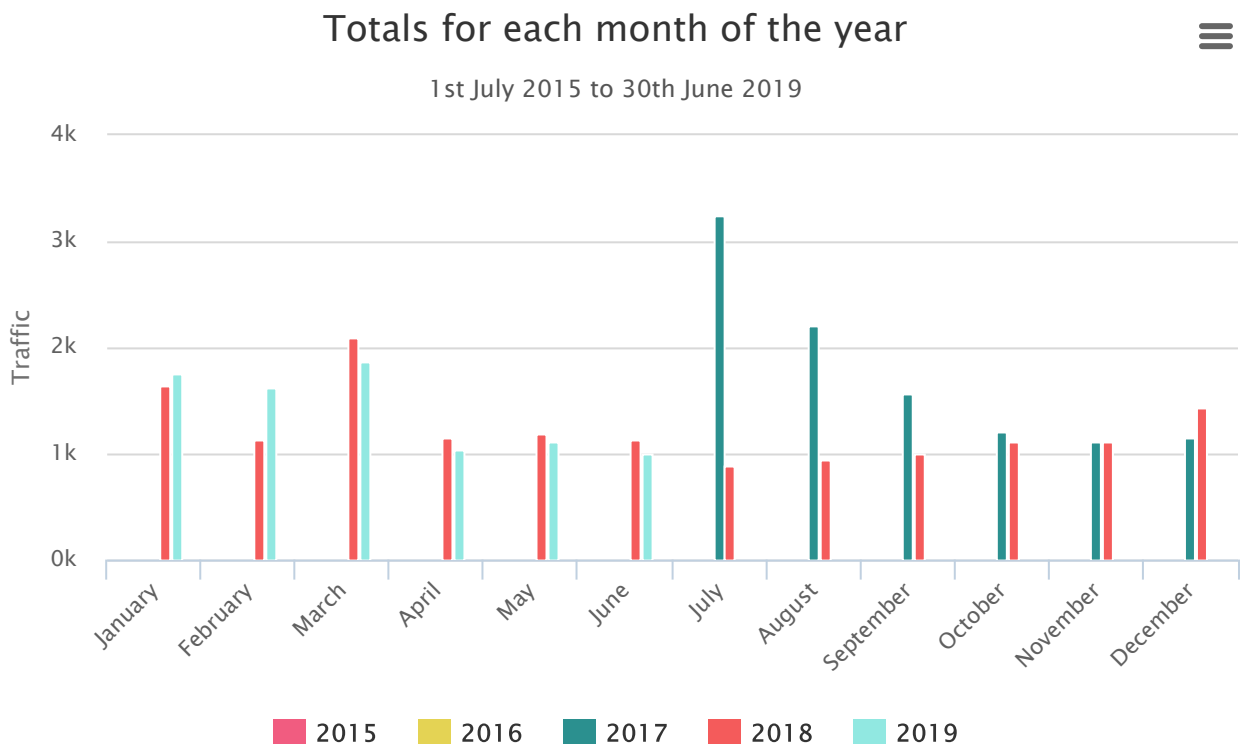

Totals for each day of the week
1st July 2015 to 30th June 2019
18%
26%
10%
14%
10%
11%
12%
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday


Totals for each hour of the day
1st July 2015 to 30th June 2019
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6...
Traffic
Glenasmole TOTAL

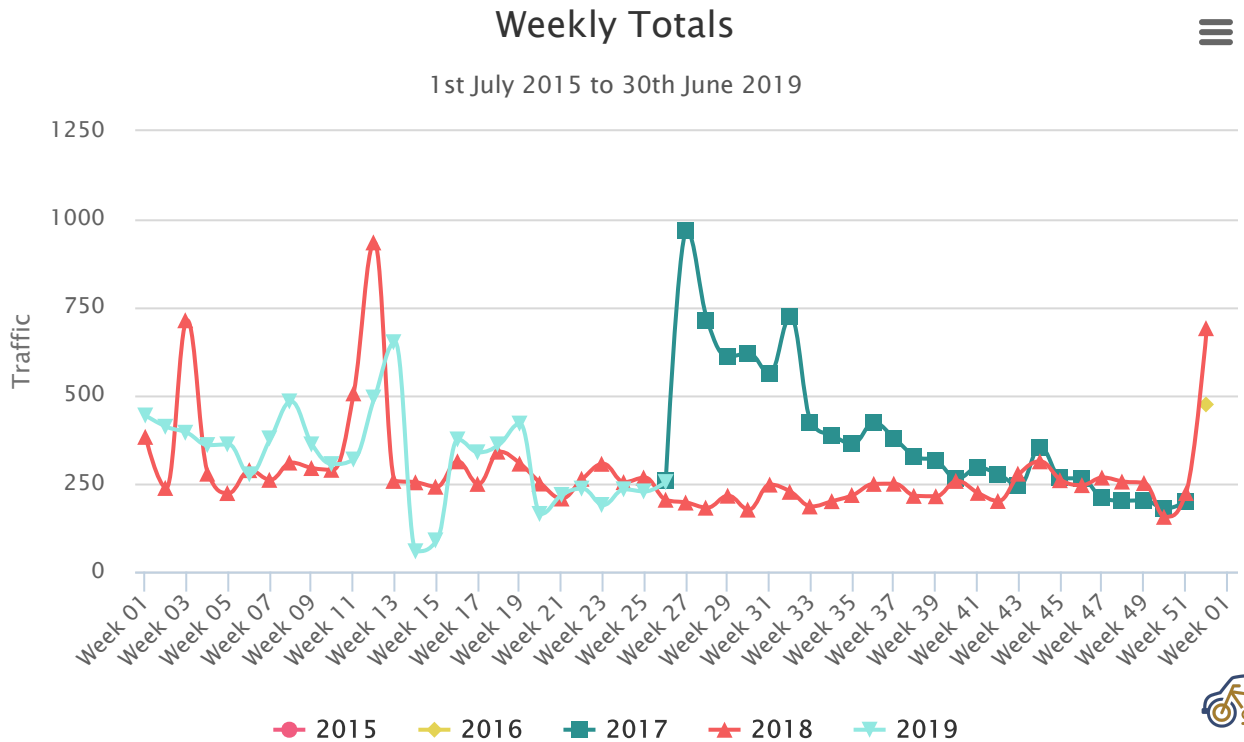
Rathmichael Woods TOTAL 0025A

Data Summary

	Rathmichael Woods TOTAL
Total Traffic for Period	33,709
Monthly Average	1,408
Weekly Average	323
Daily Average	46
Busiest day of the year	2018-03-21
Busiest day of the week	Sunday
Busiest hour of the day	15
Device Type	pedestrian
Installation Date	2017-07-01
Site ID	0025
Calibration Factor	0.5
GPS Co-ordinates	,

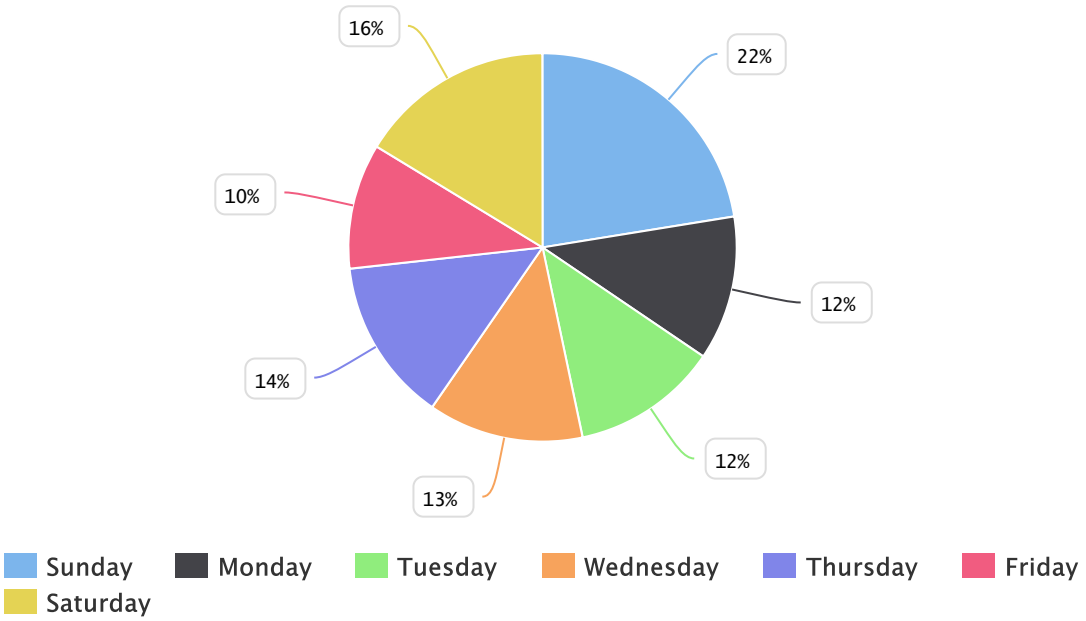


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015												
2016												
2017							3,236	2,214	1,574	1,204	1,116	1,148
2018	1,638	1,131	2,102	1,149	1,194	1,123	888	939	998	1,120	1,108	1,436
2019	1,747	1,625	1,862	1,044	1,111	1,006						



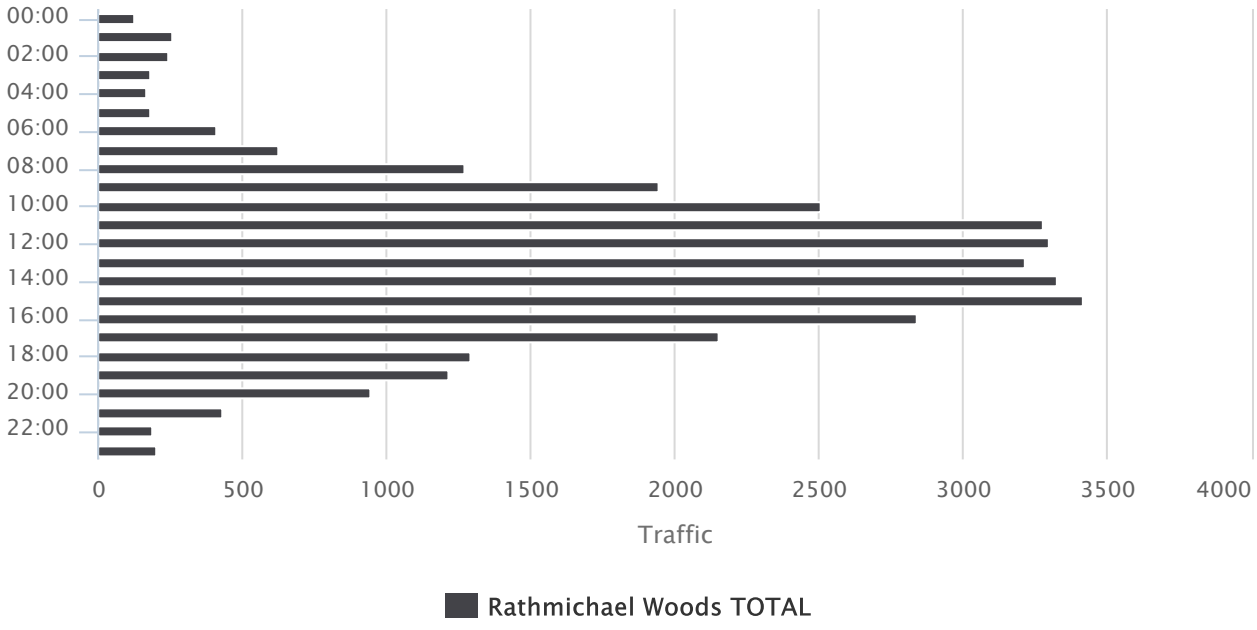
Totals for each day of the week

1st July 2015 to 30th June 2019



Totals for each hour of the day

1st July 2015 to 30th June 2019



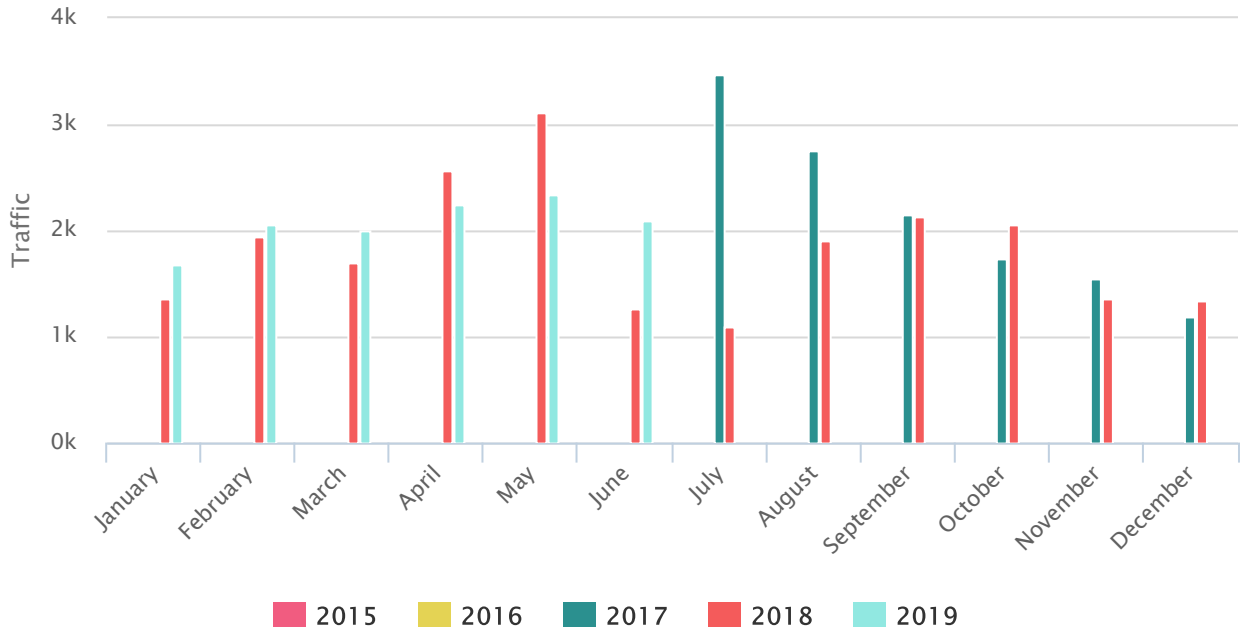
Kiltipper Park TOTAL 0026A

Data Summary

	Kiltipper Park TOTAL
Total Traffic for Period	47,158
Monthly Average	1,970
Weekly Average	452
Daily Average	65
Busiest day of the year	2018-04-21
Busiest day of the week	Sunday
Busiest hour of the day	14
Device Type	pedestrian
Installation Date	2017-07-01
Site ID	0026
Calibration Factor	0.5
GPS Co-ordinates	,

Totals for each month of the year

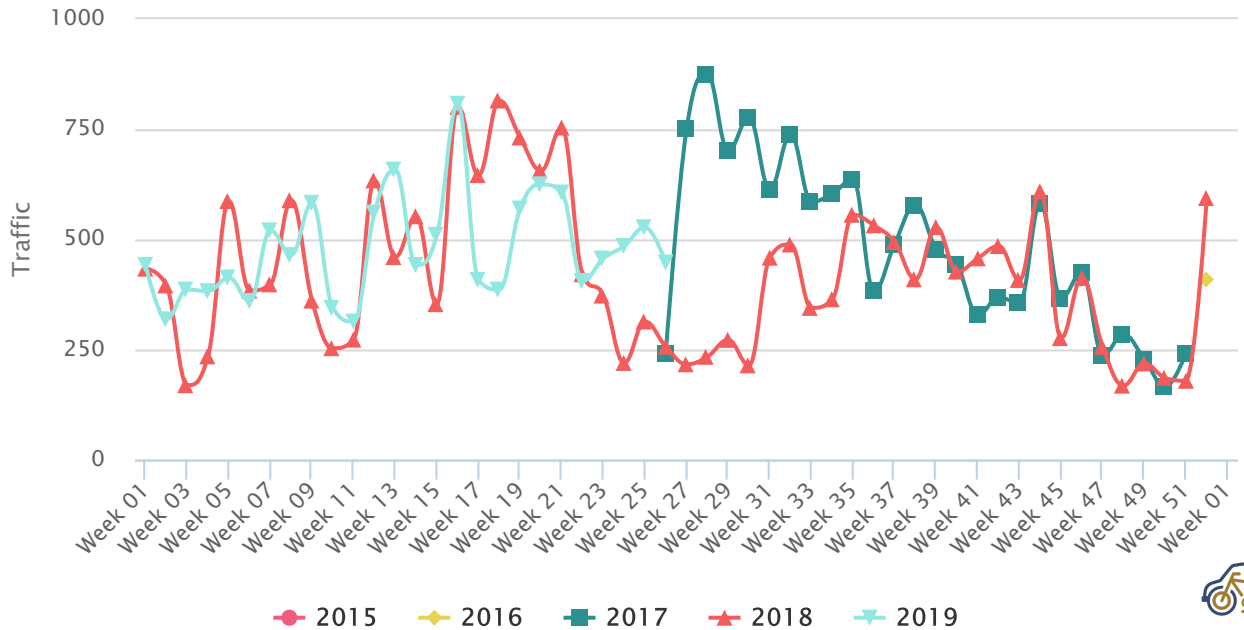
1st July 2015 to 30th June 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015												
2016												
2017							3,479	2,764	2,158	1,743	1,546	1,194
2018	1,366	1,946	1,698	2,566	3,104	1,259	1,098	1,910	2,142	2,065	1,355	1,345
2019	1,679	2,061	2,009	2,251	2,341	2,087						

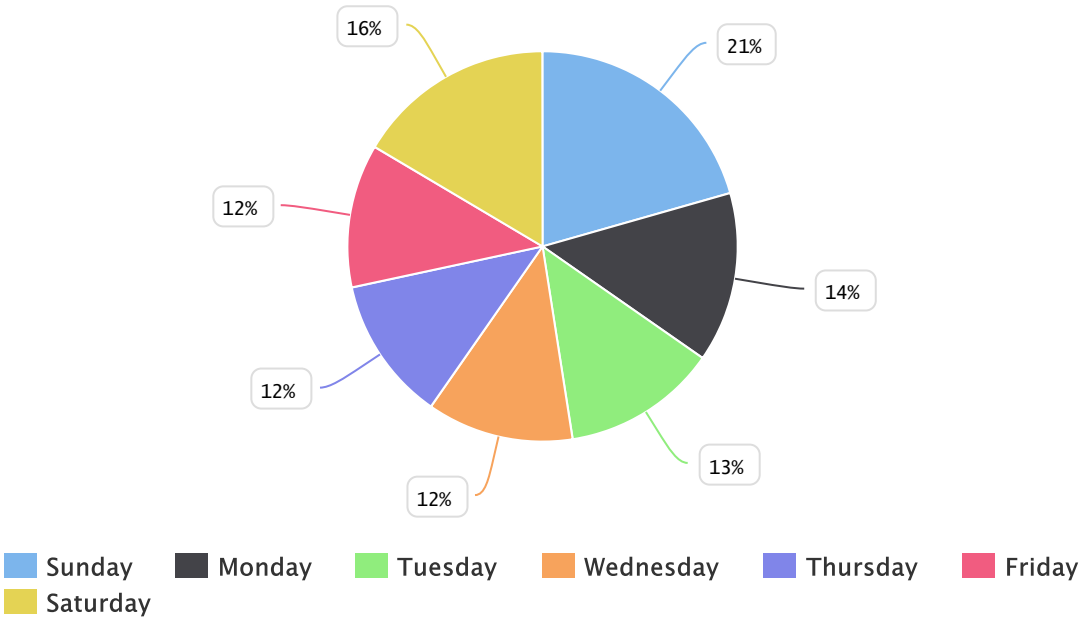
Weekly Totals

1st July 2015 to 30th June 2019



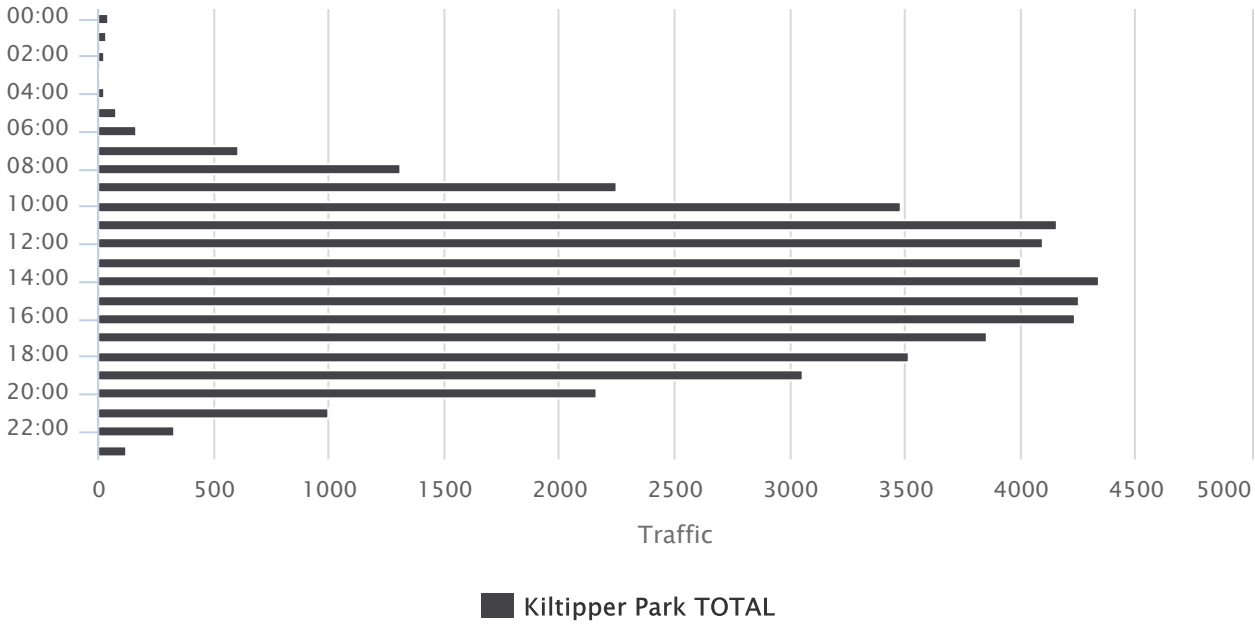
Totals for each day of the week

1st July 2015 to 30th June 2019

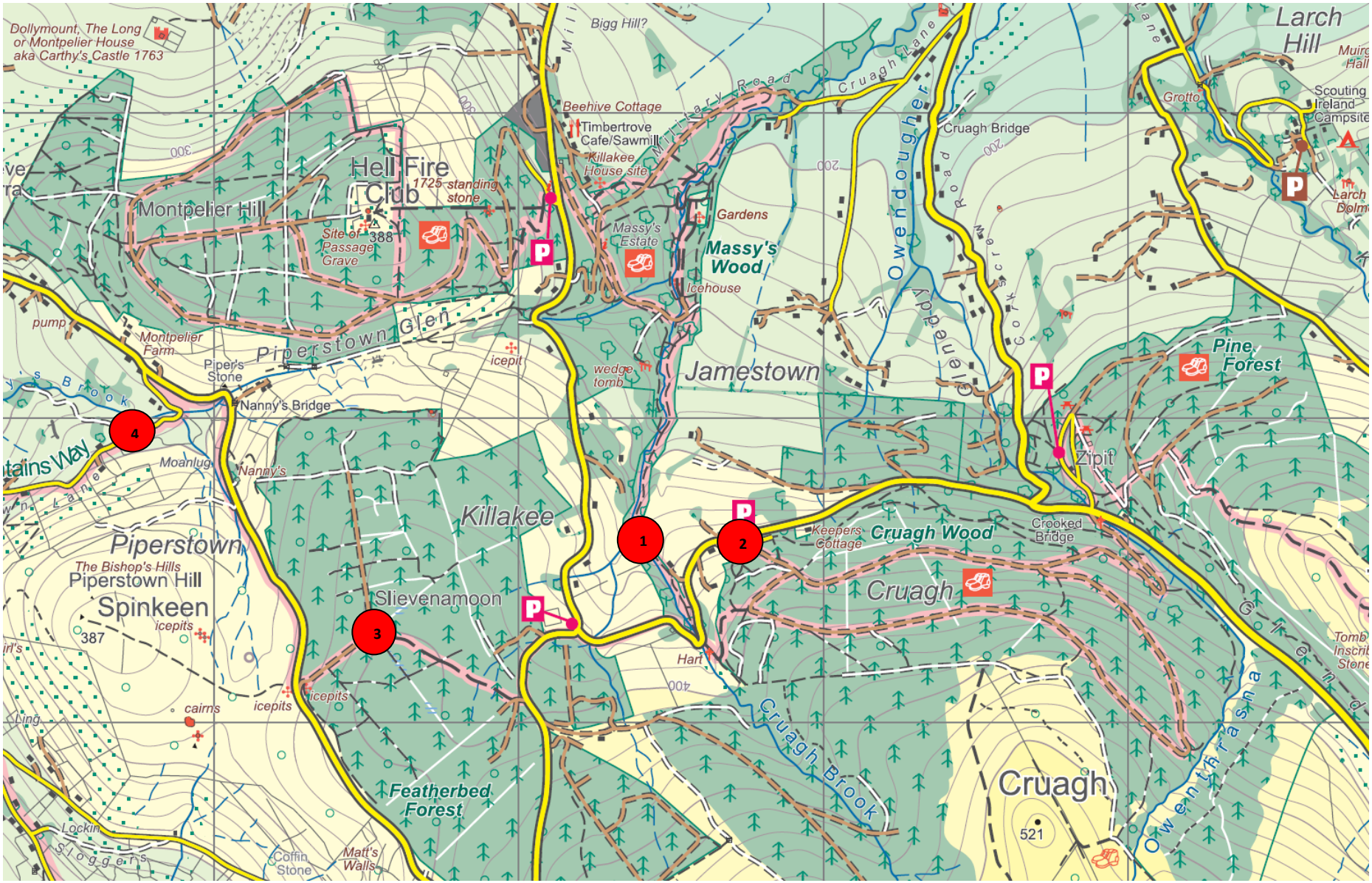


Totals for each hour of the day

1st July 2015 to 30th June 2019



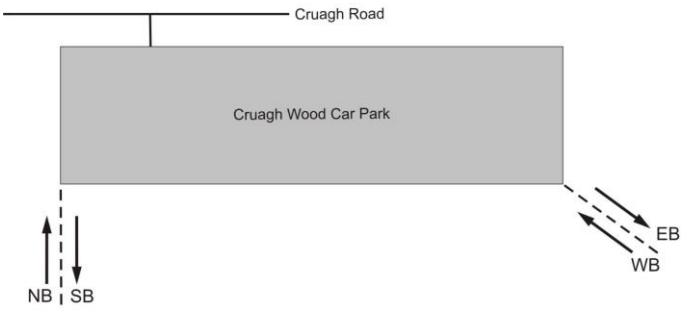
APPENDIX B
2017 Walker Survey Map



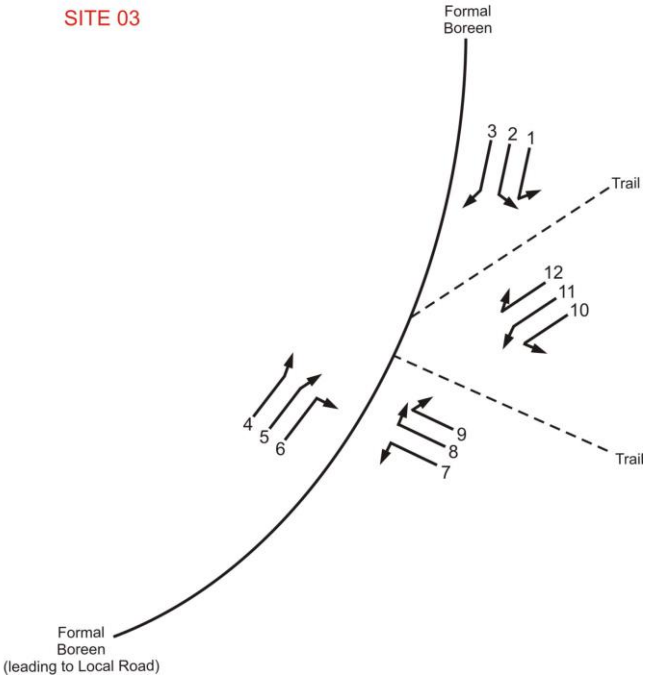
Dublin Mountains Walker Survey Locations 3rd-6th November 2017.

Movements Directions/Numbers

SITE 02



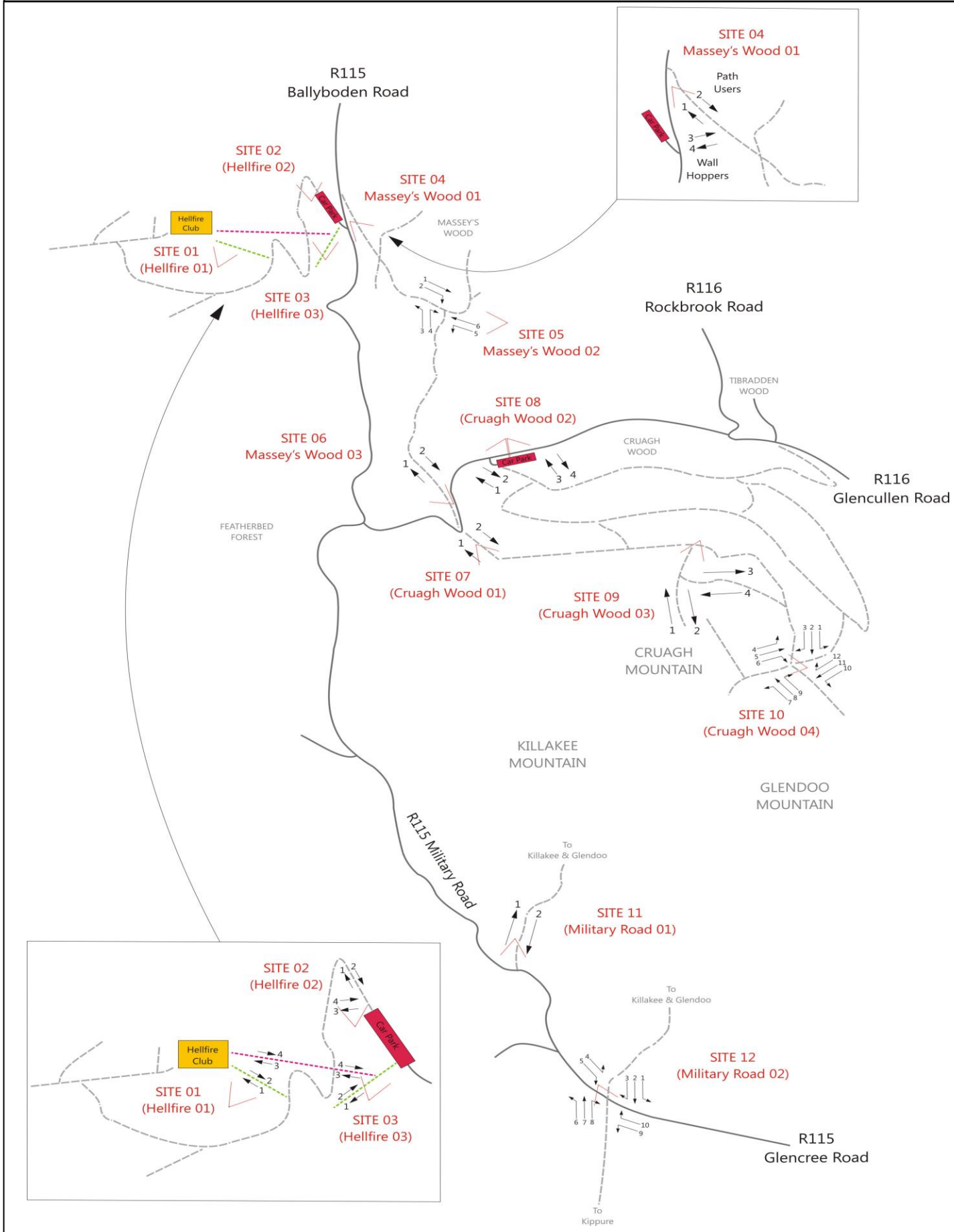
SITE 03



	Job number: Ath/17/162	Job date: Friday 3rd through Monday 6th November 2017	Drawing No: Ath/17/162-2	abacus Transportation Surveys
	Client: ROD		Author: SPW	

APPENDIX C
2019 Walker Survey Map

Site Locations/Movement Numbering



	Job number: TRA/19/143	Job Date: Fri 7th to Mon 10th June 2019 Fri 5th to Mon 8th July 2019 Fri 9th to Mon 12th August 2019	Drawing No: TRA/19/143-02	traffinomics.ie
	Client: Roughan O'Donovan		Author: SPW	

Supplementary Appendix S10

Draft Invasive Species Management Plan

Prepared by
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Dublin Mountains Visitor Centre

Draft Invasive Alien Plant Species Management Plan

November 2019

ROD
ROUGHAN & O'DONOVAN

Dublin Mountain Visitor Centre

Draft Invasive Alien Plant Species Management Plan

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Background

Roughan & O'Donovan (ROD) was appointed by South Dublin County Council (SDCC) to provide environmental consultancy services in relation to the proposed Dublin Mountains Visitor Centre ("the proposed development"). The proposed development, which is located in the Montpelier Hill and Massy's Estate area of the Dublin Mountains, involves:

(a) changes to the landscape of the site including the trails and a canopy bridge;

(b) conservation works to the architectural heritage features and interpretation of the heritage resources;

(c) development of visitor facilities, parking, services for the facilities;

(d) changes to the roads accessing the site; and,

(e) provision of a shuttle service to the site.

In addition to the above physical developments, an operational management plan is proposed to facilitate the envisaged increase in visitor access to/usage of the site.

During the ecological surveys which were carried out in 2016-2019, inclusive, to inform the Environmental Impact Assessment Report (EIAR) and the Natura Impact Statement (NIS) for the proposed development, a number of invasive alien plant species (IAPS) were identified within the footprint of the proposed development, particularly in Massy's Estate. In the absence of appropriate management, there is a significant risk that IAPS will continue to spread, either independently of or assisted by construction or operational activities associated with the proposed development.

The continued presence of IAPS within the footprint of the proposed development or the spread of such species to, from or within the site poses a significant threat to local biodiversity. Furthermore, the introduction or spread of invasive species, particularly IAPS listed on the Third Schedule to the European Communities (Birds and Natural Habitats) Regulations, 2011 (as amended) ("the Habitats Regulations"), poses a risk to the proposed development itself, as, in the absence of appropriate preventative measures, any such introduction or spread would constitute an offence under Section 49 of the Habitats Regulations. In order to address and manage the risks associated with IAPS, SDCC appointed ROD to prepare an IAPS Management Plan for the proposed development. This document comprises the draft IAPS Management Plan for the proposed development and was prepared by ROD on behalf of SDCC. The intention is that this will form the basis for the plan which will be adopted if consent for the proposed development is granted.

1.2 Location

The proposed development is situated on a 152 ha site comprised of Coillte's Hell Fire Club and Massy's Estate forest properties in the townlands of Montpelier, Killakee and Jamestown in South County Dublin. The site is bounded mostly by agricultural pasture with a small concentration of rural housing to the east of Massy's Estate along Cruagh Road (R116) in the Jamestown area and along the Old Military Road (R115) to the west. There are a small number of houses located to the south-west of Montpelier Hill. Figure 1 below illustrates the location and boundary of the proposed development.

Figure 1. Location and boundary of the site of the proposed development

1.3 Evaluation of Risk

Prior to preparing this IAPS Management Plan, the risk of IAPS both within and in the surrounding area, defined as 5 km from the development boundary, was assessed. This involved the following:

- A desk study to collect existing records of IAPS within 5 km of the development boundary.
- A IAPS survey of the site of the proposed development.
- The mapping of the extent and distribution of IAPS within the site.
- An evaluation of the risk of IAPS to biodiversity.

1.4 Purpose of this Plan

The purpose of the IAPS Management Plan is:

- To provide clear instruction and a timeline for the monitoring and eradication of IAPS.
- To evaluate the risks of re-infestation from surrounding properties.

2.0 METHODOLOGY

2.1 Consultation & Desk Study

The purpose of the desk study was to review publicly available information and recent and historical records regarding IAPS within the footprint of the proposed development and the surrounding area. Records of IAPS within 5 km of the proposed development were obtained from the National Parks & Wildlife Service (NPWS) and the National Biodiversity Data Centre (NBDC).

As with all desk studies, the data considered was only as good as the data supplied by the recorders and recording schemes. The recording schemes provide disclaimers in relation to the quality and quantity of the data they provide, and these were considered when examining the outputs of the desk study.

2.2 Invasive Species Survey

The first survey of invasive species at the site was carried out in 2016 to inform the EIAR for the proposed development. This survey identified Cherry Laurel (*Prunus laurocerasus*), Rhododendron (*Rhododendron ponticum*), Snowberry (*Symphoricarpos albus*) and Himalayan Honeysuckle (*Leycesteria formosa*). IAPS within the site were mapped on 5th June 2019. The entire site was walked to determine the distribution and abundance of all invasive species. Notes on site conditions were recorded and the stands were mapped in the field. The locations and extents of invasive species were mapped using ArcGIS. The survey was conducted using a site map of existing and proposed trails and cross-referenced with publicly available topographical maps and orthophotography.

2.3 Survey Limitations

Standard survey methods (NRA, 2010) were followed. However, any biases or limitations associated with these methods could potentially affect the results collected. Whilst every effort was made to provide a full assessment and comprehensive description of the site, it is unlikely that one survey can achieve full characterisation due to temporal variation. It is recognised that whenever a survey is carried out (within the defined season), it is a compromise, suitable for the vast majority of species, but possibly too early or too late for some species. The survey was carried out in June 2019, which is considered to fall within the optimal time of year for botanical surveys (April to September).

3.0 RESULTS

3.1 Proximity to Designated Sites

At the EU level, there are two main types of designated site: Special Protection Areas (SPAs) designated under the Birds Directive (2009/147/EC) and Special Areas of Conservation (SACs) designated under the Habitats Directive (92/43/EEC). The term "European site" applies to all EU designated sites, including SPAs and SACs. All European sites together make up the Natura 2000 network. The primary objective of each European site is to restore and maintain the favourable conservation condition of the habitats and species for which it has been selected ("qualifying interests") and, thereby, contribute to the restoration and maintenance of the favourable conservation status of those habitats and species at the national and EU level.

At the national level, Natural Heritage Areas (NHAs) are areas designated under the Wildlife Act, 1976 (as amended) ("the Wildlife Act") and considered important for the habitats and species of plants and animals whose habitat needs protection. NHAs are legally protected from the date that they are formally proposed for designation and must be a material consideration in the planning process. While proposed NHAs (pNHAs) are subject to limited protection are not individually protected under statute, they are considered to be of national conservation and heritage importance and are recognised by planning and licensing authorities for their ecological value.

Designated sites are often very sensitive to invasive species. In addition, run-off of herbicide could adversely affect the listed habitats and/or species of protected sites and would constitute an offence.

The proposed development is located in a rural area, in the townlands of Mountpelier, Killakee and Jamestown in South Dublin. The closest designated sites are the Wicklow Mountains SAC (0.6 km south), the Wicklow Mountains SPA (0.9 km southeast) and the Glenasmole Valley SAC (1.2 km southwest). These sites include habitats such as grasslands, heaths, lakes, bogs, rocky slopes, woodlands and calcareous springs and support populations of birds such as Merlin and Peregrine.

3.2 Desk Study

The desk study confirmed that 13 IAPS have been recorded within 5 km of the proposed development (see Table 3.1).

Table 3.1 Notable invasive species records within 5 km of the proposed development (NBDC, 2019).

Common Name	Scientific Name
Species listed on the Third Schedule	
American Skunk- Cabbage	*Lysichiton americanus*
Curly Waterweed	*Lagarosiphon major*
Giant Hogweed	*Heracleum mantegazzianum*
Giant Knotweed	*Fallopia sachalinensis*
Giant-rhubarb	*Gunnera tinctoria*
Himalayan Balsam	*Impatiens glandulifera*
Japanese Knotweed	*Fallopia japonica*

Common Name	Scientific Name
New Zealand Pigmyweed	*Crassula helmsii*
Parrot's-feather	*Myriophyllum aquaticum*
Rhododendron	*Rhododendron ponticum*
Other Invasive Species	
Blackcurrant	*Ribes nigrum*
Butterfly Bush	*Buddleja davidii*
Himalayan Honeysuckle	*Leycesteria formosa*
Sycamore	*Acer pseudoplatanus*

3.3 Invasive Species Survey

The 2019 field survey confirmed the presence of Rhododendron, Cherry Laurel, Himalayan Honeysuckle and Snowberry within the site. Rhododendron is listed on the Third Schedule to the Habitats Regulations and, as such, Section 49 of those regulations apply to this species.

Cherry Laurel is the most widespread IAPS within the site. The main infestations are along the Glendoo Brook and along the boundary of the R115. Rhododendron was identified along the Glendoo Brook interspersed with the Cherry Laurel. Himalayan Honeysuckle was identified in a range of locations throughout the site, mainly in the north-eastern section and along the western boundary of Massy's Estate and along the Glendoo Brook corridor. There was also a number of individual plants identified on Montpelier Hill at the carpark and along the track to the Hell Fire Club. Snowberry was identified mainly on the western side of Massy's Estate, with one stand among the Cherry Laurel on the eastern boundary of Massy's Estate.

Figure 2 below illustrates the extent and distribution of IAPS within the footprint of the proposed development.

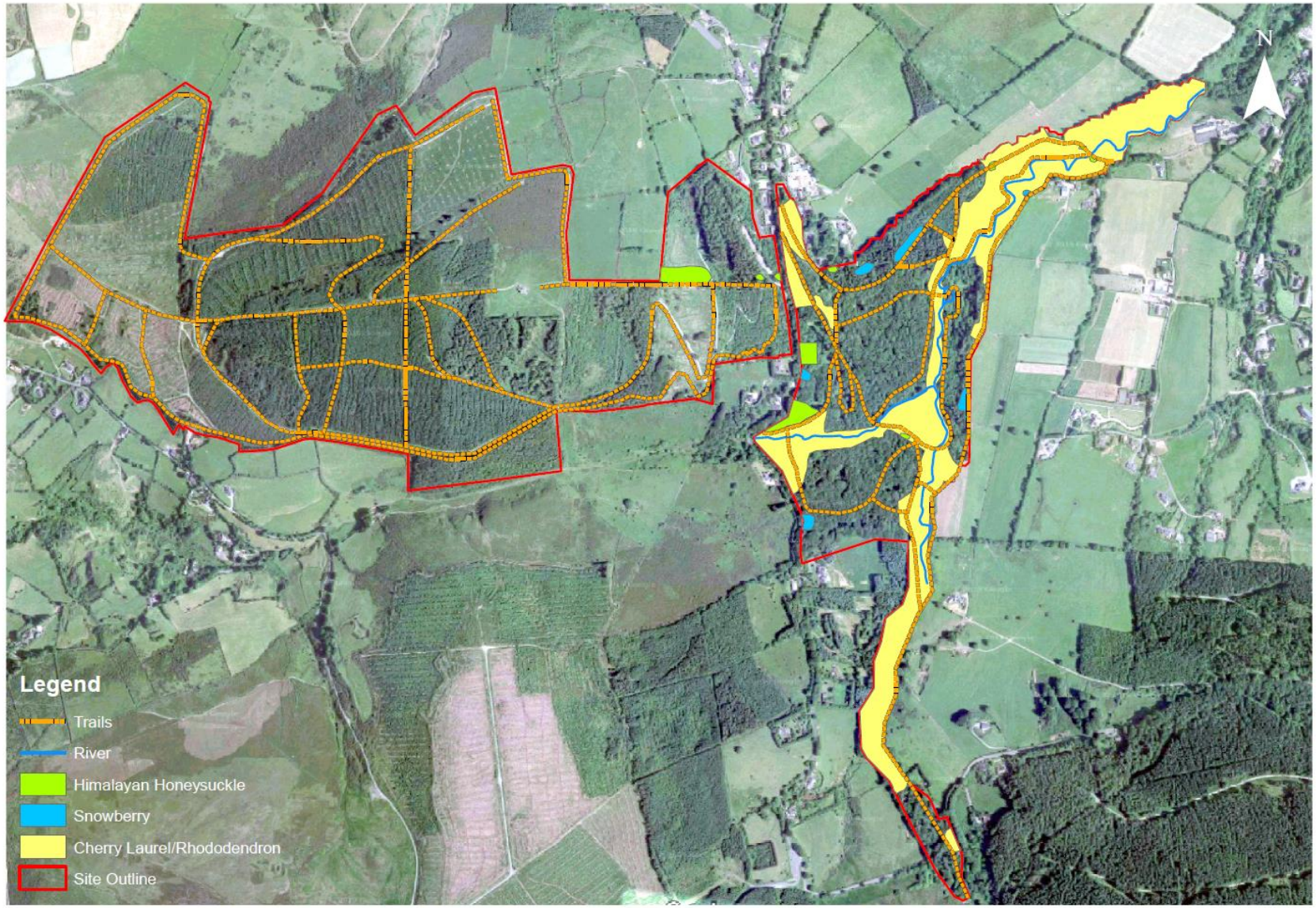

Figure 2 **Extent and distribution of invasive alien plant species on the site of the proposed development.**

4.0 OVERVIEW OF INVASIVE SPECIES

4.1 Rhododendron (*Rhododendron ponticum*)

Rhododendron is listed on the Third Schedule to the Habitats Regulations and grows in woodlands, heaths and bogs, where it can reach up to 8 m in height. It is an evergreen shrub with thick, waxy leaves. It has been found growing in a wide range of different soil types but prefers well-drained, acidic soils. Rhododendron produces inflorescences of 10-20 lilac-magenta flowers that are 6 cm in diameter and flowers in May-June, producing large quantities of pollen and nectar. It takes 6 months to produce capsules that dry out and release seeds from December onwards. The seeds are very small (0.5 mm × 1.5 mm) and are dispersed via wind, water and other vectors. Open areas within woodlands where there are breaks in the canopy are the types of areas subjected to the setting of these seeds. Areas of low moss carpets, deadwood and bare, moist soil provide optimal conditions for seed germination and establishment. Seeds usually germinate after a year but can also survive for longer. It can take between 10 and 12 years for a new plant to flower. Flowering plants that are cut back will return flowering within 3-4 years and will produce more seeds than it did before cutting. Plants remain as a single stem for the first 10 years of growth and dense thickets will take between 25 and 30 years to develop. The root systems vary according to conditions. Plants in wet soils form large shallow root balls and plants in drier soils form slightly deeper and smaller root balls (Higgins, 2008).

Rhododendron forms dense, impenetrable thickets, which creates dark, sterile environments underneath. All parts of the plant are unpalatable and toxic to small mammals, birds and invertebrates due to the cyanide within the plant tissue. This gives it a significant competitive advantage over native species.

4.2 Cherry Laurel (*Prunus laurocerasus*)

While Cherry Laurel is not listed on the Third Schedule to the Habitats Regulations, it can have detrimental impacts on native habitats. Similar to Rhododendron, Cherry Laurel is an evergreen shrub with thick leaves and can grow up to 10 m in height. In its native range, Cherry Laurel grows in woodlands as a subdominant, understory tree on moist soils. It produces small, white flowers on upright spikes which appear in spring but do not open until summer. Nectaries located on the underside of leaves and on the flowers attract pollinating insects. Birds feed on the berries and, consequently, disperse the seeds. Cherry Laurel can also reproduce vegetatively through suckering and layering (Higgins, 2008).

Similar to Rhododendron, Cherry Laurel forms dense, impenetrable thickets, which creates dark, sterile environments underneath. It is also unpalatable and toxic to small mammals, birds and invertebrates due to the cyanide within the plant tissue. This gives it a significant competitive advantage over native species.

4.3 Himalayan Honeysuckle (*Leycesteria formosa*)

While Himalayan Honeysuckle is not listed on the Third Schedule to the Habitats Regulations, it can outcompete native species leading to habitat loss (NBDC, 2019). Himalayan Honeysuckle (also known as Pheasant Berry or Flowering Nutmeg) is a deciduous shrub that can grow up to 2 m tall. It has tall, green, hollow, bamboo-like stems that support large oval or heart-shaped leaves that can grow up to 18 cm long. It has very distinctive purple funnel-shaped flowers and produces purple berries that are consumed by birds and small mammals, resulting in seed dispersal. Seeds are also dispersed in waterways by transporting fallen berries. It can be found growing in woodlands, sparsely vegetated habitats or habitats that have been subjected to

disturbance but prefers wet soils. It has the potential to form dense thickets that outcompete native plant species.

4.4 Snowberry (*Symphorica albus*)

Snowberry is not listed on the Third Schedule to the Habitats Regulations. Snowberry is a shrub that can grow up to 6 m tall with large leaves that are divided into 5-7 leaflets. It produces small, white flowers arranged in rounded clusters and small, white berries that darken when ripening in August or September. Flowers are produced from May to July. It can be found growing along riverbanks, hedgerows or in open woodland where it reproduces vis suckering which allows it to outcompete native species. It tolerates a range of different soil types but prefers heavy clay soils that are wet (Favorite & Moore, 2008).

5.0 TECHNIQUES FOR ERADICATION OF INVASIVE SPECIES

5.1 Management of Rhododendron and Cherry Laurel

There are several options which can be used to manage Rhododendron and Cherry Laurel (these species are treated together here due to the similarities in their biology and ecology). These are detailed below:

5.1.1 Herbicides

Herbicides

There are several effective herbicides that can be used when treating Rhododendron and Cherry Laurel. These include Glyphosate, Tryclopyr, Ammonium Sulphamate and Imazapyr. Glyphosate is highly effective and is one of the more widely accepted herbicides used for managing invasive species. It is also not persistent as once it comes in contact with soil, it quickly and strongly attaches to the soil particles, becoming 'locked' so that it cannot be absorbed by other plants and cause further damage to native vegetation. Glyphosate products such as Roundup ProVantage and ProBio are suitable for use near water bodies as they are non-residual and are broken down in soil or sediment into harmless substances. Therefore, it is strongly recommended to use Glyphosate-based herbicides which are approved for use near water when managing Rhododendron and Cherry Laurel (and other invasive species) at this site.

Herbicide Preparation and Use

While Glyphosate does not absorb easily through the skin, it is good practice to use gloves, protective eye wear and appropriate water-resistant work clothing during application. To prevent accidental ingestion, Glyphosate should be stored in its original labelled container and when not in use should be stored under lock and key under conditions specified by the manufacturer. Hands should always be thoroughly washed before eating or smoking to prevent ingestion. As it takes approximately 6 hours for Glyphosate to be taken up by plants, children and animals can touch and accidentally ingest Glyphosate.

While using Glyphosate it is paramount that clearly visible signs stating the use of herbicide and its risk to children, dogs and other animals are in place until treated plants are dry. Symptoms of ingestion by humans and animals consist of: burns to the mouth and throat, salivating, nausea, vomiting and diarrhoea. Animals may also go off food and appear sleepy. If pesticide ingestion is suspected medical treatment should be sought immediately.

Glyphosate has a low known toxic effect on aquatic life, however water for mixing of a 10% solution should be sourced from a private source (pre-collected and stored). Generally, no foliar application of Glyphosate should be carried out during busier periods i.e. the weekends.

Operators must comply with the legislation regarding the use of herbicides, as outlined in Section 8.0 of this draft Management Plan.

Stump Treatment

This method involves the application of herbicide to stumps directly after cutting has taken place. It is most effective when the stump is cut as close to the ground as possible (c. 2-4 cm). The herbicide should be applied immediately after cutting, and the entire above ground surface of the plant should be thoroughly wetted with herbicide. A dye, such as Methyl Violet, should be used in order to ensure that no

stumps are missed. This method is most effective when carried out by one operator as they can apply the herbicide to the stump directly after cutting it. The recommended herbicide to use is a 20% solution of Roundup Biactive, but trials with solutions as low as 10% have also proven effective. Treatment should be carried out during dry weather. If this is unavoidable, the cut should be made higher on the stem during the initial clearance, and re-cutting and herbicide application should take place during drier weather.

Due to the direct application of herbicide used in this method, there is a significant reduction in damage caused to non-target vegetation and allows for the use of a lower volume of herbicide when compared to other methods such a foliar treatment. There is also no standing dead regrowth to deal with when using this method. The reduced volume in follow-up spraying allows for the recovery of natural vegetation to begin immediately following the initial work phase. A dead hedge can be created using the deadwood from the felled trees which will create a barrier, excluding grazing pressure from recovering native vegetation. It is suitable on plants of any age or diameter and can be used all year round, however the period from November to April is recommended as it has the highest success rate (Higgins, 2008).

This method has the advantage that stumps are killed after the initial work phase. However, as with all methods, quality control requires monitoring to prove success after the initial treatment has taken place.

Direct Stem Treatment

This method involves the direct application of herbicide to standing trees. It involves the creation of a wound on the stem of a standing tree and the application of herbicide to this wound. This approach aims to contaminate the plant's transport system which is located just under the bark. Therefore, the cut in the stem must not be too deep. If there are a number of stems on one tree, a wound will need to be made and herbicide applied to each of these stems. If the stem diameter is less than 10 cm, two wounds need to be made with herbicide applied to both. If the stem diameter is greater than this, three or four wounds will be required. This method is most effective in the period February-April (Higgins, 2008). Access to the base of the plant may prove difficult in more mature dense stands. This method is only suitable for plants that are more than 1.3 m tall and for the follow up treatment of regrowth from cut stumps. This method should be carried out in dry conditions and the treated plants must remain dry for 6 hours after treatment.

The advantage of this method is that it results in kill without needing to handle brash. However, standing deadwood created from this method may be used as dead hedging. This method is a useful technique for plants that are located in places that are difficult to access as the equipment that is required (i.e. a hatchet) is small and easily held.

Foliar Spraying

For foliar applications, best results are achieved when both old (>1 year) and new growth is present at time of application. All green foliage should be treated, and the entire leaves should be covered. Formulations other than Roundup Biactive are more effective with the addition of an adjuvant such as Mixture B. Mixture B is a blend of surfactants, wetters and spreaders that improves herbicidal activity and uptake. This method can be carried out at any time of the year if weather conditions permit. It should not be carried out in very cold weather or in frosty conditions. Regrowth from cut stumps may be treated after 3 months. In harsher climates, it should occur after 12 to 18 months. Regrowth should be treated before flowers are produced (i.e. 3-4

years). If plants are treated in more waterlogged conditions; the herbicide may be less effective as translocation within the plant is reduced and the herbicide may not reach the roots. If this is the case, these plants should be treated during the most active part of the growing season, which typically occurs in June.

Foliar treatment requires checking at 12-18 months, following initial herbicide application. If plants have survived, were missed or were only partially sprayed, they will need to be retreated. It is important to avoid damaging non-target vegetation as not only will it cause damage to this vegetation, but it will create opportunity for re-infestation of Rhododendron and delay the recovery of native vegetation by several years.

5.1.2 Non-herbicidal methods

There are a number of non-herbicidal methods that can be used to remove species such as Rhododendron or Cherry Laurel from a site. These include the extraction of rootballs and the cutting of plants and the removal of their stumps. These methods are extremely labour-intensive, slow and expensive while also causing large amounts of disturbance to the soil and may not be possible in heavily infested areas or areas that are difficult to access with heavy machinery.

It is possible to remove dead stumps that have been treated with herbicide by using track mounted machinery or by hand using a pickaxe. However, for the same reasons as described above it would be unfeasible to do so and should be avoided due to the risk of sedimentation of the watercourses within the site. Therefore, the treated stumps should be left in situ.

5.1.3 Techniques for the eradication of saplings and seedlings

There are three main methods of eradicating saplings and seedlings, these are as follows:

Snip and Treat

This method involves cutting the seedlings and small plants at ground level and immediately treating the stems with a 10% Glyphosate solution. A hand-held applicator should be used in order to reduce the risk of damaging surrounding non-target vegetation. This method can be used at any time of the year in dry weather.

Pulling by Hand

The plants may be pulled by hand, if it is necessary a pickaxe may be used in order to loosen the surrounding soil. If any significant portion of the stem or root is left in the soil, this will allow for new growth. This is less likely to occur during winter months.

Spot Spray

Spot spraying is usually involved in the 'follow-up' work. It involves spraying any re-growth from cut stumps. This method should only be carried out during dry weather. This method is high-risk for non-target species surrounding the saplings. Where there is a large number of saplings a 'blanket-spray' approach is used which is very damaging to native vegetation that is growing between the samplings. Not only does it kill any recovering vegetation, but it also creates opportunity for re-infestation.

5.2 Management of Himalayan Honeysuckle

Herbicides

Himalayan Honeysuckle can be treated using herbicides and foliar application or stump treatment as described above. Leaf penetration by herbicides is improved with wetting agents, and these surfactants should be added to all foliage-active herbicide spray mixtures.

Physical Removal

Small infestations can be either pulled or dug out. This method will involve some soil disturbance and is therefore not suitable for larger infestations. These plants should be left in a designated area on site and left to dry out and rot.

5.3 Management of Snowberry

Herbicides

Due to the size of the stems of Snowberry, cut and paint methods are unsuitable. Foliar application of a Glyphosate based herbicide approved for use near water late in the season is the most effective method of controlling this species. At this time the plant is transporting carbohydrates from the leaves back to the rhizomes in preparation for winter and so the transport of the herbicide is more effective at this time of year. Leaf penetration by herbicides is improved with wetting agents, and these surfactants should be added to all foliage-active herbicide spray mixtures.

Physical Removal

Small infestation can be dug out. Care must be taken to ensure the rhizome is removed. This method will involve some soil disturbance and is therefore not suitable for larger infestations. These plants should be left in a designated area on site and left to dry out and rot.

5.4 Brash Management

Where pulled, cut or chemically treated IAPS material arises. The disposal of this material must not be allowed to result in the further spread of these species. Care must be taken, particularly along watercourses as water is quick to disperse seeds and fragments of plants. Material that contains seeds of flower heads should be disposed of by either composting, incinerating, burying the material at a depth of more than 0.5 m or disposal to a licensed landfill. All disposal should be carried out in accordance with waste management legislation and regualtions. If dead plant material is being left on site in the form of brash, there are several options available for the management of brash following treatment. The options are as follows:

Windrow/Brash Pile

Brash may be gathered into piles or windrows. This allows for access for any necessary follow-up work. Any regrowth beneath or within the piles should be treated. As the brash dries out over time, the risk of fire increases and measures should be taken to control this risk.

Dead Hedge

Sites that have been subject to heavy infestation have a sensitive and restricted ground layer that could be inhibited from regenerating in the presence of deer. Thus, brash can be used to create a dead hedge by gathering it in piles surrounding the treated area in order to exclude deer. It should be c. 2 m high and 3-4 m wide. However, the hedge may be subject to 'settlement'. A maintenance pile should be

left in order to add to the hedges when settlement occurs. Some form of gate should be left in the hedge in order to allow access for follow-up treatments.

Mulch

Mulching is unsuitable for certain species that can regenerate from fragments. Mulched material can also contain seeds. However, mulching can reduce the storage space required for brash, makes it easier to manage and reduces the fire risk associated with storing brash.

Standing Dead Rhododendron and Cherry Laurel

Standing dead trees are the result of direct stem treatment. This volume and density of standing deadwood can be a fire hazard as well as being a danger to operatives carrying out follow-up treatments. Standing deadwood resulting from direct stem treatments has been managed by flailing in some situations. However, this is not feasible in less accessible locations.

5.5 Limitations to Invasive Species Removal

The limitations that may be encountered include:

- The volume of invasive species, particularly Cherry Laurel and Rhododendron in Massy's Estate, which require treatment could lead to impacts on the Glendoo Brook through sedimentation.
- The high level of use by members of the public and animals may restrict the ability to use herbicides in large areas at any one time.
- The storage of brash on site required space and would lead to habitat loss.

6.0 RECOMMENDED MANAGEMENT MEASURES

6.1 Rhododendron and Cherry Laurel

Rhododendron and Cherry Laurel should be controlled using a Glyphosate-based herbicide approved by the manufacturer for use near water. Stump treatment is the most effective and environmentally sensitive method in the case of Massy's Estate. Snip and treat should only be used for regrowth of previously treated stumps or plants. Seedlings should be pulled or treated using the snip and treat method. Dead stumps should be left in situ in order to prevent excessive soils disturbance and sedimentation of watercourses. Cut material should be removed from site to a suitable facility.

6.2 Himalayan Honeysuckle and Snowberry

Stands of Himalayan Honeysuckle should be treated by the cut and paint method. Stands of Snowberry should be treated by foliar application. Individual plants should be physically removed using a pick-axe or spade and left in a designated area to dry out and rot.

7.0 OVERVIEW OF MANAGEMENT PLAN

This management plan describes the recommended approach for effective control of IAPS throughout the site. The site has been divided into different zones according to the level of infestation (Figure 3 below).

Zone 1 is the areas of the site which are free from IAPS. Monitoring of Zone 1 is required to ensure that any new introductions are detected as early as possible. Any saplings or seedlings can be hand pulled in this area as required.

Zone 2 contains small infestations or infestations that have been previously controlled. Stump treatment is unsuitable where the growth is vigorous thin stems. In this case snip and treat is more appropriate. Small stands of Snowberry can be treated with foliar application in late summer/autumn.

Zone 3 contains the most heavily infested areas. Zone 3 is a large area with very dense stands of mature Cherry Laurel and Rhododendron. In order to minimise impact of the surrounding area during the removal of these species, the initial phase of treatment will be carried out over a number of years. The areas of Zone 3 which are furthest south and south-west should be treated first, as this will reduce the seed being transported down the Glendoo Brook corridor. The management plan should aim to reduce the infested area by 20% per year for five years. Localised removal of IAPS may be required for the construction of the trails and canopy bridge. As areas within Zone 2 and 3 are cleared, native trees should be planted to promote native biodiversity.

An IAPS survey will take place of the entire site in June each year to identify regrowth and seedlings. Treatment will take place from September to October for a period of five years. It is anticipated that as IAPS are removed from Zones 2 and 3, the area of Zone 1 will increase in size. The Zones will be mapped each year to inform the management of IAPS in the site.

Following the five-year period of the management plan, recommendations will be made, which may include further treatment, if required. Ongoing monitoring will be necessary as part of the woodland management as the re-introduction of IAPS from sources outside the site is unavoidable.

In order to prevent damage to roots, only low ground pressure vehicles should be used. Vehicles should not leave the trails or forest roads.

Seeds and plant fragments can be transported within and outside of the site on vehicles, tools and footwear. Therefore, all equipment should be cleaned thoroughly in a designated area prior to leaving the site.

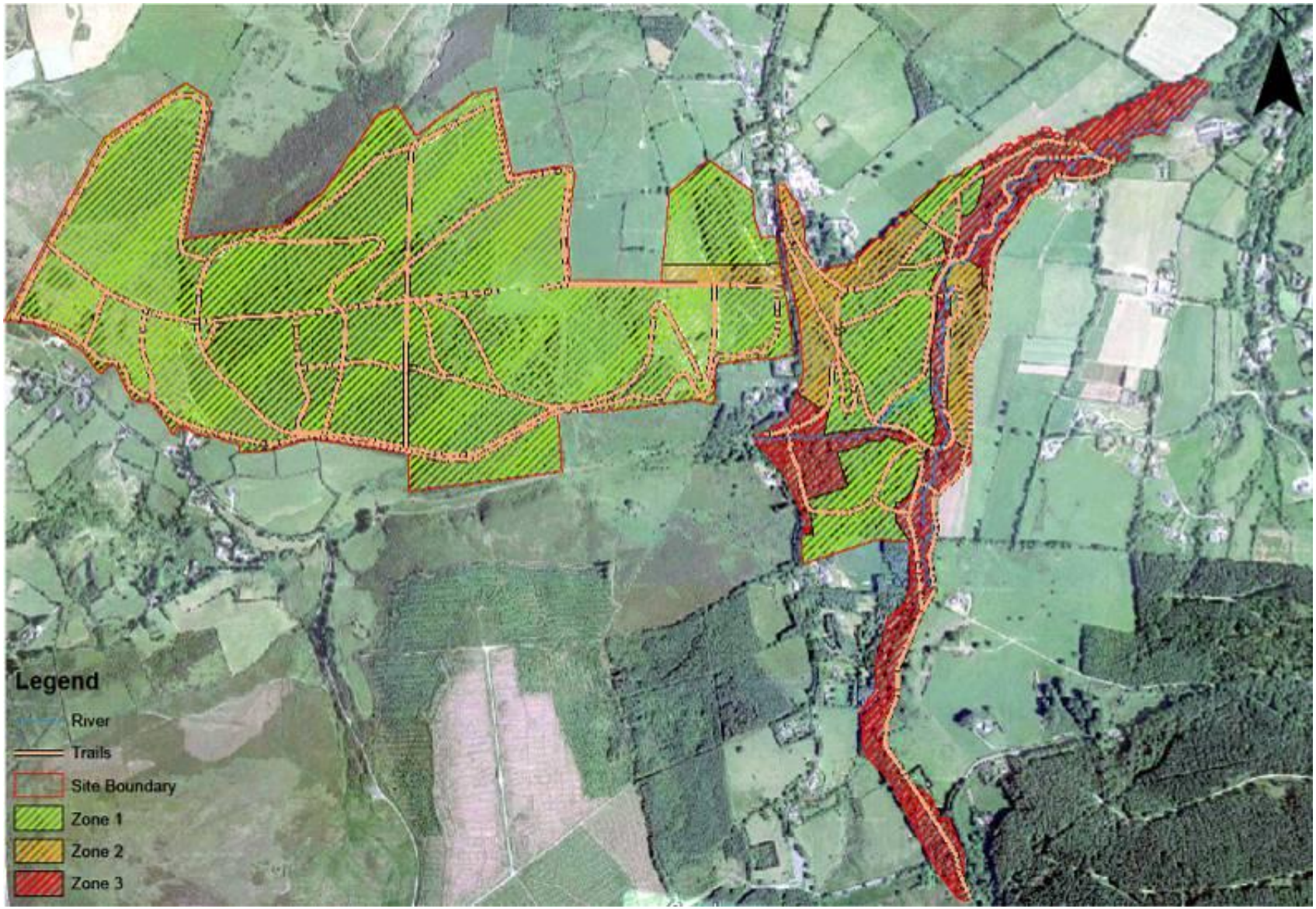

Figure 3 Zones for IAPS treatment according to level of infestation.

8.0 TRAINING AND OPERATIVE COMPETENCY

8.1 Legislative Context

In the course of treating invasive species, particularly the use of herbicides, operators must comply with all legislation regulating the treatment and management of invasive species. The relevant standards and legislation that will dictate how eradication is undertaken include:

- European Communities (Plant Protection Products) Regulations, 2012 (S.I. No.159 of 2012);
- European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No.155 of 2012);
- Waste Management Acts, 1996 to 2013, and related legislation;
- Safety, Health and Welfare at Work Act, 2005;
- Safety, Health and Welfare at Work (Construction) Regulations, 2013;
- Safety, Health and Welfare at Work (General Application) Regulations, 2007;
- Safety, Health and Welfare at Work (Chemical Agents) Regulations, 2001;
- European Communities (Birds and Natural Habitats) Regulations, 2011 to 2015; and,
- Wildlife Act, 1976 (as amended) ("the Wildlife Act").

The use of plant protection products, according to the Plant Protection Products Regulation, '*may involve risks and hazards for humans, animals and the environment, especially if used incorrectly*'. Therefore, it is important that plant protection products are used correctly as to reduce the risks and hazards, animals and the environment.

Due to the high numbers of recreational users in the area, it is strongly advised to fence off areas that are being treated with herbicides in order to minimise the risk of causing harm to members of the public or their pets as well as local biodiversity. In addition to this, the public shall well informed (through signage) about the locations and timing of herbicide use and the potential harm herbicides could cause.

To comply with Sustainable Use of Pesticides Legislation, the application of herbicide should only be undertaken by registered professional users. Only a Registered Pesticide Advisor (RPA) should approve procedures prior to works commencing. All professional users should demonstrate proper use, ensuring only authorised products are used and all treatments are catalogued and documented pursuant to the requirement of Plant Protection Products Regulations.

With regard to 'record-keeping' Article 67(1) of the Plant Protection Regulation provides that '*professional users of plant protection products shall, for at least 3 years, keep records of the plant protection products they use, containing the name of the plant protection product, the time and the dose of application, the area and the crop where the plant protection product was used'.*

In scenarios where disturbance, movement and disposal of invasive species material is required, the RPA will review applications submitted to the relevant licensing authorities prior to works commencing.

8.2 Health & Safety

An appropriate risk assessment, which includes Health & Safety considerations, should be carried out before any control or survey work is undertaken. Protective clothing must be worn when attempting control. All works to be compliant with the Safety, Health and Welfare at Work Act, 2005 as well as the Safety, Health and Welfare at Work (General Application) Regulations, 2007.

Chainsaws should only be used by those with appropriate training and skill. The use of chainsaws should adhere to the *Guide to Safe Working with Timber and Chainsaws* (HSA, 2010). Chainsaws and equipment should be properly maintained, and correct protective equipment should be used at all times.

Supervision of operatives is required on site to answer any questions and visit treated areas on a regular basis to ensure that work continues to be carried out to a high standard.

8.3 How Actions will be Evaluated

The success of the management plan will be based on the initial reduction in area of IAPS ascertained from pre-treatment surveying and defined by an increase in area of Zone 1 i.e. the area free from IAPS. It is anticipated that complete eradication can be achieved in 5 years.

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Supplementary Appendix S11

Draft Red Squirrel Management Plan

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Dublin Mountains Visitor Centre

Red Squirrel Conservation Management Plan

November 2019

ROD
ROUGHAN & O'DONOVAN

Dublin Mountains Visitor Centre

Red Squirrel Conservation Management Plan

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

Roughan & O'Donovan (ROD) was commissioned by South Dublin County Council to prepare this Red Squirrel Conservation Management Plan for the Hell Fire Club and Massy's Estate area, as part of the application for planning consent in respect of the proposed Dublin Mountains Visitor Centre.

The proposed Dublin Mountains Visitor Centre ("the proposed development") will be located at the northern gateway into the Dublin and Wicklow Mountains from Dublin City. In broad terms, the site location is in the valley of the largest tributary of the River Dodder, the Owendoher River, to the south of Rathfarnham. There are several blocks of state-owned land (Coillte conifer plantations) in and around this valley and the proposal focuses on the development of a tourism facility at Hell Fire Club and Massy's Estate area, which already provides extensive public access and walking routes linking into the higher mountains above 300 m altitude.

Red Squirrel (*Sciurus vulgaris*) are present at the Hell Fire Club and in Massy's Estate. In order to inform the Environmental Impact Assessment Report (EIAR) for the proposed development, and this management plan, squirrel surveys were conducted between November 2016 and August 2019 within the site, including a 50 m buffer, where applicable. The purpose of the surveys was to determine the status of Red Squirrel in the site and, thereby, provide a baseline for the assessment of the impacts of the proposed development on this species, in accordance with the *Practical Techniques for Surveying and Monitoring Squirrels* (Gurnell et al., 2001) and also had regard for Transport Infrastructure Ireland (TII)/National Roads Authority (NRA) publication *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes* (2008).

The EIAR identified potential for short- and medium-term impacts on Red Squirrel as a result of the proposed development. These impacts include habitat loss, habitat fragmentation, disturbance and, potentially, direct mortality during the construction phase and an increased risk of road collisions, disturbance and increased pressure from the non-native and invasive Grey Squirrel (*Sciurus carolinensis*) during the operational phase. Red Squirrel is protected under the Wildlife Act, 1976 (as amended) ("the Wildlife Act"). This conservation management plan was prepared to ensure the long-term maintenance and enhancement of the Red Squirrel population in the Hell Fire Club and Massy's Estate area. This document specifies objectives with corresponding targets and identifies the actions required to meet these targets.

The following guidance documents have been used for reference and guidance in the preparation of this conservation management plan:

- *All-Ireland Species Action Plan: Red Squirrel* (NPWS & EHS, 2008).
- *Guidelines for Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Road Schemes* (TII/NRA, 2008).
- *Guidelines for Woodland Creation where Red Squirrel are Present* (Natural Resources Wales, 2015).
- Gurnell, J., Lurz, P. and Pepper, H. (2001) *Practical Techniques for Surveying and Monitoring Squirrels.* Forestry Commission, Edinburgh.
- *Managing forests as red squirrel strongholds* (Forestry Commission Scotland, 2012).

- *Scottish Strategy for Red Squirrel Conservation* (Scottish Squirrel Group, 2015).

1.2 Scope of this Conservation Management Plan

The overarching aim of this conservation management plan is to maintain and enhance the conservation condition of the Red Squirrel population at the Hell Fire Club and Massy's Estate area. In order to ensure that the approach to Red Squirrel conservation management set out in this plan is evidenced-based, it describes in detail the current understanding of both the Red Squirrel and the Grey Squirrel populations at the Hell Fire Club and Massy's Estate and provides for adaptive implementation based on continued monitoring of these populations.

Results of desk studies and field surveys, mitigation and monitoring described in this document are identical to those described in the EIAR for the proposed development. Therefore, this red squirrel management plan may be treated as a standalone document.

1.3 Site Description

The Hell Fire Club is situated on Montpelier Hill, which rises to 388 m above sea level and is the most north-westerly hill of the Dublin Mountains. The slopes around the Hell Fire Club are under agricultural grasslands on the north side and under conifer plantations of varying ages on the remaining sides.

The woodlands at the Hell Fire Club are a working commercial forest and will likely remain so into the future. Some mature trees have been retained adjacent to the car park both for aesthetic reasons and to screen the car park. However, their retention will not be feasible in the long term due to the conifers' potential to become over-tall and prone to wind throw. The eastern side of the Hell Fire Club, close to the location of the proposed visitor centre, was clear-felled in 2016 and has not been replanted. A number of middle-aged broadleaved trees are found on the eastern side of the Hell Fire Club, including some mature trees which pre-date the forest and clearly grew in open ground in the past.

In contrast to the Hell Fire Club, Massy's Estate is a predominantly broadleaved woodland. There are some areas of coniferous plantation and specimen trees from the original Killakee Demesne. Mature specimen trees are found throughout the woodland. It is principally a recreational forest, though woodland management works are ongoing. It is expected that the management of the woodland can be adapted to accommodate the amenity value that may be required. Stone bridges and an area consisting of a walled garden originally part of the Killakee Demesne are located at the eastern extremity of the site. The Glendoo Brook flows in a south-north direction along the eastern boundary of Massy's Estate, with one tributary flowing east through Massy's Estate into Glendoo Brook, which is a tributary of the Owendoher River, which joins the River Dodder approximately 6 km downstream.

2. METHODOLOGY

2.1 Desk Study

The desk study undertaken to inform this assessment included a thorough review of the available baseline data relating to biodiversity in the study area. The following resources were used:

- National Parks & Wildlife Service (NPWS) *NPWS Viewer*
- National Biodiversity Data Centre (NBDC) *Biodiversity Maps*

As with all desk studies, the data considered were only as good as the data supplied by the recorders and recording schemes. The recording schemes provide disclaimers in relation to the quality and quantity of the data they provide, and these were considered when examining outputs of the desk study.

2.2 Field Surveys

A Red Squirrel survey was undertaken in the wooded areas of the Hell Fire Club and in Massy's Estate based on the guidance document *Practical Techniques for Surveying and Monitoring Squirrels* (Gurnell et al., 2009). A number of methods were used to establish the distribution of Red Squirrels and Grey Squirrels and provide a baseline for future monitoring of both species. The methodologies for the squirrel surveys are outlined below. Incidental records of squirrels were also recorded between 2016 and 2019 and are presented in Appendix B.

Visual Surveys

Visual surveys following the 'basic method' outlined in Gurnell et al. (2009) involved a surveyor walking a transect in Massy's Estate (3 km) or the Hell Fire Club (5 km). The transect routes entered the conifer plantations at the Hell Fire Club and followed the paths in Massy's Estate. Live sightings of squirrels were recorded on field maps.

The activity transect surveys were carried out early in the morning and within a 2-week period in April 2019. The transect routes are illustrated in Appendix A.

Drey Survey

The woodlands in the study area were divided into blocks based on the woodland characteristics, the locations of paths and other physical features. Each block was searched for dreys using 10× binoculars. The young conifer plantations at the Hell Fire Club were walked in transects c. 25 m apart. Photographs were taken and a GPS location was recorded at each drey. The purpose of the drey survey was identify dreys which may be impacted by the proposed development. The locations of the dreys are presented in Appendix B.

3. RED SQUIRREL

3.1 Ecology and Distribution

Red Squirrel is an exclusively woodland species and is most successful in mixed broadleaved woodland, provided that Grey Squirrel is not present. Red Squirrels primarily eat seeds and exhibit scatter-hoarding behaviour, where food is cached in the ground to be consumed when the natural supply of food is low in late winter and early spring, at which time they will supplement their diet with fungi, flowers, buds and insects.

Red Squirrels are most active in the morning and late afternoon, having two long periods of active foraging. Red squirrel breed from January and the first litter of kittens is born in March. If food is plentiful, they may have a second litter. Squirrels shelter in nests known as dreys. A drey is a large, dense ball of twigs, usually against the trunk of a tree or in the fork of two or more branches. Red Squirrels are not territorial but have home ranges that change in response to food availability.

Red Squirrels can occupy a wide range of different woodland types across much of Ireland. However, since the middle of the 20th Century, its distribution has become fragmented and its range has contracted. This decline in the population and range of the Red Squirrel coincides with the increase in range and population of the introduced Grey Squirrel. Where the two species coexist, Red Squirrels eventually become displaced as a result of competitive disadvantage and, to a lesser extent (at present), the squirrelpox virus.

The arrival of the Grey Squirrel to an area that has been previously occupied by Red Squirrels usually results in the replacement of the Red Squirrels within approximately 15 years. Red Squirrels can persist for longer in coniferous forests once Grey Squirrels have arrived to an area. However, the breeding success and density of the Red Squirrels greatly reduces in coniferous woodlands compared to broadleaved woodlands.

Population densities of Red Squirrels are low in Ireland although they may be concentrated in isolated wooded areas especially in the south and east while scarce in the north and along the western seaboard. In the midlands they have been largely out competed for habitats by the Grey Squirrel, especially in mixed and broadleaf woodlands.

In recent years, Pine Marten (*Martes martes*) has expanded its range following a historic decline and Red Squirrels have returned to areas where they had previously been displaced by Grey Squirrels (Sheehy & Lawton, 2014). This has been attributed to Pine Marten predating on and stressing Grey Squirrels more effectively as a result of Grey Squirrels being significantly heavier than Red Squirrels (making it more difficult for them to evade predation) and their habit of spending more time on the ground.

3.2 Conservation Status and Legislative Protection

Red Squirrel is the only squirrel species native to Ireland. It was once widespread but has declined significantly since the mid-20th Century following the first introduction of Grey Squirrel to Ireland in 1913. The current populations of Red and Grey Squirrels in Ireland are estimated at 40,000 and 250,000 respectively (NPWS & EHS, 2008).

Red Squirrel is protected under Section 23 of the Wildlife Act. As such, it is an offence to hunt or injure Red Squirrel or to wilfully destroy its breeding or resting places.

In addition, the South Dublin County Development Plan 2016-2022 contains a number of objectives relating to the protection and enhancement of biodiversity, particularly for species protected under the Wildlife Act, including Red Squirrel.

3.3 Current Factors Affecting the Population in Ireland

Spread of the Grey Squirrel

The abundance of Red Squirrel is in decline due to the arrival spread of Grey Squirrel. Red Squirrels are highly likely to disappear from woodlands in which Grey Squirrels have been introduced. Factors that favour the Grey Squirrel include their ability to utilise food such as unripe acorns that are toxic to Red Squirrels. Grey Squirrel can carry squirrelpox, which is fatal to Red Squirrels.

Woodland Availability

A fundamental determinant of Red Squirrel range is the presence of woodland. Ireland has the lowest level woodland cover of all European countries at 11%.

Woodland Species Composition

The survival of Red Squirrel depends on the availability of a constant food supply throughout the year. Red Squirrels' diet comprises mainly of tree seeds. In deciduous or mixed woodlands, larger seeds such as those produced by Hazel (*Corylus avellana*) form an important part of diet, but they are also capable of exploiting small-seeded trees such as Sitka Spruce (*Picea sitchensis*). The survival rate of Grey Squirrel is much lower in coniferous woodlands when compared with Red Squirrels. The presence of large-seeded species such as oaks (*Quercus* spp.) gives Grey Squirrels a competitive advantage and can lead to the displacement of Red Squirrels in broadleaved or mixed woodlands. This issue is complicated by the fact that Red Squirrel densities can be much higher (10x) in broadleaved woodlands.

Predation and Other Causes of Mortality

Natural predators of the Red Squirrel include Pine Marten and Buzzard (*Buteo buteo*). However, predation by these species is unlikely to be significant. Predation by domestic animals such as cats and dogs may be locally important. Disease and road collisions are also known to be causes of Red Squirrel deaths.

Disturbance

In a study by Haigh et al. (2017) on the impact of human-related disturbance on Red Squirrel in Fota Wildlife Park, which receives c. 300,000 visitors per year, Red Squirrel were shown to concentrate activities in areas without human disturbance and move into the more disturbed areas after the park closed. The study concluded that Red Squirrels can habituate to humans provided there are quiet zones nearby. Red Squirrel are found in many areas with high levels of amenity use in Ireland such as Fota Island, Co. Cork, Glendalough, Co. Wicklow, Slieve Gullion Forest Park, Co. Armagh and Killiney Hill, Co. Dublin.

3.4 Dublin Mountains Population

There are several populations of Red Squirrel in South Dublin, including small populations on Howth Head, Killiney Hill and Carrigoligan/the Scalp, and, a larger population in the connected woodlands of the Hell Fire Club, Massy's Estate, Cruagh, Tibradden, Kilmashogue and Ticknock. This area is largely coniferous plantation, where Red Squirrels are better adapted to eating the smaller seeds than Grey

Squirrels. Therefore, this area represents an important habitat for Red Squirrels in Dublin.

3.5 Field Survey Results

Red Squirrel was recorded throughout the Hell Fire Club and Massy's Estate, while Grey Squirrel was recorded in Massy's Estate only. The survey details and results are presented in Table 3.1 and Table 3.2 below. A map showing the distribution of sightings of live squirrels between November 2016 and September 2019, and, the dreys and feeding signs recorded in 2019 are presented in Appendix D. The drey survey of Massy's Estate and the Hell Fire Club were carried out on 6th April and 24th August, respectively.

Table 3.1 Squirrel activity transect survey details.

Survey No.	Date	Start	End	Site	Weather	Red/ Grey
1	03/04/2019	07:40	10:00	Hell Fire Club	Dry, 3-4ºC 70% cloud, light breeze.	1/0
1	03/04/2019	07:40	09:50	Massy's Estate	Dry, 3-4ºC, 70% cloud, light breeze.	0/0
2	09/04/2019	07:30	09:30	Massy's Estate	Dry, 8ºC, 100% cloud, light breeze.	1/0
2	09/04/2019	07:30	09:30	Hell Fire Club	Dry, 8ºC, 100% cloud, light breeze.	0/0
3	10/04/2019	07:20	09:55	Hell Fire Club	Dry, 6-9ºC, 5% cloud, calm.	0/0
3	10/04/2019	07:20	09:30	Massy's Estate	Dry, 6-9ºC, 5% cloud, calm.	0/1
4	12/04/2019	07:10	09:20	Hell Fire Club	Dry, 5ºC, 50% cloud, light breeze.	0/0
4	12/04/2019	07:10	09:20	Massy's Estate	Dry, 5ºC, 50% cloud, light breeze.	0/0

Table 3.2 Results of the drey survey in Massy's Wood.

Drey Ref.	Description
1	This drey is in a conifer stand close to entrance to Massy's Estate. The drey is on the eastern side of a tree, at 15 m above ground.
2	This drey is in a Beech on the eastern end of Massy's Estate. The tree trunk is 30 cm in diameter. The drey is 8 m high.
3	This drey is in the fork of a Beech tree next to path, at 12 m above ground.
4	This drey is in Beech tree next to first bridge on entering Massy's Estate. It is in a fork of main stem, at 15 m above ground.
5	This drey is in the fork of a Beech tree next to path. The drey is 8 m high.
6	This drey is in a conifer tree near the Miller's Cottage. The drey at 12 m above ground on eastern side.
7	This drey is in a conifer tree near the Miller's Cottage. The drey is in a bend in the trunk, at 9 m high. It is in the same stand of conifers as Drey 6.

Drey Ref.	Description
8	The drey was recorded in 2016 and is in the conifer plantation north of the existing car park in an area that is being retained.

3.6 Local Threats and Pressures

The Red Squirrel population at Hell Fire Club and Massy's Estate is currently subject to a number of threats and pressures. These threats and pressures are described below.

Grey Squirrels

It is likely that Grey Squirrels have colonised Massy's Estate from the northeast, along Glendoo Brook corridor. Grey Squirrels are better adapted than Red Squirrels to utilise the food sources in Massy's Estate, predominantly Beech mast. This reduces the food availability for Red Squirrels, which may in turn reduce the habitat connectivity between the Hell Fire Club and Tibradden. The presence of Grey Squirrels also has the potential to introduce squirrelpox virus to the local Red Squirrel population. Red Squirrel fatalities from squirrelpox have been recorded in Counties Dublin and Wicklow.

Habitat Fragmentation

The Hell Fire Club is owned by Coillte and is a commercial forest. As such, areas that reach a threshold size are routinely clear-felled. This has occurred in recent years on the eastern side of the Hell Fire Club, close to the car park. A small area of conifers has been retained as screening and Red Squirrel has been recorded here. Although it is not of sufficient size to sustain a breeding population of Red Squirrel, it forms part of a patchwork of mature woodland and provides connectivity between the Hell Fire Club and Massy's Estate. Clear-felling results in Red Squirrels having to travel over open or exposed ground to reach other areas of woodland, making them vulnerable to predation from foxes, dogs, Pine Marten and raptors.

Disturbance

The Hell Fire Club and Massy's Estate area is currently used as an amenity for some 100,000 visitors per year. The main activity undertaken is walking. However, the area is also used for cycling and horse-riding. The presence of people and dogs in the area can result in increased disturbance to Red Squirrels.

Road Mortality

Red Squirrels currently have to cross the Old Military Road between the Hell Fire Club and Massy's Estate. There is potential for Red Squirrels to be killed by passing cars, which may result in increased pressure on the population.

3.7 Potential Impacts of the Proposed Development

The impacts potentially arising from the construction and operation of the proposed development on the local Red Squirrel population are described below.

Habitat Loss and Fragmentation

Direct impacts include the loss and conversion of woodland as part of the proposed development. This includes 1.2 ha of the 1.9 ha of mature conifer woodland adjacent to the existing car cark and approximately 4.5 ha at the Hell Fire Club, which will be converted over time to mixed broadleaved woodland. Disturbance during construction and as a result of the increase in the number of visitors will also result in habitat loss

and fragmentation. A total of 25 ha of existing woodland, clear-fell and scrub will be converted or retained as native mixed woodland.

Increased Disturbance

Following the completion of the proposed development, the number of visitors to the site is expected to increase three-fold. This will inevitably lead to increase instances of disturbance.

Direct Mortality

There is the potential for accidental direct mortality of Red Squirrel to occur during tree-felling operations and increased traffic on the Old Military Road.

Increased Presence of Grey Squirrel

The conversion of areas of clear-fell, coniferous woodland and scrub to broadleaved woodland will convey a competitive advantage on Grey Squirrels over Red Squirrels. As explained in Section 3.2, Grey Squirrel competes directly with Red Squirrel for food and poses a risk of the transmission of squirrelpox to the Red Squirrel population. The increased numbers of visitors and the associated availability of food may also lead to an increase in Grey Squirrels.

4. PRINCIPLES AND APPROACH

4.1 Conservation Principles

The overarching aim of this conservation management plan is to maintain and enhance the conservation condition of the Red Squirrel population at the Hell Fire Club and Massy's Estate area. The following subsections describe the general principles which are employed in devising conservation strategies for Red Squirrel.

Woodland Composition

Planting a diverse range of trees and shrubs will ensure a year-round and varied food supply. If the woodland were to be comprised of just one or very few species, there would likely be food shortages at certain times of the year.

The proposed planting and landscape management regime are composed mainly of broadleaved species. While Grey Squirrels enjoy a competitive advantage over Red Squirrels in broadleaved woodland, this type of woodland has a much higher carrying capacity for Red Squirrel. Thus, as long as the population of Grey Squirrel does not increase, the conversion of conifer plantation to broadleaved woodland will provide an opportunity for the Red Squirrel population to increase.

Tree planting at the Hell Fire Club will consist of at least 10% Scots Pine (*Pinus sylvestris*) and shrub planting will include 20% Hazel. In the context of the wider landscape and the Red Squirrel population in South County Dublin, which currently depends on monocultures of conifers that are subject to clear-felling, the shift towards continuous-cover native woodland will be a positive impact in terms of habitat permanence.

Habitat Connectivity

Existing habitats outside the footprint of the proposed development will be retained. This includes 0.7 ha of mature conifers at the existing car park. This will reduce the negative impacts of construction and operation on Red Squirrel. The area of retained mature conifers will act as stepping-stone between the more substantial areas of mature conifers at the Hell Fire Club and Massy's Estate.

Grey Squirrel and Pine Marten

The spread of Grey Squirrel depends on factors such as suitable habitat, habitat connectivity, food availability and survival rates. At present no Grey Squirrel control measures are proposed. Monitoring of Red and Grey Squirrels is proposed for five years post construction, and recommendations will be made following a review each year, which will include Grey Squirrel control, if required.

Pine Marten nest boxes will be erected within the site as an enhancement for this species. Pine Marten have a negative impact on Grey Squirrel density.

5. MITIGATION MEASURES IN THE EIAR

5.1 General Mitigation Measures

The following are mitigation measures which have been incorporated into the design and included during the construction phase for the protection of the environment including red squirrel.

- A Strategic Oversight Group comprised of representatives at Senior Management / Director Level from SDCC and Coillte will be established to provide formal high-level governance in relation to the proposed Dublin Mountains Visitor Centre. This group will meet at least every two months in the initial year following opening of the centre in order to address strategic and governance issues in relation to the DMVC as well as responding to issues arising from the Management Steering Committee. It is proposed that the Strategic Oversight Group will be responsible for carrying out an annual inspection of the site trails. The inspections will be carried out by the DMP and Coillte. The annual inspections will establish the condition of all trails with reference to National Trails Office standards. If necessary, repair works will be specified, and implementation will be supervised by the DMP and Coillte. The trails inspection and specification of works will be informed by the results of the annual ecological surveys, in order that any necessary protection measures for heritage resources are incorporated. This may include temporarily restricting access to areas where erosion is a problem.
- The lighting plan has been designed to minimise impacts on biodiversity. Low-level bollard lighting has been proposed for the path leading from the visitor centre to the car park which will remain on at night long enough for staff to reach the car park safely, then be switched off. The proposed low-level bollard lighting will be designed in accordance with *Bats and Artificial Lighting in the UK*.

5.2 Construction Phase Mitigation Measures

The following are mitigation measures will be applied during the construction phase for the protection of the environment including red squirrel.

- The landscaping plan includes the widespread planting of native Irish species of trees and shrubs. The eastern slopes of the Hell Fire Club will be planted before site clearance so as to enhance the existing habitat. The biodiversity value of the woodlands will be low at first but will improve with time as the trees grow and a diverse field layer becomes established.
- The conversion of the conifer plantations to native woodland will take place after the construction phase and will involve the felling of a maximum of 10% of mature conifers per annum.
- A Construction and Traffic Management Plan (CTMP) shall be developed by the Contractor prior to the commencement of works. This document serves to ensure that the construction of the proposed development does not lead to any unanticipated negative impacts on the environment. It shall be developed in accordance with the description of the Outline CTMP which has been included in.
- An Ecological Clerk of Works (ECoW) shall be appointed by SDCC prior to the commencement of works. It shall be their responsibility to supervise and provide recommendations on the execution of any and all works which have the potential to give rise to negative effects on biodiversity/ecological integrity. The ECoW will have similar previous experience and be a member of the Chartered Institute for Ecology and Environmental Management (CIEEM).

- The Contractor will appoint a Site Environmental Manager (SEM) prior to the commencement of works. This person shall be responsible for carrying out environmental monitoring of the works and ensuring that the mitigation measures proposed in this EIAR (as well as the CTMP) are adhered to.
- The construction envelope associated with the proposed development will be temporarily fenced off at the outset of the construction phase of the project and will avoid the potential for un-necessary loss of habitat outside of the construction footprint.
- Site clearance will take place between October and January which is outside the period when Red Squirrel will be nursing young.
- A pre-construction survey will be undertaken 2-3 weeks prior to construction to ensure that Red Squirrel have not taken up residence within the construction envelope. The survey will cover the footprint of the proposed development and a 50m buffer. Should any dreys be found, the project ecologist will seek direction from the NPWS.
- Mature trees and scrub outside of the footprint of the proposed car park, visitor centre and canopy bridge will be retained. Fencing will be erected around trees which are to be retained and will include the Root Protection Area, as defined by a professionally qualified Arborist. It is recommended than an Arborist be retained as required by the principal contractor to monitor and advise on any works within the RPA of retained trees to ensure successful tree retention and planning compliance. All recommendations contained in the tree survey report will be followed.
- Fallen trees, standing dead trees and stumps outside the footprint of the proposed car park, visitor centre and canopy bridge will be retained as habitat for invertebrates, bryophytes and fungi. Similarly, native trees that are felled to facilitate the proposed development will be moved to areas of the Hell Fire Club where they will provide dead wood habitat.
- The use of artificial lighting on site will be minimised in terms of the area required to be illuminated and the length of time for which any lighting is switched on. Light spillage with be prevented as far as reasonably practicable. Artificial lighting will be shut off at night when not in use or when works cease at the end of the day in order to minimise the effects of light pollution and disturbance to crepuscular and nocturnal species. Security lighting, if required, will be cowled, to prevent light spill outside the compound. The ECoW will ensure that light spill is reduced as much as possible.

5.3 Operational Phase Mitigation Measures

The following are mitigation measures will be applied during the operational phase for the protection of the environment including red squirrel.

- Yearly visual surveys will be carried out as a means to calculate the relative abundance of red and grey squirrels. The results of this will determine whether Grey Squirrel management or Red Squirrel enhancement is required.
- The opening hours of the visitor centre are 8am-8pm from April to September and 9am-5pm from October to March. This will limit the presence of light spill from the visitor centre after dark. For a short period, light spill from the visitor centre will be felt over a small area. However, this will be significantly less after the vegetation matures and during the summer months when the trees are in leaf.
- Information boards will be provided at the proposed visitor centre, in the car park, at the entrance to Massy's Estate and at the southern end of Massy's Estate.

The boards shall be aesthetically pleasing and emotionally engaging to encourage buy-in from visitors. Signage has been demonstrated to effectively manage the negative impacts of recreation on wildlife. Herstine et al. (2006) concluded that signage can be an effective approach for passively managing human behaviour and tourism in natural resource settings. A study from Iceland (Marschall et al., 2017) on the impact of signage on visitor behaviour around seals showed that signage was effective, but in particular, 'teleological' signage which provided an explanation as well as a command was more effective. The information boards will provide information on the ecology of the site and include a request for visitors to remain on the trails and to keep dogs on leads. The signage will include information on red squirrel ecology and notices requesting the public not to feed grey squirrels.

- During the operational phase, the series of improved trails will maintain 'quiet zones' which will reduce the impact of noise and visual disturbance on species such as Red Squirrel and birds.
- The proposed trail improvement and new trails have been designed as Classes 1, 2 and 3 in accordance with the National Trail Office's *Classification and Grading of National Trails* (2008). This will ensure that proposed increase in footfall will not damage the existing paths which could lead to erosion outside this area.
- Tree planting at the Hell Fire Club will consist of at least 10% Scots Pine and shrub planting will include 20% hazel. In the context of the wider landscape and the South Dublin red squirrel population, which currently depends on monocultures of conifers that are subject to clear-felling, a permanent native woodland will be a positive impact. Broadleaved woodland can support a higher population density of red squirrels and provide a year-round food source for the species.
- Two rope bridges will be constructed, one on each side of the canopy bridge. The siting of the bridges will be agreed with the ecologist and the contractor, depending on ground conditions and suitable trees to link the rope bridges to. The rope bridge will be 6.25m above the road level to accommodation traffic and to match the height of the canopy bridge. The use of rope bridges to reduce road fatalities for red squirrels has been widely documented in Europe and is listed as a 'proposed action' in Section 5.3.8 of the All-Ireland Red Squirrel Species Action Plan (NPWS/ EHS, 2008).
- Two artificial dreys will be erected at the Hell Fire Club. The location will be directed by the ECoW. Suggested locations are presented in Appendix D.
- Two pine marten nest boxes will be erected. The locations will be directed by the ECoW. Suggested locations are presented in Appendix D

6. CONSERVATION MANAGEMENT PLAN

6.1 Aim and Objectives

The Aim of this conservation management plan is as follows:

Aim:	*"To maintain and enhance the conservation condition of Red Squirrel at the Hell Fire Club and in Massy's Estate."*

This Aim is supported by the following Objectives, which are based on the principles outlined in Section 4 and the mitigation measures detailed in Section 5:

Objective 1:	*"To mitigate the impacts of the Dublin Mountains Visitor Centre on Red Squirrel."*
Objective 2:	*"To enhance existing and new habitats for Red Squirrel."*
Objective 3:	*"To manage the population of Grey Squirrel."*
Objective 4:	*"To monitor the population of Red Squirrel and Grey Squirrel."*

The purpose of Objective 1 is to minimise and, where possible, eliminate any negative impacts on Red Squirrel arising from the proposed development. The purpose of Objective 2 is to maximise opportunities for Red Squirrel. The purpose of Objective 3 is to counteract any competitive advantages conveyed on Grey Squirrel by Objective 2 and to control the risk of squirrelpox. The purpose of Objective 4 is to provide for the evaluation of outcomes from the implementation of this plan and, thereby, provide the basis and evidence for its adaptation, if necessary.

6.2 Attributes, Targets and Actions

Each of the four Objectives stated in Section 6.1 above is defined by a set of Attributes, each with measurable Targets and specific Actions aimed at meeting those Targets. The Attributes, Targets and Actions for each of the four Objectives are set out in detail in Tables 6.1 to Table 6.4 below.

Table 6.1 Attributes, Targets, Actions and Notes for Objective 1: "*To mitigate the impacts of the Dublin Mountains Visitor Centre on Red Squirrel*".

Attribute	Target	Action	Note
1A Red Squirrel population	1A(1) Red Squirrel or signs of Red Squirrel recorded in the retained conifers in Y1 post construction.	1A(1)(i) A pre-construction survey will be undertaken to check for any new dreys in the construction footprint.	-
		1A(1)(ii) Tree felling during site clearance will be supervised by the ECoW to ensure that any Red Squirrels have left the area before felling commences.	-
1B Habitat connectivity	1B(1) Trees outside the footprint of the proposed development retained.	1B(1)(i) The landscape planting on the eastern slope of the Hell Fire Club will take place before construction.	-
		1B(1)(ii) Habitats outside the footprint of the proposed development will be retained.	-
		1B(1)(iii) The route of the new trails and canopy bridge will be marked out prior to commencement of construction.	To minimise the loss of habitat outside these areas and to retain the maximum number of trees in the woodland below the proposed visitor centre.

Table 6.2 Attributes, Targets, Actions and Notes for Objective 2: "*To enhance existing and new habitats for Red Squirrel*".

Attribute	Target	Action	Note
2A Habitat quality	2A(1) Converted woodlands retaining mature trees.	2A(1)(i) A maximum of 10% of mature conifers will be removed from the woodland per year during the phased conversion.	-
	2A(2) A variety of tree species present.	2A(2)(i) A mix of broadleaved trees and shrubs will be planted. At least 10% of trees will be Scots Pine. At least 20% of shrubs will be Hazel.	To provide a varied and year-round food source.
	2A(3) Two (2 No.) artificial dreys at the Hell Fire Club.	2A(3)(i) Artificial dreys will be erected in suitable locations, to be determined by the ECoW.	See Appendix A for artificial drey specification and Appendix C for suggested locations.
	2A(4) Eradication of invasive plant species.	2A(4)(i) An invasive species management plan will be adopted and implemented.	To eradicate invasive species from the site and promote the regeneration of native woodland.
2B Habitat connectivity	2B(1) Two (2 No.) rope bridges.	2B(1)(i) Two rope bridges will be constructed, one on each side of the canopy bridge.	To improve habitat connectivity.
		2B(1)(ii) The precise locations of rope bridges will be agreed between the ECoW and the Contractor.	Depending on ground conditions and suitable trees to which the rope bridges will link.
		2B(1)(iii) Rope bridges will be 6.25 m above the road level (the same height as the canopy bridge).	To accommodate traffic.
	2B(2) Trees outside the footprint of the proposed development retained.	2B(2)(i) Habitats being retained will be fenced off prior to construction.	To retain as much established woodland as possible.

Table 6.3 Attributes, Targets, Actions and Notes for Objective 3: "*To manage the population of Grey Squirrel*".

Attribute	Target	Action	Note
3A Distribution of Grey Squirrel	3A(1) Grey Squirrel absent from the Hell Fire Club and not increasing in Massy's Estate.	3A(1)(i) If an increase in Grey Squirrel is recorded in Massy's Estate or if Grey Squirrel spreads to the Hell Fire Club, a control program shall will be employed to reduce their numbers.	-
		3A(1)(ii) Signage will be provided at the location of the visitor centre and the entrances to Massy's Estate which will discourage members of the public from feeding Grey Squirrels.	-
3B Pine Marten	3B(1) Pine Marten habitat enhanced.	3B(1)(ii) Two (2 No.) Pine Marten nest boxes shall be placed in Massy's Estate and one at the Hell Fire Club. Pine Marten habitat shall be enhanced through the provision of artificial nesting boxes.	To reduce the Grey Squirrel population through increased predation pressure. See Appendix A for nest box specification and Appendix C for suggested locations.
		3B(1)(ii) Landscape planting using native species and the gradual conversion of the conifer plantation to native mixed broadleaf woodland.	-

Table 6.4 Attributes, Targets, Actions and Notes for Objective 4: "*To monitor the population of Red Squirrel and Grey Squirrel*".

Attribute	Target	Action	Note
6A Red and Grey Squirrel populations	6A(1) Data available for comparative analysis (at least annually) of the Red Squirrel and Grey Squirrel populations.	6A(1)(i) Visual survey transects shall be carried out (at least annually) in Massy's Estate and at the Hell Fire Club.	-
		6A(1)(ii) Public signage shall be erected to encourage reporting of Red Squirrels and Grey Squirrels.	-
		6A(1)(iii) Long-term records shall be made in relation to direct observations or evidence of the presence of Red Squirrels and any instances, either suspected or confirmed, of squirrelpox.	-

6.3 Adaptive Implementation

This conservation management plan is intended to be a live document and shall be reviewed updated annually following monitoring of the Red Squirrel and Grey Squirrel populations at the site. This will facilitate the adaptation of the plan to take into account any changes in the condition of the local Red Squirrel or Grey Squirrel populations, pressures on or threats to Red Squirrels or higher-level policy regarding the protection of this species. Monitoring will begin in Year 1 post-construction and will continue for a minimum of five years.

7. CONCLUSION

Given the full and proper implementation of this conservation management plan (and any subsequent versions hereof), the proposed development will not have a significant negative impact on the Red Squirrel population at the Hell Fire Club and Massy's Estate. Rather, through improved habitat quality, greater habitat continuity (both spatially and temporally) and control of Grey Squirrel, the conservation condition of the local Red Squirrel population will be enhanced and made more resilient.

8. REFERENCES

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Wildlife (Amendment) Act, 2012. *No 29 of 2012.*

APPENDIX A
Transect Routes

Massy's Estate Transect Routes

Legend

- Breeding Bird Transect
- Bat Transect
- Squirrel Transect

N

0 75 150 300 Meters

Montpelier Hill Transect Routes

Legend

- Breeding Bird Transect
- Squirrel Transect
- Montpelier Hill Bat Transect

N

0 75 150 300 Meters

APPENDIX B
Nest Box Specification

Installation of Artificial Dreys

Artificial dreys shall be erected as follows:

- A suitably qualified ecologist, i.e. an Ecological Clerk of Works (ECoW), will direct the installation of artificial dreys;
- Artificial dreys will be installed in suitable areas of Red Squirrel woodland habitat;
- The artificial drey should have dimensions c. 450 mm × 350 mm × 350 mm and should be similar in form to the example shown in Plate 1 below (available from http://www.wildcare.com).

Plate 1. Artificial drey.

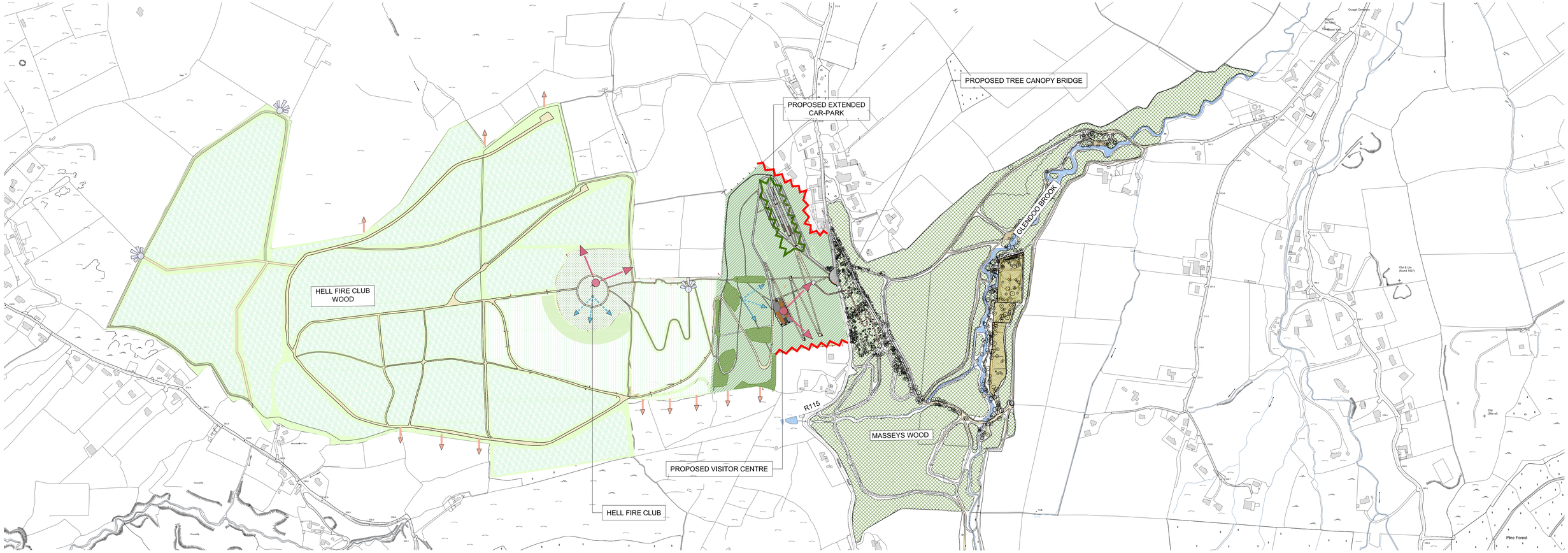
Installation of Artificial Pine Marten Nest Box

Artificial Pine Marten nest boxes shall be erected as follows:

- A suitably qualified ecologist, i.e. an Ecological Clerk of Works (ECoW), will direct the installation of the artificial Pine Marten nest boxes;
- Two artificial Pine Marten nest boxes will be installed in Massy's Estate;
- The specification of the artificial nest box should be similar to the example shown in Plate 2 below (available from http://www.nestbox.co.uk).

Plate 2. Pine Marten Nest Box.

APPENDIX C
Proposed Landscape Plan



KEY:

LANDSCAPE OBJECTIVES

Retained Commercial Forest managed to compliment enhanced amenity role.
E.g:
- Diversification of species
- Continuous cover forestry
- Enhanced ecological functions
- Exemplar forest practices

Phased removal of coniferous woodland and conversion to predominately broad-leaved woodland.

Broad-leaved woodland restoration project. Recreating historic landscape pattern. Restoring old walls, maintaining open views north and east, and integrating new site infrastructure (robust screening and fencing to adjacent residential property)

Protect Residential amenity, retained and enhanced planting to screen development, secure boundary treatment to be provided.

Integrate/screen extended car parking.
- Retain existing mature trees whilst progressing broad-leaved woodland restoration program.
- Introduce new woodland tree and shrub planting between car-park terraces.

Restore / Enhance Remnant Historic Beechwoods

Masseys Wood
- Ongoing and enhanced management of Masseys Wood for amenity and natural conservation purposes.

Walled Garden
- Repair structures and clear overgrowth as required to enhance legibility of garden form in accordance with Conservation Architects Report.

CIRCULATION

(for further details see Trails Strategy)

Pedestrian Trails, where designated Equestrian use

Shared Use Trails - Pedestrian, accommodating vehicles (Coillte and/or Shuttle Bus), where designated Equestrian use

Grassed or Earthern Equestrian Trails

MANAGEMENT OF VIEWS

Panoramas to be maintained/enhanced through the long term management of tree height & spread

Intermittent/framed vistas to be opened up or managed

Localised views to surrounding landscape to be opened up through selective thinning of trees

Developed viewpoint with seating/picnic facilities

NOTE: Restore prominence of Hell Fire Club as landmark feature/silhouette on summit of Montpellier Hill when viewed from city/suburbs and environs.
- Cut back surrounding plantations from intruding on summit profile around Hell Fire Club.

NOTES:
DRAWINGS ISSUED FOR PLANNING PURPOSES ONLY.
LANDSCAPE IS SUBJECT TO APPROVAL OF THE PLANNING AUTHORITY.

REV	DATE	AMENDMENT

CUNNANE STRATTON REYNOLDS
LAND PLANNING & DESIGN

DUBLIN OFFICE
3 MOLESWORTH PLACE DUBLIN 2
TEL 01 661 0419 FAX 01 661 0431
EMAIL info@csrlandplan.ie

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PROJECT: **DUBLIN MOUNTAINS VISITOR CENTRE**	DATE: JUNE 2017
	SCALE: 1:5000 @ A1
DRAWING: **LANDSCAPE STRATEGY**	DRAWN: DM CHECKED: DOL
	DRAWING NO: **16508-2-100**

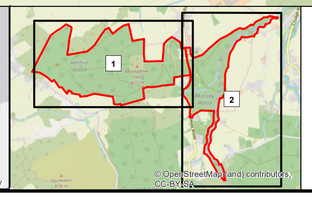
APPENDIX D
Results and Mitigation

N

0 125 250 500 Meters

Legend

- Red Squirrel Sighting
- Grey Squirrel Sighting
- Chewed Cones
- Squirrel Drey
- Pine Marten Sighting
- Pine Marten Scat
- Artificial Dreys
- Pine Marten Nest Box



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DUBLIN MOUNTAINS VISITOR CENTRE

RED SQUIRREL SURVEY RESULTS AND MITIGATION

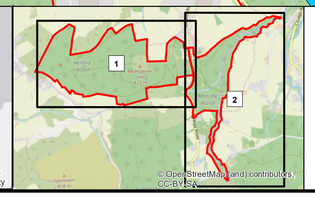
SHEET 1 OF 2

N

0 125 250 500 Meters

Legend

- Red Squirrel Sighting
- Grey Squirrel Sighting
- Chewed Cones
- Squirrel Drey
- Pine Marten Sighting
- Pine Marten Scat
- Artificial Dreys
- Pine Marten Nest Box



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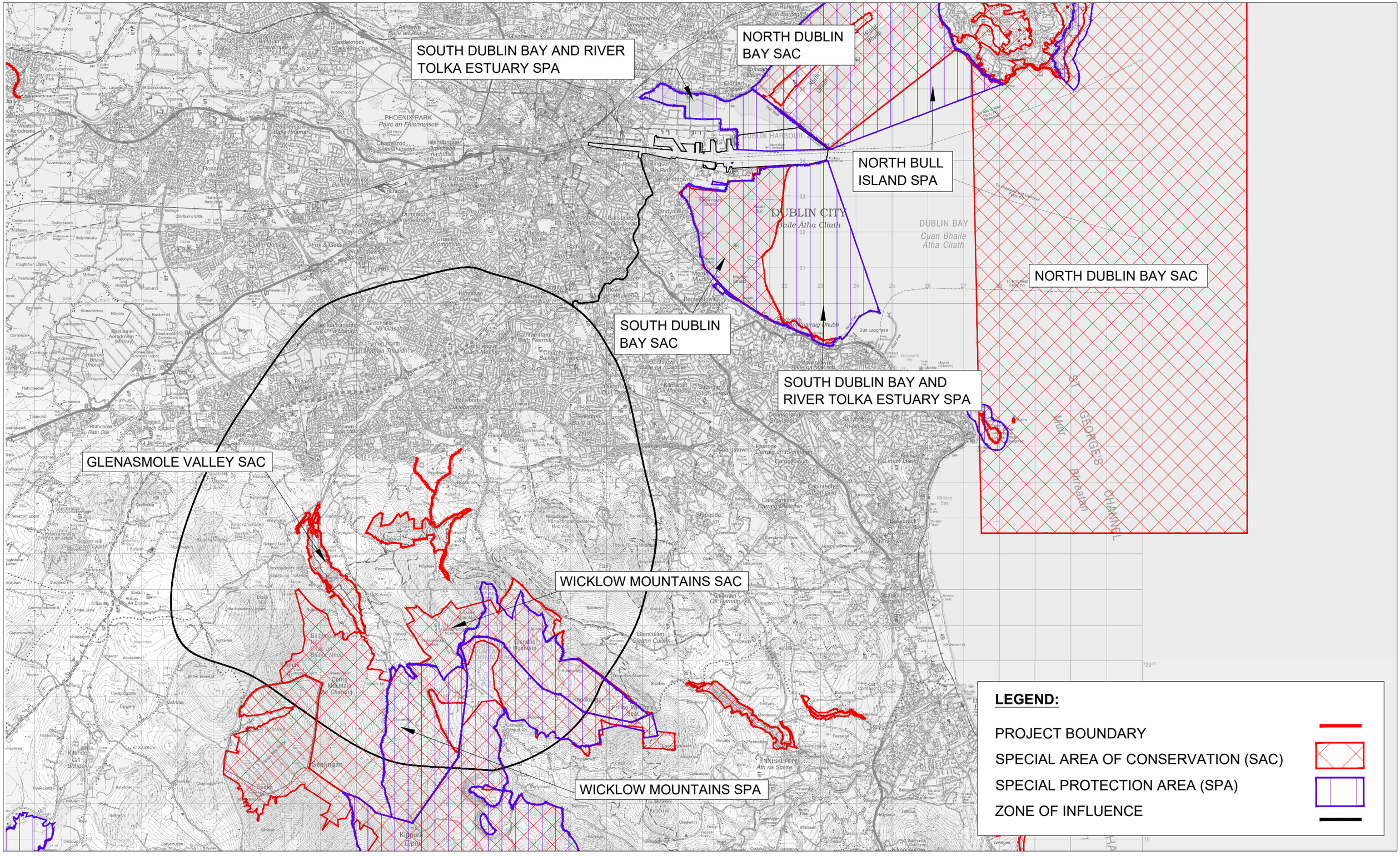
DUBLIN MOUNTAINS VISITOR CENTRE

RED SQUIRREL SURVEY RESULTS AND MITIGATION

SHEET 2 OF 2

Supplementary Appendix S12

Zone of Influence



No.	Revision	Date	By	Chk'd	App'd
	Stage		Date		App'd
	PRELIMINARY				
	APPROVAL				
	TENDER				
	CONSTRUCTION				

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Project Title: DUBLIN MOUNTAIN VISITOR CENTRE

Drawing Title: ZONE OF INFLUENCE

Designed:	Checked:	Approved:	Status:
POS	-	-	FINAL

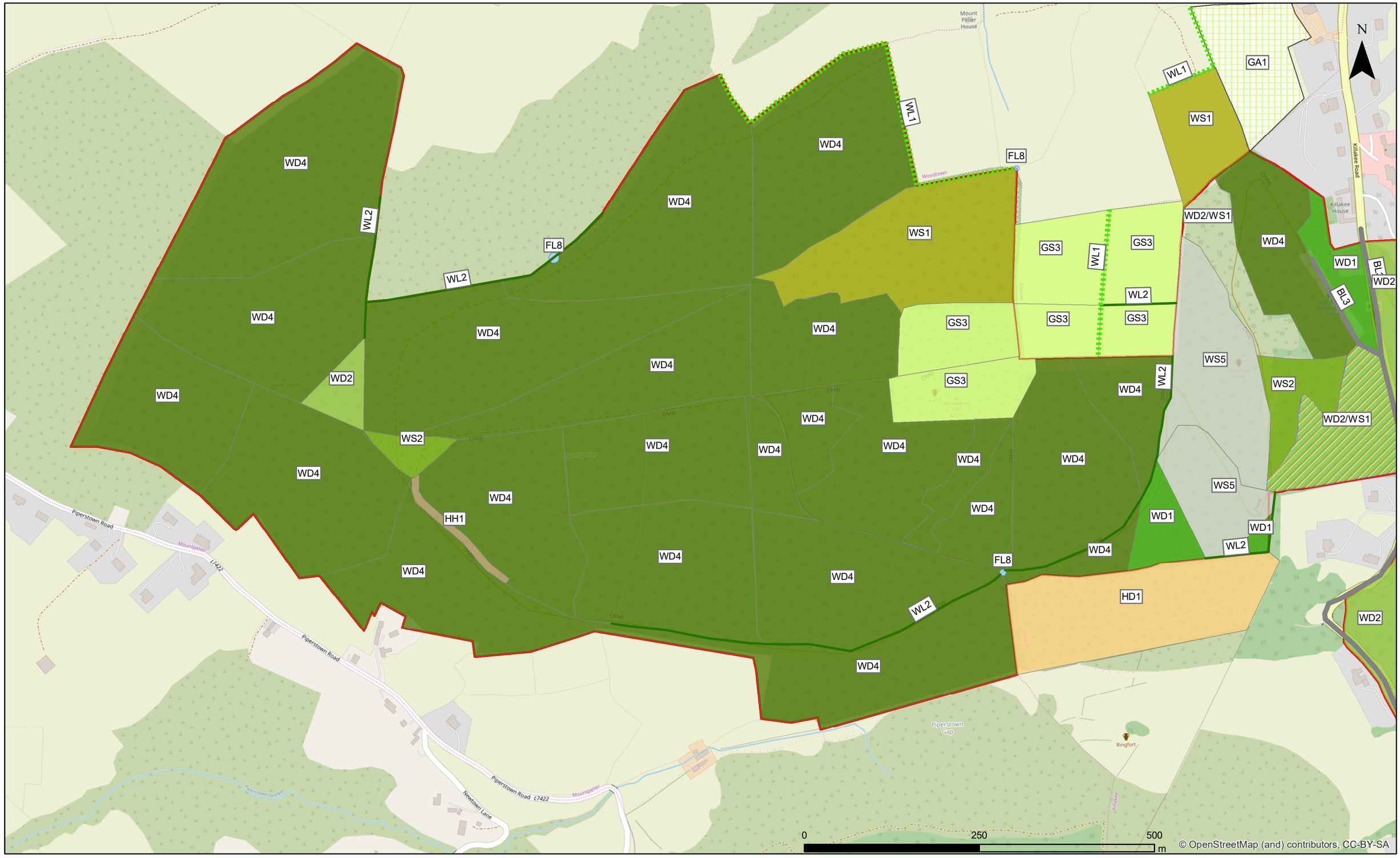
Drawn:	Job No:	Drawing No:	Rev:
AG	15.189.102	15.189.102-SK1	-
Scale: (A1) 1:50'000	Date: OCT 2019		

05 November 2019 10:53:52 \\RODDUBFP1\J\2015\15189\02 DWG\03 PRELIM\DUBLIN MOUNTAINS VISITOR CENTRE - AA SCREENING.DWG

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

Supplementary Appendix S13

Habitat Map

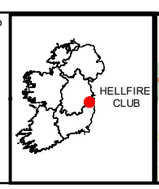


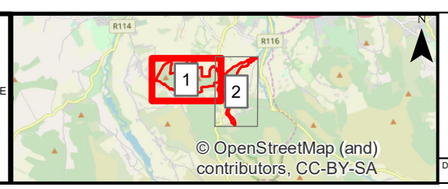
Fossitt Habitat Code Polylines

- BL3, Buildings and artificial surfaces
- FW1, Eroding/upland rivers
- WL1, Hedgerows
- WL2, Treelines

Fossitt Habitat Code Polygons

- FL8, Other artificial lakes and ponds
- GA1, Improved agricultural grassland
- GS3, Dry-humid acid grassland
- HD1, Dense bracken
- HH1, Dry siliceous heath
- WD1, Broadleaved woodland
- WD2, Mixed broadleaved /conifer woodland
- WD2/WS1, Mixed broadleaved /conifer woodland/ Scrub
- WD4, Conifer plantation
- WS1, Scrub
- WS1/WS2, Scrub/Immature woodland
- WS2, Immature woodland
- WS5, Recently-felled woodland





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POS	POS	POS	

Project Title: DUBLIN MOUNTAINS VISITOR CENTRE

Drawing Title: HABITAT MAPPING SHEET 1 OF 2

Drawn:	Job No:	Drawing No:	Rev:
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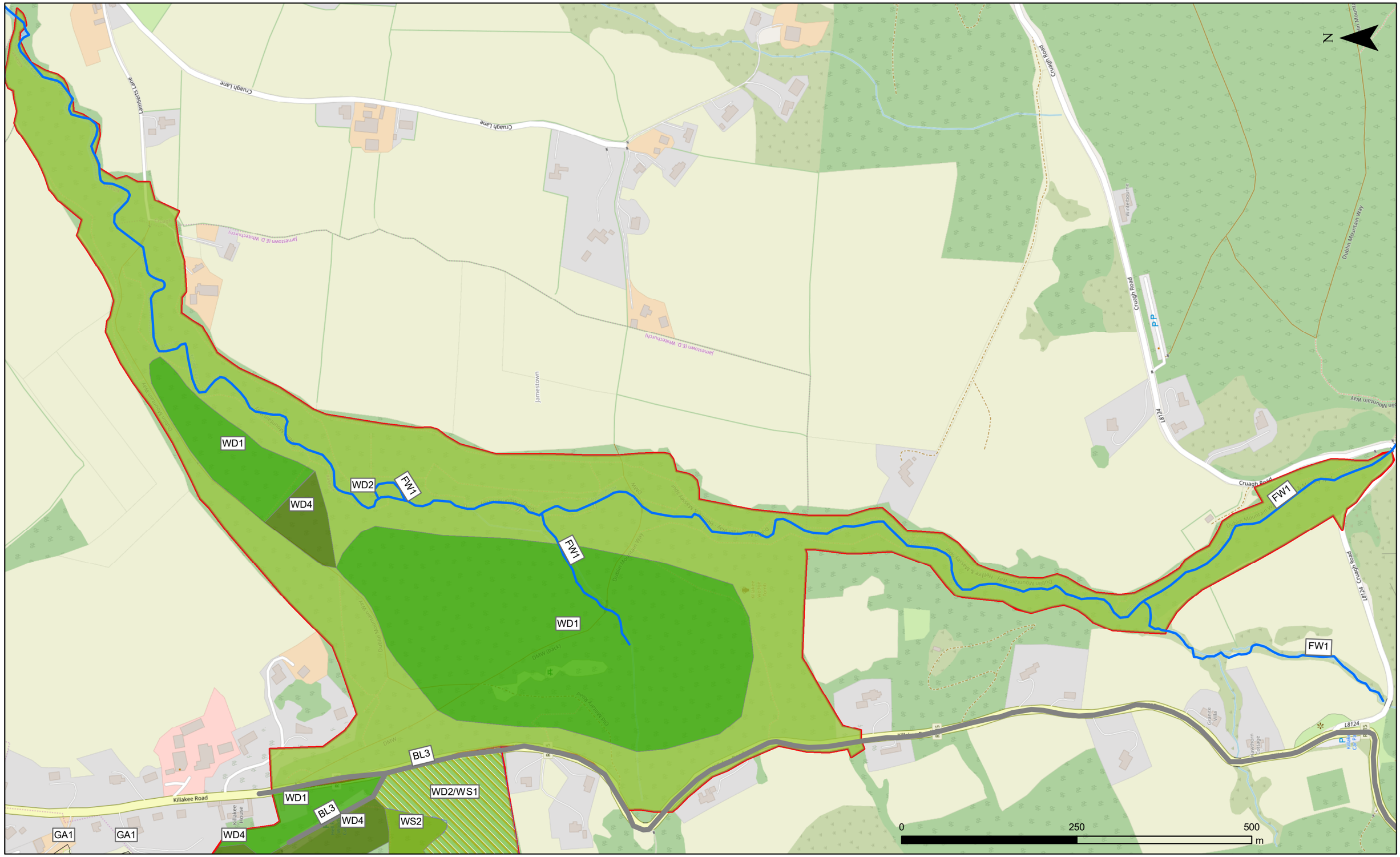
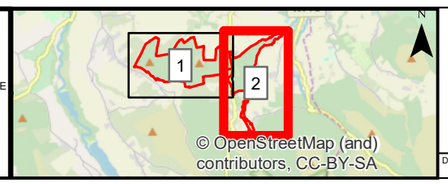


Fossitt Habitat Code Polylines

- BL3, Buildings and artificial surfaces
- FW1, Eroding/upland rivers
- WL1, Hedgerows
- WL2, Treelines

Fossitt Habitat Code Polygons

- FL8, Other artificial lakes and ponds
- GA1, Improved agricultural grassland
- GS3, Dry-humid acid grassland
- HD1, Dense bracken
- HH1, Dry siliceous heath
- WD1, Broadleaved woodland
- WD2, Mixed broadleaved /conifer woodland
- WD2/WS1, Mixed broadleaved /conifer woodland/ Scrub
- WD4, Conifer plantation
- WS1, Scrub
- WS1/WS2, Scrub/Immature woodland
- WS2, Immature woodland
- WS5, Recently-felled woodland



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Project Title: DUBLIN MOUNTAINS VISITOR CENTRE

Drawing Title: HABITAT MAPPING SHEET 2 OF 2

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Chapter 9 Air, Noise and Vibration

Supplementary Information

Chapter 9 Air, Noise and Vibration

Appendices

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DUBLIN MOUNTAIN VISITOR CENTRE

TRAFFIC NOISE IMPACT ASSESSMENT

Technical Report Prepared For

Roughan & O'Donovan
Arena House
Arena Road
Sandyford
Dublin 18

Technical Report Prepared By

Dr Stephen Smyth BA BAI MIEI MIOA

Our Reference

SS/17/9621NR01

Date Of Issue

11 July 2017

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Document History

Document Reference		Original Issue Date	
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Revision Level	Revision Date	Description	Sections Affected

Record of Approval

Details	Written by	Approved by
Signature		
Name	Stephen Smyth	Leo Williams
Title	Principal Acoustic Consultant	Acoustic Technician
Date	11 July 2017	11 July 2017

EXECUTIVE SUMMARY

AWN Consulting have been retained by Roughan & O'Donovan Ltd to assess the potential traffic noise impact of the proposed Dublin Mountain Visitor Centre at the Hell Fire Wood, Killakee, South Dublin.

To determine the noise impact of the scheme a noise survey has been carried out along Killakee Road on a Sunday afternoon to determine the existing noise climate. The future noise impact was then assessed based on the likely change in noise environment as a result of additional traffic along Killakee Road during the peak hour for the development of Sunday afternoon.

It has been found that the change in road traffic volumes on the main access route to the site, via Killakee Road, will not change significantly as a result of the development. Therefore, the change in noise environment during the peak hour period of Sunday afternoon is less than 1dB which is considered to be negligible.

In addition, the existing noise climate along Killakee Road was found to be dominated by road traffic. Therefore, the proposed development and the introduction of small amounts of additional traffic will not alter the existing soundscape in the area.

In conclusion, the proposed development will have a negligible impact on the existing noise environment as a result of additional road traffic. No mitigation is considered necessary.

CONTENTS

1.0 INTRODUCTION

This report, prepared by AWN Consulting deals with the assessment of potential noise impacts associated with additional road traffic as a result of the proposed Dublin Mountain Visitor Centre at Hell Fire Wood, Killakee, South Dublin.

The scheme involves the construction of a new visitors centre and as a result there will be an increase in the existing road traffic in the area.

2.0 ASSESSMENT CRITERIA

In order to provide some context for evaluating the potential impacts of the additional traffic as a result of the proposed development, the UK's *Design Manual for Roads and Bridges* (DMRB) Volume 11, Section 3 provides guidance on assessing the magnitude of impacts associated with changes in road traffic noise. The document suggests that during the year of opening, the magnitude of impacts between the Do Minimum and the Do Something scenarios are likely to be greater compared to the longer term period when people become more habitualised to the source. In order to assess the potential magnitude of impacts during the initial opening of the road therefore, the change in noise levels between the Do Minimum and Do Something scenarios for the year of opening are compared and categorised in line with the 'short term' table reproduced.

Noise Change, dB(A)	Magnitude of Impact
0	No Change
0.1 - 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

Table 1 Classification of Magnitude of Noise Impacts in the Short Term

3.0 EXISTING RECEIVING ENVIRONMENT

An environmental noise survey has been conducted at the site in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996: 2007: *Acoustics – Description, measurement and assessment of environmental noise.* Specific details are set out below.

3.1 Choice of Measurement Locations

Three measurement locations were selected as shown in Figure 1 and described below.

Location N1 is located at the entrance to the Hell Fire Wood carpark.

Location N2 is located along Killakee Road in the vicinity of the closest residences to the Hell Fire Woods.

Location N3 is located along Killakee Road to the north of the Hell Fire Woods.

Figure 1 Noise Monitoring Locations

3.2 Survey Periods

The noise survey was conducted between the following periods:

- 15:20hrs to 16:02hrs on Sunday 25 June 2017.

The measurements were carried out to capture a snapshot of existing noise environment during the period which is expected to correspond to the peak hour period of the proposed development. The weather during the survey periods was dry and clear with winds less than 1m/s and temperatures of some 15ºC.

3.3 Personnel and Instrumentation

Leo Williams (AWN) performed the measurements during the survey periods. Attended measurements were made using an Bruel & Kjaer 2250 Sound Level Meter. Sample periods were 15-minutes for attended noise measurements

Before and after the survey the measurement instrument was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator.

3.4 Measurement Parameters

The noise survey results are presented in terms of the following parameters.

L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.

L_{A10} is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

L_{AFmax} is the instantaneous maximum sound level measured during the sample period using the 'F' time weighting.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

3.5 Survey Results

The results of the surveys at the three monitoring locations are presented in Table 2 below.

Location	Time	Measured Noise levels (dB re. $2x10^{-5}$ Pa)				
		L_{Aeq}	L_{AFmax}	L_{AFmin}	L_{AF10}	L_{AF90}
N1	15:20 – 15:30hrs	60	79	35	63	40
N2	15:32 – 15:47hrs	67	94	35	69	41
N3	15:47 – 16:02hrs	63	81	42	66	45

Table 2 Noise Survey Results

Noise levels were dominated by road traffic movements along Killakee Road.

4.0 ASSESSMENT OF TRAFFIC NOISE

A traffic impact assessment relating to the proposed development has been prepared by Roughan & O'Donovan as part of this application. Information from this report has been used to determine the predicted change in noise levels along Killakee Road, for the opening year of the development.

For the purposes of assessing potential noise impact, it is appropriate to consider the relative increase in noise level associated with traffic movements on the existing road network. Traffic flow data for the peak hour period, which is determined to be mid-afternoon on a Sunday, have been assessed and the calculated change in noise levels during this period is summarised in Table 3. The predicted increase in noise level has been calculated in accordance with the approach outlined in the Calculation of Road Traffic Noise (CRTN) which is the preferred calculation methodology for assessing road traffic noise in Ireland.

Road	Opening Year Peak Hour		Change in Noise Level dB (A)
	Without Development	With Development	
Killakee Road	244	300	+0.9

Table 3 Change in Traffic Noise Levels During Peak Hour with Proposed Development

Making reference to the predicted change in traffic noise level in Table 3 and comparing it to the table of significance effects from Table 1, it can be seen that the proposed development is expected to have a negligible impact on the noise environment.

In summary, the future traffic volumes associated with the development are not expected to increase the existing noise levels by any noticeable amount. Furthermore, given that the existing noise climate along Killakee Road is dominated by road traffic movements the proposed development will not alter the existing soundscape.

5.0 CONCLUSIONS

The proposed Dublin Mountain Visitor Centre at Hell Fire Woods, Killakee, South County Dublin has been assessed to determine the potential for increased road traffic to the development to generate a noise impact.

It has been found that the change in road traffic volumes on the main access route to the site, via Killakee Road, will not change significantly as a result of the development. The predicted change in the noise environment during the peak hour period of Sunday afternoon is less than 1dB which is considered to be negligible. Therefore, the proposed development and the introduction of small amounts of additional traffic will not alter the existing soundscape in the area.

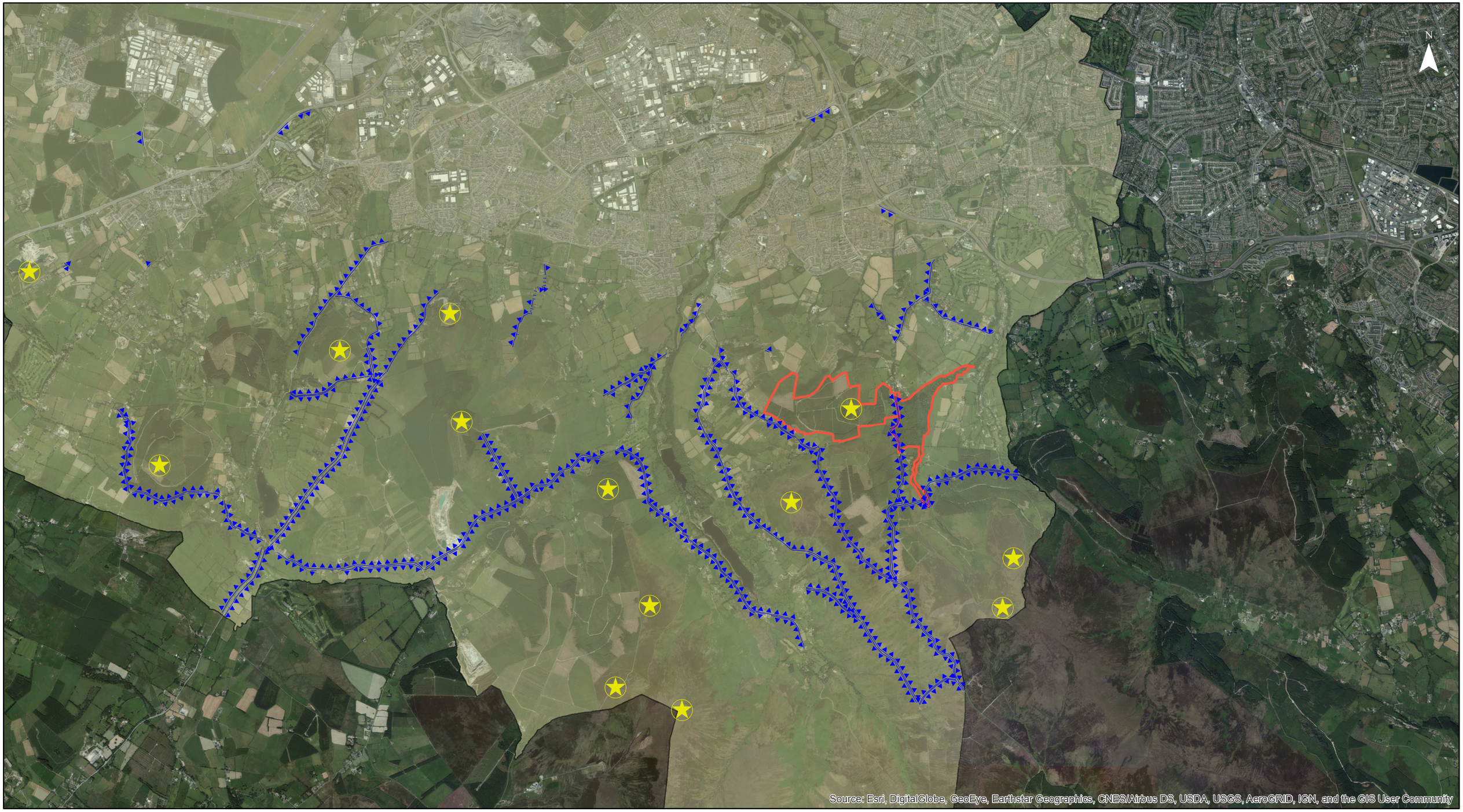
In conclusion, the proposed development will have a negligible impact on the existing noise environment as a result of additional road traffic. No mitigation is considered necessary.

Chapter 10 LVIA

Supplementary Information

Chapter 10 LVIA

Maps



Views and Prospects

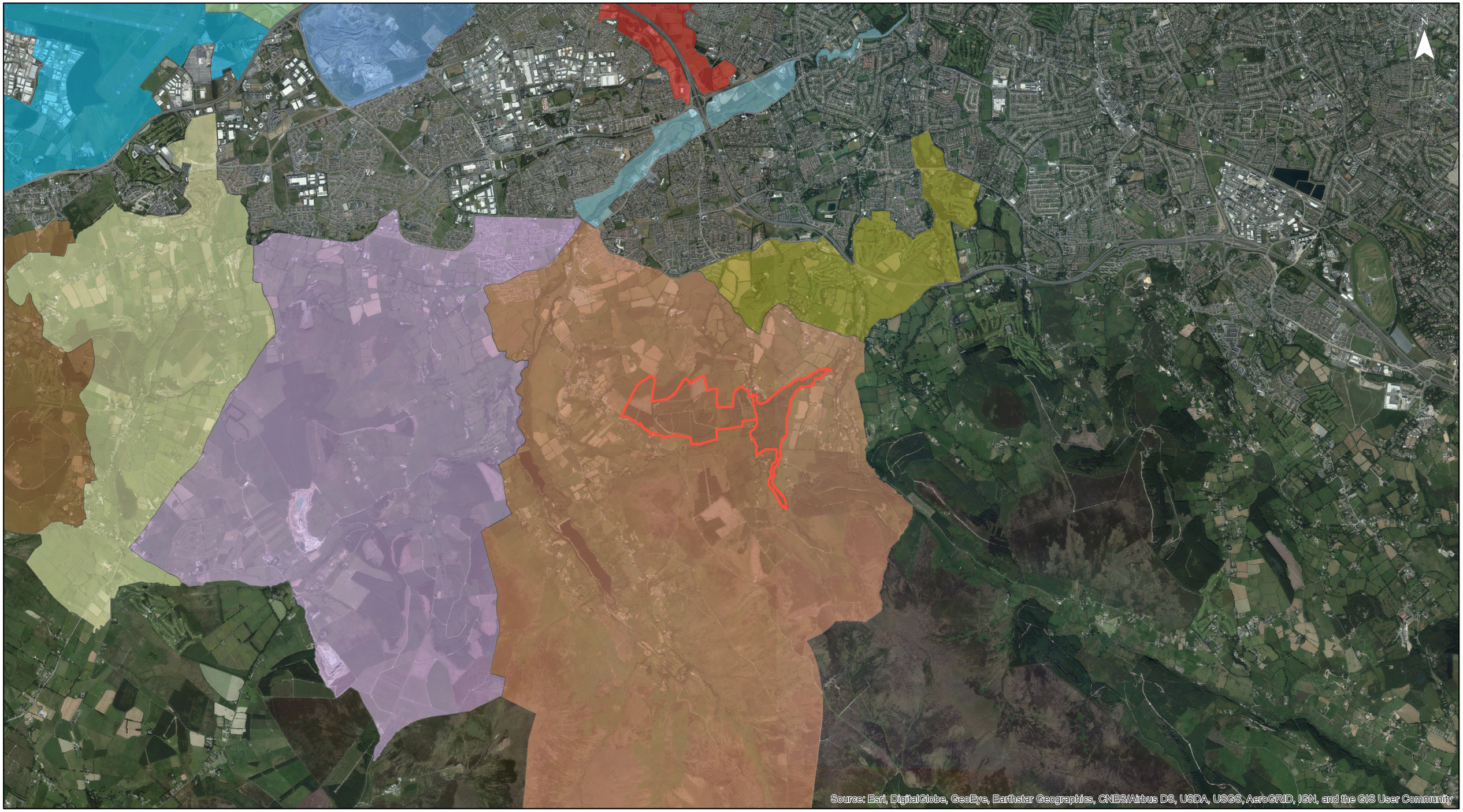
- To preserve Prospects
- Protect and Preserve Significant Views
- SDCC_CountyBoundary_ITM
- Site
- World Imagery
- Citations

0 0.250.5 1 1.5 2 Kilometers

CUNNANE STRATTON REYNOLDS
LAND PLANNING & DESIGN

Dublin Office
3 Molesworth Place
Tel: 01 6610419
Email: info@csrlandplan.ie

Project:	Date:	June 2017
The Dublin Mountains Project Hell Fire Club & Massy's Wood South Dublin	Scale:	1:50,000 @A3
	Drawn:	CL
	Checked:	RB
Drawing: Views and Prospects	Drawing No:	Map 10.1



Legend

Landscape Character Areas

Name

- Ballinascorney
- Bohernabreena
- Clondalkin
- Dodder Valley
- Firhouse
- Liffey Valley
- Lucan
- Newcastle
- Rathcoole
- Saggart
- Tallaght
- Tymon
- Site

0 0.25 0.5 1 1.5 2 Kilometers

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Project:	Date:	June 2017
The Dublin Mountains Project Hell Fire Club & Massy's Wood South Dublin	Scale:	1:50,000 @A3
	Drawn:	CL
	Checked:	RB
Drawing: Landscape Character Areas	Drawing No:	Map 10.2

SPA's, SAC's, pNHA's, NHA's

- Special Areas of Conservation
- Special Protection Areas
- Proposed Natural Heritage Areas
- Site

0 0.25 0.5 1 1.5 2 Kilometers

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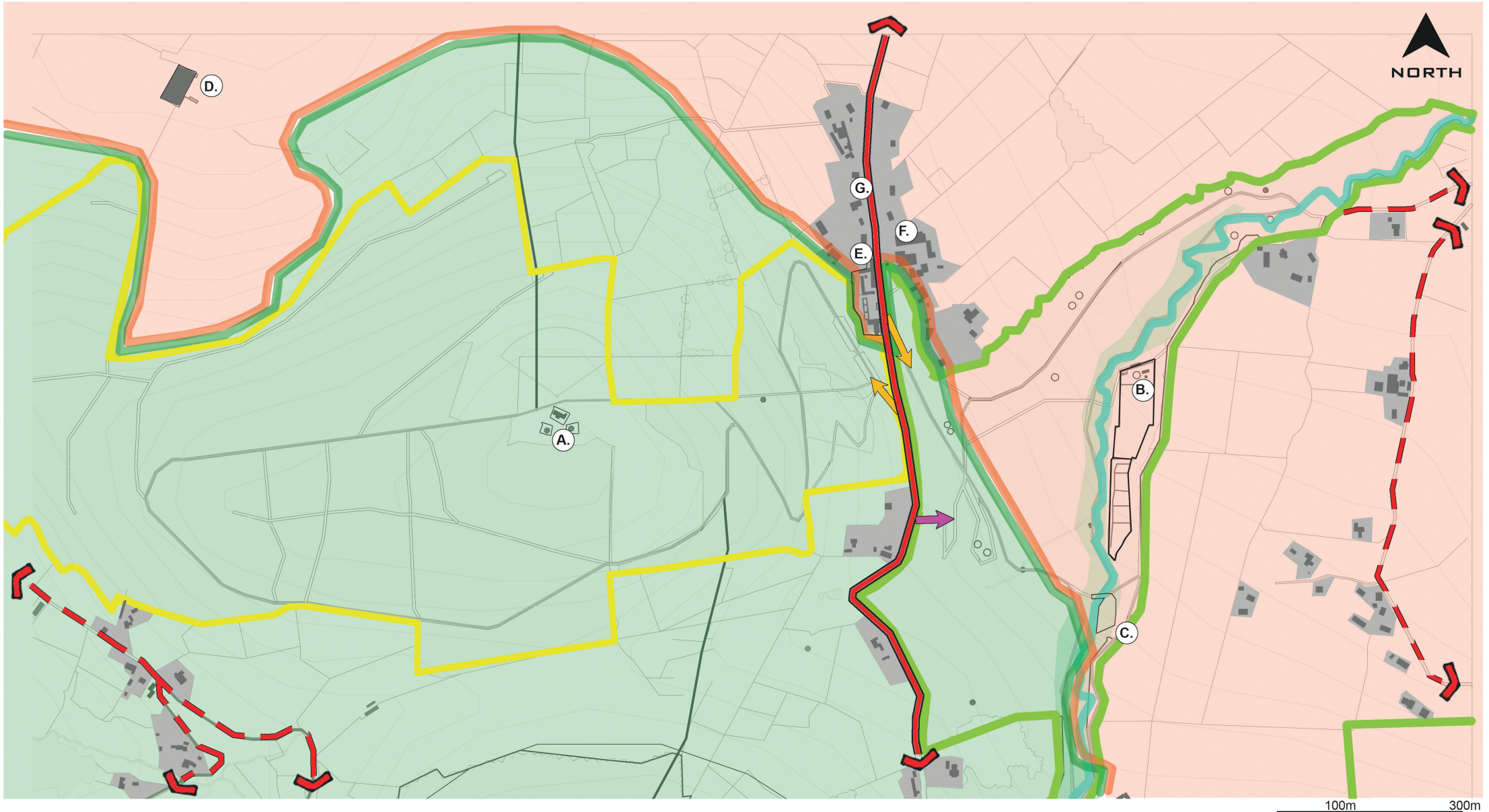
LAND PLANNING & DESIGN
Dublin Office
3 Molesworth Place
Tel: 01 6610419
Email: info@csrlandplan.ie

Project:	Date:	June 2017
The Dublin Mountains Project Hell Fire Club & Massy's Wood South Dublin	Scale:	1:50,000 @A3
	Drawn:	CL
	Checked:	RB
Drawing: SPAs, SACs, NHAs and pNHAs	Drawing No:	Map 10.2

Chapter 10 LVIA

Appendices

Figure 1 - Land Use/ Zoning & Access



Legend:

- Zone HA - Dublin Mountains Zone
- Zone RU - Rural Amenity & Agriculture
- Forestry/ Coillte - Hell Fire Club Wood
- Forestry/ Coillte - Massy's Wood
- Main Road
- Local Access
- River
- Houses/Settlements
- Vehiclular & Pedestrian Access
- Pedestrian Access

Key Heritage/Landscape Features & Points of Interest:

A- HFC
B- Walled Garden
C- Ruined Cottage, Bridge & Waterwheel
D- Carthy's Castle
E- Stweards House
F- Timbertrove Cafe
G- Montpellier Farm

Figure 2 - Trails, Forest Roads & Open Areas

Legend:

- Forestry/ Coillte - Hell Fire Club Wood
- Forestry/ Coillte - Massey's Wood
- Main Road
- Local Access
- River
- Forestry Road Trails ✱
- Rough Tracks & Other Trails -Maintenance, Desire Lines, Walks ✱
- Open Areas -Grass or Less Tree Cover
- Steep Direct Route to HFC
- Arrival, Parking & Access

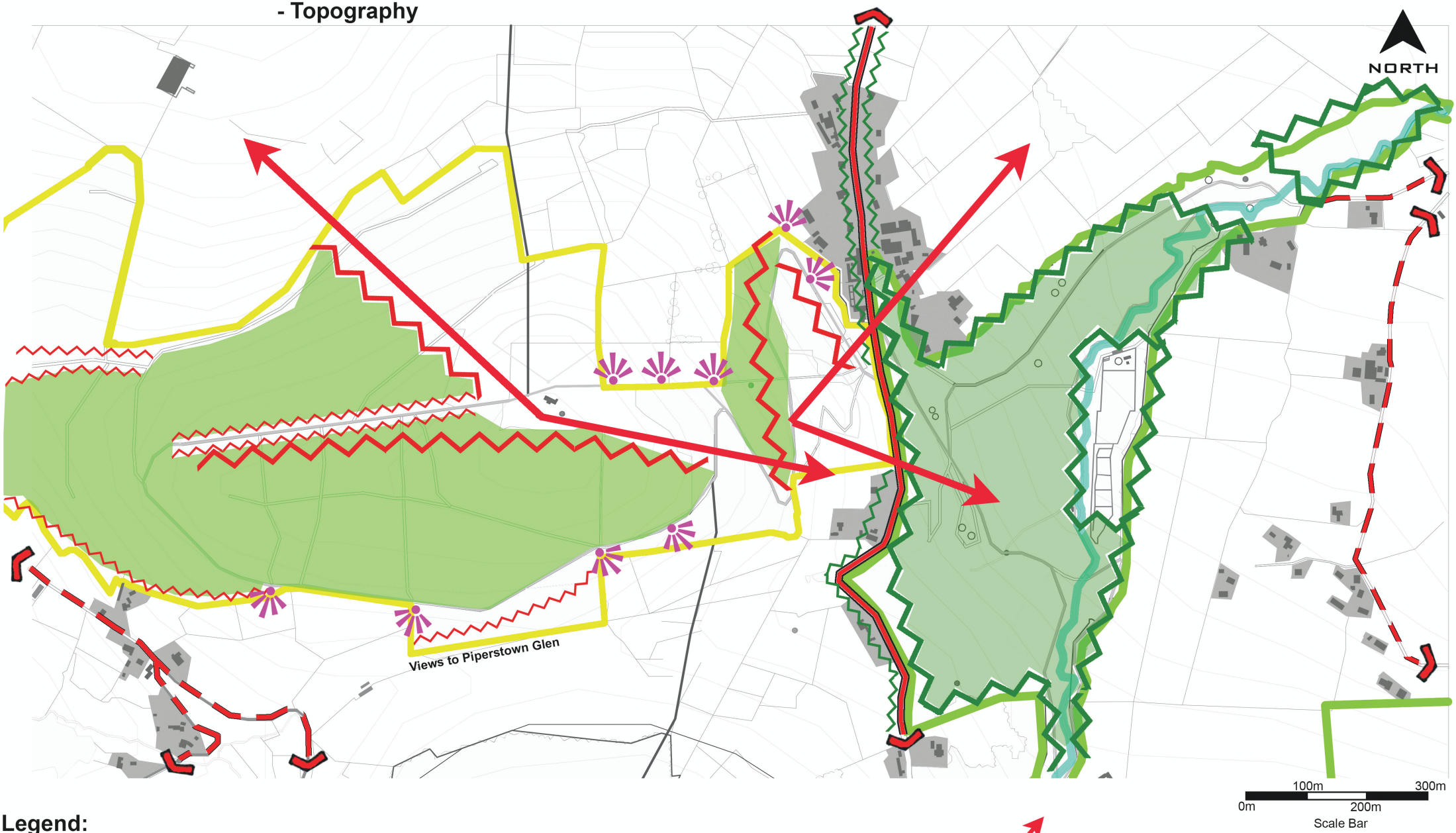
✱ All routes have been audited regarding current usage & compliance with Trails Standards & improvements & new routes proposed

Figure 3 - Vegetation & Forestry

Legend:

- Forestry/ Coillte - Hell Fire Club Wood
- Forestry/ Coillte - Massey's Wood
- Main Road
- Local Access
- River
- Recently clear felled areas with historic beech trees remaining
- Conifer Plots for Thinning 2015-2019
- Overmature Conifer Trees which will need to be felled in the coming years.
- Young/ Immature Conifer Plantations
- Regenerating/ Replanted Youngs Trees & Vegetation
- Mixed Native Trees Adjacent to Carpark
- Beech Wood to be Thinned in 2015
- Predominantly Mature Broadleafed Woodland with some Conifers/ Specimens
- Open/ Partially Open Grassed Areas

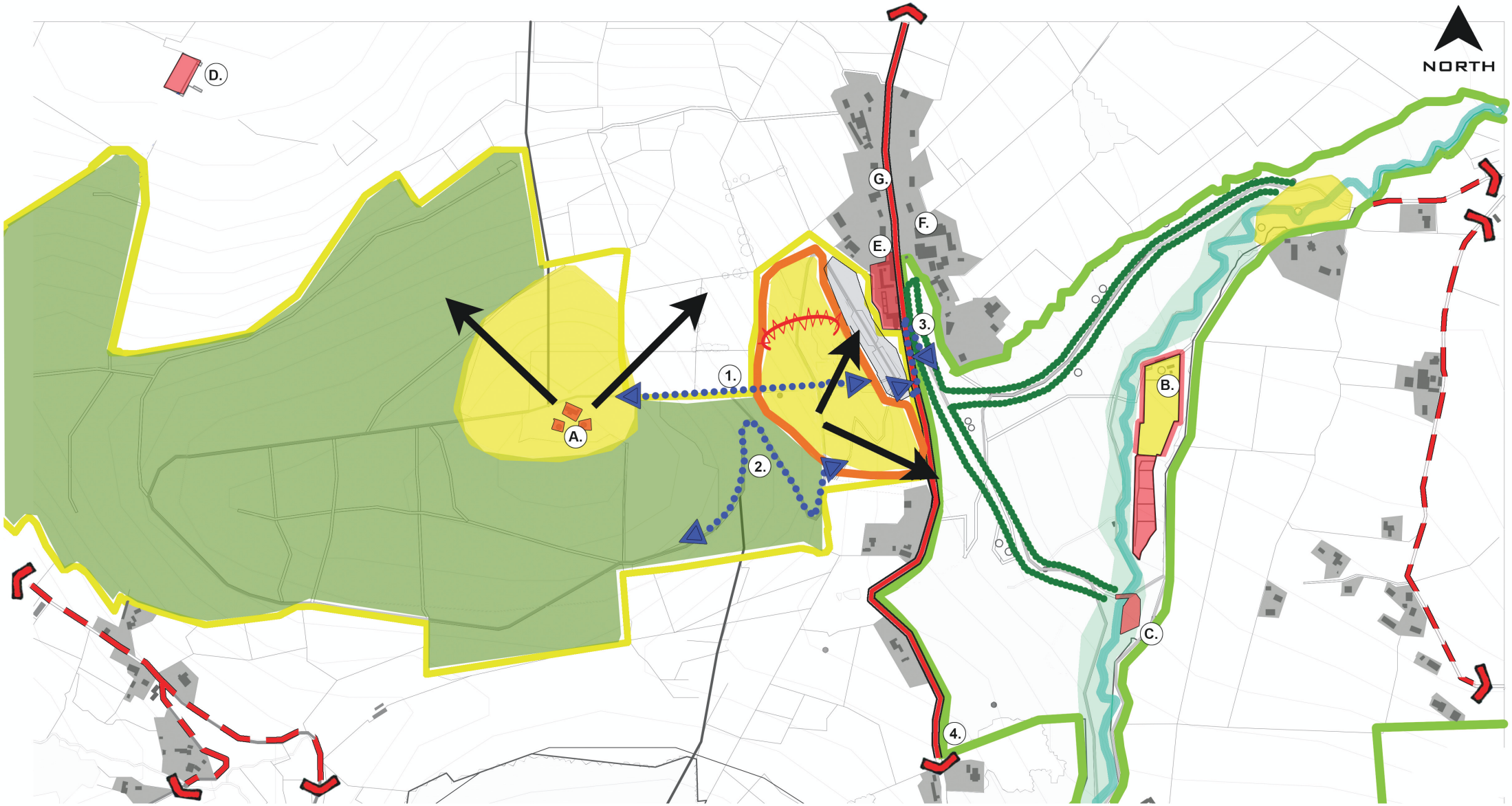
Figure 4 - Visual Analysis: Views, Visual Barriers, Enclosure - Topography



Legend:

- Forestry/ Coillte - Hell Fire Club Wood
- Forestry/ Coillte - Massey's Wood
- Main Road
- Local Access
- River
- Continuous Cover Conifer Forestry - Dark, Enclosed/ Sheltered, Very Limited Views
- Continuous Cover Woodland - Shady, Enclosed and Limited Views
- Visual Barriers -Broadleaved Trees & Vegetation
- Visual Barriers -Conifierous Trees
- Local/Partial Views & Vistas
- Citywide Panoramic Views & Vistas

Figure 5 - Synthesis: Spaces, Places & Features



Legend:

- Hell Fire Club Wood - A Forested Hill
- Massey's Wood - Magical Broadleafed Woodland
- Main Vehicular Access to City & Mountains
- Local Access
- River
- Arrival, Parking & Access
- Woodland Draw/ Ride (including Military Rd)
- Key Links:
  1. Direct Steep Route to HFC.
  2. Main Forest Road connection to HFC & Hill/Forest.
  3. Current Link between HFC & Masseys Wood along R115.
- 4. Link to Cruagh and D.M.W
- Key Panoramic Views
- Potential Future Visual Conflict
- Introductory Area/ Gateway to HFC Site - Potential Future Amenity Area following felling of Forest Plots
- Key Heritage/Landscape Features & Points of Interest:
  - A- HFC
  - B- Walled Garden
  - C- Ruined Cottage, Bridge & Waterwheel
  - D- Carthy's Castle
  - E- Stweards House
  - F- Timbertrove
  - G- Montpellier Farm

ZTV & Visual Prominence
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VISITOR CENTRE

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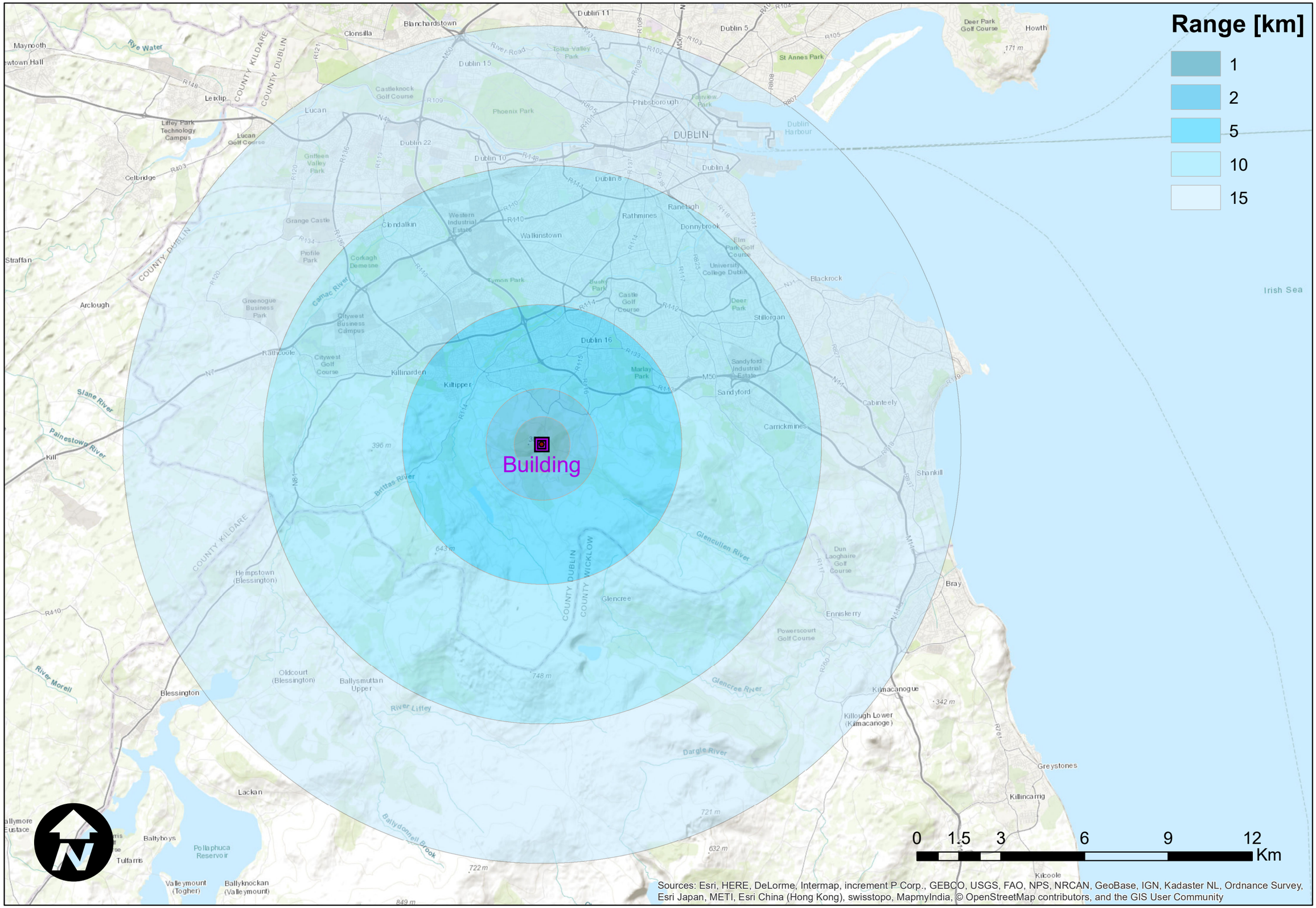
Contents

Buffer Ranges



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Visual Prominence

When choosing the extent of a proposal's impact analysis it should be noted that the degree of visual prominence reduces as the distance from the proposed development increases. Also the larger (horizontal and vertical) the development the greater the area which needs to be evaluated since it may be visually apparent from a greater distance.

As a viewer moves away from the proposed development the visual impact reduces until it is no longer visible. However, well before this point is reached the impact on the viewer's field of view will reduce so that it no longer impacts on a significant amount of the same and thus will no longer have a significant visual impact.

The LVIA specialist will also incorporate additional considerations into the requirements for the scale of the assessment including items such the receiving environment, possible landscape mitigation factors and impact on skyline.

Horizontal & Vertical Fields of View

The visual impact may be quantified by calculating the angular arc impacted by the proposed development at a number of buffer ranges around the development.

The development consists of two buildings we have used their total width of 103.5m for these computations. No allowance is made for the reduction in visible facade when the building is skewed to the viewers perspective. For vertical height the rear building is higher so we have used this max height. For the purposes of this analysis we have elected to examine 1, 2, 5, 10 & 15km bands.

The results of these computations are shown below.

HORIZONTAL			VERTICAL		
Max Building length	**103.5**	m	Max Building Vertical	**7.25**	m
Binocular view angle	**120**	degs	Vertical view angle	**130**	degs

Dist	**View impact**		**Dist**	**View impact**	
[km]	***[degs]***		***[km]***	***[degs]***	
1	5.9		1	0.4	
2	3.0		2	0.2	
5	1.2		5	0.1	
10	0.6		10	0.0	
15	0.4		15	0.0	

This is also presented visually here showing the development as a lone entity at the same range bands in standard photomontage 50mm lens which on a full frame camera has a horizontal field of view of 40° and vertical 27°.

Based on these values and input from the LVIA specialist the assessment is that the proposal only has a visual prominence up to 10km buffer range and thus we have limited our analysis to this.

1km buffer range

2km buffer range

5km buffer range

10km buffer range

15km buffer range

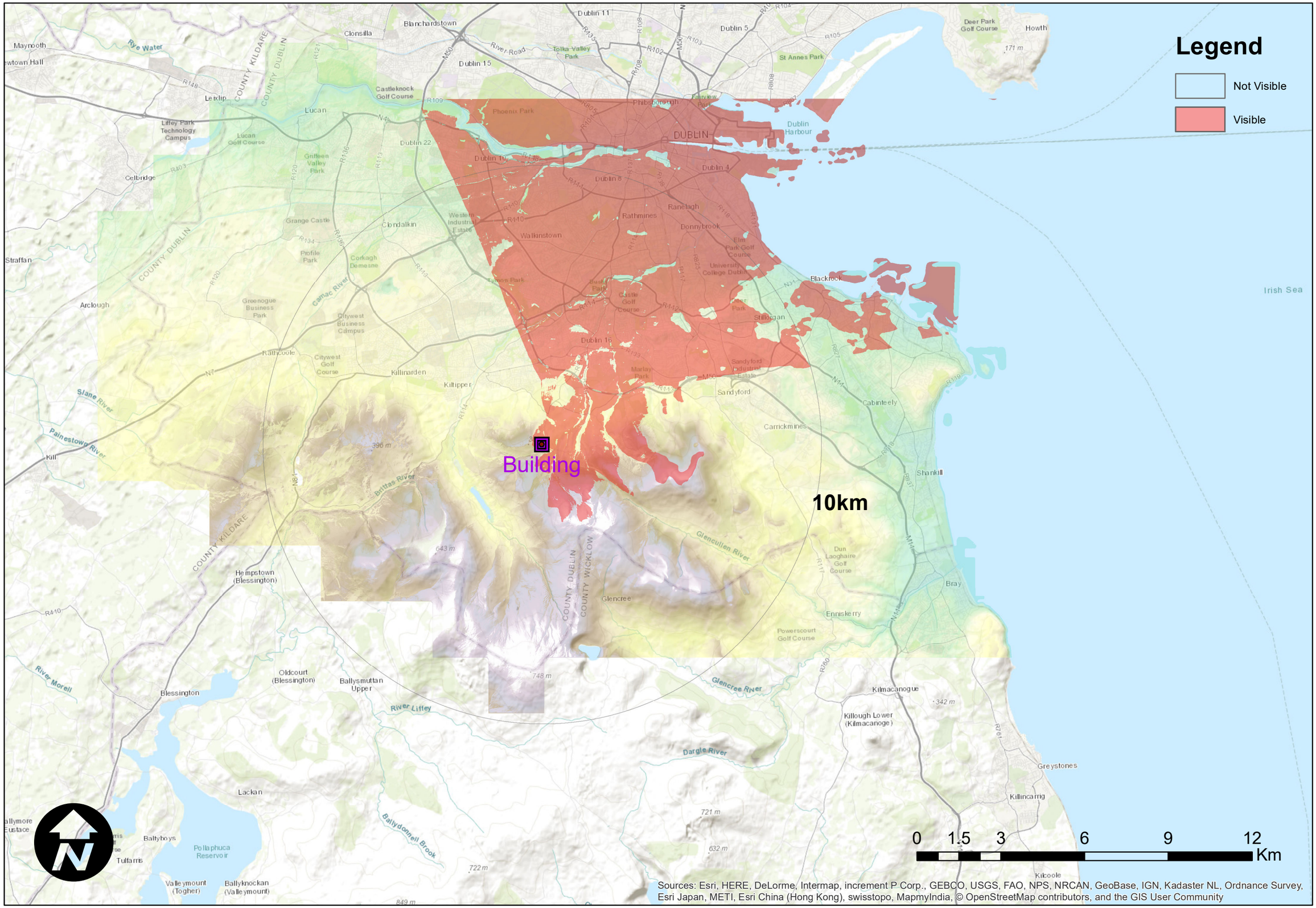
Zone of Theoretical Visibility

Zone of Theoretical Visibility (ZTV), or Zone of Visual Influence (ZVI), is a computer-generated analysis which identifies the extent of visibility of a development based on an elevation model. The results are not intended to show the actual visibility of an object, they are an aid to show where the proposal **may** be visible from. Conversely, however, areas where the analysis shows no visibility need not be checked further.

For this project the elevation model has come from Ordnance Survey Ireland and is a combination of both their 2m and 10m LiDAR grid surveys. This dataset is a bare-earth model which means it does not include trees, hedges, building, etc. and is thus a worst case scenario.

ZVT as a theoretical process and should be considered as a baseline since it does not take account of the ameliorating effects of distance in reducing the impact of a proposed development. However, used in conjunction with site surveys, photomontages and a visual prominence analysis it does provide the LVIA specialist with quantitative data for their assessment.

Zone of Theoretical Visibility



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Chapter 11-12 Archaeological, Architectural and Cultural Heritage

Supplementary Information

Chapter 11-12 Archaeological, Architectural and Cultural Heritage

Appendices

15E0101
PRELIMINARY TESTING REPORT

The Hell-Fire Archaeology Project
Testing Phase
15E0101
Montpelier Townland
County Dublin
Author/Excavation Licence Holder: Neil Jackman
29/05/2015

An Chomhairle Oidhreachta
The Heritage Council

Comhairle Contae
Átha Cliath Theas
South Dublin County Council

coillte

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ACKNOWLEDGEMENTS

This report was compiled by Neil Jackman, a licensed and published archaeologist and Managing Director of Travel Guides Limited (Abarta Audioguides). The report and geophysical survey was funded by The Heritage Council, South Dublin County Council and assisted by Coillte. This project is an action of the South Dublin County Heritage Plan 2010 – 2015.

The author of this report is very grateful to The Heritage Council for all their assistance, Earthsound Archaeological Geophysics and their team; Heather Gimson, James Bonsall, Darren Regan and volunteers Christine Melia and Joseph Culley. I am also deeply grateful to Christiaan Corlett & Tom Condit (National Monuments), Dr. Andy Halpin (National Museum), Dr. Steven Davis (UCD), Jesper Peterson (Coillte), and especially Dr Rosaleen Dwyer and Neil O'Byrne of South Dublin County Council for all their help and enthusiasm throughout this project.

I am also grateful to the superb excavation crew, Dr. Louise Nugent, William O'Shea, Lynda McCormack and Niall Garahy with excavation supervisor Róisín Burke. I also thank all the locals and visitors who showed great interest and enthusiasm throughout the dig.

SUMMARY

This report details the preliminary results of the archaeological test-trenching carried out under licence 15E0101 in Montpelier Townland in South County Dublin. This excavation was undertaken as part of the Hell-Fire Archaeology Project, which aims to highlight the archaeological landscape of Montpelier Hill, and is specifically focused on investigating the nature of the possible passage-tombs designated DU025-001001 & DU025-001002 and obtaining a better understanding of both the physical remains of the 18th Century Hunting Lodge known as the Hell-Fire Club, and a better historical insight into the group that made the site so notorious.

This hand-excavated testing phase carried out under licence 15E0101 was conducted to assess (or ground-truth) the results of the geophysical survey (carried out under licence 14R0033 by Dr. James Bonsall of Earthsound Archaeological Geophysics). Four test-pits, each measuring 2m x 2m, were targeted at specific features of archaeological potential revealed by the geophysics. The test-excavation revealed that features identified by geophysics in three of the four trenches (Trenches 1, 3 and 4) proved to be of no archaeological significance. Trench 2 revealed a possible outer berm (an enclosing element) for passage tomb DU025-001001. A feature of potentially high significance.

Following excavation, all trenches were carefully backfilled. All the archive resides in the offices of Travel Guides Ltd in Clonmel, County Tipperary. Post-excavation work and specialist analyses are currently ongoing and these will culminate to produce a final report within one year.

CONTENTS

LIST OF FIGURES

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1. INTRODUCTION & PROJECT BACKGROUND

The Hell-Fire Archaeology Project is aimed at investigating the nature of the possible passage-tombs designated DU025-001001 & DU025-001002 and obtaining a better understanding of both the physical remains of the 18th Century Hunting Lodge known as the Hell-Fire Club, and a better historical insight into the group that made the site so notorious. This test excavation carried out under licence 15E0101 took place over five days, from the 20/04/2015 – 24/04/2015.

The tombs of Montpelier Hill form part of a major cluster of megalithic tombs in the Dublin and North Wicklow mountains. In this region, eleven passage-tombs have been identified. They possibly form an extended cemetery, all are in prominent locations with extensive vistas over the landscape. The tomb at the Hell-Fire Club is one of the largest of the series. It stands on the summit of Montpelier Hill in South County Dublin. The tomb was said to have been largely destroyed when William Connolly constructed a hunting lodge (now known as the Hell-Fire Club) on the site (please see Plates 1 & 2). Stones from the tomb were said to have been incorporated into the fabric of the building. The remains now appear as a low mound with a possible circular stone kerb, with a diameter of approximately 26m. There are no visible above-ground traces of the stone cairn that is likely to have once covered the tomb (please see Plate 3). A second possible tomb has been identified, though smaller in size, located to the east (DU025-001002) though no visible remains survive today.

The Hell-Fire Archaeology Project aims to identify, examine and interpret the archaeological remains at the site, as part of a collaborative multi-disciplinary community outreach project involving a number of bodies and groups in a four phased approach.

Phase 1 (**Completed**)

Phase 1 was an investigation of the site using non-intrusive methods, primarily a desk-based assessment by the author, a LiDAR survey by Dr. Steve Davis of University College Dublin and a thorough geophysical survey by Dr. James Bonsall of Earthsound Archaeological Geophysics.

Phase 2 (**Completed**)

The ground work of Phase 2 is now completed and detailed in this report, saw a series of small hand-excavated test trenches to assess anomalies and features of archaeological potential identified during Phase 1. This was carried out by the author under excavation licence 15E0101.

Phase 3

The third phase will be a community-involved project involving experienced and professionally qualified archaeologists and students from an appropriate schools in the immediate area to conduct further trenches at the site to evaluate the archaeology.

Phase 4

The final phase will be the post-excavation analysis of any materials recovered during Phase 2 & 3, and will again involve community groups who will see and take part in the whole process of archaeological excavations from the research stage to the post-excavation stage. This phase will be focused on dissemination of the results, to ensure that the nature of the archaeology and the story of the site is produced in publication and easy to access formats.

2. SITE DESCRIPTION

Two megalithic tombs, thought to be passage-tombs dating to the Neolithic period, are recorded on Montpelier Hill, County Dublin in the SMR as DU025-001001 and DU025-001002. A passage-tomb is defined as being 'a round mound, usually surrounded by a kerb of large stones, enclosing a burial chamber, usually with a corbelled roof, which is entered by a passage, usually lintelled. Many tombs have side and end recesses opening off a central chamber, resulting in a cruciform plan. Cremation was the predominant burial rite in passage tombs which primarily date from 3300–2900 BC, though some simpler tombs in Carrowmore, County Sligo, have produced radiocarbon dates suggesting use even earlier in the Neolithic, circa 4000 BC' (National Monuments Service; Scope Note, www.archaeology.ie).

The larger of the two tombs in our study area; (DU025-001001), is located immediately to the south of the eighteenth-century building known as 'The Hell-Fire Club' (please see Figures 4 & 6). The remains of this possible tomb now appear as a low mound, with a diameter of approximately 26m. Visible undulation of the ground surface probably indicates the below-surface existence of at least part of the stone cairn that once would have covered the tomb (please see Plate 3). This tomb is said to have been largely demolished and its stone cairn quarried, when the Hell-Fire Club was constructed in the 18th century.

There are no visible above-surface remains of the smaller of the two tombs (DU025-001002). It was plotted as being immediately to the east of the larger tomb, and south-east of the Hell-Fire Club building. The exact location and nature of this tomb was identified and recorded by the geophysical survey conducted as part of Phase 1 (please see Figures 6, 7, 8 & 9 and see report 14R0033 by Gimson, H. & Bonsall, J. 2014).

The tombs are recorded in the Sites and Monuments Record as *'what survives today south of the Hell-Fire Club is a horse-shoe shaped embankment or mound with a hollowed interior, opening to the North-North-East. There is evidence for a recent fire in the interior. There are two stones visible along the perimeter in the south-east. To the east are traces of a second cairn (c.18m in diameter)'* (National Monuments Service, Sites and Monuments Record (DU025-001001). Recorded by Stout, G. 1993).

The two tombs form part of a major cluster of megalithic tombs in the Dublin / Wicklow mountains. In this region, eleven passage-tombs have been identified (Cooney, G. 2000). They possibly form an extended cemetery, all are in prominent locations with extensive vistas over the landscape. This extended cemetery appears to encompass a number of the summits of the South Dublin Mountains, and extends into North Wicklow. Other examples of passage-tombs in this extended cemetery in the Dublin Mountains were identified by Christiaan Corlett of the National Monuments Service, and includes tombs at Seahan, Tibradden, Kilmashogue, Fairy Castle, Two Rock Mountain, Saggart Hill and Killiney Hill (Corlett, C. 2012); to which it is reasonable to add the tombs of North Wicklow like Seefin, Seefinghan and other possible passage-tombs like Lackan, Tornant Upper, Blakestown Upper, and the tomb at Tuckmill Hill.

Not all of these tombs may be definitively Neolithic passage-tombs, as antiquarians investigating the tomb at Tibradden in 1849, discovered a Bronze Age Food Vessel along with cremated human remains. Though as Corlett points out, it is not unusual to discover that people during the Early Bronze Age reused older sacred sites for their own burials.

Though the tombs on Montpelier Hill are not well preserved above ground, they are still of high archaeological potential. In 1986 Dr. Stefan Bergh (now of NUI Galway Archaeology Department), who was visiting the Hell-Fire Club, found a chert scraper

[a small prehistoric stone tool] approximately 20m north-west of the larger of the two tombs (National Museum of Ireland Topographic Files; Register No. 1986:46).

The Hell-Fire Club building is listed in the National Inventory of Architectural Heritage as Reg. No. 11220022. The inventory describes the building as a: '*Detached five-bay single-storey-over-basement former hunting lodge on hill summit, built c.1740, burnt soon after, with vaulted stone roof repair, now derelict. Projecting porch / gallery with arched window to front, between plain openings in main elevation. Two wings with small rooms and sloping stone roofs, and projecting shelter walls. Projecting wing to rear with small semi-circular window. Internal rooms with fireplaces, arched doorways and niches, and connecting gallery. Robbed megalithic tomb and triangulation survey pillar nearby*'.

With its central half-octagonal projection, and two low flanking wings (please see Plate 1); the Hell-Fire Club is similar in architectural design to a mid-18th century house at Mount Gordon in Castlebar in County Mayo (Craig, M. 2006) (please see Plate 5). Like the house at Mount Gordon, it is likely that the main entrance was on the upper floor, with the lower floor being used as a kitchen, storage and for servants quarters. The upper floor had two large rooms, each lit by two large rectangular windows in the northern side, taking advantage of the wonderful views over Dublin (please see Plate 10). Both of these rooms are equipped with a fireplace. It is possible that these rooms originally served as a dining room and drawing room. Above them, though now unreachable, it is evident that there was a third storey, and this possibly provided accommodation.

The building and its layout was described in 1899 as:
'*…the house consisted of two large rooms and a hall on an upper floor. These rooms are sixteen feet square, each of them lighted by two tall windows, almost eight feet by three feet six inches, commanding a most extensive and magnificent view. There are two arched niches at each side of the rooms, with large fireplaces. Over the parlour and hall there was a small loft, but none over the drawing room. The hall door was reached by a lofty flight of stone steps; these, with most of the other*

cut granite stones about the house, were taken away at the time of the building of Lord Ely's hunting-lodge, lower down the hill.

Underneath the drawing-room was the kitchen, where the jambs of the great fireplace, ten feet wide, are still to be seen. There was a servants' hall at the other side, and there were two rooms built out at each end of the house. There were also two small apartments in a return opposite the hall door. The windows all face the north, for in the rear there are only a few narrow slits like embrasures. A semi-circular courtyard was in front with a gate in the centre. The walls are all very thick, built carelessly of rubble stone. The arched roof is of stone, as are the floors.' (Domville Handcock, W. 1899)

The unusual building was constructed as a Hunting Lodge for William Conolly in 1725. William Conolly, was originally from Ballyshannon in County Donegal. He was the son of a publican, but had a stratospheric rise through the ranks of Irish society to become one of the wealthiest and most powerful men in the British Isles. By the age of 34, his annual income was estimated to be in the region of £17,000 (roughly equivalent to over £3 million pounds per year). He had a residence on Capel Street in Dublin, and his grand estate at Castletown in County Kildare is one of the finest examples of Palladian architecture in the British Isles (O'Brien, J. & Guinness, D. 2005). He was a famous parliamentarian, and achieved the rank of Speaker in the Irish Parliament from 1715–1729, a role that became synonymous with him, as he became known as William 'Speaker' Conolly. He was widely acknowledged as the wealthiest man in Ireland by the time of his death in 1729.

In 1723–5, William Conolly purchased Rathfarnham Castle and a considerable amount of land and estates from The Duke of Wharton. This purchase included the land of Montpelier Hill. He chose this part of the estate to establish a 1,000 acre deer- park and he constructed the unusual Hunting Lodge on the summit of the hill. He chose the location as he believed it would be possible to see both his great estate at Castletown and his newly acquired Rathfarnham Castle from the Hunting Lodge.

William Speaker Conolly died in 1729; a mere four years after the construction of his new Hunting Lodge. The lodge stood empty until 1735; when it was rented by members of The Hell-Fire Club. They are said to have leased the building until the death of their leader, Richard Parsons, Earl of Rosse in 1741. In 1749 the building was purchased by Charles Cobbe, son of the Archbishop of Dublin. He died inside the building in 1751, just two years after he purchased it (Bohill, Kelly & de Gascun, 1991).

The Hunting Lodge then appears to have quickly fallen into disrepair. In 1763, much of the stonework and architectural features, along with the fine granite steps that lead into the building were taken away by Lord Ely to be reused in the construction of Killakee House nearby. Further significant damage was recorded when tar barrels were burned on the roof to create a large welcoming fire-beacon for Queen Victoria when she visited Dublin in 1849.

The building was described in 1899 as *'... a mere ruin, each winter hastening its decay. It is only used as a shelter for cattle. The lower rooms are half filled with manure and rubbish. The stone staircase, that I can remember inside, is all gone and the cattle can no longer ascend to the drawing-rooms as they used to do. The only way of getting to these rooms now is by climbing up the front wall to the hall-door; while the room in the return is almost inaccessible, except to an active climber'* (Domville Handcock, W. 1899).

The building then seems to have been left in this derelict condition until Coillte acquired the land in the 1960s. They carried out extensive restoration of the building and roof, and added a concrete staircase and steel bars over the windows to make it safer for the many visitors who frequent the site. The building and Montpelier Hill itself remain as a great asset to the locality and it is a popular and much-loved place for dog-walkers, joggers, families and those who want an unusual but scenic place to get away from it all. The Hell-Fire Club also remains a very popular venue for horror-themed tours around the Halloween Period, with a number of local guides bringing

visitors around the atmospheric building while chilling them with tales of supernatural terror from the large amounts of folklore that surrounds the site.

The tombs and the Hell-Fire Club building are near the summit of Mount Pelier Hill, at National Grid Reference: 53º15.096' N, 006º 19.815' W at an elevation of approximately 385m above sea level. Though much of Mount Pelier Hill is covered in a Coillte forest plantation, the summit with the Hell-Fire Club and tombs and a large area around remains unplanted as a grass covered hill. The Dublin and Wicklow Mountains form the largest continuous upland area in Ireland. The mountains are primarily composed of granite surrounded by an envelope of mica-schist and much older rocks such as quartzite. They were pushed up during the Caledonian orogeny at the start of the Devonian period and form part of the Leinster Chain, the largest continuous area of granite in Ireland and Britain. The mountains owe much of their present topography to the effects of the last ice age, which deepened the valleys and created corrie and ribbon lakes (Boyle, K & Bourke, O. 1990).

3. METHOD

Four test pits (Trenches 1, 2, 3 and 4), measuring 2m x 2m, were hand-excavated by a team of experienced archaeologists. Following the removal of the sod and topsoil, the trenches were meticulously cleaned by trowel to reveal any potential features of archaeological potential.

Upon location all archaeological features were cleaned and excavated by hand using methods appropriate to their composition, nature and date. All archaeological contexts were photographed and planned (in relation to the sides of the trench) prior to excavation. Sections were excavated through all features to obtain profiles and to expose the stratigraphic sequences. These section faces were drawn to scale and then fully excavated.

The composition, stratigraphic position and interpretation of all contexts were recorded on a context sheet prior to excavation. Contexts have been sampled for palaeobotanical material, radiocarbon dating, petrology and wood identification, where appropriate. Samples were taken from a number of the potential archaeological features and will be processed by suitable specialists.

4. RESULTS

Trench 1 (Dimensions 2m x 2m, average depth of 0.38m)

Figure: 11

Plates: 8, 11, 12, 13, 20

Trench 1 was opened to the west-north-west of the Hell-Fire Club building, and was targeted on a large rectangular feature that appeared to be a three-roomed structure identified during the geophysical survey (see Figures 9 & 10). The excavation of Trench 1 revealed no evidence of the potential large rectangular structure indicated on the geophysical survey. Instead, it revealed two possible archaeological features. The first, [C005], was located in the north-west area of the trench. [C005] was a sub-circular shaped cut, dug into the subsoil. It had dimensions of 0.29m x 0.20m and a depth of 0.20m. The cut had a sharp break of slope with steeply-sloping uneven sides and an uneven base. It was filled by (C004), a mid-brown coloured silty-clay with some inclusions of charcoal. This was located approximately 0.85m west-south-west of cut feature [C006]. This was another sub-circular cut, measuring 0.16m x 0.14m with a depth of 0.14m. It was filled by (C007), a moderately compacted yellowish-brown silty clay, with frequent inclusions of small pebbles and some medium sized stones. The edges of this cut appear to have been effected by root-disturbance, and it had uneven steeply sloping sides to a flattish base. It is quite possible that both of these features [C005 & C006] are the result of natural bioturbation in the form of tree-root activity, however they could potentially be stake or post-holes, ephemeral evidence of archaeological structure. The charcoal recovered within the fill of [C005] will be sent to a specialist for identification and analysis, and if deemed to be of archaeological interest, the charcoal will then be sent for radiocarbon dating.

No other features of archaeological potential were identified within Trench 1.

Trench 2 (Dimensions 2m x 2m, average depth of 0.33m)

Figures: 12 & 13

Plates: 14, 15, 16, 17, 21

Trench 2 was opened south of the Hell-Fire Club building, and was positioned closest to the passage tomb monument DU025–001001. The trench targeted a potential pit feature identified by the geophysical survey (see Figures 9 & 10). The excavation of Trench 2 revealed no evidence of a potential pit type feature. However it did reveal a feature of potential archaeological significance, (C008). This was a layer of medium – large sized stones within a light grey, loosely compacted silty clay that contained a moderate amount of charcoal. The majority of the stones were of granite and limestone with numerous pieces of quartz. This feature appeared in a distinct band that ran in a curving line across the northern half of the trench (see Figures 12 & 13), and was between 0.16–0.20m thick. It appeared to be respecting the curvature of a possible outer enclosing of passage tomb DU025–001001. This has the enticing possibility of being a second outer enclosing feature (a rare feature in Irish passage-tombs, see Discussion section below), or perhaps, is it is merely evidence of slippage, where the main cairn material has slid down during weathering or destruction of the cairn of the tomb. A quantity of charcoal from (C008), recovered during the environmental processing, will be sent to an appropriate specialist for species identification. Following any specialist recommendations the charcoal will be submitted for radiocarbon dating to help establish the date of this feature.

This feature overlay (C009), a greyish brown loose silty clay that contained very moderate inclusions of charcoal. This layer potentially represents the buried topsoil, sealed when the possible enclosing bank (C008) was constructed on top. This deposit was 0.05m thick. It overlay the natural glacial subsoil, a mid-brownish orange subsoil with heavy iron panning throughout.

No artefacts or other material of archaeological potential were identified in Trench 2.

Trench 3 (Dimensions 2m x 2m, average depth of 0.30m)

Plates: 9, 18, 22

Trench 3 was opened south of the Hell-Fire Club building, and was positioned east of Trench 2 to the south of passage tomb monument DU025–001001. The trench targeted a potential pit feature identified by the geophysical survey (see Figures 9 & 10). The excavation of Trench 3 revealed no evidence of a potential pit type feature or any other features of archaeological potential.

Trench 4 (Dimensions 2m x 2m, average depth of 0.26m)

Plates: 18 & 23

Trench 4 was opened south-east of the Hell-Fire Club building, and was positioned close to the smaller passage tomb monument DU025–001002. The trench targeted a potential enclosing element of the smaller tomb, identified by the geophysical survey (see Figures 9 & 10). The excavation of Trench 4 revealed no evidence of a potential enclosing element, and no other features of archaeological potential.

5.0 ARTEFACTS

No artefacts were discovered during the testing phase.

6.0 DISCUSSION

The primary aim of the programme of test-trenching carried out under licence 15E0101, was to evaluate the nature and archaeological potential of features identified during the geophysical survey [14R0033]. The results of the test-excavation revealed that the geophysical survey revealed the presence more targets of archaeological potential than were actually identified in the ground, and that two of the trenches (Trench 3 & Trench 4) proved to be completely sterile with no features of archaeological potential being identified. It appears that the shallow depth of soil and unusual geology of the hill led to the erroneous geophysical results. Dr. James Bonsall of Earthsound Geophysics who conducted the survey states that: *"The geophysical surveys suggested the presence of more archaeological features than were identified. One of the ways in which this is best understood is in relation to the 'large rectangular feature' that was identified as a conductivity anomaly and coincided with a spread of dipolar, ferrous, magnetic anomalies and interpreted as a structure. The feature was not found in Trench 1, whereas the stake-hole type features that were found were too small to be imaged by the geophysical surveys. The absence of the feature in the trench could suggest that the anomalies were geological, rather than archaeological, in origin, and that the surveys were imaging at a depth greater than the shallow soils on the hilltop that were revealed during the excavation. As a consequence, many of the anomalies revealed by the geophysical surveys were 'seeing deeper' than the archaeology revealed by the excavation. This could be overcome in the future by using shallow prospection methods suited to soils <20cm beneath the surface"* (Dr. James Bonsall pers.comm).

Trench 1 was targeted on what appeared to be a large rectangular structure that was identified during the geophysics. The excavation failed to identify any evidence of such a building, instead the only structural evidence that was identified were two small possible stake-hole type features (please see Figure 11 and Plates 11, 12 & 13). These could be the ephemeral remains of a wooden-framed structure, and are similar in dimension to some structural elements of Neolithic houses. However it is important to note that the base of Trench 1 was disturbed by tree roots, and it is quite probable that the two stake-hole type features are in fact sockets left by tree-roots that had long

since decomposed. The fill (C007) of one in particular [C006] was completely sterile. A small amount of charcoal was recovered from the fill (C004) of the westernmost feature [C005]. This charcoal will be sent to a specialist for species identification, analysis and comment as to the likelihood of it deriving from natural processes (a decomposed tree root) rather than burnt archaeological remains. If considered potentially archaeological, the charcoal will be sent for radiocarbon dating to help establish a date for the possible structure.

The discovery of archaeological material in Trench 2 is potentially highly significant. The deposit (C008) appeared to curve at an angle that respects a possible earthwork that is a potential outer enclosing element for the larger of the two tombs (DU025-001001). This possible earthwork appears quite distinctly on the LiDAR (please see Figure 6) as a raised bank curving around the south-west portion of the tomb. From it's size and curvature it is possible that it once completely enclosed the tomb, though it appears to have been largely removed apart from the south-eastern side. The presence of an enclosing earthwork for the larger tomb is an unusual and relatively rare feature in the Western European passage tomb tradition. Richard Bradley states that: '*It is more difficult to discuss those cases in which a megalithic tomb is actually enclosed within a circular earthwork. Apart from Maes Howe, the best examples of this arrangement are found in Ireland. Several occur in the Carrowmore Complex…'* (Bradley, R. 1998). Bradley goes on to suggest that possibility that these enclosing elements could be a later feature, part of a new form of ritual tradition that moved the ceremonial aspects and rites from the interior of the tomb to the exterior. Charcoal discovered within (C008) will hopefully produce a radiocarbon date that will aid in assessing the localised site chronology. Alternatively, it could be that the material discovered within Trench 2, along with the visible earthwork, could simply be slippage from the main cairn as a result of weathering or during the destruction activity that occurred when the Hell-Fire Club itself was being constructed in the eighteenth century. Only further excavation will reveal the full nature of the potential archaeology identified

during the project thus far, as it is clear from the results of Trench 2, that there is high potential for sub-surface archaeological remains on the site.

Accounts suggest that the cairn itself was demolished and the stone reused as building material. *'Upon the top of Mont Pelier, from time immemorial, stood a large cairn, similar to those on Seefin and Seeghane Mountains. The limits were composed of great stones set edgeways, which made a sort of wall or boundary; within small stones were heaped up; and in the centre there was a large slab, nine feet long, six feet wide, and three feet thick, not raised upon others, but lying low, with the small stones cleared from around it. There were several other large stones; and about sixty yards south-west stood a pillar stone about five feet out of the ground. These ancient remains have nearly disappeared. A great portion of the cairn was used in building the house.'* (Domville Handcock, 1899). Supported by Austin Cooper who also suggested that the cairn provided building materials for the building in the 18th Century (National Monuments Archive, DU025-001001). However, though the tombs were nearly entirely obliterated during the construction of the Hell-Fire Club, it is still possible to see potential evidence of some of the larger stones (possible orthostats and kerbing) reused in the fabric of the Hell-Fire Club itself (plates 6 & 7). Perhaps 3–D laser scanning with a high-density point-cloud could even reveal traces of megalithic art on some of these stones, it is a tantalising possibility.

It is clear that from its large size and potential complexity, the tombs of Mount Pelier Hill are of high significance in the Irish passage tomb tradition, and the larger tomb may be the focal point of the Dublin / Wicklow Mountains Megalithic Cemetery. Though both tombs were largely destroyed during the construction of The Hell-Fire Club, as the excavation of Trench 2 indicated, there is still high potential for sub-surface remains. Through careful archaeological excavation, there is still much these tombs can reveal of the nature, design and ritual activity of Irish passage graves.

7.0 RECOMMENDATIONS

The testing phase revealed that there is high potential for the preservation of sub-surface archaeological deposits and features associated with the passage tombs DU025-001001 and DU025-001002. The potential enclosing elements hinted at in the LiDAR survey and in the remains discovered in Trench 2 give a tantalising glimpse of the continued ritual importance of the larger of the two passage tombs beyond its initial conception and use as a tomb. The rarity of this type of feature in the European passage tomb tradition certainly requires further investigation. A larger scale excavation, that incorporates at least 50% of tomb DU025-001001 is recommended to establish the true size, nature and features of the tomb, and to establish the nature of the possible enclosing element to evaluate it's archaeological potential and to establish a local site chronology. If it proves to be an enclosing element, it is of high importance to archaeological research to assess whether the enclosing element is contemporary with the first use of the tomb, or whether as Bradley suggests, it is a later feature that indicates a change in custom, rites and ritual in the later Neolithic period.

APPENDIX 1: LIST OF CONTEXTS

C #	Type	Interpretation	Description	Dimensions	Location
1	Deposit	Sod	Sod overlying the site. Mid brown peaty sod which was moderately compact with frequent inclusions of roots. Varying in depth of 0.05 m - 0.25m across the four trenches excavated. No archaeological artefacts were recovered from this context.	Varying thickness of 0.05–0.25m	All trenches
2	Deposit	Topsoil	Mid brown moderately compact topsoil. Occasional modern artefacts like plastic and aluminium cans were found dispersed throughout the four trenches. Sub angular stones found throughout topsoil. The deposit varies in depth of 0.07m - 0.20m across the four trenches excavated. No archaeological finds or charcoal was recovered from this context.	Varying thickness of 0.07–0.20m	All trenches
3	Deposit	Natural subsoil	Mid brownish orange subsoil with heavy iron panning throughout. Underlies sod and topsoil. C003 is a natural layer with no charcoal or archaeological artefacts retrieved from it.	N/A	All trenches
4	Deposit	Fill of possible pit	This deposit was the fill of cut C005. Mid brown silty clay with very moderate inclusions of charcoal. Sub circular in shape with dimensions of 0.29m x 0.20m and had a depth of 0.20m. When excavated C004 had iron pan along the eastern edge of the deposit. There were moderate angular pebbles (dimensions: 0.03m x 0.04m) within the eastern half of the fill. There were a lot of roots mixed into the deposit. One soil sample was taken from this deposit. It has been interpreted as a possible post hole but given the proportion of root activity and the general abundance of roots within the trench, it could be fill of a naturally occurring cut. No archaeological artefacts were recovered from this deposit.	0.29m x 0.20m x 0.20m	Trench 1
5	Fill	Cut of possible pit	Sub circular cut dug into subsoil C003. This cut was filled with the deposit: C004. The cut was sub circular in shape and located in the north-west corner of Trench One. It was located approximately 0.85 metres to the north east of C006 (a similar possible post located in Trench One). The break of slope at the top of the cut was sharp and the sides of the cut sloped sharply to the base. The eastern side of the cut is uneven and has a number of crevices above and below stones located in the side of the cut. The break of slope at the base was gradual and the base was concave. It is possible that this cut was a post hole but given the uneven sides of the cut and the root activity surrounding it, it is also possible that this is natural root activity. No archaeological artefacts were recovered from this cut.	0.24m x 0.20m x 0.24m	Trench 1
6	Fill	Cut of possible pit	Sub circular cut dug into subsoil C003. This cut was filled with the deposit: C007. The cut was sub circular in shape and was located in the north-western corner of Trench One, approximately 0.85 metres to the south west of C005. The break of slope at the top of the cut was sharp on three sides and more gradual on the Northern side. The sides of the cut sloped sharply to the concave base. The break of slope at the base of the cut was sharp. It is possible that this cut was a post hole but given the uneven sides of the cut and the root activity surrounding it, it is also possible that this is natural root activity. It was noted that during de-sodding, a thick root was revealed following the orientation of this post hole. No archaeological artefacts were recovered from this context.	0.16m x 0.14m x 0.14m	Trench 1

C #	Type	Interpretation	Description	Dimensions	Location
7	Cut	Fill of possible pit	C007 was the deposit that filled the cut C006. Moderately compact yellowish brown silty clay. There were frequent inclusions of small pebbles and very occasional inclusions of larger stones (dimensions: 0.08m x 0.06m). There was frequent inclusions of root activity within this deposit. The dimensions of the deposit were: 0.16m x 0.14 m and a depth of 0.14m. C007 was similar in colour and consistency to C004 but there were no charcoal inclusions in C007. The was some flecks of manganese throughout the fill. It is possible that C007 is the fill of a posthole. It is also possible that it is the non archaeological fill of a root bole. No archaeological artefacts were recovered from this context.	0.16m x 0.14m x 0.14m	Trench 1
8	Deposit	Possible enclosing element associated with passage tomb (DU025-01001)	Light grey brown loosely compacted silty clay with frequent inclusions of medium and large stones which formed stone packing. Occasional flecks of charcoal were found throughout the deposit. Most of the stone inclusions were granite and limestone with occasional quartz. There were very occasional inclusions of slate and unworked chert. The deposit had a depth of 0.16m and extended from east - west across Trench Two (2 metres in diameter). It extended 1.35m from the northern baulk at the western edge of the trench and approximately 0.40m from the northern baulk at the eastern edge of the trench.There were larger pieces of quartz found in the centre of the deposit towards the northern edge of the trench. It is possible that C008 is the fill of a berm on the southern extent of the passage tomb monument (SMR number: DU025-00100001). It was found beneath C001 and C002 and overlies C009 and C003. Sample #002 was taken from this deposit (two 1 litre bags of soil and one 1 litre bag of stones). No archaeological artefacts were retrieved from this context.	Average thickness of 0.16m	Trench 2
9	Deposit	Deposit beneath C08	Grey brown silty clay loosely compacted with very moderate inclusions of charcoal. C009 was located in the northern half of Trench 2 and extended east - west across the trench. C009 extended 1.10m out from the northern baulk at the western edge of Trench 2 and 0.80m from the northern baulk at the eastern edge of Trench 2. It had a depth of approximately 0.05m. It is possible that this context is reburied soil beneath C008 which was a mixture of soil and stone which may be part of a berm of the passage tomb. A lens of charcoal was found within C009 and this was sampled (Sample # 003). C009 was found beneath C001, C002 and C008 and overlay C003. No archaeological artefacts were recovered from this context.	Average thickness of 0.05m	Trench 2

APPENDIX 2: LIST OF SAMPLES

Sample Number	Context	Size	Date	Sampled By:	Description
1	C04	0.5 Litres	21/04/2015	Louise Nugent	Fill of possible post hole in Trench One (inclusions of charcoal)
2	C08	3 litres	22/04/2015	Lynda McCormack	Clay associated with stone packing thought to be be berm of passage tomb (DU025-01001)
3	C09	1 litre	23/04/2015	Lynda McCormack	Deposit underlying C008 (inclusions of charcoal)

APPENDIX 3: LIST OF QUANTITIES

Context Sheets	Drawings	Samples	Finds	Photos	Registers	Notebooks
9	9	3	0	570 Digital	5	1

APPENDIX 4: PROPOSAL FOR POST-EXCAVATION AND ARCHIVING

ARTEFACTS:

Not applicable

SAMPLES:

Work done to date

All samples were passed through a 2mm, 1mm and 0.25m sieve and the charcoal and retent separated.

Further work:

Two charcoal samples are to be sent for specialist identification. Following specialist identification, if suitable the two samples are to be sent for radiocarbon dating (following approval and licence from the statutory authorities).

ILLUSTRATION:

Work done to date:

The trench plans and sections for the site have been digitised.

Further work:

None required.

FIGURES

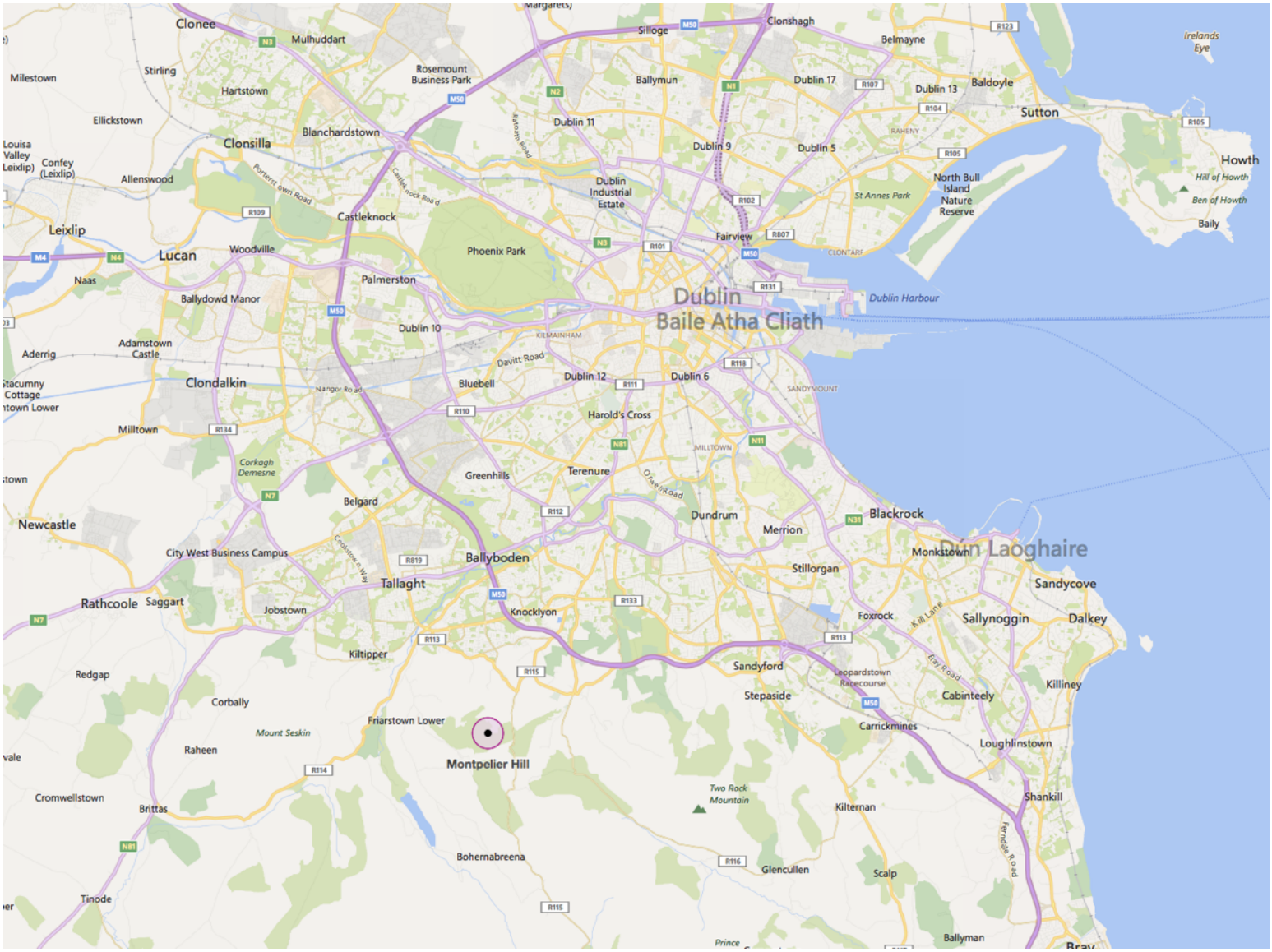


Figure 1: Location Map of Montpelier Hill (Bing Maps)

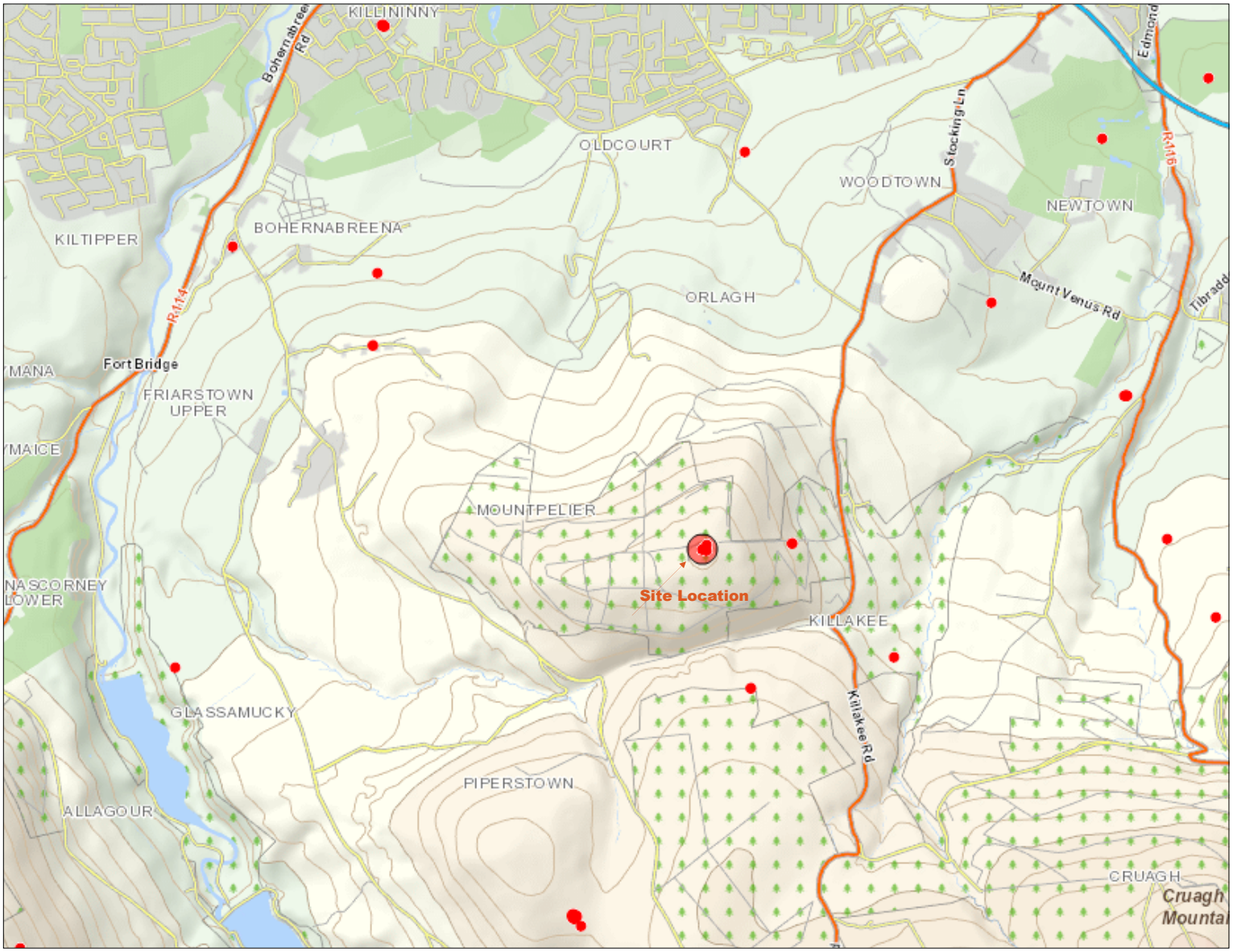
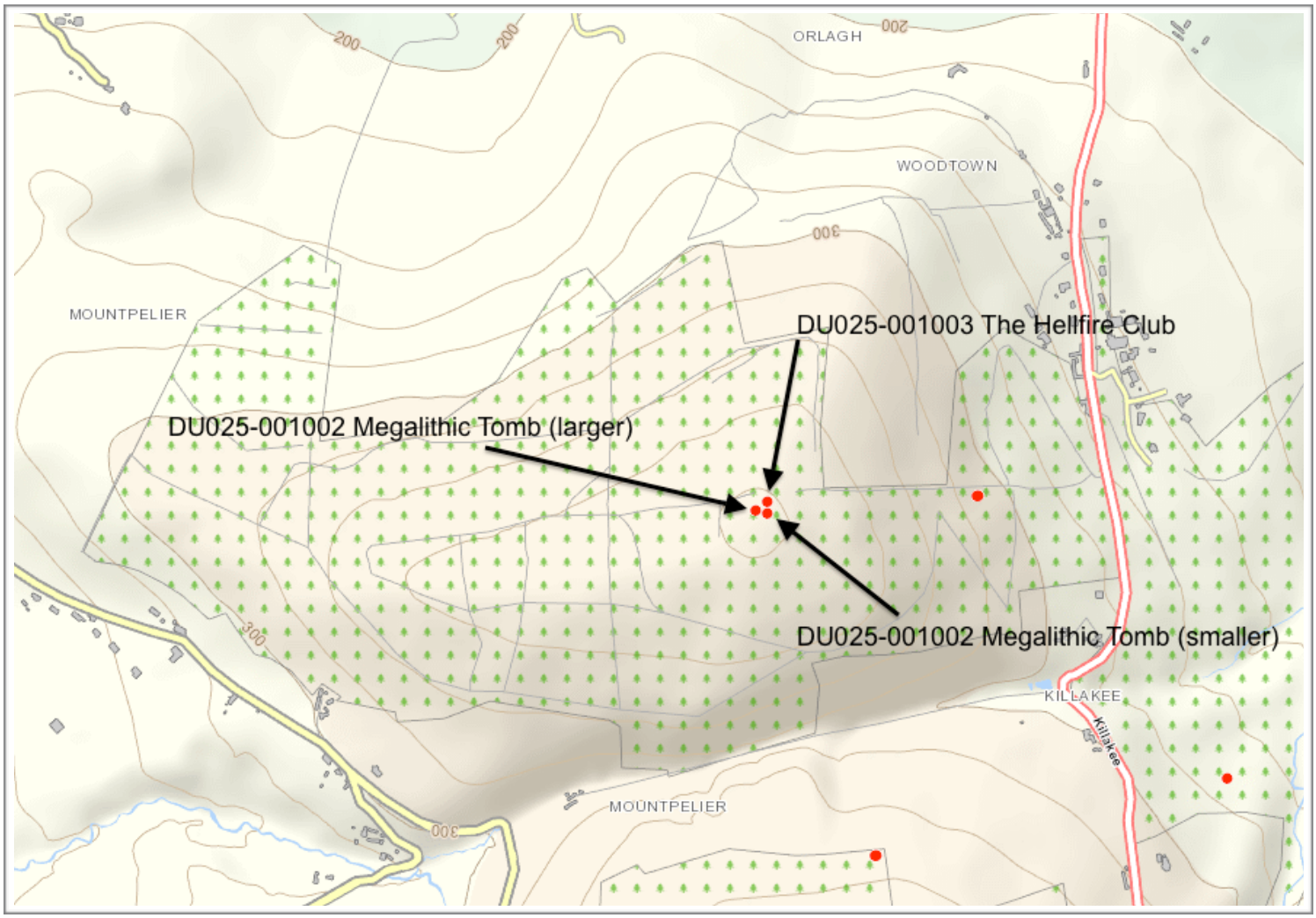


Figure 2: Site Location on Ordnance Survey Ireland Map.

Figure 3: Satellite View of Site (Bing)



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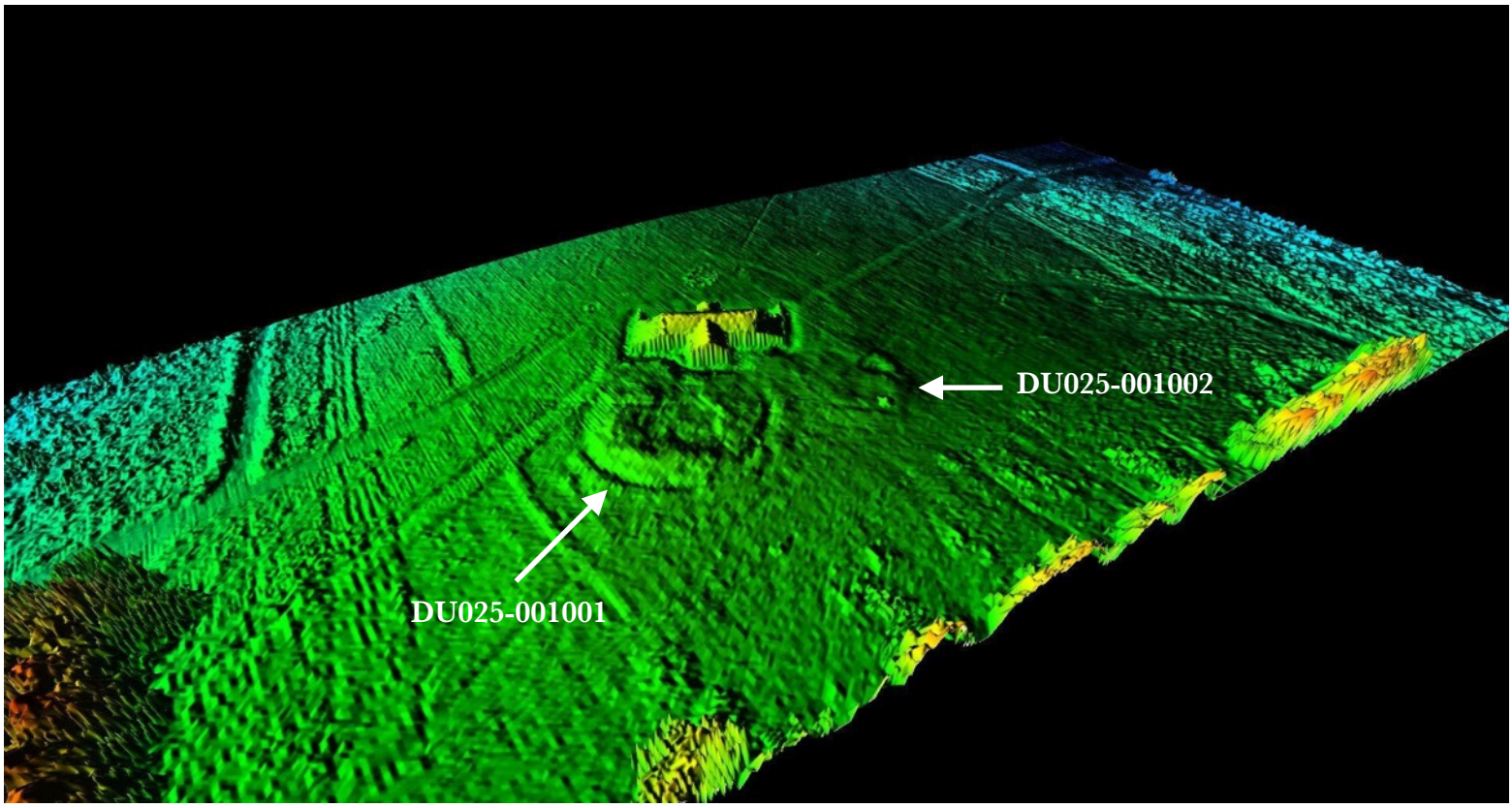
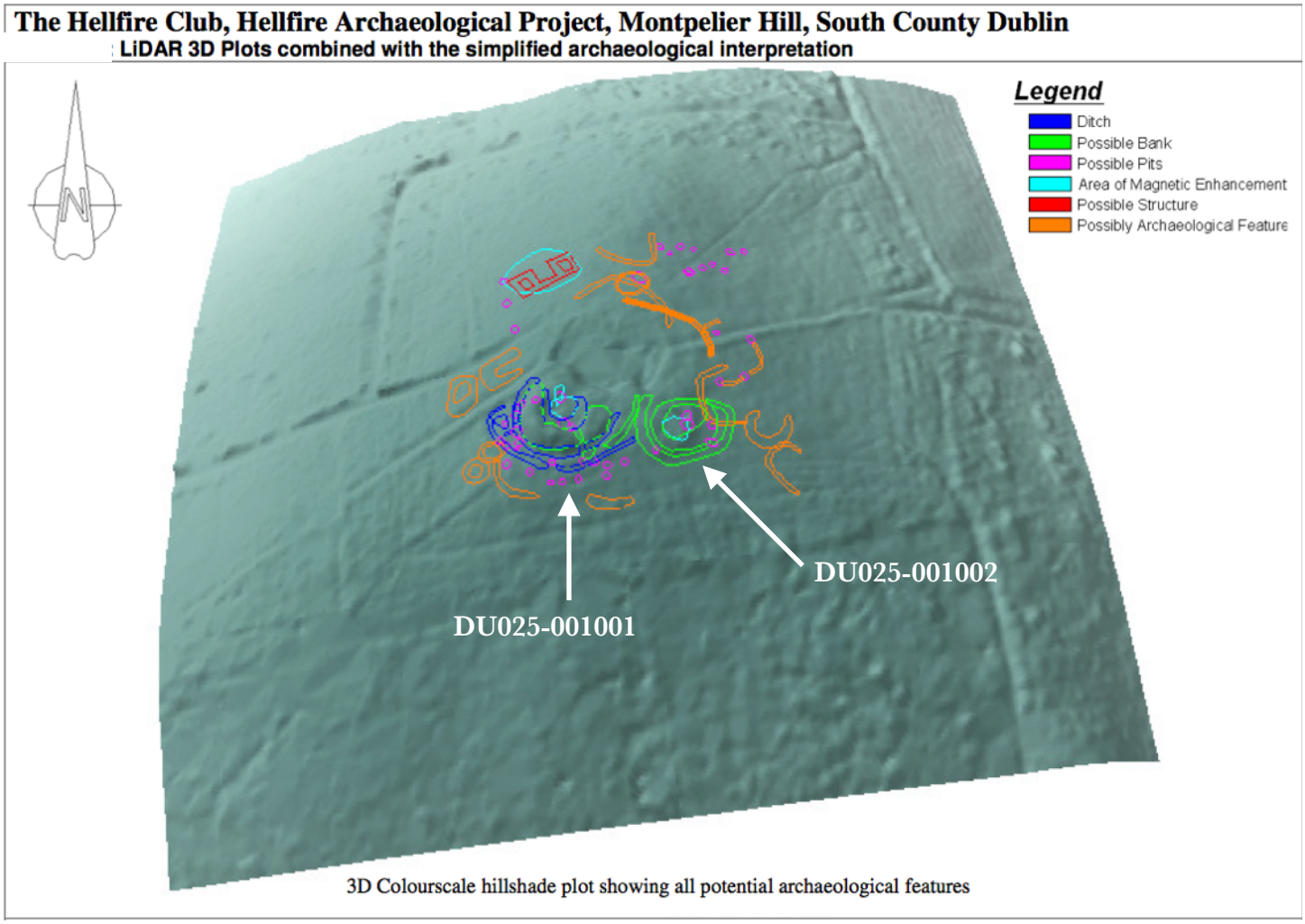


Figure 6: LiDAR survey of Montpelier Hill, the two tombs are clearly visible south of the Hell-Fire Club (with thanks to Dr. Steve Davis, UCD)



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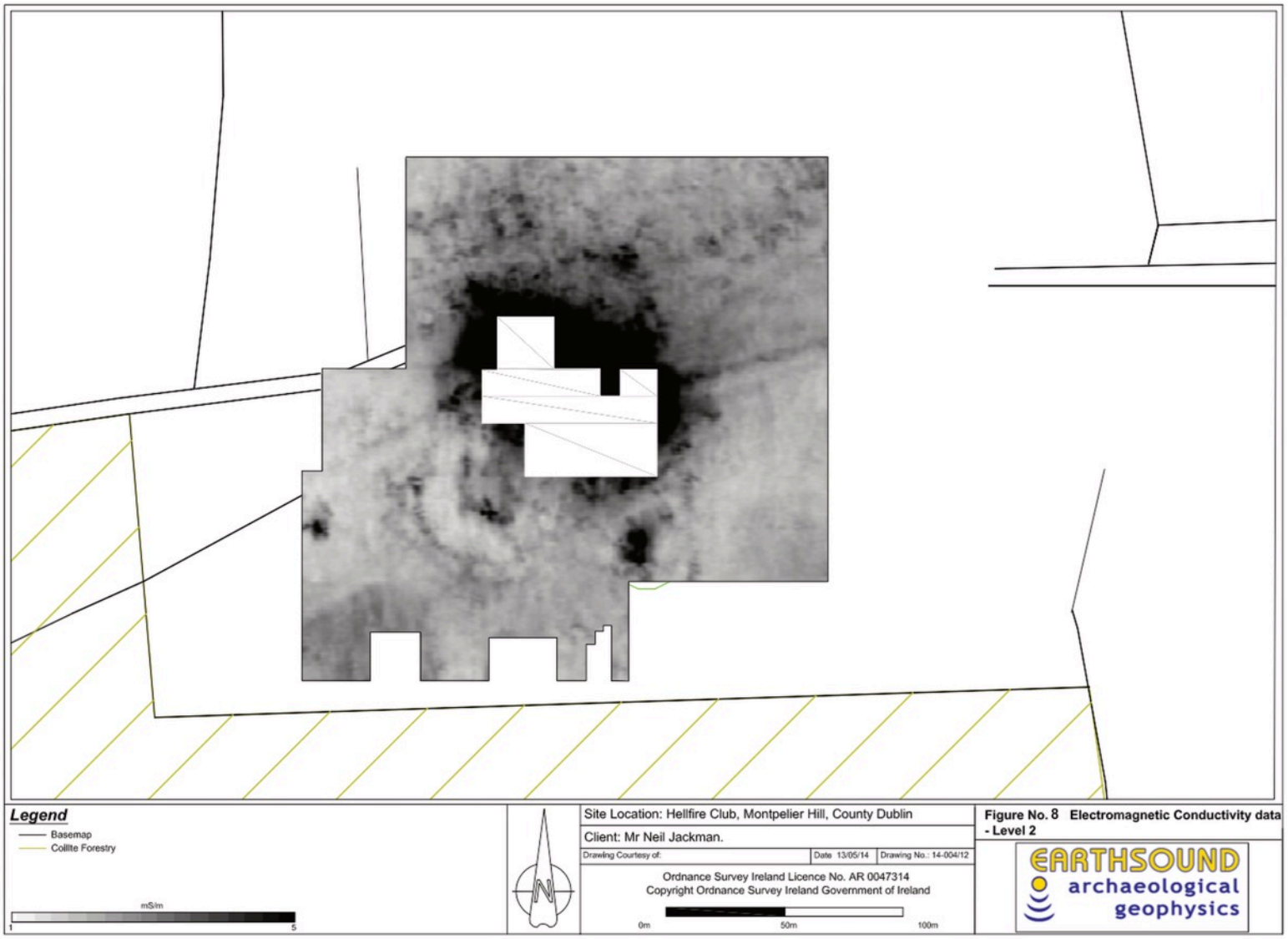

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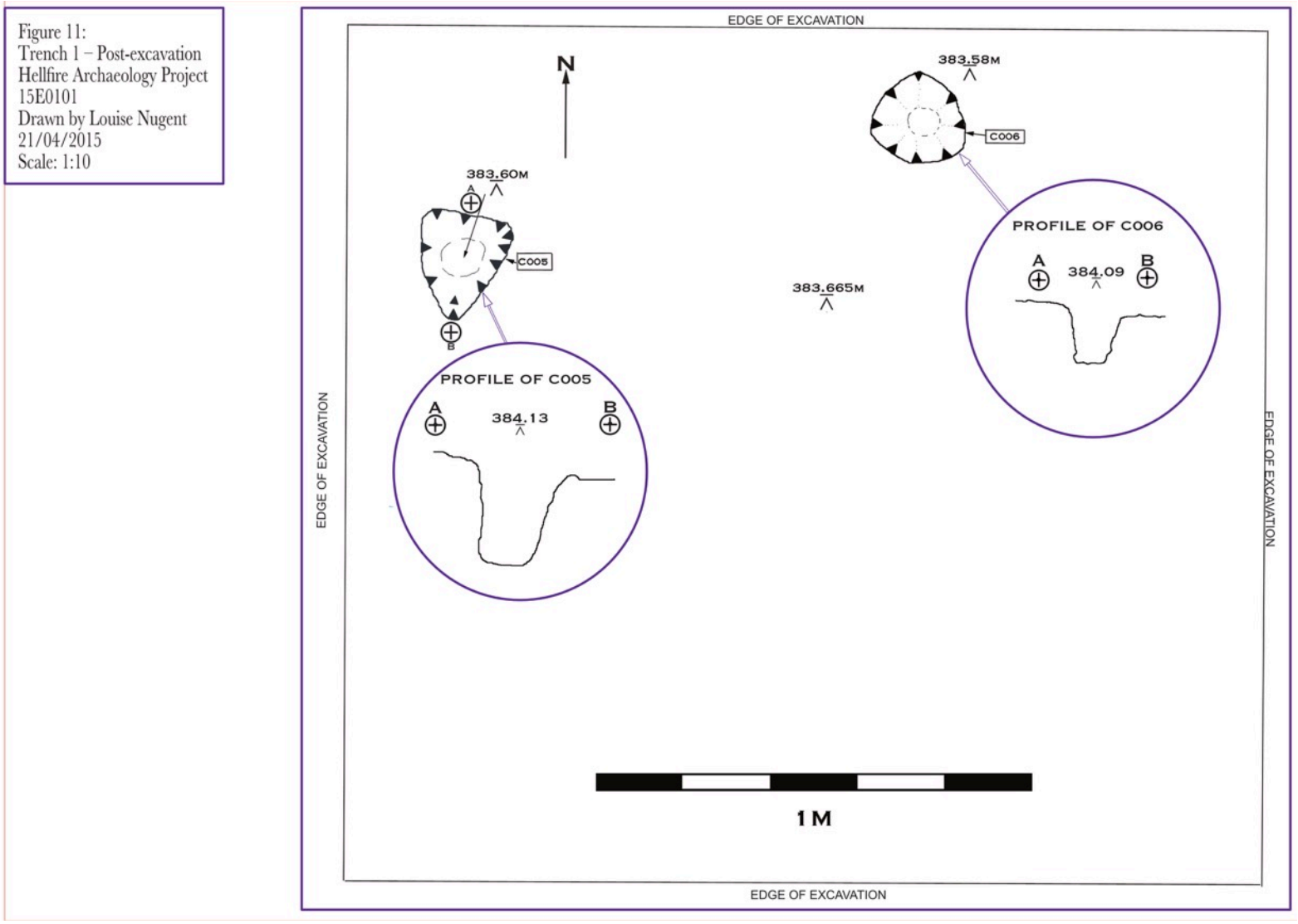

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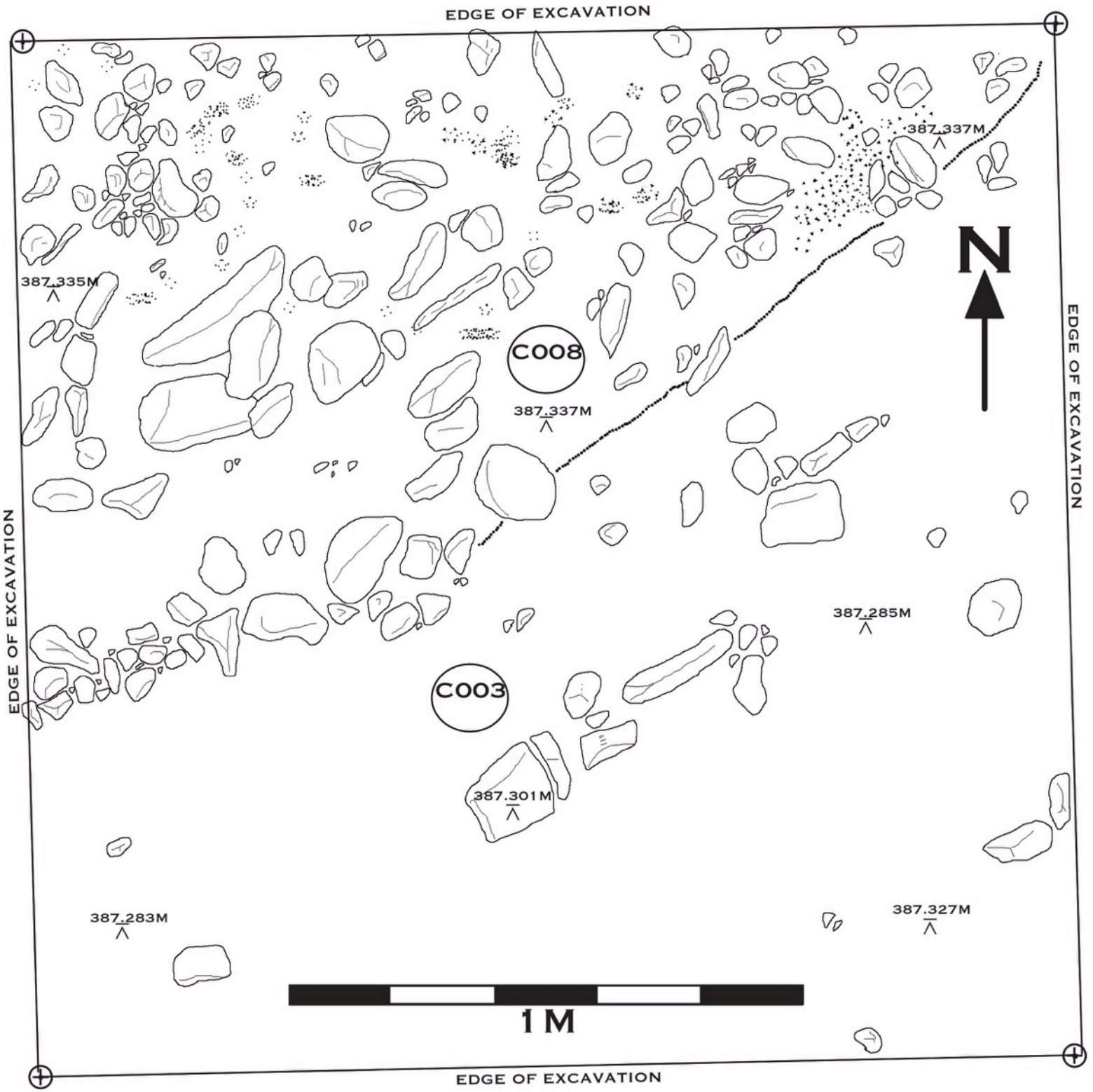

FIGURE 12: MID-EXCAVATION PLAN OF TRENCH 2
SCALE: 1:10
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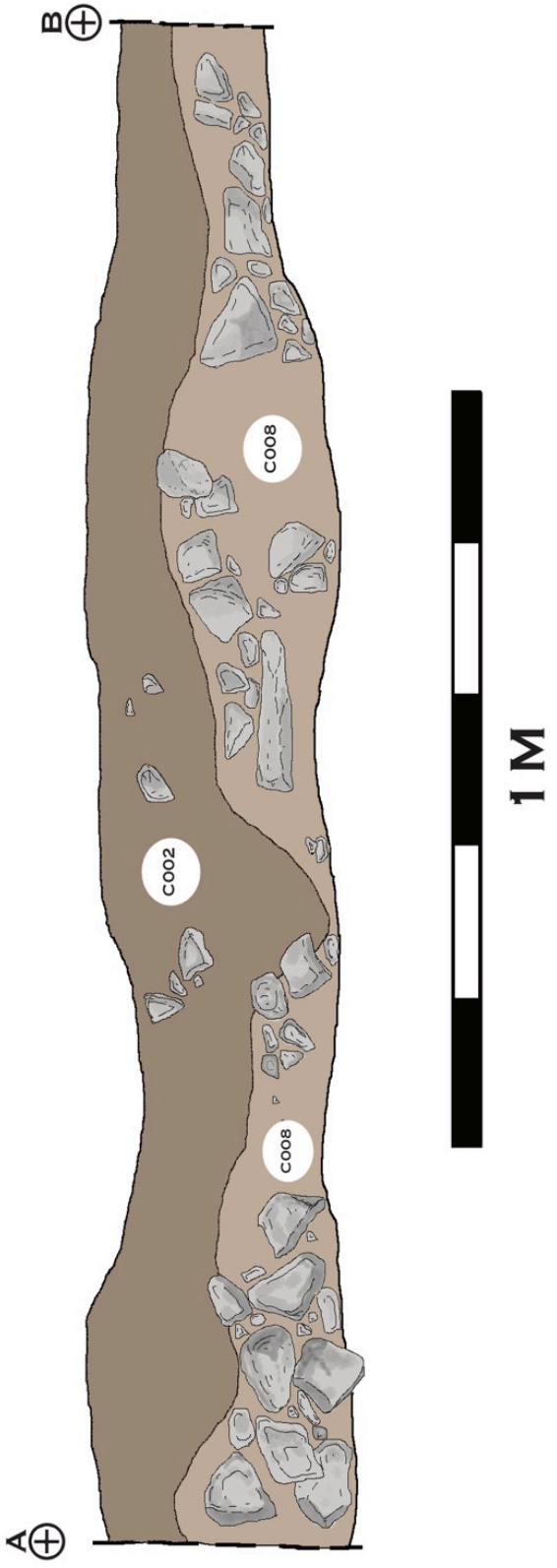
DATE: 20/04/2015
HELLFIRE CLUB PHASE 1
15E0101

Figure 12: Mid-excavation plan of Trench 2



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SCALE: 1:10
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DATE: 22/04/2015
HELLFIRE CLUB PHASE 1
15E0101

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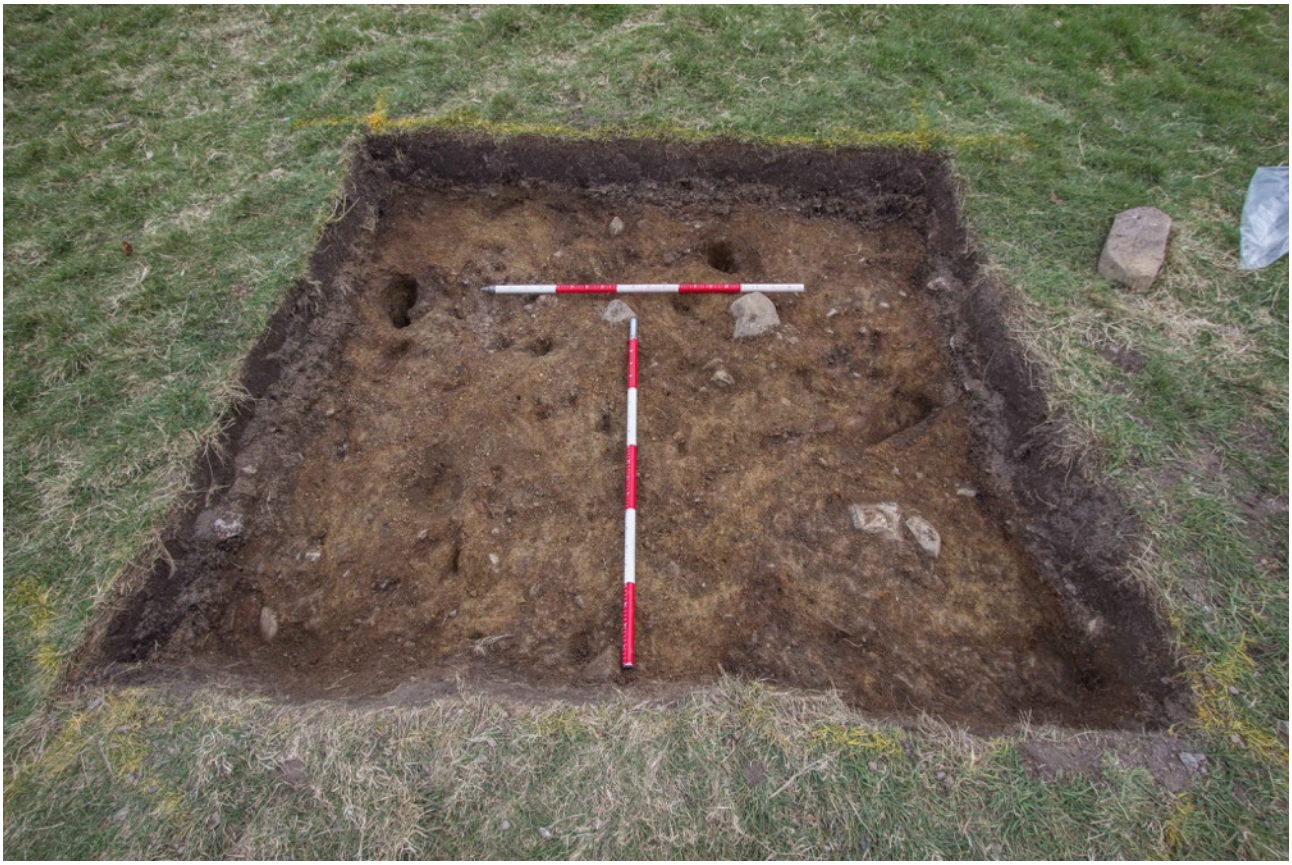

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Preliminary Report
on Excavation 16E0497
Montpelier Hill, Co. Dublin

Excavation Director:
Neil Jackman, Abarta Heritage

Hellfire Club Archaeological Project
Issued November, 2016

Contents

Abstract

This report details the preliminary results of an excavation carried out under licence 16E0497 on the summit of Montpelier Hill, Co. Dublin. This excavation was undertaken as part of the Hellfire Club Archaeological Project, which aims to explore the archaeological landscape of Montpelier Hill. Previous phases of the project have included desk-based research, a geophysical survey by Earthsound Geophysics (under licence 14R0033) and a small programme of test-excavation by the author (under licence 15E0101). The Hellfire Club Archaeological Project is a collaborative, multi-agency community outreach project. A key objective of the Hellfire Club Archaeological Project, is to try to raise awareness and public engagement with the heritage of Montpelier Hill, including the tombs, Hellfire Club itself, and the wider story of the Dublin Mountains.

This excavation focused on DU025–001001, previously recorded as a possible passage tomb in the Archaeological Survey of Ireland. This monument was thought to have been largely destroyed by the construction of the Hellfire Club in the early eighteenth century. Two trenches were placed into the monument, primarily to assess whether any archaeological features had survived the disturbance of the eighteenth century, and secondly, if archaeological features were present, to assess if it is possible to conclusively prove that DU025–001001 was indeed a neolithic passage tomb or another type of archaeological monument.

Based on the results of this excavation, it is possible to determine that monument DU025–001001 does indeed represent the remains of a badly disturbed neolithic passage tomb. Trench 1 revealed that part of the mound and cairn still exists, particularly on the southern side of the monument. Trench 2 revealed that archaeological features still survive even in the area most disturbed and damaged by the construction of the Hellfire Club and other early modern activity. Artefacts recovered during the excavation included a large stone bearing megalithic art, a polished stone axehead, a number of pieces of worked flint and a small quantity of burnt bone along with a large amount of post-medieval and early modern artefacts.

Specialist analysis of these artefacts, along with environmental processing and retrieval of suitable material for radiocarbon dating from the soil samples, are currently ongoing. These results will be detailed in a Final Report to be completed within twelve months. Following excavation, all trenches were carefully backfilled. All the archive resides in the offices of Travel Guides Ltd in Clonmel, County Tipperary.

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Acknowledgements

This excavation was carried out as part of the Hellfire Club Archaeological Project, with funding from South Dublin County Council under the South Dublin County Heritage Plan, and with the kind support of Coillte, Dublin Mountains Partnership, University College Dublin School of Archaeology, the National Monuments Service and the National Museum of Ireland.

I particularly wish to thank Dr Rosaleen Dwyer, Heritage Officer of South Dublin County Council for all of her support and work throughout the project to date, and the superb excavation team of Dr. Ros Ó'Maoldúin, Lee Scotland, Brí Greene and volunteers Mark Heffernan, Stephen Matthews, Dr. Laura O'Gorman, Christina Hughes and Michala Nagyova and of course Róisín Burke of Abarta Heritage, for all of her essential work behind the scenes.

We'd also like to thank Jesper Petersen and Coillte and the Dublin Mountains Partnership, Professor Muiris O'Sullivan, Dr Steve Davis, Conor MacDermott and University College Dublin, the Discovery Programme, Earthsound Geophysics, Ken Williams, Dr Elizabeth Shee Twohig, Sean Kirwan and Andy Halpin for all of their invaluable help and support throughout the project, and Steven Duffy for his fine photography.

We'd especially like to thank everyone who came to visit us during the excavation, from locals, cyclists, joggers, dog walkers, schools and local historians – we felt so incredibly welcome and honoured to help to tell the story of this remarkable place.

1. Introduction

This report comprises the preliminary results of the partial excavation of a passage tomb on Montpellier Hill, in Montpelier townland, County Dublin (DU025–001001). These works are part of the ongoing *Hellfire Club Archaeological Project* that seeks to discover the story of the heritage of Montpelier Hill. The work was chiefly funded by South Dublin County Council, with additional resources from Abarta Heritage. The excavation was directed by Neil Jackman of Abarta Heritage, and carried out under licence number 16E0497, during October 2016. This work follows one season of archaeological testing and a geophysical survey (Jackman 2015, Bonsall & Gimson 2014).

1.1 Site Location

The monument DU025–001001 is located on Montpelier Hill, County Dublin, at National Grid / Transverse Mercator: (Easting) 311496 (Northing) 223648, [Latitude: 53:251769 Longitude: -6:330298], at an elevation of approximately 383m (Figure 1). Montpelier Hill is located in South County Dublin, approximately 12.8km southwest of Dublin City Centre and approximately 6km southeast of Tallaght.

Plate 1: The summit of Montpelier Hill surrounded by Coillte forest plantation.

Montpelier Hill forms part of the Dublin Mountains, and the site is located on Coillte land. It is a popular place for recreation, with many daily visitors. The Dublin and Wicklow Mountains form the largest continuous upland area in Ireland. The mountains are primarily composed of granite surrounded by an envelope of mica-schist and much older rocks such as quartzite. They were pushed up during the Caledonian orogeny at the start of the Devonian period and form

part of the Leinster Chain, the largest continuous area of granite in Ireland and Britain. The mountains owe much of their present topography to the effects of the last ice age, which deepened the valleys and created corrie and ribbon lakes (Boyle, K & Bourke, O. 1990).

Though most of the hill is part of a Coillte managed forest plantation, the summit of the hill, including the immediate area around the possible tombs and the Hellfire Club itself, is an open grassy field (see Plate 1). Further south, towards the tree plantation, the ground is more saturated and boggy, with rushes and water loving grasses more dominant along with some gorse.

Plate 2: The hunting lodge, tomb and a series of earthworks clearly visible from the air

The topography of the hill is quite varied (see Plate 2), with earthworks that possibly relate to the eighteenth century hunting lodge. The larger of the tombs (DU025–001001) appears above the surface as a significant curving earthen bank, hollowed in the centre and flattened to the north (in proximity to the Hellfire Club). Little can be discerned above the surface of the second tomb (DU025–001002), beyond a slightly raised platform surmounted by a modern Ordnance Survey Pillar.

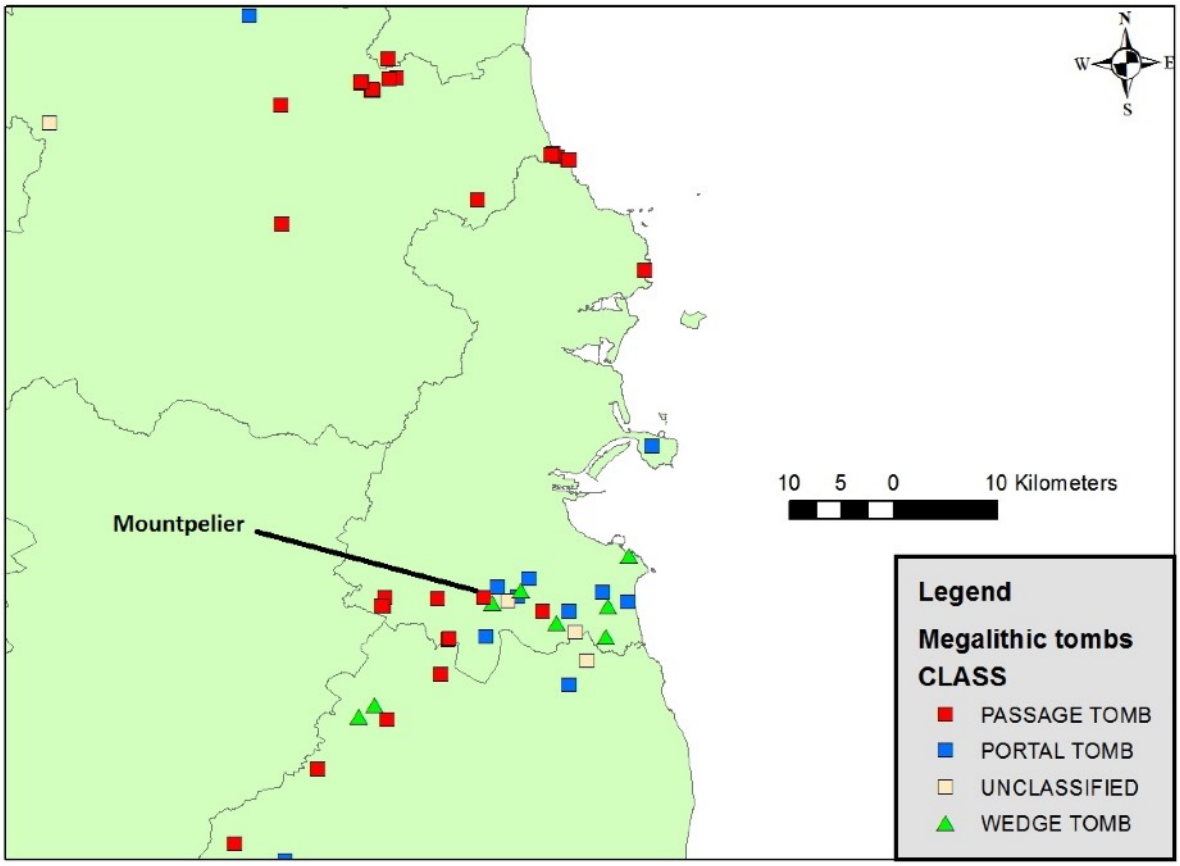

Fig 1 Site location

Fig 2 Trench locations

1.2 Project Background

The Hellfire Club Archaeological Project is aimed at investigating the nature of the possible passage-tombs designated DU025-001001 & DU025-001002 and obtaining a better understanding of both the physical remains of the eighteenth century hunting lodge known as the Hellfire Club, and a better historical insight into the group that made the site so notorious.

Primarily the Hellfire Club Archaeological Project aims to identify, examine and interpret the archaeological remains at the site, as part of a collaborative multi-disciplinary community outreach project involving a number of bodies and groups in a phased approach.

Phase 1 (Completed)
Phase 1 was an investigation of the site using non-intrusive methods, primarily a desk-based assessment by the author, a LiDAR survey by Dr. Steve Davis of University College Dublin and a geophysical survey by Dr. James Bonsall of Earthsound Archaeological Geophysics.

Phase 2 (Completed)
A series of small hand-excavated test trenches to assess anomalies and features of archaeological potential identified during Phase 1. This was carried out by the author under excavation licence 15E0101.

Phase 3 (Current Phase)
The ground work of the third phase is now completed and detailed in this report. It consisted of a partial excavation of tomb DU025–001001. The post-excavation analysis is currently underway and will culminate in a final report within one year.

1.3 Archaeological & Historical Background

Two megalithic tombs, thought to be passage-tombs dating to the Neolithic period, are recorded on Montpelier Hill, County Dublin in the SMR as DU025-001001 and DU025-001002. A passage-tomb is defined as being 'a round mound, usually surrounded by a kerb of large stones, enclosing a burial chamber, usually with a corbelled roof, which is entered by a passage, usually lintelled. Many tombs have side and end recesses opening off a central chamber, resulting in a cruciform plan. Cremation was the predominant burial rite in passage tombs which primarily date from 3300–2900 BC, though some simpler tombs in Carrowmore, County Sligo, have produced radiocarbon dates suggesting use even earlier in the Neolithic, circa 4000 BC' (National Monuments Service; Scope Note, www.archaeology.ie).

The larger of the two tombs, and the focus of this excavation; (DU025-001001), is located immediately to the south of the eighteenth-century building known as 'The Hellfire Club'. The

remains of this possible tomb now appear as a low mound, that has a diameter of approximately 26m. Visible undulation of the ground suggests the below-surface existence of at least part of the stone cairn that once would have covered the tomb (see Plate 3). This tomb is said to have been largely demolished and its stone cairn quarried, when the Hellfire Club was constructed in the eighteenth century.

Plate 3: Tombs DU025-001001 & DU025-001002 from the air

There are no visible above-surface remains of the smaller of the two tombs (DU025-001002). It was plotted as being immediately to the east of the larger tomb, and south-east of the Hellfire Club building. The exact location and nature of this tomb was identified and recorded by the geophysical survey conducted as part of Phase 1 (please see Report 14R0033 by Gimson, H. & Bonsall, J. 2014).

An important account of the site comes from the eighteenth century antiquarian Austin Cooper, who visited Montpelier Hill in 1779, just 54 years after the construction of the hunting lodge. He recorded that:

'*On The Top of the Hill of Montpelier stands a house built by the late Mr. Connolly, it is all arched & is now entirely out of Repair. Upon the Top of this Hill formerly stood a Kairn, which was removed to make room for the house… behind the house are still the Remains of the Kairn, the Limits of it, were composed of large Stones set Edgeways, which made a sort of a Wall or*

Boundary of abt. 18 Inches high & withinside those, were the small stones heaped up. It is 34 yards Diameter or 102 in Circumfe. In the very Centre, is a large Stone 9 feet long, 6 feet broad & abt. 3 feet thick, not raised upon large Stones but lying low, with the Stones cleared away from about it. There are several other large Stones lying upon the Heap. About 60 yards S.W. of this Stands a single Stone, of abt. 5 feet high, but whethr. it is a part of this Druidical Remains, or only put up there for the Cattle to scratch themselves (the Use it is now made of) I shall not positively say'.

(from the diaries of Austin Cooper, Montpelier eighteenth July 1779, in Price, L. (ed) 1942).

This account suggests that the tomb was not wholly destroyed by the construction of the Hellfire Club in 1725, and that significant features such as a kerb (…*large Stones set Edgeways, which made a sort of a Wall or Boundary…*), and large stones that may have formed part of key features such as the chamber or passageway, along with a possible standing stone, were still present at the time of his visit in 1779. Unfortunately, many of these features, including the possible kerb, are not in existence today. The construction of the Old Military Road is a likely culprit for the removal of these features. Construction of the Military Road commenced in 1800 in the aftermath of the 1798 rebellion of the United Irishmen, after which many rebels continued to hide out in the remote Wicklow Mountains. The road led from Rathfarnham in County Dublin to Aughavannagh in County Wicklow, and the remnants of the cairns at the Hellfire Club could well have provided a convenient (and still potentially substantial) source of stone.

The tombs are recorded in the Sites and Monuments Record:

'what survives today south of the Hellfire Club is a horse-shoe shaped embankment or mound with a hollowed interior, opening to the North-North-East. There is evidence for a recent fire in the interior. There are two stones visible along the perimeter in the south-east. To the east are traces of a second cairn (c.18m in diameter)'

(National Monuments Service, Sites and Monuments Record (DU025-001001). Recorded by Stout, G. 1993).

The two tombs form part of a major cluster of megalithic tombs in the Dublin and Wicklow mountains (Fig 1). In this region, eleven passage-tombs have been identified (Cooney, G. 2000). They possibly form an extended cemetery, all are in prominent locations with extensive vistas over the landscape. This extended cemetery appears to encompass a number of the summits of the South Dublin Mountains, and extends into North Wicklow. Other examples of passage-tombs in this extended cemetery in the Dublin Mountains were identified by Christiaan Corlett of the National Monuments Service, and includes tombs at Seahan, Tibradden, Kilmashogue, Fairy Castle, Two Rock Mountain, Saggart Hill and Killiney Hill (Corlett, C. 2012); to which it is reasonable to add the tombs of North Wicklow like Seefin, Seefinghan and other possible passage-tombs like Lackan, Tornant Upper, Blakestown Upper, and the tomb at Tuckmill Hill.

Not all of these tombs may be definitively Neolithic passage-tombs, as antiquarians investigating the tomb at Tibradden in 1849, discovered a Bronze Age Food Vessel along with cremated human remains. Though as Corlett points out, it is not unusual to discover that people during the Early Bronze Age reused older sacred sites for their own burials.

Artefacts dating to the Neolithic period have been discovered in the vicinity of the possible tombs. In 1986 Dr. Stefan Bergh (now of NUI Galway Archaeology Department), who was visiting the Hellfire Club, found a chert scraper [a small prehistoric stone tool] approximately 20m north-west of the larger of the two tombs (National Museum of Ireland Topographic Files; Register No. 1986:46).

The Hellfire Club building is listed in the National Inventory of Architectural Heritage as Reg.No. 11220022. The inventory describes the building as a: '*Detached five-bay single-storey-over-basement former hunting lodge on hill summit, built c.1740, burnt soon after, with vaulted stone roof repair, now derelict. Projecting porch / gallery with arched window to front, between plain openings in main elevation. Two wings with small rooms and sloping stone roofs, and projecting shelter walls. Projecting wing to rear with small semi-circular window. Internal rooms with fireplaces, arched doorways and niches, and connecting gallery. Robbed megalithic tomb and triangulation survey pillar nearby*'.

Plate 4: The front of the hunting lodge popularly known as The Hellfire Club

With its central half-octagonal projection, and two low flanking wings; the Hellfire Club is similar in architectural design to a mid-eighteenth century house at Mount Gordon in Castlebar in County Mayo (Craig, M. 2006). Like the house at Mount Gordon, it is likely that the main entrance was on the upper floor, with the lower floor being used as a kitchen, storage and for servants quarters. The upper floor had two large rooms, each lit by two large rectangular windows in the northern side, taking advantage of the wonderful views over Dublin (please see Plate 5). Both of these rooms are equipped with a fireplace. It is possible that these rooms originally served as a dining room and drawing room. Above them, though now unreachable, it is evident that there was a third storey, and this possibly provided accommodation.

Plate 5: The view over Dublin from immediately in front of the Hellfire Club. With such a vista it is easy to understand what attracted the neolithic tomb builders, and later William Conolly, to such a spot.

The building and its layout was described in 1899 as:
'*...the house consisted of two large rooms and a hall on an upper floor. These rooms are sixteen feet square, each of them lighted by two tall windows, almost eight feet by three feet six inches, commanding a most extensive and magnificent view. There are two arched niches at each side of the rooms, with large fireplaces. Over the parlour and hall there was a small loft, but none over the drawing room. The hall door was reached by a lofty flight of stone steps; these, with most of the other cut granite stones about the house, were taken away at the time of the building of Lord Ely's hunting- lodge, lower down the hill.*

Underneath the drawing-room was the kitchen, where the jambs of the great fireplace, ten feet wide, are still to be seen. There was a servants' hall at the other side, and there were two rooms built out at each end of the house. There were also two small apartments in a return opposite the hall door. The windows all face the north, for in the rear there are only a few narrow slits like embrasures. A semi- circular courtyard was in front with a gate in the centre. The walls are all very thick, built carelessly of rubble stone. The arched roof is of stone, as are the floors.' (Domville Handcock, W. 1899)

The unusual building was constructed as a hunting lodge for William Conolly in 1725. William Conolly, was originally from Ballyshannon in County Donegal. He was the son of a publican, but had a stratospheric rise through the ranks of Irish society to become one of the wealthiest and most powerful men in the British Isles. By the age of 34, his annual income was estimated to be in the region of £17,000 (roughly equivalent to over £3 million pounds per year). He had a residence on Capel Street in Dublin, and his grand estate at Castletown in County Kildare is one of the finest examples of Palladian architecture in the British Isles (O'Brien, J. & Guinness, D. 2005). He was a famous parliamentarian, and achieved the rank of Speaker in the Irish Parliament from 1715–1729, a role that became synonymous with him, as he became known as William 'Speaker' Conolly. He was widely acknowledged as the wealthiest man in Ireland by the time of his death in 1729.

In 1723–5, William Conolly purchased Rathfarnham Castle and a considerable amount of land and estates from The Duke of Wharton. This purchase included the land of Montpelier Hill. He chose this part of the estate to establish a 1,000 acre deer- park and he constructed the unusual Hunting lodge on the summit of the hill. He chose the location as he believed it would be possible to see both his great estate at Castletown and his newly acquired Rathfarnham Castle from the Hunting lodge. William Speaker Conolly died in 1729; a mere four years after the construction of his new Hunting lodge. The lodge stood empty until 1735; when it was rented by members of The Hellfire Club. They are said to have leased the building until the death of their leader, Richard Parsons, Earl of Rosse in 1741. In 1749 the building was purchased by Charles Cobbe, son of the Archbishop of Dublin. He died inside the building in 1751, just two years after he purchased it (Bohill, Kelly & de Gascun, 1991).

The Hunting lodge then appears to have quickly fallen into disrepair. In 1763, much of the stonework and architectural features, along with the fine granite steps that lead into the building were taken away by Lord Ely to be reused in the construction of Killakee House nearby. Further significant damage was recorded when tar barrels were burned on the roof to create a large welcoming fire-beacon for Queen Victoria when she visited Dublin in 1849.

The building was described in 1899 as *'... a mere ruin, each winter hastening its decay. It is only used as a shelter for cattle. The lower rooms are half filled with manure and rubbish. The stone*

staircase, that I can remember inside, is all gone and the cattle can no longer ascend to the drawing- rooms as they used to do. The only way of getting to these rooms now is by climbing up the front wall to the hall-door; while the room in the return is almost inaccessible, except to an active climber' (Domville Handcock, W. 1899).

The building then seems to have been left in this derelict condition until Coillte acquired the land in the 1960s. They carried out extensive restoration of the building and roof, and added a concrete staircase and steel bars over the windows to make it safer for the many visitors who frequent the site. The building and Montpelier Hill itself remain as a great asset to the locality and it is a popular and much-loved place for dog-walkers, joggers, families and those who want an unusual but scenic place to get away from it all. The Hellfire Club also remains a very popular venue for horror- themed tours around the Halloween Period, with a number of local guides bringing visitors around the atmospheric building while chilling them with tales of supernatural terror from the large amounts of folklore that surrounds the site.

Plate 6: The Hellfire Club

2. The Excavation

Excavation was carried out during October 2016, in unusually dry and settled weather conditions.

2.1 Excavation Methodology

In the original methodology, the excavation was to encompass the south-east quarter of the passage tomb, with the excavated quadrant measuring 25m x 20m. In order to better assess the nature of the potential archaeology, the excavation began with a 15m x 2m trench, hand-excavated along the western side of the quadrant. When this trench revealed that the mound was of high archaeological potential and complexity, it was decided to then alter the strategy to maximise resources in an attempt to answer key research questions. The strategy was altered to excavate two trenches; the initially opened 15m x 2m cutting became Trench 1, and Trench 2 was also opened, this time measuring 10m x 2m.

The sod was cut by spade, removed by hand and stacked neatly on plastic adjacent to the excavation area for later backfilling. The upper topsoil layers of the trenches were removed by hand using mattocks and shovels. All archaeological layers were excavated by trowel. Any artefacts and samples were bagged and recorded by context and 3D co-ordinates on a local floating grid were taken. Soil samples were also retained for environmental analysis (see ongoing post-excavation work below). All contexts were recorded on context sheets. Plans and sections were drawn on pre-gridded permatrace, using planning frames and off-sets, as appropriate. Laser scanning and photogrammetry of the megalithic art was also carried out on-site.

Plate 7: Team member Dr Ros Ó'Maoldúin excavating the topsoil layer with a mattock.

2.2 Results of the Archaeological Excavation

Trench 1

(SW corner – 311429.5E/223658.5N)

Trench 1 measured 15m x 2m and aligned approximately north – south. It extended from the south of the monument, into its centre, and traversed the bank/highest remnant of the cairn. The purpose of Trench 1 was to ascertain whether the bank did indeed represent the in-situ remains of a prehistoric tomb, and if so, to assess the level of disturbance of the early modern period. If the mound did indeed prove to be in-situ archaeology, another key aim of the trench was to retrieve any material suitable for radiocarbon dating.

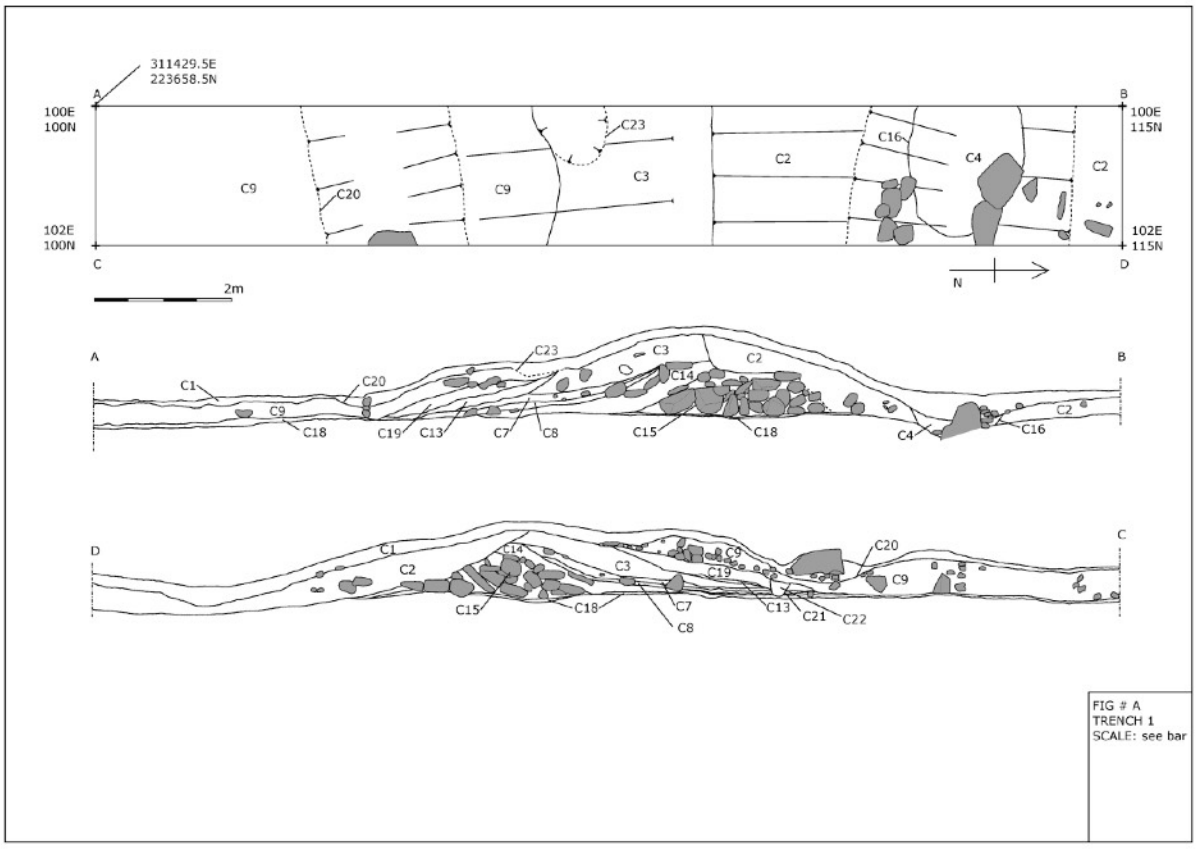

Fig 3 Trench 1

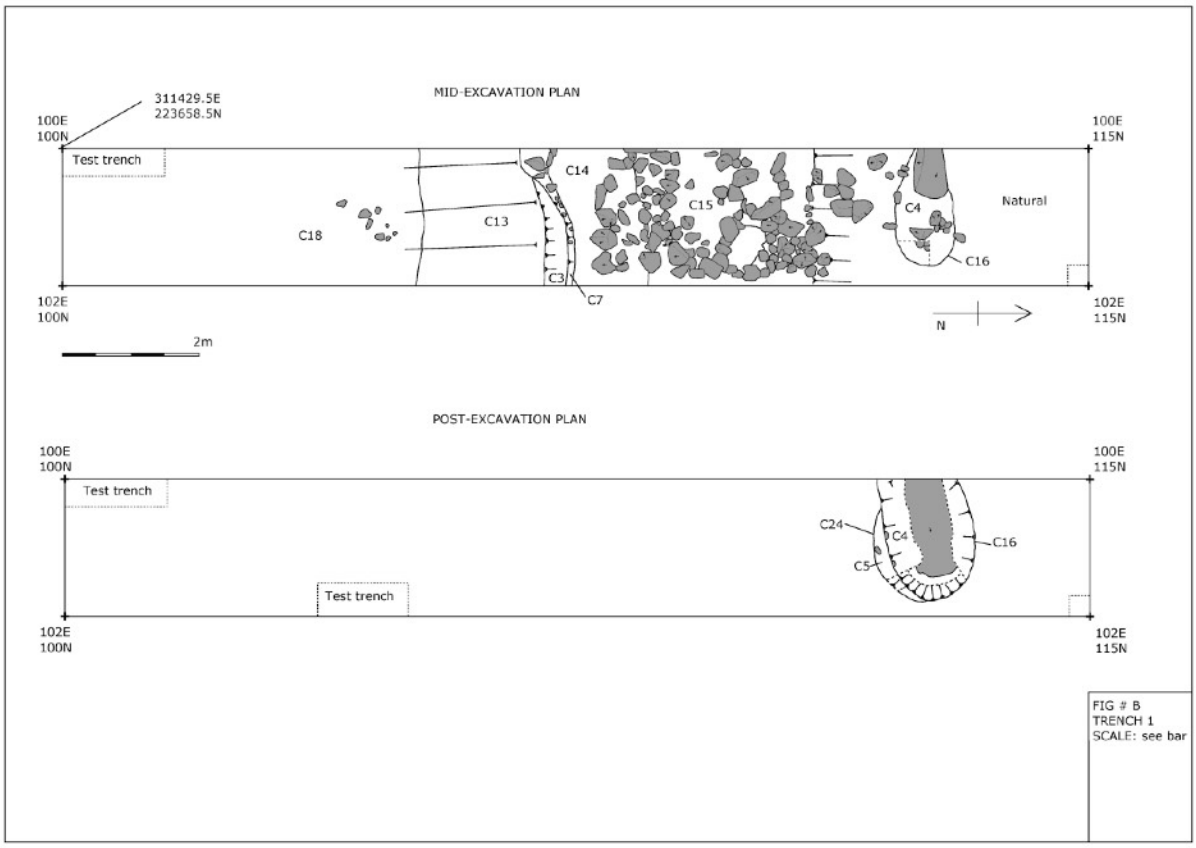

Fig 4 Trench 1

The oldest layer encountered in Trench 1 was a clay layer (C18), sealed beneath the cairn. This comprised light bluish-grey silty clay with very occasional flecks of charcoal, 0.06m deep. This was relatively well-sealed where it was encountered beneath the cairn material. The only artefacts retrieved from this layer were two potentially worked pieces of flint. These were found in (C18), just to the south of the cairn material.

The surviving cairn material (C15) in Trench 1 lay directly on top of (C18). (C15) comprised 2-3 courses of large stones up to 0.5m in diameter. These were loosely stacked and frequently interspersed by voids.

On the southern side of the cairn remnant there was a series of 6 potentially prehistoric layers, (C14), (C8), (C7), (C3), (C13) and (C19). These were approximately 0.8m in depth combined (See Appendix 3 for individual descriptions). They comprised gravels and silty clays in alternating mid-brown and bluish grey layers, interspersed with layers of iron-pan. It is likely that the bluish grey clay-like components of these layers were created through leaching and gleying processes, caused by the impermeable barriers of iron-panning. These layers may have been an original part of the construction, and possibly represent layers of cut sods that were piled around the outer edge of the cairn to help to prevent the loose stone from slipping outwards at the base.

A cut (C21), truncating the series of layers on the cairn, was noted in the east facing section of T1. It was 0.52m wide and 0.6m deep and cut through the uppermost of these layers, (C19). It was located under a large boulder, which could conceivably have been a kerbstone, and it could have served as its socket, but if so the kerbstone was later than all of the layers in that sequence. (C21) was filled by a mid-orangey brown silty clay, (C22), lighter in colour than, but not dissimilar to, the local topsoil.

A layer of fist-sized angular stones and dark blackish brown clayey silt c.0.35m (C9) covered was banked up against the outside of the cairn and extended south from it for the distance exposed within the trench (c.4m). It contained relatively modern, eighteenth–nineteenth century artefacts and is likely to represent disturbed backfilled material from a previous building or quarrying episode. One piece glazed tile, potentially medieval [though more likely eighteenth century], was found within this deposit.

Plate 8: Working shot of Trench 1

A shallow ditch (C20) runs around the exterior of the monument, visible as a topographical trace that closely follows the curvature of the mound. Where exposed within the trench it appeared to cut into (C9), the relatively modern layer, and have no expression lower down. This ditch quite probably represents a 'robber trench', from the removal of the kerb during the quarrying of the tomb for the Old Military Road in the first decade of the nineteenth century.

A layer of mid-yellowish-brown moderately compacted silty clay and gravel (C2) sat on the interior of the bank and in the middle of the monument (in the north of trench 2). Approximately 6m was exposed within the trench and it was a maximum of 0.7m deep. It is

likely to be quarry-backfill. An eighteenth – nineteenth century clay pipe and a glazed tile (potentially medieval or eighteenth century in date) were recovered from near the top of this context.

Several large stones protruded from the earth, at the base of the slope created by the bank, on the interior of the monument prior to excavation. They proved to be out of their original position, and sitting in modern bonfire debris in the upper portions of a pit (C16) cut into C2. The upper material was full of very recent rubbish, beer cans, etc. A number of large boulders were rolled out of this debris, one of which was found to have megalithic art (see description in Finds below). Underneath this material, was an oval east-west aligned pit with rounded corners and steep sides that broke gradually at the base to a flat base. 1.9m of its length was exposed within the trench, and it was 1.6m wide and 1.48m deep. It contained a very large granite boulder, almost 2m in length, and was filled by loose friable dark brown clayey silt containing frequent pebbles (C4) and some larger stones. Window glass was found near the base of the cut under the large stone. This possibly represents evidence of an attempt to remove the large stone to utilise it either in the construction of the hunting lodge, or the later construction of the Old Military Road. The possible remnant of an earlier pit (C24) was noted. The earlier cut was shallower and only survived along the southern edge of (C16). The portion that survived was 1.4m long, 0.3m wide and 0.28m deep. It was filled with mid yellowish brown firmly compacted clayey silt containing occasional rounded pebbles (C5). No finds were recovered from the small portion that was excavated. The large stone in (C16) may have been a chamber orthostat and the earlier pit remnant (C24) may have been its socket.

Plate 9: Trench 1 & 2 from above

Plate 10: The cairn (C15)

Plate 11: Pit (C16) mid-excavation

Plate 12: (C13) in section (photograph by Steven Duffy)

Trench 2

(SW corner – 530524.831 / 706891.316 ITM)

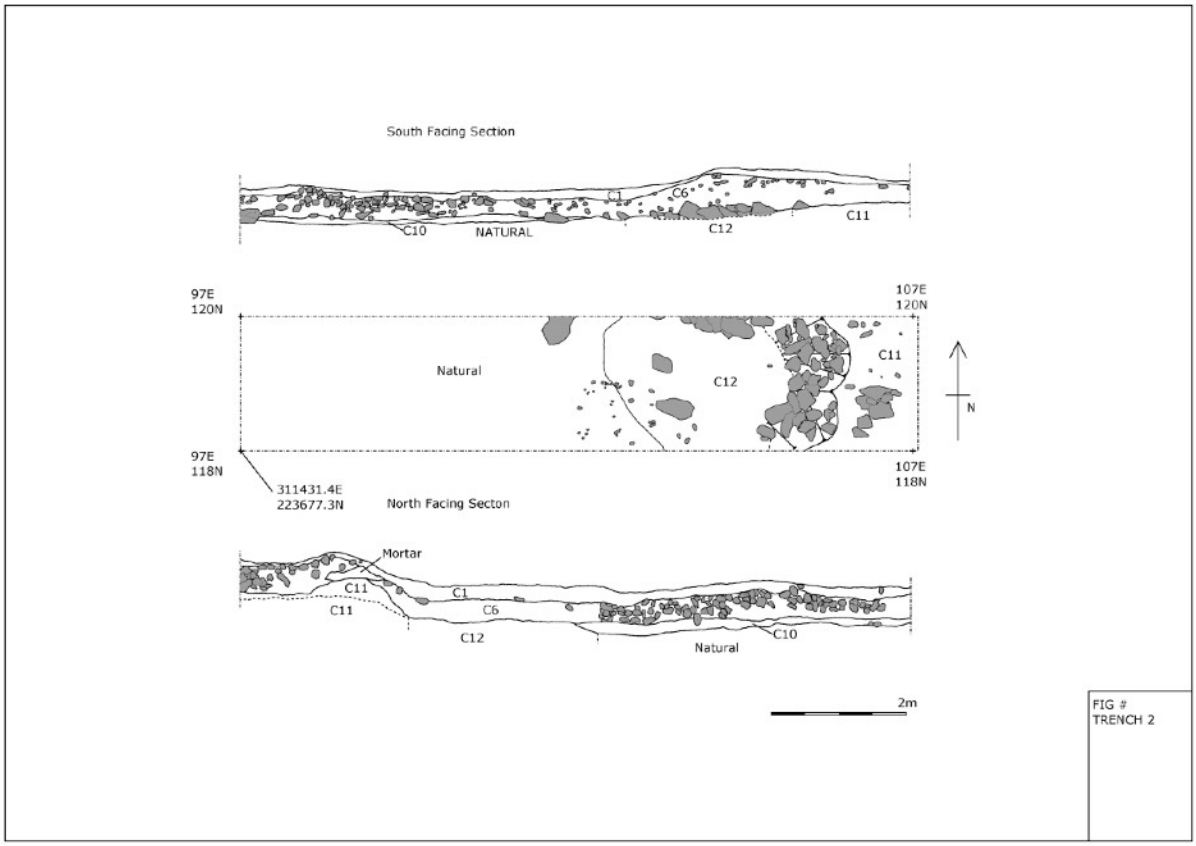

Fig 5 Trench 2

Trench 2 measured 10m x 2m, and was orientated east–west in the northern part of the tomb. It was positioned to evaluate the potential for archaeological features to survive even in the most disturbed and damaged part of the monument. At this part of the monument, the circular 'bank' is largely invisible having been flattened and landscaped during the construction of the hunting lodge.

Only the upper layers of Trench 2 were excavated. A quantity of modern and early modern debris was discovered during the removal of the sod and topsoil (similar material though in smaller quantity to that discovered in Trench 1). Following the removal of the sod and topsoil, a layer of disturbed material (C6) was identified. This contained a substantial quantity of small–medium sized stones, along with eighteenth & nineteenth century artefacts, mortar and eighteenth century brick. It appeared that this context represented backfill and waste from the disturbance of the tomb. The presence of large chunks of mortar and brick suggests that it is possible that it represented the early nineteenth century disturbance during the quarrying for the Old Military Road. Some possible flint artefacts and a particularly fine polished stone axehead were also recovered from this layer, presumably having been accidentally disturbed

from their original context. This context is possibly the same as (C9), that appeared in the southern end of the Trench 1.

At the eastern end of Trench 2, features of archaeological potential were identified, with similar contexts to those discovered in Trench 1. Though due to time and resource constraints, we did not excavate those layers, they appeared to be in-situ elements of the tomb. This discovery suggests the high potential for significant archaeological features and deposits even in the most disturbed area of the site.

Plate 13: (C6) exposed in Trench 2

Plate 14: Trench 2 facing west

Plate 15: Trench 2 facing east

3. Artefacts

3.1 Post-Medieval Artefacts

As would be expected in close proximity to a large eighteenth century building and in a place so popular over the years for hillwalkers, picnics and parties, a large assemblage of eighteenth, nineteenth and twentieth century artefacts were recovered during the dig. Of the more recent twentieth century artefacts, a representative sample of material was kept and the rest suitably disposed of. The representative sample includes pottery, glass, bottle tops and other detritus, mainly from recreational activity. A number of twentieth century coins were also discovered, including (Find 1:5) a one penny piece (1937) that was found together with a halfpenny (1939) presumably where they had slipped from the pocket of an unfortunate visitor to the site who was reclining on the mound (please see Plate 16).

Plate 16: Two coins (F:1.5) in-situ

Two pieces of tile (F:2.2 & F:9.1) were found within the upper fills of Trench 1. These tiles appear to have the remains of a lead glaze, they are similar to those of medieval date though they may well represent a 'rusticated' type tiling from the kitchens or working area of the hunting lodge. They certainly bear further examination by an expert to assess the likely period and provenance.

Of the post-medieval artefacts, perhaps the most evocative is the very fine clay tobacco pipe (F:2.1) that was recovered from Trench 1 (please see Plate 17). It is bears zoomorphic decoration, with a bird's claw holding the pipe bowl, (perhaps the bowl represents an egg). The pipe is likely to date to the first half of the nineteenth century, though it will be assessed by an expert to obtain a more definitive date.

Plate 17: Clay tobacco pipe with zoomorphic design (F:2.1) [Steven Duffy]

3.2 Prehistoric Artefacts

A number of artefacts of prehistoric date were recovered during the excavation. These included a number of pieces of worked flint, likely to represent debitage, waste material during the manufacture of flint tools. Some pieces of possibly worked chert were also discovered. A visitor to the site brought a large flint blade that they had discovered on the slopes of Montpelier Hill some years ago. All of the lithic assemblage will be subject to expert analysis.

Plate 18: Polished stone axehead (F:6.1) [Ken Williams, Shadows & Stone]

A fine example of a polished stone axehead (F:6.1) (please see Plate 18) was recovered from an upper layer of Trench 2, where it had presumably come to rest after being disturbed from its original context by either the construction of the hunting lodge, or by the quarrying for the Old Military Road. From initial observation, it looks as if the axehead had never been used, as there are no obvious signs of wear or damage along the cutting edge (please see Plate 19). However the axehead is clearly broken at the back. This may represent a ritual offering, with the axehead being made especially to be interred within the tomb, perhaps as a grave good or possibly an offering to the ancestors or ancient gods. The break may well have been deliberate, as an act of ritually 'killing' the object in this world so it is useful in the otherworld. A similarly broken axehead was discovered during the excavation of the Mound of the Hostages, the neolithic passage tomb on the Hill of Tara in County Meath (O'Sullivan, 2005).

Plate 19: Polished stone axehead (F:6.1), note lack of wear on cutting edge [Ken Williams, Shadows & Stone]

The discovery of megalithic art (F:1.9) is highly significant, as it gives extremely strong evidence that the tomb is indeed a passage tomb as megalithic art is found almost exclusively on passage graves in Ireland (Shee Twohig, E. 1981). Although the large stone that bears the art was found ex-situ, it is quite likely that it originally formed part of the kerb or burial chamber of the tomb, and was disturbed during the quarrying of the site in the eighteenth or nineteenth century. The position of the stone, exposed to the elements and the boundary of many modern bonfires, has led it to be very weathered and it has clearly suffered damage from burning. Therefore the art is very ephemeral and difficult to discern with the naked eye in less than perfect light. Laser scanning by Robert Shaw and Gary Devlin of the Discovery Programme, and photogrammetry by Ken Williams of Shadows & Stone have helped to reveal the art in detail. Further expert analysis of the art may reveal more information.

Plate 20: Team members Neil Jackman (left) and Dr Ros Ó'Maoldúin (right) with (F:1.9) [Ken Williams, Shadows & Stone]

Plate 21: Megalithic art (F:1.9) [Ken Williams, Shadows & Stone]

4. Post Excavation Works to be Carried Out

4.1 Environmental Processing & Radiocarbon Dating

Bulk soil and charcoal samples were taken during the excavation. A selection of these samples will be wet-sieved to retrieve charcoal or other organic material. Any charcoal retrieved will need to be identified by an appropriate expert, with an appropriate selection sent for radiocarbon dating. It is hoped that at least three samples from within and below the cairn and mound material will be found suitable for radiocarbon dating, therefore providing a possible construction date of the tomb.

A suitable sample from the mound material will be selected for pollen analysis to help to gain an understanding of the local environment and flora at the time that the tomb was constructed.

4.2 Artefact Analysis & Processing

All pre-nineteenth century artefacts will be photographed, illustrated and assessed by appropriate experts, with reports submitted to inform the Final Report for this excavation. The megalithic art will be assessed in terms of its geology and decoration by appropriate experts. It will also be subject to further laser scanning, to identify all decoration and to aid in its possible reconstruction in the future.

5. Conclusion

The excavation was carried out in the hopes of:

a) Discovering whether the earthworks at the rear of the Hellfire Club did indeed represent the remains of a megalithic tomb.
b) If it did prove to be a tomb, we hoped to discover material suitable to provide a secure date, so the tomb can be placed in the overall chronology of passage tombs in Ireland.

Based on the archaeological features encountered, and the artefactual assemblage – particularly in light of the discovery of megalithic art – it can be said with confidence that the remains of DU025–001001 represents a neolithic passage tomb. If we can obtain radiocarbon dates from the charcoal material discovered in the lowest layers of the cairn, we should be able to securely date the construction of the monument and place it within the overall chronology of Irish passage tombs. Similarly, detailed analysis of the artefactual assemblage could reveal much about the use and activity associated with the monument and landscape. Post excavation analysis of the materials, samples and artefacts from the excavation has great potential to lead to further information about the nature, period and activity on the site.

As Trench 2 proved that even at the most disturbed part of the site there is significant potential for the survival of buried archaeological contexts. This discovery offers great potential for future archaeological excavation to discover more of the story of the tombs of Montpelier Hill. An excavation that targets the north-eastern quadrant of the tomb may reveal the stone sockets that held the orthostats upright. This will allow the orientation of the passageway to be identified, and could lead to information about whether the tomb was aligned to any particular geographical feature, or whether it had an alignment to a solstice or astronomical feature. The discovery of surviving archaeology at such a disturbed point also gives hope that a partial excavation of the smaller tomb (DU025–001002) may provide evidence about the nature and period of this monument. This could answer key questions such as, does the smaller tomb date to the same period as the larger? If so, does this indicate a societal hierarchical message? Or does the tomb date to another period? In which case does it suggest an ongoing cultural or spiritual focus on Montpelier Hill as a sacred landscape?

Though this small excavation can be considered a success, it is clear that Montpelier Hill is a landscape rich in archaeology, history and folklore and deserving of much focused study for the future.

6. Appendices

6.1 List of Contexts

Context	Description	Dimensions (Maximum)	Cutting
1	Sod and topsoil.		1 & 2
2	Mid yellowish brown moderately compacted silty clay and gravel.	L: 6m exp., W: 2m exp. & D: 0.7m	1
3	Light blueish grey firmly compacted silty clay containing occasional small stones, flecks of charcoal and veins of iron panning.	L: 4.5m exp., W: 2m exp. & D: 0.48m	1
4	Loose/friable dark brown clayey silt containing frequent pebbles and some larger stones. Fill of C16.	L: 1.9m exp., W: 1.6m & D: 1.48m	1
5	Mid yellowish brown firmly compacted clayey silt containing occasional rounded pebbles. Fill of C24.	L:1.4m, W:0.3m & D: 0.28m	1
6	Yellowish brown moderately compacted yellowish brown silty sand containing small to large sub-angular stones, post-medieval brick and mortar.	L:extent of trench, W: extent of trench & D: 0.38m	2
7	Light yellowish brown silty clay and grit containing frequent sub-rounded gravels.	L:3.3m, W:2m exp. & D: 0.25m	1
8	Light bluish grey silty clay containing frequent flecks of charcoal.	L:4.2m, W: 2m exp. & D: 0.23m	1
9	Mixed fist-sized angular stones and dark blackish brown clayey silt containing modern finds.	L:3.5m, W:2m exp. & D: 0.35m	1
10	Mottled light cream and light orangey brown friable silty sand containing occasional charcoal flecks.	L:5.15m, W: 2m exp. & D: 0.13m	2
11	Mottled orangey brown and cream friable sandy clay with a high degree of iron panning.	L:2.3m exp., W:2m exp. & D:Unknown	2
12	Light yellowish cream soft clay containing small to large stones.	L:3.1m exp., W: 2m exp. & D: Unknown	2
13	Dark bluish grey silty clay containing frequent flecks of charcoal.	L:3.2m, W:2m exp. & D: 0.16m	1
14	Cairn material. Mid orangey brown clayey silt and grit containing occasional small and large stones.	L:3.5m, W:2m & D:0.65m	1

15	2-3 courses of large stones (up to 0.5m in diam.) loosely stacked with frequent intermittent voids.	L:2.6m, W:2m exp. & D/ H:0.7m	1
16	Large oval pit with rounded corners with steep sides that broke sharply at the top and gradually at the base. It had a flat base and was orientated east-west. Filled by C4	L:1.9m exp., W:1.6m & D:1.48m	1
17	VOID	VOID	VOID
18	Light bluish grey silty clay with very occasional flecks of charcoal.	L:10m exp., W:2m & D: 0.06m	1
19	Mottled mid orangey brown and dark brown silty sand containing frequent small angular stones.	L:2.2m, W:2m exp. & D: 0.29m	1
20	Linear ditch running around the outside of the bank edge. It had gently sloping sides that broke gradually to a concave base. It ran through the trench in an east-west direction. Filled by topsoil and stone.	L:2m exp., W:1.3m & D: 0.34m	1
21	Not discerned in plan/only recorded in section. Cut of a pit with steep to vertical sides that broke gradually to a rounded base. Filled by C22.	L:?, W:0.52m & D:0.6m	
22	Mid orangey brown silty clay.	L:?, W:0.52m & D:0.6m	
23	Cut of an oval pit with rounded corners and gradually sloping sides the broke gradually to a concave base. Orientated east west. Filled by topsoil	L:0.8m exp., W:0.75m & D:0.25m	
24	Cut truncated by later cut C16. Appears to be the remnant of the cut of a pit with a curved edge, possibly circular or oval, and moderately sloping sides.	L:1.4m survives, W:0.3m survives & D:0.28m survives	

6.2 Appendix 2: List of Artefacts

Find #	Material	Description	Context	Trench
F1.1	Various	Modern and post-medieval glass, pottery and other assorted finds	1	1
F1.2	various	Modern and post-medieval glass, pottery and other assorted finds	1	1
F1.3	stone	Water rolled stone – potential hammerstone.	1	1
F1.4	various	Modern and post-medieval glass, pottery and other assorted finds	1	2
F1.5	metal	Two coins found together	1	1
F1.6	Metal	Three coins	1	1
F1.7	stone	Small water rolled stone	1	1
F1.8	stone	Possible worked sandstone	1	1
F1.9	stone	Megalithic art. Large stone in 4 parts	1	1
F2.1	Ceramic	Clay pipe bowl and stem	2	1
F2.2	Ceramic	Floor tile with glaze- possibly medieval	2	1
F3.1	Stone	Flint flake	3	1
F3.2	Stone	Chert flake	3	1
F3.4	Stone	Flint flake (possibly burnt)	3	1
F3.5	Stone	Chert (possible debitage)	3	1
F4.1	Glass	Post medieval window glass	4	1
F6.1	Stone	Polished stone Axehead	6	2
F6.2	Brick	Post medieval bricks	6	2
F6.3	Stone	Possible flint core	6	2
F6.4	Stone	Flint (possibly burnt)	6	2
F6.5	Stone	Possibly shaped stone	6	2
F9.1	Ceramic	Floor tile with glaze (possibly medieval)	9	1
F14.1	Stone	Chert flake	14	1
F18.1	Stone	Flint (possible debitage)	18	1
F18.2	Stone	Flint (possible debitage)	18	1

6.3 Appendix 3 List of Samples

Sample	Description	Context	Cutting
1	Bulk Soil sample	3	1
2	Bulk Soil sample	8	1
3	Bulk Soil sample	14	1
4	Bulk Soil sample	18	1
5	Mortar sample	6	2

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