APPENDIX A: Static survey - bat passes data

Table 32 below shows the total number of passes detected by the Kaleidoscope software within each survey month for each position, after data handling and removal of noise.

Table 32: Number of passes recorded by each detector in each deployment (post data handling)

Count of File	Month (number of passes recorded)						Total Passes
Static Location	May	June	July	August	September	October	Total
A	2799	2191	2478	1703	5058	180	14409
B	1996	2653	3561	1998	5993	450	16651
C	628	296	92	52	58	1320	2446
D	862	839	316	209	406	1260	3892
E	711	522	375	*	541	87	2236
F	156	101	103	60	59	339	818
G	3494	1045	448	495	95	2252	7829
H	52	506	606	16	153	24	1357
Total Passes	10698	8153	7979	4533	12363	5912	49638

* Bat detector technical fault – no bat data recorded

APPENDIX B: Static survey - hours of data recording analysed

Table 33: Hours of data recording assessed at each deployment location

Position	Month (hours of data recorded)					Total hours
	May	June	July	August	September	
A	47.58	42.18	46.83	55.18	62.15	73.87
B	47.58	42.18	46.83	55.50	62.15	73.87
C	48.08	42.18	37.38	33.25	63.77	73.30
D	48.08	42.18	46.83	54.60	75.55	73.30
E	47.58	42.20	46.60	*	24.15	73.87
F	47.58	42.20	46.83	55.50	65.68	73.87
G	47.58	42.18	47.30	55.82	63.25	73.00
H	47.58	42.18	18.78	10.80	63.45	73.00
Grand Total	381.64	337.48	337.38	320.65	480.15	558.08

* no data recorded – considered likely to be detector technical issues

APPENDIX C: Full results of bat static surveys

Table 34: full data from static bat surveys

Month	May								May Total	June							June Total	July							July Total	August							August Total	September							September Total	October							October Total
SPECIES	A	B	C	D	E	F	G	H		A	B	C	D	E	F	G	H		A	B	C	D	E	F	G	H		A	B	C	D	E	F	G	H		A	B	C	D	E	F	G	H		A	B	C	D	E	F	G	H	
BARBAR																																															1	1	2
BIG BAT	1					1	1	1	4		1	2						3	15	8	1	5	1	2	1	1	34	5	106	2	2				115	5		46		1				4	51								1	1
EPTSER	1	1			1	1			4		1			1	1	1		4	6	4						1	11	2	193						195	2	4	26	1	1				32									
MYODAU																																														1		4		5
MYONAT								1	1								1	1																											2	1			3	11	1	18
MYOTIS	4	15	4	3	1		10	5	42	2	11	2	2	5	2	22	2	48	5	35		2			7	3	52	3	24	2	2		11		42	3	11	6		6		1	15	16	55	61	6	3	3	2	9	49	7	140
NYCLEI			1		3				4				4		2			6		4					2	2	8		2		1			3										1			1		1	3
NYCNOC	2	3	9	1	27	15	40	7	104	4	6	3	13	12	6	20	27	91	8	12	3		2	7	2	1	35	4	24	4	4	1	4		41	4	17	115	4	4	3	5	1	18	167	3	1			5	2	3		14
NYCTALUS				1				1	2	2						1	4	7					1				1				1				1			7			1	1			9	1							1
PIP SP	12	9	16		21	4		2	64	220	4		35	35	5		1	300	72	71	24	20		35	8	11	241	89	3	1	3	22	8		126	89	45	31	6	10	2				94		2		7		129			138
PIPNAT					10			3	13	60	1	5	11				23	100							1		1										12	4		1		2			19		1	2	2			16		21
PIPPIP	2756	1917	596	853	644	1311	3442	31	10370	1890	2602	282	762	466	83	1000	447	7532	2363	3358	64	280	370	58	389	579	7461	1558	1611	40	192	34	458	16	3909	1558	4952	5644	43	3811	533	50	77	53	11733	1100	425	1310	1246	79	119	2062	7	5358
PIPPYG	22	38	1	4	3	4	1		73	10	6		11	2	2	1	1	33	6	25		9	1	1	3	6	51	38	16	1	3	3	1		62	38	7	97	2	2	1				109	2	7		2		75	102	1	189
PLECOTUS	1	13	1		1			1	17	3	21	2	1	1				28	3	44					35	2	84	4	19	2	1		13		39	4	3	24	2		1		2	62	94	1	6	4		1	1	4	5	22

APPENDIX D: Static survey - sm4 set up details

SM4 default settings

Deployment Scenario		Reason
SM4BAT-FS		
Start dd/mm/yy hh:mm:ss	Ignore	
Slot A	128GB	
Slot B	128GB	
Mic 0:	SMM-U1	
Trig Ratio (%)	10% (default)	
Battery (Wh)	72 Wh (default)	
Setting		
Prefix	SM4-FS-001 (to 030)	
Gain	12dB	
Timezone	UTC+01 *(= BST. Need to change to UTC when the clock go back)*	
Lat	xx.xxN	Add appropriate value
Lon:	yy.yyW	Add appropriate value
16 kHz HPF	Off	
Sample rate	256kHz	
Call duration min	0.5ms	
Call duration max	Off	
Call frequency min	10kHz *(default is 16kHz)*	
Trigger level	*Use default (12dB)*	
Trigger window	3s	
Trigger max time	00:15	
Sunrise/sunset		
LED delay off		
Schedule		
Start	Set – 00:30	
Duty	always	
End	Rise + 00:30	

APPENDIX E: Static survey - data verification results

- It was necessary to utilise Auto ID from the results of the static detector surveys due to the large number of files obtained (585,659 passes prior to data rationalisation). Kaledoscope Auto ID was utilised to conduct the Auto ID. Initially, four deployment records were fully analysed by human verification, and this was compared with the results from the Auto ID. The positions checked were:
- May, detector 3, SD card 102
- May detector 3, SD card 14
- May detector 29, SD card 7
- June detector 2, SD card 14

In total 16,203 passes were manually assessed. The results of these assessments are presented in Table 36 to Table 39. A summary of the results of this assessment is presented in Table 35

This was used to inform the requirement for manually identifying the calls by a human. In summary:

- Noise was almost always correctly identified by the auto ID (92% of the time identified correctly), this identification from the Auto ID was used and the data was removed from the dataset;
- Common and soprano pipistrelles were almost always correctly identified (99.125% identified to the correct genus);
- All other calls were not sufficiently reliably identified by the Auto ID so were manually identified for all deployments. These were calls auto ID identified as:
  - Noctule
  - Nathusius' pipistrelle
  - Brandt's bat
  - Whiskered bat
  - No ID
  - Daubenton's bat
  - Barbastelle
  - Serotine
  - Brown long-eared bat.

The results subsequent to this data rationalisation were used in all subsequent assessments.

Table 35: Summary of the results from bat data verification exercise

Species from Auto ID	Total count	Average exact	Average group	Data handling subsequent to the Auto ID
Noctule	74	60.75	60.75	All files checked
Nathusius' pipistrelle	16	0	75	All files checked
Common pipistrelle	3827	98	98.25	All files used as identified by Auto ID
Soprano pipistrelle	3	25	100	
Brandt's bat	1	0	100	All files checked
Whiskered bat	1	0	100	All files checked
Noise	12017	92.25	92.25	All files classified as noise
No ID	253	1.4	1.4	All files checked
Daubenton's bat	4	0	50.5	All files checked
Barbastelle	1	0	0	All files checked
Serotine	3	0	50	All files checked
Brown long-eared bat	3	50	50	All files checked

Table 36: Results from bat data verification exercise: May detector 3 SD card 102

Species id by Kaleidoscope	Files analysed	Exact Match	Match within same 'Group'	Comment
Noctule	19	16/19 (84%)	16/19 (84%)	All other files were verified as noise
Nathusius' pipistrelle	7	0/7 0%	7/7 (100%)	All files verified as common pipistrelles
Common pipistrelle	2382	2382/2382 (100%)	100%	All correct

Species id by Kaleidoscope	Files analysed	Exact Match	Match within same ‘Group’	Comment
Soprano pipistrelle	2	½ (50%)	2/2 (100%)	Small sample size
Brandt’s bat	1	0/1	1/1	File verified as Myotis
Whiskered bat	1	0/1	1/1	File verified as Myotis
Noise	4579	4425/4579 (96%)	N/A	Non-noise files verified as: 144 common pipistrelle (3%) 9 Myotis (0.19%) 1 noctule (0.02%)
No ID	154	1/154 (0.6%)	N/A	Non-no ID files verified as: 146 common pipistrelle (94%) 4 Myotis (2%) 3 noctule (1%)

Table 37: Results from bat data verification exercise: May detector 3, SD card 14

Species id by Kaleidoscope	Files analysed	Exact Match	Match within same ‘Group’	Comment
Noctule	30	23/30 (76%)	23/30 (76%)	Non-noctule files verified as noise
Nathusius' pipistrelle	3	0/3 0%	3/3 (100%)	All files were verified as common pipistrelles
Common pipistrelle	1112	1110/1112 (99%)	1110/1112 (99%)	Non-common pipistrelle files were verified as Myotis
Daubenton’s bat	1	0/1 (0%)	1/1 (100%)	File verified as Myotis
Noise	600	496/600 (83%)	N/A	Non-noise files verified as: 92 common pipistrelle (15%)

Species id by Kaleidoscope	Files analysed	Exact Match	Match within same ‘Group’	Comment
				6 Myotis (1%) 6 noctule (1%)
No ID	65	3/65 (5%)	N/A	Non-no ID files verified as: 1 big bat (1%) 58 common pipistrelle (89%) 3 Myotis (5%)

Table 38: Results from bat data verification exercise: May detector 29, SD card 7

Species id by Kaleidoscope	Files analysed	Exact Match	Match within same ‘Group’	Comment
Barbastelle	1	0/1 (0%)	0/1 (0%)	File verified as Myotis
Noctule	10	7/10 (70%)	7/10 (70%)	Non-noctule files verified as noise
Serotine	1	0/1 (0%)	1/1 (100%)	File verified as a big bat
Nathusius' pipistrelle	5	0/5 0%	5/5 (100%)	All files were verified as common pipistrelles
Common pipistrelle	45	45/45 (100%)	45/45 (100%)	N/A
Soprano pipistrelle	1	0/1 (0%)	1/1 (100%)	File was verified as common pipistrelle
Brown long-eared bat	2	2/2 (100%)	2/2 (100%)	N/A
Daubenton’s bat	3	0/3 (0%)	3/3 (100%)	Files verified as Myotis
Noise	4193	4173/4193 (99%)	N/A	Non-noise files verified as: 4 big bat (0.09%) 5 brown long-eared bat (0.11%)

Species id by Kaleidoscope	Files analysed	Exact Match	Match within same ‘Group’	Comment
				8 common pipistrelle (0.19%)
No ID	9	0/9 (0%)	N/A	Non-no ID files verified as: 2 noise (22%) 2 Myotis (22%) 3 common pipistrelle (33%) 2 noctule (22%)

Table 39: Results from bat data verification exercise: June detector 2, SD card 14

Species id by Kaleidoscope	Files analysed	Exact Match	Match within same ‘Group’	Comment
Noctule	15	2/15 (13%)	2/15 (13%)	13 noise (87%)
Serotine	2	0/2 (0%)	0/2 (0%)	2 not possible to ID to genus
Nathusius' pipistrelle	1	0/1	0/1	1 not possible to ID to genus
Common pipistrelle	288	268/288 (93%)	270/288 (94%)	2 files with multiple common pipistrelle (0.7%) 18 Noise / not possible to ID
Brown long-eared bat	1	0/1	0/1	Noise
Noise	2645	2431/2645 (91%)	N/A	Non-noise files verified as: 190 common pipistrelle (7%) 1 file with multiple bat species ((common pipistrelle and noctule) 0.03%) 10 Myotis (0.4%) 1 noctule (0.03%)

Species id by Kaleidoscope	Files analysed	Exact Match	Match within same 'Group'	Comment
No ID	25	0/25 (0%)	N/A	Non-no ID files verified as: 12 common pipistrelle (48%) 2 Myotis (8%) 1 Noctule (4%) 3 Noise (12%)

APPENDIX F: Transect survey - details and weather information

Table 40: Summary dates of Activity Transects

Transect	May		June		July		August*		September		October	
	Dusk	Dawn	Dusk	Dawn	Dusk	Dawn	Dusk	Dawn	Dusk	Dawn	Dusk	Dawn
1	21/05/2018		18/06/2018		26/07/2018		20/08/2018	20/08/2018	13/09/2018			17/10/2018
2	22/05/2018		19/06/2018		25/07/2018		22/08/2018	23/08/2018	11/09/2018		N/A	N/A
3	30/05/2018		26/06/2018		24/07/2018		22/08/2018		12/09/2018	13/09/2018	18/10/2018	
4	23/05/2018		25/06/2018		23/07/2018		N/A	N/A	10/09/2018			16/10/2018

Table 41: Weather information for surveys conducted in 2018

Transect	Month	Date	Dusk / Dawn	Surveyors	Sunrise / Sunset	Start Time	End Time	Temperature (°C) Start-Finish	Cloud Cover (okta)	Wind (Beaufort)	Equipment Id
1	May	21/05/2018	Dusk	JP, DJ	20:53	20:53	23:33	17	6	0	BL28 + Rolands 11
2	May	22/05/2018	Dusk	JP, KOB	20:54	20:54	23:32	17	0	2	BL28 + Rolands 11
3	May	30/05/2018	Dusk	PT, EB	21:04	21:04	23:30	21	6	0	BL28 + Rolands 11
4	May	23/05/2018	Dusk	JP, SC	20:55	20:55	23:00	18	1	2	BL28 + Rolands 11

Transect	Month	Date	Dusk / Dawn	Surveyors	Sunrise / Sunset	Start Time	End Time	Temperature (°C) Start-Finish	Cloud Cover (okta)	Wind (Beaufort)	Equipment Id
1	June	18/06/2018	Dusk	LF, EM	21:17	21:17	23:45	18	3	1	BL38 + Tascam 30
2	June	19/06/2018	Dusk	LF, EM	21:18	21:18	00:16	19	0	2	BL38 + Tascam 30
3	June	26/06/2018	Dusk	SC, DJ	21:20	21:20	00:07	19	0	1	BL28 + Rolands 14
4	June	25/06/2018	Dusk	SC, DJ	21:20	21:20	23:52	21	0	0	BL38 + Rolands 14
1	July	26/07/2018	Dusk	PT, DJ	20:57	20:57	23:28	25	3	2	BL32
2	July	25/07/2018	Dusk	PT, DJ	21:00	21:00	23:18	23	2	0	BL32
3	July	24/07/2018	Dusk	PT, DJ	21:00	21:00	23:45	23	1	1	BL33
4	July	23/07/2018	Dusk	PT, EQ	21:00	21:00	23:49	22	0	1	BL33
1	August	20/08/2018	Dusk	SC, DJ	20:11	20:11	22:42	22	7	3	BL34 + Tascam 30
1	August	20/08/2018	Dawn	AE, EB	05:58	03:30	05:58	20	8	0	BL 33
2	August	22/08/2018	Dusk	AE, EB	20:09	20:20	22:26	19	8	2	BL33
2	August	23/08/2018	Dawn	AE, EB	05:58	03:22	05:58	18	8	1	BL33
3	August	22/08/2018	Dusk	SC, DJ	20:08	20:08	22:45	20	7	1	BL34
1	September	13/09/2019	Dusk	PT, CL	19:21	19:21	21:35	18	2	0	BL29
2	September	11/09/2018	Dusk	PT, CL	19:25	19:25	21:29	19	8	1	BL29

Transect	Month	Date	Dusk / Dawn	Surveyors	Sunrise / Sunset	Start Time	End Time	Temperature (°C) Start-Finish	Cloud Cover (okta)	Wind (Beaufort)	Equipment Id
3	September	12/09/2018	Dusk	PT, CL	19:23	19:23	22:05	17	6	1	BL32
3	September	13/09/2018	Dawn	PT, CL	06:32	03:45	06:31	9	1	0	BL29
4	September	10/09/2018	Dusk	PT, CL	19:27	19:27	21:43	19	4	2	BL29
1	October	17/10/2018	Dawn	AE, KOB	07:30	04:56	07:30	10	4	0	BL37 + Rolands 29
3	October	18/10/2018	Dusk	AE, KOB	18:02	18:10	19:30	12	0	0	BL37 + Rolands 29
4	October	16/10/2018	Dawn	AE, KOB	07:30	04:53	07:30	13	8	0	BL37 + Rolands 29

APPENDIX G: Emergence / re-entry survey meta data

Table 14: Meta data from bat emergence and re-entry surveys

Building	Survey 1				Survey 2				Survey 3			
	Type	Date	Time	Weather	Type	Date	Time	Weather	Type	Date	Time	Weather
1	Dusk	29/07/2019	20:37 - 22:52	26-19oC, wind 1, 50% cloud, no rain.								
2 and 3	Dawn	30/07/2019	3:23 - 5:38	19-18oC, no wind, 0% cloud.	Dusk	12/08/2019	20:15 - 22:10	17-14oC, no rain, 0-60% cloud, minimal wind.	Dusk	29/08/2019	19:42 - 21:44	22- 19oC, no rain, 0-3 wind, 0% cloud.
4	Dusk	14/08/2019	20:10 - 22:24	17oC, light drizzle at the start, 3-4 wind, 100% cloud cover.								
9	Dusk	14/08/2019	20:15 - 22:20	19oC, light rain at start of survey, little wind.	Dawn	03/10/2019	5.25 - 7.19	5oC, no wind, 10% cloud, no rain	Dawn	04/10/2019	5.30 - 7.21	12oC, 25% cloud, no rain, no wind.
13	Dawn	30/08/2019	4:30 - 6:22	17-14oC, no wind, no rain, 15% cloud.	Dusk	03/10/2019	18.20 - 20.40	12oC, 1-2 wind, 90% cloud, sporadic light showers throughout.	Dusk and Dawn	9/10/2019 pm and 10/10/2019 am	17:50 - 20:00 and 5:40 - 7.30	Dusk: 14-10oC, 3 okta cloud, wind 1, rain shortly before

Building	Survey 1				Survey 2				Survey 3			
	Type	Date	Time	Weather	Type	Date	Time	Weather	Type	Date	Time	Weather
												survey, but none during. Dawn: 8oC, 0 okta, wind 1, no rain.
17a	Dusk	31/07/2019	20:35-20:50	20-17oC, no wind or rain.	Dawn	13/08/2019	4:12 - 5:52	11-8oC on batlogger, but felt colder. No wind or rain.	Dusk	28/08/2019	19:45 - 21:30	20-18oC, 3-4 wind, 90-100% cloud, no rain.
17b	Dusk	31/07/2019	20:35-20:50	20-17oC, no wind or rain.								
20	Dawn	14/08/2019	4.12 - 5.55	15-17oC, no wind or rain.								
21a	Dawn	01/08/2019	3:25 - 5:40	17-12oC, no wind, no rain.	Dusk	13/09/2019	20:17 - 22:15	14-15oC, gentle wind, no rain, 0-10% cloud.	Dawn	01/10/2019	5:20 - 7.16	15oC, 1/2 wind, 100% cloud cover, no rain.

Building	Survey 1				Survey 2				Survey 3			
	Type	Date	Time	Weather	Type	Date	Time	Weather	Type	Date	Time	Weather
21b	Dusk and Dawn	15/08/2019 - 16/08/2019	Dusk: 20:10 - 22:20. Dawn: 4:15 - 6:00	Dusk: 19oC, no rain, gentle breeze. Dawn: 16-13oC, no wind, no rain.	Dusk and Dawn	27/08/2019 - 28/08/2019	Dusk: 19:43 - 22.08. Dawn: 4:24 - 6:22.	Dusk: 26-23oC, 0% cloud, no rain. Dawn: 18oC, 10% cloud, no rain.	Dusk	02/10/2019	18:22 - 20:12	9-10oC, 5% cloud, no rain, 1 wind.
21c	Dusk	15/08/2019	20:10 - 22:24	19-17oC, wind 2-3, no rain, no cloud.	Dawn	28/08/2019	4:20 - 6.21	18oC, 10% cloud, no rain.	Dawn	02/10/2019	5:20 - 7:17	7oC, 20% cloud, no rain.
22	Dawn	14/08/2019	4:12 - 5:57	15-14oC, no rain, no wind	Dawn	02/10/2019	5:19 - 7.10	8-9oC, no cloud, 2/3 wind, no rain.	Dawn	03/10/2019	5.37 - 7.10	2-3oC, 10% cloud, no wind, no rain.
27	Dusk	30/07/2019	20:57-22:51	17-15oC, 2 wind, no rain.	Dawn	15/08/2019	4:11 - 6:00	17-16oC, slight breeze, no rain, 50-60% cloud cover.	Dawn	29/08/2019	4:18 - 6:20	15-12oC, 0-1 wind, cloud 100%, no rain.

APPENDIX H: Bat emergence / re-entry survey results

Table 13: Full emergence / re-entry survey results

Building	Survey no.	Dusk/ Dawn	Bats emerged/ re-entrerd	Date	Time	Species	Comments
1	1	Dusk	None	29/07/2019	N/A	N/A	No sound analysis conducted for this building.
2 & 3	1	Dawn	Re-entry	30/07/2019	04:23	1 x C.pip	Re-entry: 1 bat re-entered under hanging tile at gable end above 2nd floor window on south western aspect of building
					04:56	1 x unknown bat. Seen not heard.	Re-entry: 1 bat re-entered under handing tile on western gable end. Same location as above. Seen not heard
	2	Dusk	Emergence	12/08/2019	20:54	1 x S. Pip	Emergence: 1 bat seen emerging from eaves of south building (B3) on south western aspect.
	3	Dusk	Emergence	29/08/2019	20:04	1 x unknown bat. Seen not heard.	Emergence: 1 bat seen emerging from soffit on south western aspect of B3
					20:07	1 x C.pip	Emergence: 1 bat emerged from apex of gable end on north aspect of building (B2).
					20:12	1 x C.pip	Emergence: 1 bat emerged from under guttering on the north west aspect of the building (B2).
					20:28	1 x C.pip	Emergence: 1 bat emerged from undert the soffet on the north east corner of the building.
					20:18	1 x Pip. Sp	Emergence: 1 bat emerged from under soffet on the eastern aspect of building (B3).
					20:00	1 x C. pip	Emergence: 1 bat emerged from wooden soffet on south western aspect of building.

Building	Survey no.	Dusk/ Dawn	Bats emerged/ re-entrerd	Date	Time	Species	Comments
					20:04	1 x C. pip	Emergence: emerged from bottom of 2nd floor window on south western aspect of building.
					20:06	2 x Pip. Sp	Emergence: 2 bats emerged. 1st - from under the apex of gable end on south western aspect. 2nd - from under guttering on the southern aspect of building.
					20:12	1 x C. pip	Emergence: emerged from bottom corner of 2nd floor window on south western aspect.
4	1	Dusk	None	14/08/2019	N/A	N/A	No sound analysis conducted for this building.
9	1	Dusk	Emergence	14/08/2019	20:55	1 x C.pip	Emergence: 1 bat emerged from SW corner of roof.
13	1	Dawn	Re-entry	30/08/2019	05:43	1 x C.pip	Re-entry: 1 bat flew from NW side of barn around to the southern aspect of building and re-entered under wood siding(?) underneath apex of gable.
	2	Dusk	Emergence	03/10/2019	18:46	1 x C.pip	Emergence: 1 bat emerged from apex of gable end on southern aspect of building.
17a	1	Dusk	Emergence	31/07/2019	21:31	1 x C.pip	Emergence: bat seen emerging from roof on eastern aspect.
					21:18	1 x Pip. Sp	Emergence: 1 bat emerged from hanging tiles to left of 2nd floor window. Very faint call - surveyor said it sounded like Pip. No call was picked up by detector. No CSV file.
					21:05	1 x C.pip	Emergence: 1 bat seen emerging from under guttering/poss tiles below on south eastern aspect. Surveyor didn't hear bat echolocate - sound analysis very faint call, might need checking.
17b	1	Dusk	None	31/07/2019	N/A	N/A	No sound analysis conducted for this building.
20	1	Dawn	None	14/08/2019	N/A	N/A	Emergence: 1 bat emerged from lower gable end of large barn roof on the south west aspect (not the brick build extension).

Building	Survey no.	Dusk/ Dawn	Bats emerged/ re-entrerd	Date	Time	Species	Comments
21a	1	Dawn	Emergence	01/08/2019	04:33	1x C. pip	Re-entry: 1 bat seen flying from the eastern aspect of building and re-entered in similar location as bat @04:33. Lower gable end of large barn roof on south west aspect.
			Re-entry		04:42	1x C. pip	Emergence: Surveyor saw bat emerge from apex of roof on the north west aspect of building, bat did a loop and then flew west. Possible swarming activity and bat had re-entered previously.
		Dawn	Emergence	01/08/2019	03:27	1x C. pip	Re-entry: Flew from NW and entered the barn on the western aspect
			Re-entry		04:57	1x C. pip	Re-entry: 3 bats seen re-entring at different locations. 1st - in same location as bat above. 2nd - on gable end on north west corner of barn.
			Re-entry		04:58	2x C.pip	Re-entry: On the north west (although western aspect of barn) corner.
			Re-entry		05:02	1x C. pip	Emergence: Emergence from barn opening on eastern aspect.
	2	Dusk	Emergence	13/08/2019	20:51	1x C. pip	Re-entry: 1 bat seen re-entering under roof tile just south of barn opening on south western aspect of barn. Surveyor notes also say BLE but is pip 49khz.
	3	Dawn	Re-entry	01/10/2019	06:28	1x Pip sp.	Re-entry: 2x bats seen re-entering under the wooden boarding, approx 2m high, on the western aspect of the barn. Slightly south of courtyard brick wall
					06:40	2x C. pip	Re-entry: bat re-enter near apex of pitched roof on eastern aspect of roof
		Dawn	Re-entry	01/10/2019	06:15	1x C. pip	
21b	1	Dusk	Emergence	15/08/2019	20:42	1x C. pip	Emergence: Surveyors notes says C.pip emerged from gable end of 2-storey building on south western aspect. No echolocation confirmed in sound analysis at time; however, C.pip calls before & after.

Building	Survey no.	Dusk/ Dawn	Bats emerged/ re-entrerd	Date	Time	Species	Comments
		Dusk	Emergence	15/08/2019	20:31	1 xPip spp	Emergence: Emerged from under the gutter on the north western extension of the building. Surveyor was positioned on southern aspect. Peak freq is - freq is 51khz.
		Dusk	Emergence	15/08/2019	20:39	1 xC. pip	Emergence: 1 bat seen emerging from under barge board on north western aspect of building.
		Dawn	Re-entry	16/08/2019	05:18	5x BLE	Re-entry: BLE seen re-entering apex of eastern gable on porch, porch located on south east aspect of building. Swarming activity also observed prior to re-entries, lots of BLE activity picked up by detector.
	2	Dusk	Emergence	27/08/2019	20:10	2x C. pip	Emergence: emerged from bottom left corner of gable end on south western aspect of building
		Dusk	Emergence	27/08/2019	20:12	2 x C. pip	Emergence: 2 bats emerged from apex of gable end on double story building on south eastern aspect of building.
					20:20	1 x BLE	Emergence: from gable end on south eastern aspect.
					20:29	2 x BLE	Same as above.
					20:33	2 x BLE	Same as above.
					20:38	1 x BLE	Same as above.
					20:40	1 x BLE	Same as above.
					20:41	1 x BLE	Same as above.
					20:43	2 x BLE	Same as above.
					20:47	2 x BLE	Same as above.
		Dawn	Emergence	28/08/2019	05:41	1x C. pip	Re-entry: emerged into bottom left corn of gable end on south western aspect of building
21c	2	Dawn	Re-entry	28/08/2019	05:27	1 BLE	Re- entry: Actually on 21b on SE aspect - apex of pitched roof.

Building	Survey no.	Dusk/ Dawn	Bats emerged/ re-entrerd	Date	Time	Species	Comments
		Dawn	Re-entry	28/08/2019	06:05	1x C. pip	Re- entry: Sound analysis only picked up C. pip at 06:05. Surveyors notes - bat seen emerging in same location on 21b not 21c.
22	1	Dawn	Re-entry (no detector)	14/08/2019	05:04	Pip sp.	1 potential bat thought to be Pip spp from flight. Bat flew re-entered on the SE corner of building under barge board. BL failure no sound analysis to verify
27	1	Dusk	Emergence	30/07/2019	21:35	1x C. pip	Emergence: on the north western aspect from the doorway.

APPENDIX I: Building assessment results

Table 42: Buildings assessed within the roosting potential surveys and results

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B1	Commercial building, with conservatory attachment	Brick built with barge boards and weather boarding cladding. Dormer windows present Pitched roof, with clay tiles and concrete ridge capping.	Within a golf course, residential properties to the east.	Some gaps in brick work wooden cladding		Low	Yes – at least one emergence / re-entry survey	Has potential
B2	Commercial office, changing rooms and residential property	Brick built Pitched roof. Concrete tiles and ridge tiles. Large chimney	Within a golf course, residential properties to the east.	Raised tiles Some gaps in barge boarding due to age /weathering Gap in NE dormer window Gaps in brickwork		High	Yes – at least three emergence / re-entry surveys	Has potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B3	Residential	Attached to B2 Brick built Pitched roof with cement roof and ridge tiles Skylights present on S side	Within a golf course, residential properties to the east.	Broken and raised tiles Cavities behind hanging tiles Some gaps in barge boarding due to age /weathering Gap in NE dormer window Gaps in brickwork		High	Yes – at least three emergence / re-entry surveys	Has potential
B4	Commercial Golf buggy storage & gym exercise room	Brick built Flat felt roof with small pitched porten with skylights Felt capping with parapet edges Gym side: pitched clay tiles with clay ridge tiles	Within a golf course, residential properties to the east.	Minor loss of mortar in brick work Slipped and raised tiles on gym building Raised ridge tiles with gaps beneath		Low	Yes – at least one emergence / re-entry survey	Has potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B5	Residential	Brick built Pitched cement roof with cement ridge tiles	Within a golf course, residential properties to the east.	No Features potentially suitable to support roosting bats were observed.		Negligable	No	Negligible potential
B6	Greenkeepers storehouse with compound	Steel frame and concrete slab construct Very slightly pitched asbestos roof with ridge tiles and skylights	Within a golf course,	Some bitchumen felt on gable end hanging loose Some gaps present in concrete slabs but open to the internal building		Negligible	No	Negligible potential
B7	Hay store and occasional livestock barn	Steel frame and wooden cladding construct Pitched corrugated asbestos roof with skylights	Surrounded by arable with patches of woodland / scrub. Field margins are lined with trees and hedgerows	Dense ivy on external but stands away from the wall		Negligible	No	Negligible potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B8	Hay storage shed (open on all sides	Wooden frame construct Pitched corrugated aluminium roof	Surrounded by arable with patches of woodland / scrub. Field margins are lined with trees and hedgerows	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential
B9	Converted barn used as garage / storage	Brick Construct with wooden barge boards Hipped clay tile roof with clay ridge tiles	Surrounded by arable with patches of woodland / scrub. Field margins are lined with trees and hedgerows	Slipped roof tiles Gaps present on the north end of the barge boards		Low	Yes – at least one emergence / re-entry survey	Has potential
B10	Storage building	Timber frame and timber cladding Pitched corrugated metal sheeting roof	Surrounded by arable with patches of woodland / scrub. Field margins are lined with trees and hedgerows	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B11	Large storage building	Steel frame and corrugated metal sheeting construct Pitched corrugated asbestos with skylights present	Surrounded by arable with patches of woodland / scrub. Field margins are lined with trees and hedgerows	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential
B12	Storage building	Steel frame and corrugated metal sheeting construct Rounded corrugated sheeting roof	Surrounded by arable with patches of woodland / scrub. Field margins are lined with trees and hedgerows	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential
B13	Two buildings Arts & Community Centre	Community Centre is brick built with a pitched clay tile roof and clay ridge tiles Arts Centre has wooden cladding with a pitched clay tile roof with cement ridge tiles	Residential to the east. Woodland to the south and arable fields to the west	Potential cavities in wall Small number of slipped roof tiles. One damaged tile on the community centre building Large open vent on community centre building Hole at peak of cladding on arts centre building		Moderate	Yes – at least two emergence / re-entry survey	Has potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B14	Stables and storage	Timber frame with wooden cladding and felt lining Shallow sloped mono-pitched roof covered by felt lining	Residential to the east. Woodland to the south and arable fields to the west	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential
B15	Storage building	Timber frame and wooden cladding construct Shallow pitched roof lined with bitchsum felt	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential
B16	Residential property	Two storey, brick builit with peddledash render Pitched roof with clay roof and ridge tiles	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Some gaps in hanging tiles Small number of missing / slipped roof tiles		Low	Yes – at least one emergence / re-entry survey	Has potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B17A	Residential property	Two storey, brick built construct Pitched roof with clay roof and ridge tiles Three chimneys present	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Potential cavity wall Gaps in brick motor Broken / slipped / raised hanging tiles Small number of slipped and broken roof tiles Gap at eave on N side		High	Yes – at least three emergence / re-entry surveys	Has potential
B17B	Outhouse	Brick constructed with wooden barge boards Pitched roof with clay roof and ridge tiles	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	1 missing ridge tile Gaps present in barge boards		Low	Yes – at least one emergence / re-entry survey	Has potential
B18	Shed storage / kennels for guard dog	Wooden frame and wooden cladding Pitched corrugated onduline roof with plastic ridge cap	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B19	Storage building	Breeze block construct with wooden timber frame and wooden cladding Pitched asbestos roof with asbestos capping	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential
B20	Workshop / Storage	Brick construct with hanging tiles and some aluminium cladding Pitched corrugated aluminium roof	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Some broken hanging tiles with gaps exposing cavities		Low	Yes – at least one emergence / re-entry survey	Negligible potential
B21A	Hay barn and attached abandoned stable	Timber frame and wooden cladding Pitched roof with clay roof and ridge tiles	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Minor cracks in wooden cladding Number of missing / raised roof tiles Large vent structure Some weather boards have crevices/ space between		Moderate	Yes – at least two emergence / re-entry survey	Has potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B21B	Storage and workshop building	Brick construct Pitched roof with plastic roof tiles and ridge capping	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Lead flashing raised out at NW corner		Low	Yes – at least one emergence / re-entry survey	Has potential
B21C	Stables	Brick construct Pitched roof with clay roof and ridge tiles	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Broken guttering exposing eaves		Negligible	No	Negligible potential
B21D	Disused storage building	Brick construct Multi-pitched corrugated asbestos roof with asbestos capping	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Open under vents		Negligible	No	Negligible potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B22	Disused building	Brick construct Multi-pitched roof with plastic roof and ridge capping	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Some very limited lead flashing present with potential access Loft void is present with access through broken door and ceiling		Low	Yes – at least one emergence / re-entry survey	Has potential
B23	Disused – previously storage	Timber frae construct Corrrugated plastic panels at the back and wooden side panels Shallow single pitch, sloped corrugated aluminium roof	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential
B24	Storage building	Brick construct Pitched roof with clay roof and ridge tiles	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Slipped and raised roof tiles by dense ivy (access is limited) Missing ridge tiles Gaps at eaves where rafters join the roof		Low	Yes – at least one emergence / re-entry survey	Has potential

Building Identification	Building type	Building description	Surrounding habitat	Features and signs	Photograph	Summer Roost Potential (initial assessment)	Further Surveys recommended	Does the structure have hibernation potential
B25	Residential building	Brick construct with wooden cladding / weather boarding Pitched roof with clay roof and ridge tiles Chimney present	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	Potential cavity in wall 1-2 raised roof tiles Small gaps in the chimney, eaves and weather boarding		Low	Yes – at least one emergence / re-entry survey	Has potential
B26	Cattle shed	Steel frame and wooden panels Pitched corrugated asbestos roof with steel rafters and asbestos capping	Surrounded by pastureland with scattered scrub Woodland further north and west. Residential to the south east	No Features potentially suitable to support roosting bats were observed.		Negligible	No	Negligible potential
B27	Residential building	Brick construct Pitched roof with clay roof tiles. Wooden extension of timber construct supports a corrugated steel roof	Surrounded by arable with patches of woodland / scrub. Field margins are lined with trees and hedgerows	Missing and slipped roof tiles Broken wooden cladding on external entrance way Gaps present beneath lead flashing		High	Yes – at least three emergence / re-entry surveys	Has potential

APPENDIX J: Surveyor pen portraits

Table 43: Pen portraits of key surveyors

Surveyor	Pen Portrait
Brandon Murray MCIEEM (Principal Ecological Consultant) BSc(hons)	Brandon has been a professional ecologist for eight years. Brandon has been planning, leading and completing bat surveys for over six years, including bat transects, static detector surveys, bat emergence and re-entry surveys and aerial tree inspections. Brandon is a Class II bat licence holder (Licence Number 2016-19420-CLS-CLS). Brandon has assessed the potential impacts to bats from multiple development projects and written bat survey and impact assessment reports for multiple sites. Brandon has been named on two bat development licences.
Alex Ellis (Senior Ecologist) MCIEEM BSc	Alex has been a professional ecologist for seven years. Alex has experience of a diverse range of ecological surveys and mitigation / enhancement techniques. Alex has been planning, leading and undertaking bat surveys for over six years, including bat transects, static detector surveys, bat emergence and re-entry surveys and overseeing site contractors. Alex is a Class II bat licence holder (Licence Number 2015-11399-CLS-CLS).
Marielle James (Senior Ecologist) BSc (Hons), MRes	Marielle has been a professional ecologist for six years. Marielle has experience in a range of protected species surveys and has led and undertaken bat surveys for three years, including bat transects, static detector surveys and bat emergence and re-entry surveys. Marielle is a Class II bat licence holder (Licence number 2019-39454-CLS-CLS).
Porscha Thompson (Ecologist) ACIEEM BSc (Hons) MSc	Porscha has been a professional ecologist for five years and has experience in a range of protected species surveys including great crested newts, dormice, reptiles and badger surveys, phase 1 habitat surveys and ecological clerk of works. Porscha has experience in assessing sites for potential ecological impacts and is able to provide appropriate recommendations and mitigation in order to reduce potential impacts. Porscha has been a lead surveyor for a range of bat surveys including emergence and re-entry surveys, transect surveys and tree assessments.
Ellen Quinton (Ecologist) BSc, MSc, Grad CIEEM	Ellen has been a professional ecologist for four years and has experience in a range of protected species surveys including bats, great crested newts, dormice, reptiles, water voles and ecological clerk of works. Ellen has experience in assessing sites for potential ecological impacts and is able to provide appropriate recommendations and mitigation in order to reduce potential impacts. Ellen has been a lead surveyor for a range of bat surveys including emergence and re-entry surveys, transect surveys and building and tree assessments.

Surveyor	Pen Portrait
Elisabeth (Libby) Brooks (Graduate Ecologist) Grad CIEEM BSc (Hons)	Libby has been a professional ecologist for over a year and has experience in a range of protected and sensitive species surveys such as badger, dormice, reptile, water vole, otter, breeding birds, overwintering birds and ecological clerk of works. Libby has assisted in a range of bat surveys including transect surveys, re-entry and emergence surveys and building and tree surveys.
Kailey O'Brien (Graduate Ecologist) Grad CIEEM BSc, MSc	Kailey has been a professional ecologist for 2 years and has assisted on a number of bat surveys within consultancy and through volunteering with her local bat group. Experience includes emergence and re-entry surveys, transect surveys, static detector surveys and tree assessments.

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APPENDIX 8.30: LAND WEST OF IFIELD – HAZEL DORMOUSE SURVEY REPORT

Intended for
Turner & Townsend plc. on behalf of Homes England

Date
November 2022

Project Number
1620007949

LAND WEST OF IFIELD
HAZEL DORMOUSE SURVEY REPORT

RAMBOLL

LAND WEST OF IFIELD
HAZEL DORMOUSE SURVEY REPORT

Project No.	**1620007949**
Issue No.	**1**
Date	**November 2022**
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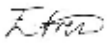
Checked:	
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1. INTRODUCTION

1.1 Background

Ramboll UK Limited ('Ramboll') was commissioned by Turner & Townsend plc on behalf of Homes England (the 'Client'), to carry out a series of hazel dormouse *Muscardinus avellanarius* surveys in relation to the proposed development plans for the Land West of Ifield, Ifield, West Sussex (the 'site', as illustrated in Figure 1, Appendix 1). This report presents the findings of the hazel dormouse surveys carried out by Ramboll ecologists between June and October 2022 across the entirety of the site (not including the off-site Ifield Brook Wood and Meadows Local Wildlife Site that has been previously surveyed).

Hazel dormouse surveys were previously undertaken by Arcadis Consulting Ltd (Arcadis) from July to November 2019 at the site. Results from the 2019 survey report[1] confirmed that no hazel dormice were recorded. Due to the time elapsed since these surveys were completed, update surveys were required at the site. The 2019 surveys also included the Ifield Brook Wood and Meadows Local Wildlife Site (LWS) to the east of the site, which was previously incorporated within the proposed development area, however this area is no longer part of the proposed redline boundary (other than a potential cycle / pedestrian route crossing this area in one location).

For the purposes of the dormouse survey, the site has been split up into three geographical sections[2].

These comprise:

1. Golf Course (approx. central grid reference: TQ 23679 36673);
2. Pastoral (Area 1) and Arable fields (Area 2) (approx. central grid reference: TQ 24331 37818); and
3. Thrifts Yard, Welbeck and Rydon (approx. central grid reference: TQ 23683 37199).

Figure 1 (found in Appendix 1) shows the location of these areas within the proposed redline boundary of the site at the time of writing.

1.2 Proposed Development

At the time of writing the proposed development would comprise: 3,000 new residential units with associated infrastructure; space for employment, retail, community uses and landscaping; and access arrangements.

Further details regarding the proposed development will be determined in due course and may be subject to revision.

1.3 Objectives

The content of this report is based on the findings of presence/likely absence surveys for hazel dormouse at the site.

The specific objectives of this report are to:

- Determine the presence/likely absence of dormice on the site;
- Where dormice are present, determine the size of the population and their spatial use of the site; and

[1] Arcadis (October 2019). Land west of Ifield – Dormouse Survey Report. Report reference: 10020728-ARC-XX-XX-RP-YE-111-Dormouse Survey Report.

[2] The areas have been split up to define the locations for the overall project.

- Assess potential impacts of the proposed development upon hazel dormouse in light of the survey findings and identify an approach to mitigation where necessary.

This report presents factual information on the findings of the survey. This report is intended to inform masterplanning and design and will form part of the baseline information used to support the Environmental Impact Assessment (EIA) of the Land West of Ifield planning application.

The report is supported by the following appendices:

- Appendix 1: Figures.
- Appendix 2: Photograph.

The structure and content of this report is based on current ecological report writing guidance (CIEEM, 2017[3]).

1.4 Legislation and Policy Framework

In the UK, the hazel dormouse is legally protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended)[4] and has significant further protection as a European Protected Species (EPS) under the Conservation of Habitats and Species Regulations 2017 (as amended)[5].

This combined legislation makes it an offence to:

- Intentionally kill, injure or take a dormouse;
- Possess or control any live or dead specimen or anything derived from a dormouse (unless it can be shown to have been legally acquired);
- Intentionally or recklessly damage, destroy or obstruct access to any structure or place used for shelter or protection by a dormouse; and
- Intentionally or recklessly disturb a dormouse while it is occupying a structure or place which it uses for that purpose.

Dormice are a 'Species of Principal Importance for the conservation of biodiversity' listed under section 41 of the Natural Environment and Rural Communities Act 2006 (NERC).

[3] CIEEM (2017). Guidelines on Ecological Report Writing. Chartered Institute of Ecology and Environmental Management, Winchester.
[4] Her Majesty's Stationery Office (HMSO), 1981. The Wildlife and Countryside Act 1981 [as amended in Quinquennial Review and by the Countryside and Rights of Way Act 2000 and the Natural Environment and Rural Communities Act 2006]. HMSO.
[5] Her Majesty's Stationery Officer (HMSO), 2017. The Conservation of Habitats and Species Regulations 2017. HMSO.

2. SURVEY METHODOLOGY

2.1 Hazel Dormouse Survey

The hazel dormouse survey was conducted following best practice guidance set out in the Dormouse Conservation Handbook[6] for surveying dormouse using nest tubes.

Dormouse nest tubes are used to confirm the presence or likely absence of this species from a particular area. Presence is indicated by nesting material being deposited in the tube, or by the presence of the animals themselves during checks.

To investigate whether hazel dormice are present in the hedgerows and woodland within the site a total of 700 nest tubes (plastic nest tubes 250 mm long and 65 mm square with a wooden tray that extends beyond the end of the tube by 55 mm) were placed within areas of suitable habitat with the potential to be affected by the proposed works across the whole site. The nest tubes were deployed across the site in March 2022. Tubes were hung just below branches in order to encourage use by dormice. The location of the nest tubes and nest boxes are shown in Figures 1 in Appendix 1. Boxes were spaced at approximately 20 m intervals in line with the Dormouse Conservation Handbook methodology.

Following a minimum period of a month after the nest tubes were deployed to allow nesting to occur, nest-tubes were inspected for the presence of dormice or dormouse nesting material. Checks were undertaken by an ecologist who holds a Natural England dormouse survey licence (Class 1)[7] during the months of June, July, August, September and October 2022. All nest-tubes were inspected and direct observations of dormouse, or potential signs indicating their presence were recorded.

The nest-tubes surveys were conducted over the following dates:

- Visit 1: 10th June 2022, 17th June 2022;
- Visit 2: 8th July 2022 and 15th July 2022;
- Visit 3: 5th August 2022, 17th August 2022 and 31st August 2022;
- Visit 4: 9th September 2022, 13th September 2022 and 23rd September 2022; and
- Visit 5: 14th October 2022, 21st October 2022 and 31st October 2022.

Scoring Index

There is an established scoring system to determine the thoroughness of any nest-tube survey (Table 2.1 below). All the monthly scores for the period over which the tubes are in place are added together (irrespective of whether the tubes are actually inspected in that month). Assumed absence should not be based on a search effort score of less than 20[8]. This is the index of probability of finding dormice present in nest-tubes in any one month. These monthly scores are based on 50 tubes having been deployed in a given survey area; the scores should be adjusted to account for situations in which greater or fewer than 50 tubes are deployed; for example, the monthly scores can be doubled for 100 tubes but should be halved for 25.

[6] The Dormouse Conservation handbook. (2006). The Dormouse Conservation Handbook (English Nature) | CIEEM
[7] Class Licence (Level 1) reference number: 2019-41718-CLS-CLS-1
[8] (The Dormouse Conservation handbook. (2006). The Dormouse Conservation Handbook (English Nature) | CIEEM

Table 2.1: Index of probability of finding dormice present in any one month

Month	Score (50 Tubes)	Score (100 Tubes)	The Golf Course (150 Tubes)	Thrift yard, Welbeck and Rydon (100 Tubes)	Area 1 (Pastoral) & Area 2 (Arable) (450 Tubes)
April	1	2	-	-	-
May	4	8	-	-	-
June	2	4	4	4	4
July	2	4	4	4	4
August	5	10	10	10	10
September	7	14	14	14	14
October	2	4	4	4	4
November	2	4	-	-	-
Total	25	50	36	54	162

The survey included nest tube survey at the golf course, Thrift yard, Welbeck and Rydon, Area 1 (Pastoral) and Area 2 (Arable) in woodlands, woodland boundaries and along hedgerows within the site. While the locations are not all directly connected, they all form part of a network of potentially suitable habitat within the wider local area. Given that at each survey location nest tubes were deployed at standard intervals of one nest tube approximately every 20 m of suitable habitat, for the purposes of calculating the overall search effort/index of probability score they have been considered as a single survey area (the golf course, Thrift yard, Welbeck and Rydon, Area 1 (Pastoral) and Area 2 (Arable)).

2.2 Limitations

The hazel dormouse surveys took place between June and October 2022. However, due to the high number of tubes installed which provides a high index score and therefore it is unlikely that the reduced survey period had a significant effect on the reliability of the results which have been obtained during the survey period.

This report has been prepared for the Client and shall not be relied upon by any third party unless that party has been granted a contractual right to rely on this report for the purpose for which it was prepared.

Ramboll is satisfied that this report represents a robust appraisal of the site for the purpose of a hazel dormouse survey. If no action or development has taken place on this land within twenty-four months of the review date of this report, the findings of this survey should be reviewed by a suitably qualified ecologist and may need to be updated.

3. RESULTS

3.1 Introduction

During the hazel dormouse survey, only one potential hazel dormouse nest was identified with no individual hazel dormouse being identified across the survey period.

3.1.1 Survey Conditions

The weather conditions during the surveys are shown in Table 3.1.

Table 3.1: Survey Conditions of Hazel Dormouse Surveys

Visit	Date	Time (24hr)	Temperature (°C)	% Cloud Cover	Wind Speed	Precipitat -ion	Humidity (%)
1	10/06/2022	09:30 to 3:00	24	25	2	0	49
	17/06/2022	09:30 to 3:00	31	0	2	0	34
2	08/07/2022	09:30 to 3:00	28	0	1	0	38
	15/07/2022	09:30 to 3:00	25	0	1	0	35
3	05/08/2022	09:30 to 3:00	22	0	1	0	32
	17/08/2022	09:30 to 3:00	24	100	3	100	75
	31/08/2022	09:30 to 3:00	23	100	2	0	42
4	09/09/2022	09:30 to 3:00	21	55	1	0	78
	13/09/2022	09:00 to 3:30	19	100	1	100	77
	23/09/2022	09:30 to 3:00	18	60	1	0	68
5	14/10/2022	09:30 to 3:00	17	100	1	100	84
	21/10/2022	09:30 to 3:00	18	45	2	0	85
	31/10/2022	09:30 to 3:00	17	65	2	0	75

3.2 Golf Course

No hazel dormice were recorded at the Golf Course, and they are therefore considered likely to be absent from this part of the site. Habitats surveyed at the Golf Course were hedgerow, woodland boundaries and woodland pockets within the centre of this survey area, which do offer suitable habitat for hazel dormouse. No hazel dormouse were recorded in the Golf Course and Thrifts Yard, Welbeck and Rydon. Despite the Golf Course providing no records, this survey area does have connectivity to the wider landscape, which includes suitable habitat for hazel dormouse (if present).

3.3 Pastoral (Area 1) and Arable fields (Area 2)

No hazel dormice were recorded within the Pastural Fields (Area 1), and are therefore considered likely to be absent from this survey area. One potential hazel dormouse nest was identified along the woodland boundary adjacent to the River Mole at the Arable Fields (Area 2) during visit 5 on the 31st October 2022, this nest was determined potentially to have been created by a juvenile hazel dormouse (See Appendix 2: Photodoc). The habitats surveyed at the Pastoral and Arable Fields comprised hedgerow, woodland and woodland boundaries, which do offer suitable habitat for hazel dormouse. However, despite the Area 2 recording one potential hazel dormouse nest and Area 1 providing no records, the site does have connectivity to the wider landscape, where it is unknown if hazel dormouse have been recorded.

3.4 Thrifts Yard, Welbeck and Rydon

No hazel dormice were recorded at the Thrifts Yard, Welbeck and Rydon survey area, and this species are therefore considered likely to be absent from this part of the overall site. Habitats surveyed at Thrifts Yard, Welbeck and Rydon comprised hedgerow and woodland boundaries, which do offer suitable habitat for hazel dormouse. This survey area also has connectivity to the wider site and surrounding landscape, via the Golf Course and Arable Fields (Area 2) survey areas.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Summary of Findings/ Population Size of Site

During the five survey visits, across the Golf Course, Pastoral (Area 1) and Arable Fields (Area 2), and Thrift Yard, Welbeck and Rydon survey areas, only one potential hazel dormouse nest was identified. This was found during visit 5 on the 31st October 2022 along a woodland boundary within the Arable Fields (Area 2). This nest in question had features which are indicative of hazel dormouse nest-building, in the form of the nest being woven. However, this does not confirm the presence of hazel dormouse within the Arable fields (Area 2).

During the surveys there was a large number of wood mouse *Apodemus sylvaticus* nests and food caches identified along the eastern boundary of the Pastoral Fields (Area 1) adjacent to the Ifield Brook Wood and Meadows LWS.

No hazel dormice (or evidence of) were recorded in the Golf Course, Pastoral Fields (Area 1) or Thrift yard, Welbeck and Rydon. It is considered likely that they are absent from these areas of the site.

Considering the suitable habitat within the wider landscape to the north and west of the site, in combination with the lack of survey findings throughout the majority of the site and only one record of a potential nest overall, it is likely that the north-west boundary of the site constitutes the edge of a small number of individual territories for this species. These individuals may use suitable foraging habitat within close proximity to this part of the site, such as species-rich hedgerows with good connectivity to the north-west boundary, but are not present in any detectable number throughout the remainder of the site.

Appropriate recommendations for mitigation and enhancement (where applicable) will be determined in due course once development proposals are finalised and included in separate documentation. The proposed planning application will be supported by an Environmental Statement which will include a chapter on biodiversity and outline appropriate recommendations for hazel dormouse.

APPENDIX 1
FIGURE

Legend

- Potential Dormouse Nests
- Wood Mouse Nests
- Dormouse Tube Locations
- Red Line Boundary

Figure Title	Dormouse Survey
Project Name	West of Ifield 2022 Ecology Surveys
Project Number	1620007949
Figure No.	1
Date	November 2022
Prepared By	NS
Scale	1:9,000 @A3
Issue	1
Client	**Homes England**

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.

APPENDIX 2
PHOTODOC

Photo 1. Potential juvenile hazel dormouse found in the Arable Fields (Area 2)

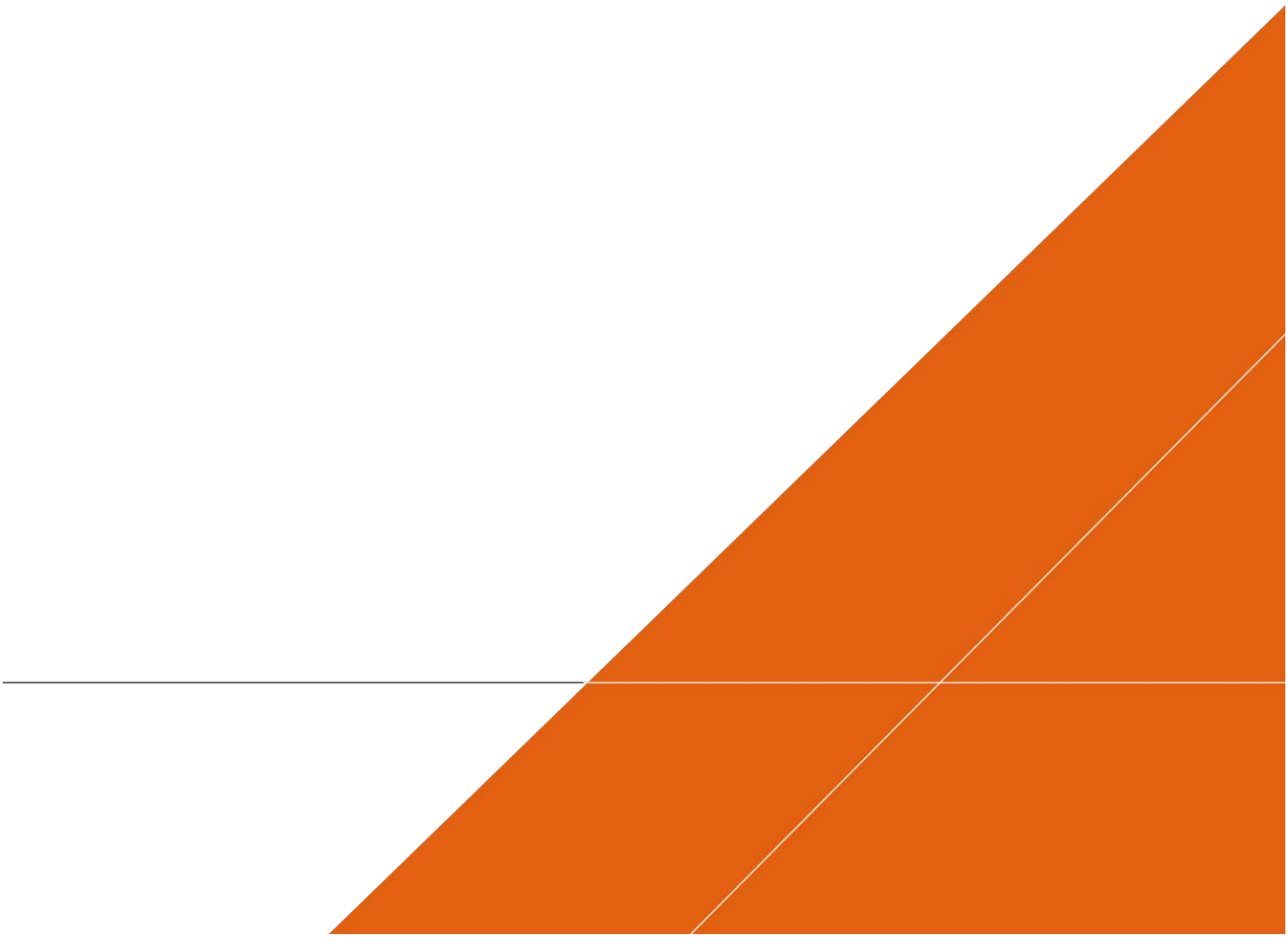
APPENDIX 8.31: LAND WEST OF IFIELD – DORMOUSE SURVEY REPORT

ARCADIS Design & Consultancy for natural and built assets

LAND WEST OF IFIELD

Dormouse Survey Report

OCTOBER 2019



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Land west of Ifield

Dormouse Survey Report

Author	Ellen Quinton
Checker	Lucy Fay, Brandon Murray
Approver	Martina Girvan
Report No	10020728-ARC-XX-XX-RP-YE-11
Date	OCTOBER 2019

VERSION CONTROL

Version	Date	Author	Changes
01	October 2019	Brandon Murray	Issue of report

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Figure 1: Location of Dormouse Survey Tubes

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Executive Summary

This report presents the results of dormouse surveys conducted on a site west of Ifield, West Sussex undertaken by Arcadis Consulting (UK) Ltd on behalf of Homes England. Hereafter, the site is referred to as 'Land West of Ifield', this survey was conducted to inform potential development within this area. The proposed development of the land west of Ifield comprises the construction of approximately 3000 residential dwellings, three schools (two primary and one secondary) and associated infrastructure.

A desk study was undertaken in June 2018 in order to identify any existing information relating to the proposed development site and its surroundings. This confirmed the presence of dormouse within the area surrounding the site. A Phase 1 habitat survey was undertaken between May and July 2018 to map the Phase 1 habitats present and to assess their potential to support protected species of plants and/or animals, including dormouse.

In total, 492 dormouse nest tubes were deployed in areas considered suitable habitat for dormouse in May and June 2018 (suitability based on the findings of the Phase 1 habitat survey). Checks were carried out once every two months between July 2018 and November 2018 in accordance with The Dormouse Conservation Handbook Second Edition and Interim Natural England Advice Note. No evidence of dormouse was recorded during the surveys. Therefore, it is reasonable to conclude that dormouse is absent from the survey areas and that this species does not represent a constraint to the proposed development.

However, the presence of dormouse in the area surrounding the site is known, from the results of the desk study. As such, the survey area has the potential to become populated by dormouse. The design of any development should maximise the value for the site and surrounding area for dormouse, to provide habitat and allow the potential for dormouse to colonise the area.

1 Introduction and Aims

Arcadis Consulting (UK) Ltd, working on behalf of Homes England, was instructed to undertake dormouse nest tube surveys to inform an Environmental Impact Assessment (EIA) of a proposed masterplan for residential use on land to the west of Ifield, West Sussex.

The aim of the survey was to establish the presence/likely absence of dormouse (*Muscardinus avellanarius*) within the site boundary. This report presents the findings of dormouse surveys and, where appropriate, includes recommendations for further surveys, mitigation and design considerations to inform the development of the scheme.

2 Background Information and Proposed Development

2.1 Site Location

The proposed development site is located to the west of Ifield, Crawley (central grid reference - TQ 24133 37360).

The site, which covers approximately 200ha in total, supports a range of habitats including semi-improved grassland, arable fields, amenity grassland, woodland, grazing pasture, a network of hedgerows and several ponds. The River Mole flows west to east through the north of the site, and Ifield Brook, runs flows south to north through the west of the site. Rusper Road passes through the south of the site.

The site is situated to the north-west of the A23 (Crawley Avenue) and is bordered by residential properties to the east, farmland to the west and woodland to the north and south.

An aerial image illustrating the site surveyed is presented in Image 1.

Image 1: Aerial imagery of the site

2.2 Proposed Development

The proposed development comprises the construction of approximately 3000 residential dwellings, three schools (two primary and one secondary) and associated infrastructure.

2.3 Dormouse Biology

The dormouse is a species native to the UK as well as parts of Europe. Habitat preferences usually consist of species-rich hedgerows or broad-leaved woodland (Wembridge et al., 2016). Dormouse has a strong preference for woodland which includes coppiced Hazel (*Corylus avellana*), a species often found in woodlands designated as ancient woodland. It is also classified as an indicator species due to their sensitivity to changes in quality of their habitat (Mortelliti et al., 2014).

Dormouse is nocturnal and will forage amongst tree branches from April to September. During the day, it can be found sleeping in small circular nests woven from strips of bark and leaves. Dormouse is a slow breeder and normally produce a single litter annually. Young are typically born between July and August in order to reach a minimum weight of 15g. When conditions are cold or wet, or if food is scarce, dormouse curl up into a ball and go into a state similar to hibernation for a short time (called torpor) in order to save energy. Between October and May dormouse "hibernate" in nests beneath the leaf litter on the forest floor or in the base of hedgerows. It is subject to predation from birds of prey, squirrels and badgers, but predation is not a major threat to the population, rather this is thought to be habitat loss and fragmentation (PTES, 2017).

Dormouse feed on the flowers of typical British hedgerow and woodland species such as Pedunculate Oak (*Quercus robur*), Hawthorn (*Crataegus monogyna*), Sycamore (*Acer pseudoplatanus*) and Willow (*Salix* sp.) but later in the season will also feed on Bramble (*Rubus fruticosus* agg.)flowers and berries. Dormouse has a distinctive method of eating Hazel nuts and characteristic toothmarks are often used as diagnostic feature by surveyors to establish the presence of dormouse. This species is not completely herbivorous and will also feed on small or juvenile insects (Chanin *et al.*, 2015).

2.4 Legislation and Conservation Status

The dormouse is protected by National and European legislation. It is listed under Schedule 5 of the Wildlife and Countryside Act (WCA) 1981 (as amended) (HMSO, 1981) which makes it an offence to:

- intentionally kill, injure or take a dormouse;
- possess or control any live or dead specimen or anything derived from a dormouse;
- intentionally or *recklessly damage, destroy or obstruct access to any structure or place used for shelter or protection by a dormouse (whether occupied or not); and
- intentionally or *recklessly disturb a dormouse while it is occupying a structure or place which it uses for that purpose.

*The term "recklessly" was added as an amendment to the WCA 1981 as a result of the Countryside and Rights of Way Act 2000 (HMSO, 2000).

The dormouse is included on Schedule 2 of the Conservation of Habitats and Species Regulations 2017 (Anon, 2017) which makes it an offence to:

- deliberately capture or kill a dormouse;
- deliberately disturb a dormouse;
- damage or destroy a breeding site or resting place of a dormouse; and
- keep, transport, sell or exchange, or offer for sale or exchange a live or dead dormouse or any part of a dormouse.

The dormouse is declining across much of its northern range due to habitat loss and fragmentation. Dormouse need well managed woodlands connected by hedgerows in order to disperse and thrive. It is thought that their range in the UK has shrunk by approximately half in the past century with populations concentrated in the south of the country (south of Suffolk) (Wembridge *et al*., 2016).

The dormouse was a UK Biodiversity Action Plan (BAP) Priority Species and is now included on Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (Anon 2006).

3 Methodology

3.1 Desk Study

A desk study was undertaken in June 2018 in order to identify any existing information relating to the proposed development site and its surroundings.

Biological records were obtained from Sussex Biodiversity Record Centre.

3.2 Dormouse Nest Tube Survey

Dormouse nest tube surveys were undertaken in accordance with the guidance provided in The Dormouse Conservation Handbook (Bright *et al* 2006). The survey method used was a 'dormouse nest-tube survey', whereby specially constructed artificial nesting tubes were fastened underneath horizontal branches using garden wire in areas of suitable habitat and were left in place over a period of several months. When present, dormouse often make nests in these tubes and their presence can then be detected by means of periodic monitoring to find actual animals or nests, both of which are distinctive.

The standard survey methodology requires the deployment of at least 50 nest tubes, per site, and uses an index of probability to calculate a survey effort score. Nest tubes are most frequently occupied in May, August and September and so these months score the highest. The minimum acceptable score for survey effort is 20. The survey effort score is shown in Table 1 and confirms that the survey effort undertaken at the site was sufficient to provide robust data and allow a reliable assessment.

Between 9 and 24 May 439 dormouse tubes were installed on the site. An additional 53 tubes were added between 25 May and 4 June.

These dormouse tubes were deployed at approximately 20m intervals in areas identified as suitable dormouse habitat. These locations included woodland, hedgerows and scrub and can be found on Figure 1. Nest tube checks were carried out once every two months in accordance with guidance published by Natural England (Natural England 2011) on dates detailed in Table 1 below. Each survey was carried out by at least one experienced licenced surveyor and an assistant as detailed in Table 1. Details of the surveyors who conducted the surveys are presented in Appendix C. In total, 20 survey 'points' were achieved during the surveys as presented in Table 2.

Table 1: Dormouse survey check dates

Visit/activity	Survey date	Surveyors
Nest tubes deployed	10/05/2018 – 24/05/2019 28/05/2019 - 04/06/2018	Lucy Fay, Sian Carr, Kailey O'Brien, Sam Saunders Davies, Ellen Quinton, Libby Brooks, Daniel Jones & Julie Player (Arcadis)
Check 1	23/07/2018 - 27/07/18	Ellen Quinton & Elisabeth Brooks (Arcadis)
Check 2	25/09/2018 – 28/09/2018	Tim Buckland & John Burnham (Babec)
Check 3 and remove nest tubes and boxes	21/11/2018 – 23/11/2018	Tim Buckland, Shaun Pryor & Jeff Turton (Babec)
Total		

Table 2: Points achieved during the dormouse surveys

Month tubes were present	Points score
May	(4) – not counted as tubes were installed late in the month
June	2

Month tubes were present	Points score
July	2
August	5
September	7
October	2
November	2
TOTAL POINT SCORE	20

4 Survey Constraints

Due to cattle (bulls, females and calves) being present, surveyors were unable to deploy dormouse nest tubes in certain hedgerows within the north of the site due to health and safety concerns and practical survey reasons (i.e. tubes were likely to be disturbed by livestock). This area is identified within Figure 1 There remained a large number of dormouse tubes in adjacent areas of the site within similar habitat, and the total number of tubes deployed was far greater than the survey mandated minimum (50) therefore this is not considered a significant constraint to the survey.

Dormouse nest tubes were not positioned at the recommended 20m intervals within the vegetation along the River Mole due to the lack of suitable habitat, and this is not considered to have impacted upon the validity of the survey results.

During the September visit, two tubes in the east of the site could not be checked as a temporary works site was active in the location of the tubes, shown in photograph 3 in Appendix B. However, these tubes were checked in November and contained no evidence of dormice or of disturbance, and this is not considered to have impacted upon the validity of the survey results.

5 Results

5.1 Desk Study

The desk study returned two records of dormouse since 2008, 1.8km and 2km south east of the proposed development.

The habitat within the site, notably areas of woodland and connecting hedgerows are considered suitable to support dormouse, and also provide connectivity to other suitable habitat in the wider landscape.

5.2 Field Survey

No dormouse or evidence of dormouse was found during the surveys. Several wood mice (*Apodemus sylvaticus*) were identified within nest tubes across the site. Images of a subset of the wood mouse nests found are presented in Appendix B.

6 Discussion

The desk study returned two records of dormouse since 2008, 1.8km and 2km south east of the proposed development.

Dormouse surveys were undertaken from May to November 2018 within the site boundary and the interface of off-site woodlands with the site.

No evidence of dormouse was recorded during the surveys. It is therefore likely that dormouse are absent from the survey area and that this species does not represent a constraint to the proposed development.

However, the presence of dormouse in the area surrounding the site is known, from the results of the desk study. As such, the survey area has the potential to become populated by dormouse. The design of any development should maximise the value for the site and surrounding area for dormouse, to provide habitat and allow the potential for dormouse to colonise the area.

7 Mitigation Recommendations and Further Work

7.1 Introduction

This section outlines proposed mitigation for dormouse within the development. As dormouse are not present within the site (although they are present within 2km of the site), only high level design mitigation is provided. This should maximise the value of the site and surroundings for dormouse, allowing this species to recolonise the area or move through the site.

7.2 Design Mitigation

Although on-site 'mitigation' is not required (as this species is not present within the site), within the masterplan design, measures should implemented to maximise the value of the site for dormouse and to safeguard dormouse which have been recorded as present within adjacent and nearby habitats (as recorded within the desk study record from 2008). The following measures are being incorporated within the masterplan design:

- A buffer of 50m around ancient woodlands from built development;
- Appropriate buffers around retained woodlands within the site;
- Retention of hedgerows where possible;
- Planting of new woodland blocks and creation of new hedgerows.

7.3 Enhancement Measures

Planting of replacement species-rich habitats and/or enhancement of existing habitats will be required to compensate for any loss of habitat during the construction phase. Vegetation sourced and grown local to the proposed development site should be used. Favoured species include Hawthorn for its flowers and berries and Hazel for its nuts and ability to support insect species. A diversity of other species to offer flowers, insects and fruits at different times including Bramble Pedunculate Oak , Honeysuckle (*Lonicera periclymenum*), Sycamore, Yew (*Taxus baccata*), Blackthorn (*Prunus spinosa*) and Sweet Chestnut (*Castanea sativa*) should be also be considered. The planting of replacement vegetation will need to maintain/enhance the current connectivity already found over the site.
This would also contribute to achieving net gain for biodiversity within the development.

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Figure 1: Location of Dormouse Survey Tubes

NOTES:

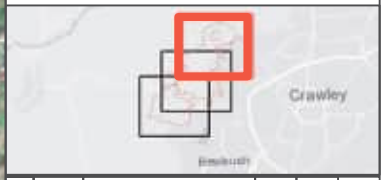
Not a full BS5837-2012 survey, only significant trees have been plotted

Legend:

points

Type

- Dormouse Nest Tubes



Rev	Date	Description	Drawn	Check	Approv
01	20/06/19	First Issue	RM	PT	AJ

Client

Homes England

HOMES ENGLAND
CLIENT 2

PROJECT:

LAND WEST OF IFIELD

Site
Land West of Ifield

Client
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www.arcadis.com

TITLE:

Dormouse Survey
Page 1 of 3

Drawn	M.Azzopardi	Date: 20JUN19	Signed:
Checked	B.Murray	Date: 20JUN19	Signed:
Approved	B.Murray	Date: 20JUN19	Signed:
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Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10020728

Suitability Description:
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NOTES:

Not a full BS5837-2012 survey, only significant trees have been plotted

Legend:

points

Type

- Dormouse Nest Tubes

Rev	Date	Description	Drawn	Check	Approv
01	20/06/19	First Issue	RM	PT	AJ

Client

Homes England

HOMES ENGLAND
CLIENT 2

PROJECT:

LAND WEST OF IFIELD

Site
Land West of Ifield

Client
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Page 2 of 3

		Date	Signed
Drawn	M.Azzopardi	20JUN19	
Checked	B.Murray	20JUN19	
Approved	B.Murray	20JUN19	
Scale:	1:5,000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10020728

Suitability Description:
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P1

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NOTES:

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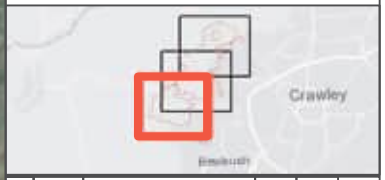
Legend:

points

Type

- Dormouse Nest Tubes



Rev	Date	Description	Drawn	Check	Approv
01	20/06/19	First Issue	RM	PT	AJ

Client

Homes England

HOMES ENGLAND
CLIENT 2

PROJECT:

LAND WEST OF IFIELD

Site
Land West of Ifield

Client
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TITLE:

Dormouse Survey
Page 3 of 3

Drawn	M.Azzopardi	Date: 20JUN19	Signed:
Checked	B.Murray	Date: 20JUN19	Signed:
Approved	B.Murray	Date: 20JUN19	Signed:
Scale:	1:5,000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10020728

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Revision: P1

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APPENDIX A: Survey Conditions During Surveys and Surveyors

Table 3: Weather conditions during the surveys and surveyors

Survey date	Weather conditions	Surveyors
23/07/2018 - 27/07/18	Dry and sunny 18ºC - 30ºC	Ellen Quinton & Elisabeth Brooks (Arcadis)
25/09/2018 – 28/09/2018	Dry, light wind 6ºC - 18ºC	Tim Buckland & John Burnham (Babec)
21/11/2018 – 23/11/2018	Dry and sunny 0ºC - 10ºC	Shaun Pryor & Jeff Turton (Babec)

APPENDIX B: Site Photographs

Photograph 1: A tube containing a wood mouse nest

Photograph 2: A tube containing evidence of mammal feeding. The marks in the hazelnuts are not indicative of dormice.

Photograph 3: Location of two tubes that could not be surveyed in September

Photograph 4: A hazelnut found within the golf course. This presents the indicative chew marks of wood mouse not dormouse.

APPENDIX C: Key Surveyor Pen Portraits

Table 4: Key surveyor pen portraits

Surveyor	CV details
Tim Buckland BSc MSc MCIEEM	Tim is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM) and has a BSc in Marine Biology and an MSc in Biodiversity Survey. He has a strong understanding of mammal ecology and holds survey licenses for great crested newts, bats, dormice (Class licence registration number: 2016-21677-CLS-CLS) and barn owls.
Shaun Pryor BSc GradCIEEM	Shaun has held a Natural England level 1 survey licence for dormice (class licence registration number: 2016-21149-CLS-CLS) for over six years. He has a BSc in Environmental Science. Shaun is experienced at undertaking Phase 1 habitat surveys and protected species surveys. He has also assisted with botanical and invertebrate surveys.
Ellen Quinton (Ecologist) BSc, MSc, GradCIEEM	Ellen has been a professional ecologist for four years and has experience in a range of protected species surveys including bats, great crested newts, dormice, reptiles, water voles and ecological clerk of works. Ellen has experience in assessing sites for potential ecological impacts and is able to provide appropriate recommendations and mitigation in order to reduce potential impacts. Ellen has been a lead surveyor for a range of bat surveys including emergence and re-entry surveys, transect surveys and building and tree assessments. 2017-30916-CLS-CLS
Elisabeth (Libby) Brooks (Graduate Ecologist) GradCIEEM BSc (Hons)	Libby has been a professional ecologist for over a year and has experience in a range of protected and sensitive species surveys such as badger, dormice, reptile, water vole, otter, breeding birds, overwintering birds and ecological clerk of works.
Kailey O'Brien (Graduate Ecologist) BSc, MSc GradCIEEM	Kailey has been a professional ecologist for 2 years and has assisted on surveys within consultancy and through volunteering.
Jeff Turton BSc (Hons) GradCIEEM	Jeff is a graduate member of the Chartered Institute of Ecology and Environmental Management and holds a BSc in Conservation Biology and an ND in Countryside Management. Jeff also holds a wide range of practical certifications, including tree climbing and aerial rescue, IPAF and first aid.

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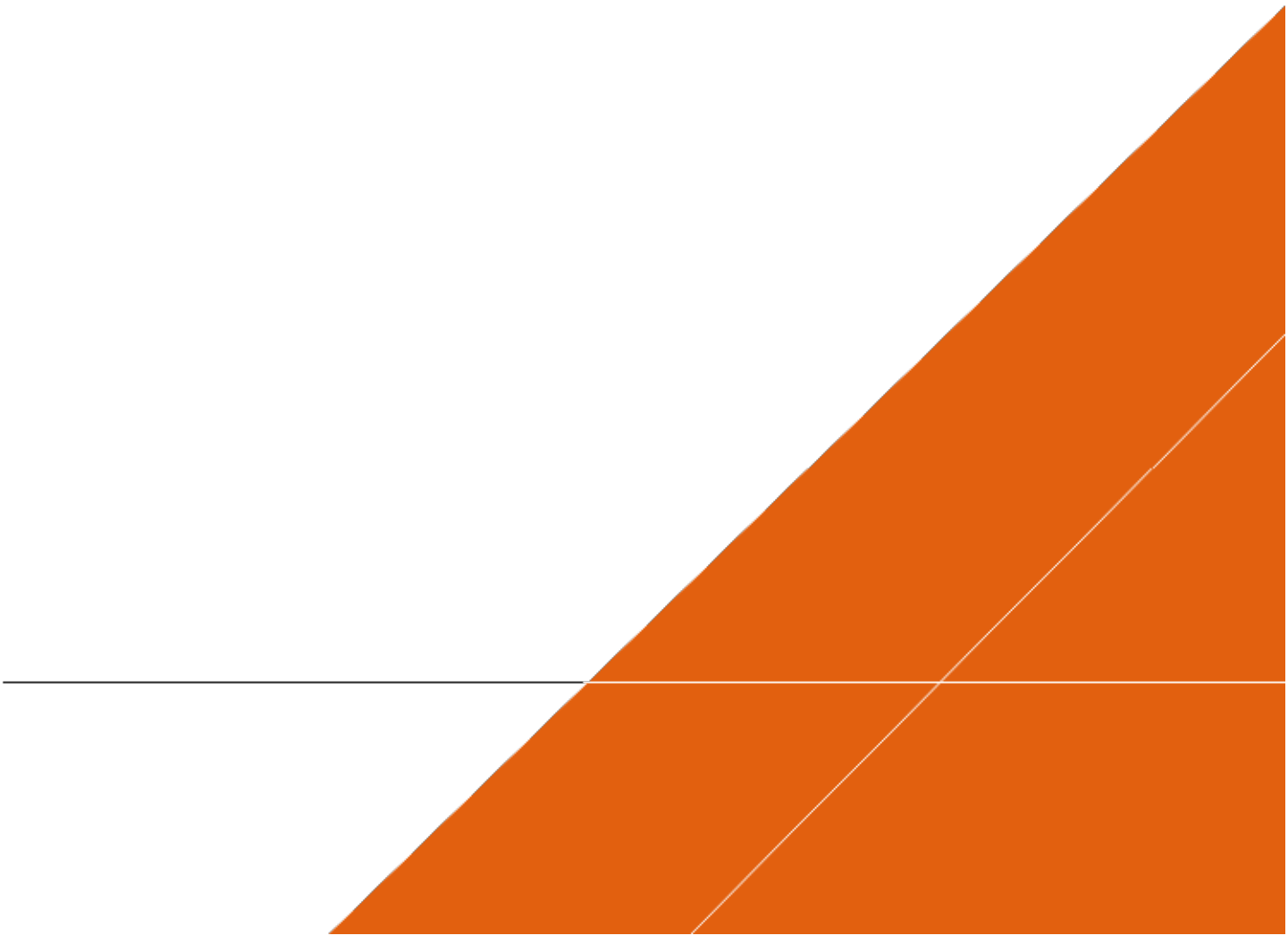
APPENDIX 8.32: LAND WEST OF IFIELD – OTTER AND WATER VOLE SURVEY REPORT

ARCADIS Design & Consultancy for natural and built assets

LAND WEST OF IFIELD

Otter and Water Vole Survey Report

OCTOBER 2019



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Otter and Water Vole Survey Report

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Report Reference	WOI-AUK-XX-WS-RP-EC-0007-01-Otter and Water Vole Survey Report
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Executive Summary

Arcadis Consulting (UK) Ltd was commissioned on behalf of Homes England to undertake a survey for water vole and otter on the land associated with the proposed housing development west of Ifield, Crawley. This report has been prepared to inform a proposed masterplan for residential use on land to the west of Ifield, West Sussex.

The site is located to the west of Ifield, Crawley (central grid reference – TQ 24133 37360). The site which covers approximately 200 ha in total supports a range of habitats including semi-improved grassland, arable fields, amenity grassland, woodland, grazing pasture, a network of hedgerows and several ponds. The River Mole flows west to east through the north of the site, and Ifield Brook, runs flows south to north through the west of the site. Rusper Road passes through the south of the site. The site is situated to the north-west of the A23 (Crawley Avenue) and is bordered by residential properties to the east, farmland to the west and woodland to the north and south.

The potential for otter and water vole to be present on the site was identified during Phase 1 habitat surveys conducted in May, June and July 2018. Subsequently, dedicated otter and water vole surveys were conducted between 12 and 14 June 2018, between 12 and 16 August 2018, 10 May 2019 and 29 May 2019.

The following activities were undertaken on the given dates:

- 12 to 14 June 2018: watercourse scoping assessment and water vole survey; otter survey of on-site watercourses;
- 14 to 16 August 2018: water vole survey; otter survey of on-site watercourses;
- 10 May 2019: water vole survey; otter survey of onsite watercourses.
- 29 May 2019: otter survey of off-site crossing points

During the surveys, 28 ‘waterbodies’ were surveyed throughout the site and surrounding area based on an assessment of their habitat suitability for water vole and / or otter.

One old otter spraint was found within the site. No evidence of otter resting sites were recorded, features with suitability to be utilised by resting otter were observed. On the basis of the evidence collected otter could be using the site at low frequencies, possibly passing through to access more favourable areas of foraging habitat.

No definitive signs of water vole were recorded within the site. One small mammal burrow was identified, but no definitive signs of water vole were recorded such as feeding signs or droppings, and so, this was most likely a rat burrow. Water vole were considered absent from the site and adjacent habitats.

1 Introduction

1.1 Overview

Arcadis Consulting (UK) Ltd, working on behalf of Homes England, was instructed to undertake ecological surveys to inform a proposed masterplan for residential use on land to the west of Ifield, West Sussex.

The aim of the surveys was to establish the presence/likely absence of otter (*Lutra lutra*) and water vole (*Arvicola amphibius*) within the site. This report presents the findings of otter and water vole surveys and, where appropriate, includes recommendations for further surveys and design considerations to inform the development of the scheme.

1.2 Site Location & Setting

The proposed development site is located to the west of Ifield, Crawley (central grid reference - TQ 24133 37360) (see Figure 1 for the site location and survey boundary).

The site which covers approximately 200 ha in total and supports a range of habitats including semi-improved grassland, arable fields, amenity grassland, woodland, grazing pasture, a network of hedgerows and several ponds. The River Mole flows west to east through the north of the site, and Ifield Brook, runs flows south to north through the west of the site. Rusper Road passes through the south of the site.

The site is situated to the north-west of the A23 (Crawley Avenue) and is bordered by residential properties to the east, farmland to the west and woodland to the north and south.

An aerial image illustrating the site surveyed is presented in Image 1.

Image 1: Aerial imagery of the site

1.3 Proposed development

The proposed development comprises the construction of approximately 3000 residential dwellings, three schools (two primary and one secondary) and associated infrastructure.

Due to the proximity of the site to Gatwick Airport (approximately 1.3km to the north), the development is to be concentrated towards the southern end of the site, with the northern part of the site forming open space.

1.4 Survey aims

During an extended Phase 1 habitat survey conducted in May to July 2018, it was identified that the ditches and ponds within the study area provided suitable habitat for water vole and otter. Targeted surveys for water vole and otter were carried out to determine the population status and distribution of these species on, and in the near vicinity of, the site.

1.5 Species biology

1.5.1 Otter biology

Otter are a member of the mustelid family, native to Britain but also distributed throughout Europe, China and Russia.

Otter can live in a wide range of aquatic habitats but more recently in the UK have developed a preference for lakes and estuaries due to the lower concentrations of pollutants. They are carnivorous, feeding predominantly on fish (over 70% of their diet) but can also feed on birds, amphibians, reptiles, crustaceans and small mammals, hunting both on land and in water. Occasionally, they may prey on water vole but are not considered a major threat to water vole populations (Conroy and Chanin, 2001).

The average life expectancy for otter is 5 years. Sexual maturity is reached at 2 years and breeding takes place all year round. Litters usually contain 1-4 pups which remain with the female until they are a year old. Otter are principally nocturnal and are normally solitary. They are highly territorial and mark their home range by “sprainting” (leaving faeces). Sprainting is often used to prevent competition when food resources are scarce (Rey, 2016). Another otter sign is the misnomer “anal jelly” once thought to be a secretion from the anal gland, but is now thought to be a mucal secretion from the lining of the gut which acts as a lubricant for protection from sharp bones and indigestible material.

1.5.2 Water vole biology

Water vole are the largest native species of vole in Britain. Their distribution is largely within the south-east of the UK, with some patchy distribution elsewhere (McGuire and Whitefield, 2017).

Water vole reside along steep, grassy banks either side of slow-moving rivers/streams. Their burrow entrances are often in the water or near the water’s edge. The main components of their diet are bankside vegetation including grasses, reeds, sedges and rushes. In winter they may also feed on tree bark and fruit where available. Water vole have occasionally been known to feed on insects. It is important that they forage as much as possible during the summer months to ensure they have sufficient fat reserves to survive the winter (PTES, 2019).

Water vole are social animals and live in colonies, although these colonies are spread out along watercourses. Females are highly territorial and have territory sizes ranging from 30-150m, whilst male’s territories range from 70-300m; these territories are marked using latrines. There is no hibernation period for water vole, but in the winter months they spend a greater proportion of their time in burrows. Water vole usually breed between April and October. Females often have up to five litters a year, frequently with more than five young per litter.

1.6 Legislation and conservation status

1.6.1 Otter legislation

The otter is protected by national legislation.

It is listed under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) (HMSO, 1981) which makes it an offence to:

- intentionally or *recklessly disturb an otter whilst it is occupying a structure or place which it uses for shelter or protection;
- intentionally or *recklessly obstruct access to any structure or place used for shelter or protection by an otter;
- sell, offer or expose for sale, or to possess or transport for sale alive or dead otter or any part of or anything derived from an otter.

*The term “recklessly” was added as an amendment to the WCA 1981 as a result of the Countryside and Rights of Way Act (HMSO, 2000).

The otter is also included on Schedule 2 of the Conservation of Habitats and Species Regulations (HMSO, 2017) which makes it an offence to:

- deliberately capture or kill an otter;
- deliberately disturb an otter (where disturbance is likely to impair their ability to survive, breed or reproduce, rear or nurture their young; or to hibernate or migrate; or to affect significantly the local distribution or abundance of otter).
- damage or destroy a breeding site or resting place of an otter; and
- be in possession of, control, transport, sell or exchange, or offer for sale or exchange any live or dead wild otter or any part of a wild otter or anything derived from an otter or any part of a wild otter.

Licences may be granted by Natural England under Regulation 53 of the Conservation of Habitats and Species Regulations (HMSO, 2010) for certain purposes affecting otter, including development works. Regulation 53 (2)(e) states that such licences can be granted for the purpose of “preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment”. Those activities listed under Schedule 2 (see above) would not constitute an offence if carried out in accordance with the terms of such a licence.

1.6.2 Otter conservation status

Native otter populations have previously been in decline due to hunting, road traffic incidents, food scarcity and pollution, but recent conservation efforts have seen an increase in the population over the last 25 years. The People’s Trust for Endangered Species now estimate the United Kingdom (UK) population to be around 10,300 (PTES, 2017). The otter declined by 95% of its range in western Europe during the 20th century, and despite some recent population increases in the UK, is considered to be to be Near Threatened by the IUCN (Roos et al., 2015). Otter are a priority species in the UK Biodiversity Action Plan and are classified as Near Threatened on the IUCN Red List (Baillie et al., 2004). They were hunted to near extinction in the UK.

For the 5th National Otter Survey of England in 2010, reports of otter in the Thames region (in which Ifield is located) were dramatically increasing. The region has shown the largest increase in positive sites of any region, up from 8% to 41% between the 2000-02 and 2009-10 surveys. However, signs of otter were not found along the river Mole, which runs through the site.

The most significant threats to otter in the UK are:

- Water pollution – due to the introduction of insecticides in the 1950’s, in particular mercury, dieldrin and polychlorinated biphenyls. The otter’s sensitivity to pollutants and the increase in the use of agricultural chemicals lead to a rapid decline in the number of otter, particularly within watercourses within or neighbouring farmland (Conroy and Chanin, 2001).

- Increase in road traffic – which has led to the number of otter killed in road traffic accidents increasing. A post mortem conducted in 1997 on 230 otter corpses found that 80% of them had died from road traffic incidents (Simpson, 1997).

Habitat loss and fragmentation – due to a nationwide loss of aquatic habitats. Otter are particularly sensitive to canalisation, dam construction and the draining of wetlands. A reduction in the availability of fish due to urbanisation also has had a negative impact on the otter population (Reuther, 1998)

1.6.3 Water vole legislation

The water vole is protected by national legislation.

It is listed under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) (HMSO, 1981) which makes it an offence to:

- intentionally kill, injure or take a water vole;
- possess or control any live or dead specimen or anything derived from a water vole;
- intentionally or *recklessly damage or destroy any structure or place used for shelter or protection by a water vole;
- intentionally or *recklessly disturb a water vole whilst it is occupying a structure or place which it uses for shelter or protection;
- intentionally or *recklessly obstruct access to any structure or place used for shelter or protection by a water vole;
- sell, offer or expose for sale, or to possess or transport for sale a live or dead water vole or any part of or anything derived from a water vole.

*The term “recklessly” was added as an amendment to the WCA 1981 as a result of the Countryside and Rights of Way Act (HMSO, 2000).

There is no licensing mechanism in place that permits development activities to proceed, that would otherwise result in the contravention of the Wildlife and Countryside Act (WCA, 1981). However, licenses are issued by Natural England for conservation purposes.

Where development activities would result in an offence being committed under the 1981 Act, it may be considered necessary to capture and remove the animals from the affected area providing this is done under a conservation licence. Natural England will only issue such a license if it will result in a conservation benefit for the species. It would be necessary to demonstrate that the potential impacts to the water vole could not reasonably have been avoided and the works must have lawful authority such as an appropriate planning permission.

1.6.4 Water vole conservation status

The water vole is the UK’s most rapidly declining mammal and has been lost from 94% of places where they were once prevalent (Strachan et al., 2003). Their numbers have rapidly declined in the past century and early 21st century, partly due to loss and fragmentation of habitat, and partly due to increased predation by American mink. The PTES estimate the UK population of water vole to be approximately 875,000 (PTES, 2019). The water vole is considered vulnerable to extinction in the UK. They are a Section 41 species of principle importance under the NERC Act (Anon, 2006). Current efforts to halt population loss appear to be failing, with a 30% decline in the last 10 years (McGuire and Whitfield, 2017).

It is thought that the two most influential factors contributing to the decline of the water vole in Britain are:

- Loss of traditional agricultural land, particularly floodplains, due to urbanisation. This has caused a steady decline in the water vole population in the last 100 years due to the loss and fragmentation of habitat and scarcity of bankside vegetation for foraging (Lawton and Woodroffe, 1991). In recent years there has been emphasis put on correct maintenance of floodplains which should benefit water vole and prevent drought and flooding which often threatens populations.
- American mink (*Neovison vison*) were introduced to the UK in the 1980’s as part of the fur trade. During animal rights campaigns, many were released from these “mink farms” into the wild where they rapidly adapted to life in British watercourses. Their success was in part due to the ready availability of prey, in

particular, water vole. Mink not only overlap water vole with their habitat preferences, but they also have large ranges (up to 35km) and are small enough to enter water vole burrows. This leaves water vole highly vulnerable to mink predation in comparison to predation by other mammals (Rushton et al., 2000).

2 Methodology

2.1 Desk study

As part of the extended Phase 1 habitat survey of the site a desk study was undertaken to identify any existing ecological information relating to the site and its surroundings. The Sussex Biodiversity Record Centre (SBRC) were consulted in May 2018 to check whether they held any records of otter and water vole within 2km of the site.

A summary of all of the results of this data search are detailed in the Land West of Ifield extended Phase 1 survey report (Arcadis, 2019). Data that is relevant has also been detailed in this report. Field Survey

2.2 Otter Survey

Habitat suitability assessment of all of the watercourses on the site and the first otter survey was undertaken between 12 and 14 June 2018 and a second survey was undertaken between 14 and 16 August 2018 by experienced ecological surveyors Sam Saunders-Davies (MCIEEM) and Polly Tayler (MCIEEM). A third suite of surveys were carried out by Marielle James (Grad CIEEM) and Liam Price (Grad CIEEM) on 10 May 2019 of the on-site watercourses. The surveys comprised a walk along the banks of the watercourses within the site boundary and aimed to determine presence and/ or likely absence of otter, location of likely otter resting sites (holts/ couches) and their status i.e. how regularly these are used and how recently, the likelihood of any suitable habitat to support breeding otter and any requirements for further surveys/ monitoring and/ or licencing. Subsequently, Rich Prew (Grad CIEEM) and Liam Price (GradCIEEM) carried out spot checks at bridges / river crossings beyond the site boundary on 29 May 2019.

The locations of the watercourse surveyed within the site and the off-site crossing points are presented in Figure 2. Pen portraits of the key surveyors are presented in Appendix D.

The otter survey involved searching the watercourses and banks up to 10m from the water's edge, where access was possible. To determine presence and/ or likely absence, the field signs surveyed for were:

- spraints – these are usually black in colour and smell of fresh cut hay. The otter uses spraints to define its home range, and are located at prominent points such as on boulders and ledges;
- 'anal jelly', a means the otter uses for marking territory;
- footprints – the otter has five toes that are webbed, leaving footprints around 50-60mm wide that are very characteristic and easy to recognise. Measurement of footprints can be used to estimate population density and to sex the tracks, as fully-grown male otter tracks are significantly larger than female tracks;
- mammal paths found along riverbanks;
- flattened vegetation;
- holts and 'couches' – holes in the riverbank, hollow trees, cavities amongst tree roots, piles of rocks, wood or debris may all be used as holts or 'couches'; and
- feeding remains.

The locations of the watercourses surveyed are presented in Figure 2.

2.3 Water vole Survey

Initial water vole suitability surveys and water vole surveys were undertaken between 12 and 14 June 2018 and a second suite of surveys were undertaken between 14 and 16 August 2018, by experienced ecological surveyors Sam Saunders-Davies and Polly Tayler. A third survey was carried out by Marielle James (MCIWEM GradCIEEM) and Liam Price on 10 May 2019. Pen portraits of the key surveyors are presented in Appendix D. The surveys comprised a detailed search of each waterbody present on site and was carried out following standard guidance within The Water Vole Mitigation Handbook (Dean *et al*., 2016). This involved searching bankside vegetation for:

- Latrines/droppings – water vole droppings are often concentrated in discrete latrine sites near the nest, at territorial boundaries and places where they regularly enter and exit the water. While most droppings will be deposited in latrines, some may be found scattered along runways in vegetation;

- Feeding stations – feeding remains in the form of neat piles of chewed lengths of vegetation are often found in runways and at haul-out platforms;
- Burrows – these are typically found along the water's edge and on top of the bank up to 5 m from the water's edge. Holes on top of banks often have grazed 'lawns' around them;
- Nests – where vegetation cover is dense, and the water table is high (limiting opportunities for burrowing), water vole nests may be found woven into the base of rushes, sedges or grass tussocks; and
- Footprints – these may be identified in soft mud or silt.

The locations of the watercourses surveyed are presented in Figure 2.

2.4 Summary of surveys conducted

The table below summarises the dates of the surveys conducted.

Table 1: Summary of surveys undertaken for otter and water vole

ACTIVITY	12 – 14 June 2018	14 - 16 August 2018	10 May 2019	29 May 2019
Watercourse scoping survey	Y	N	N	N
Water vole survey	Y	Y	Y	N
Otter Survey Watercourses on site	Y	Y	Y	N
Otter survey off-site crossing points	N	N	N	Y

2.5 Survey Constraints

2.5.1 Desk study

Data held by the local records centre is submitted by members of the public on an *ad hoc* basis. It is not a comprehensive list of all species that could be present. SBRC do not hold records for otter and data was not obtained from other organisations due to the sensitivity of the scheme.

2.5.2 Field survey

Due to steep banks, deep water and dense vegetation, in places it was not possible to fully survey all of the watercourses. Four watercourses (5, 18, 19 and 25) could not be accessed to survey, these watercourses are shown on Figure 1. However, these limitations are not anticipated to have impacted the results of the survey as most of the length of each watercourse within the site boundary was surveyed.

3 Results

3.1 Desk study

SBRC returned no records of water vole within 2km of the site. SBRC do not hold records of otter, so it was not possible to obtain records for this species.

3.2 Field survey

3.2.1 Otter survey

Watercourse descriptions and the suitability of each watercourse to support otters based on the habitats present are shown in Appendix A. Four watercourses (15, 20, 21 and 26) were identified as being suitable to support otter as they provided opportunities for foraging and shelter. The remaining watercourses were assessed as having negligible potential.

The Ifield Brook featured evidence of previous use by otters, with old otter spraint being found on roots of a fallen tree on eastern bank (TN6). In addition, both the River Mole and Ifield Brook, watercourses 20 and 21 respectively, featured signs indicating potential use by otters including possible prints, claw marks and potential resting sites (TN 1 to 14 in Appendix B and shown in Figure 1). However, no evidence was found that confirmed recent use of these two watercourses by otters.

No signs of otter were found in any of the other watercourses on the site. No otter signs were observed during the survey of off-site crossing points.

3.2.2 Water vole survey

Watercourse descriptions and the suitability of each watercourse to support water vole based on the habitats present are shown in Appendix A. Five watercourses (6, 15, 20, 21 and 26) were identified as being suitable to support water vole, these watercourses provide limited foraging opportunities and burrowing substrate.

No signs of water vole were recorded in the 2018 surveys. A single mammal burrow (TN 1 in Appendix C and shown in Figure 1) was identified on Ifield Brook in the 2019 survey, but no water vole field signs were recorded. Considering the thorough nature of the surveys that were conducted, it is considered that this burrow was created by a brown rat (*Rattus norvegicus*). Water vole are considered absent from the site.

4 Conclusion

4.1 Otter

Four watercourses on the site were found to be suitable for use by otters. However, no confirmed evidence of recent otter activity and only limited evidence of historic activity was found during the survey (old spraint at a single location – see TN6 in Appendix A and Figure 1). Despite the number of potentially suitable rest sites for otters within the site, the lack of evidence of otter activity indicates that the site and immediate surroundings are of low importance to otters. It is likely that the use of the Ifield Brook, River Mole and other suitable watercourses by otters is limited to commuting to more favoured areas of foraging habitat within their range.

4.2 Water vole

The watercourses on the site were found to be largely unsuitable for water voles, with five having low potential and the remainder having negligible potential to support this species. No evidence of water vole activity was observed during the surveys. The lack of any evidence of water vole activity found during the comprehensive surveys, combined with the absence of any records for the species within 2km, indicates that water vole are likely absent from the site.

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Figure 1: Waterbodies surveyed and results plan

Notes:

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend:

- Application Site Boundary
- Water Vole Target Note
- Otter Target Note
- Watercourse not surveyed
- Watercourse surveyed

Rev	Date	Description	Drawn	Check	Approv
P01	30/10/19	First Issue	AH	LP	BM

Client

HOMES ENGLAND

PROJECT:

LAND WEST OF IFIELD

Homes England

Site

Land West of Ifield

Client

Homes England
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TITLE:

Figure 1: OTTER AND WATER VOLE SURVEY RESULTS

Drawn	A.Hankinson	Date: 30OCT19	Signed:
Checked	L.Price	Date: 30OCT19	Signed:
Approved	B.Murray	Date: 30OCT19	Signed:
Scale:	1:10,000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10020728

Suitability Description:

Issued for information

Drawing Number: 10020728-ARC-XX-XX-DR-YE-0024

Revision: P01

km
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50mm on Original

Print Date: 10-30-19 11:27:01

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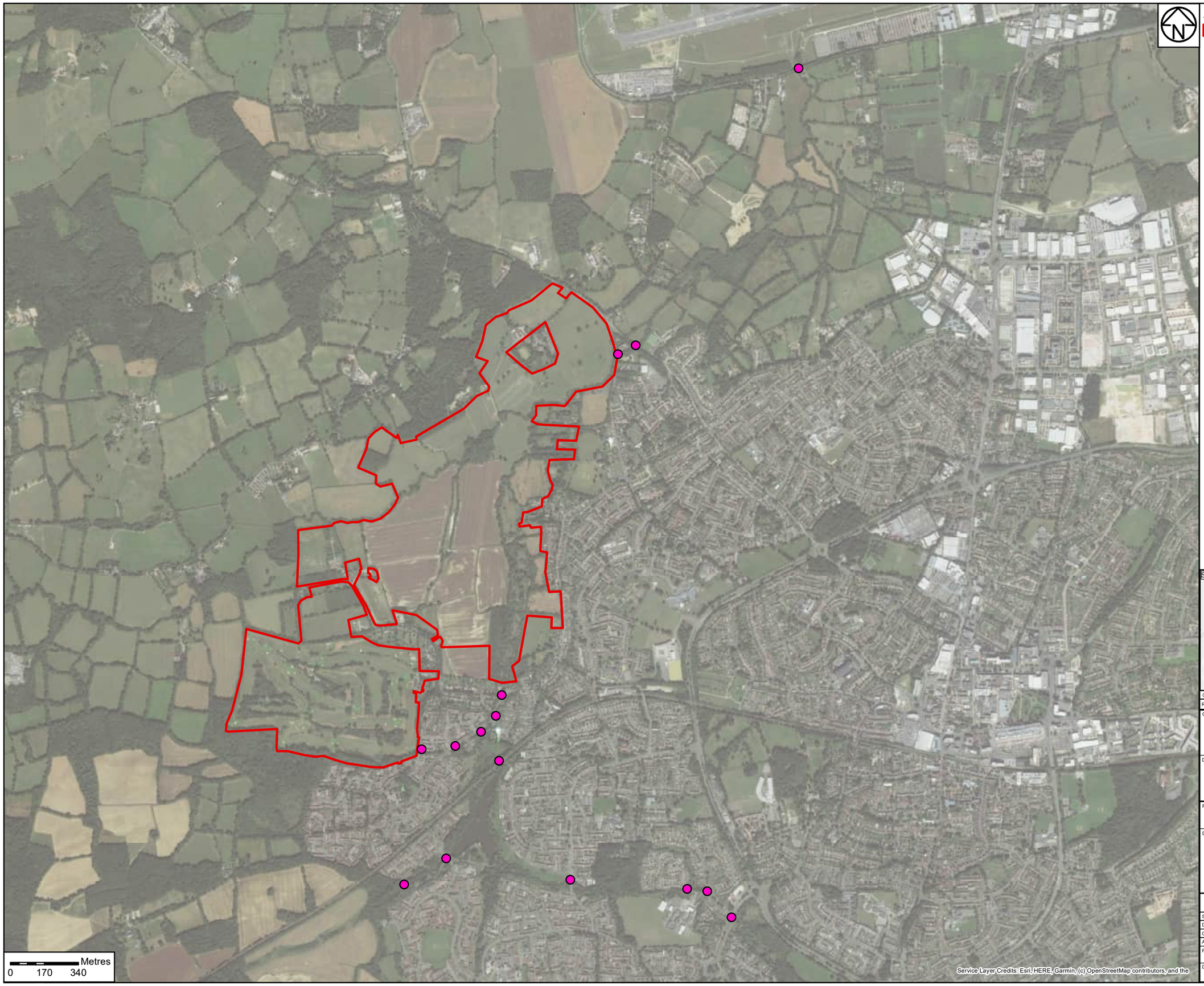
Figure 2: Locations of crossing points surveyed for evidence of otter

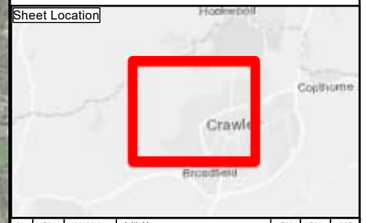


Legend

Red Line Boundary

'Crossing Point' checked for signs of Otters

Sheet Location



Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
01	S2	30/10/19	Initial Issue	PN	BM	MG

Client: Homes England

Designer: ARCADIS

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Project: Land West of Ifield

Drawing Title: Figure 2 Otter Crossing Check Locations

	Status: S2	Revision: 01	
Scale	1:17,500	Date	30/10/19
Drawn By	P. Nehete		
Checked By	B. Murrary		
Approved By	M. Girvan		
PINS No.			

Drawing number: HE P/N | Originator | Volume | Location | Type | Role | Number

APPENDIX A: Watercourse descriptions and photographs

Table 2: Watercourses surveyed and details

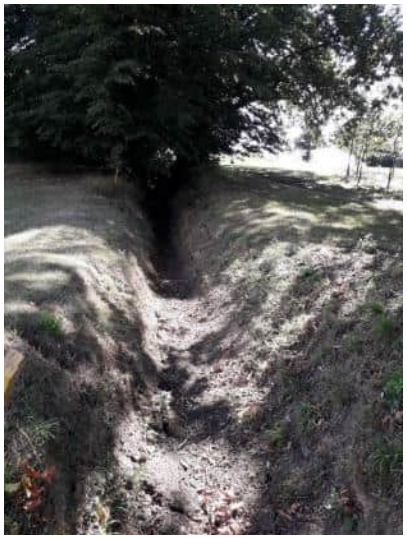
Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
1	TQ 23293 36736	Negligible	Negligible	Ifield Golf course - Managed ditch in middle of golf course. Channel approx. 20cm wide with a max depth of 50cm. Ditch approx. 130m long. Dry during June and August visit.	

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
2	TQ 23323 36812	Negligible	Negligible	Ifield Golf course – Small ditch connecting to ditch 1. Channel 50cm wide. Heavily shaded within small wooded area. Ditch approx. 30m long. Dry during August visit.	
3	TQ 23432 36824	Negligible	Negligible	Ifield Golf course – Heavily managed ditch in middle of golf course. Shallow sided channel approx. 50cm wide. Ditch holding water in places with a depth of <5cm during August visit. Dry during June visit. Ditch approx. 150m long.	

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
4	TQ 23456 36829	Negligible	Negligible	Ifield Golf course – Small isolated ditch located in middle of golf course. Channel vegetated with bramble and rushes. Holding some water, depth <5cm, during August visit. Ditch approx. 10m long.	
5	TQ 23527 36915	Negligible	Negligible	Ifield Golf course – Densely vegetated. Not surveyed.	No Photograph

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
6	TQ 23678 36955	Negligible (east section) Low (west section)	Negligible	Ifield Golf course – Long ditch running through woodland area to the north of Ifield Golf Course. Ditch heavily shaded throughout with woody vegetation. Channel between 0.5-1m wide with shallow sided banks. Ditch is dry towards the eastern extent but holding water in areas, 15cm max depth, towards the western section.	
7	TQ 23796 36887	Negligible	Negligible	Ifield Golf course – Heavily managed ditch in middle of golf course with grassy banks. Channel approx. 50cm wide with a max depth of 1m. Ditch approx. 250m long. Dry during June and August visit.	

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
8	TQ 23532 36809	Negligible	Negligible	Ifield Golf course – Ditch located in middle of the golf course. Channel 30cm wide with steep grassy banks up to 50cm deep. Ditch approx. 40m long. Dry during August visit.	
9	TQ 23671 36755	Negligible	Negligible	Ifield Golf course – Ditch in middle of golf course with grassy banks and adjacent woodland vegetation. Densely vegetated channel approx. 30cm wide with a max depth of 50cm. Ditch approx. 150m long. Dry during June and August visit.	

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
10	TQ 23634 36715	Negligible	Negligible	Ifield Golf course – Managed ditch in middle of golf course. Vertically sided with a depth of 2m in places. Channel approx. 50cm wide. Wooded on northern bank. Ditch approx. 80m long. Dry during August visit.	
11	TQ 23584 36668	Negligible	Negligible	Ifield Golf course – Managed ditch located in the middle of the golf course. Channel 50cm wide and 1m deep. Ditch approx. 20m long. Dry during August visit.	

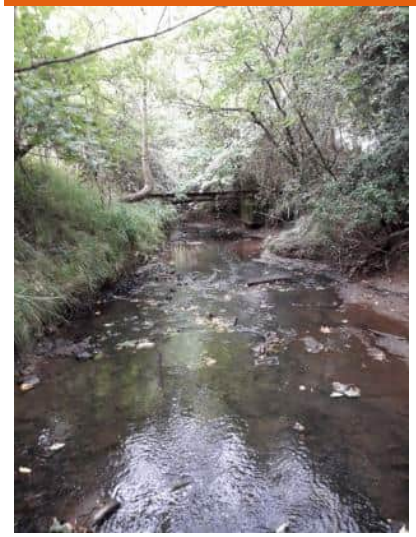
Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
12	TQ 23701 36691	Negligible	Negligible	Ifield Golf course – Ditch located within a wooded area of the golf course. Channel 50cm wide and 50cm deep and overgrown with bramble. Ditch approx. 90m long. Dry during August visit.	
13	TQ 23872 36812	Negligible	Negligible	Ifield Golf course – Managed ditch in middle of golf course. Channel approx. 30cm wide with a max depth of 1m. Ditch approx. 80m long. Holding small amount of water at eastern extent. Rest of ditch dry during August visit.	

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
14	TQ 23983 36912	Negligible	Negligible	Ifield Golf Course – Small ditch towards the north of the golf course. Channel approx. 30cm wide with shallow sides vegetated with bramble to southern side and a Beech, Hawthorn and oak tree line on northern bank. Western section heavily managed. Ditch approx. 170m long. Dry during August visit.	
15	TQ 24129 36830	Low	Low	Ifield Golf course – Ditch on eastern boundary of golf course. Shallow sided bank with dense vegetation in places including reeds, nettle and hemlock water dropwort. Channel approx. 30cm wide with a depth of <5cm and silty substrate. Ditch approx. 100m long. Holding some water during August visit. Unable to access northern part	

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
				of ditch due to dense vegetation.	
16	TQ 24063 36488	Negligible	Negligible	Ifield Golf Course – Overgrown ditch in middle of golf course. Grassy banks with bramble patches. Channel approx. 30cm wide with max depth of 50cm. Ditch approx. 100m long Dry during June and August visit.	

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
17	TQ 23932 36444	Negligible	Negligible	Ifield Golf Course – Ditch in middle of golf course, partially within wooded area. Shallow sided channel with grassy banks approx. 30cm wide. Ditch approx. 40m long. Dry during June and August visit.	
18 Hyde Hill Brook	TQ 23936 36326			Hyde Hill Brook – inaccessible to survey	No Photograph
19	TQ 24247 37381	Negligible	Negligible	Arable fields – Small overgrown ditch that connects to River Mole. Holding some water during August visit. Unable to access due to dense vegetation. Not surveyed.	No Photograph

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
20 River Mole	TQ 24592 38087	Moderate (south-west section) Low (north-east section)	Moderate	River Mole – River running from west to east across the site. Channel is between 3-6m wide with variable depth. Mostly shallow throughout the watercourse with a depth of 20cm but there are sections with deeper pools up to 50cm in depth. River is slow flowing with steep banks. Substrate varies between stone and silt/mud. There are also a number of concrete bridges crossing the river. Banks mostly vegetated with woody vegetation. Eastern extent of the river is heavily shaded and runs through a small woodland area. Towards the north eastern section of the river there are some open areas with grassy banks. Towards the south west section of the river the banks are less wooded and	 South-west section of River Mole.

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
				vegetated with tall ruderal and reeds. Some areas of the river inaccessible due to dense vegetated and steep vertical banks.	 North-east section of River Mole.

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
21 Ifield Brook	TQ 24523 37621	Low	Moderate	Ifield Brook – Stream flows south to north through broadleaved woodland across most of the site. Channel is between 2-4m wide and up to 0.5m deep in places. Substrate varies between stones and silt/mud. Stream is slow flowing. In most parts the channel has steep sided muddy banks which are heavily shaded and vegetated with woody and scrub vegetation. In places the watercourse is heavily disturbed by dog walkers. Towards the most southern point of the stream the channel is open, slow flowing and vegetated with reeds. The channel was dry during the survey carried out on 19 June 2018.	 Wooded area of Ifield Brook

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
					 Southern extent of Ifield Brook

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
22	TQ 24599 37647	Negligible	Negligible	Ifield Brook Wood and Meadows SINC – Overgrown ditch connecting to Ifield Brook. Ditch approx. 40m long. Channel densely vegetated with Bramble, nettle, willowherb and doc. Dry during August visit.	
23	TQ 24580 37419	Negligible	Negligible	Ifield Brook Wood and Meadows LWS – small ditch located to eastern extent of the site. Heavily shaded with shallow sloping banks. Ditch approx. 50m long. Dry during August visit.	

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
24	TQ 24631 37290	Negligible	Negligible	Ifield Brook Wood and Meadows LWS – Overgrown ditch connecting to Ifield Brook. Ditch approx. 40m long. Shallow sided channel. Heavily shaded, densely vegetated and dry during August visit.	
25	TQ 24631 37290	Negligible	Negligible	Heavily shaded, densely vegetated. Not surveyed.	No Photograph

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
26. Ifield Mill stream	TQ 24580 37191	Low	Low	Ifield Mill stream - Small stream running through woodland. Channel 1-2m wide and shallow with a max depth of 20cm. Muddy shallow sloping banks are sparsely vegetated. Stream has a medium flow with a deep muddy substrate. Signs of pollution.	
27	TQ 24620 37531	Negligible	Negligible	Dry ditch, 100% shaded on southern bank.	*No photograph*

Watercourse ID	Grid reference	Suitability for water vole	Suitability for otter	Watercourse description	Photograph
28	TQ 24834 38601	Negligible	Negligible	Ifield Court Hotel – Small ditch located towards the northern extent of the site. Channel is approx. 1m wide with shallow banks with reed and grassy vegetation. The ditch is heavily shaded and approx. 150m long. Dry during June and August visit.	

APPENDIX B: Otter Target Notes

Table 3:

TN	Description
1	Hollow under Sycamore - extends back 1m+. Potential resting site on southern bank of River Mole
2	Hollow under Ash tree with slight path down to river. Extends back at least 30+cm. Potential resting site on River Mole.
3	Hole underneath eastern bank. Smoothed out with possible claws marks in entrance and path down to water. Potential resting site on River Mole. Another hole under ash tree 2m away.
4	Potential otter resting site beneath roots of oak tree on western bank of Ifield Brook.
5	Potential otter resting site under fallen alder which is leaning across eastern bank. Muddy ledge is smoothed out beneath tree trunk.
6	Old otter spraints on roots of fallen tree on eastern side of Ifield Brook.
7	Potential otter resting site under tree root/bramble scrub on western bank of Ifield Brook. Muddy ledge appears to be smoothed out under scrub cover.
8	Potential otter print in mud on eastern bank of Ifield Brook.
9	Large tree with hollow chamber underneath on eastern bank. Possible resting place
10	Large hollow chamber under ash tree. Potential resting site
11	Hollow underneath roots of oak. Western bank. Potential resting site
12	Series of holes and hollows under ash and oak trees on western bank. Potential resting site
13	Large deep hollow under oak on western bank. Potential resting site

APPENDIX C: Water Vole Target Notes

Table 4:

TN	Description
1	Small mammal burrow at water level with no evidence of water vole activity present locally and likely to have been created by a brown rat

APPENDIX D: Key Surveyor Pen Portraits

Table 5: Key surveyor pen portraits

Surveyor	CV details
Samantha Saunders-Davies (CEcol) BA	Sam has eleven years' experience as an ecological consultant working on a broad range of infrastructure projects including rail, highways and property within the public and private sectors. These roles have provided her with a wide range of technical experience, and a thorough understanding of environmental legislation and excellent organisation skills. Sam has a breadth of survey skill including dedicated surveys for Otter and Water Vole
Polly Tayler (MCIEEM) BSc MSc	Polly has over eight years' of experience as an ecologist within independent and multi-disciplinary consultancies. Polly has worked on and managed a diverse range of projects for clients both in the public and private sector. Polly has a good understanding of current UK wildlife legislation. She can conduct a range of species surveys, including those for water vole and otter. She is experienced in writing technical reports including constraints reports, Ecological Impact Assessments, environmental management plans and precautionary methods of working.
Rich Prew (GradCIEEM) MSc BSc	Rich is an ecologist who specialises in invertebrates and has worked in the sector for over two years. He has undertaken a range of protected species surveys including reptile, bat activity, otter and water vole, great crested newt and phase 1 surveys and is a highly experienced adder handler. Rich has had extensive ecological clerk of works experience and has experience of planning and conducting invertebrate surveys and report writing.
Liam Price (GradCIEEM) MBiol	Liam has worked on the ecological inputs of large infrastructure projects for the transport, commercial, utilities and residential sectors. These works largely involved species and habitat surveys and protected species mitigation, including translocations. Liam has experience with delivering surveys and reporting, ensuring that these tasks are completed to schedule and on budget. Liam has experience in planning and managing health and safety approaches for site work. Liam has experience both supporting others in technical ecological surveying and carrying them out independently. Liam has undertaken surveys for: great crested newt, reptiles, water voles, otters, bats and badgers. Liam has experience supervising reptile translocations from the construction of herpetile fencing to the completion of the translocation. Liam has worked as an accredited agent on a great crested newt EPS development licence. Liam has supported extended Phase 1 habitat surveys (PEAs) and holds FISC level 2 in botanical identification. Liam has experience in Ecological clerk of works roles.

Surveyor	CV details
Marielle James (MCIWEM, GradCIEEM) BSc MRes	Marielle has 4 years of experience of professional consultancy specialising in the ecology of protected species, Marielle has extensive experience leading surveys for GCN, bats, badger, otters, water voles and dormice, and is also an experienced Phase 1 habitat surveyor. Marielle is an experienced project manager, responsible for organising and supervising survey teams, undertaking assessment and report writing.

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APPENDIX 8.33: LAND WEST OF IFIELD – CONFIDENTIAL BADGER APPENDIX

Confidential

APPENDIX 8.34: LAND WEST OF IFIELD - CONFIDENTIAL BADGER REPORT

Confidential

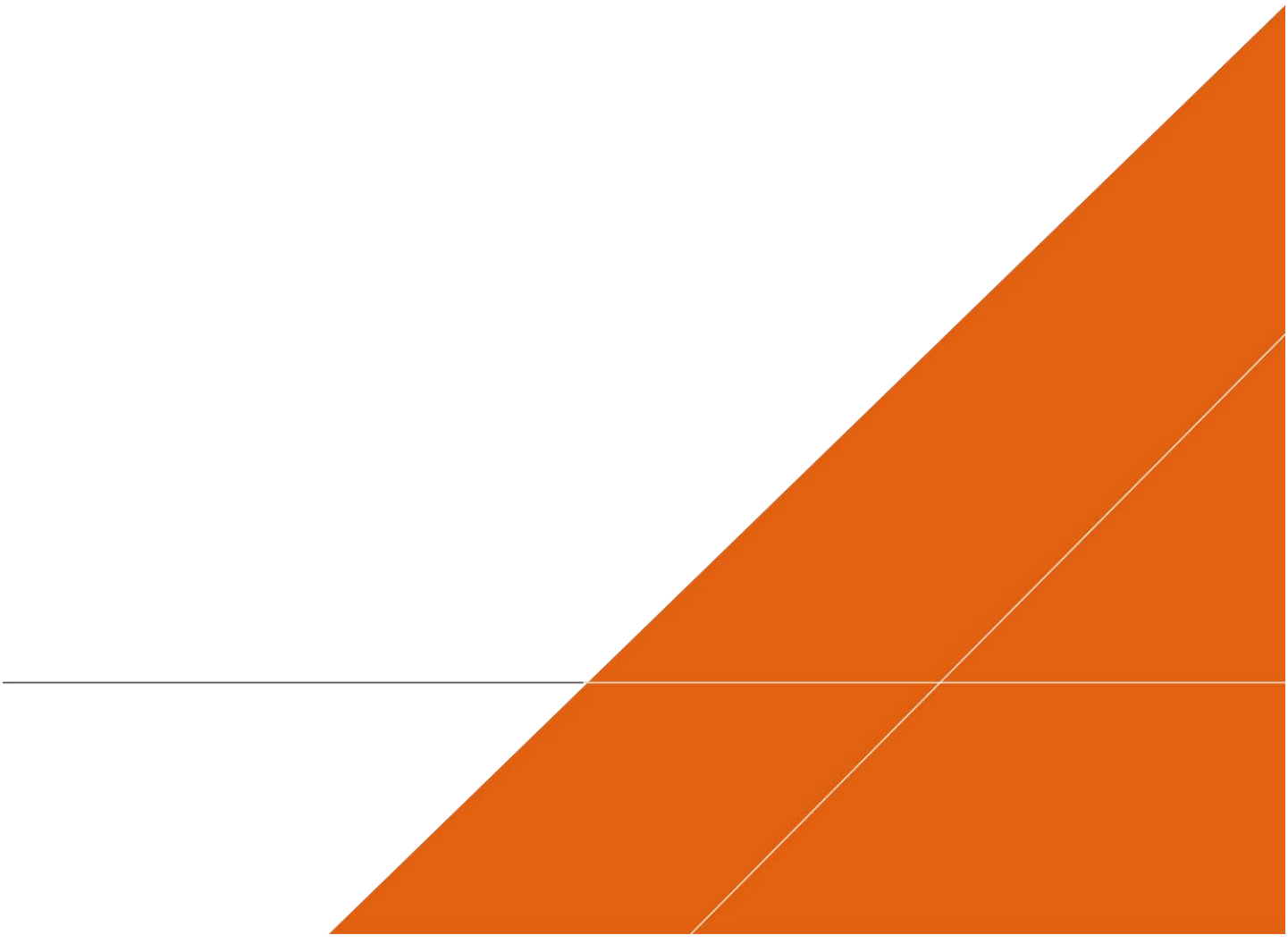
APPENDIX 8.35: LAND WEST OF IFIELD – HEDGEROW SURVEY REPORT

ARCADIS Design & Consultancy for natural and built assets

LAND WEST OF IFIELD

Hedgerow Survey Report

OCTOBER 2019



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Land West of Ifield

Hedgerow Survey Report

Author	Porscha Thompson
Checker	Lucy Fay/Brandon Murray
Approver	Samantha Walters
Report Reference	WOI-AUK-XX-WS-RP-EC-0009-01-Hedgerow Survey Report
Date	OCTOBER 2019

VERSION CONTROL

Version	Date	Author	Changes
001	October 2019	Porscha Thompson	Report Issue

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FIGURES

Figure 1: Hedgerow survey results - hedgerow types recorded
Figure 2: Survey results – Important hedgerows recorded during the survey

APPENDIX A : HEDGEROW REGULATIONS ASSESSMENT DETAILS

APPENDIX B : PHOTOGRAPHS

APPENDIX C : PEN PORTRAITS OF SURVEYORS

Executive Summary

This report presents the findings of a hedgerow survey of land associated with a proposed housing development on an area referred to as 'Land West of Ifield', Crawley, undertaken by Arcadis Consulting (UK) Ltd on behalf of Homes England. Herein the area assessed is referred to as 'the site'. The proposed development comprises the construction of approximately 3000 residential dwellings, three schools (two primary and one secondary) and associated infrastructure.

This report has been prepared to inform Homes England of any ecological constraints associated with the proposed development.

Initial surveys were carried out between 9 and 11 July 2018. Access to an additional area in the west of the site was obtained during 2019, this area was surveyed on 10 and 11 April 2019. Forty hedgerows were recorded across the proposed development site during surveys, of these 15 were covered by the Hedgerows Regulations, i.e. they were curtilage boundaries, or located with a golf course. Five hedgerows within the site (H1, H5, H11, H20 and H25) were classified as "important" hedgerows under the Wildlife and Landscape Criteria of the regulations.

Of the hedgerows surveyed under the Hedgerows Regulations, five were intact and species-rich; two were defunct and species-rich, five were species-rich with trees, fifteen were intact and species poor, one was defunct and species poor and three were species-poor with trees.

The proposed development has the potential to lead to widespread loss of hedgerows which are a Habitat of Principal importance under the NERC Act 2006 (Anon 2006). It is advised that where possible, hedgerows are retained particularly those classified as "important" (H1, H5, H11, H20 and H25).

The recommendations outlined below have been provided to minimise the ecological effects of the proposed development and deliver a net gain in biodiversity as required by legislation and policy:

- Consultation with Crawley Borough Council is recommended and an application for a Hedgerow Removal Notice should be made for removal or partial removal of hedgerows unless otherwise granted under planning permission.
- Where hedgerow removal is necessary this will be subject to timing restrictions to minimise ecological impacts which will be determined based on targeted protected species surveys.
- Appropriate measures (e.g. buffer zones) should be put in place to safeguard retained trees and hedgerows (in accordance with BS 5837:2012).
- The invasive species Rhododendron was identified within hedgerow H17. This would need to be managed in accordance with current best practice guidelines and legislation to ensure that this species does not colonise other parts of the site.

Where possible, enhancement measures should be incorporated into the scheme proposals including:

- Planting of species-rich hedges to compensate where hedgerow removal is unavoidable using a minimum of five species (preferably seven) different native shrub/tree species to maintain the current connectivity already found across the site
- Where hedgerows are retained they should, where possible, be managed by cutting only once every three years (or less) on rotation and maintained at a minimum height 3m and monitored on a yearly basis to ensure a structure that is favourable to wildlife is maintained.

1 Introduction

1.1 Overview

Arcadis Consulting (UK) Ltd, working on behalf of Homes England, was instructed to undertake ecological surveys to inform an Environmental Impact Assessment (EIA) of a proposed masterplan for residential use on land to the west of Ifield, West Sussex.

The aim of the survey reported within this document was to assess hedgerows within the proposed development boundary to determine if they are classified as 'important' hedgerows a defined by the Wildlife and Landscape Criteria in the Hedgerows Regulations. This report presents the findings of the hedgerow survey and, where appropriate, includes recommendations for design considerations to inform the development of the scheme, mitigation and possible enhancements.

1.2 Site Location

The proposed development site is located to the west of Ifield, Crawley (central grid reference - TQ 24133 37360).

The site, which covers approximately 200ha in total, supports a range of habitats including semi-improved grassland, arable fields, amenity grassland, woodland, grazing pasture, a network of hedgerows and several ponds. The River Mole flows west to east through the north of the site, and Ifield Brook, runs flows south to north through the west of the site. Rusper Road passes through the south of the site.

The site is situated to the north-west of the A23 (Crawley Avenue) and is bordered by residential properties to the east, farmland to the west and woodland to the north and south.

An aerial image illustrating the site surveyed is presented in Image 1.

Image 1: Aerial imagery of the site

1.3 Proposed Development

The proposed development comprises the construction of approximately 3000 residential dwellings, three schools (two primary and one secondary) and associated infrastructure.

Due to the proximity of the site to Gatwick Airport (approximately 1.3km to the north), the development is to be concentrated towards the southern end of the site, with the northern part of the site forming open space.

2 Methodology

2.1 Hedgerow Assessment

A Hedgerows Regulations Assessment was conducted to determine the legislative status of the hedgerows (i.e. the status of each hedge with regard to the Hedgerows Regulations (1997) (Anon 1997) under the wildlife and landscape criteria). Further information on the Hedgerow Assessment are presented in Appendix C. Where hedgerows it was apparent, from data obtained during the Phase 1 habitat survey, that the hedgerows were not covered by the Hedgerows Regulations these were not re surveyed (i.e., hedgerows bordering residential properties and single ornamental species hedges).

A survey of the hedgerows within the proposed development site boundary was undertaken between 9 and 11 July 2018 by Porscha Thompson (ACIEEM). Access to an additional area in the west of the site was obtained during 2019, this area was surveyed on 10 and 11 April 2019, this survey was undertaken by Brandon Murray (MCIEEM). Pen portraits of surveyors are presented in Appendix C.

In addition, the hedgerows were classified according to the parameters within the presented in the Phase 1 Habitat Typologies and guidance within the Hedgerow Survey Guidelines (JNCC 2010, DEFRA 2007), identifying the hedgerows into the following typologies:

- Species rich hedgerow:
  - Intact Hedgerow;
  - Defunct Hedgerow;
  - Hedgerow with trees.
- Species-poor hedgerow:
  - Intact Hedgerow;
  - Defunct Hedgerow;
  - Hedgerow with trees.

The criteria for categorising hedgerows as ‘Important’ and the results of the hedgerow survey are presented in Appendix A. All hedgerows are identified and numbered H1 to H40 on Figure 1, with photographs of all hedgerows presented in Appendix B.

2.2 Survey Constraints

A hedgerow in the north of the proposed development site (H22) was not fully assessed due to the hedgerow being part of a privately-owned residential property. This has not impacted the results of the survey as under the Hedgerows Regulations do not apply to this hedgerow as it is a curtilage boundary.

A hedgerow within Ifield Golf Course (H31) was not fully assessed due to the presence of large amounts of scrub in front of it therefore not all features of the hedgerow could be viewed. Again this has not affected the results as the Hedgerows Regulations do not apply to hedgerows that are within golf courses.

This habitat survey is considered to provide sufficiently robust information for the purposes of masterplanning and the EIA.

2 Results

Forty hedgerows (H1-H40) were recorded within the site during the Phase 1 habitat survey. Of these, nine were not covered by the Hedgerows Regulations (H14, H22, H30, H31, H32, H33, H34, H37 and H38). Hedgerows were split into three categories: intact hedgerows, defunct hedgerows and hedgerows with trees and from this split into species-rich and species-poor. These typologies are largely based upon the categories presented in the Phase 1 Habitat typologies and guidance within the Hedgerow Survey Guidelines (JNCC 2010, DEFRA 2007). Table 1 below summarises the definition of the hedgerow typologies utilised in this assessment. Table 2 presents the results of the Hedgerows Regulations assessment.

Table 1: Summary of hedgerow category descriptions used within this report

	Intact Hedgerow	Defunct Hedgerow	Hedgerow with trees
Species-rich hedgerow	These have a diversity of native woody species and a good hedgerow bottom flora. Within this assessment, five woody species within a 30m section of the hedgerow was used to define a species-rich hedge. Intact hedges are entire and more-or-less stockproof.	Hedges in which there are gaps and which are no longer stock-proof fall into this category. These have a diversity of native woody species and a good hedgerow bottom flora.	These have a diversity of native woody species and a good hedgerow bottom flora. Standard trees are present in these hedgerows.
Species-poor hedgerow	Intact hedges are entire and more-or-less stockproof.	These hedgerows have a lower diversity of woody species. Hedges in which there are gaps and which are no longer stock-proof fall into this category.	These hedgerows have a lower diversity of woody species. Standard trees are present in these hedgerows.

*Table 2: Summary of hedgerows assessed under the Hedgerow Regulations (*important hedgerows)*

	Intact Hedgerow	Defunct Hedgerow	Hedgerow with trees
Species-rich hedgerow	H1*, H4, H6, H7 and H27	H38, H40	H5*, H8, H11*, H12, H15
Species-poor hedgerow	H3, H9, H10, H13, H16, H18, H19, H20*, H23, H24, H25*, H26, H28, H29, H35	H21	H2, H17, H36

Five hedgerows (H1, H5, H11, H20 and H25) were classified as “important” hedgerows these hedgerows were located within arable fields and within the fields of semi-improved grassland. Ten hedgerows (three of which are “important”) were recorded as species-rich and 19 (2 of which are “important” were recorded as species-poor. Seven of the hedgerows were recorded with standard trees.

The most common woody species recorded within these hedgerows were Hawthorn (*Crataegus monogyna*), Blackthorn (*Prunus spinosa*), Hazel (*Corylus avellana*) and rose species (*Rosa* sp.). Other woody species recorded less frequently included Ash (*Fraxinus excelsior*), Elder (*Sambucus nigra*), Field Maple (*Acer campestre*), Spindle (*Euonymus europaeus*), Hornbeam (*Carpinus betulus*) and Holly (*Ilex aquifolium*).

Climbing species including Bramble (*Rubus fruticosus* agg.), Black Bryony (*Tamus communis*) and Honeysuckle (*Lonicera periclymenum*) were recorded in a number of hedgerows.

The hedgerows tended to support a limited range of ground flora species. Frequently recorded species included False Oat-grass (*Arrhenatherum elatius*), Common Bent (*Agrostis capillaris*), Field Bindweed (*Convolvulus arvensis*), Broad-leaved Dock (*Rumex obtusifolius*), Cleavers (*Galium aparine*), Common Nettle (*Urtica dioica*), Cow Parsley (*Anthriscus sylvestris*), Betony (*Betonica officinalis*), Hogweed (*Heracleum sphondylium*), Hedge Bedstraw (*Galium album*), Common Ivy (*Hedera helix*) and Cock's-foot (*Dactylis glomerata*).

Ground flora species recorded infrequently included Creeping Thistle (*Cirsium arvense*), Spear Thistle (*Cirsium vulgare*), Timothy (*Phleum pratense*), Ground-ivy (*Glechoma hederacea*), Remote Sedge (*Carex remota*) and willowherb species (*Epilobium* sp.).

Within the ground flora of H15 Lord's-and-Ladies (*Arum maculatum*) was recorded and Wood Avens (*Geum urbanum*) and Wild Strawberry (*Fragaria vesca*) within H21. These species are classified as valuable ground flora species under the Hedgerows Regulations 1997.

Many of the hedgerows also contained mature standard trees including oak (*Quercus* sp.), Sycamore (*Acer pseudoplatanus*), Horse-chestnut (*Aesculus hippocastanum*) and conifer species.

The invasive plant species Rhododendron (*Rhododendron ponticum*) was recorded within hedgerow H17; a species listed under Schedule 9 of the Wildlife & Countryside Act (1981).

3 Discussion and Conclusion

Initial surveys were carried out between 9 and 11 July 2018. Access to an additional area in the west of the site was obtained during 2019, this area was surveyed on 10 and 11 April 2019. Forty hedgerows were recorded across the proposed development site during the initial Phase 1 Habitat survey, of these 12 were not covered by the Hedgerows Regulations. Five hedgerows (H1, H5, H11, H20 and H25) were classified as “important” hedgerows under the wildlife and landscape criteria of the Regulations.

The proposed development has the potential to lead to widespread loss of hedgerows which are a Habitat of Principal importance under the NERC Act 2006. It is advised that where possible, hedgerows are retained in particular those classified as “important” (H1, H5, H11, H20 and H25).

The hedgerows provide suitable habitat to support a number of notable invertebrate species including brown hairstreak (*Thecla betulae*) which lay their eggs on Blackthorn shoots and white admiral (*Limenitis camilla*) which lays eggs exclusively on Honeysuckle. Hedgerows often contain a large amount of dead wood and plant litter which provides suitable habitat for a variety of invertebrate species which in turn provide a food resource for a number of reptile, amphibian, bird and mammal species. Hedgerows and their margins (in particular areas of long, unmanaged grassland, ruderal and scrub habitat) provide suitable foraging and hibernacula habitat for reptile and amphibian species as well as providing valuable corridors for dispersal of these species. The hedgerows provide suitable nesting habitat for breeding birds and also provide food resources for a variety of bird species. Hedgerows are also suitable foraging and commuting habitat for bats and trees within the hedgerows have the potential to support roosting bats. The hedgerows are also suitable nesting and hibernation habitat for dormouse as well as providing suitable food resources and acting as dispersal corridors for dormouse and a number of other mammal species.

It is advised that where possible, hedgerows are retained in particular those classified as important (H1, H5, H11, H20 and H25). This will ensure habitat loss is kept to a minimum and that maximum connectivity across the proposed development site is maintained, allowing species to continue to move across the site to reduce the effects of habitat fragmentation.

4 Recommendations for Consultation, General Mitigation and Potential Enhancements

4.1 Consultation

- The proposed development would need to be in accordance with local policy, in addition to national policy and legislation. As part of the Crawley Borough Council (CBC) Local Plan 2015-2030 (Crawley Borough Council) all development proposals are expected to incorporate features to encourage biodiversity where appropriate and where possible enhance existing features of nature conservation within and around the development. As part of Horsham District Council (HDC) Planning Framework (Horsham District Council 2015) developments will be supported where they can demonstrate that it maintains or enhances the existing network of green infrastructure. Proposals that would result in the loss of existing green infrastructure will be resisted unless it can be demonstrated that new opportunities will be provided that mitigates or compensates for this loss, and ensures that the ecosystem services of the area are retained It is therefore recommended that consultation with Crawley Borough Council and Horsham District Council is undertaken at an early stage.
- An application for a Hedgerow Removal Notice should be made to the Local Authority for removal or partial removal of hedgerows protected under the Hedgerows Regulations, unless otherwise covered under planning permission.
- The hedgerows were assessed using wildlife and landscape criteria only, therefore more hedgerows may be considered as important under other criteria such as archaeological criteria. Consultation with archaeologists is recommended to confirm if any additional hedgerows are considered important.

4.2 General Mitigation

The recommendations outlined below have been provided to minimise the ecological effects of the proposed development and deliver a net gain in biodiversity as required by legislation and policy:

- Where possible the removal of hedgerows should be avoided within the development masterplan.
- Planting of species-rich hedges should be incorporated into the development design to compensate where hedgerow removal is unavoidable. A minimum of five (preferably seven) different shrub/tree species should be planted per hedgerow. Favoured species to plant include Hawthorn, Hazel, oak, Yew, Blackthorn, and Sweet Chestnut (*Castanea sativa*). Bramble and Honeysuckle should also be considered to provide a diverse structure and a variety of food resources for wildlife year-round. The planting of replacement hedgerows would need to maintain the current connectivity already found over the site.
- Where hedgerow removal is necessary this will be subject to timing restrictions to minimise ecological impacts which will be determined following the completion of targeted protected species surveys.
- Hedgerows that do not require removal for the proposed development should be protected during construction through the implementation of root protection zones calculated in accordance with British Standard BS5837:2012 (BSI 2012). Protective fencing should be installed around hedgerows (at least at maximum canopy/branch distance extending to a distance of 12x trunk diameter where standard trees are present. Should the protected species be present the protection zone is likely to be greater). This would also ensure that protected species (i.e. reptiles, amphibians, nesting birds, bats and dormice) are also protected.
- The invasive species Rhododendron was identified within hedgerow H17. This would need to be managed in accordance with current best practice guidelines and legislation to ensure that this species is not spread to other locations within or out with the site (Anon 1981).

4.3 Enhancement Measures

The following enhancement measures have been suggested to provide ecological enhancement in relation to hedgerows:

- Where hedgerows have been identified as defunct, planting to fill gaps using a diverse range of native shrub and tree species could be undertaken to improve connectivity.
- The planting of additional native species-rich hedgerows could be incorporated into the development design for garden planting and wider landscape planting to help with maintaining connectivity across the site and to the wider landscape.
- Where possible hedgerows should only be trimmed once every three years (or less) and maintained at a minimum height of 3m. to maximise their value to wildlife. All cutting tools including a flail must be kept sharp to create a clean cut and reduce damage to the hedgerow structure.
- Hedgerow management should be carried out on rotation e.g. cutting only one side of a hedgerow in any one year. This will ensure that flowing, fruiting and nut-bearing hedgerows are present in the appropriate season.
- Hedgerows should be monitored on a yearly basis and where the structure becomes gappy or lacking in density they should be managed using coppicing or laying methods.

5 References

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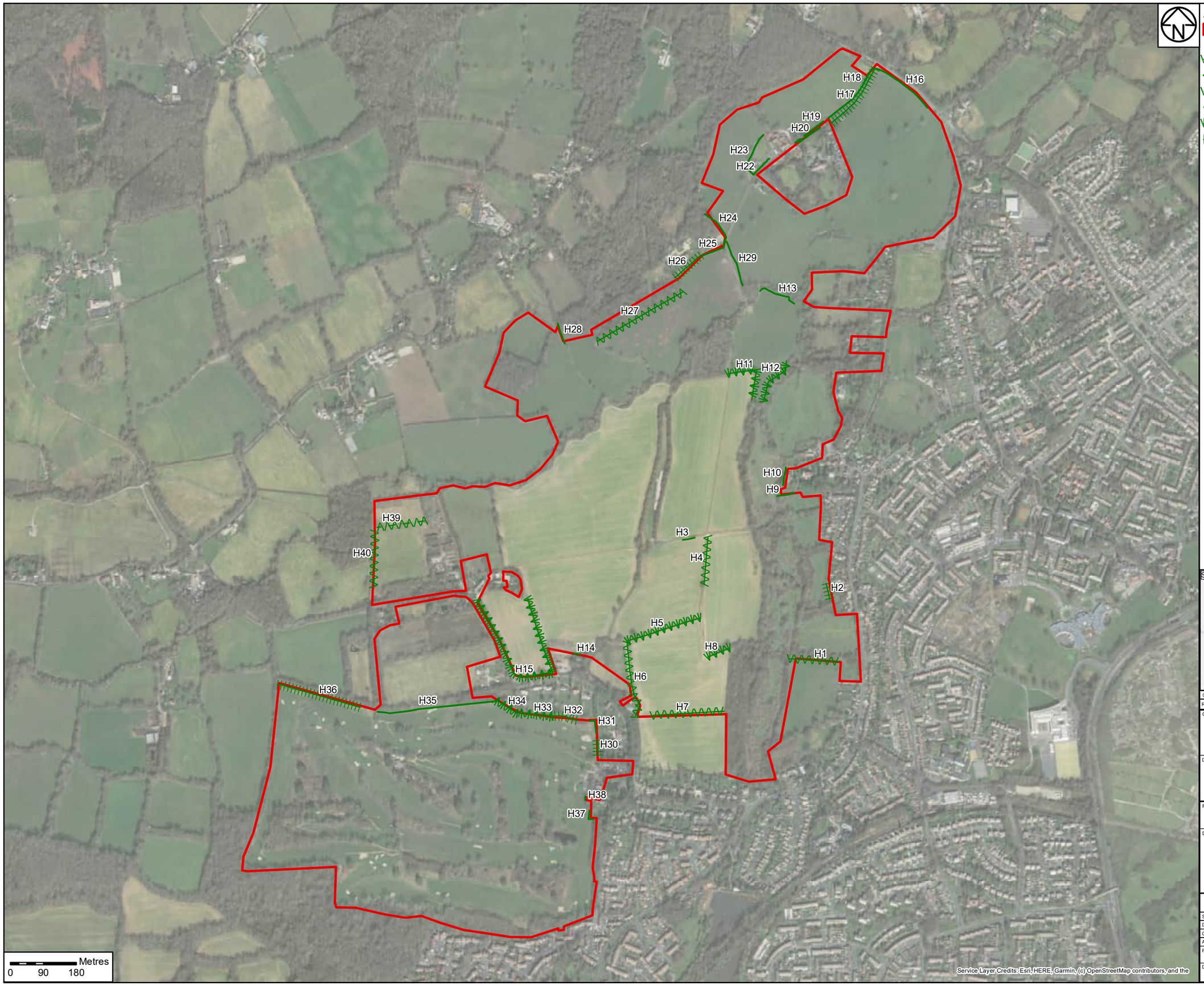
Figure 1: Hedgerow survey results - hedgerow types recorded



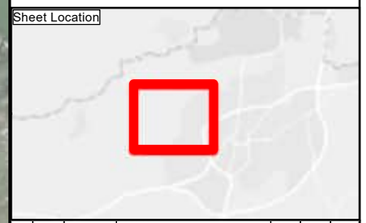
Legend

- Red Line Boundary

Hedgerow Survey

- Intact hedge - native species-rich
- Intact hedge - species-poor
- Defunct hedge - native species-rich
- Defunct hedge - species-poor
- Hedge with trees - native species-rich
- Hedge with trees - species-poor

Sheet Location



Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
01	S2	30/10/19	Initial issue	PN	BM	MG

Client: Homes England

Designer: ARCADIS

Registered office: Arcadis House, 34 York Way, London, N1 9AB

Coordinating office: 5th Floor, 401 Faraday Street, Birchwood, Warrington, WA3 6GA

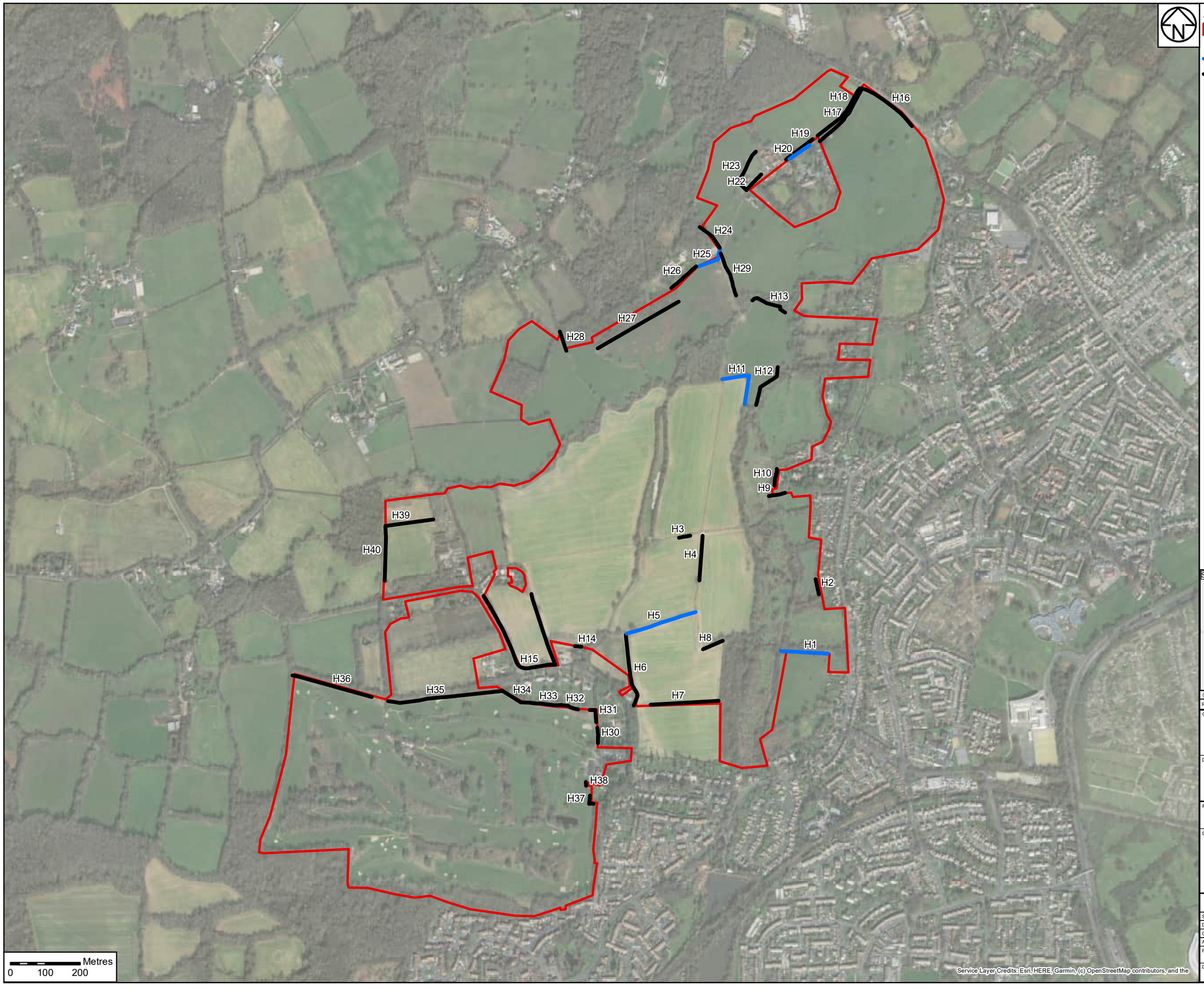
Project: Land West of Ifield

Drawing Title: Figure 1 Hedgerow Survey

	Status: S2	Revision: 01
Scale	1:9,524	Date: 30/10/19
Drawn By	P. Nehete	
Checked By	B. Murrary	
Approved By	M. Girvan	
PINS No.		

Drawing number: HE P/N | Originator | Volume | Location | Type | Role | Number

Figure 2: Survey results – Important hedgerows recorded during the survey



Legend

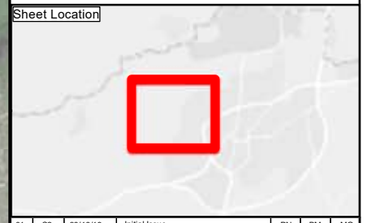
Red Line Boundary

Hedgerow Survey

Important Hedgerows

Other Hedgerows Surveyed

Sheet Location



Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
01	S2	30/10/19	Initial Issue	PN	BM	MG

Client: Homes England

Designer: ARCADIS

Registered office:
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34 York Way
London
N1 9AB

Coordinating office:
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Birchwood
Warrington
WA3 6GA

Project: Land West of Ifield

Drawing Title: Figure 2
Hedgerow Survey
Important Hedgerows

	Status: S2	Revision: 01	
Scale	1:10,000	Date	30/10/19
Drawn By	P. Nehete		
Checked By	B. Murrary		
Approved By	M. Girvan		
PINS No.			

Drawing number: HE P:IN | Originator | Volume | Location | Type | Role | Number

APPENDIX A: Hedgerow Regulations Assessment Details

This appendix provides details of the assessment under the Wildlife and Landscape Criteria of the hedgerow regulations assessment. These Regulations only apply to hedgerows adjacent to land in agricultural/horticultural use. A hedgerow may be classified as 'important' for archaeological/historical reasons, or according to Wildlife and Landscape criteria. To be classified as 'important' under the Wildlife and Landscape criteria, the hedgerow must have been over 30 years old in 1997 and should comprise one of the following:

- at least 7 woody species/30m;
- at least 6 woody species/30m and at least 3 features;
- at least 6 woody species/30m including any one black poplar/wild service-tree/small-leaved lime/large-leaved lime;
- at least 5 woody species and at least 4 features; or
- if adjacent to a bridleway/footpath, at least 4 woody species and at least 2 features.

The presence of a number of features along a hedgerow influences the classification under the Regulations. The terms used on the record sheet are explained below.

Table 3: 'Features' relevant to the Wildlife and Landscape criteria of the Hedgerow Regulations

Feature	Description
Bank/ wall	The hedgerow is supported along at least half of its length by a bank/wall.
Intact	The hedgerow contains less than 10% gaps along its length.
Trees	The hedgerow supports at least 1 standard tree per 50m length of hedgerow (standard trees are defined as those which when measured at 1.3m above ground level and have a diameter of at least 20cm, or 15cm for multi-stemmed trees).
3 flora spp.	The hedgerow supports at least 3 of the valuable ground flora species defined by the Regulations. The hedgerow is considered to support a plant if it is rooted within 1m (in any direction) of the hedgerow.
Ditch	There is a ditch along at least half of the length of the hedgerow
Connection ≥ 4 points	A hedgerow must score 4 or more 'connection points' where connections with an adjoining hedgerow(s) score 1 point each, and a connection with a pond or woodland (in which the majority of the trees are broad-leaved) scores 2 points each. A hedgerow is considered to be connected if it meets the feature, or if it has a point within 10m of it and would meet if the line of the hedgerow continued.
Parallel hedge	A parallel hedgerow is present within 15m.

N.B A hedgerow may also be classified as 'important' due to the presence/recorded presence of a particular animal and plant species (see Criteria 6 subparagraphs (1)-(4) of the Regulations for details). This has not been considered in our assessment as we do not currently have data of this type that could contribute to the assessment.

Table 4: Colour codes used in Table 5 to Table 9

Colour code used in Table 5 to Table 9	Meaning of colour code
	Important Hedgerow
	Hedgerows not covered by Hedgerows Regulations (i.e. not adjacent to agricultural use or curtilage boundaries)

Table 5: Hedgerow survey results H1 – H8

Hedge No.		H1	H2	H3	H4	H5	H6	H7	H8
Does the hedgerow classify as 'important'		✓	X	X	X	✓	X	X	X
Does the hedgerow run parallel to a designated bridleway/footpath		X	X	X	X	X	X	X	X
Black poplar/wild service-tree/small leaved lime/large leaved lime		X	X	X	X		X	X	X
No of woody species per 30m		7	1	3	6	7	6	5	6
Features	Bank/wall	X	X	X	X	X	X	X	X
	Intact	✓	✓	✓	✓	✓	✓	✓	✓
	Trees	X	✓	✓	✓	✓	X	X	X
	3 flora sp.	X	X	X	X	X	X	X	X
	Ditch	X	X	X	X	✓	X	X	X
	Connections	X	X	X	X	X	X	X	X
	Parallel hedge	X	X	X	X	X	X	X	X
Woody species present recognised by the Hedgerow Regulations		Blackthorn, Elder, Hazel, Rose sp., Field Maple, Hawthorn, Oak	x2 Oak	Blackthorn Hawthorn Rose sp.	Hazel Rose sp. Blackthorn Elder Oak Alder	Oak Hawthorn Blackthorn Ash Rose sp. Hazel Willow sp.	Blackthorn Willow Oak Hawthorn Rose sp. Field Maple	Hazel Hawthorn Blackthorn Hornbeam Field Maple	Oak Blackthorn Hazel Rose sp. Hawthorn Ash
Other woody species present			Snowberry		Apple				

Table 6: Hedgerow survey results H9 – H16

Hedge No.		H9	H10	H11	H12	H13	H14	H15	H16
Does the hedgerow classify as 'important'		X	X	✓	X	X	X	X	X
Does the hedgerow run parallel to a designated bridleway/footpath		X	X	✓	X	X	X	X	X
Black poplar/wild service-tree/small leaved lime/large leaved lime		X	X	X	X	X	X	X	X
No of woody species per 30m		0	4	6	5	4	2	5	4
Features	Bank/wall	X	X	X	X	X	X	X	X
	Intact	X	✓	✓	X	✓	✓	✓	✓
	Trees	X	X	✓	✓	X	✓	✓	X
	3 flora sp.	X	X	X	X	X	X	X	X
	Ditch	X	X	X	X	X	X	✓	X
	Connections	X	X	✓	✓	✓	X	X	X
	Parallel hedge	X	X	X	X	X	X	X	X
Woody species present recognised by the Hedgerow Regulations			Hazel Field Maple Hawthorn Ash	Blackthorn Oak Hawthorn Rose sp. Holly Elder	Ash Blackthorn Hawthorn Hazel Rose sp.	Hawthorn Ash Oak Blackthorn	Ash Sycamore Blackthorn	Oak Blackthorn Hazel Rose sp. Silver birch	Hawthorn Blackthorn Rose sp. Hazel
Other woody species present		Laurel sp.					Laurel sp. Conifer sp.		

Table 7: Hedgerow survey results H17 – H24

Hedge No.		H17	H18	H19	H20	H21	H22	H23	H24
Does the hedgerow classify as 'important'		X	X	X	✓	X	X	X	X
Does the hedgerow run parallel to a designated bridleway/footpath		✓	✓	✓	✓	✓	✓	X	X
Black poplar/wild service-tree/small leaved lime/large leaved lime		X	X	X	X	X	x	X	X
No of woody species per 30m		3	4	4	4	0	3	4	3
Features	Bank/wall	X	X	X	X	X	X	X	X
	Intact	✓	✓	X	✓	✓	✓	✓	✓
	Trees	✓	X	✓	✓	X	X	X	X
	3 flora sp.	x	X	X	X	X	X	X	X
	Ditch	✓	X	X	X	X	X	X	X
	Connections	X	X	X	X	X	X	X	X
	Parallel hedge	✓	✓	X	✓	X	X	X	X
Woody species present recognised by the Hedgerow Regulations		Blackthorn, Hazel, Oak	Hawthorn Oak Ash Rose sp.	Oak Hawthorn Field Maple Blackthorn	Field Maple, Blackthorn, Hawthorn, Hazel		Hawthorn, Ash, Privet	Elder, Ash, Rose sp., Blackthorn	Hawthorn, Blackthorn, Ash
Other woody species present		Cotoneaster sp., Rhododendron	Snowberry, Cotoneaster sp.	Horse chestnut, Cotoneaster sp., Sycamore	Horse Chestnut	Snowberry	Ivy		

Table 8: Hedgerow survey results H25 – H32

Hedge No.		H25	H26	H27	H28	H29	H30	H31	H32
Does the hedgerow classify as 'important'		✓	X	X	X	X	X	X	X
Does the hedgerow run parallel to a designated bridleway/footpath		✓	X	X	✓	✓	X	X	X
Black poplar/wild service-tree/small leaved lime/large leaved lime		X	X	X	X	X	X	X	X
No of woody species per 30m		4	2	5	3	4	4	4	3
Features	Bank/wall	X	X	X	X	X	X	X	X
	Intact	✓	X	✓	✓	✓	✓	✓	✓
	Trees	X	✓	X	X	X	✓	X	✓
	3 flora sp.	X	X	X	X	X	X	X	X
	Ditch	X	X	X	X	X	✓	X	✓
	Connections	X	✓	✓	✓	✓	X	X	X
	Parallel hedge	✓	X	X	X	X	X	X	X
Woody species present recognised by the Hedgerow Regulations		Hawthorn Blackthorn Ash Rose sp.	Blackthorn Field Maple	Blackthorn Hawthorn Rose sp. Field Maple Spindle	Blackthorn Rose sp. Hawthorn	Blackthorn Field Maple Rose sp. Hawthorn	Blackthorn Hawthorn Rose sp. Oak	Hawthorn Blackthorn Oak Field maple	Beech Rose sp. Blackthorn
Other woody species present			Snowberry, Bridewort						

Table 9: Hedgerow survey results H33 – H40

Hedge No.		H33	H34	H35	H36	H37	H38	H39	H40
Does the hedgerow classify as 'important'		✓	✓	X	X	X	X	X	X
Does the hedgerow run parallel to a designated bridleway/footpath		X	✓	✓	✓	✓	✓	N	N
Black poplar/wild service-tree/small leaved lime/large leaved lime		X	X	X	X	X	X	N	N
No of woody species per 30m		6	4	1	3	1	1	6	5
Features	Bank/wall	X	X	X	X	X	X	X	X
	Intact	✓	✓	✓	X	✓	✓	X	X
	Trees	✓	✓	✓	✓	X	X	✓	✓
	3 flora sp.	X	X	X	X	X	X	X	X
	Ditch	✓	✓	✓	X	X	X	X	X
	Connections	X	X	X	X	X	X	✓	X
	Parallel hedge	X	X	X	X	X	X	X	✓
Woody species present recognised by the Hedgerow Regulations		Blackthorn Yew Oak Holly Hawthorn Beech	Beech. Blackthorn Oak Hawthorn	Blackthorn	Blackthorn Hawthorn Hazel	Beech	Beech	Hawthorn, Blackthorn, Ash, Oak, Rose, Elder	Hawthorn, Blackthorn, Ash, Oak, Rose
Other woody species present			Pine sp.						

APPENDIX B: Photographs

Photo 1: Hedgerow 1

Photo 2: Hedgerow 2

Photo 3: Hedgerow 3

Photo 4: Hedgerow 4

Photo 5: Hedgerow 5

Photo 6: Hedgerow 6

Photo 7: Hedgerow 7

Photo 8: Hedgerow 8

Photo 9: Hedgerow 9

Photo 10: Hedgerow 10

Photo 11: Hedgerow 11

Photo 12: Hedgerow 12

Photo 13: Hedgerow 13

Photo 14: Hedgerow 14

Photo 15: Hedgerow 15

Photo 16: Hedgerow 16

Photo 17: Hedgerow 17

Photo 18: Hedgerow 18

Photo 19: Hedgerow 19

Photo 20: Hedgerow 20

Photo 21: Hedgerow 21

Photo 22: Hedgerow 23

Photo 23: Hedgerow 24

Photo 24: Hedgerow 25

Photo 25: Hedgerow 26

Photo 26: Hedgerow 27

Photo 27: Hedgerow 28

Photo 28: Hedgerow 29

Photo 29: Hedgerow 30

Photo 30: Hedgerow 31

Photo 31: Hedgerow 32

Photo 32: Hedgerow 33

Photo 33: Hedgerow 34

Photo 34: Hedgerow 35

Photo 35: Hedgerow 36

Photo 36: Hedgerow 37

Photo 37: Hedgerow 38

Photo 38: Hedgerow 39

Photo 39: Hedgerow 39 (right hand side of image)

Photo 40: Hedgerow 40 (right hand side of image)

APPENDIX C: Pen portraits of surveyors

Surveyor	Pen Portrait
Brandon Murray MCIEEM (Principal Ecological Consultant) BSc(hons)	Brandon has been a professional ecologist for over nine years and has undertaken multiple Phase 1 habitat surveys and Hedgerow Assessments. Brandon has planned and led surveys for many species including badgers, bats, GCN (Great Crested Newts) water voles and reptiles and is very confident in assessing habitats for their protected species suitability.
Porscha Thompson ACIEEM (Graduate Ecologist) MSc BSc (Hons)	Porscha has experience in assessing sites for potential ecological impacts and is able to provide appropriate recommendations and mitigation in order to reduce potential impacts. Porscha has experience in undertaking a range of protected species surveys including bats, great crested newts (GCN), dormice, reptiles and badger surveys, phase 1 habitat surveys and ecological clerk of works and has a keen interest in botany. She also has strong report writing, desk study and coordination skills. She currently holds a Class 1 Natural England GCN licence, is an accredited agent of a Natural Resources Wales GCN licence and bat licence.

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APPENDIX 8.36: LAND WEST OF IFIELD – CONFIDENTIAL BADGER SURVEY REPORT

Confidential