Appendix 6.1: Ecological Survey Schedule

Passive Bat detector deployment and collection schedule

BD ID	Start Date	End Date	Duration in Days	Winter/Summer	Latitude	Longitude
BD1	16/11/2019	19/12/2019	33	Winter	52.6077	-9.05292
BD2	12/07/2019	18/08/2019	37	Summer	52.6258	-9.06879
BD3	17/09/2019	30/10/2019	43	Winter	52.6162	-9.05984
BD4	06/09/2019	24/09/2019	18	Summer	52.62	-9.05983
BD5	27/06/2019	05/07/2019	8	Summer	52.6258	-9.06879
BD6	15/11/2019	20/12/2019	35	Winter	52.6248	-9.06738
BD7	27/06/2019	13/07/2019	16	Summer	52.6148	-9.0607
BD8	20/05/2019	04/07/2019	45	Summer	52.6131	-9.08094
BD9	05/07/2019	12/07/2019	7	Summer	52.6258	-9.06879
BD10	06/09/2019	27/09/2019	21	Summer	52.6114	-9.05802
BD11	06/09/2019	21/09/2019	15	Summer	52.6107	-9.05469
BD12	21/07/2020	23/08/2020	33	Summer	52.6228	-9.05757
BD13	30/06/2021	20/07/2021	20	Summer	52.606	-9.0533
BD14	27/07/2020	21/08/2020	25	Summer	52.6048	-9.05588
BD15	07/10/2020	30/10/2020	23	Winter	52.6048	-9.05588
BD16	27/08/2020	09/09/2020	13	Summer	52.6174	-9.08372
BD17	26/09/2020	31/10/2020	35	Winter	52.6222	-9.05262
BD18	31/05/2020	29/06/2020	29	Summer	52.606	-9.05323
BD19	23/06/2021	06/07/2021	13	Summer	52.6222	-9.05744
BD20	11/06/2021	25/06/2021	14	Summer	52.616	-9.0623
BD21	13/02/2020	28/03/2020	44	Winter	52.6162	-9.06045
BD22	31/10/2020	06/12/2020	36	Winter	52.6047	-9.06188
BD23	28/11/2020	02/01/2021	35	Winter	52.605	-9.05582
BD24	29/05/2020	25/06/2020	27	Summer	52.6108	-9.05395
BD25	27/02/2020	19/03/2020	21	Winter	52.6108	-9.05395
BD26	19/05/2020	29/05/2020	10	Summer	52.618	-9.06674
BD27	27/02/2020	12/04/2020	45	Winter	52.618	-9.08438
BD28	27/02/2020	06/04/2020	39	Winter	52.6097	-9.05369

Habitat Mapping & Botanical Surveys

Date	Personnel	Surveys
06/09/2019	Michelle O'Neill	Habitat mapping and botanical surveys
24/09/2019	Michelle O'Neill	Habitat mapping and botanical surveys
11/06/2020	Michelle O'Neill	Habitat mapping and botanical surveys
29/07/2021	Claire Deasy	Habitat mapping and botanical surveys

Trail camera deployment, dates of mammal walkover surveys and trail camera collection dates

NAME	LATITUDE	LONGITUDE	DATE COLLECTED	Start Date	End Date	Duration (Days)
Trail Camera	52.60474246	-9.062160244		31/10/20	28/11/20	28
Trail Camera	52.60483281	-9.058857439	31/10/20	27/07/20	03/09/20	38
Trail Camera	52.60487325	-9.058843022	27/07/20	26/06/20	27/07/20	31
Trail Camera	52.60489584	-9.057688415	30/06/20	29/05/20	30/06/20	32
Trail Camera	52.60497497	-9.056362398	27/07/20	26/06/20	27/07/20	31
Trail Camera	52.60503553	-9.055819921	NA	NA	NA	
Trail Camera	52.60674581	-9.072906515	31/10/20	27/06/20	08/08/20	42
Trail Camera	52.60884443	-9.05390365	29/05/20	27/02/20	29/05/20	92
Trail Camera	52.60897125	-9.053757051	30/06/20	29/05/20	30/06/20	32
Trail Camera	52.60933138	-9.05363082	30/06/20	19/05/20	30/06/20	42
Trail Camera	52.60967244	-9.053205103	29/05/20	27/02/20	28/03/20	30
Trail Camera	52.60983794	-9.053171407	29/05/20	27/02/20	29/05/20	92
Trail Camera	52.60996899	-9.077917133	21/07/20	26/06/20	27/07/20	31
Trail Camera	52.61096011	-9.078793125	31/10/20	21/07/20	17/09/20	58
Trail Camera	52.61329275	-9.059361191	30/06/20	NA	NA	NA
Trail Camera	52.61330176	-9.0594575	27/07/20	26/06/20	27/07/20	31
Trail Camera	52.61370183	-9.06317194	06/02/2021	28/11/20	06/02/2021	70
Trail Camera	52.61391469	-9.061905183		17/09/20	28/11/20	72
Trail Camera	52.61411627	-9.058845621	29/05/20	13/02/20	29/05/20	106
Trail Camera	52.61422494	-9.059253233	29/05/20	13/02/20	29/05/20	106
Trail Camera	52.61442963	-9.06253282	29/05/20	NA	NA	NA

NAME	LATITUDE	LONGITUDE	DATE COLLECTED	Start Date	End Date	Duration (Days)
Trail Camera	52.61451102	-9.08231453	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.61460301	-9.061298501	29/05/20	13/02/20	29/05/20	106
Trail Camera	52.614645	-9.063325161	29/05/20	13/02/20	29/05/20	106
Trail Camera	52.6146489	-9.063485591	30/06/20	29/05/20	30/06/20	32
Trail Camera	52.61498061	-9.061314259	27/07/20	NA	NA	NA
Trail Camera	52.6156479	-9.063396826	06/02/2021	28/11/20	06/02/2021	70
Trail Camera	52.61612977	-9.062622674	19/05/20	13/02/20	19/05/20	96
Trail Camera	52.61644108	-9.061997049	19/05/20	12/02/20	25/03/20	42
Trail Camera	52.616461	-9.060142	29/05/20	14/02/20	16/02/20	2
Trail Camera	52.61668713	-9.060063092	29/05/20	31/08/2019	27/09/2019	27
Trail Camera	52.61675406	-9.060167447	30/06/20	19/05/20	30/06/20	42
Trail Camera	52.61676269	-9.060111372	29/05/20	13/02/20	29/05/20	106
Trail Camera	52.61730236	-9.083987391	27/08/20	21/07/20	27/08/20	37
Trail Camera	52.61757075	-9.056131979	29/05/20	14/02/20	08/04/20	54
Trail Camera	52.61770637	-9.060856607	30/06/20	19/05/20	30/06/20	42
Trail Camera	52.61781307	-9.062904892	19/05/20	13/02/20	25/03/20	41
Trail Camera	52.61784333	-9.06307295	27/07/20	26/06/20	19/07/20	23
Trail Camera	52.61784337	-9.062993741	30/06/20	19/05/20	30/05/20	11
Trail Camera	52.61786621	-9.058755515		31/10/20	28/11/20	28
Trail Camera	52.61786621	-9.058755515	06/02/2021	28/11/20	06/02/2021	70
Trail Camera	52.61786621	-9.058755515	06/02/2021	NA	NA	
Trail Camera	52.61819952	-9.084554091	21/07/20	26/06/20	27/07/20	31

NAME	LATITUDE	LONGITUDE	DATE COLLECTED	Start Date	End Date	Duration (Days)
Trail Camera	52.61829704	-9.059474766	31/10/20	28/07/20	31/10/20	95
Trail Camera	52.61843631	-9.084629444	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.61871798	-9.085477442	31/10/20	27/08/20	31/10/20	65
Trail Camera	52.61882497	-9.084729021	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.61887254	-9.085538713	31/10/20	27/08/20	31/10/20	65
Trail Camera	52.61889471	-9.085565535	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.6188966	-9.085513232	31/10/20	27/08/20	31/10/20	65
Trail Camera	52.61890159	-9.085272672	27/08/20	21/07/20	27/08/20	37
Trail Camera	52.61890402	-9.085173346	31/10/20	27/08/20	31/10/20	65
Trail Camera	52.62010732	-9.055988314	27/07/20	26/06/20	27/07/20	31
Trail Camera	52.62013976	-9.05852057	27/07/20	26/06/20	27/07/20	31
Trail Camera	52.62048115	-9.074584907	21/07/20	26/06/20	27/07/20	31
Trail Camera	52.62060688	-9.061286934	06.02.2021	28/11/20	06/02/2021	70
Trail Camera	52.62116935	-9.060071977		31/10/20	28/11/20	28
Trail Camera	52.62123511	-9.073757613	31/10/20	26/09/20	31/10/20	35
Trail Camera	52.6215496	-9.074927308	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.62158358	-9.059080901	06.02.2021	28/11/20	07/01/2021	40
Trail Camera	52.62162952	-9.055854874	26/09/20	27/07/20	26/09/20	61
Trail Camera	52.62167872	-9.074908784	31/10/20	NA	NA	n/a
Trail Camera	52.62169846	-9.057242582	31/10/20	26/09/20	31/10/20	35
Trail Camera	52.62195754	-9.066206608	26/06/20	19/05/20	26/06/20	38
Trail Camera	52.62212631	-9.052874101	31/10/20	28/09/20	31/10/20	33

NAME	LATITUDE	LONGITUDE	DATE COLLECTED	Start Date	End Date	Duration (Days)
Trail Camera	52.62214224	-9.074968379	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.62215351	-9.056124687		26/09/20	28/11/20	63
Trail Camera	52.62220426	-9.052200699	26/09/20	27/07/20	26/09/20	61
Trail Camera	52.62235887	-9.058117652		26/09/20	28/11/20	63
Trail Camera	52.6225211	-9.074766207	27/08/20	21/07/20	27/08/20	37
Trail Camera	52.62258937	-9.056773614	26/09/20	27/07/20	26/09/20	61
Trail Camera	52.6226252	-9.057364287	26/06/20	19/05/20	26/06/20	38
Trail Camera	52.62262965	-9.057281474	27/07/20	26/06/20	27/07/20	31
Trail Camera	52.6227335	-9.075131575	31/10/20	27/08/20	31/10/20	65
Trail Camera	52.6227335	-9.075131575		28/08/20	08/09/20	11
Trail Camera	52.62275487	-9.057854125		26/09/20	28/11/20	63
Trail Camera	52.622956	-9.057023	26/09/20	27/07/20	26/09/20	61
Trail Camera	52.62299749	-9.074383825	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.62301274	-9.0743622	26/06/20	19/05/20	26/06/20	38
Trail Camera	52.62302179	-9.058348155	26/09/20	27/07/20	26/09/20	61
Trail Camera	52.62366984	-9.068673654	31/10/20	27/08/20	31/10/20	65
Trail Camera	52.62437794	-9.07054835	21/07/20	26/06/20	27/07/20	31
Trail Camera	52.62437794	-9.07054835	27/08/20	21/07/20	27/08/20	37
Trail Camera	52.62445053	-9.070366798	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.62449797	-9.070330337	26/06/20	19/05/20	26/06/20	38
Trail Camera	52.62480563	-9.067148315	26/06/20	19/05/20	26/06/20	38
Trail Camera	52.62481112	-9.067138676	21/07/20	26/06/20	27/07/20	31

NAME	LATITUDE	LONGITUDE	DATE COLLECTED	Start Date	End Date	Duration (Days)
Trail Camera	52.62496321	-9.067241186	27/08/20	21/07/20	27/08/20	37
Trail Camera	52.62542145	-9.049720326	26/06/20	19/05/20	24/06/20	36
Trail Camera	52.62543511	-9.067431372	31/10/20	27/08/20	31/10/20	65
Trail Camera	52.6254613	-9.049755363	27/07/20	26/06/20	27/07/20	31
Trail Camera	52.62585395	-9.048651131	26/09/20	27/07/20	26/09/20	61
Trail Camera	52.62594444	-9.048736291		26/09/20	28/11/20	63
Trail Camera	52.62600801	-9.048775602		26/09/20	28/11/20	63
Trail Camera	52.62728617	-9.064771794	26/06/20	19/05/20	26/06/20	38
Trail Camera	52.62728822	-9.065214777	27/08/20	21/07/20	27/08/20	37
Trail Camera	52.62778615	-9.064790485	26/06/20	19/05/20	26/06/20	38
Trail Camera	52.62898904	-9.049384966	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.62902407	-9.049369711	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.62952485	-9.049453698	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.63022281	-9.050083347	19/05/20	27/02/20	19/05/20	82
Trail Camera	52.63054384	-9.050404122	19/05/20	16/11/2019	19/05/20	185
Trail Camera	52.63579627	-9.065187369	26/06/20	19/05/20	26/06/20	38

Additional mammal walkover survey dates and deployment/collection dates for trail cameras at the artificial badger sett.

Location	Deployment Date	Collection Date
Nr. Artificial Sett	06-Mar-21	03-May-21

Location	Deployment Date	Collection Date
Nr. Artificial Sett	06-Mar-21	03-May-21
Nr. Artificial Sett	03-May-21	11-Jun-21
Nr. Artificial Sett	03-Oct-19	14-Feb-20
Nr. Artificial Sett	15-Nov-19	06-Mar-20

Summer and Winter Season Bird Survey Schedule (other taxa recorded during these walkover survey visits)

Date	Surveys
05/07/2019	Transect 1-3 & Point Counts
27/06/2019	Transect 1-3 & Point Counts
12/07/2019	Transect 1-3 & Point Counts
16/11/2019	Transect 1-3 & Point Counts
28/11/2019	Transect 1-3 & Point Counts
27/02/2020	Transect 1-3 & Point Counts
29/04/2020	Transect 1-4 & Point Counts
09/06/2020	Transect 1-4 & Point Counts
29/07/2020	Transect 1-4 & Point Counts
07/10/2020	Transect 1-4 & Point Counts
31/10/2020	Transect 1-4 & Point Counts
28/11/2020	Transect 1-4 & Point Counts

Collection dates and numbers of Trail cameras collected

Collection no.	No. of Cams collected	Collection Date
Collection 1	15	19/05/2020
Collection 2	12	01/05/2020
Collection 3	17	01/06/2020
Collection 4	14	01/07/2020
Collection 5	6	01/08/2020
Collection 6	7	01/09/2020
Collection 7	9	01/10/2020
Collection 8	10	01/11/2020
Collection 9	7	01/02/2021

Appendix 6.2: Bird Survey Results 2019-2020

Results of bird survey transects and point counts from summer 2019.

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Blackbird	*Turdus merula*	2	3	1	1	1	1	1	x	2
Blackcap	*Sylvia atriacapilla*	1				x		x		1
Black-headed Gull	*Chroicocephalus ridibundus*					x				
Blue Tit	*Cyanistes caeruleus*		1	1		1	1	2		x
Bullfinch	*Pyrrhula pyrrhula*	2					2	2		
Buzzard	*Buteo buteo*		1			2	x	1		
Chaffinch	*Fringilla coelebs*	2	3	2	1	3	1	2	1	2
Chiffchaff	*Phylloscopus collybita*	1	1			1		x		
Coal Tit	*Periparus ater*	2				2		1		
Collared Dove	*Streptopelia decaocto*		2							
Crossbill	*Loxia curvirostra*	1				2				
Cuckoo	*Cuculus canorus*				x		x		x	
Dunnock	*Prunella modularis*		1	1	1		1	1	1	
Goldcrest	*Regulus regulus*	1				1		2		2
Goldfinch	*Carduelis carduelis*		2	2	1					
Great Tit	*Parus major*	1			1	1				
Greenfinch	*Carduelis chloris*		1		x					1
Grey Heron	*Ardea cinerea*				x				1	
Herring Gull	*Larus argentatus*				x					
Hooded Crow	*Corvus cornix*	1	2	2	4		2	x	4	x

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
House Martin	*Delichon urbica*		3	1					2	
House Sparrow	*Passer domesticus*			4						
Jackdaw	*Corvus monedula*	2	1	3	2		3	1	x	1
Jay	*Garrulus glandarius*					1		x		x
Kestrel	*Falco tinnunculus*		1	1						x
Lesser Black-backed Gull	*Larus fuscus*				1				2	
Lesser Redpoll	*Acanthis cabaret*	2						2		
Linnet	*Linaria cannabina*			2					7	
Little Egret	*Egretta garzetta*				x					
Long-tailed Tit	*Aegithalos caudatus*							4		
Magpie	*Pica pica*	1	2	2			2	x	1	
Mallard	*Anas platyrhynchos*				2				3	
Meadow Pipit	*Anthus pratensis*		2	3	2		1		1	2
Mistle Thrush	*Turdus viscivorus*			2				1		2
Moorhen	*Gallinula chloropus*								x	
Oystercatcher	*Haematopus ostralegus*				x					
Peregrine Falcon	*Falco peregrinus*				x					
Pheasant	*Phasianus colchicus*		1	1	x		x	x	x	

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Pied Wagtail	*Motacilla alba*	1		1						
Reed Bunting	*Emberiza schoeniclus*				1				1	
Robin	*Erithacus rubecula*	3	2	2	2	1	x	1	1	2
Rook	*Corvus frugilegus*	3	6	2	1	x		3	x	2
Sedge Warbler	*Acrocephalus schoenobaenus*				1				x	
Siskin	*Carduelis spinus*	1								1
Skylark	*Alauda arvenis*	1	1	2	1				2	2
Snipe	*Gallinago gallinago*			2					1	
Song Thrush	*Turdus philomelos*	1	1			x	x	1		x
Starling	*Sturnus vulgaris*	2		7	4				6	
Stonechat	*Saxicola torquata*				1					
Swallow	*Hirundo rustica*	4	3	8	x	2	2	3	4	10
Swift	*Apus apus*		1	2					2	1
Willow Warbler	*Phylloscopus trochilus*	3	1	1		2	2	2		3
Woodpigeon	*Columba palumbus*	2	4	6	2	2	x	8		5
Wren	*Troglodytes troglodytes*	3	1	2	x	1	1	1		2

Results of bird survey transects and point counts from winter 2019/2020.

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Blackbird	*Turdus merula*	2	2	4	2	1	2		1	1
Black-headed Gull	*Chroicocephalus ridibundus*				1				2	
Blue Tit	*Cyanistes caeruleus*	1	1	1		2	1	1		1
Bullfinch	*Pyrrhula pyrrhula*		2	2			2			1
Buzzard	*Buteo buteo*						x			x
Chaffinch	*Fringilla coelebs*	4	2	3	2	5	1	2		3
Coal Tit	*Periparus ater*	2		1		3		1		3
Collared Dove	*Streptopelia decaocto*			2				2		
Cormorant	*Phalocrocorax carbo*				1					
Curlew	*Numenius arquata*				2				x	
Dunnock	*Prunella modularis*	1		1	1				1	
Goldcrest	*Regulus regulus*	3	2	2		3		1		2
Golden Plover	*Pluvialis apricaria*								x	
Goldfinch	*Carduelis carduelis*	2	4					12	2	
Great Tit	*Parus major*	1		2		2		x		1
Grey Heron	*Ardea cinerea*	1			1				x	
Herring Gull	*Larus argentatus*	1			x				x	
Jackdaw	*Corvus monedula*			2	x		2	1	3	

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Jay	*Garrulus glandarius*	1				x		x		x
Kestrel	*Falco tinnunculus*						1		1	
Linnet	*Linaria cannabina*		2						13	
Little Egret	*Egretta garzetta*				x					
Long-tailed Tit	*Aegithalos caudatus*	2		1		4				
Magpie	*Pica pica*	1	2	1	1	x	x	1	3	
Mallard	*Anas platyrhynchos*				2				x	
Meadow Pipit	*Anthus pratensis*		1	4	1		1		3	
Mistle Thrush	*Turdus viscivorus*	2	1					2		
Mute Swan	*Cygnus olor*								x	
Peregrine Falcon	*Falco peregrinus*								x	
Pheasant	*Phasianus colchicus*		1	1		x	x	x	x	
Pied Wagtail	*Motacilla alba*			1				1		
Raven	*Corvus corax*	1			1		x		x	x
Redwing	*Turdus iliacus*	5		7					4	1
Reed Bunting	*Emberiza schoeniclus*								1	
Robin	*Erithacus rubecula*	4	3	3	1	2		2	1	4
Rock Dove	*Columba l. livia*							3		

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Rook	*Corvus frugilegus*	7	4	5	2	1	8	9	x	4
Shelduck	*Tadorna tadorna*				2					
Siskin	*Carduelis spinus*	1				2				2
Snipe	*Gallinago gallinago*								1	
Song Thrush	*Turdus philomelos*	1	1	2		1	x			1
Sparrowhawk	*Accipiter nisus*					x		1		1
Starling	*Sturnus vulgaris*		1	3	17				7	
Stonechat	*Saxicola torquata*				x					
Teal	*Anas crecca*				x					
Treecreeper	*Certhia familiaris*					1				
Woodcock	*Scolopax rusticola*					1				
Woodpigeon	*Columba palumbus*	4	2	6	x	3	x	3	2	x
Wren	*Troglodytes troglodytes*	4	2	3	1	2		1	1	3

Results of bird survey transects and point counts from summer 2020.

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	T4 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Blackbird	*Turdus merula*	2		2	2		2	1	2		1
Blackcap	*Sylvia atriacapilla*	1					1		1		
Black-headed Gull	*Chroicocephalus ridibundus*	2				1				3	
Blue Tit	*Cyanistes caeruleus*		2	1		1	1		1		1
Bullfinch	*Pyrrhula pyrrhula*		2					2			
Buzzard	*Buteo buteo*			1	1		x	x			
Chaffinch	*Fringilla coelebs*	2	2	3	2		3	1	3	1	2
Chiffchaff	*Phylloscopus collybita*	1		1	1	x	1				
Coal Tit	*Periparus ater*		1	1			2		1		1
Common Gull	*Larus canus*	1									
Cormorant	*Phalocrocorax carbo*		1			x					
Dunnock	*Prunella modularis*	1		1	1	1		1		1	
Goldcrest	*Regulus regulus*	1		2			3		2		
Goldfinch	*Carduelis carduelis*				2	3			2	2	2
Great Tit	*Parus major*		1	1					1		1
Grasshopper Warbler	*Locustella naevia*					x				x	

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	T4 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Grey Heron	*Ardea cinerea*					x			x		
Grey Wagtail	*Motacilla cinerea*									1	
Herring Gull	*Larus argentatus*					1				2	
Hooded Crow	*Corvus cornix*		2	2	2	2	x	2	x	4	2
House Martin	*Delichon urbica*		3							2	
House Sparrow	*Passer domesticus*					3				6	2
Jackdaw	*Corvus monedula*	2		1	3		2	1	4	1	4
Jay	*Garrulus glandarius*	x		1							
Kestrel	*Falco tinnunculus*								1	1	x
Lesser Black-backed Gull	*Larus fuscus*					2				x	
Lesser Redpoll	*Acanthis cabaret*			2			2		1		
Linnet	*Linaria cannabina*		2		4			6		3	
Long-tailed Tit	*Aegithalos caudatus*						3				
Magpie	*Pica pica*	1	1		3		2	x	x	2	1
Mallard	*Anas platyrhynchos*					x				2	
Meadow Pipit	*Anthus pratensis*		2	2	2	1		2		2	
Mistle Thrush	*Turdus viscivorus*			2	1						1

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	T4 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Pheasant	*Phasianus colchicus*			1	2			x		x	x
Pied Wagtail	*Motacilla alba*	1	1						1		1
Reed Bunting	*Emberiza schoeniclus*					x					
Robin	*Erithacus rubecula*	2	1	3	1	1	3	x	4		2
Rook	*Corvus frugilegus*	4	2		4	3	7	2	3	x	5
Sand Martin	*Riparia riparia*				2	4					
Sedge Warbler	*Acrocephalus schoenobaenus*					1				x	
Siskin	*Carduelis spinus*		1								1
Skylark	*Alauda arvenis*	1	2	1	1	x		1		1	x
Snipe	*Gallinago gallinago*			1	1			1			
Song Thrush	*Turdus philomelos*	1					1		x		x
Sparrowhawk	*Accipiter nisus*		1						1		
Starling	*Sturnus vulgaris*		3	11				3		5	2
Stonechat	*Saxicola torquata*										
Swallow	*Hirundo rustica*	3	4	6	3	1	2	5	4	8	7
Swift	*Apus apus*		1						2		
Wheatear	*Oenanthe oenanthe*							1			

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	T4 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Whitethroat	*Sylvia communis*			1			1				
Willow Warbler	*Phylloscopus trochilus*	2	1	3	2	1	2	1	2		2
Woodpigeon	*Columba palumbus*	2	2		4		4	4	3	2	3
Wren	*Troglodytes troglodytes*	1	3	2		1	2	1	3		2

Results of bird survey transects and point counts from winter 2020/2021.

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	T4 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Blackbird	*Turdus merula*	2	1	2	1	1	1	2	3	2	1
Black-headed Gull	*Chroicocephalus ridibundus*				1	3				1	
Blue Tit	*Cyanistes caeruleus*	1		2	1		2		1		1
Bullfinch	*Pyrrhula pyrrhula*			2	2			1			1
Buzzard	*Buteo buteo*		x				x		x		
Chaffinch	*Fringilla coelebs*	3	3	4		1	4	1	3	1	3
Coal Tit	*Periparus ater*	2	2				1				

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	T4 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Collared Dove	*Streptopelia decaocto*				2		x				1
Cormorant	*Phalocrocorax carbo*					1				1	
Crossbill	*Loxia curvirostra*	2	4						2		
Dunnock	*Prunella modularis*	1	2			1			1	1	1
Fieldfare	*Turdus pilaris*				3			2		x	
Goldcrest	*Regulus regulus*	2	2	1			1				
Goldfinch	*Carduelis carduelis*		3		20		2			14	
Great Black-backed Gull	*Larus marinus*					1					
Great Tit	*Parus major*	1	1	1	1		1	x	1		1
Grey Heron	*Ardea cinerea*					x				x	
Grey Wagtail	*Motacilla cinerea*					1					
Herring Gull	*Larus argentatus*					3				x	
Jackdaw	*Corvus monedula*	1	2		1	3		2	x	3	5
Jay	*Garrulus glandarius*		x								
Lesser Redpoll	*Acanthis cabaret*		1				2				
Linnet	*Linaria cannabina*				6	2					
Little Egret	*Egretta garzetta*					x				x	

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	T4 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Long-tailed Tit	*Aegithalos caudatus*			5							2
Magpie	*Pica pica*	1	1	2	1	1	1	2	1	x	1
Mallard	*Anas platyrhynchos*					4					
Meadow Pipit	*Anthus pratensis*		1	2	2	1		3		1	
Mistle Thrush	*Turdus viscivorus*			1					1		2
Oystercatcher	*Haematopus ostralegus*					x					
Peregrine Falcon	*Falco peregrinus*								x		
Pheasant	*Phasianus colchicus*			1	1			x			
Pied Wagtail	*Motacilla alba*	1		1					1		1
Raven	*Corvus corax*					x	x			x	
Redshank	*Tringa totanus*					x					
Redwing	*Turdus iliacus*	6	2	7	3	2		x	3	1	
Reed Bunting	*Emberiza schoeniclus*					1					
Robin	*Erithacus rubecula*	4	2	3	2	1	3	1	2	1	3
Rook	*Corvus frugilegus*	3	5	19	9	x	2	4	6	x	8
Siskin	*Carduelis spinus*	2									

Species	Scientific Name	T1 (<100m; peak)	T2 (<100m; peak)	T3 (<100m; peak)	T4 (<100m; peak)	PC1 (<50m; Peak)	PC2 (<50m; Peak)	PC3 (<50m; Peak)	PC4 (<50m; Peak)	PC5 (<50m; Peak)	PC6 (<50m; Peak)
Snipe	*Gallinago gallinago*				3			x			
Song Thrush	*Turdus philomelos*	1	x	x			1		x		x
Starling	*Sturnus vulgaris*		3	4	1	4		3	12	4	
Teal	*Anas crecca*									x	
Woodpigeon	*Columba palumbus*	6	2	4	2		3	1	5	2	2
Wren	*Troglodytes troglodytes*	3	2	3	2		1	1	2		2

Appendix 6.3: Trail Camera Record – Sample images


12 C
ECIRECAM09
05/24/2020 12:03AM
11℃
06/02/2020 02:30AM CAMERA1


9 C
ECIRECAM09
11/19/2020 11:46PM
15/01/2021 22:33
05°C
SPYPOINT

Sample of Badger photos from Trail Camera Record


08/08/2020 09:29 12°C
SPYPOINT FORCE-DARK


29.94 inHg 19°C 08/06/2020 08:21PM CAMERA1

Sample of Badger photos from Trail Camera Record

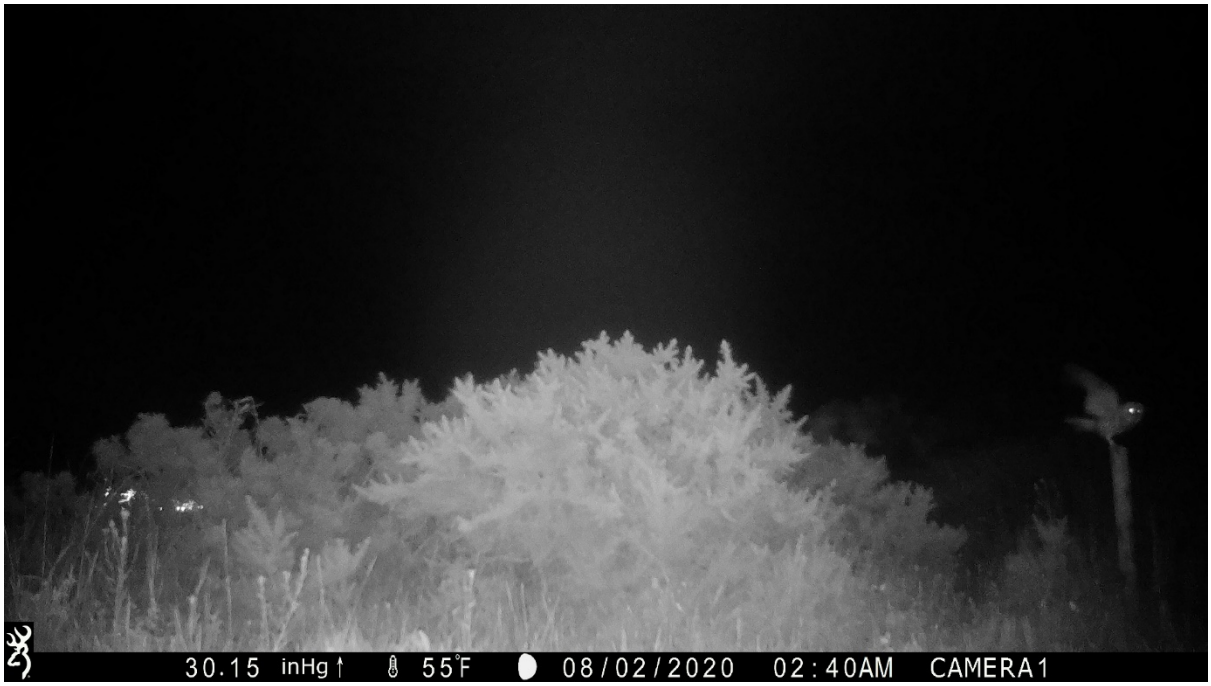

6 C
ECIRECAM04
03/08/2020 09:11PM
5 C
ECIRECAM04
03/18/2020 09:22PM


13.C
ECIRECAM05
07/28/2020 11:41PM
8℃
10/01/2020 06:02PM CAMERA1

Sample of Otter images from Trail Camera Record


30.21 inHg - 55°F 09/04/2020 02:41AM CAMERA1
30/08/2020 21:20 05°C
SPYPOINT FORCE-DARK


51F
ECIRECAM02
07/19/2020 11:55PM
30.03 inHg
18℃
08/15/2020 03:49AM CAMERA1



Sample of Barn Owl Images

Whimbrel – recorded on passage in May 2020.


62 F
ECIRECAM02
08/13/2020 10:06AM
16 C
ECIRECAM05
07/31/2020 09:30AM

Sample images of Mink from the Trail Camera record

Sample images of Stoats from the trail camera record

Sample image of Buzzard from the Trail Camera record

Red Squirrel on the trail camera record

Pheasants from the trail camera record

Redwing on the trail camera record

Bat (unidentified species) on the trail camera record

Kestrel on the trail camera record

Irish Hare on the trail camera record

Appendix 6.4: Marine Mammal Risk Assessment in relation to blasting operation of a Borrow Pit (2020)

MARINE MAMMAL RISK ASSESSMENT FOR AUGHINISH BORROW PIT

AUGHINISH ALUMINA LTD., AUGHINISH ISLAND, ASKEATON, CO. LIMERICK

Prepared for:

Aughinish Alumina Ltd.

Prepared by:

Croft Ecology,

On behalf of Ecology Ireland.

May 2020

MARINE MAMMAL RISK ASSESSMENT FOR AUGHINISH BORROW PIT

AUGHINISH ALUMINA LTD., AUGHINISH ISLAND, ASKEATON, CO. LIMERICK

Document Rev. No.	Details	Principal Author	Checked by	Date
A	Draft to Client	Dr. Daphne Roycroft	Dr. Gavin Fennessy	22.05.20

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Executive Summary

The report comprises a Marine Mammal Risk Assessment (MMRA) of a permitted borrow pit at Aughinish Island, Askeaton, Co. Limerick. This MMRA was requested by the Environmental Protection Agency (EPA) as part of the Industrial Emissions Licensing review for Aughinish Alumina Ltd. due to concerns over the proximity of the activity to the Lower River Shannon SAC and the potential for impact on marine mammals, in particular Bottlenose Dolphins, due to noise and vibration associated with blasting activities at the borrow pit.

Given the terrestrial location of the development site and the fact that all blasting activities will take place on land and not in the underwater environment. this project is not considered to pose any risk of death, injury or disturbance to marine mammals. Following a detailed risk assessment, the risk of any adverse effects on marine mammals (specifically Bottlenose Dolphins) has been ruled out and no mitigation measures beyond those stipulated in the EIAR for the development are deemed necessary. Therefore **no additional mitigation** is recommended for this development.

1 Introduction

Ecology Ireland was commissioned by Aughinish Alumina Ltd. to complete a Marine Mammal Risk Assessment (MMRA) of a permitted borrow pit at Aughinish Island, Askeaton, Co. Limerick (planning reference 17714, An Bord Pleanála Reference PL91.301011). This MMRA was completed by Croft Ecology[1] on behalf of Ecology Ireland. This MMRA was requested by the Environmental Protection Agency (EPA) as part of the Industrial Emissions Licensing review for Aughinish Alumina Ltd. (Reg. No.: P0035-07, letter dated 6th May 2020), as follows:

'In view of the proximity of the activity to the Lower River Shannon SAC (Site Code 002165) and the potential for impact on the Shannon Estuary's Bottlenose Dolphin population, particularly due to noise and vibration as a result of blasting at the borrow pit, please submit a marine mammal risk assessment (MMRA), completed by a suitably qualified marine ecologist, evaluating the risk to marine mammals from the proposed activities.

The risk assessment should be completed in accordance with the approach outlined in Guidance to Manage Risk to Marine Mammals from Man-made Sound Sources in Irish Waters published in January 2014 by the Department of Heritage, Culture and the Gaeltacht (available at https://www.npws.ie/marine/best-practice-guidelines). The MMRA shall clearly outline any additional mitigation measures required to protect marine mammals, as necessary.'

In November 2018, ten year permission was granted for the development of a borrow pit adjoining Aughinish Alumina Ltd plant (planning reference 17714, An Bord Pleanála Reference PL91.301011). An Environmental Impact Assessment Report (EIAR) and Appropriate Assessment Screening Report was submitted as part of the planning application (TPA, 2017), however no MMRA was completed. The development site is located c. 120m from the Lower River Shannon SAC; where Bottlenose Dolphin is a qualifying interest of the SAC.

1.1 Legislation and Guidance

All marine mammals occurring in Ireland are afforded legal protection by the Wildlife Acts (1976 - 2010) and the EU Habitat's Directive. Four regularly occurring marine mammal species are listed on Annex II of the EU Habitat's Directive and as such their breeding populations require protection; Grey Seal *Halichoerus grypus*, Harbour Seal *Phoca vitulina* (also known as Common Seal), Bottlenose Dolphin *Tursiops truncatus* and Harbour Porpoise *Phocoena phocoena*. The Irish government has designated Special Areas of Conservation (SACs) for each of these species, where the Lower River Shannon SAC (site code 0002165) includes Bottlenose Dolphin as a qualifying interest (NPWS 2012, see Section 3.1 for further details).

Under current legislation in Ireland, it is an offence to disturb or injure a marine mammal, whether this occurs via introduced sound or another anthropogenic source. The induction of temporary or permanent tissue damage and a Temporary Threshold Shift (TTS) in hearing sensitivity, which can have negative effects on the ability to use natural sounds (e.g., to communicate, navigate, locate prey) for a period of minutes, hours or days, may constitute such an injury (NPWS 2014). It is therefore considered that anthropogenic

[1] Trading name of Dr Daphne Roycroft

sound sources with the potential to induce TTS in a receiving marine mammal contain the potential for both (a) disturbance, and (b) injury to the animal (NPWS 2014).

In 2014, the National Parks and Wildlife Service (NPWS) of the Department of Arts, Heritage and the Gaeltacht produced the following guidance document; '*Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters*' (NPWS, 2014). This guidance document sets out the potential risks to marine mammals from anthropogenic sounds. It states that "*An assessment of risk forms an important part of the decision-making framework for mitigating the effects of anthropogenic sound in the marine environment. It is recommended that … [certain] coastal and marine activities undergo a risk assessment for anthropogenic sound-related impacts on relevant protected marine mammal species, to inform the consenting process*."

Specific maritime activities that should be considered in relation to introduced sound and the prevention of injury or disturbance to marine mammals are outlined as follows; dredging, drilling, pile driving, geophysical acoustic surveys and blasting (in the marine environment; NPWS, 2014). Note that, in all cases, underwater (seabed or coastal/pier) activities are referred to and no above water or inland noise sources are identified as requiring risk assessment.

In the case of the permitted borrow pit under consideration here, all blasting activity will take place on land (8.5m above Ordinance Datum (OD) level) within the borrow pit site boundary, which is located a minimum of c. 560m from the nearest coastline. As such, the blasting activity associated with the borrow pit is not considered to be an activity typically requiring a Marine Mammal Risk Assessment as described in the NPWS guidance document (i.e. NPWS 2014). However, a MMRA had been completed for this development in order to fulfil the request of the EPA (as detailed above).

This MMRA has been completed following the established guidelines (NPWS, 2014) and has been informed by the development application documents and a desktop study of available information on marine mammals in the Lower River Shannon (see Section 6 for list of references).

1.2 Statement of Competency

1.2.1 Dr Daphne Roycroft

Daphne has over 10 years of experience in the field of Ecological Consultancy and holds a BSc and PhD in Ecology from the National University of Ireland, Cork. She has a background in seabird and marine mammal monitoring, where her PhD studies focused on the high-risk inshore environments of Bantry Bay and the Lower River Shannon Estuary. Daphne has studied the distribution of marine mammals in the Shannon Estuary and interactions with anthropogenic activities including aquaculture and shipping.

Dr. Roycroft was the retained Marine Mammal Observer (MMO) for the remediation of the East Tip at Haulbowline, on behalf of Cork County Council. This included detailed observations (2015-2018) and provision of advice in relation to construction works (including piling) in and adjacent to the marine environment.

Daphne is a self-employed Ecological consultant, trading as Croft Ecology. She is experienced in the preparation of Ecological Impact Assessment Reports and Appropriate Assessment screening appraisals as well as Natura Impact Statements for a variety of projects including wind farms, solar farms, roads,

pipelines, residential developments, ports and landfill sites. She has published research papers in several peer-reviewed scientific journals and has lectured on several degree and certificate courses in The National University of Ireland, Cork. Examples of marine mammal projects that Daphne has been involved with include pre-construction and construction phase marine mammal monitoring of the Haulbowline Island East-tip remediation project in Cork Harbour and seabird and marine mammal monitoring of the Arklow Bank Wind Farm, Co. Wicklow.

1.2.2 Dr. Gavin Fennessy

Dr. Gavin Fennessy (Director & Principal Ecologist, Ecology Ireland) – Gavin has over 20 years of professional consultancy experience. He has designed and Project Managed ecological surveys for many large infrastructural projects in Ireland. Dr. Fennessy has prepared Biodiversity Sections of Environmental Impact Assessment Reports, Screening for AA and Natura Impact Statements for many large infrastructural projects. He is experienced in peer review of ecological reports and assessment.

Dr. Fennessy is a graduate of UCC, having received a Zoology Degree in 1996 and PhD in 2001. He has worked as a freelance consultant ecologist since 1998, contributing to environmental impact assessments for a wide range of projects, including residential and mixed-use developments, roads, piers and grid and wind farm infrastructure. He carried out 4 years of Post Doctoral Research on wildlife hazard management at civilian airports, presenting lectures at international conferences in Warsaw (2003) and Athens (2005). Since 2006, Gavin has worked as an ecological consultant, establishing Ecology Ireland Wildlife Consultants Ltd. in 2011. Ecology Ireland is a leading independent ecological consultancy in Ireland, based in County Limerick, providing advice to Clients in the public and private sectors.

He is a Guest Lecturer at UCC – teaching undergraduate and postgraduate degree students on environmental impact assessment and Appropriate Assessment. He is a member of the Irish Policy Group of the Chartered Institute of Ecology & Environmental Management. Gavin is an experience expert witness having contributed to a number of An Bord Pleanála Oral Hearings – most recently the Opera Development Oral Hearing in Limerick in November, 2019.

2 Description of the Site and Proposed Activity

The permitted alumina production facility, operated by Aughinish Alumina Ltd., is located on Aughinish Island, *c.*6km from Askeaton, Co. Limerick (Figure 1). The proposed works for which this MMRA was completed includes the preparation and operation of a borrow pit of *c*. 4.5 ha in area to extract *c*. 374,000 m^3 of rock within part of the site comprised of previously disturbed ground, including part of a former borrow pit. The borrow pit site is located towards the centre of the Applicant's landholding at Aughinish Island, to the south of the process area of the plant. The site is surrounded by grassland and the AAL Sports Grounds to the east and south, the Bauxite Residue Disposal Area (BRDA) to the west, and the plant area to the north.

The proposed extraction activities at the site will require deepening of the existing ground level by 8m, down to 8.5m above Ordinance Datum (OD) level. Extraction will take place in a northerly direction, from the existing former borrow pit toward the alumina plant area. It is proposed that extraction will occur over a 10 year period, with the borrow pit operational between April and September each year, with blasting occurring around 6/7 times within this period (*i.e.* per year).

The proposed borrow pit application boundary is approximately 120m from the Lower River Shannon SAC (Site Code 002165) and is located c. 560m from the coastline.

There are three broad stages in the extraction process:

1) Blasting of rock faces;
2) Crushing of Rock; and
3) Stockpiling of Rock.

Stage 1) Blasting of rock has been identified as having the potential for impacts on Bottlenose Dolphins in the adjacent SAC by the EPA (see Section 1) and this is the activity that will be assessed in this report.

2.1 Description of Blasting Activity

In order to extract the limestone, the active rock face must be blasted using explosives. The blast charges will be placed at regular intervals. It is anticipated that blasting will occur on site c. 6 to 7 times per year. The operational period of the Borrow Pit (blasting, crushing and stockpiling) will be restricted to between April and September each year. The operation of the Borrow Pit will take place between 08:00 and 1800 hours on Monday to Friday. No operations will take place on site on Saturdays, Sundays and Public Holidays.

The Applicant will employ specialist blast contractors to design and carry out each blast in the Borrow Pit. All blasts at the site are subject to a specific design, which is carried out in accordance with the relevant design standards, which establish best practice and safety, and has regard to the built environment.

Each blast is specifically designed to release a quantum of rock from the working Borrow Pit face. In this regard, a pre-determined grid of vertical holes is drilled on top of the Borrow Pit face to a required depth. The intervals between the drill holes are specifically designed having regard to the explosives to be placed within each of the holes and the depth of the rock, which is sought to be released. There are pre-determined intervals or delays in the detonation of explosives in the drilled holes. This process minimises vibration arising from the blasting and increases the efficiency with which the rock can be removed. The

shot-firing of the blasts and the explosives used are monitored by the Borrow Pit Manager (TPA 2017, EIAR Noise Chapter).

The detonation of explosive produces a very rapid and dramatic increase in volume due to the conversion of the explosive from a solid to a gaseous state. When this occurs within the confines of a borehole, it has the following effects (after Golder 2017):

- The bedrock in the area immediately adjacent to the explosive product is crushed,
- As the energy from the detonation radiates outward from the borehole, the bedrock between the borehole and quarried face becomes fragmented and is displaced while there is minimal fracturing of the bedrock behind the borehole, and
- Energy not used in the fracturing of and displacement of the bedrock dissipates in the form of ground vibrations, sound and airblast. This energy attenuates rapidly from the blast site due to geometric spreading and natural damping.

2.1.1 Blast Noise and Air Overpressure

Details of the noise and vibration associated with the borrow pit development are contained in the EIAR for the development (TPA 2017, Chapter 11). Activities on site (including noise emissions) are licensed by the EPA - Industrial Emissions' Licence (IPPC Licence Reg.: P0035 06). Furthermore; Aughinish Alumina facility is certified according to ISO 14001 (environmental management standard), ISO 9001 (quality management standard) and ISRS (health and safety management standard) (TPA 2017). Noise emissions from the existing Aughinish Alumina facility are monitored annually and are found to be comfortably within the IEL noise criteria for daytime, evening and night-time periods. With consideration of the current site noise emissions and predicted noise emission values associated with the proposed borrow pit, the cumulative noise emissions are also expected to remain comfortably within the IEL noise criteria at all nearby noise sensitive locations (TPA 2017, Chapter 11). The application of binding noise limits, hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration impact will not have a significant impact on the surrounding environment. The resultant residual noise impact from this source will be of minor, perceptible short term impact (TPA 2017, Chapter 11).

It should be noted that blast noise was not specifically assessed in the EIAR, as the EPA requirements for blasts are only in relation to vibration and air overpressure (air blast). Blast noise assessment is not generally required due to the short duration of the noise event and the typically large distances between the blast site and noise sensitive locations (i.e. dwellings), such that the risk of impact from the noise itself is very low. However assuming a very high blast noise level of 120dB(A) at 1m from the blast, the noise generated by the blast is expected to be attenuated by ~60dB in the air at a distance of 1km from the blast source, due to the distance alone and excluding any natural screening/absorption due to the ground contours in-between (calculated using standard equation for free field propagation of noise[2]). It should also be noted that this relates to airborne sound and that the noise would be predicted to reduce

[2] https://www.who.int/occupational_health/publications/noise1.pdf Page 39, Equation 21.

significantly when transferred from air to water[3]. This can be assumed to be a worst-case scenario as in reality there will be increased attenuation due to the screening berm and other topography between the blast site and the sensitive receptor – which in the case of Bottlenose Dolphins is the estuarine habitat located over 1.3km from the development site. Shallower intertidal areas closer to the coast are unsuitable habitat for Bottlenose Dolphin.

EPA Guidance indicates acceptable limits for air overpressure should not exceed 125dB (Lin) Peak Value. Due to the uncertainties with meteorological conditions and specific charge variations, it is not possible to predict with certainty the maximum air overpressure values that will be experienced at nearby sensitive locations (EIAR 2017). In order to control air overpressure during blasting, the best practical approach is to implement a scheme to reduce pressure levels at the source and monitor air overpressure at receivers. Just such an approach is specified in the EIAR (RPS 2017, Chapter 11) and this should be effective in ensuring that the specified air overpressure limit values are not exceeded.

2.1.2 Blast Vibration

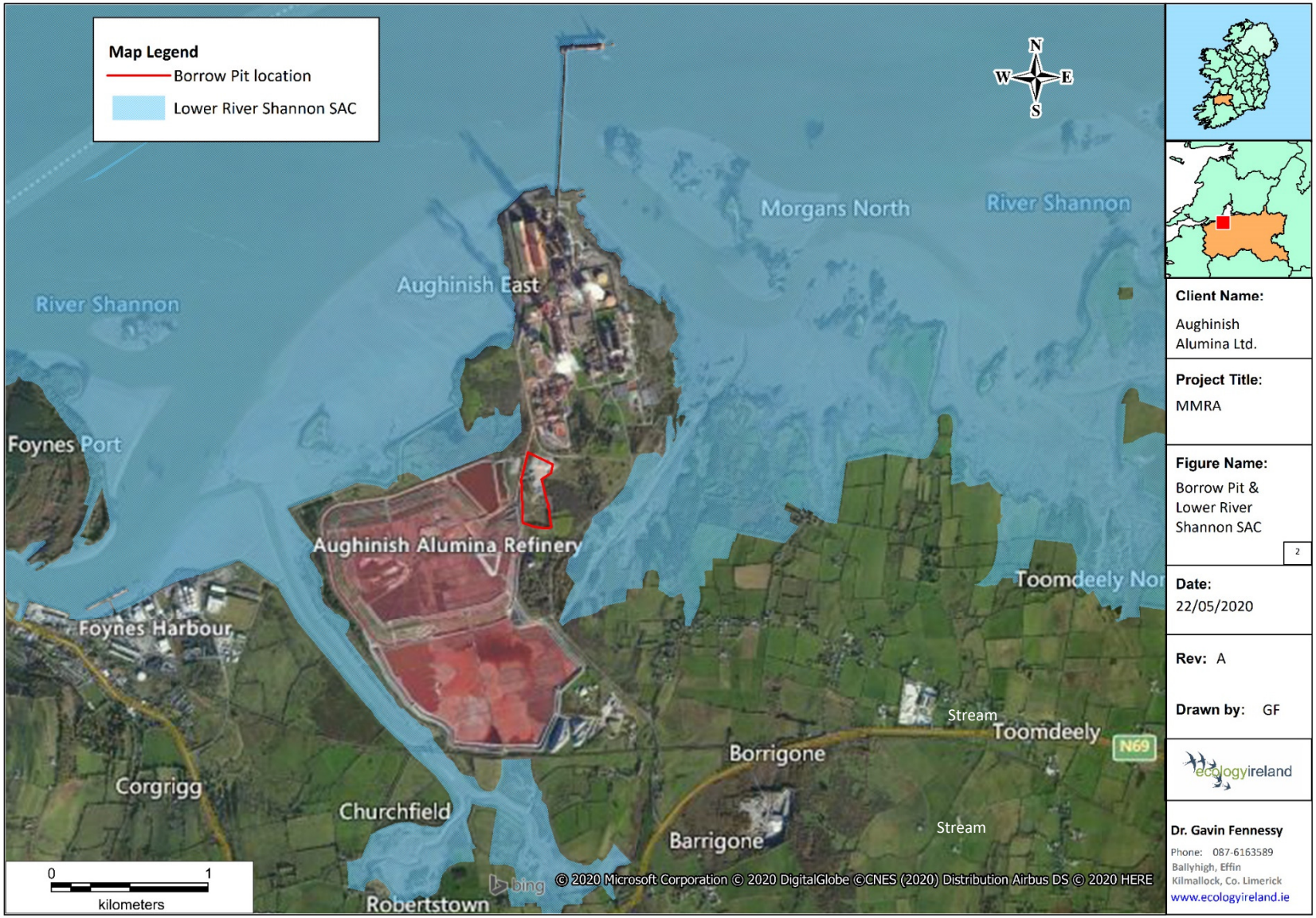
A Blast Vibration Assessment was completed for the borrow pit development to assess the potential impacts of blasting on the embankments and raises within the adjacent Bauxite Residue Disposal Area (BRDA) located to the west and southwest of the borrow pit site (Golder 2017).

The effect of blasting within the footprint of the proposed Borrow Pit was evaluated and found to pose a very unlikely risk to the stability of the adjacent Bauxite Residue Disposal Area (BRDA). The intensity of ground vibrations due to the blasting, expressed as a peak particle velocity (PPV) was calculated based on the type and size of blast and characteristics of the area. This was then calibrated with previous blasting in the area. Appendix A shows the PPV contour plot for the borrow pit development (after Golder 2017). The PPV reduces with distance from the blast from 165 mm/s at the blast site to 4mm/s at a distance of 240m from the blast site (Appendix A). The energy attenuates rapidly from the blast site due to geometric spreading and natural damping. Given that the nearest coastline is >550m from the borrow pit boundary, the residual ground vibration within the estuary is considered to be imperceptible.

[3] In simple terms, water is denser than air, so it takes more energy to generate a sound wave, such that and a faint sound in air wouldn't be transmitted in water as the wave wouldn't have enough energy to force the water particles to move.

Figure 1: Location of permitted Borrow Pit at Aughinish Island.

Figure 2: Site Location and Lower River Shannon SAC



3 Marine Mammals in the Existing Environment

A desktop study of previous studies as well as historical marine mammal records for the Lower River Shannon was completed as part of this MMRA in order to identify the marine mammal species requiring consideration in this assessment. The following marine (or semi aquatic) mammal species were considered to have the potential to occur in the vicinity of the development site; Bottlenose Dolphin, Otter, Grey Seal, and Harbour Seal. Further details on the occurrence of these species in the study area are provided below. Note that no other cetacean species are known to regularly occur in the Lower River Shannon Estuary.

3.1 Bottlenose Dolphin

Bottlenose dolphins are listed in Annex II of the EU's Habitats Directive and the Lower River Shannon is one of two Special Areas of Conservation (SAC) designated for this species in Irish waters. The Lower River Shannon SAC provides critical habitat for a resident population of Bottlenose Dolphins, where the SAC boundary is located c. 120m from the borrow pit site boundary. The most recent population estimate of dolphins using the SAC is c. 139 dolphins (CV: 0.109, 95% confidence interval: 121-160, Rogan *et al*., 2018). This estimate lies within the range of previous estimates calculated since 1997 indicating a stable population size (Rogan *et al*. 2018).

Bottlenose dolphins are known to range widely throughout the SAC site, occurring on occasion as far upstream as Limerick City, with the outer estuary (i.e. between Tarbert and Loop Head/Kerry Head) being of particular importance for this species (Figure 3, NPWS 2012b). Within its downstream range, continued robust research effort has led to the identification of two core locations within which the majority of dolphin records occur (Ingram & Rogan 2002, NPWS 2012b). These 'critical areas' (see Figure 3 after NPWS 2012a) represent high value habitats used preferentially by the species within its overall range at the site and they broadly coincide with areas of steep benthic (i.e. seafloor) slope, greater depth and stronger currents (Ingram & Rogan 2002, NPWS 2012b).

The borrow pit development site is located c. 18km upstream of the nearest critical Bottlenose Dolphin habitat (Figure 3) in an area of the SAC believed to be of much lesser importance for the dolphin population. Dolphins can occur in this area of the inner estuary from time to time and all suitable aquatic habitat (as shown in Figure 3) is considered relevant to the species' range and ecological requirements within the overall SAC (Berrow 2009, NPWS 2012b).

A number of acoustic monitoring studies have been completed in the Foynes/Aughinish areas in recent years and the results indicate that dolphins occur in the inner estuary, including close to deep water berths, on a regular basis (i.e. 31% of days surveyed at Aughinish, although there was a trend of declining detection rates the further up-river monitoring was carried out, O'Brien and Berrow 2012). O'Brien *et al*. 2013 recorded dolphins on 41% of the days surveyed at the nearby Foynes port study area. Interestingly more detections were recorded at night in the Aughinish/Foynes areas during both studies (O'Brien & Berrow 2012 & O'Brien 2013) and 'Season' had a significant effect on the presence of dolphins at Aughinish, with more detections during the winter months during one study (O'Brien & Berrow 2012) and more detections in Spring in the Foynes study (O'Brien *et al*. 2013).

Clearly, some bottlenose dolphins within the Lower River Shannon SAC occur with some regularity in the waters adjacent to Foynes and Aughinish Island. The duration of detections is low suggesting that dolphins that occur are transiting the area and with little evidence of prolonged occurrence, or the presence of regularly used foraging areas (O'Brien & Berrow 2012).

3.2 Otter

Otter *lutra lutra* is a qualifying species of the Lower River Shannon SAC. This species was surveyed as part of the EIAR for the planning application for the borrow pit (TPA 2017, Chapter 7). Otter sightings or signs tended to be restricted to the coastal areas of Aughinish Island (TPA 2017). Otters were regularly recorded on trail cameras deployed on or adjacent to the coastal flood embankment at the site in recent years. There were no sightings or signs recorded of Otter within or adjacent to the borrow pit area during the EIAR survey (TPA 2017) and given the location of the proposed development, within the industrial plant away from the shoreline, it is unlikely that Otters occur in this area with any regularity. It is possible that Otters may commute across, or forage in the area on occasion, but the lack of watercourses in this part of the site decreases the likelihood that it is an area frequented by Otters.

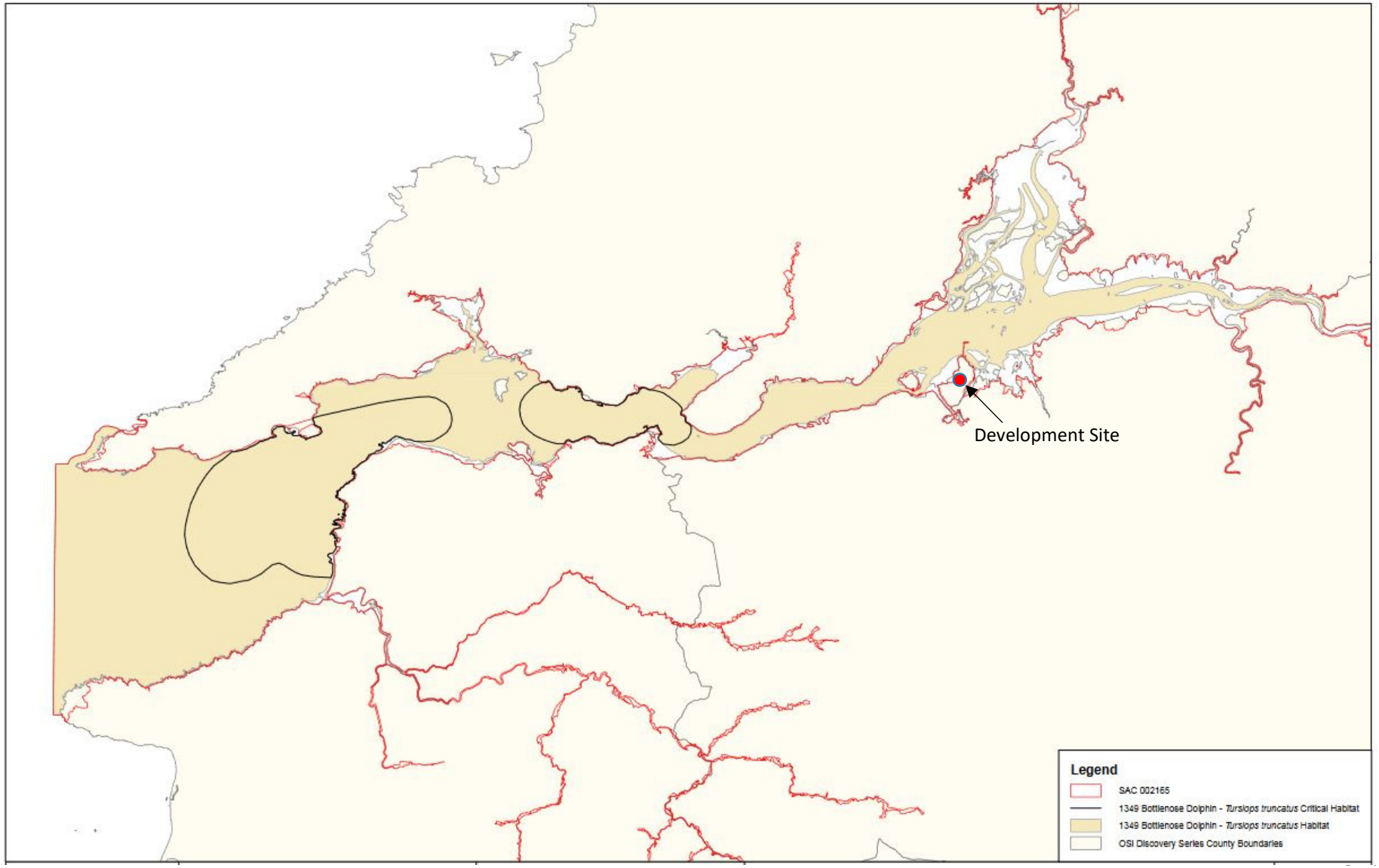
The activity (including blasting) at the proposed borrow pit will be largely restricted to daylight hours when Otters are much less likely to be present in the area. This further minimises the risk that any Otters would be disturbed or displaced through noise disturbance or the operation of machinery and personnel in the area. There are no signs that the areas within or adjacent to the proposed borrow pit area are of importance for Otters and it is not expected that the proposed development will have any significant impact upon Otters in the wider area (EIAR 2017).

3.3 Seals

The Lower River Shannon is not of known significance for either of the two seal species which occur in Irish waters; Grey Seal *Halichoerus grypus* and Harbour Seal *Phoca vitulina*.

The nearest known significant breeding site for Grey Seals is the Blasket Island SAC in County Kerry, located over 115km from Aughinish (Ó'Cadhla *et al*., 2013) and Harbour Seals are not known to breed in the Shannon Estuary (Cronin *et al*., 2004 and Duck & Morris, 2013). Both species are known to forage in the Lower River Shannon Estuary and Grey Seals have been recorded as far inshore as Shannon Airport (NBDC database, Cronin et al. 2004). The nearest Harbour Seal haul out site (1-10 individuals) is located on Canon Island at the mouth of the Fergus Estuary, approximately 5km from the borrow pit site (Cronin *et al*., 2004 and Duck & Morris, 2013). These seals are part of a much wider, highly mobile, population and are not considered to be at risk from the blasting activity at the borrow pit site.

Figure 3 Study Site and Bottlenose Dolphin Habitat (after NPWS 2012a)



4 Risk Assessment

Given the importance of the Lower River Shannon SAC for Bottlenose Dolphin and the location of suitable habitat for this species c.1.3m from the development site, this risk assessment will focus on Bottlenose Dolphin species only. The development area has been shown to be of low importance to Pinnipeds and the potential impacts on Otter have been adequately assessed in the EIAR (TPA 2017).

It is important to reiterate that the blasting referred to in this report will take place on land and is not associated with the marine environment. Blasting activity in the marine environment has the potential to introduce pulsed sounds at levels that may impact very significantly upon marine mammal individuals and/or populations (NPWS 2014). Therefore, it commonly requires the implementation of very stringent mitigation measures for the protection of these species (NPWS 2014). This is not the case for terrestrial/airborne blasting, where the sound/energy attenuates rapidly from the blast site due to geometric spreading and natural damping and where any residual noise would be expected to reduce greatly when meeting the air-water interface.

It is also important to note that the development site is located within a highly disturbed environment where anthropogenic noise levels are already elevated due to presence of industrial activities and shipping (i.e. Foynes Port). Noise-monitoring results show that the Lower Shannon Estuary is a noisy place (100 ± 7.5 dB; O'Brien *et al*. 2016). It is likely that Bottlenose Dolphins are habituated to the existing levels of anthropogenic noise within this busy shipping channel. Indeed, results from static acoustic monitoring show that Bottlenose Dolphins regularly use deepwater channels that are the main shipping routes used in the estuary (O'Brien *et al*. 2016). In this context, there is no likelihood that the infrequent (6-7 times per year) blasting associated with the borrow pit operations (located over 1km from the nearest Bottlenose Dolphin habitat) is likely to impact upon the Bottlenose Dolphin population of the wider SAC.

4.1 NPWS Assessment Criteria

An evidence-based risk assessment for each marine mammal species that occurs in and around the proposed works area needs to consider the nature of the sound source (see Section 2), its likely and/or potential effects on individuals and/or populations and on their likely habitats, and could usefully address the following questions where appropriate (after NPWS 2014):

Do individuals or populations of marine mammal species occur within the proposed area?
The development site is located c.1.3km from the nearest suitable Bottlenose Dolphin habitat and c. 18km from the nearest critical habitat (see Figure 3). While Bottlenose Dolphins are known to occur in the waters surrounding the Aughinish and Foynes area (e.g. on 31 to 41% of the days surveyed), the duration of detections is low suggesting they are transiting the area and there is no evidence of prolonged occurrence or the presence of regularly used foraging areas (O'Brien & Berrow 2012). The mouth of the estuary (west of Tarbert) is much more frequently used and is of much higher importance to this species than the inner estuary, near where the development site is located. It should be reiterated that the development site is not located within the estuary or

directly on the coastline, but is situated c. 560m inland (above sea level) within the Aughinish Alumina site.
Is the plan or project likely to result in death, injury or disturbance of individuals?
Given the terrestrial location of the development site and the fact that all blasting activities will take place on land and not in the underwater environment this project is not considered to pose any risk of death, injury or disturbance to individuals. As described in Section 2.1 the noise and vibration levels of the blast will attenuate quickly such that they pose no risk to sensitive receptors in the vicinity of the site, and where the nearest Bottlenose Dolphin habitat is located over 1.3km for the development site. The worst-case scenario airborne noise levels associated with the blast activity would be of the order of 60dB(A) at a distance of 1km from the blast site and this would be reduced greatly when transferred to the water environment. This is well below the levels known to cause a significant behavioural response in dolphin species (see Appendix 2). Similarly the PPV levels associated with the blast will attenuate rapidly from the blast site due to geometric spreading and natural damping (see Appendix A). The residual ground vibration within the estuary at a distance of 1km from the blast site is considered to be imperceptible and will not result in any disturbance impacts to marine mammals. Furthermore, Bottlenose Dolphins have been found to occur most often at night, and in the winter period in the vicinity of the development area (O'Brien & Berrow 2012 and O'Brien 2013) and as such are less likely to be disturbed by the blasting activity which will take place during the day (in the summer months) and will only occur up to seven times per year.
Is it possible to estimate the number of individuals of each species that are likely to be affected?
It is estimated that c.139 Bottlenose Dolphins are resident within the Lower River Shannon SAC (Rogan *et al*., 2018). It is not known what percentage of the population venture upstream as far as the Aughinish area, however abundance appears to be low in the area, particularly when compared to the outer estuary (Berrow 2009). No individuals will be affected by the proposed blasting activities associated with the borrow pit operations due to the reasons outlined above.
Will individuals be disturbed at a sensitive location or sensitive time during their life cycle?
While the Lower River Shannon is an important breeding habitat for Bottlenose Dolphin, the development site is located c.1.3km from the nearest suitable Bottlenose Dolphin habitat and c. 18km from the nearest critical habitat (see Figure 3). Therefore the blasting activities will not result in disturbance of any individuals occurring within sensitive locations.
Are the impacts likely to focus on a particular section of the species' population, e.g., adults vs. juveniles, males vs. females?
The Lower River Shannon is an important breeding habitat for Bottlenose Dolphin and an average of seven calves (range 3–10) calves were born each summer (Baker *et al*. 2018). A 2015 analysis of demographics found that the adult : calf/juvenile ratio was 2:1 and, where sex was known, the adult population comprised mostly females (Baker *et al*. 2018). While the inner estuary is not of known importance for calving it must be assumed that all individuals of the population (including calves)

may potentially occur in the area. As described above, this project is not considered to pose any risk of death, injury or disturbance to any individuals in the Lower River Shannon SAC.
Will the plan or project cause displacement from key functional areas, e.g., for breeding, foraging, resting or migration?
The development site is located c. 18km from the nearest critical Bottlenose Dolphin habitat (see Figure 3). This project is not considered to pose any risk of displacement from key functional areas.
How quickly is the affected population likely to recover once the plan or project has ceased?
This development is not considered to pose any risks to the Bottlenose Dolphin population in the Lower River Shannon SAC.

4.2 Mitigation Measures Proposed

Following the initial identification and assessment of risk arising from a plan or project (see section 4.1), a menu of management options is available for consideration by Regulatory Authorities in their decision-making process including as follows (after NPWS 2014):

- A1. Consent without mitigation (e.g., where the risk of any adverse effects has been ruled out)
- A2. No consent given for the activity
- A3. Avoid critical habitats for marine mammals (e.g., designated sites or other locations identified as sensitive via the risk assessment process), and/or
- A4. Avoid operations during key periods of the species' life cycle (e.g., breeding/resting, migration), and/or
- A5. Avoid time periods when effective impact mitigation is not possible, and/or
- A6. Risk minimisation measures where appropriate

In the case of the borrow pit development, the regulatory authority is the EPA (Industrial Emissions Licencing Programme) as planning consent has already been granted for this development.

Given the terrestrial location of the development site and the fact that all blasting activities will take place on land and not in the underwater environment this project is not considered to pose any risk of death, injury or disturbance to individuals. Following the detailed risk assessment presented in Section 4.1 above, the risk of any adverse effects on marine mammals (specifically Bottlenose Dolphins) has been ruled out and no mitigation measures beyond those stipulated in the EIAR (TPA 2017) are deemed necessary. Therefore **consent without mitigation** is recommended for this development.

5 Summary and Conclusions

Given the terrestrial location of the development site and the fact that all blasting activities will take place on land and not in the underwater environment, this project is not considered to pose any risk of death, injury or disturbance to any marine mammal individuals. As described in Section 2.1 the noise and vibration levels of the blast will attenuate quickly such that they pose no risk to sensitive receptors in the vicinity of the site, and where the nearest Bottlenose Dolphin habitat is located over 1.3km for the development site.

The development site is located within a highly disturbed environment where anthropogenic noise levels are already elevated due to presence of industrial activities and shipping (i.e. Foynes Port). Recent studies suggest that Bottlenose Dolphins are habituated to these noise levels and that they regularly use deepwater berths that are the main shipping routes used in the estuary. In this context, the infrequent (6-7 times per year) blasting associated with the borrow pit operations located over 1km from the nearest Bottlenose Dolphin habitat is likely to be imperceptible to the resident Bottlenose Dolphin population.

No mitigation measures beyond those stipulated in the EIAR (TPA 2017) are deemed necessary for the borrow pit blasting activity. Therefore **consent without mitigation** is recommended for this development in terms of the IEL review.

6 References

Baker, I., O'Brien, J., McHugh K. and Berrow S. 2018. Female reproductive parameters and population demographics of bottlenose dolphins (Tursiops truncatus) in the Shannon Estuary, Ireland. Marine Biology (2018) 165:15.

Berrow, S.D., Whooley, P., O'Connell, M. and Wall, D. 2010. Irish Cetacean Review (2000-2009). Irish Whale and Dolphin Group, 60pp.

Berrow 2008. Winter distribution of Bottle-nosed Dolphins (*Tursiops truncatus* (Montagu)) in the inner Shannon Estuary. Irish Naturalists' Journal *30 No.1 2009*: 35-39

Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & O' Keeffe, C., 2004. Harbour seal population assessment in the Republic of Ireland: August 2003. *Irish Wildlife Manuals*, No. 11. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Duck, C. & Morris, C. (2013). An aerial survey of Harbour Seals in Ireland: Part 2: Galway Bay to Carlingford Lough. August-September 2012. Unpublished report to the National Parks & Wildlife Service, Department of Arts, Heritage & the Gaeltacht, Dublin.

Golder Associates Ltd. 2017. Aughinish Alumina Limited, Borrow Pit: Phase 1 BRDA Blast Vibration Assessment. Prepared by Golder Associates Ireland Ltd. July 2017.

Ingram, S. and Rogan, E. 2002. Identifying critical areas and habitat preferences of bottlenose dolphins (*Tursiops truncatus*). *Marine Ecology Progress Series* 244: 247-255.

JNCC, 2001. Marine Monitoring Handbook, March 2001. Joint Nature Conservation Committee, UK Marine SAC's Project.

Lysaght, L. & Marnell, F. (Eds) 2016. Atlas of mammals in Ireland 2010 – 2015, National Biodiversity Data Centre, Waterford.

NPWS 2012a. Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS 2012b. Lower River Shannon SAC 002165. Conservation objectives supporting document-marine habitats and species Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS 2014. Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters. Department of Arts, Heritage and the Gaeltacht. January 2014.

O'Brien, J. and Berrow, S. 2012. The use of deep-water shipping berths by bottlenose dolphins in the Shannon Estuary. Final Report from static acoustic monitoring at Moneypoint, Foynes, Aughinish and Shannon Airport in the Shannon Estuary cSAC between November 2011 and November 2012.

O'Brien et al. 2013. Marine Mammals and Megafauna in Irish Waters - Behaviour, Distribution and Habitat Use. Developing Acoustic Monitoring Techniques. Marine Research Sub-Programme (NDP 2007-'13) Series. Marine Institute.

O'Brien, J., Beck, S., Berrow, S., André, M., van der Schaar, M, O'Connor I, and McKeown E. P. 2016. Chapter 95. The Use of Deep Water Berths and the Effect of Noise on Bottlenose Dolphins in the Shannon Estuary cSAC. In, A.N. Popper, A. Hawkins (eds.), *The Effects of Noise on Aquatic Life II*, Advances in Experimental Medicine and Biology 875, DOI 10.1007/978-1-4939-2981-8_95 .

Ó Cadhla, O. & Strong, D. 2007. Grey seal moult population survey in the Republic of Ireland, 2007. Report to the National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Ó Cadhla, O., Keena, T., Strong, D., Duck, C. and Hiby, L. (2013) Monitoring of the breeding population of grey seals in Ireland, 2009 - 2012. Irish Wildlife Manuals, No. 74. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Rogan, E, Garagouni, M, Nykänen, M, Whitaker A and Ingram, S. 2018. Bottlenose dolphin survey in the Lower River Shannon SAC, 2018. Report to the National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht. University College Cork. 19pp

TPA, 2017. Environmental Impact Assessment Report in Respect of Proposed Borrow Pit at Aughinish Alumina Ltd., Aughinish Islandm Askeaton, Co. Limerick. July 2012.

APPENDIX A

Peak Particle Velocity (PPV)[4] Contour Plot Borrow Pit Development (After Golder, 2017)

[4] The intensity of ground vibrations, which is an elastic effect measured in units of Peak Particle Velocity (PPV) is defined as the speed of excitation of particles within the ground resulting from vibratory motion. The PPV is the most commonly used measure of the intensity of ground vibration due to blasts. For the purposes of this report the PPV is measured in mm/s.

INSERT COUNTOUR PLOT

APPENDIX B

Marine Mammal Noise Exposure Criteria After NPWS 2014

Appendix 3 - Transcription of marine mammal noise exposure criteria given by Southall *et al.*[23]. Table B includes received levels (RL) from multiple pulse and non-pulse sound events reported to elicit significant behavioural responses* in previous studies. [* w.r.t. Irish-occurring species]

A. Criteria for Permanent Injury - estimated values for PTS-onset.

Cetaceans			Pinnipeds	Pinnipeds
Low frequency	*Mid-frequency*	*High frequency*	*in Water*	*in Air*
7 Hz-22 kHz	150 Hz-160 kHz	200 Hz-180 kHz	75 Hz-75 kHz	75 Hz-30 kHz
Baleen whales	Most toothed whales, dolphins	Certain toothed whales, porpoises	All species	All species
Single Pulse: 230 dB SPL 198 dB SEL Multiple Pulse: 230 dB SPL 198 dB SEL Non-pulses: 230 dB SPL 215 dB SEL	Single Pulse: 230 dB SPL 198 dB SEL Multiple Pulse: 230 dB SPL 198 dB SEL Non-pulses: 230 dB SPL 215 dB SEL	Single Pulse: 230 dB SPL 198 dB SEL Multiple Pulse: 230 dB SPL 198 dB SEL Non-pulses: 230 dB SPL 215 dB SEL	Single Pulse: 218 dB SPL 186 dB SEL Multiple Pulse: 218 dB SPL 186 dB SEL Non-pulses: 218 dB SPL 203 dB SEL	Single Pulse: 149 dB SPL 144 dB SEL Multiple Pulse: 149 dB SPL 144 dB SEL Non-pulses: 149 dB SPL 144.5 dB SEL

B. Criteria and values for TTS-onset (single pulses only) and Disturbance/Behavioural Response (multiple pulses and non-pulses).

Cetaceans			Pinnipeds	Pinnipeds
Low frequency	*Mid-frequency*	*High frequency*	*in Water*	*in Air*
7 Hz-22 kHz	150 Hz-160 kHz	200 Hz-180 kHz	75 Hz-75 kHz	75 Hz-30 kHz
Baleen whales	Most toothed whales, dolphins	Certain toothed whales, porpoises	All species	All species
Single Pulse: 224 dB SPL 183 dB SEL Multiple Pulse: 120-180 dB RL Not applicable Non-pulses: 120-160 dB RL Not applicable	Single Pulse: 224 dB SPL 183 dB SEL Multiple Pulse: 120-180 dB RL Not applicable Non-pulses: 90-200 dB RL Not applicable	Single Pulse: 224 dB SPL 183 dB SEL Multiple Pulse: Data unavailable Not applicable Non-pulses: 90-170 dB RL Not applicable	Single Pulse: 212 dB SPL 171 dB SEL Multiple Pulse: 150-200 dB RL Not applicable Non-pulses: 100+ dB RL Not applicable	Single Pulse: 109 dB SPL 100 dB SEL Multiple Pulse: Data unavailable Not applicable Non-pulses: 110-120 dB RL Not applicable

* Units of measurement:
Sound Pressure Level, SPL (in water): measured in dB re: 1 µPa (peak) (flat)
Sound Exposure Level, SEL (in water): measured in dB re: 1 μPa^2-s
Sound Pressure Level, SPL (*in air*): measured in dB re: 20 µPa (peak) (flat)
Sound Exposure Level, SEL (*in air*): measured in dB re: $(20\ \mu Pa)^2$-s

Appendix 6.5: Biodiversity Management Plan

Aughinish Alumina Ltd.

BIODIVERSITY MANAGEMENT PLAN

5 Year Plan

Prepared By: Seán Dundon	***Approval***			***Reference No.***
	Name	***Signature***	***Date***	
Revised by: *Seán Dundon* ***Date:*** *17/11/2021*	Env Manager Technical Manager			***Issue*** 1 ***Revision*** 1

RUSAL
AUGHINISH

CONTENTS

1.0 **Introduction**

Biodiversity (or biological diversity) refers to the variety of all living things in a particular location. This includes both wild and domesticated plants and animals, as well as fungi, bacteria and other microorganisms. Biodiversity can be broken into four main parts:

1. Species
2. Genetics
3. Habitats
4. Ecosystem diversity

Ecosystem diversity, the most important of these recognises that a species, or a habitat, does not exist independently of its surroundings. In order to protect an individual species or habitat, the entire community in which it exists must be protected. In the context of biodiversity conservation, it is vital that diversity of ecosystems are understood, promoted and protected.

Baseline information on habitats and the green infrastructure they support is fundamentally important for biodiversity management and conservation in Aughinish Alumina (AAL). This Biodiversity Management Plan, which documents how we manage biodiversity in Aughinish, identifies opportunities and recommends practical measure for biodiversity enhancement and conservation.

Ecological corridors and stepping stones facilitate the movement of plants and animals between local biodiversity areas and Aughinish. Apart from the Shannon estuary, patches of scrub, woodland and unimproved grassland provide some connectivity across the landscape.

Aughinish has a large variety of habitats and species present on it. These habitats range from salt marsh to low land hay meadow. Species range from Eurasian otters to barn owls. This range of both habitats and species are taken into consideration when setting out the targets for this plan. Protected habitats, flora and fauna have been given priority when setting specific targets.

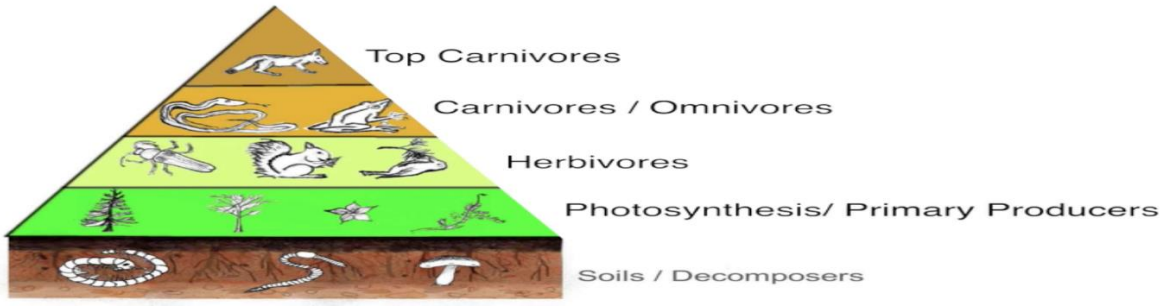


Fig. 1 Trophic levels diagram

Similar to the objectives of the National Biodiversity Action Plan 2017-2021, the AAL Biodiversity Management 5 year plan is consistent with this 'ecosystem approach'. The ecosystem approach ensures that all of the essential processes, functions and interactions between species, their habitats and their local, non-living environment have been taken into account when promoting best practice management and guidelines for biodiversity conservation. While the size of different ecosystems varies, we must ensure that we protect them in their entirety in order to ensure critical relationships are maintained.

This biodiversity management plan includes objectives and targets associated with native species, vegetation management, habitat management, improving ecological connectivity and increasing biodiversity awareness.

2.0 Background

2.1 Location and Refining Process

AAL operates a long established alumina refinery, located at Aughinish on the southern side of the Shannon Estuary near the village of Foynes, Co. Limerick. The refining process removes the alumina from bauxite. The bauxite, which is transported by ship from South America and West Africa, is unloaded at a dedicated Marine Terminal located in the Shannon Estuary, and transferred by enclosed conveyor to the plant, refined using the Bayer process. This process results in the production of alumina and a bauxite residue, which is deposited in the Bauxite Residue Disposal Area (BRDA). Alumina is exported to smelters in other European countries, where it is used to produce aluminium.

The alumina extraction plant commenced operation in 1983, and has been the subject of considerable expansion and investment. The plant is now one of the most efficient facilities for alumina extraction in the world, and the state-of-the-art facilities provide considerable employment in this region.

The Shannon estuary is the most important geographical feature for biodiversity in Aughinish. The estuary is home to bottlenose dolphins, otters, numerous species of birds, fish and bivalves. The estuary creates many habitats for flora and fauna to thrive including sandflats, mudflats, calcareous rock slopes, siliceous rock slopes, salt marsh and the estuary itself. These habitats provide vital food sources for wintering birds, otters and dolphins. The estuary allows rivers like the Robertstown River to flow into it, thus allowing adult salmon to swim from salt water to fresh water to spawn. On land, the main habitats are agricultural grassland, semi natural grassland, hedgerows, scrubland and semi natural woodland.

The bird sanctuary located on the North west side of the island is a key habitat for numerous bird and mammal species. Large flocks of migratory winter waders descend upon the bird sanctuary for food and shelter. All variety of waders are present in the bird sanctuary in the

winter months from Wigeon to Shoveler to Mute Swans. The tall reeds are used as ideal protection from large predators like buzzards. Another key habitat located on Aughinish is Hunts dragonfly Lough located along the east side of Aughinish. This lough is rich in species of dragonflies and damselflies. Common Darter to four spotted Chaser to the Irish damselfly have all been recorded in Hunts dragonfly lough. The lough is also used by numerous species such as mallards, smooth newts and grey herons.

2.2 Proximity to Designated Sites

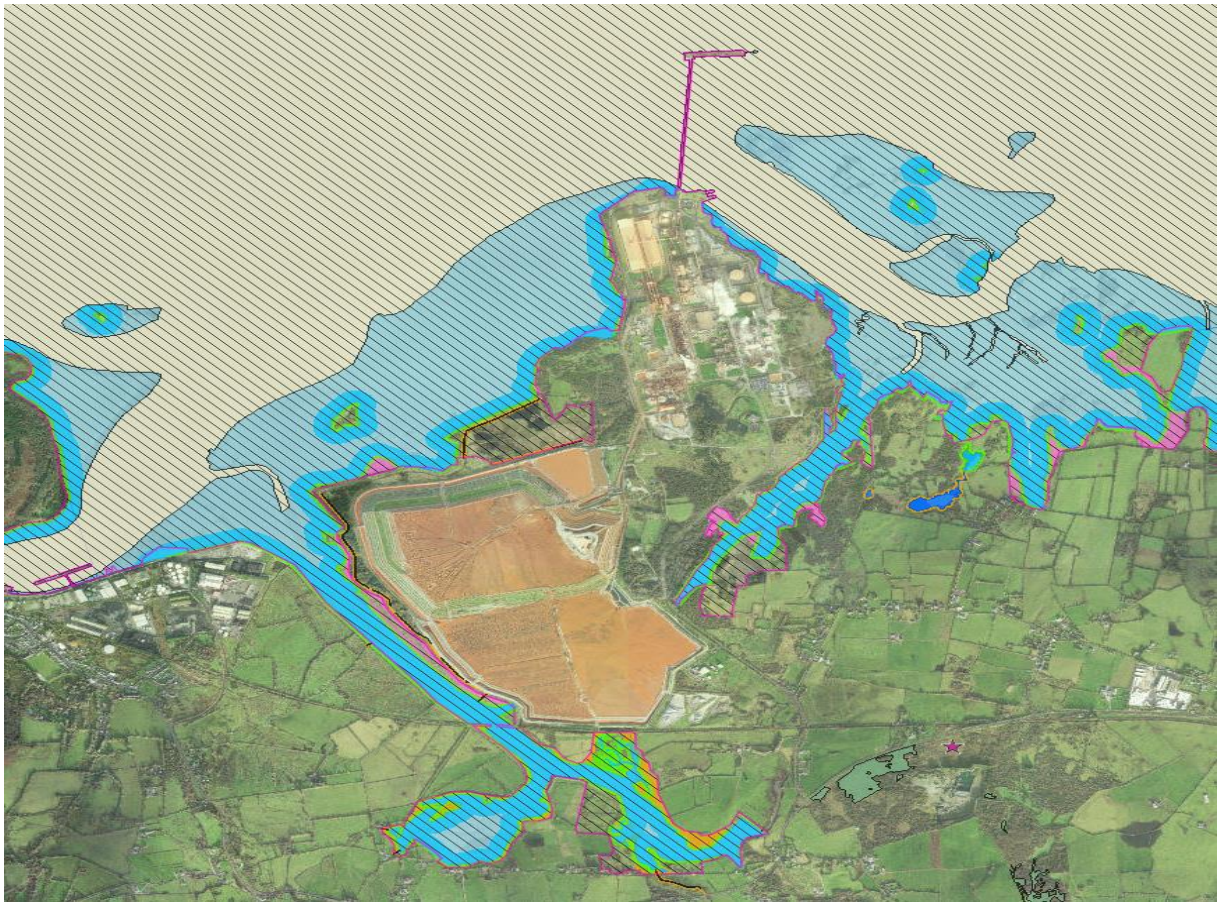


Fig 2. Map of all protected sites on and around AAL land holdings

Legend

Legend	
	SAC Annex I Atlantic Salt Meadow
	SAC Annex I Mediterranean Salt Meadow
	Atlantic and Mediterranean Salt Meadow Mosaic/ SAC Annex II Otter Habitat
	SAC Annex I Coastal Lagoon
	SAC Annex II for Otter Marine
	SAC Annex II for Bottlenose Dolphin
	SPA Boundary line
	SAC Annex II for Otter Freshwater/Terrestrial
	Extent of SPA

2.3 Plan Layout

The following table outlines the approach taken to develop this Biodiversity Management Plan.

	Description	Detail
1	National and County Biodiversity context	Describes the approach taken at National and County level to manage Biodiversity
2	Desktop Study	Outlines desktop study methodology applied
3	Habitat description	Provides an overview of the main habitats on and around Aughinish
4	Flora and Fauna description	Provides and overview of key species and their impacts on habitats
5	Objectives, targets, methodology, monitoring and reporting	Recommended objectives, targets including timeframes, methodology to be applied and monitoring and reporting frequencies

3.0 Aim of Biodiversity Management Plan

This biodiversity management plan identifies opportunities for biodiversity enhancement, conservation and recommends practical measures aimed at conserving and enhancing the natural heritage of Aughinish. The main aims of this plan are:

1. Identify habitats, areas of local biodiversity importance and ecological corridors.

2. Strengthen the knowledge base for conservation, management and sustainable application of biodiversity.
3. Increase awareness and appreciation of biodiversity and ecosystems services.
4. To conserve and/or enhance biodiversity and ecosystem services.

4.0 National and County Biodiversity Context

4.1 National Biodiversity Context

Due to Ireland's geographic isolation and recent geological history, it has a lower diversity of non-marine flora and fauna than is found on continental Europe. Nevertheless, Ireland's aquatic systems and wetlands support internationally significant populations of birds, fish and invertebrates. Ireland's marine environment is particularly biodiverse and is among Europe's richest for cetaceans (whales, dolphins and porpoises). It supports large seabird breeding colonies, a great range of invertebrate species, and its cold-water coral communities are of particular note, supporting a diverse array of associated fauna. In addition, Ireland has a significant number of internationally important habitats including limestone pavements, machair, turloughs and active peatlands.

It is estimated that in the EU 17% of habitats and species protected under the Habitats Directive (92/43/EEC) are in a favourable state. Recent evidence shows that Ireland's biodiversity capital is in decline.

Irelands Vision for biodiversity is "that biodiversity and ecosystems in Ireland are conserved and restored, delivering benefits essential for all sectors of society and that Ireland contributes to efforts to halt the loss of biodiversity and the degradation of ecosystems in the EU and globally".

The National Biodiversity Action Plan (NBAP), the third such plan for Ireland, captures the objectives, targets and actions for biodiversity that will be undertaken by a wide range of government, civil society and private sectors to achieve Irelands Vision for Biodiversity. The NBAP provides a framework to track and assess progress towards Irelands Vision for Biodiversity over a five year timeframe. To achieve the vision, seven strategic objectives are identified in the second National Biodiversity Action Plan "Actions for Biodiversity".

1. Mainstream biodiversity into the decision making process across all sectors
2. Strengthen knowledge base for conservation, management and sustainable use of biodiversity
3. Increase awareness and appreciation of biodiversity and ecosystems services
4. Conserve and restore biodiversity and ecosystem services in the wider countryside

5. Conserve and restore biodiversity and ecosystem services in the marine environment
6. Expand and improve on the management of protected areas and species
7. Strengthen international governance for biodiversity and ecosystem services

4.2 County Biodiversity Context

Limerick City and County has a very rich and diverse range of natural ecosystems. From the Shannon Estuary and its tributaries, to the upland areas such as the Ballyhouras. The agricultural lowlands including the Golden Vale also contribute to the extensive biodiversity of Limerick, as does natural woodlands such as that found in Curraghchase, and the extensive natural hedgerows throughout the county.

Wetlands areas are found throughout the county on the upland bogs, and in the city at Westfields. Fens are also located in Limerick and close-by in the Askeaton area. The Loughmore Common turlough is located on the outskirts of the city at Mungret. The Barrigone SAC is approx. 2km from Aughinish Island. Barrigone was selected as an SAC due to the presence of three habitats listed in Annex 1 of the EU Habitats Directive. Two of these are priority habitats Limestone pavement and semi natural dry grasslands and scrub facies on calcareous substrates (Festuco-Brometalia) (important orchid sites). The third Annex I habitat is Juniperus Communis formations on heaths or calcareous grassland. The site was also designated to protect a significant population, a species listed in Annex II of the habitats Directive, namely Marsh Fritillary butterfly.

Many of these habitats are of international importance having been designated Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and NHAs, as determined by the National Parks and Wildlife Service (NPWS), having notable species of flora and fauna. There are 19 such designations in Limerick City and County.

At Aughinish we are located beside the SAC of the Shannon Estuary. This is the largest protected habitat in the county of Limerick and is vitally important to the overall ecosystem functionality of the entire county. The SPA runs along our shoreline and is hugely important to international bird populations. We also have award winning Annex 1 lowland hay meadow habitat located along the North West of the island. This habitat is hugely important on a national level as low land hay meadows are very rare.

5.0 Desktop Study

A desktop review of existing information on habitats at Aughinish was carried out with particular focus on habitats and also species of conservation importance at the International, National and County levels. Habitats and species of County-level importance include those considered to be rare or threatened in County Limerick.

Specific data sources reviewed, which are the most recently published, include:

1. National Biodiversity Action Plan 2017-2021.
2. Environmental Impact Statement (EIS) Aughinish Alumina for the BRDA extension June 2005.
3. NPWS the monitoring and assessment of three EU Habitats Directive Annex I grassland habitats.
4. The Irish semi-natural grasslands survey 2007-2012.
5. Management Plan for the rare plant receptor areas Aughinish Alumina, County Limerick.
6. Birds of Conservation Concern in Ireland.
7. All-Ireland Pollinator Plan 2021-2025.
8. Dragonfly dash 2019- 2024.
9. A manifesto for Nature (Proposals to address the Biodiversity and climate emergency in Ireland).
10. Marine Mammal Observer report of Maintenance Plough Dredging works at Aughinish Jetty, County Limerick 2020.
11. Guidance to manage the risk to marine mammals from manmade sound sources in Irish waters (NPWS, 2014).
12. The status of EU Protected Habitats and Species in Ireland 2019.

6.0 Habitat Description

6.1 Lands of Aughinish Island

The lands of Aughinish Island, located along the Shannon Estuary encompass a wide array of habitats and species. The lower Shannon estuary has SAC (Special Area of Conservation) and SPA (Special Protection Area) designation. The habitats which are designated as Annex 1 which occur at Aughinish are estuaries, intertidal mudflats, Atlantic salt meadows, Mediterranean salt meadows, siliceous rocky slopes, calcareous rocky slopes, floating river vegetation, coastal lagoons, limestone pavement, saltmarsh, intertidal flats, low land hay meadow and calcareous grassland. The habitats included into the SAC in Annex 2 are controlled by protected species. The protected species in the area are the Eurasian otter (Lutra lutra) and the bottle nose dolphin (Tursiops truncates).

6.2 Lower Shannon Estuary SAC

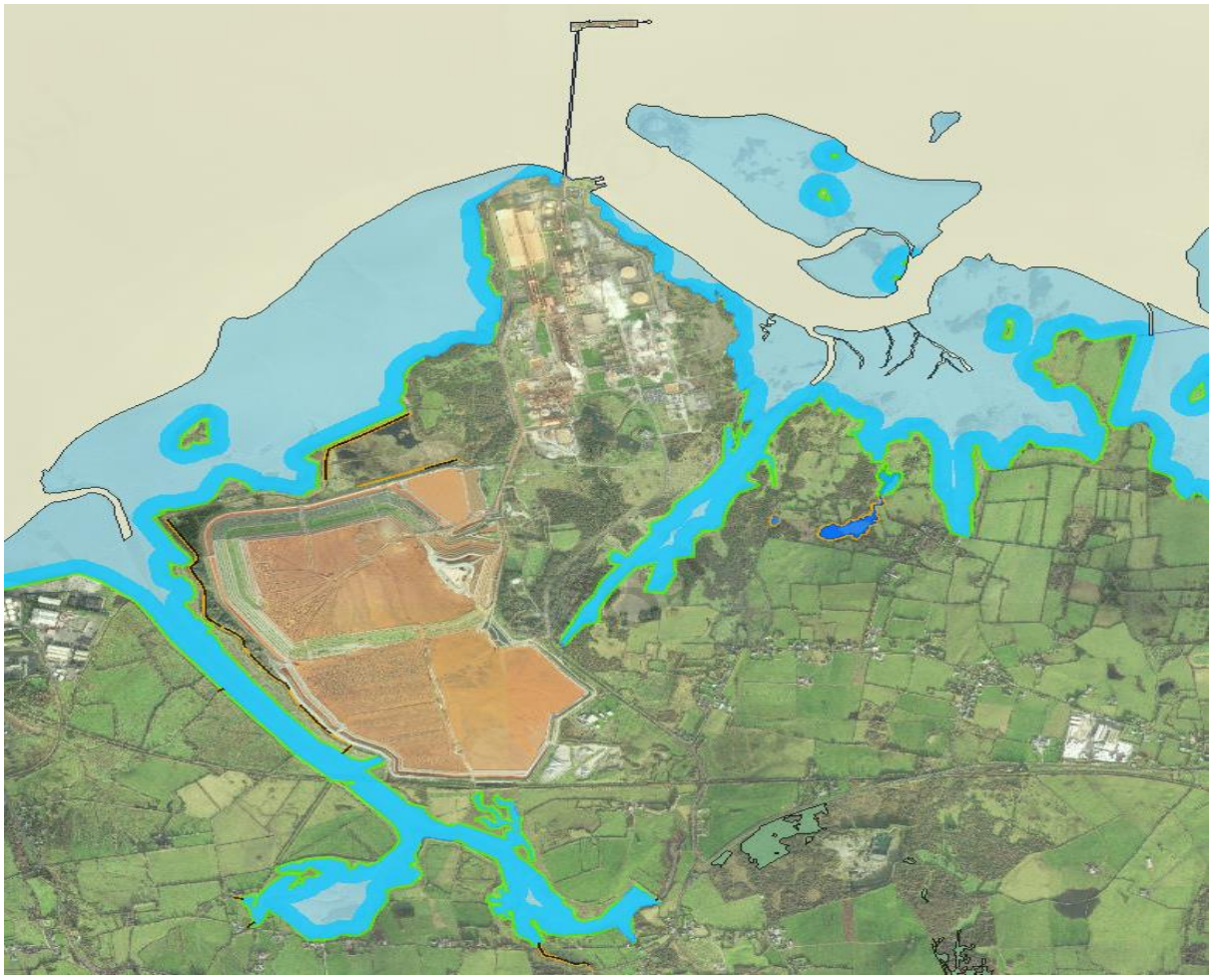


Fig.3 Map of lower Shannon estuary SAC

Legend	
	SAC Annex I Atlantic Salt Meadow
	SAC Annex I Mediterranean Salt Meadow
	Atlantic and Mediterranean Salt Meadow Mosaic/ SAC Annex II Otter Habitat
	SAC Annex I Coastal Lagoon
	SAC Annex II for Otter Marine
	SAC Annex II for Bottlenose Dolphin
	SAC Annex II for Otter Freshwater/Terrestrial

The lower Shannon estuary Special Area of Conservation is a large site that encompasses the lower reaches of the River Shannon extending from just south of Lough Derg at its eastern end to a line drawn from Loop Head to Kerry Head at the west. The Mulkear and Maine rivers are included in the site as well as the lower portions of others, such as the Fergus and Maigue. The Lower River Shannon SAC is designated for the Annex I qualifying interests of large shallow inlets and bays, estuaries, mudflats and intertidal flats not covered by seawater at low tide, Sandbanks which are slightly covered by sea water all the time and reefs and the Annex II species bottle-nose dolphin (Tursiops truncates).

The Annex I habitat shallow inlets and bays is a large physiographic feature that may wholly or partly incorporate other Annex I habitats including reefs, sandbanks and intertidal flats within its area. This is also the case for estuaries, which may wholly or partly incorporate other Annex I habitats including reefs and intertidalflats within its area.

6.3 Lower Shannon Estuary SPA

Fig 4.Map of the lower Shannon estuary SPA

Legend
Extent of SPA

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds provides for the conservation of wild birds by, classifying important ornithological sites as Special Protection Areas. The bird species protected under 4(1) and (2) of the Directive are Cormorant, Whooper Swan, Light-bellied Brent Goose, Shelduck, Wigeon, Teal, Pintail, Shoveler, Scaup, Golden Plover, Ringed Plover, Grey Plover, Lapwing, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Greenshank and Black-headed Gull. All of these species have been recorded at Aughinish.

6.4 Estuaries

Estuaries are coastal inlets where there is a significant freshwater influence. The high water points of estuaries are often formed from boulders/ shingle and frequently by man-made margins in urban areas. The intertidal flanks can be composed of deposited material such as sand and mud/silt. The estuarine bed is often eroded to coarse material or bedrock. In faster flowing estuaries from shorter rivers little alluvium may aggregate, whereas in sites at the terminus of larger river basins a significant fringing of intertidalflats may accumulate. Finer sediments are often mobilised and removed in estuaries inundated with large swell driven waves. The degree of tidal range can effect mobilisation of finer fractions but may act to reduce downstream current velocities, which cause the deposition of coarser material and may result in the formation of a delta.

Eurasian Otter along the shoreline at Aughinish.

AAL operates in compliance with its Industrial Emissions Licence authorized by the Environmental Protection Agency of Ireland. This licence includes for the discharge of treated effluent to the Shannon, which is carried out in accordance with the limits set out in the EPA licence. AAL are fully compliant with these limits. AAL, in 2020, conducted a Natura Impact Statement or NIS of all emissions from the site, including the treated effluent discharge to the Shannon Estuary. This NIS scientifically concluded that the AAL site is not having any negative impact on the adjacent designated sites and their qualifying interests.

6.5 Intertidal flats

These sediment habitats are found between the low water and mean high water tide marks. The finer silt and clay sediments are dominant in intertidal flats and the larger sand particles are associated with areas exposed to greater wave forces. In addition, changes can occur in salinity, temperature, and exposure to air. The fine sediment of intertidal flats are typically deposited in estuaries. These sediments are often rich in nutrients but the depth of suitable habitat for fauna is limited by the access of oxygen rich seawater. Where tide and wave exposure conditions are suitable, the sediment can form into stable mixed sediment flats. In areas exposed to large waves with little riverine influence, the habitat is lacking binding silt or mud and is mostly composed of larger sand grains.

Kilewee Wildlife surveys the intertidal flats on Aughinish Island weekly. This survey includes what species were on the intertidal flats and in what density. It also notes whether any invasive species were recorded e.g American mink.

6.6 Coastal Lagoons

Coastal lagoons are expanses of shallow coastal salt water, of varying salinity or water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks. Salinity may vary from brackish water to hyper salinity depending on rainfall, evaporation and through the addition of fresh seawater from storms, temporary flooding by the sea in winter or tidal exchange.

While these habitats are rare in Ireland, they are another vital habitat for the Eurasian Otter. These lagoons are monitored weekly by Kilewee Wildlife for species presence, densities, invasive species and current grazing regime.

6.7 Atlantic Salt Meadows

Atlantic salt meadows are communities of herbaceous halophytic (salt-tolerant) plants growing on the margins of tidally inundated shores. They lie at the upper end of a succession between the early colonising species such as common glasswort and transitions to vegetation where tidal influence is limited. Salt marshes and coastal meadows are key habitats for several bird species listed in Annex I of the EU Birds Directive. Their occurrence is often the main justification for their designation as Special Protected Areas (SPAs).

Salt meadows still host viable populations of various widespread bird species not listed in Annex I of the EU Birds Directive but with an unfavourable conservation in Europe due to recent declines in the agricultural landscape. They include wader birds such as northern lapwing, common snipe, black-tailed godwit and common redshank. At least at a local and regional level, salt meadows are sometimes the only remaining habitats where these birds can still be found in important numbers.

Atlantic salt meadows host a number of species, which are not suitable for heavy grazing. Overgrazing is the number one threat to salt meadows. No grazing occurs on salt meadows at Aughinish.

6.8 Mediterranean Salt Meadows

Mediterranean salt meadows occupy the upper zone of saltmarshes and usually occur adjacent to the boundary with terrestrial habitats. They are widespread on the Irish coastline; however, they are not as extensive as Atlantic salt meadows. The habitat is distinguished from Atlantic salt meadows by the presence of rushes such as Sea Rush and/or, Sharp Rush.

Salt meadows host viable populations of various widespread bird species not listed in Annex I of the EU Birds Directive but with an unfavourable conservation in Europe due to recent declines in the agricultural landscape. They include wader birds such as northern lapwing, common snipe, black-tailed godwit and common redshank. At least at a local and regional level, salt meadows are sometimes the only remaining habitats where these birds can still be found in important numbers.

All Mediterranean salt meadows habitats at Aughinish are excluded from grazing as they don't respond well to any form of grazing. Mediterranean salt meadows are grazed naturally by wildfowl including wigeon, over winter to encourage fresh growth in spring.

6.9 Calcareous rocky slopes

Calcareous rocky slopes consist of vertical or near vertical exposures of calcareous bedrock with cracks, fissures and overhangs that support chasmophytic vegetation (i.e. vegetation in crevices). Chasmophytic vegetation is characterised by green spleenwort, lady-fern, yellow saxifrage (Saxifraga aizoides) and numerous bryophytes which are present due to the specific habitat conditions provided by the rock face and fissures.

Black tailed Godwit on calcareous rocky slopes at Aughinish.

These habitats exist all along our shoreline, they are monitored by Kilewee Wildlife services for signs of New Zealand willow herb (Epilobium brunnescens). New Zealand willow herb is an invasive plant that must be removed as it can colonise this habitat and out compete our native vegetation such as Green spleenwort and lady fern.

6.10 Siliceous rocky slopes

Siliceous rocky slopes consist of vertical or near vertical exposures of siliceous bedrock with cracks, fissures and overhangs that support chasmophytic vegetation. Chasmophytic vegetation is characterised by black spleenwort (Asplenium adiantum-nigrum), Wilson's filmy-fern (Hymenophyllum wilsonii) and St Patrick's-cabbage (Saxifraga spathularis), which are present due to the specific habitat conditions provided by the rock face and fissures.

White tailed sea eagle on siliceous rocky slopes at Aughinish.

These habitats exist all along our shoreline and are monitored for signs of New Zealand willow herb (Epilobium brunnescens). New Zealand willow herb is an invasive plant that must be removed as it can colonise this habitat and out compete our native vegetation such as Black spleenwort and St.Patricks-cabbage. Siliceous rock slopes at Aughinish are monitored monthly by Kilewee Wildlife for species presence, densities and invasive species.

6.11 Limestone Pavement

Limestone pavement consists of blocks of rock, known as clints, separated by fissures or grikes. Some areas consist of massive blocks of smooth, relatively un-weathered pavement with well-developed grikes, other areas consist of shattered, rubble-strewn pavement. The rock surface is almost devoid of overlying soils although patches of shallow skeletal soils and occasional areas of deeper soil can occur. This morphology results in a variety of microclimates, and together with the varied soil types allows for the establishment of a complex vegetation mosaic of different communities of calcareous grassland, heath, woodland and scrub.

Common Lizard on teasel leaf on limestone pavement in Poulaweala.

Species associated with this habitat include bloody crane's-bill, carline thistle, and blue moor-grass. Limestone pavement can also occur in a mosaic with areas of scrub/woodland, with extensive areas dominated by hazel and hawthorn. Buckthorn, alder buckthorn and spindle. The mosaic of communities also supports arctic-montane plants such as mountain avens and spring gentian.

6.12 Floating river vegetation

Floating river vegetation has a broad definition, covering river habitats as diverse as upland, flashy, oligotrophic, bryophyte- and algal-dominated stretches, to tidal reaches dominated by higher plants. Many Irish rivers have been modified via arterial drainage and channelisation. These activities have changed channel morphology and introduced larger amounts of fine sediment. These sediments provide a rooting medium for plants and, consequently, water crowfoot has increased in abundance.

Crowfoot-dominated stretches frequently have low diversity, are of low conservation value and indicate damage. Of greater conservation interest are lowland depositing and tidal rivers and un-modified, fast-flowing, low-nutrient rivers. A number of rare submerged and marginal species are associated with the former including opposite leaved pondweed, starworts, triangular club-rush, needle spike rush and mud-dwelling mosses.

Kilewee Wildlife completes monthly monitoring of floating vegetation.

6.13 Lowland Hay meadow

Lowland hay meadows are represented in Ireland by mesotrophic semi-natural grasslands that are almost always managed as traditional hay meadows (cut only once a year in late summer or autumn with the hay crop removed). These meadows are closely associated with the fertile plains of the larger river systems, such as the Shannon. However, they are also found on flatter ground amongst low hills and drumlins, and there are some sites on the coast.

Lowland hay meadows are composed of grasses and broadleaved herbs which are tolerant of annual mowing. Although the vegetation will be tall in mid-late summer, there is generally little leaf litter remaining from the previous season's growth. Plants found frequently in this habitat in Ireland include red clover, ribwort plantain, meadow buttercup, common knapweed, common bird's-foot-trefoil, meadowsweet, cat's ear, yellow oat-grass and meadow foxtail. Plants which indicate that the habitat is of better quality include smooth brome, field scabious, ox-eye daisy, greater burnet-saxifrage, yellow rattle, great burnet, Goat's-beard and orchids such as common spotted-orchid, bee orchid and early purple orchid.

The hay meadows to the North of the BRDA and in Fawnamore are managed by being cut and baled every year in late August or September. The lowland hay meadows to the North of the BRDA were ranked first out of 1192 sites as the best semi natural grassland in Ireland.

Lowland Hay meadow in full bloom in Aughinish.

6.14 Dry calcareous grassland

This calcareous grassland habitat comprises species-rich plant communities found on shallow, well drained calcareous substrates, often occurring on obvious geological features such as eskers and outcropping limestone rock, and in association with limestone pavement.

Peacock Butterfly on Devils bit scabious in dry calcareous grassland in Poulaweala.

The habitat comprises a mixture of grasses and herbs, with calcicole species typically frequent. Species such as mountain everlasting (Antennaria dioica) kidney vetch (Anthyllis vulneraria), carline thistle (Carlina vulgaris) and orchids such as the common spotted orchid (Dactylorhiza fuchsia) and the early purple orchid (Orchis mascula). Other typical species found within species-rich calcareous grassland include wild carrot (Daucus carota), lady's bedstraw (Galium verum) and common bird's foot-trefoil (Lotus corniculatus).

6.15 Mixed Woodland

This habitat comprises of 75-100 % broadleaved trees (native and non-native) and 0-25% conifer trees. The species included in this habitat are Oak (Quercus petraea), Ash (Fraxinus excelsior), Hazel (Corylus avellana), Rowan (Sorbus aucuparia), Sycamore (Acer pseudoplatanus) and Alder (Alnus glutinosa).

These habitats which were planted in the 1980s are well established, providing vital homes for many mammals and bird species. The woodlands owned by AAL were surveyed in 2020 by an independent arborist. The arborist has given AAL a number of recommendations in his final report. His recommendations are part of the targets of this BMP.

Eurasian Red Fox in Mixed woodland plantation at Aughinish.

6.16 Hedgerows

Hedgerows are linear strips of shrubs, often with occasional trees, that typically form field or property boundaries. Most hedgerows originate from planting and many occur on raised banks of earth that are derived from the excavation of associated drainage ditches.

Species composition varies with factors such as age, management, geology, soils and exposure. Hedgerows commonly support a high proportion of spinose plants such as Hawthorn (Crataegus monogyna), Blackthorn (Prunus spinose), Gorse (Ulex europaeus), Holly (Ilex aquifolium), Dog-rose (Rosa canina) or Bramble (Rubus fruticosus agg.) They can also have a variety of native and non-native trees including Ash (Fraxinus excelsior), Hazel (Corylus avellana), Sycamore (Acer pseudoplatanus), Beech (Fagus sylvatica) and willows (Salix spp.) Hedgerows can also contain climbing plants such as Ivy (Hedera helix), Honeysuckle (Lonicera periclymenum) and Cleavers (Galium aparine).

Blackthorn blossom in a hedgerow at Aughinish.

Hedgerows at Aughinish are managed by being cut and shaped before March and after August annually to allow birds nesting season to occur undisturbed. This encourages new growth and promotes diversity within the hedgerow. Hedgerows are important habitats for numerous bird and mammal species along with vital corridors across our landscape for invertebrates to feed and live.

6.17 Scrub

Scrub habitat is a very common habitat in Ireland. Scrub frequently develops as a precursor to woodland. This habitat is dominated by at least 50% cover of shrubs, stunted trees or brambles. In the absence of grazing and mowing, scrub can expand to replace grassland or heath vegetation. Scrub can be either open, or dense and impenetrable, and it can occur on areas of dry, damp or waterlogged ground. Common components of this habitat are Hawthorn (Crataegus monogyna), Blacthorn (Prunus monogyna), Gorse (Ulex europaeus), Bramble (Rubus fruticosus agg.), Dog rose (Rosa canina), Willows (Salix spp.), stunted birches (Betula spp.) and stunted hazels (Corylus avellana).

6.18 All habitats on lands owned by AAL

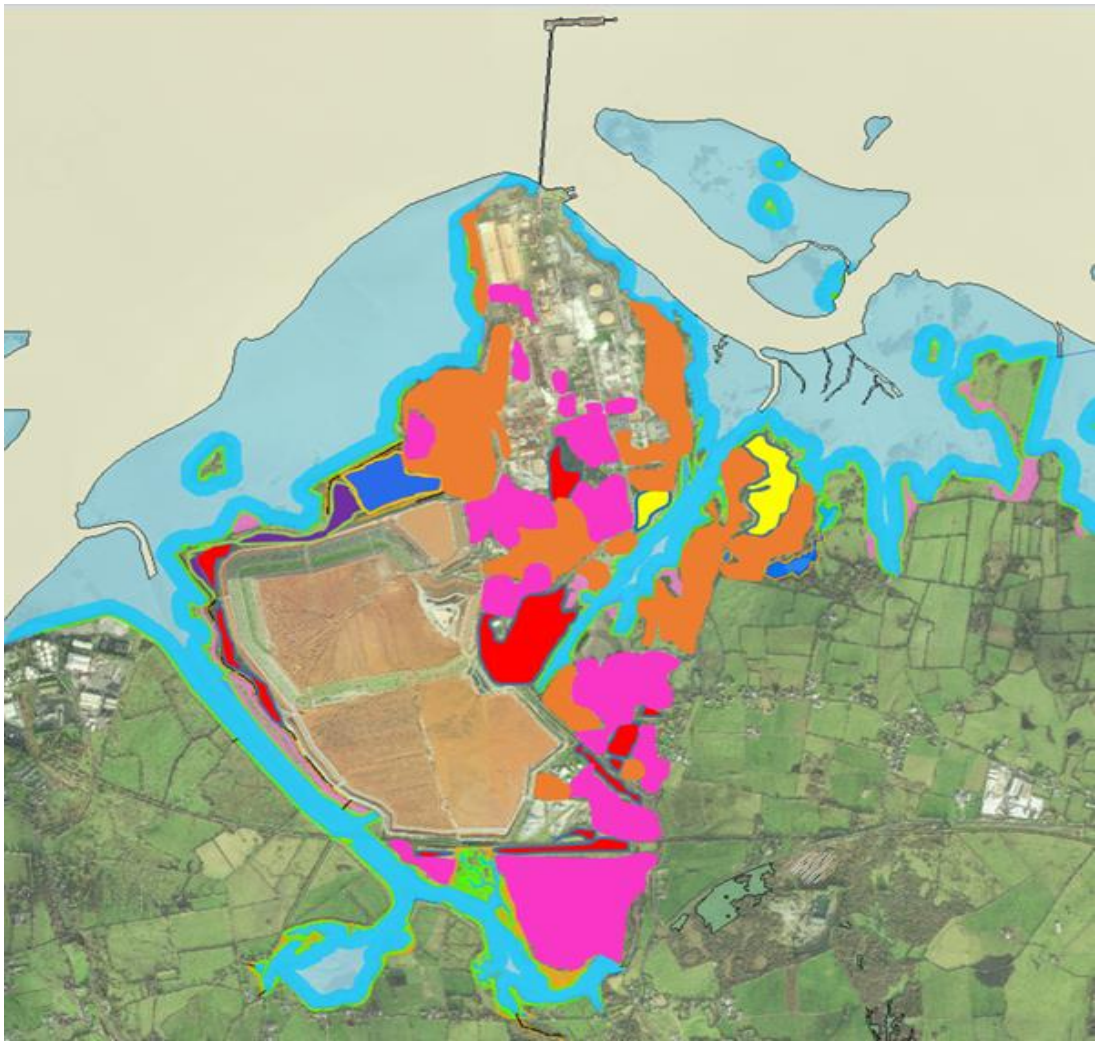


Fig 5. Map of all habitats on lands owned by AAL

Legend
SAC Annex I Atlantic Salt Meadow
SAC Annex I Mediterranean Salt Meadow
SAC Annex I Atlantic and Mediterranean Salt Meadow Mosaic/ SAC Annex II Otter Habitat
SAC Annex I Coastal Lagoon
SAC Annex II for Otter Marine
SAC Annex II for Bottlenose Dolphin
SPA Boundary line
SAC Annex II for Otter Freshwater/Terrestrial
Scrub
Improved grassland
SAC Annex I Dry Calcaerous Grassland
Mixed Woodland
SAC Annex I Lowland Hay Meadow

7.0 Flora and Fauna Description

7.1 Bottlenose Dolphin

The Shannon Estuary is the most important site in Ireland for bottlenose dolphins (Tursiops truncatus) and was designated as a SAC for this species in 1999. This is one of only two sites designated for this species in Ireland and one of only about 20 in Europe. A study on genetics of bottlenose dolphins in Ireland suggested that the bottlenose dolphins in the Shannon Estuary are genetically discrete and thus of very high conservation value.

As part of the SIFP for the Shannon Estuary, long-term Static Acoustic Monitoring (SAM) was carried out at 4 deep water jetty sites in the Shannon Estuary. A C-POD (Cetacean Acoustic Hydrophone Network) was deployed from the jetty at Aughinish for a period of 225 C-POD days and at the jetty at Foynes for a period of 288 days from November 5th 2011 to November 4th 2012. The C-POD had a range of c. 800m. Bottlenose dolphins were detected on 31% of the days (70 days) at Aughinish and on 47% of the days (135 days) at Foynes.

AAL is permitted to carry out routine maintenance plough dredging of estuarine sediment at their deep water jetty and at their adjacent pilot berth on the Shannon Estuary, Askeaton, County Limerick. This area is located within the Lower River Shannon Special Area of Conservation (SAC, site code 002165). Routine maintenance plough dredging occurs at least annually in compliance with applicable permits. This includes consideration of Guidance to manage the risk to marine mammals from manmade sound sources in Irish waters (NPWS, 2014). In this regard, a Marine Mammal Observer (MMO) completes a survey before, during and after dredging operations, as reported to the EPA annually.

7.2 Eurasian Otter

Ireland is considered to have the healthiest otter population in Europe. Surveys show that otters are present in more than ninety percent of our inland waterways and coastal waters. The species, already extinct over much of its former range, are listed as “vulnerable to extinction” by the IUCN (International Union for the Conservation of Nature) and the thriving Irish otter population is of international importance in terms of otter conservation.

The riparian zone around Aughinish is designated as a Special Area of Conservation (SAC, site code 002165) along with the freshwater lough within the Bird Sanctuary.

The otter is a top predator in many European freshwater systems and thus has an important role in ecosystem functioning. Otter population density, seasonality of breeding, reproductive

success, carrying capacity, foraging behaviour and local rates of mortality may be linked to prey availability and, hence, reflect the overall status of an ecosystem.

The sea wall on the North west side of Aughinish is a common location for Eurasian Otters to be observed. The sea wall has had maintenance works carried out over the last 60 years to ensure its longevity into the future. Due to the location of the sea wall between an SAC (Special Area of Conservation) and an SPA (Special Protected Area for Birds), these works are undertaken with the utmost care and attention, outside of the nesting season for birds and breeding season for otters.

Otters have been recorded along the riparian zone at Aughinish through camera trapping and also otter spraints. There are also three artificial otter holts built by Aughinish alumina along the western side of the island that otters frequent. Otter sightings are recorded weekly by Kilewee Wildlife.

Eurasian Otter on shoreline of Aughinish.

7.3 Great Burnett and Meadow Barley

The Great Burnet (Sanguisorba officinalis) and Meadow Barley (Hordeum secalinum) were identified in 2004 in the meadows in the proposed foot print of the phase 2 extension of the Bauxite Residue Disposal Area (BRDA). These plants are protected under the Flora Protection Order 1999 now 2015. This protection under the umbrella of the Wildlife Act 1976 hereby states that if any damage or removal of these plants occurs that the State may prosecute those responsible for crimes against wildlife.

AAL applied for a licence in 2006 to translocate these protected plants from National Park and Wildlife Services under the guidance of BEC (Botanical and Ecological Consultants). One of the conditions of the licence was that monitoring of the translocations would be carried out for five years. The monitoring of these translocations was under taken by BEC on behalf of AAL.

The rare plant translocations were proposed in the Environmental Impact Statment (EIS) for the expansion of the BRDA as a mitigation measure to prevent the loss of these plants through the proposed development. Prior to the translocations, Great Burnet plants occurred in two fields in the townland of Aughinish West. Meadow Barley occurred in two adjacent fields separated by a narrow ditch which formed the townland boundary between Island MacTeigue and Glenbane West. In 2005, trial translocations were carried out. Small numbers of Meadow Barley, from Island MacTeigue, and Great Burnet, from Aughinish West, were translocated to receptor areas north of the BRDA. The main translocation commenced in March 2007 with Meadow Barley plants from Glenbane West townland being translocated to a receptor site in Fawnamore. The remaining Meadow barley was translocated to the meadows north of the BRDA. All of the Great Burnet was translocated to the meadows north of the BRDA.

After the translocations were conducted, the onsite Wildlife Ranger (Mr. Liam Dundon) carried out some management for the translocated plots. Following the March 2007 translocation the plants were watered during a dry spell of weather. Some of the receptor beds at Fawnamore were being heavily grazed by rabbits in the year after the translocation. To prevent this, rabbit fencing was erected around the receptors bed during 2007. The fence was removed in autumn 2007 to facilitate winter grazing by cattle. The beds in Fawnamore were also found to be containing broad leaved dock (Rumex obtusifolius) and to control the growth of these large plants which could outcompete the Meadow Barley, they were removed by AAL staff member Liam Dundon.

Part of the long term care of these translocations was the development of a management plan. The management plan states that the meadows to the north of the BRDA are cut and bailed in late August or September to allow flower heads to go to seed.

These have been monitored on a number of occasions since 2007. In 2015, the translocations were deemed a success as both the meadow barley and Great Burnet have expanded in numbers. This success is due to the current management of these habitats. The beds are inspected weekly by Kilewee Wildlife.

Meadow Barley (Hordeum secalinum) **The Great Burnet (Sanguisorba officinalis)**

7.4 Invasive Species

7.4.1 American Mink

Introduction of the American mink species to Ireland although accidental has added to our mammalian species diversity whilst not affecting any resident species too greatly. In other European countries which had established populations of European minks the spread of the more successful American mink has directly led to that species decline.

In Ireland the effects on prey species can be damaging when minks come into contact with animals which are being captively reared such as farmed salmon, game birds and poultry. Wild populations of ground nesting birds and waterfowl will suffer increased losses if the American mink continues to spread. Smaller mammals such as bank voles and pygmy shrews may also be affected if the American mink numbers continue to increase. The Irish otter is the native species which is most directly in competition with the mink both for prey items and habitat preference, their effects on the Irish otter are not yet fully known.

The main causes of death for the American mink are from road traffic, water pollution and from wounds received by males during the mating season from other minks. As the American mink is an introduced mammal species it is not protected legally so it can be trapped to reduce its numbers if they threaten game fish or game bird populations.

American Mink have been observed at Aughinish. American Mink can become a severe problem to native bird and mammal species in high valuable habitats which exist on Aughinish Island. Kilewee Wildlife reports any mink sightings as part of its weekly monitoring program.

7.4.2 Invasive Plants

Non-native species can pose a major threat to our indigenous fauna and flora. When removed from predators, competitors, and other controls of their original environment; non-native species can become invasive and outcompete and overwhelm their new neighbours. These invasive species can cause irreversible damage to habitats.

The most wide spread invasive plants are Japanese Knotweed (Fallopia japonica), Himalayan Balsam (Impatiens glandulifera), Giant Hogweed (Heracleum mantegazzianum) and Rhododendron (Rhododendron ponticum). All these plants shed their seed into soil. This means that all soil has to be screened before arriving on site. The landscaping contractor Richard Raleigh Landscaping Limited provides this screening service before any soil is brought to site.

8.0 Objectives, targets, methodology, monitoring and reporting

Objective No.	Objective	Target	Methodology	Monitoring	Evaluation/Reporting
1	Complete 5 yearly baseline survey of small mammals	Complete survey every 5 years to demonstrate diversity and population density of species present	1. Engage Ecologist to define survey scope 2. Monitor, including via use of traps, to determine species diversity and population	Complete survey every 5 years	Engage Ecologist to develop 5 yearly report to include scope for future years
2	Control population of invasive American mink	Achieve effective control of American Mink annually	Set traps weekly and relocated every 2 weeks	Document mink count detected	Complete annual Mgt. review regarding changes required to methodology
3	Determine population of large mammals	Quantify the health of the large mammal population annually	Install 4 camera traps	Evaluate camera footage fortnightly. Log results in the Biodiversity spreadsheet.	Report to Mgt team on an annual basis and determine if further actions are required
4	Install bat roost sites	Provide opportunity for bats to roost on Aughinish within a 5 year timeframe	1. Install five bat boxes in the period 2021-2026 2. Erect appropriate signage	1. Evaluate bat boxes annually for leaks or damage. 2. Survey bat boxes twice per annum for presence of bats	Report to Mgt team on an annual basis and determine if further actions are required
5	Install hedgehog habitats	Provide opportunity for hedgehogs to overwinter on	1. Install ten hedgehog hotels in the period 2021 - 2026 2. Erect appropriate signage	Evaluate location of hedgehog hotels annually for presence of hedgehogs	Report to Mgt. team on an annual basis and determine if further actions are required.

Objective No.	Objective	Target	Methodology	Monitoring	Evaluation/Reporting
		Aughinish, within a 5 year timeframe			
6	Determine population of migratory birds	Quantify migratory bird species detected on the Island, annually.	Complete weekly surveys for migratory bird species between 1st November and 28th February annually.	Document migratory bird count detected	Report to Mgt. team on an annual basis in the form of a yearly comparison of bird species and consider external database inputs.
7	Complete upgrade of existing bird hides	Repair and enhance bird hides so they are fit for public use within a 5 year timeframe	Complete upgrade of existing bird hide (ref) in 2021-2026 as per Brady Shipman Martin recommendation.	On completion of upgrade works, evaluate bird hide condition annually to determine maintenance requirements.	Report to Mgt. team on an annual basis condition of bird hides and determine if further actions are required.
8	Install bird boxes and feeders	Provide nesting and feeding opportunities to sustain population densities of birds in Winter months. Within a 5 year timeframe.	1. Install bird boxes and feeders (with supply of bird feed) in the period 2021-2026 2. Set up camera adjacent to bird box and feeder to evaluate use 3. Erect appropriate signage 4. Clean out bird boxes each October	1. Evaluate bird boxes annually for leaks or damage. 2. Survey bird boxes twice per annum for presence of birds 3. Evaluate top up requirements for feeders	Report to Mgt. team on an annual basis use of bird boxes, feeding requirements and if further actions are required. Consider contributing data to Birdwatch Ireland garden bird counts
9	Complete recommendations from Arborists 2020 report	To improve the health and biodiversity of our woodlands	Weed suppression, species choice and improve fencing are the main recommendations from the report	John Morgan Arborist to return to site every July to evaluate woodlands	Report to Mgt team on an annual basis.

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Objective No.	Objective	Target	Methodology	Monitoring	Evaluation/Reporting
10	Participate in Dragonfly Dash	Monitor and evaluate the diversity of dragonfly and damselflies, at least annually	1. Complete 2/year at Hunts Dragonfly Lough and at Neck Trench near the Lowland Hay Meadow 2. Each year monitor the same locations twice (Jun-Sep) 3. Erect appropriate signage	1. Obtain relevant monitoring form from Biodiversity Data Centre 2. Evaluate data in context of National data	1. Report findings to National Biodiversity Centre annually 2. Report to Mgt team on an annual basis
11	Develop wildflower habitats	Create wildflower habitats within the refinery area within a 5 year timeframe	1. Develop recipe for hydroseeding with wildflower mix 2. Identify areas where hydroseeding is appropriate 3. Hydroseed 2 areas per annum 4. Erect appropriate signage	Surveys all hydroseeded areas annually	Report to Mgt team on an annual basis. Follow requirements of All Ireland Pollinator Plan.
12	Participate in the All Ireland Pollinator Plan	Develop baseline of bee diversity within 5 year timeframe	Complete monthly survey of bumblebees between April to Sept. annually	Document survey outcomes	Report to Mgt. team on an annual basis.
13	Participate in the National Butterfly monitoring scheme	Develop baseline of butterflies diversity within 5 year timeframe	Complete monthly survey of butterflies between April to Sept. annually	Document survey outcomes	Report to Mgt. team on an annual basis.
14	Develop Biodiversity training tool	Develop biodiversity video in 2021 and update annually	Develop a video which outlines how biodiversity is managed onsite	Maintain training records annually	Report to Mgt. team on an annual basis.

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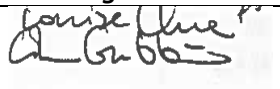
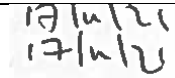
Revised by: *Seán Dundon* ***Date:*** *17/11/2021*	Env Manager Technical Manager			***Issue*** 1 ***Revision*** 1

9.0 Annual biodiversity management plan event calendar 2021

	January	Status	February	Status	March	Status
Meeting/Admin			BMP launch meeting			
Documentation	Set Targets		Take meeting minutes			
Budget	Monthly cost run		Monthly cost run		Monthly cost run	
Wildlife/ Habitat Inspections	Bi-weekly wildlife/ habitat inspections		Bi-weekly wildlife/ habitat inspections		Bi-weekly wildlife/ habitat inspections	
Mink Control			Bi-weekly trap check/log		Bi-weekly trap check/log	
Camera trap					Bi-weekly trap check/log	

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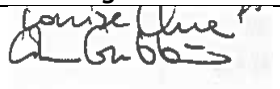
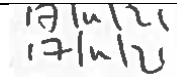
Revised by: *Seán Dundon* ***Date:*** *17/11/2021*	Env Manager Technical Manager			***Issue*** 1 ***Revision*** 1

Install/ Monitor hedgehog hotels					Install 5 hedgehog hotels	
Install/ Monitor bat boxes						
Winter bird count	Weekly bird count		Weekly bird count		Weekly bird count	
Install/ Monitor birdboxes and feeders	10 bird boxes installed		Monitor bird boxes		Monitor bird boxes	
Monitor condition of bird hides	Weekly bird hide inspection		Weekly bird hide inspection		Weekly bird hide inspection	
Woodland Management					Fence Area 3 & 5 and weed suppression	
Dragonfly Dash						
National Butterfly monitoring scheme						
All Ireland Pollinator plan						
Develop wildflower gardens			Cut grass beside plant car park		Hydroseed areas in the plant	
Other	Photos of wildlife		Photos of wildlife		Photos of wildlife	
	April	**Status**	**May**	**Status**	**June**	**Status**
Meeting/Admin			Q2 Review meeting			
Documentation			Take meeting minutes			
Budget	Monthly cost run		Monthly cost run		Monthly cost run	
Wildlife/ Habitat Inspections	Bi-weekly wildlife/ habitat inspections		Bi-weekly wildlife/ habitat inspections		Bi-weekly wildlife/ habitat inspections	
Mink Control	Bi-weekly trap check/log		Bi-weekly trap check/log		Bi-weekly trap check/log	
Camera trap	Bi-weekly trap check/log		Bi-weekly trap check/log		Bi-weekly trap check/log	
Install/ Monitor hedgehog hotels	Monitor hedgehog hotel		Monitor hedgehog hotel		Monitor hedgehog hotel	

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Install/ Monitor bat boxes	Install 2 bat boxes along nature trails		Monitor bat boxes		Monitor bat boxes	
Winter bird count						
Install/ Monitor birdboxes and feeders	Monitor bird boxes		Monitor bird boxes		Monitor bird boxes	
Monitor condition of bird hides	Weekly bird hide inspection		Weekly bird hide inspection		Weekly bird hide inspection	
Woodland Management	Weed suppression/ Cut pathways into sitka spruce		Weed suppression		Weed suppression	
Dragonfly Dash					Complete dragonfly survey at Hunts Lough	
National Butterfly monitoring scheme	Complete monthly butterfly survey in Poulaweala		Complete monthly butterfly survey in Poulaweala		Complete monthly butterfly survey in Poulaweala	
All Ireland Pollinator plan	Complete monthly bumblebee survey in Poulaweala		Complete monthly bumblebee survey in Poulaweala		Complete monthly bumblebee survey in Poulaweala	
Develop wildflower gardens	Hydroseed areas in the plant		Cut grass beside plant car park			
Other	Photos of wildlife		Photos of wildlife		Photos of wildlife	
	July	**Status**	**August**	**Status**	**September**	**Status**
Meeting/Admin			Q3 Review meeting			
Documentation			Take meeting minutes			
Budget	Monthly cost run		Monthly cost run		Monthly cost run	
Wildlife/ Habitat Inspections	Bi-weekly wildlife/ habitat inspections		Bi-weekly wildlife/ habitat inspections		Bi-weekly wildlife/ habitat inspections	
Mink Control	Bi-weekly trap check/log		Bi-weekly trap check/log		Bi-weekly trap check/log	
Camera trap	Bi-weekly trap check/log		Bi-weekly trap check/log		Bi-weekly trap check/log	
Install/ Monitor hedgehog hotels	Monitor hedgehog hotel		Monitor hedgehog hotel		Install 5 hedgehog hotels/ Monitor hedgehog hotel	

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Install/ Monitor bat boxes	Install 2 bat boxes along nature trails		Monitor bat boxes		Monitor bat boxes	
Winter bird count					Weekly bird count	
Install/ Monitor birdboxes and feeders	Monitor bird boxes		Monitor bird boxes		Monitor bird boxes	
Monitor condition of bird hides	Weekly bird hide inspection		Weekly bird hide inspection		Weekly bird hide inspection	
Woodland Management	Weed suppression/ John Morgan visit to site		Weed suppression		Weed suppression	
Dragonfly Dash					Complete dragonfly survey at Hunts Lough	
National Butterfly monitoring scheme	Complete monthly butterfly survey in Poulaweala		Complete monthly butterfly survey in Poulaweala		Complete monthly butterfly survey in Poulaweala	
All Ireland Pollinator plan	Complete monthly bumblebee survey in Poulaweala		Complete monthly bumblebee survey in Poulaweala		Complete monthly bumblebee survey in Poulaweala	
Develop wildflower gardens			Cut grass beside plant car park			
Other	Photos of wildlife		Photos of wildlife		Photos of wildlife	
	October	**Status**	**November**	**Status**	**December**	**Status**
Meeting/Admin			Q4 Review meeting		Annual Management Review	
Documentation			Take meeting minutes			
Budget	Monthly cost run		Monthly cost run		Monthly cost run	
Wildlife/ Habitat Inspections	Bi-weekly wildlife/ habitat inspections		Bi-weekly wildlife/ habitat inspections		Bi-weekly wildlife/ habitat inspections	
Mink Control	Bi-weekly trap check/log		Bi-weekly trap check/log		Bi-weekly trap check/log	
Camera trap	Bi-weekly trap check/log		Bi-weekly trap check/log		Bi-weekly trap check/log	
Install/ Monitor hedgehog hotels	Monitor hedgehog hotel		Monitor hedgehog hotel		Monitor hedgehog hotel	

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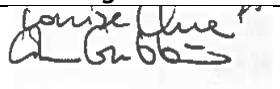
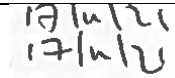
Revised by: *Seán Dundon*	Env Manager Technical Manager			***Issue*** 1
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Install/ Monitor bat boxes	**Monitor bat boxes**		**Monitor bat boxes**		**Monitor bat boxes**	
Winter bird count	**Weekly bird count**		**Weekly bird count**		**Weekly bird count**	
Install/ Monitor birdboxes and feeders	**Monitor bird boxes/ Install/Monitor feeders**		**Monitor bird boxes/feeders**		**Monitor bird boxes/feeders**	
Monitor condition of bird hides	**Weekly bird hide inspection**		**Weekly bird hide inspection**		**Weekly bird hide inspection**	
Woodland Management	**Plant and create berm along main plant road**		**Plant and create berm along main plant road**			
Dragonfly Dash						
National Butterfly monitoring scheme						
All Ireland Pollinator plan						
Develop wildflower gardens	**Cut Hydroseeding in the plant**					
Other	**Photos of wildlife**		**Photos of wildlife**		**Photos of wildlife**	

MP Event Calendar 2021

Prepared By: Seán Dundon	***Approval***			***Reference No.***
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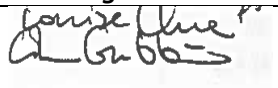
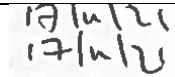
Revised by: *Seán Dundon* ***Date:*** *17/11/2021*	Env Manager Technical Manager			***Issue*** 1 ***Revision*** 1

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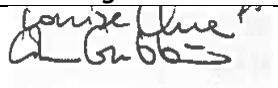
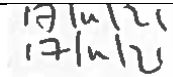
Revised by: *Seán Dundon* ***Date:*** *17/11/2021*	Env Manager Technical Manager			***Issue*** 1 ***Revision*** 1