APPENDIX 8C: ANALYSIS OF DISPLACEMENT IMPACTS ON SEABIRDS

INTRODUCTION

8.1. The presence of wind turbines has the potential to directly disturb and displace birds from within and around the optimised Seagreen Project. This in effect represents indirect habitat loss which would reduce the area available for feeding, loafing and moulting for seabird species that may occur at the optimised Seagreen Project.

8.2. This Appendix presents data to inform assessments presented in EIA Report Chapter 8 (Ornithology) and Chapter 16 (Habitats Regulations Appraisal) which determine the significance of displacement impacts. The analyses presented in this Appendix have been informed by recent guidance published jointly by the UK Statutory Nature Conservation Bodies (SNCBs) (JNCC *et al.*, 2017) and through consultation with Scottish Natural Heritage (SNH), Marine Scotland Science (MSS) and the Royal Society for the Protection of Birds (RSPB).

BACKGROUND

8.3. Many groups of seabirds exhibit species-specific behavioural responses to operational offshore wind farms. These responses generally constitute an avoidance reaction in response to rotating turbines or vessel movements. Such a response can result in indirect habitat loss as species avoid areas in which operational wind farms are present (Maclean *et al.*, 2009; Langston, 2010). The vulnerability of the species identified in Appendix 8A: Ornithology Technical Report to displacement effects is shown in Table 8.1 with this information derived from Wade *et al.* (2016) or Garthe and Hüppop (2004).

8.4. Also included in Table 8.1 is an 'uncertainty level' associated with the vulnerability scores from Wade *et al.* (2016). The uncertainty levels were defined by the quantity and quality of available data informing the respective vulnerability score.

Table 8.1 Vulnerability of species to displacement from structures (Wade *et al.*, 2016; Garthe and Hüppop, 2004) .

Species	Vulnerability	Uncertainty level (Wade *et al.*, 2016)
Kittiwake	Low	Very Low
Guillemot	High	Very low
Razorbill	High	Very low
Puffin	Moderate	Moderate

8.5. Displacement may impact bird populations by affecting site usage which may be for foraging, resting or moulting purposes. As a result of displacement an individual bird may experience a decrease in fitness, due to the effect of re-locating to alternative foraging grounds and/or changes to energy budgets due to the increased energy expenditure when avoiding a wind farm. These impacts, in turn, may have indirect effects on birds at areas that may be some distance from the wind farm including reduced energy acquisition as a result of increased competition at other foraging sites which can result in further reductions in fitness affecting reproductive success. However, due to limited empirical evidence quantifying the likely energetic consequences of displacement, SNCB advice is to consider displacement impacts in terms of direct mortality on bird populations (JNCC *et al.*, 2017).

While this advice has been followed within this Appendix it is noted that it represents an approach that is considerably precautionary.

8.6. JNCC *et al.* (2017) suggests a variety of factors can be used to determine an appropriate rate of mortality that occurs as a result of displacement. These include the defined vulnerability of seabird species to displacement in combination with habitat use flexibility. The defined habitat use flexibility of a number of species/species groups is presented, as defined by Wade *et al.* (2016) in Table 8.2.

8.7. Chapter 8 (Ornithology) and Chapter 16 (Habitats Regulations Appraisal) present further context on the assumptions relied upon when following the methodology proposed in JNCC *et al.* (2017) in particular from the results of Searle *et al.* (2014). This work presented models for certain key seabird species that were developed to estimate the population consequences of displacement (adult survival and breeding success) from the proposed Forth and Tay wind farms.

Table 8.2 Habitat use flexibility of species considered for displacement (Wade *et al.*, 2016).

Habitat use flexibility	Species / species group
Very High	None
High	Kittiwake
Medium	Guillemot, razorbill, puffin,
Low	None
Very Low	None

8.8. Following guidance in JNCC *et al.* (2017), a 2 km buffer around Project Alpha, Project Bravo and Projects Alpha and Bravo combined is applied to the assessment. Species where a 4 km buffer is considered appropriate (those with a Very High vulnerability to displacement such as divers and seaducks; Wade *et al.*, 2016) were not selected for inclusion in the analyses presented in this Appendix.

METHODOLOGY

Species for consideration

8.9. Baseline information on species that may be affected by impacts associated with the optimised Seagreen Project is documented in the Technical Report (Appendix 8A: Ornithology Technical Report). The selection of species was based entirely on advice received from Marine Scotland through the 2017 Scoping Opinion, with species being those deemed to be of concern for the originally consented Seagreen Project in 2014. Population estimates.

8.10. Project-specific data for the optimised Seagreen Project has been collected by twelve boat-based surveys undertaken between 2010 and 2012, which informed the assessment of the originally consented Seagreen Project in 2014. This data has been supplemented by six boat-based surveys through the breeding season of 2017 (April to September[1]) (see Appendix 8A: Ornithology Technical Report). The 2017 surveys followed an identical methodology in obtaining seabird abundance data as the 2010-2012 surveys, but covered the optimised Seagreen Project area, the Scalp Bank, a known important area for seabirds,

[1] April to September was the intended timing of surveys however, due to survey logistics and weather constraints surveys were not undertaken in April (replaced with a survey in early May) and September (cancelled).

and included a 2 km buffer. Population estimates calculated for the July 2017 survey were influenced by a large-scale feeding event (see Appendix 8A: Ornithology Technical Report). In order to reduce the potential for over-estimating displacement impacts, displacement matrices are presented using mean-peak populations calculated including and excluding the July 2017 population estimates. Further information on the boat-based survey programme undertaken for Seagreen and the methodologies used to derive population estimates is provided in the Appendix 8A: Ornithology Technical Report.

8.11. The primary data that informs the basis for the assessment of displacement effects are seasonal mean peak population estimates (corrected for survey coverage) including birds both on the water and in flight. Table 8.3 presents the defined season for each species as advised in guidance provided to the optimised Seagreen Project by MMS/SNH. As agreed with Marine Scotland and SNH, the densities for birds in flight have been corrected by a factor of 0.785 to allow a common currency approach with other Forth and Tay projects. As detailed In Appendix 8A: Ornithology Technical Report, there is a clear difference between the 'radial snapshot' methodology in recording aerial densities of birds applied to the baseline boat-based surveys at Seagreen, compared to the more widespread 'box method' applied elsewhere.

Table 8.3 Seasonal definitions for each species assessed.

Species	Breeding	Post-breeding	Non-breeding	Pre-breeding
Kittiwake	(Apr – Aug)	(Sep – Dec)		(Jan – Mar)
Guillemot	(Apr – Aug)		(Sep – Mar)	
Razorbill	(Apr – Aug)		(Sep – Mar)	
Puffin	(Apr – Aug)		(Sep – Mar)	

8.12. For those species identified for displacement assessment, a 2 km buffer is considered appropriate to inform the analysis. Mean peak estimates have been derived using all data available – i.e. an estimate has been selected by referring to both the 2010 – 2012 and 2017 datasets where they are available for a given season for a species. Data within a 2 km buffer around the optimised Seagreen Project was only collected as part of the 2017 survey programme. An approach, agreed with Marine Scotland and SNH, was adopted using scaling factors calculated using the densities recorded in 2017, which were applied to the 2009-2011 data. A full description of this approach is provided in Section 3.2 of Appendix 8A: Ornithology Technical Report. Analyses have been undertaken for Project Alpha and Project Bravo alone in addition to Projects Alpha and Bravo combined with the seasonal mean-peak populations for each area presented in Table 8.4. Breeding season mean-peak populations excluding July 2017 are presented in Table 8.5 (see Chapter 8: Offshore Ornithology and Appendix 8A: Ornithology Technical Report for explanation as to why these data have been excluded).

Table 8.4 Seasonal mean-peak population estimates for species under consideration.

Species	Breeding	Post-breeding	Non-breeding	Pre-breeding
Project Alpha				
Kittiwake	7,213	3,184		1,112

Species	Breeding	Post-breeding	Non-breeding	Pre-breeding
Guillemot	13,606		4,688	
Razorbill	5,876		1,003	
Puffin	2,572		1,526	
Project Bravo				
Kittiwake	4,159	1,342		941
Guillemot	11,118		4,112	
Razorbill	3,698		1,272	
Puffin	3,582		3,863	
Projects Alpha and Bravo combined				
Kittiwake	9,980	4,598		1,966
Guillemot	22,074		8,949	
Razorbill	8,324		2,105	
Puffin	5,634		5,259	

Table 8.5 Breeding season mean-peak population estimates for species under consideration excluding July 2017.

Species	Project Alpha	Project Bravo	Projects Alpha and Bravo combined
Kittiwake	2,884	2,157	4,538
Guillemot	9,129	6,810	15,104
Razorbill	3,221	1,442	4,282
Puffin	2,572	3,582	5,634

Displacement and mortality rates

8.13. Displacement matrices are presented below for each species and associated seasons. Potential displacement impacts for each species are presented here based on a wide range of potential displacement (0-100%) and mortality rates (0-100%) following recent SNCB advice (JNCC *et al.*, 2017).

8.14. Based on the Scoping Opinion and subsequent consultation for the optimised Seagreen Project (Marine Scotland, 2017), a 30% displacement rate was assumed for kittiwake.

8.15. Monitoring studies have often recorded auks inside of wind farm areas and on the basis of the information presented in Chapter 8: Ornithology, a displacement value of 50% has been used for guillemots informed by the observations of Vanerman *et al.* (2016, 2017) and

Nelson *et al.* (2015) in particular. Razorbill is suggested to have a lower vulnerability to displacement impacts than guillemot (see studies summarised in Chapter 8: Ornithology), especially when considering the results obtained at Thortonbank (Vanerman *et al.*, 2017), Blighbank (Vanerman *et al.*, 2016) and Robin Rigg (Nelson *et al.*, 2015) which all show lower displacement rates than those calculated for guillemot. As such, a displacement rate of 40% is considered appropriate for razorbill.

8.16. There have been few studies which have included puffin as a separate species to assess displacement rates, with the majority combining all auks together. For assessment purposes, a displacement value of 50% during the breeding and non-breeding seasons is considered appropriate for puffin, based on the rationale described for razorbill, but with an added degree of precaution due to a lower level of empirical evidence.

8.17. The displacement rates identified for the three auk species are presented in addition to a 60% rate advised on all auk species for Forth and Tay projects by Marine Scotland (e.g. Marine Scotland, 2017).

8.18. The mortality rates advised by Marine Scotland in their Scoping Opinion for Seagreen (Marine Scotland, 2017) are followed for the purposes of the Seagreen assessment (i.e. 1% for guillemot and razorbill; 2% for puffin and kittiwake).

8.19. The displacement and mortality rates used for each species for which displacement analyses have been conducted are presented in Table 8.6.

Table 8.6 Displacement and mortality rates applied for each species

Species	Displacement rate(s) (%)	Mortality rate (%)
Kittiwake	30	2
Guillemot	50-60	1
Razorbill	40-60	1
Puffin	50-60	2

8.20. In Chapter 8: Ornithology the degree of change predicted to occur at the population level for a species is further explored by comparing the predicted displacement mortality to the relevant 1% threshold of background mortality for each species. This approach is consistent with other contemporaneous assessments of offshore wind farm projects (e.g. Hornsea Project Two). As such, each matrix in the following species-specific sections is shaded to indicate where the displacement mortality surpasses the 1% threshold of background mortality of the relevant regional or national population for each species. The relevant population against which displacement mortality is compared and the background mortality for each species (inverse of adult survival from Horswill and Robinson (2015)) are presented in each matrix.

RESULTS

Kittiwake

Table 8.7 Predicted kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	7	14	36	72	144	216	289	361	433	505	577	649	721
20	14	29	72	144	289	433	577	721	866	1010	1154	1298	1443
30	22	43	108	216	433	649	866	1082	1298	1515	1731	1947	2164
40	29	58	144	289	577	866	1154	1443	1731	2020	2308	2597	2885
50	36	72	180	361	721	1082	1443	1803	2164	2524	2885	3246	3606
60	43	87	216	433	866	1298	1731	2164	2597	3029	3462	3895	4328
70	50	101	252	505	1010	1515	2020	2524	3029	3534	4039	4544	5049
80	58	115	289	577	1154	1731	2308	2885	3462	4039	4616	5193	5770
90	65	130	325	649	1298	1947	2597	3246	3895	4544	5193	5842	6491
100	72	144	361	721	1443	2164	2885	3606	4328	5049	5770	6491	7213

Regional population = 77,664 breeding adults
Background mortality = 0.146

< 1% background mortality

> 1% background mortality

Table 8.8 Predicted kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer during the post-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	3	6	16	32	64	96	127	159	191	223	255	287	318
20	6	13	32	64	127	191	255	318	382	446	509	573	637
30	10	19	48	96	191	287	382	478	573	669	764	860	955
40	13	25	64	127	255	382	509	637	764	891	1019	1146	1274
50	16	32	80	159	318	478	637	796	955	1114	1274	1433	1592
60	19	38	96	191	382	573	764	955	1146	1337	1528	1719	1910
70	22	45	111	223	446	669	891	1114	1337	1560	1783	2006	2229
80	25	51	127	255	509	764	1019	1274	1528	1783	2038	2292	2547
90	29	57	143	287	573	860	1146	1433	1719	2006	2292	2579	2865
100	32	64	159	318	637	955	1274	1592	1910	2229	2547	2865	3184

Regional population = 829,937 individuals
Background mortality = 0.146

< 1% background mortality

> 1% background mortality

Table 8.9 Predicted kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer during the pre-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	6	11	22	33	44	56	67	78	89	100	111
20	2	4	11	22	44	67	89	111	133	156	178	200	222
30	3	7	17	33	67	100	133	167	200	233	267	300	333
40	4	9	22	44	89	133	178	222	267	311	356	400	445
50	6	11	28	56	111	167	222	278	333	389	445	500	556
60	7	13	33	67	133	200	267	333	400	467	534	600	667
70	8	16	39	78	156	233	311	389	467	545	623	700	778
80	9	18	44	89	178	267	356	445	534	623	711	800	889
90	10	20	50	100	200	300	400	500	600	700	800	900	1000
100	11	22	56	111	222	333	445	556	667	778	889	1000	1112

Regional population = 627,816 individuals
Background mortality = 0.146

< 1% background mortality

> 1% background mortality

Table 8.10 Predicted kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	8	21	42	83	125	166	208	250	291	333	374	416
20	8	17	42	83	166	250	333	416	499	582	665	749	832
30	12	25	62	125	250	374	499	624	749	873	998	1123	1248
40	17	33	83	166	333	499	665	832	998	1164	1331	1497	1663
50	21	42	104	208	416	624	832	1040	1248	1456	1663	1871	2079
60	25	50	125	250	499	749	998	1248	1497	1747	1996	2246	2495
70	29	58	146	291	582	873	1164	1456	1747	2038	2329	2620	2911
80	33	67	166	333	665	998	1331	1663	1996	2329	2662	2994	3327
90	37	75	187	374	749	1123	1497	1871	2246	2620	2994	3369	3743
100	42	83	208	416	832	1248	1663	2079	2495	2911	3327	3743	4159

Regional population = 77,664 breeding adults
Background mortality = 0.146

< 1% background mortality

> 1% background mortality

Table 8.11 Predicted kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer during the post-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	3	7	13	27	40	54	67	81	94	107	121	134
20	3	5	13	27	54	81	107	134	161	188	215	242	268
30	4	8	20	40	81	121	161	201	242	282	322	362	403
40	5	11	27	54	107	161	215	268	322	376	429	483	537
50	7	13	34	67	134	201	268	336	403	470	537	604	671
60	8	16	40	81	161	242	322	403	483	564	644	725	805
70	9	19	47	94	188	282	376	470	564	658	752	846	940
80	11	21	54	107	215	322	429	537	644	752	859	966	1074
90	12	24	60	121	242	362	483	604	725	846	966	1087	1208
100	13	27	67	134	268	403	537	671	805	940	1074	1208	1342

Regional population = 829,937 individuals
Background mortality = 0.146

< 1% background mortality

> 1% background mortality

Table 8.12 Predicted kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer during the pre-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	5	9	19	28	38	47	56	66	75	85	94
20	2	4	9	19	38	56	75	94	113	132	151	169	188
30	3	6	14	28	56	85	113	141	169	198	226	254	282
40	4	8	19	38	75	113	151	188	226	263	301	339	376
50	5	9	24	47	94	141	188	235	282	329	376	423	470
60	6	11	28	56	113	169	226	282	339	395	452	508	564
70	7	13	33	66	132	198	263	329	395	461	527	593	658
80	8	15	38	75	151	226	301	376	452	527	602	677	753
90	8	17	42	85	169	254	339	423	508	593	677	762	847
100	9	19	47	94	188	282	376	470	564	658	753	847	941

Regional population = 627,816 individuals
Background mortality = 0.146

< 1% background mortality

> 1% background mortality

Table 8.13 Predicted kittiwake mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	10	20	50	100	200	299	399	499	599	699	798	898	998
20	20	40	100	200	399	599	798	998	1198	1397	1597	1796	1996
30	30	60	150	299	599	898	1198	1497	1796	2096	2395	2695	2994
40	40	80	200	399	798	1198	1597	1996	2395	2794	3194	3593	3992
50	50	100	250	499	998	1497	1996	2495	2994	3493	3992	4491	4990
60	60	120	299	599	1198	1796	2395	2994	3593	4192	4790	5389	5988
70	70	140	349	699	1397	2096	2794	3493	4192	4890	5589	6287	6986
80	80	160	399	798	1597	2395	3194	3992	4790	5589	6387	7186	7984
90	90	180	449	898	1796	2695	3593	4491	5389	6287	7186	8084	8982
100	100	200	499	998	1996	2994	3992	4990	5988	6986	7984	8982	9980

Regional population = 77,664 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.14 Predicted kittiwake mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the post-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	5	9	23	46	92	138	184	230	276	322	368	414	460
20	9	18	46	92	184	276	368	460	552	644	736	828	920
30	14	28	69	138	276	414	552	690	828	966	1104	1242	1380
40	18	37	92	184	368	552	736	920	1104	1288	1472	1655	1839
50	23	46	115	230	460	690	920	1150	1380	1609	1839	2069	2299
60	28	55	138	276	552	828	1104	1380	1655	1931	2207	2483	2759
70	32	64	161	322	644	966	1288	1609	1931	2253	2575	2897	3219
80	37	74	184	368	736	1104	1472	1839	2207	2575	2943	3311	3679
90	41	83	207	414	828	1242	1655	2069	2483	2897	3311	3725	4139
100	46	92	230	460	920	1380	1839	2299	2759	3219	3679	4139	4598

Regional population = 829,937 individuals Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.15 Predicted kittiwake mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the pre-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	2	4	10	20	39	59	79	98	118	138	157	177	197
20	4	8	20	39	79	118	157	197	236	275	315	354	393
30	6	12	29	59	118	177	236	295	354	413	472	531	590
40	8	16	39	79	157	236	315	393	472	551	629	708	786
50	10	20	49	98	197	295	393	492	590	688	786	885	983
60	12	24	59	118	236	354	472	590	708	826	944	1062	1180
70	14	28	69	138	275	413	551	688	826	963	1101	1239	1376
80	16	31	79	157	315	472	629	786	944	1101	1258	1416	1573
90	18	35	88	177	354	531	708	885	1062	1239	1416	1593	1770
100	20	39	98	197	393	590	786	983	1180	1376	1573	1770	1966

Regional population = 627,816 individuals Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.16 Predicted guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	14	27	68	136	272	408	544	680	816	952	1088	1225	1361
20	27	54	136	272	544	816	1088	1361	1633	1905	2177	2449	2721
30	41	82	204	408	816	1225	1633	2041	2449	2857	3265	3674	4082
40	54	109	272	544	1088	1633	2177	2721	3265	3810	4354	4898	5442
50	68	136	340	680	1361	2041	2721	3401	4082	4762	5442	6123	6803
60	82	163	408	816	1633	2449	3265	4082	4898	5714	6531	7347	8163
70	95	190	476	952	1905	2857	3810	4762	5714	6667	7619	8572	9524
80	109	218	544	1088	2177	3265	4354	5442	6531	7619	8708	9796	10885
90	122	245	612	1225	2449	3674	4898	6123	7347	8572	9796	11021	12245
100	136	272	680	1361	2721	4082	5442	6803	8163	9524	10885	12245	13606

Regional population = 219,623 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.17 Predicted guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer during the non-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	5	9	23	47	94	141	188	234	281	328	375	422	469
20	9	19	47	94	188	281	375	469	563	656	750	844	938
30	14	28	70	141	281	422	563	703	844	985	1125	1266	1407
40	19	38	94	188	375	563	750	938	1125	1313	1500	1688	1875
50	23	47	117	234	469	703	938	1172	1407	1641	1875	2110	2344
60	28	56	141	281	563	844	1125	1407	1688	1969	2250	2532	2813
70	33	66	164	328	656	985	1313	1641	1969	2297	2626	2954	3282
80	38	75	188	375	750	1125	1500	1875	2250	2626	3001	3376	3751
90	42	84	211	422	844	1266	1688	2110	2532	2954	3376	3798	4220
100	47	94	234	469	938	1407	1875	2344	2813	3282	3751	4220	4688

Regional population = 1,617,306 individuals
Background mortality = 0.061

< 1% background mortality

> 1% background mortality

Table 8.18 Predicted guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	11	22	56	111	222	334	445	556	667	778	889	1001	1112
20	22	44	111	222	445	667	889	1112	1334	1557	1779	2001	2224
30	33	67	167	334	667	1001	1334	1668	2001	2335	2668	3002	3335
40	44	89	222	445	889	1334	1779	2224	2668	3113	3558	4002	4447
50	56	111	278	556	1112	1668	2224	2779	3335	3891	4447	5003	5559
60	67	133	334	667	1334	2001	2668	3335	4002	4670	5337	6004	6671
70	78	156	389	778	1557	2335	3113	3891	4670	5448	6226	7004	7783
80	89	178	445	889	1779	2668	3558	4447	5337	6226	7115	8005	8894
90	100	200	500	1001	2001	3002	4002	5003	6004	7004	8005	9006	10006
100	111	222	556	1112	2224	3335	4447	5559	6671	7783	8894	10006	11118

Regional population = 219,623 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.19 Predicted guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer during the non-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	8	21	41	82	123	164	206	247	288	329	370	411
20	8	16	41	82	164	247	329	411	493	576	658	740	822
30	12	25	62	123	247	370	493	617	740	864	987	1110	1234
40	16	33	82	164	329	493	658	822	987	1151	1316	1480	1645
50	21	41	103	206	411	617	822	1028	1234	1439	1645	1851	2056
60	25	49	123	247	493	740	987	1234	1480	1727	1974	2221	2467
70	29	58	144	288	576	864	1151	1439	1727	2015	2303	2591	2879
80	33	66	164	329	658	987	1316	1645	1974	2303	2632	2961	3290
90	37	74	185	370	740	1110	1480	1851	2221	2591	2961	3331	3701
100	41	82	206	411	822	1234	1645	2056	2467	2879	3290	3701	4112

Regional population = 1,617,306 individuals
Background mortality = 0.061

< 1% background mortality

> 1% background mortality

Table 8.20 Predicted guillemot mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	22	44	110	221	441	662	883	1104	1324	1545	1766	1987	2207
20	44	88	221	441	883	1324	1766	2207	2649	3090	3532	3973	4415
30	66	132	331	662	1324	1987	2649	3311	3973	4636	5298	5960	6622
40	88	177	441	883	1766	2649	3532	4415	5298	6181	7064	7947	8830
50	110	221	552	1104	2207	3311	4415	5519	6622	7726	8830	9933	11037
60	132	265	662	1324	2649	3973	5298	6622	7947	9271	10596	11920	13245
70	155	309	773	1545	3090	4636	6181	7726	9271	10816	12362	13907	15452
80	177	353	883	1766	3532	5298	7064	8830	10596	12362	14128	15893	17659
90	199	397	993	1987	3973	5960	7947	9933	11920	13907	15893	17880	19867
100	221	441	1104	2207	4415	6622	8830	11037	13245	15452	17659	19867	22074

Regional population = 219,623 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.21 Predicted guillemot mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the non-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	9	18	45	89	179	268	358	447	537	626	716	805	895
20	18	36	89	179	358	537	716	895	1074	1253	1432	1611	1790
30	27	54	134	268	537	805	1074	1342	1611	1879	2148	2416	2685
40	36	72	179	358	716	1074	1432	1790	2148	2506	2864	3222	3580
50	45	89	224	447	895	1342	1790	2237	2685	3132	3580	4027	4475
60	54	107	268	537	1074	1611	2148	2685	3222	3759	4296	4833	5370
70	63	125	313	626	1253	1879	2506	3132	3759	4385	5012	5638	6265
80	72	143	358	716	1432	2148	2864	3580	4296	5012	5728	6444	7160
90	81	161	403	805	1611	2416	3222	4027	4833	5638	6444	7249	8055
100	89	179	447	895	1790	2685	3580	4475	5370	6265	7160	8055	8949

Regional population = 1,617,306 individuals Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Razorbill

Table 8.22 Predicted razorbill mortality as a result of displacement from Project Alpha plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	6	12	29	59	118	176	235	294	353	411	470	529	588
20	12	24	59	118	235	353	470	588	705	823	940	1058	1175
30	18	35	88	176	353	529	705	881	1058	1234	1410	1586	1763
40	24	47	118	235	470	705	940	1175	1410	1645	1880	2115	2350
50	29	59	147	294	588	881	1175	1469	1763	2056	2350	2644	2938
60	35	71	176	353	705	1058	1410	1763	2115	2468	2820	3173	3525
70	41	82	206	411	823	1234	1645	2056	2468	2879	3290	3702	4113
80	47	94	235	470	940	1410	1880	2350	2820	3290	3760	4230	4700
90	53	106	264	529	1058	1586	2115	2644	3173	3702	4230	4759	5288
100	59	118	294	588	1175	1763	2350	2938	3525	4113	4700	5288	5876

Regional population = 41,009 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.23 Predicted razorbill mortality as a result of displacement from Project Alpha plus a 2 km buffer during the non-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	5	10	20	30	40	50	60	70	80	90	100
20	2	4	10	20	40	60	80	100	120	140	160	181	201
30	3	6	15	30	60	90	120	150	181	211	241	271	301
40	4	8	20	40	80	120	160	201	241	281	321	361	401
50	5	10	25	50	100	150	201	251	301	351	401	451	501
60	6	12	30	60	120	181	241	301	361	421	481	542	602
70	7	14	35	70	140	211	281	351	421	491	562	632	702
80	8	16	40	80	160	241	321	401	481	562	642	722	802
90	9	18	45	90	181	271	361	451	542	632	722	812	903
100	10	20	50	100	201	301	401	501	602	702	802	903	1003

Regional population = 218,622 individuals Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.24 Predicted razorbill mortality as a result of displacement from Project Bravo plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	7	18	37	74	111	148	185	222	259	296	333	370
20	7	15	37	74	148	222	296	370	444	518	592	666	740
30	11	22	55	111	222	333	444	555	666	776	887	998	1109
40	15	30	74	148	296	444	592	740	887	1035	1183	1331	1479
50	18	37	92	185	370	555	740	924	1109	1294	1479	1664	1849
60	22	44	111	222	444	666	887	1109	1331	1553	1775	1997	2219
70	26	52	129	259	518	776	1035	1294	1553	1812	2071	2329	2588
80	30	59	148	296	592	887	1183	1479	1775	2071	2366	2662	2958
90	33	67	166	333	666	998	1331	1664	1997	2329	2662	2995	3328
100	37	74	185	370	740	1109	1479	1849	2219	2588	2958	3328	3698

Regional population = 41,009 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.25 Predicted razorbill mortality as a result of displacement from Project Bravo plus a 2 km buffer during the non-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	3	6	13	25	38	51	64	76	89	102	114	127
20	3	5	13	25	51	76	102	127	153	178	203	229	254
30	4	8	19	38	76	114	153	191	229	267	305	343	382
40	5	10	25	51	102	153	203	254	305	356	407	458	509
50	6	13	32	64	127	191	254	318	382	445	509	572	636
60	8	15	38	76	153	229	305	382	458	534	610	687	763
70	9	18	45	89	178	267	356	445	534	623	712	801	890
80	10	20	51	102	203	305	407	509	610	712	814	916	1017
90	11	23	57	114	229	343	458	572	687	801	916	1030	1145
100	13	25	64	127	254	382	509	636	763	890	1017	1145	1272

Regional population = 218,622 individuals
Background mortality = 0.105

< 1% background mortality

> 1% background mortality

Table 8.26 Predicted razorbill mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	8	17	42	83	166	250	333	416	499	583	666	749	832
20	17	33	83	166	333	499	666	832	999	1165	1332	1498	1665
30	25	50	125	250	499	749	999	1249	1498	1748	1998	2247	2497
40	33	67	166	333	666	999	1332	1665	1998	2331	2664	2997	3330
50	42	83	208	416	832	1249	1665	2081	2497	2913	3330	3746	4162
60	50	100	250	499	999	1498	1998	2497	2997	3496	3995	4495	4994
70	58	117	291	583	1165	1748	2331	2913	3496	4079	4661	5244	5827
80	67	133	333	666	1332	1998	2664	3330	3995	4661	5327	5993	6659
90	75	150	375	749	1498	2247	2997	3746	4495	5244	5993	6742	7491
100	83	166	416	832	1665	2497	3330	4162	4994	5827	6659	7491	8324

Regional population = 41,009 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.27 Predicted razorbill mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the non-breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	2	4	11	21	42	63	84	105	126	147	168	189	210
20	4	8	21	42	84	126	168	210	253	295	337	379	421
30	6	13	32	63	126	189	253	316	379	442	505	568	631
40	8	17	42	84	168	253	337	421	505	589	674	758	842
50	11	21	53	105	210	316	421	526	631	737	842	947	1052
60	13	25	63	126	253	379	505	631	758	884	1010	1137	1263
70	15	29	74	147	295	442	589	737	884	1031	1179	1326	1473
80	17	34	84	168	337	505	674	842	1010	1179	1347	1515	1684
90	19	38	95	189	379	568	758	947	1137	1326	1515	1705	1894
100	21	42	105	210	421	631	842	1052	1263	1473	1684	1894	2105

Regional population = 218,622 individuals Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Puffin

Table 8.28 Predicted puffin mortality as a result of displacement from Project Alpha plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	3	5	13	26	51	77	103	129	154	180	206	232	257
20	5	10	26	51	103	154	206	257	309	360	412	463	514
30	8	15	39	77	154	232	309	386	463	540	617	695	772
40	10	21	51	103	206	309	412	514	617	720	823	926	1029
50	13	26	64	129	257	386	514	643	772	900	1029	1158	1286
60	15	31	77	154	309	463	617	772	926	1080	1235	1389	1543
70	18	36	90	180	360	540	720	900	1080	1261	1441	1621	1801
80	21	41	103	206	412	617	823	1029	1235	1441	1646	1852	2058
90	23	46	116	232	463	695	926	1158	1389	1621	1852	2084	2315
100	26	51	129	257	514	772	1029	1286	1543	1801	2058	2315	2572

Regional population = 373,138 individuals
Background mortality = 0.094

< 1% background mortality

> 1% background mortality

Table 8.29 Predicted puffin mortality as a result of displacement from Project Bravo plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	7	18	36	72	107	143	179	215	251	287	322	358
20	7	14	36	72	143	215	287	358	430	501	573	645	716
30	11	21	54	107	215	322	430	537	645	752	860	967	1075
40	14	29	72	143	287	430	573	716	860	1003	1146	1290	1433
50	18	36	90	179	358	537	716	895	1075	1254	1433	1612	1791
60	21	43	107	215	430	645	860	1075	1290	1504	1719	1934	2149
70	25	50	125	251	501	752	1003	1254	1504	1755	2006	2257	2507
80	29	57	143	287	573	860	1146	1433	1719	2006	2292	2579	2866
90	32	64	161	322	645	967	1290	1612	1934	2257	2579	2901	3224
100	36	72	179	358	716	1075	1433	1791	2149	2507	2866	3224	3582

Regional population = 373,138 individuals
Background mortality = 0.094

< 1% background mortality

> 1% background mortality

Table 8.30 Predicted puffin mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	6	11	28	56	113	169	225	282	338	394	451	507	563
20	11	23	56	113	225	338	451	563	676	789	901	1014	1127
30	17	34	85	169	338	507	676	845	1014	1183	1352	1521	1690
40	23	45	113	225	451	676	901	1127	1352	1577	1803	2028	2253
50	28	56	141	282	563	845	1127	1408	1690	1972	2253	2535	2817
60	34	68	169	338	676	1014	1352	1690	2028	2366	2704	3042	3380
70	39	79	197	394	789	1183	1577	1972	2366	2760	3155	3549	3944
80	45	90	225	451	901	1352	1803	2253	2704	3155	3606	4056	4507
90	51	101	254	507	1014	1521	2028	2535	3042	3549	4056	4563	5070
100	56	113	282	563	1127	1690	2253	2817	3380	3944	4507	5070	5634

Regional population = 373,138 individuals Background mortality = 0.094		< 1% background mortality		> 1% background mortality

RESULTS – EXCLUDING DATA FROM JULY 2017

Kittiwake

Table 8.31 Predicted kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	3	6	14	29	58	87	115	144	173	202	231	260	288
20	6	12	29	58	115	173	231	288	346	404	461	519	577
30	9	17	43	87	173	260	346	433	519	606	692	779	865
40	12	23	58	115	231	346	461	577	692	807	923	1038	1153
50	14	29	72	144	288	433	577	721	865	1009	1153	1298	1442
60	17	35	87	173	346	519	692	865	1038	1211	1384	1557	1730
70	20	40	101	202	404	606	807	1009	1211	1413	1615	1817	2019
80	23	46	115	231	461	692	923	1153	1384	1615	1845	2076	2307
90	26	52	130	260	519	779	1038	1298	1557	1817	2076	2336	2595
100	29	58	144	288	577	865	1153	1442	1730	2019	2307	2595	2884

Regional population = 77,664 breeding adults
Background mortality = 0.146

< 1% background mortality

> 1% background mortality

Table 8.32 Predicted kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	2	4	11	22	43	65	86	108	129	151	173	194	216
20	4	9	22	43	86	129	173	216	259	302	345	388	431
30	6	13	32	65	129	194	259	324	388	453	518	582	647
40	9	17	43	86	173	259	345	431	518	604	690	777	863
50	11	22	54	108	216	324	431	539	647	755	863	971	1079
60	13	26	65	129	259	388	518	647	777	906	1035	1165	1294
70	15	30	75	151	302	453	604	755	906	1057	1208	1359	1510
80	17	35	86	173	345	518	690	863	1035	1208	1381	1553	1726
90	19	39	97	194	388	582	777	971	1165	1359	1553	1747	1941
100	22	43	108	216	431	647	863	1079	1294	1510	1726	1941	2157

Regional population = 77,664 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.33 Predicted kittiwake mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	5	9	23	45	91	136	182	227	272	318	363	408	454
20	9	18	45	91	182	272	363	454	545	635	726	817	908
30	14	27	68	136	272	408	545	681	817	953	1089	1225	1361
40	18	36	91	182	363	545	726	908	1089	1271	1452	1634	1815
50	23	45	113	227	454	681	908	1134	1361	1588	1815	2042	2269
60	27	54	136	272	545	817	1089	1361	1634	1906	2178	2450	2723
70	32	64	159	318	635	953	1271	1588	1906	2223	2541	2859	3176
80	36	73	182	363	726	1089	1452	1815	2178	2541	2904	3267	3630
90	41	82	204	408	817	1225	1634	2042	2450	2859	3267	3676	4084
100	45	91	227	454	908	1361	1815	2269	2723	3176	3630	4084	4538

Regional population = 77,664 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.34 Predicted guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	9	18	46	91	183	274	365	456	548	639	730	822	913
20	18	37	91	183	365	548	730	913	1095	1278	1461	1643	1826
30	27	55	137	274	548	822	1095	1369	1643	1917	2191	2465	2739
40	37	73	183	365	730	1095	1461	1826	2191	2556	2921	3286	3652
50	46	91	228	456	913	1369	1826	2282	2739	3195	3652	4108	4564
60	55	110	274	548	1095	1643	2191	2739	3286	3834	4382	4930	5477
70	64	128	320	639	1278	1917	2556	3195	3834	4473	5112	5751	6390
80	73	146	365	730	1461	2191	2921	3652	4382	5112	5842	6573	7303
90	82	164	411	822	1643	2465	3286	4108	4930	5751	6573	7394	8216
100	91	183	456	913	1826	2739	3652	4564	5477	6390	7303	8216	9129

Regional population = 219,623 breeding adults
Background mortality = 0.061

< 1% background mortality

> 1% background mortality

Table 8.35 Predicted guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	7	14	34	68	136	204	272	340	409	477	545	613	681
20	14	27	68	136	272	409	545	681	817	953	1090	1226	1362
30	20	41	102	204	409	613	817	1021	1226	1430	1634	1839	2043
40	27	54	136	272	545	817	1090	1362	1634	1907	2179	2452	2724
50	34	68	170	340	681	1021	1362	1702	2043	2383	2724	3064	3405
60	41	82	204	409	817	1226	1634	2043	2452	2860	3269	3677	4086
70	48	95	238	477	953	1430	1907	2383	2860	3337	3814	4290	4767
80	54	109	272	545	1090	1634	2179	2724	3269	3814	4358	4903	5448
90	61	123	306	613	1226	1839	2452	3064	3677	4290	4903	5516	6129
100	68	136	340	681	1362	2043	2724	3405	4086	4767	5448	6129	6810

Regional population = 219,623 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.36 Predicted guillemot mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	15	30	76	151	302	453	604	755	906	1057	1208	1359	1510
20	30	60	151	302	604	906	1208	1510	1812	2115	2417	2719	3021
30	45	91	227	453	906	1359	1812	2266	2719	3172	3625	4078	4531
40	60	121	302	604	1208	1812	2417	3021	3625	4229	4833	5437	6042
50	76	151	378	755	1510	2266	3021	3776	4531	5286	6042	6797	7552
60	91	181	453	906	1812	2719	3625	4531	5437	6344	7250	8156	9062
70	106	211	529	1057	2115	3172	4229	5286	6344	7401	8458	9515	10573
80	121	242	604	1208	2417	3625	4833	6042	7250	8458	9666	10875	12083
90	136	272	680	1359	2719	4078	5437	6797	8156	9515	10875	12234	13593
100	151	302	755	1510	3021	4531	6042	7552	9062	10573	12083	13593	15104

Regional population = 219,623 breeding adults
Background mortality = 0.061

< 1% background mortality

> 1% background mortality

Razorbill

Table 8.37 Predicted razorbill mortality as a result of displacement from Project Alpha plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	3	6	16	32	64	97	129	161	193	225	258	290	322
20	6	13	32	64	129	193	258	322	386	451	515	580	644
30	10	19	48	97	193	290	386	483	580	676	773	870	966
40	13	26	64	129	258	386	515	644	773	902	1031	1159	1288
50	16	32	81	161	322	483	644	805	966	1127	1288	1449	1610
60	19	39	97	193	386	580	773	966	1159	1353	1546	1739	1932
70	23	45	113	225	451	676	902	1127	1353	1578	1803	2029	2254
80	26	52	129	258	515	773	1031	1288	1546	1803	2061	2319	2576
90	29	58	145	290	580	870	1159	1449	1739	2029	2319	2609	2898
100	32	64	161	322	644	966	1288	1610	1932	2254	2576	2898	3221

Regional population = 41,009 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.38 Predicted razorbill mortality as a result of displacement from Project Bravo plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	3	7	14	29	43	58	72	86	101	115	130	144
20	3	6	14	29	58	86	115	144	173	202	231	259	288
30	4	9	22	43	86	130	173	216	259	303	346	389	432
40	6	12	29	58	115	173	231	288	346	404	461	519	577
50	7	14	36	72	144	216	288	360	432	505	577	649	721
60	9	17	43	86	173	259	346	432	519	605	692	778	865
70	10	20	50	101	202	303	404	505	605	706	807	908	1009
80	12	23	58	115	231	346	461	577	692	807	923	1038	1153
90	13	26	65	130	259	389	519	649	778	908	1038	1168	1297
100	14	29	72	144	288	432	577	721	865	1009	1153	1297	1442

Regional population = 41,009 breeding adults
Background mortality = 0.105

< 1% background mortality

> 1% background mortality

Table 8.39 Predicted razorbill mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	9	21	43	86	128	171	214	257	300	343	385	428
20	9	17	43	86	171	257	343	428	514	599	685	771	856
30	13	26	64	128	257	385	514	642	771	899	1028	1156	1285
40	17	34	86	171	343	514	685	856	1028	1199	1370	1541	1713
50	21	43	107	214	428	642	856	1070	1285	1499	1713	1927	2141
60	26	51	128	257	514	771	1028	1285	1541	1798	2055	2312	2569
70	30	60	150	300	599	899	1199	1499	1798	2098	2398	2697	2997
80	34	69	171	343	685	1028	1370	1713	2055	2398	2740	3083	3425
90	39	77	193	385	771	1156	1541	1927	2312	2697	3083	3468	3854
100	43	86	214	428	856	1285	1713	2141	2569	2997	3425	3854	4282

Regional population = 41,009 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Puffin

Table 8.40 Predicted puffin mortality as a result of displacement from Project Alpha plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	3	5	13	26	51	77	103	129	154	180	206	232	257
20	5	10	26	51	103	154	206	257	309	360	412	463	514
30	8	15	39	77	154	232	309	386	463	540	617	695	772
40	10	21	51	103	206	309	412	514	617	720	823	926	1029
50	13	26	64	129	257	386	514	643	772	900	1029	1158	1286
60	15	31	77	154	309	463	617	772	926	1080	1235	1389	1543
70	18	36	90	180	360	540	720	900	1080	1261	1441	1621	1801
80	21	41	103	206	412	617	823	1029	1235	1441	1646	1852	2058
90	23	46	116	232	463	695	926	1158	1389	1621	1852	2084	2315
100	26	51	129	257	514	772	1029	1286	1543	1801	2058	2315	2572

Regional population = 373,138 individuals
Background mortality = 0.094

< 1% background mortality

> 1% background mortality

Table 8.41 Predicted puffin mortality as a result of displacement from Project Bravo plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	7	18	36	72	107	143	179	215	251	287	322	358
20	7	14	36	72	143	215	287	358	430	501	573	645	716
30	11	21	54	107	215	322	430	537	645	752	860	967	1075
40	14	29	72	143	287	430	573	716	860	1003	1146	1290	1433
50	18	36	90	179	358	537	716	895	1075	1254	1433	1612	1791
60	21	43	107	215	430	645	860	1075	1290	1504	1719	1934	2149
70	25	50	125	251	501	752	1003	1254	1504	1755	2006	2257	2507
80	29	57	143	287	573	860	1146	1433	1719	2006	2292	2579	2866
90	32	64	161	322	645	967	1290	1612	1934	2257	2579	2901	3224
100	36	72	179	358	716	1075	1433	1791	2149	2507	2866	3224	3582

Regional population = 373,138 individuals
Background mortality = 0.094

< 1% background mortality

> 1% background mortality

Table 8.42 Predicted puffin mortality as a result of displacement from Projects Alpha and Bravo combined plus a 2 km buffer during the breeding season.

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	6	11	28	56	113	169	225	282	338	394	451	507	563
20	11	23	56	113	225	338	451	563	676	789	901	1014	1127
30	17	34	85	169	338	507	676	845	1014	1183	1352	1521	1690
40	23	45	113	225	451	676	901	1127	1352	1577	1803	2028	2253
50	28	56	141	282	563	845	1127	1408	1690	1972	2253	2535	2817
60	34	68	169	338	676	1014	1352	1690	2028	2366	2704	3042	3380
70	39	79	197	394	789	1183	1577	1972	2366	2760	3155	3549	3944
80	45	90	225	451	901	1352	1803	2253	2704	3155	3606	4056	4507
90	51	101	254	507	1014	1521	2028	2535	3042	3549	4056	4563	5070
100	56	113	282	563	1127	1690	2253	2817	3380	3944	4507	5070	5634

Regional population = 373,138 individuals Background mortality = 0.094		< 1% background mortality		> 1% background mortality

RESULTS – HABITATS REGULATIONS APPRAISAL

Project Alpha

Buchan Ness to Collieston Coast SPA

Kittiwake

Table 8.43 Predicted annual kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0

	Mortality rate (%)												
90	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0

SPA population = 22,964 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.44 Predicted annual kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0

SPA population = 22,964 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.45 Predicted annual guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	2	2	3	3	3	4	4
2	0	0	0	1	2	3	3	4	5	6	7	8	8
5	0	0	1	2	4	6	8	11	13	15	17	19	21
10	0	1	2	4	8	13	17	21	25	29	34	38	42
20	1	2	4	8	17	25	34	42	51	59	67	76	84
30	1	3	6	13	25	38	51	63	76	88	101	114	126
40	2	3	8	17	34	51	67	84	101	118	135	152	168
50	2	4	11	21	42	63	84	105	126	147	168	190	211
60	3	5	13	25	51	76	101	126	152	177	202	227	253
70	3	6	15	29	59	88	118	147	177	206	236	265	295
80	3	7	17	34	67	101	135	168	202	236	270	303	337
90	4	8	19	38	76	114	152	190	227	265	303	341	379
100	4	8	21	42	84	126	168	211	253	295	337	379	421

SPA population = 33,632 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality	

Table 8.46 Predicted annual guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	1	2	2	2	3	3	3
2	0	0	0	1	1	2	3	3	4	4	5	6	6
5	0	0	1	2	3	5	6	8	10	11	13	14	16
10	0	1	2	3	6	10	13	16	19	22	26	29	32
20	1	1	3	6	13	19	26	32	38	45	51	58	64
30	1	2	5	10	19	29	38	48	58	67	77	86	96
40	1	3	6	13	26	38	51	64	77	90	102	115	128
50	2	3	8	16	32	48	64	80	96	112	128	144	160
60	2	4	10	19	38	58	77	96	115	134	154	173	192
70	2	4	11	22	45	67	90	112	134	157	179	202	224
80	3	5	13	26	51	77	102	128	154	179	205	230	256
90	3	6	14	29	58	86	115	144	173	202	230	259	288
100	3	6	16	32	64	96	128	160	192	224	256	288	320

SPA population = 33,632 breeding adults
Background mortality = 0.061

< 1% background mortality

> 1% background mortality

Forth Islands SPA

Kittiwake

Table 8.47 Predicted annual kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	2	2	2	3	3	3	4
2	0	0	0	1	2	2	3	4	5	5	6	7	8
5	0	0	1	2	4	6	8	10	11	13	15	17	19
10	0	1	2	4	8	11	15	19	23	27	31	34	38
20	1	2	4	8	15	23	31	38	46	54	61	69	77
30	1	2	6	11	23	34	46	57	69	80	92	103	115
40	2	3	8	15	31	46	61	77	92	107	123	138	153
50	2	4	10	19	38	57	77	96	115	134	153	172	191
60	2	5	11	23	46	69	92	115	138	161	184	207	230
70	3	5	13	27	54	80	107	134	161	188	214	241	268
80	3	6	15	31	61	92	123	153	184	214	245	276	306
90	3	7	17	34	69	103	138	172	207	241	276	310	345
100	4	8	19	38	77	115	153	191	230	268	306	345	383

SPA population = 9,326 breeding adults | < 1% background mortality | > 1% background mortality

	Mortality rate (%)				
Background mortality = 0.146					

Table 8.48 Predicted annual kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	1	1	1	1	1	1	2
2	0	0	0	0	1	1	1	2	2	2	3	3	3
5	0	0	0	1	2	2	3	4	5	6	7	7	8
10	0	0	1	2	3	5	7	8	10	12	13	15	17
20	0	1	2	3	7	10	13	17	20	23	26	30	33
30	0	1	2	5	10	15	20	25	30	35	40	45	50
40	1	1	3	7	13	20	26	33	40	46	53	59	66
50	1	2	4	8	17	25	33	41	50	58	66	74	83
60	1	2	5	10	20	30	40	50	59	69	79	89	99
70	1	2	6	12	23	35	46	58	69	81	92	104	116
80	1	3	7	13	26	40	53	66	79	92	106	119	132
90	1	3	7	15	30	45	59	74	89	104	119	134	149
100	2	3	8	17	33	50	66	83	99	116	132	149	165

SPA population = 9,326 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.49 Predicted annual guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	4	5	7	9	11	12	14	16	18
2	0	1	2	4	7	11	14	18	21	25	29	32	36
5	1	2	4	9	18	27	36	45	53	62	71	80	89
10	2	4	9	18	36	53	71	89	107	125	143	160	178
20	4	7	18	36	71	107	143	178	214	250	285	321	356
30	5	11	27	53	107	160	214	267	321	374	428	481	535
40	7	14	36	71	143	214	285	356	428	499	570	642	713
50	9	18	45	89	178	267	356	446	535	624	713	802	891
60	11	21	53	107	214	321	428	535	642	749	855	962	1069
70	12	25	62	125	250	374	499	624	749	873	998	1123	1248
80	14	29	71	143	285	428	570	713	855	998	1141	1283	1426
90	16	32	80	160	321	481	642	802	962	1123	1283	1444	1604
100	18	36	89	178	356	535	713	891	1069	1248	1426	1604	1782

SPA population = 38,573 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.50 Predicted annual guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	3	4	5	7	8	9	11	12	14
2	0	1	1	3	5	8	11	14	16	19	22	24	27
5	1	1	3	7	14	20	27	34	41	47	54	61	68
10	1	3	7	14	27	41	54	68	81	95	108	122	135
20	3	5	14	27	54	81	108	135	162	189	217	244	271
30	4	8	20	41	81	122	162	203	244	284	325	365	406
40	5	11	27	54	108	162	217	271	325	379	433	487	541
50	7	14	34	68	135	203	271	338	406	474	541	609	677
60	8	16	41	81	162	244	325	406	487	568	650	731	812
70	9	19	47	95	189	284	379	474	568	663	758	853	947
80	11	22	54	108	217	325	433	541	650	758	866	975	1083
90	12	24	61	122	244	365	487	609	731	853	975	1096	1218
100	14	27	68	135	271	406	541	677	812	947	1083	1218	1353

SPA population = 38,573 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Razorbill

Table 8.51 Predicted annual razorbill mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	2	3	3	4	4	5	6	6
2	0	0	1	1	3	4	5	6	8	9	10	11	13
5	0	1	2	3	6	9	13	16	19	22	25	28	31
10	1	1	3	6	13	19	25	31	38	44	50	57	63
20	1	3	6	13	25	38	50	63	75	88	101	113	126
30	2	4	9	19	38	57	75	94	113	132	151	170	189
40	3	5	13	25	50	75	101	126	151	176	201	226	252
50	3	6	16	31	63	94	126	157	189	220	252	283	315
60	4	8	19	38	75	113	151	189	226	264	302	340	377
70	4	9	22	44	88	132	176	220	264	308	352	396	440
80	5	10	25	50	101	151	201	252	302	352	403	453	503
90	6	11	28	57	113	170	226	283	340	396	453	510	566
100	6	13	31	63	126	189	252	315	377	440	503	566	629

SPA population = 7,792 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.52 Predicted annual razorbill mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	2	2	2	3	3	4	4
2	0	0	0	1	2	2	3	4	5	5	6	7	8
5	0	0	1	2	4	6	8	10	12	14	16	18	19
10	0	1	2	4	8	12	16	19	23	27	31	35	39
20	1	2	4	8	16	23	31	39	47	54	62	70	78
30	1	2	6	12	23	35	47	58	70	82	93	105	117
40	2	3	8	16	31	47	62	78	93	109	124	140	156
50	2	4	10	19	39	58	78	97	117	136	156	175	194
60	2	5	12	23	47	70	93	117	140	163	187	210	233
70	3	5	14	27	54	82	109	136	163	191	218	245	272
80	3	6	16	31	62	93	124	156	187	218	249	280	311
90	4	7	18	35	70	105	140	175	210	245	280	315	350
100	4	8	19	39	78	117	156	194	233	272	311	350	389

SPA population = 7,792 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Puffin

Table 8.53 Predicted annual puffin mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	2	3	4	4	5	6	7	8	9
2	0	0	1	2	4	5	7	9	11	12	14	16	18
5	0	1	2	4	9	13	18	22	26	31	35	39	44
10	1	2	4	9	18	26	35	44	53	61	70	79	88
20	2	4	9	18	35	53	70	88	105	123	140	158	175
30	3	5	13	26	53	79	105	131	158	184	210	236	263
40	4	7	18	35	70	105	140	175	210	245	280	315	350
50	4	9	22	44	88	131	175	219	263	306	350	394	438
60	5	11	26	53	105	158	210	263	315	368	420	473	525
70	6	12	31	61	123	184	245	306	368	429	490	552	613
80	7	14	35	70	140	210	280	350	420	490	560	630	700
90	8	16	39	79	158	236	315	394	473	552	630	709	788
100	9	18	44	88	175	263	350	438	525	613	700	788	876

SPA population = 90,010 breeding adults Background mortality = 0.094		< 1% background mortality		> 1% background mortality

Table 8.54 Predicted annual puffin mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	2	3	4	4	5	6	7	8	9
2	0	0	1	2	4	5	7	9	11	12	14	16	18
5	0	1	2	4	9	13	18	22	26	31	35	39	44
10	1	2	4	9	18	26	35	44	53	61	70	79	88
20	2	4	9	18	35	53	70	88	105	123	140	158	175
30	3	5	13	26	53	79	105	131	158	184	210	236	263
40	4	7	18	35	70	105	140	175	210	245	280	315	350
50	4	9	22	44	88	131	175	219	263	306	350	394	438
60	5	11	26	53	105	158	210	263	315	368	420	473	525
70	6	12	31	61	123	184	245	306	368	429	490	552	613
80	7	14	35	70	140	210	280	350	420	490	560	630	700
90	8	16	39	79	158	236	315	394	473	552	630	709	788
100	9	18	44	88	175	263	350	438	525	613	700	788	876

SPA population = 90,010 breeding adults Background mortality = 0.094		< 1% background mortality		> 1% background mortality

Fowlsheugh SPA

Kittiwake

Table 8.55 Predicted annual kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	1	2	4	8	11	15	19	23	26	30	34	38
2	1	2	4	8	15	23	30	38	45	53	60	68	75
5	2	4	9	19	38	56	75	94	113	132	151	169	188
10	4	8	19	38	75	113	151	188	226	263	301	339	376
20	8	15	38	75	151	226	301	376	452	527	602	677	753
30	11	23	56	113	226	339	452	564	677	790	903	1016	1129
40	15	30	75	151	301	452	602	753	903	1054	1204	1355	1505
50	19	38	94	188	376	564	753	941	1129	1317	1505	1693	1881
60	23	45	113	226	452	677	903	1129	1355	1580	1806	2032	2258
70	26	53	132	263	527	790	1054	1317	1580	1844	2107	2371	2634
80	30	60	151	301	602	903	1204	1505	1806	2107	2408	2709	3010
90	34	68	169	339	677	1016	1355	1693	2032	2371	2709	3048	3386
100	38	75	188	376	753	1129	1505	1881	2258	2634	3010	3386	3763

	Mortality rate (%)			
SPA population = 19,310 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.56 Predicted annual kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	3	5	6	8	9	11	12	14	15
2	0	1	2	3	6	9	12	15	19	22	25	28	31
5	1	2	4	8	15	23	31	39	46	54	62	69	77
10	2	3	8	15	31	46	62	77	93	108	123	139	154
20	3	6	15	31	62	93	123	154	185	216	247	278	308
30	5	9	23	46	93	139	185	231	278	324	370	416	463
40	6	12	31	62	123	185	247	308	370	432	493	555	617
50	8	15	39	77	154	231	308	386	463	540	617	694	771
60	9	19	46	93	185	278	370	463	555	648	740	833	925
70	11	22	54	108	216	324	432	540	648	756	864	971	1079
80	12	25	62	123	247	370	493	617	740	864	987	1110	1234
90	14	28	69	139	278	416	555	694	833	971	1110	1249	1388
100	15	31	77	154	308	463	617	771	925	1079	1234	1388	1542

SPA population = 19,310 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.57 Predicted annual guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	1	1	3	5	10	15	21	26	31	36	41	46	52
2	1	2	5	10	21	31	41	52	62	72	83	93	103
5	3	5	13	26	52	77	103	129	155	181	206	232	258
10	5	10	26	52	103	155	206	258	310	361	413	465	516
20	10	21	52	103	206	310	413	516	619	723	826	929	1032
30	15	31	77	155	310	465	619	774	929	1084	1239	1394	1548
40	21	41	103	206	413	619	826	1032	1239	1445	1652	1858	2065
50	26	52	129	258	516	774	1032	1290	1548	1807	2065	2323	2581
60	31	62	155	310	619	929	1239	1548	1858	2168	2478	2787	3097
70	36	72	181	361	723	1084	1445	1807	2168	2529	2890	3252	3613
80	41	83	206	413	826	1239	1652	2065	2478	2890	3303	3716	4129
90	46	93	232	465	929	1394	1858	2323	2787	3252	3716	4181	4645
100	52	103	258	516	1032	1548	2065	2581	3097	3613	4129	4645	5161

SPA population = 74,379 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.58 Predicted annual guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	1	2	4	8	12	16	20	24	27	31	35	39
2	1	2	4	8	16	24	31	39	47	55	63	71	78
5	2	4	10	20	39	59	78	98	118	137	157	176	196
10	4	8	20	39	78	118	157	196	235	274	314	353	392
20	8	16	39	78	157	235	314	392	470	549	627	706	784
30	12	24	59	118	235	353	470	588	706	823	941	1058	1176
40	16	31	78	157	314	470	627	784	941	1098	1254	1411	1568
50	20	39	98	196	392	588	784	980	1176	1372	1568	1764	1960
60	24	47	118	235	470	706	941	1176	1411	1646	1882	2117	2352
70	27	55	137	274	549	823	1098	1372	1646	1921	2195	2470	2744
80	31	63	157	314	627	941	1254	1568	1882	2195	2509	2822	3136
90	35	71	176	353	706	1058	1411	1764	2117	2470	2822	3175	3528
100	39	78	196	392	784	1176	1568	1960	2352	2744	3136	3528	3920

SPA population = 74,379 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Razorbill

Table 8.59 Predicted annual razorbill mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	4	6	8	10	12	14	16	17	19
2	0	1	2	4	8	12	16	19	23	27	31	35	39
5	1	2	5	10	19	29	39	48	58	68	78	87	97
10	2	4	10	19	39	58	78	97	116	136	155	174	194
20	4	8	19	39	78	116	155	194	233	271	310	349	388
30	6	12	29	58	116	174	233	291	349	407	465	523	581
40	8	16	39	78	155	233	310	388	465	543	620	698	775
50	10	19	48	97	194	291	388	484	581	678	775	872	969
60	12	23	58	116	233	349	465	581	698	814	930	1046	1163
70	14	27	68	136	271	407	543	678	814	949	1085	1221	1356
80	16	31	78	155	310	465	620	775	930	1085	1240	1395	1550
90	17	35	87	174	349	523	698	872	1046	1221	1395	1569	1744
100	19	39	97	194	388	581	775	969	1163	1356	1550	1744	1938

SPA population = 9,950 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.60 Predicted annual razorbill mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	2	4	5	6	7	8	10	11	12
2	0	0	1	2	5	7	10	12	14	17	19	22	24
5	1	1	3	6	12	18	24	30	36	42	48	54	60
10	1	2	6	12	24	36	48	60	72	84	96	108	120
20	2	5	12	24	48	72	96	120	144	168	192	216	240
30	4	7	18	36	72	108	144	180	216	252	287	323	359
40	5	10	24	48	96	144	192	240	287	335	383	431	479
50	6	12	30	60	120	180	240	299	359	419	479	539	599
60	7	14	36	72	144	216	287	359	431	503	575	647	719
70	8	17	42	84	168	252	335	419	503	587	671	755	838
80	10	19	48	96	192	287	383	479	575	671	767	862	958
90	11	22	54	108	216	323	431	539	647	755	862	970	1078
100	12	24	60	120	240	359	479	599	719	838	958	1078	1198

SPA population = 9,950 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

St Abb's to Fast Castle SPA

Kittiwake

Table 8.61 Predicted annual kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	2	3	3	4	5	5	6	7
2	0	0	1	1	3	4	5	7	8	9	11	12	13
5	0	1	2	3	7	10	13	17	20	23	27	30	33
10	1	1	3	7	13	20	27	33	40	47	53	60	66
20	1	3	7	13	27	40	53	66	80	93	106	120	133
30	2	4	10	20	40	60	80	100	120	140	159	179	199
40	3	5	13	27	53	80	106	133	159	186	213	239	266
50	3	7	17	33	66	100	133	166	199	233	266	299	332
60	4	8	20	40	80	120	159	199	239	279	319	359	399
70	5	9	23	47	93	140	186	233	279	326	372	419	465
80	5	11	27	53	106	159	213	266	319	372	425	478	532
90	6	12	30	60	120	179	239	299	359	419	478	538	598
100	7	13	33	66	133	199	266	332	399	465	532	598	664

SPA population = 9,606 breeding adults		< 1% background mortality		> 1% background mortality

	Mortality rate (%)				
Background mortality = 0.146					

Table 8.62 Predicted annual kittiwake mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	1	1	2	2	2	3	3
2	0	0	0	1	1	2	2	3	3	4	4	5	6
5	0	0	1	1	3	4	6	7	8	10	11	13	14
10	0	1	1	3	6	8	11	14	17	20	22	25	28
20	1	1	3	6	11	17	22	28	34	39	45	50	56
30	1	2	4	8	17	25	34	42	50	59	67	75	84
40	1	2	6	11	22	34	45	56	67	78	89	101	112
50	1	3	7	14	28	42	56	70	84	98	112	126	140
60	2	3	8	17	34	50	67	84	101	117	134	151	168
70	2	4	10	20	39	59	78	98	117	137	156	176	196
80	2	4	11	22	45	67	89	112	134	156	179	201	224
90	3	5	13	25	50	75	101	126	151	176	201	226	251
100	3	6	14	28	56	84	112	140	168	196	224	251	279

SPA population = 9,606 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.63 Predicted annual guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	3	4	5	6	8	9	10	12	13
2	0	1	1	3	5	8	10	13	16	18	21	23	26
5	1	1	3	6	13	19	26	32	39	45	52	58	65
10	1	3	6	13	26	39	52	65	78	91	104	117	130
20	3	5	13	26	52	78	104	130	156	182	208	234	259
30	4	8	19	39	78	117	156	195	234	272	311	350	389
40	5	10	26	52	104	156	208	259	311	363	415	467	519
50	6	13	32	65	130	195	259	324	389	454	519	584	649
60	8	16	39	78	156	234	311	389	467	545	623	701	778
70	9	18	45	91	182	272	363	454	545	636	727	817	908
80	10	21	52	104	208	311	415	519	623	727	830	934	1038
90	12	23	58	117	234	350	467	584	701	817	934	1051	1168
100	13	26	65	130	259	389	519	649	778	908	1038	1168	1297

SPA population = 36,206 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.64 Predicted annual guillemot mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	2	3	4	5	6	7	8	9	10
2	0	0	1	2	4	6	8	10	12	14	16	18	20
5	0	1	2	5	10	15	20	25	30	34	39	44	49
10	1	2	5	10	20	30	39	49	59	69	79	89	99
20	2	4	10	20	39	59	79	99	118	138	158	177	197
30	3	6	15	30	59	89	118	148	177	207	236	266	296
40	4	8	20	39	79	118	158	197	236	276	315	355	394
50	5	10	25	49	99	148	197	246	296	345	394	443	493
60	6	12	30	59	118	177	236	296	355	414	473	532	591
70	7	14	34	69	138	207	276	345	414	483	552	621	690
80	8	16	39	79	158	236	315	394	473	552	631	709	788
90	9	18	44	89	177	266	355	443	532	621	709	798	887
100	10	20	49	99	197	296	394	493	591	690	788	887	985

SPA population = 36,206 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality	

Razorbill

Table 8.65 Predicted annual razorbill mortality as a result of displacement from Project Alpha plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	1	1	1	1	2	2	2	2
2	0	0	0	0	1	1	2	2	3	3	4	4	5
5	0	0	1	1	2	4	5	6	7	9	10	11	12
10	0	0	1	2	5	7	10	12	15	17	20	22	25
20	0	1	2	5	10	15	20	25	29	34	39	44	49
30	1	1	4	7	15	22	29	37	44	52	59	66	74
40	1	2	5	10	20	29	39	49	59	69	79	88	98
50	1	2	6	12	25	37	49	61	74	86	98	110	123
60	1	3	7	15	29	44	59	74	88	103	118	132	147
70	2	3	9	17	34	52	69	86	103	120	137	155	172
80	2	4	10	20	39	59	79	98	118	137	157	177	196
90	2	4	11	22	44	66	88	110	132	155	177	199	221
100	2	5	12	25	49	74	98	123	147	172	196	221	245

SPA population = 2,067 breeding adults
Background mortality = 0.105

< 1% background mortality

> 1% background mortality

Table 8.66 Predicted annual razorbill mortality as a result of displacement from Project Alpha plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	1	1	1	1	1	1	2
2	0	0	0	0	1	1	1	2	2	2	2	3	3
5	0	0	0	1	2	2	3	4	5	5	6	7	8
10	0	0	1	2	3	5	6	8	9	11	12	14	15
20	0	1	2	3	6	9	12	15	18	21	24	27	30
30	0	1	2	5	9	14	18	23	27	32	36	41	46
40	1	1	3	6	12	18	24	30	36	42	49	55	61
50	1	2	4	8	15	23	30	38	46	53	61	68	76
60	1	2	5	9	18	27	36	46	55	64	73	82	91
70	1	2	5	11	21	32	42	53	64	74	85	96	106
80	1	2	6	12	24	36	49	61	73	85	97	109	121
90	1	3	7	14	27	41	55	68	82	96	109	123	137
100	2	3	8	15	30	46	61	76	91	106	121	137	152

SPA population = 2,067 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Project Bravo

Buchan Ness to Collieston Coast SPA

Kittiwake

Table 8.67 Predicted annual kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0

	Mortality rate (%)												
100	0	0	0	0	0	0	0	0	0	0	0	0	0

SPA population = 22,964 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.68 Predicted annual kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0

SPA population = 22,964 breeding adults
Background mortality = 0.146

< 1% background mortality

> 1% background mortality

Guillemot

Table 8.69 Predicted annual guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	1	2	2	2	3	3	4
2	0	0	0	1	1	2	3	4	4	5	6	6	7
5	0	0	1	2	4	5	7	9	11	12	14	16	18
10	0	1	2	4	7	11	14	18	21	25	28	32	35
20	1	1	4	7	14	21	28	35	42	49	56	63	70
30	1	2	5	11	21	32	42	53	63	74	84	95	105
40	1	3	7	14	28	42	56	70	84	98	112	126	140
50	2	4	9	18	35	53	70	88	105	123	140	158	175
60	2	4	11	21	42	63	84	105	126	147	168	190	211
70	2	5	12	25	49	74	98	123	147	172	197	221	246
80	3	6	14	28	56	84	112	140	168	197	225	253	281
90	3	6	16	32	63	95	126	158	190	221	253	284	316
100	4	7	18	35	70	105	140	175	211	246	281	316	351

SPA population = 33,632 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.70 Predicted annual guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	1	1	2	2	2	2	3
2	0	0	0	1	1	2	2	3	3	4	4	5	5
5	0	0	1	1	3	4	5	6	8	9	10	11	13
10	0	1	1	3	5	8	10	13	15	18	20	23	25
20	1	1	3	5	10	15	20	25	30	35	41	46	51
30	1	2	4	8	15	23	30	38	46	53	61	68	76
40	1	2	5	10	20	30	41	51	61	71	81	91	101
50	1	3	6	13	25	38	51	63	76	89	101	114	127
60	2	3	8	15	30	46	61	76	91	106	122	137	152
70	2	4	9	18	35	53	71	89	106	124	142	160	177
80	2	4	10	20	41	61	81	101	122	142	162	182	203
90	2	5	11	23	46	68	91	114	137	160	182	205	228
100	3	5	13	25	51	76	101	127	152	177	203	228	253

SPA population = 33,632 breeding adults
Background mortality = 0.061

< 1% background mortality

> 1% background mortality

Forth Islands SPA

Kittiwake

Table 8.71 Predicted annual kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	1	1	1	1	2	2	2	2
2	0	0	0	0	1	1	2	2	3	3	4	4	4
5	0	0	1	1	2	3	4	6	7	8	9	10	11
10	0	0	1	2	4	7	9	11	13	15	18	20	22
20	0	1	2	4	9	13	18	22	26	31	35	40	44
30	1	1	3	7	13	20	26	33	40	46	53	59	66
40	1	2	4	9	18	26	35	44	53	62	70	79	88
50	1	2	6	11	22	33	44	55	66	77	88	99	110
60	1	3	7	13	26	40	53	66	79	92	106	119	132
70	2	3	8	15	31	46	62	77	92	108	123	139	154
80	2	4	9	18	35	53	70	88	106	123	141	158	176
90	2	4	10	20	40	59	79	99	119	139	158	178	198
100	2	4	11	22	44	66	88	110	132	154	176	198	220

SPA population = 9,326 breeding adults | < 1% background mortality | > 1% background mortality

	Mortality rate (%)				
Background mortality = 0.146					

Table 8.72 Predicted annual kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	1	1	1	1	1	1
2	0	0	0	0	0	1	1	1	1	2	2	2	2
5	0	0	0	1	1	2	2	3	4	4	5	5	6
10	0	0	1	1	2	4	5	6	7	8	10	11	12
20	0	0	1	2	5	7	10	12	14	17	19	21	24
30	0	1	2	4	7	11	14	18	21	25	29	32	36
40	0	1	2	5	10	14	19	24	29	33	38	43	48
50	1	1	3	6	12	18	24	30	36	42	48	54	60
60	1	1	4	7	14	21	29	36	43	50	57	64	72
70	1	2	4	8	17	25	33	42	50	59	67	75	84
80	1	2	5	10	19	29	38	48	57	67	76	86	96
90	1	2	5	11	21	32	43	54	64	75	86	97	107
100	1	2	6	12	24	36	48	60	72	84	96	107	119

SPA population = 9,326 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.73 Predicted annual guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	3	4	6	7	9	10	12	13	15
2	0	1	1	3	6	9	12	15	18	21	24	27	30
5	1	1	4	7	15	22	30	37	45	52	59	67	74
10	1	3	7	15	30	45	59	74	89	104	119	134	149
20	3	6	15	30	59	89	119	149	178	208	238	267	297
30	4	9	22	45	89	134	178	223	267	312	356	401	446
40	6	12	30	59	119	178	238	297	356	416	475	535	594
50	7	15	37	74	149	223	297	371	446	520	594	668	743
60	9	18	45	89	178	267	356	446	535	624	713	802	891
70	10	21	52	104	208	312	416	520	624	728	832	936	1040
80	12	24	59	119	238	356	475	594	713	832	950	1069	1188
90	13	27	67	134	267	401	535	668	802	936	1069	1203	1337
100	15	30	74	149	297	446	594	743	891	1040	1188	1337	1485

SPA population = 38,573 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.74 Predicted annual guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	2	3	4	5	6	8	9	10	11
2	0	0	1	2	4	6	9	11	13	15	17	19	21
5	1	1	3	5	11	16	21	27	32	38	43	48	54
10	1	2	5	11	21	32	43	54	64	75	86	97	107
20	2	4	11	21	43	64	86	107	129	150	172	193	215
30	3	6	16	32	64	97	129	161	193	225	257	290	322
40	4	9	21	43	86	129	172	215	257	300	343	386	429
50	5	11	27	54	107	161	215	268	322	375	429	483	536
60	6	13	32	64	129	193	257	322	386	450	515	579	644
70	8	15	38	75	150	225	300	375	450	526	601	676	751
80	9	17	43	86	172	257	343	429	515	601	686	772	858
90	10	19	48	97	193	290	386	483	579	676	772	869	965
100	11	21	54	107	215	322	429	536	644	751	858	965	1073

SPA population = 38,573 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Razorbill

Table 8.75 Predicted annual razorbill mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	2	2	3	3	4	4	5
2	0	0	0	1	2	3	4	5	5	6	7	8	9
5	0	0	1	2	5	7	9	11	14	16	18	21	23
10	0	1	2	5	9	14	18	23	27	32	37	41	46
20	1	2	5	9	18	27	37	46	55	64	73	82	92
30	1	3	7	14	27	41	55	69	82	96	110	124	137
40	2	4	9	18	37	55	73	92	110	128	147	165	183
50	2	5	11	23	46	69	92	115	137	160	183	206	229
60	3	5	14	27	55	82	110	137	165	192	220	247	275
70	3	6	16	32	64	96	128	160	192	225	257	289	321
80	4	7	18	37	73	110	147	183	220	257	293	330	367
90	4	8	21	41	82	124	165	206	247	289	330	371	412
100	5	9	23	46	92	137	183	229	275	321	367	412	458

SPA population = 7,792 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.76 Predicted annual razorbill mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	1	1	2	2	2	2	3
2	0	0	0	1	1	2	2	3	3	4	4	5	5
5	0	0	1	1	3	4	5	6	8	9	10	11	13
10	0	1	1	3	5	8	10	13	15	18	20	23	25
20	1	1	3	5	10	15	20	25	30	36	41	46	51
30	1	2	4	8	15	23	30	38	46	53	61	69	76
40	1	2	5	10	20	30	41	51	61	71	81	91	102
50	1	3	6	13	25	38	51	64	76	89	102	114	127
60	2	3	8	15	30	46	61	76	91	107	122	137	152
70	2	4	9	18	36	53	71	89	107	125	142	160	178
80	2	4	10	20	41	61	81	102	122	142	163	183	203
90	2	5	11	23	46	69	91	114	137	160	183	206	229
100	3	5	13	25	51	76	102	127	152	178	203	229	254

SPA population = 7,792 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Puffin

Table 8.77 Predicted annual puffin mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	2	4	5	6	7	9	10	11	12
2	0	0	1	2	5	7	10	12	15	17	20	22	24
5	1	1	3	6	12	18	24	30	37	43	49	55	61
10	1	2	6	12	24	37	49	61	73	85	98	110	122
20	2	5	12	24	49	73	98	122	146	171	195	219	244
30	4	7	18	37	73	110	146	183	219	256	293	329	366
40	5	10	24	49	98	146	195	244	293	341	390	439	488
50	6	12	30	61	122	183	244	305	366	427	488	549	610
60	7	15	37	73	146	219	293	366	439	512	585	658	731
70	9	17	43	85	171	256	341	427	512	597	683	768	853
80	10	20	49	98	195	293	390	488	585	683	780	878	975
90	11	22	55	110	219	329	439	549	658	768	878	987	1097
100	12	24	61	122	244	366	488	610	731	853	975	1097	1219

SPA population = 90,010 breeding adults Background mortality = 0.094		< 1% background mortality		> 1% background mortality

Table 8.78 Predicted annual puffin mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	2	4	5	6	7	9	10	11	12
2	0	0	1	2	5	7	10	12	15	17	20	22	24
5	1	1	3	6	12	18	24	30	37	43	49	55	61
10	1	2	6	12	24	37	49	61	73	85	98	110	122
20	2	5	12	24	49	73	98	122	146	171	195	219	244
30	4	7	18	37	73	110	146	183	219	256	293	329	366
40	5	10	24	49	98	146	195	244	293	341	390	439	488
50	6	12	30	61	122	183	244	305	366	427	488	549	610
60	7	15	37	73	146	219	293	366	439	512	585	658	731
70	9	17	43	85	171	256	341	427	512	597	683	768	853
80	10	20	49	98	195	293	390	488	585	683	780	878	975
90	11	22	55	110	219	329	439	549	658	768	878	987	1097
100	12	24	61	122	244	366	488	610	731	853	975	1097	1219

SPA population = 90,010 breeding adults Background mortality = 0.094		< 1% background mortality		> 1% background mortality

Fowlsheugh SPA

Kittiwake

Table 8.79 Predicted annual kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	4	7	9	11	13	15	17	20	22
2	0	1	2	4	9	13	17	22	26	30	35	39	43
5	1	2	5	11	22	33	43	54	65	76	87	98	108
10	2	4	11	22	43	65	87	108	130	152	173	195	217
20	4	9	22	43	87	130	173	217	260	304	347	390	434
30	7	13	33	65	130	195	260	325	390	455	520	585	650
40	9	17	43	87	173	260	347	434	520	607	694	781	867
50	11	22	54	108	217	325	434	542	650	759	867	976	1084
60	13	26	65	130	260	390	520	650	781	911	1041	1171	1301
70	15	30	76	152	304	455	607	759	911	1062	1214	1366	1518
80	17	35	87	173	347	520	694	867	1041	1214	1388	1561	1735
90	20	39	98	195	390	585	781	976	1171	1366	1561	1756	1951
100	22	43	108	217	434	650	867	1084	1301	1518	1735	1951	2168

	Mortality rate (%)			
SPA population = 19,310 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.80 Predicted annual kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	2	3	5	6	7	8	9	10	11
2	0	0	1	2	5	7	9	11	14	16	18	21	23
5	1	1	3	6	11	17	23	29	34	40	46	51	57
10	1	2	6	11	23	34	46	57	68	80	91	103	114
20	2	5	11	23	46	68	91	114	137	160	183	205	228
30	3	7	17	34	68	103	137	171	205	240	274	308	342
40	5	9	23	46	91	137	183	228	274	320	365	411	457
50	6	11	29	57	114	171	228	285	342	400	457	514	571
60	7	14	34	68	137	205	274	342	411	479	548	616	685
70	8	16	40	80	160	240	320	400	479	559	639	719	799
80	9	18	46	91	183	274	365	457	548	639	731	822	913
90	10	21	51	103	205	308	411	514	616	719	822	925	1027
100	11	23	57	114	228	342	457	571	685	799	913	1027	1141

SPA population = 19,310 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.81 Predicted annual guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	1	2	4	9	13	17	22	26	30	34	39	43
2	1	2	4	9	17	26	34	43	52	60	69	77	86
5	2	4	11	22	43	65	86	108	129	151	172	194	215
10	4	9	22	43	86	129	172	215	258	301	344	387	430
20	9	17	43	86	172	258	344	430	516	602	688	774	860
30	13	26	65	129	258	387	516	645	774	903	1032	1161	1290
40	17	34	86	172	344	516	688	860	1032	1204	1376	1548	1720
50	22	43	108	215	430	645	860	1075	1290	1505	1720	1935	2150
60	26	52	129	258	516	774	1032	1290	1548	1806	2064	2323	2581
70	30	60	151	301	602	903	1204	1505	1806	2107	2409	2710	3011
80	34	69	172	344	688	1032	1376	1720	2064	2409	2753	3097	3441
90	39	77	194	387	774	1161	1548	1935	2323	2710	3097	3484	3871
100	43	86	215	430	860	1290	1720	2150	2581	3011	3441	3871	4301

SPA population = 74,379 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.82 Predicted annual guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	1	2	3	6	9	12	16	19	22	25	28	31
2	1	1	3	6	12	19	25	31	37	43	50	56	62
5	2	3	8	16	31	47	62	78	93	109	124	140	155
10	3	6	16	31	62	93	124	155	186	217	249	280	311
20	6	12	31	62	124	186	249	311	373	435	497	559	621
30	9	19	47	93	186	280	373	466	559	652	746	839	932
40	12	25	62	124	249	373	497	621	746	870	994	1118	1243
50	16	31	78	155	311	466	621	777	932	1087	1243	1398	1553
60	19	37	93	186	373	559	746	932	1118	1305	1491	1677	1864
70	22	43	109	217	435	652	870	1087	1305	1522	1740	1957	2174
80	25	50	124	249	497	746	994	1243	1491	1740	1988	2237	2485
90	28	56	140	280	559	839	1118	1398	1677	1957	2237	2516	2796
100	31	62	155	311	621	932	1243	1553	1864	2174	2485	2796	3106

SPA population = 74,379 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Razorbill

Table 8.83 Predicted annual razorbill mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	3	4	6	7	8	10	11	13	14
2	0	1	1	3	6	8	11	14	17	20	23	25	28
5	1	1	4	7	14	21	28	35	42	49	56	64	71
10	1	3	7	14	28	42	56	71	85	99	113	127	141
20	3	6	14	28	56	85	113	141	169	198	226	254	282
30	4	8	21	42	85	127	169	212	254	296	339	381	423
40	6	11	28	56	113	169	226	282	339	395	452	508	564
50	7	14	35	71	141	212	282	353	423	494	564	635	706
60	8	17	42	85	169	254	339	423	508	593	677	762	847
70	10	20	49	99	198	296	395	494	593	691	790	889	988
80	11	23	56	113	226	339	452	564	677	790	903	1016	1129
90	13	25	64	127	254	381	508	635	762	889	1016	1143	1270
100	14	28	71	141	282	423	564	706	847	988	1129	1270	1411

SPA population = 9,950 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.84 Predicted annual razorbill mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	2	2	3	4	5	5	6	7	8
2	0	0	1	2	3	5	6	8	9	11	13	14	16
5	0	1	2	4	8	12	16	20	23	27	31	35	39
10	1	2	4	8	16	23	31	39	47	55	63	70	78
20	2	3	8	16	31	47	63	78	94	110	125	141	157
30	2	5	12	23	47	70	94	117	141	164	188	211	235
40	3	6	16	31	63	94	125	157	188	219	250	282	313
50	4	8	20	39	78	117	157	196	235	274	313	352	391
60	5	9	23	47	94	141	188	235	282	329	376	423	470
70	5	11	27	55	110	164	219	274	329	383	438	493	548
80	6	13	31	63	125	188	250	313	376	438	501	564	626
90	7	14	35	70	141	211	282	352	423	493	564	634	704
100	8	16	39	78	157	235	313	391	470	548	626	704	783

SPA population = 9,950 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

St Abb's to Fast Castle SPA

Kittiwake

Table 8.85 Predicted annual kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	2	2	2	3	3	3	4
2	0	0	0	1	2	2	3	4	5	5	6	7	8
5	0	0	1	2	4	6	8	10	11	13	15	17	19
10	0	1	2	4	8	11	15	19	23	27	31	34	38
20	1	2	4	8	15	23	31	38	46	54	61	69	77
30	1	2	6	11	23	34	46	57	69	80	92	103	115
40	2	3	8	15	31	46	61	77	92	107	122	138	153
50	2	4	10	19	38	57	77	96	115	134	153	172	191
60	2	5	11	23	46	69	92	115	138	161	184	207	230
70	3	5	13	27	54	80	107	134	161	188	214	241	268
80	3	6	15	31	61	92	122	153	184	214	245	276	306
90	3	7	17	34	69	103	138	172	207	241	276	310	344
100	4	8	19	38	77	115	153	191	230	268	306	344	383

SPA population = 9,606 breeding adults | < 1% background mortality | > 1% background mortality

	Mortality rate (%)				
Background mortality = 0.146					

Table 8.86 Predicted annual kittiwake mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	1	1	1	1	1	2	2	2
2	0	0	0	0	1	1	2	2	2	3	3	4	4
5	0	0	1	1	2	3	4	5	6	7	8	9	10
10	0	0	1	2	4	6	8	10	12	14	16	18	20
20	0	1	2	4	8	12	16	20	25	29	33	37	41
30	1	1	3	6	12	18	25	31	37	43	49	55	61
40	1	2	4	8	16	25	33	41	49	57	65	74	82
50	1	2	5	10	20	31	41	51	61	72	82	92	102
60	1	2	6	12	25	37	49	61	74	86	98	110	123
70	1	3	7	14	29	43	57	72	86	100	115	129	143
80	2	3	8	16	33	49	65	82	98	115	131	147	164
90	2	4	9	18	37	55	74	92	110	129	147	166	184
100	2	4	10	20	41	61	82	102	123	143	164	184	205

SPA population = 9,606 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.87 Predicted annual guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	2	3	4	5	6	8	9	10	11
2	0	0	1	2	4	6	9	11	13	15	17	19	22
5	1	1	3	5	11	16	22	27	32	38	43	49	54
10	1	2	5	11	22	32	43	54	65	76	86	97	108
20	2	4	11	22	43	65	86	108	130	151	173	195	216
30	3	6	16	32	65	97	130	162	195	227	259	292	324
40	4	9	22	43	86	130	173	216	259	303	346	389	432
50	5	11	27	54	108	162	216	270	324	378	432	487	541
60	6	13	32	65	130	195	259	324	389	454	519	584	649
70	8	15	38	76	151	227	303	378	454	530	605	681	757
80	9	17	43	86	173	259	346	432	519	605	692	778	865
90	10	19	49	97	195	292	389	487	584	681	778	876	973
100	11	22	54	108	216	324	432	541	649	757	865	973	1081

SPA population = 36,206 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.88 Predicted annual guillemot mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	2	2	3	4	5	5	6	7	8
2	0	0	1	2	3	5	6	8	9	11	12	14	16
5	0	1	2	4	8	12	16	20	23	27	31	35	39
10	1	2	4	8	16	23	31	39	47	55	62	70	78
20	2	3	8	16	31	47	62	78	94	109	125	141	156
30	2	5	12	23	47	70	94	117	141	164	187	211	234
40	3	6	16	31	62	94	125	156	187	219	250	281	312
50	4	8	20	39	78	117	156	195	234	273	312	351	390
60	5	9	23	47	94	141	187	234	281	328	375	422	469
70	5	11	27	55	109	164	219	273	328	383	437	492	547
80	6	12	31	62	125	187	250	312	375	437	500	562	625
90	7	14	35	70	141	211	281	351	422	492	562	632	703
100	8	16	39	78	156	234	312	390	469	547	625	703	781

SPA population = 36,206 breeding adults
Background mortality = 0.061

< 1% background mortality

> 1% background mortality

Razorbill

Table 8.89 Predicted annual razorbill mortality as a result of displacement from Project Bravo plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	1	1	1	1	1	1	2	2
2	0	0	0	0	1	1	1	2	2	3	3	3	4
5	0	0	0	1	2	3	4	4	5	6	7	8	9
10	0	0	1	2	4	5	7	9	11	13	14	16	18
20	0	1	2	4	7	11	14	18	21	25	29	32	36
30	1	1	3	5	11	16	21	27	32	38	43	48	54
40	1	1	4	7	14	21	29	36	43	50	57	64	71
50	1	2	4	9	18	27	36	45	54	63	71	80	89
60	1	2	5	11	21	32	43	54	64	75	86	96	107
70	1	3	6	13	25	38	50	63	75	88	100	113	125
80	1	3	7	14	29	43	57	71	86	100	114	129	143
90	2	3	8	16	32	48	64	80	96	113	129	145	161
100	2	4	9	18	36	54	71	89	107	125	143	161	179

SPA population = 2,067 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.90 Predicted annual razorbill mortality as a result of displacement from Project Bravo plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	1	1	1	1	1
2	0	0	0	0	0	1	1	1	1	1	2	2	2
5	0	0	0	0	1	1	2	2	3	3	4	4	5
10	0	0	0	1	2	3	4	5	6	7	8	9	10
20	0	0	1	2	4	6	8	10	12	14	16	18	20
30	0	1	1	3	6	9	12	15	18	21	24	27	30
40	0	1	2	4	8	12	16	20	24	28	32	36	40
50	0	1	2	5	10	15	20	25	30	35	40	45	50
60	1	1	3	6	12	18	24	30	36	42	48	54	59
70	1	1	3	7	14	21	28	35	42	49	55	62	69
80	1	2	4	8	16	24	32	40	48	55	63	71	79
90	1	2	4	9	18	27	36	45	54	62	71	80	89
100	1	2	5	10	20	30	40	50	59	69	79	89	99

SPA population = 2,067 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Project Alpha and Project Bravo combined

Buchan Ness to Collieston Coast SPA

Kittiwake

Table 8.91 Predicted annual kittiwake mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0

	Mortality rate (%)												
90	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0

SPA population = 22,964 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.92 Predicted annual kittiwake mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0

SPA population = 22,964 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.93 Predicted annual guillemot mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	2	3	4	4	5	6	6	7
2	0	0	1	1	3	4	6	7	9	10	11	13	14
5	0	1	2	4	7	11	14	18	22	25	29	32	36
10	1	1	4	7	14	22	29	36	43	50	57	65	72
20	1	3	7	14	29	43	57	72	86	100	115	129	143
30	2	4	11	22	43	65	86	108	129	151	172	194	215
40	3	6	14	29	57	86	115	143	172	201	230	258	287
50	4	7	18	36	72	108	143	179	215	251	287	323	359
60	4	9	22	43	86	129	172	215	258	301	344	387	430
70	5	10	25	50	100	151	201	251	301	351	402	452	502
80	6	11	29	57	115	172	230	287	344	402	459	516	574
90	6	13	32	65	129	194	258	323	387	452	516	581	646
100	7	14	36	72	143	215	287	359	430	502	574	646	717

	Mortality rate (%)			
SPA population = 33,632 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.94 Predicted annual guillemot mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	2	2	3	3	4	4	5	6
2	0	0	1	1	2	3	4	6	7	8	9	10	11
5	0	1	1	3	6	8	11	14	17	20	22	25	28
10	1	1	3	6	11	17	22	28	34	39	45	50	56
20	1	2	6	11	22	34	45	56	67	78	90	101	112
30	2	3	8	17	34	50	67	84	101	118	134	151	168
40	2	4	11	22	45	67	90	112	134	157	179	201	224
50	3	6	14	28	56	84	112	140	168	196	224	252	280
60	3	7	17	34	67	101	134	168	201	235	269	302	336
70	4	8	20	39	78	118	157	196	235	274	313	353	392
80	4	9	22	45	90	134	179	224	269	313	358	403	448
90	5	10	25	50	101	151	201	252	302	353	403	453	504
100	6	11	28	56	112	168	224	280	336	392	448	504	560

SPA population = 33,632 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Forth Islands SPA

Kittiwake

Table 8.95 Predicted annual kittiwake mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	2	2	3	3	4	4	5	5
2	0	0	1	1	2	3	4	5	6	7	9	10	11
5	0	1	1	3	5	8	11	13	16	19	21	24	27
10	1	1	3	5	11	16	21	27	32	37	43	48	53
20	1	2	5	11	21	32	43	53	64	75	85	96	107
30	2	3	8	16	32	48	64	80	96	112	128	144	160
40	2	4	11	21	43	64	85	107	128	149	171	192	213
50	3	5	13	27	53	80	107	133	160	186	213	240	266
60	3	6	16	32	64	96	128	160	192	224	256	288	320
70	4	7	19	37	75	112	149	186	224	261	298	336	373
80	4	9	21	43	85	128	171	213	256	298	341	384	426
90	5	10	24	48	96	144	192	240	288	336	384	432	480

	Mortality rate (%)												
100	5	11	27	53	107	160	213	266	320	373	426	480	533

SPA population = 9,326 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.96 Predicted annual kittiwake mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	1	1	2	2	2	2	3
2	0	0	0	1	1	2	2	3	3	4	4	5	5
5	0	0	1	1	3	4	5	6	8	9	10	12	13
10	0	1	1	3	5	8	10	13	16	18	21	23	26
20	1	1	3	5	10	16	21	26	31	36	41	47	52
30	1	2	4	8	16	23	31	39	47	54	62	70	78
40	1	2	5	10	21	31	41	52	62	73	83	93	104
50	1	3	6	13	26	39	52	65	78	91	104	117	130
60	2	3	8	16	31	47	62	78	93	109	124	140	155
70	2	4	9	18	36	54	73	91	109	127	145	163	181
80	2	4	10	21	41	62	83	104	124	145	166	187	207
90	2	5	12	23	47	70	93	117	140	163	187	210	233
100	3	5	13	26	52	78	104	130	155	181	207	233	259

SPA population = 9,326 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality	

Guillemot

Table 8.97 Predicted annual guillemot mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	1	2	3	6	9	12	15	18	21	24	27	30
2	1	1	3	6	12	18	24	30	36	42	49	55	61
5	2	3	8	15	30	46	61	76	91	106	121	137	152
10	3	6	15	30	61	91	121	152	182	212	243	273	304
20	6	12	30	61	121	182	243	304	364	425	486	546	607
30	9	18	46	91	182	273	364	455	546	637	728	819	911
40	12	24	61	121	243	364	486	607	728	850	971	1093	1214
50	15	30	76	152	304	455	607	759	911	1062	1214	1366	1518
60	18	36	91	182	364	546	728	911	1093	1275	1457	1639	1821
70	21	42	106	212	425	637	850	1062	1275	1487	1700	1912	2125
80	24	49	121	243	486	728	971	1214	1457	1700	1943	2185	2428
90	27	55	137	273	546	819	1093	1366	1639	1912	2185	2458	2732
100	30	61	152	304	607	911	1214	1518	1821	2125	2428	2732	3035

	Mortality rate (%)			
SPA population = 38,573 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.98 Predicted annual guillemot mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	5	7	9	12	14	17	19	21	24
2	0	1	2	5	9	14	19	24	28	33	38	43	47
5	1	2	6	12	24	36	47	59	71	83	95	107	118
10	2	5	12	24	47	71	95	118	142	166	189	213	237
20	5	9	24	47	95	142	189	237	284	331	379	426	474
30	7	14	36	71	142	213	284	355	426	497	568	639	710
40	9	19	47	95	189	284	379	474	568	663	758	852	947
50	12	24	59	118	237	355	474	592	710	829	947	1065	1184
60	14	28	71	142	284	426	568	710	852	994	1137	1279	1421
70	17	33	83	166	331	497	663	829	994	1160	1326	1492	1657
80	19	38	95	189	379	568	758	947	1137	1326	1515	1705	1894
90	21	43	107	213	426	639	852	1065	1279	1492	1705	1918	2131
100	24	47	118	237	474	710	947	1184	1421	1657	1894	2131	2368

SPA population = 38,573 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Razorbill

Table 8.99 Predicted annual razorbill mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	2	3	4	5	6	7	8	9	10
2	0	0	1	2	4	6	8	10	11	13	15	17	19
5	0	1	2	5	10	14	19	24	29	34	38	43	48
10	1	2	5	10	19	29	38	48	57	67	77	86	96
20	2	4	10	19	38	57	77	96	115	134	153	172	192
30	3	6	14	29	57	86	115	144	172	201	230	259	287
40	4	8	19	38	77	115	153	192	230	268	307	345	383
50	5	10	24	48	96	144	192	239	287	335	383	431	479
60	6	11	29	57	115	172	230	287	345	402	460	517	575
70	7	13	34	67	134	201	268	335	402	469	536	603	671
80	8	15	38	77	153	230	307	383	460	536	613	690	766
90	9	17	43	86	172	259	345	431	517	603	690	776	862
100	10	19	48	96	192	287	383	479	575	671	766	862	958

SPA population = 7,792 breeding adults | < 1% background mortality | > 1% background mortality

	Mortality rate (%)			
Background mortality = 0.105				

Table 8.100 Predicted annual razorbill mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	2	2	3	4	4	5	5	6
2	0	0	1	1	2	4	5	6	7	8	9	11	12
5	0	1	1	3	6	9	12	15	18	21	24	27	30
10	1	1	3	6	12	18	24	30	36	41	47	53	59
20	1	2	6	12	24	36	47	59	71	83	95	107	118
30	2	4	9	18	36	53	71	89	107	124	142	160	178
40	2	5	12	24	47	71	95	118	142	166	189	213	237
50	3	6	15	30	59	89	118	148	178	207	237	266	296
60	4	7	18	36	71	107	142	178	213	249	284	320	355
70	4	8	21	41	83	124	166	207	249	290	332	373	415
80	5	9	24	47	95	142	189	237	284	332	379	426	474
90	5	11	27	53	107	160	213	266	320	373	426	480	533
100	6	12	30	59	118	178	237	296	355	415	474	533	592

SPA population = 7,792 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Puffin

Table 8.101 Predicted annual puffin mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	4	6	8	10	12	13	15	17	19
2	0	1	2	4	8	12	15	19	23	27	31	35	38
5	1	2	5	10	19	29	38	48	58	67	77	86	96
10	2	4	10	19	38	58	77	96	115	134	153	173	192
20	4	8	19	38	77	115	153	192	230	268	307	345	383
30	6	12	29	58	115	173	230	288	345	403	460	518	575
40	8	15	38	77	153	230	307	383	460	537	614	690	767
50	10	19	48	96	192	288	383	479	575	671	767	863	959
60	12	23	58	115	230	345	460	575	690	805	920	1035	1150
70	13	27	67	134	268	403	537	671	805	940	1074	1208	1342
80	15	31	77	153	307	460	614	767	920	1074	1227	1381	1534
90	17	35	86	173	345	518	690	863	1035	1208	1381	1553	1726
100	19	38	96	192	383	575	767	959	1150	1342	1534	1726	1917

	Mortality rate (%)			
SPA population = 90,010 breeding adults Background mortality = 0.094		< 1% background mortality		> 1% background mortality

Table 8.102 Predicted annual puffin mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	4	6	8	10	12	13	15	17	19
2	0	1	2	4	8	12	15	19	23	27	31	35	38
5	1	2	5	10	19	29	38	48	58	67	77	86	96
10	2	4	10	19	38	58	77	96	115	134	153	173	192
20	4	8	19	38	77	115	153	192	230	268	307	345	383
30	6	12	29	58	115	173	230	288	345	403	460	518	575
40	8	15	38	77	153	230	307	383	460	537	614	690	767
50	10	19	48	96	192	288	383	479	575	671	767	863	959
60	12	23	58	115	230	345	460	575	690	805	920	1035	1150
70	13	27	67	134	268	403	537	671	805	940	1074	1208	1342
80	15	31	77	153	307	460	614	767	920	1074	1227	1381	1534
90	17	35	86	173	345	518	690	863	1035	1208	1381	1553	1726
100	19	38	96	192	383	575	767	959	1150	1342	1534	1726	1917

SPA population = 90,010 breeding adults Background mortality = 0.094		< 1% background mortality		> 1% background mortality

Fowlsheugh SPA

Kittiwake

Table 8.103 Predicted annual kittiwake mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	1	1	3	5	10	16	21	26	31	37	42	47	52
2	1	2	5	10	21	31	42	52	63	73	83	94	104
5	3	5	13	26	52	78	104	130	157	183	209	235	261
10	5	10	26	52	104	157	209	261	313	365	417	470	522
20	10	21	52	104	209	313	417	522	626	730	835	939	1043
30	16	31	78	157	313	470	626	783	939	1096	1252	1409	1565
40	21	42	104	209	417	626	835	1043	1252	1461	1669	1878	2087
50	26	52	130	261	522	783	1043	1304	1565	1826	2087	2348	2608
60	31	63	157	313	626	939	1252	1565	1878	2191	2504	2817	3130
70	37	73	183	365	730	1096	1461	1826	2191	2556	2921	3287	3652
80	42	83	209	417	835	1252	1669	2087	2504	2921	3339	3756	4173
90	47	94	235	470	939	1409	1878	2348	2817	3287	3756	4226	4695

	Mortality rate (%)												
100	52	104	261	522	1043	1565	2087	2608	3130	3652	4173	4695	5217

SPA population = 19,310 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.104 Predicted annual kittiwake mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	5	7	10	12	15	17	19	22	24
2	0	1	2	5	10	15	19	24	29	34	39	44	48
5	1	2	6	12	24	36	48	61	73	85	97	109	121
10	2	5	12	24	48	73	97	121	145	170	194	218	242
20	5	10	24	48	97	145	194	242	291	339	388	436	485
30	7	15	36	73	145	218	291	364	436	509	582	655	727
40	10	19	48	97	194	291	388	485	582	679	776	873	970
50	12	24	61	121	242	364	485	606	727	849	970	1091	1212
60	15	29	73	145	291	436	582	727	873	1018	1164	1309	1455
70	17	34	85	170	339	509	679	849	1018	1188	1358	1528	1697
80	19	39	97	194	388	582	776	970	1164	1358	1552	1746	1940
90	22	44	109	218	436	655	873	1091	1309	1528	1746	1964	2182
100	24	48	121	242	485	727	970	1212	1455	1697	1940	2182	2425

SPA population = 19,310 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.105 Predicted annual guillemot mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	1	2	4	9	18	26	35	44	53	62	70	79	88
2	2	4	9	18	35	53	70	88	105	123	141	158	176
5	4	9	22	44	88	132	176	220	264	308	352	396	440
10	9	18	44	88	176	264	352	440	527	615	703	791	879
20	18	35	88	176	352	527	703	879	1055	1231	1406	1582	1758
30	26	53	132	264	527	791	1055	1319	1582	1846	2110	2373	2637
40	35	70	176	352	703	1055	1406	1758	2110	2461	2813	3165	3516
50	44	88	220	440	879	1319	1758	2198	2637	3077	3516	3956	4395
60	53	105	264	527	1055	1582	2110	2637	3165	3692	4219	4747	5274
70	62	123	308	615	1231	1846	2461	3077	3692	4307	4923	5538	6153
80	70	141	352	703	1406	2110	2813	3516	4219	4923	5626	6329	7032
90	79	158	396	791	1582	2373	3165	3956	4747	5538	6329	7120	7911
100	88	176	440	879	1758	2637	3516	4395	5274	6153	7032	7911	8790

	Mortality rate (%)			
SPA population = 74,379 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Table 8.106 Predicted annual guillemot mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	1	1	3	7	14	21	27	34	41	48	55	62	69
2	1	3	7	14	27	41	55	69	82	96	110	123	137
5	3	7	17	34	69	103	137	171	206	240	274	309	343
10	7	14	34	69	137	206	274	343	411	480	549	617	686
20	14	27	69	137	274	411	549	686	823	960	1097	1234	1371
30	21	41	103	206	411	617	823	1029	1234	1440	1646	1851	2057
40	27	55	137	274	549	823	1097	1371	1646	1920	2194	2469	2743
50	34	69	171	343	686	1029	1371	1714	2057	2400	2743	3086	3429
60	41	82	206	411	823	1234	1646	2057	2469	2880	3292	3703	4114
70	48	96	240	480	960	1440	1920	2400	2880	3360	3840	4320	4800
80	55	110	274	549	1097	1646	2194	2743	3292	3840	4389	4937	5486
90	62	123	309	617	1234	1851	2469	3086	3703	4320	4937	5554	6172
100	69	137	343	686	1371	2057	2743	3429	4114	4800	5486	6172	6857

SPA population = 74,379 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Razorbill

Table 8.107 Predicted annual razorbill mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	1	1	3	6	9	12	15	18	21	24	27	29
2	1	1	3	6	12	18	24	29	35	41	47	53	59
5	1	3	7	15	29	44	59	74	88	103	118	133	147
10	3	6	15	29	59	88	118	147	177	206	236	265	295
20	6	12	29	59	118	177	236	295	354	413	472	531	590
30	9	18	44	88	177	265	354	442	531	619	708	796	885
40	12	24	59	118	236	354	472	590	708	826	944	1062	1180
50	15	29	74	147	295	442	590	737	885	1032	1180	1327	1475
60	18	35	88	177	354	531	708	885	1062	1239	1416	1593	1770
70	21	41	103	206	413	619	826	1032	1239	1445	1652	1858	2065
80	24	47	118	236	472	708	944	1180	1416	1652	1888	2124	2360
90	27	53	133	265	531	796	1062	1327	1593	1858	2124	2389	2655
100	29	59	147	295	590	885	1180	1475	1770	2065	2360	2655	2950

SPA population = 9,950 breeding adults | < 1% background mortality | > 1% background mortality

	Mortality rate (%)			
Background mortality = 0.105				

Table 8.108 Predicted annual razorbill mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	4	5	7	9	11	13	15	16	18
2	0	1	2	4	7	11	15	18	22	26	29	33	36
5	1	2	5	9	18	27	36	46	55	64	73	82	91
10	2	4	9	18	36	55	73	91	109	128	146	164	182
20	4	7	18	36	73	109	146	182	219	255	292	328	365
30	5	11	27	55	109	164	219	274	328	383	438	492	547
40	7	15	36	73	146	219	292	365	438	511	584	656	729
50	9	18	46	91	182	274	365	456	547	638	729	821	912
60	11	22	55	109	219	328	438	547	656	766	875	985	1094
70	13	26	64	128	255	383	511	638	766	894	1021	1149	1276
80	15	29	73	146	292	438	584	729	875	1021	1167	1313	1459
90	16	33	82	164	328	492	656	821	985	1149	1313	1477	1641
100	18	36	91	182	365	547	729	912	1094	1276	1459	1641	1824

SPA population = 9,950 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

St Abb's to Fast Castle SPA

Kittiwake

Table 8.109 Predicted annual kittiwake mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	2	3	4	5	6	6	7	8	9
2	0	0	1	2	4	6	7	9	11	13	15	17	18
5	0	1	2	5	9	14	18	23	28	32	37	42	46
10	1	2	5	9	18	28	37	46	55	65	74	83	92
20	2	4	9	18	37	55	74	92	111	129	148	166	185
30	3	6	14	28	55	83	111	138	166	194	222	249	277
40	4	7	18	37	74	111	148	185	222	258	295	332	369
50	5	9	23	46	92	138	185	231	277	323	369	415	462
60	6	11	28	55	111	166	222	277	332	388	443	499	554
70	6	13	32	65	129	194	258	323	388	452	517	582	646
80	7	15	37	74	148	222	295	369	443	517	591	665	739
90	8	17	42	83	166	249	332	415	499	582	665	748	831

	Mortality rate (%)												
100	9	18	46	92	185	277	369	462	554	646	739	831	923

SPA population = 9,606 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Table 8.110 Predicted annual kittiwake mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	2	2	3	3	4	4	4
2	0	0	0	1	2	3	4	4	5	6	7	8	9
5	0	0	1	2	4	7	9	11	13	15	18	20	22
10	0	1	2	4	9	13	18	22	26	31	35	40	44
20	1	2	4	9	18	26	35	44	53	61	70	79	88
30	1	3	7	13	26	40	53	66	79	92	105	119	132
40	2	4	9	18	35	53	70	88	105	123	141	158	176
50	2	4	11	22	44	66	88	110	132	154	176	198	220
60	3	5	13	26	53	79	105	132	158	184	211	237	263
70	3	6	15	31	61	92	123	154	184	215	246	277	307
80	4	7	18	35	70	105	141	176	211	246	281	316	351
90	4	8	20	40	79	119	158	198	237	277	316	356	395
100	4	9	22	44	88	132	176	220	263	307	351	395	439

SPA population = 9,606 breeding adults Background mortality = 0.146		< 1% background mortality		> 1% background mortality

Guillemot

Table 8.111 Predicted annual guillemot mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	4	7	9	11	13	15	18	20	22
2	0	1	2	4	9	13	18	22	27	31	35	40	44
5	1	2	6	11	22	33	44	55	66	77	88	99	110
10	2	4	11	22	44	66	88	110	133	155	177	199	221
20	4	9	22	44	88	133	177	221	265	309	354	398	442
30	7	13	33	66	133	199	265	331	398	464	530	597	663
40	9	18	44	88	177	265	354	442	530	619	707	795	884
50	11	22	55	110	221	331	442	552	663	773	884	994	1105
60	13	27	66	133	265	398	530	663	795	928	1061	1193	1326
70	15	31	77	155	309	464	619	773	928	1083	1237	1392	1547
80	18	35	88	177	354	530	707	884	1061	1237	1414	1591	1768
90	20	40	99	199	398	597	795	994	1193	1392	1591	1790	1989
100	22	44	110	221	442	663	884	1105	1326	1547	1768	1989	2210

SPA population = 36,206 breeding adults | < 1% background mortality | > 1% background mortality

	Mortality rate (%)			
Background mortality = 0.061				

Table 8.112 Predicted annual guillemot mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	1	2	3	5	7	9	10	12	14	16	17
2	0	1	2	3	7	10	14	17	21	24	28	31	34
5	1	2	4	9	17	26	34	43	52	60	69	78	86
10	2	3	9	17	34	52	69	86	103	121	138	155	172
20	3	7	17	34	69	103	138	172	207	241	276	310	345
30	5	10	26	52	103	155	207	259	310	362	414	465	517
40	7	14	34	69	138	207	276	345	414	483	552	621	689
50	9	17	43	86	172	259	345	431	517	603	689	776	862
60	10	21	52	103	207	310	414	517	621	724	827	931	1034
70	12	24	60	121	241	362	483	603	724	845	965	1086	1207
80	14	28	69	138	276	414	552	689	827	965	1103	1241	1379
90	16	31	78	155	310	465	621	776	931	1086	1241	1396	1551
100	17	34	86	172	345	517	689	862	1034	1207	1379	1551	1724

SPA population = 36,206 breeding adults Background mortality = 0.061		< 1% background mortality		> 1% background mortality

Razorbill

Table 8.113 Predicted annual razorbill mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (including data from July 2017).

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	1	2	2	3	3	3	4
2	0	0	0	1	1	2	3	4	4	5	6	7	7
5	0	0	1	2	4	6	7	9	11	13	15	17	19
10	0	1	2	4	7	11	15	19	22	26	30	34	37
20	1	1	4	7	15	22	30	37	45	52	60	67	75
30	1	2	6	11	22	34	45	56	67	78	90	101	112
40	1	3	7	15	30	45	60	75	90	105	120	134	149
50	2	4	9	19	37	56	75	93	112	131	149	168	187
60	2	4	11	22	45	67	90	112	134	157	179	202	224
70	3	5	13	26	52	78	105	131	157	183	209	235	261
80	3	6	15	30	60	90	120	149	179	209	239	269	299
90	3	7	17	34	67	101	134	168	202	235	269	303	336
100	4	7	19	37	75	112	149	187	224	261	299	336	374

	Mortality rate (%)			
SPA population = 2,067 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

Table 8.114 Predicted annual razorbill mortality as a result of displacement from Project Alpha and Project Bravo combined plus a 2 km buffer (excluding data from July 2017)

	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	1	1	1	1	2	2	2	2
2	0	0	0	0	1	1	2	2	3	3	4	4	5
5	0	0	1	1	2	3	5	6	7	8	9	10	12
10	0	0	1	2	5	7	9	12	14	16	18	21	23
20	0	1	2	5	9	14	18	23	28	32	37	42	46
30	1	1	3	7	14	21	28	35	42	48	55	62	69
40	1	2	5	9	18	28	37	46	55	65	74	83	92
50	1	2	6	12	23	35	46	58	69	81	92	104	115
60	1	3	7	14	28	42	55	69	83	97	111	125	139
70	2	3	8	16	32	48	65	81	97	113	129	145	162
80	2	4	9	18	37	55	74	92	111	129	148	166	185
90	2	4	10	21	42	62	83	104	125	145	166	187	208
100	2	5	12	23	46	69	92	115	139	162	185	208	231

SPA population = 2,067 breeding adults Background mortality = 0.105		< 1% background mortality		> 1% background mortality

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