Shannon Bridge Crossing
Route Selection Report
Volume C - Appendices

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NDP
NATIONAL DEVELOPMENT PLAN

RPS Consulting Engineers

APPENDICES

APPENDIX A

MODEL TRAFFIC VOLUMES

Table A.1: 2007 AM Peak hour flow comparison, 2-way, cars and LGV's

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**
R494	238	236	236	245	245	245	245	245	245	245	245	245	245
N7 (north)	954	1,001	1,001	1,040	1,040	1,040	1,040	1,040	1,040	1,040	1,040	1,040	1,040
R503	490	494	494	513	513	513	513	513	513	513	513	513	513
N7 (south)	1,445	1,459	1,459	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518
R463	396	418	418	434	434	434	434	434	434	434	434	434	434
R466	167	173	173	181	181	181	181	181	181	181	181	181	181
R463	302	307	307	319	319	319	319	319	319	319	319	319	319
Killaloe Bridge	571	577	511	519	517	497	498	464	442	337	282	421	282
Montpelier Bridge	386	390	444	475	226	267	299	350	354	388	386	408	210
New crossing	0	0	0	0	250	229	196	189	207	281	340	172	515
All crossings	957	967	955	994	993	993	993	1,003	1,003	1,006	1,008	1,001	1,007

Table A.2: 2007 AM Peak hour flow comparison, 2-way, HGV's

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	2,007
R494	13	13	13	13	13	13	13	13	13	13	13	13	13
N7 (north)	179	179	179	186	186	186	186	186	186	186	186	186	186
R503	17	13	13	14	14	14	14	14	14	14	14	14	14
N7 (south)	227	225	225	234	234	234	234	234	234	234	234	234	234
R463	21	21	21	21	21	21	21	21	21	21	21	21	21
R466	38	38	38	40	40	40	40	40	40	40	40	40	40
R463	31	31	31	32	32	32	32	32	32	32	32	32	32
Killaloe Bridge	32	32	32	33	33	34	33	28	32	18	11	18	11
Montpelier Bridge	46	54	54	56	31	39	46	47	46	53	50	56	29
New crossing	0	0	0	0	25	17	10	13	10	18	27	15	48
All crossings	78	86	86	89	89	90	89	88	88	89	88	89	88

Table A.3: 2007 AM Peak hour flow comparison, 2-way, car and LGV's + 2xHGV's (PCU's)

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**
R494	264	262	262	271	271	271	271	271	271	271	271	271	271
N7 (north)	1,312	1,359	1,359	1,412	1,412	1,412	1,412	1,412	1,412	1,412	1,412	1,412	1,412
R503	524	520	520	541	541	541	541	541	541	541	541	541	541
N7 (south)	1,899	1,909	1,909	1,986	1,986	1,986	1,986	1,986	1,986	1,986	1,986	1,986	1,986
R463	438	460	460	476	476	476	476	476	476	476	476	476	476
R466	243	249	249	261	261	261	261	261	261	261	261	261	261
R463	364	369	369	383	383	383	383	383	383	383	383	383	383
Killaloe Bridge	635	641	575	585	583	565	564	520	506	373	304	457	304
Montpelier Bridge	478	498	552	587	288	345	391	444	446	494	486	520	268
New crossing	0	0	0	0	300	263	216	215	227	317	394	202	611
All crossings	1,113	1,139	1,127	1,172	1,171	1,173	1,171	1,179	1,179	1,184	1,184	1,179	1,183
% on new crossing					26%	22%	18%	18%	19%	27%	33%	17%	52%

Table A.4: 2007 AADT flow comparison, 2-way, cars and LGV's

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**
R494	2,261	2,242	2,242	2,328	2,328	2,328	2,328	2,328	2,328	2,328	2,328	2,328	2,328
N7 (north)	9,063	9,510	9,510	9,880	9,880	9,880	9,880	9,880	9,880	9,880	9,880	9,880	9,880
R503	4,655	4,693	4,693	4,874	4,874	4,874	4,874	4,874	4,874	4,874	4,874	4,874	4,874
N7 (south)	13,728	13,861	13,861	14,421	14,421	14,421	14,421	14,421	14,421	14,421	14,421	14,421	14,421
R463	3,762	3,971	3,971	4,123	4,123	4,123	4,123	4,123	4,123	4,123	4,123	4,123	4,123
R466	1,587	1,644	1,644	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720
R463	2,869	2,917	2,917	3,031	3,031	3,031	3,031	3,031	3,031	3,031	3,031	3,031	3,031
Killaloe Bridge	5,425	5,482	4,855	4,931	4,912	4,722	4,731	4,408	4,199	3,202	2,679	4,000	2,679
Montpelier Bridge	3,667	3,705	4,218	4,513	2,147	2,537	2,841	3,325	3,363	3,686	3,667	3,876	1,995
New crossing	0	0	0	0	2,375	2,176	1,862	1,796	1,967	2,670	3,230	1,634	4,893
All crossings	9,092	9,187	9,073	9,443	9,434	9,434	9,434	9,529	9,529	9,557	9,576	9,510	9,567

Table A.5: 2007 AADT flow comparison, 2-way, HGV's

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**
R494	124	124	124	124	124	124	124	124	124	124	124	124	124
N7 (north)	1,701	1,701	1,701	1,767	1,767	1,767	1,767	1,767	1,767	1,767	1,767	1,767	1,767
R503	162	124	124	133	133	133	133	133	133	133	133	133	133
N7 (south)	2,157	2,138	2,138	2,223	2,223	2,223	2,223	2,223	2,223	2,223	2,223	2,223	2,223
R463	200	200	200	200	200	200	200	200	200	200	200	200	200
R466	361	361	361	380	380	380	380	380	380	380	380	380	380
R463	295	295	295	304	304	304	304	304	304	304	304	304	304
Killaloe Bridge	304	304	304	314	314	323	314	266	304	171	105	171	105
Montpelier Bridge	437	513	513	532	295	371	437	447	437	504	475	532	276
New crossing	0	0	0	0	238	162	95	124	95	171	257	143	456
All crossings	741	817	817	846	846	855	846	836	836	846	836	846	836

Table A.6: 2007 AADT flow comparison, 2-way, car and LGV's + 2xHGV's (PCU's)

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**	**2007**
R494	2,508	2,489	2,489	2,575	2,575	2,575	2,575	2,575	2,575	2,575	2,575	2,575	2,575
N7 (north)	12,464	12,911	12,911	13,414	13,414	13,414	13,414	13,414	13,414	13,414	13,414	13,414	13,414
R503	4,978	4,940	4,940	5,140	5,140	5,140	5,140	5,140	5,140	5,140	5,140	5,140	5,140
N7 (south)	18,041	18,136	18,136	18,867	18,867	18,867	18,867	18,867	18,867	18,867	18,867	18,867	18,867
R463	4,161	4,370	4,370	4,522	4,522	4,522	4,522	4,522	4,522	4,522	4,522	4,522	4,522
R466	2,309	2,366	2,366	2,480	2,480	2,480	2,480	2,480	2,480	2,480	2,480	2,480	2,480
R463	3,458	3,506	3,506	3,639	3,639	3,639	3,639	3,639	3,639	3,639	3,639	3,639	3,639
Killaloe Bridge	6,033	6,090	5,463	5,558	5,539	5,368	5,358	4,940	4,807	3,544	2,888	4,342	2,888
Montpelier Bridge	4,541	4,731	5,244	5,577	2,736	3,278	3,715	4,218	4,237	4,693	4,617	4,940	2,546
New crossing	0	0	0	0	2,850	2,499	2,052	2,043	2,157	3,012	3,743	1,919	5,805
All crossings	10,574	10,821	10,707	11,134	11,125	11,144	11,125	11,201	11,201	11,248	11,248	11,201	11,239
% on new crossing					26%	22%	18%	18%	19%	27%	33%	17%	52%

Table A.7: 2022 AM Peak hour flow comparison, 2-way, cars and LGV's

Location	Observed Flows	Model Network											
		Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**
R494	238	236	236	291	291	291	291	291	291	291	291	291	291
N7 (north)	954	1,001	1,001	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230
R503	490	494	494	606	606	606	606	606	606	606	606	606	606
N7 (south)	1,445	1,459	1,459	1,795	1,795	1,795	1,795	1,795	1,795	1,795	1,795	1,795	1,795
R463	396	418	418	514	514	514	514	514	514	514	514	514	514
R466	167	173	173	213	213	213	213	213	213	213	213	213	213
R463	302	307	307	377	377	377	377	377	377	377	377	377	377
Killaloe Bridge	571	577	511	621	614	611	605	583	461	378	332	464	332
Montpelier Bridge	386	390	444	561	273	306	352	388	401	426	419	447	251
New crossing	0	0	0	0	293	267	226	223	349	411	463	299	637
All crossings	957	967	955	1,182	1,180	1,184	1,183	1,194	1,211	1,215	1,214	1,210	1,220

Table A.8: 2022 AM Peak hour flow comparison, 2-way, HGV's

Location	Observed Flows	Model Network											
		Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**
R494	13	13	13	18	18	18	18	18	18	18	18	18	18
N7 (north)	179	179	179	223	223	223	223	223	223	223	223	223	223
R503	17	13	13	17	17	17	17	17	17	17	17	17	17
N7 (south)	227	225	225	279	279	279	279	279	279	279	279	279	279
R463	21	21	21	26	26	26	26	26	26	26	26	26	26
R466	38	38	38	47	47	47	47	47	47	47	47	47	47
R463	31	31	31	39	39	39	39	39	39	39	39	39	39
Killaloe Bridge	32	32	32	40	40	40	39	34	38	21	14	21	14
Montpelier Bridge	46	54	54	66	36	47	54	56	55	63	60	66	35
New crossing	0	0	0	0	30	19	12	16	12	22	32	18	57
All crossings	78	86	86	106	106	106	105	106	105	106	106	105	106

Table A.9: 2022 AM Peak hour flow comparison, 2-way, cars and LGV's + 2xHGV's (PCU's)

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**
R494	264	262	262	327	327	327	327	327	327	327	327	327	327
N7 (north)	1,312	1,359	1,359	1,676	1,676	1,676	1,676	1,676	1,676	1,676	1,676	1,676	1,676
R503	524	520	520	640	640	640	640	640	640	640	640	640	640
N7 (south)	1,899	1,909	1,909	2,353	2,353	2,353	2,353	2,353	2,353	2,353	2,353	2,353	2,353
R463	438	460	460	566	566	566	566	566	566	566	566	566	566
R466	243	249	249	307	307	307	307	307	307	307	307	307	307
R463	364	369	369	455	455	455	455	455	455	455	455	455	455
Killaloe Bridge	635	641	575	701	694	691	683	651	537	420	360	506	360
Montpelier Bridge	478	498	552	693	345	400	460	500	511	552	539	579	321
New crossing	0	0	0	0	353	305	250	255	373	455	527	335	751
All crossings	1,113	1,139	1,127	1,394	1,392	1,396	1,393	1,406	1,421	1,427	1,426	1,420	1,432
% on new crossing					25%	22%	18%	18%	26%	32%	37%	24%	52%

Table A.10: 2022 AADT flow comparison, 2-way, cars and LGV's

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	**2005**	**2005**	**2005**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**	**2022**
R494	2,261	2,242	2,242	2,765	2,765	2,765	2,765	2,765	2,765	2,765	2,765	2,765	2,765
N7 (north)	9,063	9,510	9,510	11,685	11,685	11,685	11,685	11,685	11,685	11,685	11,685	11,685	11,685
R503	4,655	4,693	4,693	5,757	5,757	5,757	5,757	5,757	5,757	5,757	5,757	5,757	5,757
N7 (south)	13,728	13,861	13,861	17,053	17,053	17,053	17,053	17,053	17,053	17,053	17,053	17,053	17,053
R463	3,762	3,971	3,971	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883	4,883
R466	1,587	1,644	1,644	2,024	2,024	2,024	2,024	2,024	2,024	2,024	2,024	2,024	2,024
R463	2,869	2,917	2,917	3,582	3,582	3,582	3,582	3,582	3,582	3,582	3,582	3,582	3,582
Killaloe Bridge	5,425	5,415	5,482	5,900	5,833	5,805	5,748	5,539	4,380	3,591	3,154	4,408	3,154
Montpelier Bridge	3,667	3,705	3,705	5,330	2,594	2,907	3,344	3,686	3,810	4,047	3,981	4,247	2,385
New crossing	0	0	0	0	2,784	2,537	2,147	2,119	3,316	3,905	4,399	2,841	6,052
All crossings	9,092	9,120	9,187	11,229	11,210	11,248	11,239	11,343	11,505	11,543	11,533	11,495	11,590

Table A.11: 2022 AADT flow comparison, 2-way, HGV's

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	2005	2005	2005	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022
R494	124	124	124	171	171	171	171	171	171	171	171	171	171
N7 (north)	1,701	1,701	1,701	2,119	2,119	2,119	2,119	2,119	2,119	2,119	2,119	2,119	2,119
R503	162	124	124	162	162	162	162	162	162	162	162	162	162
N7 (south)	2,157	2,138	2,138	2,651	2,651	2,651	2,651	2,651	2,651	2,651	2,651	2,651	2,651
R463	200	200	200	247	247	247	247	247	247	247	247	247	247
R466	361	361	361	447	447	447	447	447	447	447	447	447	447
R463	295	295	295	371	371	371	371	371	371	371	371	371	371
Killaloe Bridge	304	304	304	380	380	380	371	323	361	200	133	200	133
Montpelier Bridge	437	513	513	627	342	447	513	532	523	599	570	627	333
New crossing	0	0	0	0	285	181	114	152	114	209	304	171	542
All crossings	741	817	817	1,007	1,007	1,007	998	1,007	998	1,007	1,007	998	1,007

Table A.12: 2022 AADT flow comparison, 2-way, cars and LGV's + 2xHGV's (PCU's)

Location	Observed	Model Network											
	Flows	Base	Signals	Do min	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 7+1
Year	2005	2005	2005	2022	2022	2022	2022	2022	2022	2022	2022	2022	2022
R494	2,508	2,489	2,489	3,107	3,107	3,107	3,107	3,107	3,107	3,107	3,107	3,107	3,107
N7 (north)	12,464	12,911	12,911	15,922	15,922	15,922	15,922	15,922	15,922	15,922	15,922	15,922	15,922
R503	4,978	4,940	4,940	6,080	6,080	6,080	6,080	6,080	6,080	6,080	6,080	6,080	6,080
N7 (south)	18,041	18,136	18,136	22,354	22,354	22,354	22,354	22,354	22,354	22,354	22,354	22,354	22,354
R463	4,161	4,370	4,370	5,377	5,377	5,377	5,377	5,377	5,377	5,377	5,377	5,377	5,377
R466	2,309	2,366	2,366	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917
R463	3,458	3,506	3,506	4,323	4,323	4,323	4,323	4,323	4,323	4,323	4,323	4,323	4,323
Killaloe Bridge	6,033	6,090	5,463	6,660	6,593	6,565	6,489	6,185	5,102	3,990	3,420	4,807	3,420
Montpelier Bridge	4,541	4,731	5,244	6,584	3,278	3,800	4,370	4,750	4,855	5,244	5,121	5,501	3,050
New crossing	0	0	0	0	3,354	2,898	2,375	2,423	3,544	4,323	5,007	3,183	7,135
All crossings	10,574	10,821	10,707	13,243	13,224	13,262	13,234	13,357	13,500	13,557	13,547	13,490	13,604
% on new crossing					25%	22%	18%	18%	26%	32%	37%	24%	52%

APPENDIX B

SCIENTIFIC NAMES OF PLANTS AND ANIMALS MENTIONED IN THE TEXT

Plants

Common Name	Scientific Name
Alder	*Alnus glutinosa*
Annual Knawel	*Scleranthus annuus*
Ash	*Fraxinus excelsior*
Bearded Stonewort	*Chara canescens*
Beech	*Fagus sylvatica*
Bents	*Agrostis* spp.
Birch	*Betula* sp.
Bird Cherry	*Prunus padus*
Common Knapweed	*Centaurea nigra*
Cock's-foot	*Dactylis glomerata*
Common Reedmace	*Typha latifolia*
Convergent Stonewort	*Chara conivens*
Cowslip	*Primula veris*
Creeping Bent	*Agrostis stolonifera*
Creeping Buttercup	*Ranunculus repens*
Creeping Thistle	*Cirsium arvense*
Crested Dogstail	*Cyanosaurus cristatus*
Devil's-bit Scabious	*Succisa pratensis*
Downy birch	*Betula pubescens*
Golden Dock	*Rumex maritimus L.*
Great Sweet-grass	*Glyceria maxima*
Greater Bird's-foot Trefoil	*Lotus pedunculatus*
Grey Willow	*Salix cinerea*
Hairy Violet	*Viola hirta*
Hawthorn	*Crataegus monogyna*
Heath Cudweed	*Gnaphalium sylvaticum*
Holly	*Ilex aquifolium*
Horse-chestnut	*Aesculus hippocastanum*
Meadowsweet	*Filipendula ulmaria*
Opposite-leaved Pondweed	*Groenlandia densa*
Pedunculate Oak	*Quercus robur*
Ribwort Plantain	*Plantago lanceolata*
Rye-grasses	*Lolium* spp.
Sessile Oak	*Quearcus petrea*
Sharp-flowered Rush	*Juncus acutiflorus*
Soft Rush	*Juncus effusus*
Sweet Vernal-grass	*Anthoxanthum odoratum*
Sycamore	*Acer psuedoplantanus*
Triangular Club-rush	*Scirpus triqueter*
Tufted Hair-grass	*Deschampsia cespitosa*
Yellow Iris	*Iris pseudacorus*
Yorkshire Fog	*Holcus lanatus*

Mammals

Common Name	Scientific Name
Badger	*Meles meles*
Bottle-nosed dolphin	*Tursiops truncatus*
Brown Long Earred	*Plecotus auritus*
Common Pipestrelle	*Pipistrellus pipistrellus*
Daubenton's Bat	*Myotis daubentoni*
Hedgehog	*Erinaceus europaeus*
Irish Hare	*Lepus timidus hibernicus*
Irish Stoat	*Mustela erminea*
Leisler's Bat	*Nyctalus leisleri*
Lesser Horseshoe Bat	*Rhinolophus hipposideros*
Natterer's bat	*Myotis nattereri*
Otter	*Lutra lutra*
Pine Marten	*Martes Martes*
Pygmy Shrew	*Sorex minutes*
Red Deer	*Cervus elaphus*
Red Squirrel	*Sciurus vulgaris*
Soprano Pipestrelle	*Pipistrellus pygmaeus*
Whiskered Bat	*Myotis mystacinus*

Birds

Common Name	***Scientific Name***
Barn Owl	*Tyto alba*
Bewick's Swan	*Cygnus columbianus*
Blackcap	*Sylvia atricapilla*
Common Tern	*Sterna hirundo*
Corncrake	*Crex crex*
Curlew	*Numenius arquata*
Golden Plover	*Pluvialis apricaria*
Great Crested Grebe	*Podiceps cristatus*
Greenland White-fronted Goose	*Anser albifrons flavirostris*
Hen Harrier	*Circus cyaneus*
Jay	*Garrulus glandarius*
Kingfisher	*Alcedo atthis*
Lapwing	*Vanellus vanellus*
Little Grebe	*Tachybaptus ruficollis*
Mute Swan	*Cygnus olor*
Peregrine	*Falco peregrinus*
Sandwich Tern	*Sterna sandvicensis*
Treecreeper	*Certhia familiaris*
Whooper Swan	*Cygnus cygnus*

FISH

Common Name	***Scientific Name***
Atlantic salmon	*Salmo salar*
Brook lamprey	*Lampetra planeri*
River lamprey	*Lampetra fluviatilis*
Sea lamprey	*Petromyzon marinus*
Twaite shad	*Alosa fallax fallax*

APPENDIX C

NATIONAL PARKS AND WILDLIFE SERVICE SITE SYNOPSIS OF LOWER RIVER SHANNON cSAC

SITE NAME : LOWER RIVER SHANNON

SITE CODE : 2165

This very large site stretches along the Shannon valley from Killaloe to Loop Head/ Kerry Head, a distance of some 120 km. The site thus encompasses the Shannon and Fergus Estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick) and the marine area between Loop Head and Kerry Head. The Shannon and Fergus flow through Carboniferous limestone as far as Foynes, but west of Foynes Namurian shales and flagstones predominate (except at Kerry Head, which is formed from Old Red Sandstone).

The site is of high ecological interest, containing a number of habitats listed on Annex I of the EU Habitats Directive. Of these, one is a priority habitat: Lagoons. The site also supports a range of mammals, fish and invertebrates listed on Annex II of the EU Habitats Directive. Most of the estuarine part of the site has been designated a Special Protection Area (SPA), under the EU Birds Directive, primarily to protect the large numbers of migratory birds present in winter.

The Shannon and Fergus Estuaries form the largest estuarine complex in Ireland. They form a unit stretching from the upper tidal limits of the Shannon and Fergus Rivers to the mouth of the Shannon estuary (considered to be a line across the narrow strait between Kilcredaun Point and Kilconly Point). Within this main unit there are several tributaries with their own 'sub-estuaries' e.g. the Deel River and Maigue River. To the west of Foynes, a number of small estuaries form indentations in the predominantly hard coastline, namely Poulnasherry Bay, Ballylongford Bay, Clonderalaw Bay and the Feale or Cashen River Estuary.

Both the Fergus and inner Shannon estuaries feature vast expanses of intertidal mudflats, often fringed with saltmarsh vegetation. The smaller estuaries also feature mudflats, but have their own unique characteristics, e.g. Poulnasherry Bay is stony and unusually rich in species and biotopes. Plant species are typically scarce on the mudflats, although there are some Eel-grass beds (*Zostera* spp.) and patches of green algae (e.g. *Ulva* sp. and *Enteromorpha* sp.). The main macro-invertebrate community, which has been noted from the inner Shannon and Fergus estuaries, is a *Macoma-Scrobicularia-Nereis* community.

In the transition zone between mudflats and saltmarsh, specialised colonisers of mud predominate: swards of Common Cord-grass (*Spartina anglica*) frequently occur in the upper parts of the estuaries. Less common are swards of Glasswort (*Salicornia europaea* agg.). In the innermost parts of the estuaries, the tidal channels or creeks are fringed with species such as Common Reed (*Phragmites australis*) and Club-rushes (*Scirpus maritimus, S. tabernaemontani* and *S. triqueter*). In addition to the nationally rare Triangular Club-rush (*Scirpus triqueter*), two scarce species are found in some of these creeks (e.g. Ballinacurra Creek): Lesser Bulrush (*Typha angustifolia*) and Summer Snowflake (*Leucojum aestivum*).

Saltmarsh vegetation frequently fringes the mudflats. Over twenty areas of estuarine saltmarsh have been identified within the site, the most important of which are around the Fergus Estuary and at Ringmoylan Quay. The dominant type of saltmarsh present is Atlantic salt meadow occurring over mud. Characteristic species occurring include Common Saltmarsh Grass (*Puccinellia maritima*), Sea Aster (*Aster tripolium*), Thrift (*Armeria maritima*), Sea-milkwort (*Glaux maritima*), Sea Plantain (*Plantago maritima*), Red Fescue (*Festuca rubra*), Creeping Bent (*Agrostis stolonifera*), Saltmarsh Rush (*Juncus gerardi*), Long-bracted Sedge (*Carex extensa*), Lesser Sea-spurrey (*Spergularia marina*) and Sea Arrowgrass (*Triglochin maritima*). Areas of Mediterranean salt meadows, characterised by clumps of Sea Rush (*Juncus maritimus*) occur occasionally. Two scarce species are found on saltmarshes in the vicinity of the Fergus Estuary: a type of robust Saltmarsh-grass

(*Puccinellia foucaudii*), sometimes placed within the compass of Common Saltmarsh-grass (*Puccinellia maritima*) and Hard-grass (*Parapholis strigosa*).

Saltmarsh vegetation also occurs around a number of lagoons within the site. The two which have been surveyed as part of a National Inventory of Lagoons are Shannon Airport Lagoon and Cloonconeen Pool. Cloonconeen Pool (4-5 ha) is a natural sedimentary lagoon impounded by a low cobble barrier. Seawater enters by percolation through the barrier and by overwash. This lagoon represents a type which may be unique to Ireland since the substrate is composed almost entirely of peat. the adjacent shore features one of the best examples of a drowned forest in Ireland. Aquatic vegetation in the lagoon includes typical species such as Beaked Tasselweed (*Ruppia maritima*) and green algae (*Cladophora* sp.). The fauna is not diverse, but is typical of a high salinity lagoon and includes six lagoon specialists (*Hydrobia ventrosa, Cerastoderma glaucum, Lekanesphaera hookeri, Palaemonetes varians, Sigara stagnalis* and *Enochrus bicolor*). In contrast, Shannon Airport Lagoon (2 ha) is an artificial saline lake with an artificial barrier and sluiced outlet. However, it supports two Red Data Book species of Stonewort (*Chara canescens* and *Chara cf. connivens*).

Most of the site west of Kilcredaun Point/Kilconly Point is bounded by high rocky sea cliffs. The cliffs in the outer part of the site are sparsely vegetated with lichens, Red Fescue, Sea Beet (*Beta vulgaris*), Sea Campion (*Silene maritima*), Thrift and Plantains (*Plantago* spp.). A rare endemic Sea Lavender (*Limonium recurvum* subsp. *pseudotranswallinum*) occurs on cliffs near Loop Head. Cliff-top vegetation usually consists of either grassland or maritime heath. The boulder clay cliffs further up the estuary tend to be more densely vegetated, with swards of Red Fescue and species such as Kidney Vetch (*Anthyllis vulneraria*) and Bird's-foot Trefoil (*Lotus corniculatus*).

Other coastal habitats that occur within the site include the following:

- stony beaches and bedrock shores - these shores support a typical zonation of seaweeds (*Fucus* spp., *Ascophyllum nodosum* and kelps).
- shingle beaches - the more stable areas of shingle support characteristic species such as Sea Beet, Sea Mayweed (*Matricaria maritima*), Sea Campion and Curled Dock (*Rumex crispus*).
- sand dunes - a small area of sand dunes occurs at Beal Point. The dominant species is Marram Grass (*Ammophila arenaria*).

Flowing into the estuaries are a number of tidal rivers. In some cases non-tidal portions of the rivers have been included in the site, most notably the Shannon from Killaloe to Limerick (along with some of its tributaries, such as the Mulkear River and the Kilmastulla River), the Fergus up as far as Ennis, and the Cloon River. The three rivers are very different in character: the Shannon being broad, generally slow-flowing and naturally eutrophic; the Fergus being smaller and alkaline; while the narrow, fast-flowing Cloon is acid in nature. Semi-natural habitats, such as wet grassland, wet woodland and marsh occur by the rivers, however, improved grassland is most common.

Woodland is infrequent within the site, however Cahiracon Wood contains a strip of old Oak woodland. Sessile Oak (*Quercus petraea*) forms the canopy, with an understorey of Hazel (*Corylus avellana*) and Holly (*Ilex aquifolium*). Great Wood-rush (*Luzula sylvatica*) dominates the ground flora. Less common species present include Great Horsetail (*Equisetum telmeteia*) and Pendulous Sedge (*Carex pendula*).

A number of plant species that are Irish Red Data Book species occur within the site - several are protected under the Flora (Protection) Order, 1999:

- Triangular Club-rush (*Scirpus triqueter*) - in Ireland this protected species is only found in the Shannon Estuary, where it borders creeks in the inner estuary.

- Opposite-leaved Pondweed (*Groenlandia densa*) - this protected pondweed is found in the Shannon where it passes through Limerick City.
- Meadow Barley (*Hordeum secalinum*) - this protected species is abundant in saltmarshes at Ringmoylan and Mantlehill.
- Hairy Violet (*Viola hirta*) - this protected violet occurs in the Askeaton/Foynes area.
- Golden Dock (*Rumex maritimus*) - noted as occurring in the River Fergus Estuary.
- Bearded Stonewort (*Chara canescens*) - a brackish water specialist found in Shannon Airport lagoon.
- Convergent Stonewort (*Chara connivens*) - presence in Shannon Airport Lagoon to be confirmed.

Overall, the Shannon and Fergus Estuaries support the largest numbers of wintering waterfowl in Ireland. The highest count in 1995-96 was 51,423 while in 1994-95 it was 62,701. Species listed on Annex I of the EU Birds Directive which contributed to these totals include: Great Northern Diver (3; 1994/95), Whooper Swan (201; 1995/96), Pale-bellied Brent Goose (246; 1995/96), Golden Plover (11,067; 1994/95) and Bar-tailed Godwit (476; 1995/96). In the past, three separate flocks of Greenland White-fronted Goose were regularly found but none were seen in 1993/94.

Other wintering waders and wildfowl present include Greylag Goose (216; 1995/96), Shelduck (1,060; 1995/96), Wigeon (5,976; 1995/96); Teal (2,319; 1995-96); Mallard (528; 1995/96), Pintail (45; 1995/96), Shoveler (84; 1995/96), Tufted Duck (272; 1995/96), Scaup (121; 1995/96), Ringed Plover (240; 1995/96), Grey Plover (750; 1995/96), Lapwing (24,581; 1995/96), Knot (800; 1995/96), Dunlin (20,100; 1995/96), Snipe (719, 1995/96), Black-tailed Godwit (1062; 1995/96), Curlew (1504; 1995/96), Redshank (3228; 1995/96), Greenshank (36; 1995/96) and Turnstone (107; 1995/96). A number of wintering gulls are also present, including Black-headed Gull (2,216; 1995/96), Common Gull (366; 1995/96) and Lesser Black-backed Gull (100; 1994/95). This is the most important coastal site in Ireland for a number of the waders including Lapwing, Dunlin, Snipe and Redshank. It also provides an important staging ground for species such as Black-tailed Godwit and Greenshank.

A number of species listed on Annex I of the EU Birds Directive breed within the site. These include Peregine Falcon (2-3 pairs), Sandwich Tern (34 pairs on Rat Island, 1995), Common Tern (15 pairs: 2 on Sturamus Island and 13 on Rat Island, 1995), Chough (14-41 pairs, 1992) and Kingfisher. Other breeding birds of note include Kittiwake (690 pairs at Loop Head, 1987) and Guillemot (4010 individuals at Loop Head, 1987)

There is a resident population of Bottle-nosed Dolphin in the Shannon Estuary consisting of at least 56-68 animals (1996). This is the only known resident population of this EU Habitats Directive Annex II species in Ireland. Otter, a species also listed on Annex II of this directive, is commonly found on the site.

Five species of fish listed on Annex II of the EU Habitats Directive are found within the site. These are Sea Lamprey (*Petromyzon marinus*), Brook Lamprey (*Lampetra planeri*), River Lamprey (*Lampetra fluviatilis*), Twaite Shad (*Allosa fallax fallax*) and Salmon (*Salmo salar*). The three lampreys and Salmon have all been observed spawning in the lower Shannon or its tributaries. Twaite Shad is not thought to spawn within the site. There are few other river systems in Ireland which contain all three species of Lamprey.

Two additional fish of note, listed in the Irish Red Data Book, also occur, namely Smelt (*Osmerus eperlanus*) and Pollan (*Coregonus autumnalis pollan*). Only the former has been observed spawning in the Shannon.

Freshwater Pearl-mussel (*Margaritifera margaritifera*), a species listed on Annex II of the EU Habitats Directive, occurs abundantly in parts of the Cloon River.

There are a wide range of landuses within the site. The most common use of the terrestrial parts is grazing by cattle and some areas have been damaged through over-grazing and poaching. Much of the land adjacent to the rivers and estuaries has been improved or reclaimed and is protected by embankments (especially along the Fergus Estuary). Further, reclamation continues to pose a threat as do flood relief works (e.g. dredging of rivers).

In the past, Cord-grass (*Spartina* sp.) was planted to assist in land reclamation. This has spread widely, and may oust less vigorous colonisers of mud and may also reduce the area of mudflat available to feeding birds.

Domestic and industrial wastes are discharged into the Shannon, but water quality is generally satisfactory - except in the upper estuary, reflecting the sewage load from Limerick City. Analyses for trace metals suggest a relatively clean estuary with no influences by industrial discharges apparent. Further industrial development along the Shannon and water polluting operations are potential threats.

Other uses of the site include commercial and recreational angling, oyster farming, boating (including dolphin-watching trips) and shooting. Some of these may pose threats to the birds and dolphins through disturbance. Specific threats to the dolphins include underwater acoustic disturbance, entanglement in fishing gear and collisions with fast moving craft.

This site is of great ecological interest as it contains a high number of habitats and species listed on Annexes I and II of the EU Habitats Directive, including the priority habitat lagoon, the only known resident population of Bottle-nosed Dolphin in Ireland and all three Irish lamprey species. A good number of Red Data Book species are also present, perhaps most notably the thriving populations of Triangular Club-rush. A number of species listed on Annex I of the EU Birds Directive are also present, either wintering or breeding. Indeed, the Shannon and Fergus Estuaries form the largest estuarine complex in Ireland and support more wintering wildfowl and waders than any other site in the country.

APPENDIX D

CRITERIA FOR EVALUATING THE ECOLOGICAL IMPORTANCE AND MAGNITUDES OF IMPACTS OF SITES (NRA, 2004)

Table D.1: Criteria for Site Evaluation

Internationally important	Sites designated (or qualifying for designation) as SAC* or SPA* under the EU Habitats or Birds Directives. Undesignated sites containing good examples of Annex I priority habitats under the EU Habitats Directive. Major salmon river fisheries. Major salmonid (salmon, trout or char) lake fisheries.
Nationally important	Sites or waters designated or proposed as an NHA* or statutory Nature Reserves. Undesignated sites containing good examples of Annex I habitats (under EU Habitats Directive). Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive or species protected under the Wildlife (Amendment) Act 2000. Major trout river fisheries. Water bodies with major amenity fishery value. Commercially important coarse fisheries.
High value, locally important	Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or significant populations of locally rare species. Small water bodies with known salmonid populations or with good potential salmonid habitat. Sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive. Large water bodies with some coarse fisheries value.
Moderate value, locally important	Sites containing some semi-natural habitat or locally important for wildlife. Small water bodies with some coarse fisheries value or some potential salmonid habitat. Any water body with unpolluted water (Q-value rating 4-5).
Low value, locally important	Artificial or highly modified habitats with low species diversity and low wildlife value. Water bodies with no current fisheries value and no significant potential fisheries value.

Table D.2: Criteria for Assessment of Impact Significance

Impact level	Sites of International Importance	Sites of National Importance	Sites of high value, locally Important	Sites of moderate value, locally important	Sites of low value, locally important
Severe negative	Any permanent impacts	Permanent impacts on a large part of the site			
Major negative	Temporary impacts on a large part of a site	Permanent impacts on a small part of the site	Permanent impacts on a large part of the site		
Moderate negative	Temporary impacts on a small part of a site	Temporary impacts on a large part of a site	Permanent impacts on a small part of the site	Permanent impacts on a large part of the site	
Minor negative		Temporary impacts on a small part of a site	Temporary impacts on a large part of a site	Permanent impacts on a small part of the site	Permanent impacts on a large part of the site
Neutral	No impacts	No impacts	No impacts	No impacts	Permanent impacts on a small part of the site
Minor positive				Permanent beneficial impacts on a small part of the site	Permanent beneficial impacts on a large part of the site
Moderate positive			Permanent beneficial impacts on a small part of the site	Permanent beneficial impacts on a large part of the site	
Major positive		Permanent beneficial impacts on a small part of the site	Permanent beneficial impacts on a large part of the site		

APPENDIX E

INVENTORY OF RECORDED ARCHAEOLOGICAL SITES

RMP No.	CL045-032---
Townland	Knockyclovaun
Type of Feature	Holy Well
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16977, 17321
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL045-033---
Townland	Knockyclovaun / Shantraud
Type of Feature	Historic Town
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	17018, 17296
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL045-047---
Townland	Cloonfadda
Type of Feature	Fulacht Fiadh
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16847, 17021
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL045-04801-
Townland	Cloonfadda
Type of Feature	Standing Stone
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16908, 17096
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL045-04802-
Townland	Cloonfadda
Type of Feature	Standing Stone
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16920, 17096
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL045-04803-
Townland	Cloonfadda
Type of Feature	Standing Stone
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16924, 17103
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL045-049---
Townland	Killestry
Type of Feature	Enclosure
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16960, 17176
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL045-050---
Townland	Moys
Type of Feature	Cross, site of
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	17051, 17192
Sources of Information	Archaeological Survey of Ireland Files
Description	Note: This is the site on which a high cross, removed from Kilfenora in W Clare, was re-erected by Bishop Mant in 1820. It is not an archaeological site. The cross is now in St Flannan's Cathedral.

RMP No.	CL054-003---
Townland	Ardataggle
Type of Feature	Road
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16537, 16676
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL054-005---
Townland	O'Brien's Bridge
Type of Feature	Cist
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16647, 16705
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL054-006---
Townland	O'Brien's Bridge
Type of Feature	Enclosure
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16689, 16796
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL054-00701-
Townland	O'Brien's Bridge
Type of Feature	Church
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16716, 16721
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL054-00702-
Townland	O'Brien's Bridge
Type of Feature	Graveyard
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16716, 16721
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	CL054-008---
Townland	O'Brien's Bridge
Type of Feature	Enclosure
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16725, 16756
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	LI001-005---
Townland	Montpelier
Type of Feature	Bridge
Legal Protection	Recorded Monument; O'Brien's Bridge. Protected Structure No. 215 (Clare Co Dev Plan 2005); Protected Structure No. H1 (1) (Limerick Co Dev Plan 2005)
OS Sheet/Plan/Trace	-
National Grid Reference No.	16639, 16686
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	LI001-006---
Townland	Montpelier
Type of Feature	Graveyard
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16683, 16691
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	TN025-008---
Townland	Cullenagh (Templeachally Parish)
Type of Feature	Weir
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	17010, 17321
Sources of Information	Archaeological Survey of Ireland Files
Description	-

RMP No.	TN025-015---
Townland	Ballina
Type of Feature	Castle: Hall House (possible)
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	025-/06/04
National Grid Reference No.	17082, 17258
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	Situated on high ground overlooking a deep ravine and nearby church (TN025-016---) to the S. The poorly preserved remains of a small rectangular building surviving to first-floor level only, built with roughly coursed sandstone rubble of cyclopean appearance. The building consists of a narrow small ground-floor chamber (int. dims. 6.65m N-S; 3.05m E-W; Wall T 2m) accessed from a segmental-arched doorway situated in the centre of the E wall. This appears to be an insertion and may belong to a later phase of construction. The ground floor had a wooden ceiling carried in the thickness of the wall with a destroyed flat-headed window in the centre of the W wall which replaced an earlier window. At first-floor level there is a single-light round-arched window in the N wall (Fitzpatrick 1985, vol. 3, 75-86) which is now obscured by ivy growth. At the E end of the extant S wall there is the remains of a garderobe chute. Possible stairs are visible at the E end of the S wall which gave access to the E chamber (now destroyed). There was no cut stone used in the fabric of the building. It is unclear from the surviving evidence and the dense cover of ivy if this building survives fully intact or whether only the W half of the castle survives. There is possible evidence for a bawn wall extending E from the SE angle of the castle.

RMP No.	TN025-016---
Townland	Roolagh
Type of Feature	Church & Graveyard
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	025-/06/04
National Grid Reference No.	17079, 17243
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	Indicated on OS map editions as 'Templeachally Church (in Ruins), Grave Yd.' Situated on a natural rise of ground overlooking the River Shannon to the W with a nearby castle (TN025-15---) to the N. The poorly preserved remains of a rectangular late medieval church (ext. dims. 9.7m N-S; 21.3m E-W); wall T 1m) built with roughly coursed sandstone rubble. The E, S and W walls stand to full height with only the partial wall returns of the N wall surviving. The W end of the church may have had two floors as indicated by a destroyed window at first-floor level. There is also a single-light window at ground-floor level in this gable as well as a destroyed single-light window at the E end of the S wall. The E gable has a partially destroyed twin-light traceried window in the centre. The destroyed doorway at the W end of the S was described in the OS Letters as a pointed sandstone door (O'Flanagan 1930, vol. 2, 11-12). In the centre of the S wall is a segmental-arched tomb-niche and at the E end is a four-centred arched piscina with moulded bases, chamfered jambs and a six-lobed marigold pattern around the drain-hole. The graveyard around the church contains 18th and 19th century headstones. The top soil cover has been removed during a recent graveyard scheme.

RMP No.	TN025-01901-
Townland	Roolagh
Type of Feature	Standing Stone
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	025-/10/01
National Grid Reference No.	17102, 17233
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	Situated in a slight hollow on a N-S ridge overlooking ground to the W with a nearby standing stone (TN025-01902-) to the SW. A tall triangular shaped limestone slab (H 1.05m; dims. 1.4m x 1.1m) orientated on an E-W axis with the top of the stone sloping from S to N.

RMP No.	TN025-01902-
Townland	Roolagh
Type of Feature	Standing Stone
Legal Protection	Recorded Monument

OS Sheet/Plan/Trace	025-/10/01
National Grid Reference No.	17098, 17228
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	Situated on a N-S ridge overlooking ground to the W with a nearby standing stone (TN025-01901-) to the NE. A small irregular-shaped conglomerate (H 0.8m; dims. 0.86m x 0.74m) orientated on an E-W axis with packing stones visible at its base.
RMP No.	TN025-021---
Townland	Friars Island
Type of Feature	Holy Well
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	025-/10-01
National Grid Reference No.	17062, 17208
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	Holy Well (site) situated on Friars Island which was submerged during the Shannon Hydroelectric scheme in 1929. The well was situated at the N end of the island with a church (TN025-022---) to the S.

RMP No.	TN025-022---
Townland	Friars Island
Type of Feature	Church (site of)
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	025-/10/01
National Grid Reference No.	17062, 17197
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	Originally located on Friars Island on the river Shannon until its removal and re-erection in the grounds of Killaloe RC church in 1929. The church was moved due to flooding of the River Shannon by ESB for the Ardnacrusha power station. Present remains consist of a nave (ext. dims. Nave 5.57m N-S; 8.2m E-W; wall T 0.8m) and chancel (4.2m N-S; 4m E-W; wall T1.05m) church, the nave of which is the earlier building with the chancel being added later (Leask 1930, 130-35), as revealed when the church was being moved to its present location. The nave walls are constructed with uncoursed cyclopean sandstone masonry while the chancel walls are constructed with roughly squared stones of smaller size. The chancel has a single-light round-headed E window with stepped sillstone and unusual flat-headed doorway in the S wall. The round-headed chancel arch has curious jambstones which are not flush with the chancel arch and project inwards. The triangular-shaped chancel roof is bonded with lime mortar and is well preserved. The nave walls are poorly preserved and only survive several courses high with a poorly preserved trabeate doorway in the W wall. Excavations at Friars Island prior to the removal of the church revealed that the church

	was constructed on a stone platform enclosed by a possible cashel with a revetment wall of unknown purpose. A second platform (22ft (6.71m) N-S; 50ft (15.25m) E-W) was located to the S of the church and eleven skeletons were uncovered under or close to the foundations of the N wall of the church (Macalister 1929, 16-24).

RMP No.	TN025-094---
Townland	Ballina/Cullenagh
Type of Feature	Town
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	025-/06/01
National Grid Reference No.	17052, 17316
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	Situated on the E bank of the River Shannon with Killaloe Bridge (TN025-09401-) connecting Ballina to the neighbouring town of Killaloe, Ballina castle (TN025-09402-) is located at the N end of the modern town with Cloghaneena castle (TN025-015---) and Templeachally church (TN025-016---) located at the S end. In 1607 the 'castle, town and lands of Belanagh in Arra' were granted to Murtagh Mc Ibrien (Cal. Pat. Rolls, Ire., Jas I, 89).

RMP No.	TN025-09401-
Townland	Ballina/Cullenagh
Type of Feature	Bridge
Legal Protection	Recorded Monument; Protected Structure No. 210
OS Sheet/Plan/Trace	025-/06/04
National Grid Reference No.	17042, 17308
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	A 19th century bridge over the River Shannon which probably had its origins in the 17th century and has been greatly altered since. Bradley (n.d. 96-7) refers to an early plank bridge at this location which was utilised during Brian Boru's lifetime (pre-1014). He also refers to a *'droichet'* built by Toirdelbach Ua Briain in 1071 (*ibid.*). According to an entry in the Annals of Innisfallen in 1071 a bridge, presumably wooden, was built at Killaloe in a fortnight (Simington and O'Keeffe 1991, 59). In 1599 Hugh O'Donnell destroyed the bridge at Killaloe (Bradley n.d., 96-7). Though described in the Civil Survey of 1654-6 as a bridge crossing the river of Shannon to Killaloe (Simington 1934, vol. 2, 163), the bridge is not depicted on Moll's map of 1714 which shows a ferry crossing at the site. The bridge is drawn on Taylor and Skinner's map of 1778. The bridge, as described in a plan of 1837, consisted of fifteen segmental arches with an

	average width of 20ft (6m), though five at the centre of the bridge are 40ft (12m) wide. The roadway was 18ft (5.5m) wide between the stone parapet walls. There were triangular cutwaters fore and aft coped with semi-pyramidal cappings, except for eleven that were brought up to parapet level to form pedestrian refuges.

RMP No.	TN025-09402-
Townland	Ballina/Cullenagh
Type of Feature	Tower House
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	025-/06/01
National Grid Reference No.	17047, 17316
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	Tower House (site) situated on the E bank of the River Shannon with Killaloe bridge (TN025-09401-) immediately to the S. Described in the Civil Survey of 1654-6 as the ruins of a castle and barbican (Simington 1931, vol. 1, 163). Donogh O'Bryen is listed as proprietor in 1640 (*ibid.*). Described by Westropp (1911-12, 203) as one of two peel towers of 15th century date constructed at either end of the bridge between Killaloe and Ballina. According to the OS Letters the castle of Ballina was located on a low rock forty feet from the bridge of Killaloe to the North (O'Flanagan 1930, vol. 2, 13). The castle was associated with the Mac Ibrien Ara (*ibid.*, 10). No visible remains; modern housing now occupies this area.

RMP No.	TN025-09403-
Townland	-
Type of Feature	Weir
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	17041, 17306
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	-

RMP No.	TN031-005---
Townland	Birdhill
Type of Feature	Standing Stone
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	031-01/05
National Grid Reference No.	16917, 16771
Sources of Information	Farrelly & O'Brien *et.al.* 2002
Description	Situated on flat pasture in an upland area with extensive view to W and N. A tall rectangular stone (H 2.1m; dims. 0.85m x 0.5m) set into a slight hollow with packing stones visible. The top of the stone tapers from NE to SW along the orientation of the stone.

RMP No.	TN031-006---
Townland	-
Type of Feature	Burial Ground
Legal Protection	Recorded Monument
OS Sheet/Plan/Trace	-
National Grid Reference No.	16945, 16764
Sources of Information	Archaeological Survey of Ireland Files
Description	-

APPENDIX F

FEATURES NOT CONDUCIVE TO GEOPHYSICAL SURVEY

- Wire fencing can produce a large distortion in the local magnetic field thus data should be collected at least 1m away from each strand of wire in a fence, disturbance can usually be detected at least 5m away.

- Overhead power cables generally do not have any effect of the quality of geophysical results using a fluxgate gradiometer.

- Pylons are obviously problematic due to the large quantity of iron used in their construction. Accordingly, 20 to 30m is the closest the operator should get to them during a magnetometer survey.

- Communication masts also cause problems but the extent of their effect is ultimately dependant on the frequency at which they operate.

APPENDIX G

DESCRIPTION OF GEOPHYSICAL TECHNIQUES

Resistivity Survey

This process is an 'active geophysical prospecting technique which detects subsurface features in terms of the resistance they present to the passage of an artificially induced electric current' (Noel M 1997, 263). Conducting a good electrical resistance survey depends on many variables whether they are climatic, feature construction or the arrangement of the electrodes. The moisture balance can vary between the subsurface archaeological features and the natural background and hence climatic conditions ultimately affect the effectiveness of the survey.

It is generally assumed that optimum conditions for electrical resistivity surveys are on well-drained soils in mid-to late summer when moisture contrasts attain a maximum (Clark 1990, 48-51). Over the last 15 years the twin electrode scheme has become popular for archaeological survey, as it is generally more effective than the other array configurations. This array type was unlike other array types, purposefully designed for archaeological survey and 'eliminates many of the spurious and directionally sensitive anomaly shapes associated with the Wenner Array' (Fenwick 1997, 33).

The resistivity meter is carried with one potential and one current electrode with their corresponding soil electrodes. This is an extremely effective method, 'although the need for soil contact and a cable to the remote electrodes makes this a slower method than magnetometry' (Noel, M 1997, 263). Also the equipment needed for this type of survey is significantly cheaper than those used for most other types of geophysical survey.

Resistance measurements are particularly successful at detecting pits that have been filled with cultural debris, they are also good for locating architectural stone if the surrounding soil contains little stone or sand. According to Clark (1990) 'the electrical resistance of the ground is almost entirely dependant upon the amount and distribution of moisture within it' (Clark 1990, 27). The current created by the electrodes is relatively weak but various subsurface materials will have varying differences in resistivity, which can be measured, and consequently archaeological remains can be discovered.

The principles of resistivity are based on Ohms Law, R=V/I which means that 'resistance is the ratio of potential difference to current flow…resistivity is specific resistance, which enables the resistance of different materials to be compared in a standardised way' (Clark 1990, 27). So say for instance there was a current flowing between electrodes on a resistivity meter, here comparisons are made to the resistance of the induced current caused by different features and materials under the soil. Clays generally has a resistivity of between 1-10Ω-m while porous rocks and non-porous rocks fall usually between 100-1000Ω-m and 10000-106Ω-m6 respectively (Clark 1990, 27).

Certain material and features have varying degrees of resistance and this leads to the isolation of archaeological sites whether they are positive or negative anomalies. If we had for instance a positive archaeological structure, perhaps a stonewall, this would have a high resistance to the induced current, hence, rather than going through the structure the current naturally goes around the anomaly where the resistance is not so high but here the typical pattern returned changes. If this were a low resistance feature such as a waterlogged structure then the current would be attracted to it and once again change the pattern. According to Clark (1990), this either reduces or increases current density in the vicinity of the feature, either reducing or increasing the potential gradient and consequently returning either a positive or negative anomaly result.

Geomagnetic Methods

Geomagnetic methods respond to subsurface materials and features both natural and artificial, that are magnetic and whose magnetism is sufficiently higher or lower than the background magnetic

signal so as to be recorded. Differing geology and soil types can possess varying amounts of magnetism or acquire magnetic characteristics in the presence of a magnetic field. Some features have an inherent or permanent magnetic presence.

Magnetically susceptible surveys are based on the principles of acquired magnetism. This acquired magnetism is lost when the external magnetic field is removed. Archaeological features may also express magnetic characteristics as a result of being heated beyond a certain temperature, the Curie point and subsequently cooled in the presence of the earth's magnetic field. This is termed thermoemenence and archaeological features that display this characteristic are for example, kilns, furnaces or hearths and are easily detected by geophysical methods. The two main geomagnetic methods employed in this survey were magnetometry and magnetic susceptibility.

Magnetometry

This method, which needs no direct contact with the soil, is generally considered the primary technique in any geophysical survey (Fenwick 1997 Vol. 1, 27). Ultimately, two main types of instrument are used in magnetometry surveys, namely the proton magnetometer and the fluxgate gradiometer. Previously, it was considered standard practice to use proton magnetometers for all normal archaeological prospection (Clark 1990, 69). However, due to the significantly faster speed in survey, the fluxgate gradiometer is a more effective method for large scale surveys (Fenwick 1997 Vol. 1, 27) and has been described by Clark as the 'workhorse – and the racehorse – of British archaeological prospecting' (Clark 1990, 69).

The Bartington Grad-601 fluxgate gradiometer measures variances in the vertical component of the earth's magnetic field due to shallow sub-surface magnetic sources. This instrument is, unlike the proton magnetometer which is omni-directional, directionally sensitive measuring only that part of the field, which is along its length (Clark 1990, 69). Because a single magnetometer sensor is subject to extensive diurnal or 'daily' drift of the earth's magnetic field, two separate sensors 1m apart are vertically spaced on this instrument reducing the tendency for diurnal variations.

Before the instrument can be what is termed 'zeroed' and the survey begun, the instrument must be balanced to compensate for directional sensitivity. Subsequently, zeroing the instrument eliminates the effects of the earth's main magnetic field from the measurements of magnetic gradient. Consequently, measurements of magnetic gradient over the survey area are therefore relative to, either above or below this arbitrary zero point. There is, however, still a tendency for diurnal drift and so the instrument must be balanced after each panel or every few panels.

Magnetic surveys are probably the most productive prospecting methods employed in archaeology. Different deposits can vary in the type and density of magnetic iron compounds. The removal of magnetically enriched topsoil during the construction of ditches, house pits or other depressions causes a lowering of the magnetic field over these features. Adversely, accumulations of topsoil, which are magnetically enhanced, occur in mound or sod constructions, berms adjacent to excavated ditches, or when storage or other pit features are filled with topsoil after abandonment and create local increases in the magnetic field. Rocks employed in the construction of houses such as those in this survey area might be more magnetic than the surrounding soil.

Iron objects produce a large magnetic reading or dipole, positive and then negative extremes in readings. Essentially, magnetic surveys are comparatively fast, allowing coverage of large areas. Surveys of larger areas increase the likelihood of recognition of culturally patterned anomalies in the landscape. This survey would be undertaken using the instrument adjusted to 0.1nt, which provides relatively good sensitivity. Improved sensitivity means better anomaly definition, and the ability to recognise weaker and deeper anomalies.

Magnetic Susceptibility

'Its importance is now being increasingly exploited for archaeology in ways beyond the reach of magnetometers' (Clark 1990, 98). David (1995, 20) proposes that the primary function of magnetic susceptibility surveys are to provide additional information to support that found by magnetometer surveys and secondly to prospecting method to derive meaning in its own right, however, it should always be used in conjunction with magnetometer surveys.

The usefulness of magnetic susceptibility techniques is found in the fact that topsoil is normally more susceptible than underlying layers and the enhancement of this susceptibility by the activities of human occupation. Hence, features do not need to be located as the technique can pick up evidence of occupation in the topsoil itself.

The instrument generally used is the Bartington MSD2 susceptibility loop in conjunction with the Bartington MS2 sensor. The susceptibility loop generates its own induced magnetic field and measures the response of the soil to that field. La Borgne noted that the topsoil generally had a higher magnetic susceptibility than the subsoil or even the parent bedrock. He suggested that the enhancement of the susceptibility was due to the presence of maghemite in the soil caused by the conversion of hematite, a weakly ferromagnetic oxide, to the strongly ferromagnetic maghemite caused by, according to La Borgne, by the burning of the soil, (La Borgne 1955, 17) and 'the main process by which magnetic susceptibilities on archaeological sites are enhanced' (Doggart 1985, 40). The depth of investigation is generally half the diameter of the susceptibility loop, which is 20cm long, therefore a depth of investigation of c.10cm is consequently achievable.

APPENDIX H

CATALOGUE OF ARTEFACTS FROM STUDY AREA

Museum No.	1960:512
Year of Discovery	1927; Date of Acquisition 17/5/1960
Townland	Roolagh
County	Tipperary
Artefact Classification/Type	Polished Stone Axehead (Calp Limestone)
Notes	Found at Killaloe 1927 near St. Lua's Oratory. Made from a water rolled pebble. The cutting edge is considerably chipped. The butt is straight and slopes from one narrow edge to the other. Irregular, as if there had been a double fracture which was polished. One narrow edge is flat, the other rounded. L 9.5cm W 7.1cm Max Thickness 2.3cm OS 6''sheet 25
References	-

Museum No.	1937:2488
Year of Discovery	1937
Townland	Roolagh
County	Tipperary
Artefact Classification/Type	Stone Axehead
Notes	Discovered in cleaning old ash pit, beside his house 3" below the ground. OS 6''sheet 25. Located directly South from junction in road, where splits on way from Ballina, ca 400m from road.
References	-

Museum No.	1961:204 (Group 1961: 196-207)
Year of Discovery	1961
Townland	Shantraud
County	Clare (Killaloe parish)
Artefact Classification/Type	Polished stone axe.
Notes	The rounded cutting edge and portion of the body of axehead; the butt and remainder is missing. The fragment remaining is damaged on both wide faces. 8.3cm long 8.0cm wide at cutting edge 6.7cm wide at broken end 2.0cm maximum thickness OS 6'' sheet 45 51.7cm from west 13.3cm from north Found in the mortar of well found at back of St. Flannan's Catholic church, Killaloe. Probably introduced into the wall with gravel used in the building of the wall.
References	-

Museum No.	1961:207 (Group 1961: 196-207)
Year of Discovery	1961; Date of Acquisition 17/7/61
Townland	Shantruad
County	Clare (Killaloe Parish)
Artefact Classification/Type	Possible Hammerstone (Siderite Limestone?).
Notes	Somewhat kidney shaped stone which is smooth on all surfaces except at one end which is abraded. It may have been used as a hammerstone. Has an oval cross-section. 13.2cm long 6.0cm maximum width at centre 3.2cm maximum thickness OS 6''Sheet 45 46cm from West 14.4cm from North
References	-

Museum No.	Record IA/86/72
Year of Discovery	-
Townland	-
County	-
Artefact Classification/Type	Stone Axehead.
Notes	Damaged, appears to be of black chert/limestone. Chipped all over (due to damage?) partially polished on broad faces. Butt and cutting edge not intact. Oval cross-section. Length 12.8cm Thickness 3.2cm Width 6.2cm The axe was discovered during the building of new boy's national school, Killaloe.
References	-

Museum No.	1938:8623
Year of Discovery	1938; 14/6/38
Townland	Killestry
County	Clare (Killaloe Parish)
Artefact Classification/Type	1 Stone axe
Notes	Part of a hoard of finds apparently handed in by different people but could well have been found in the dredging of waterways around Killaloe from which many artifacts of this type were discovered. OS 6'' Sheet 45
References	-

Museum No.	1986:23
Year of Discovery	ca. 1976
Townland	Killestry
County	Clare (Killaloe Parish)
Artefact Classification/Type	Polished stone axehead ground pebble type
Notes	Pointed butt, asymmetrical cutting edge.

	Irregular facets on each broad face. Pebble seems relatively little modified by grinding. Found ca. 1976 in digging of house foundations in Shantraud area of Killaloe. Dimensions: Length 16.7cm Max Width 6.2cm Max Thick 2.4cm Co-ordinates OS 6''Sheet 45 43.0cm East 22.1cm North
References	-

Museum No.	1947:107,108,109
Year of Discovery	1947
Townland	Killestry
County	Clare
Artefact Classification/Type	1947:107: Stone Axehead
Notes	In good state of preservation. Surface is ground and polished all over. Oblong shape narrowing at thin rounded butt. Cutting edge deeply curved and sharp. Rough stained mottled grey stone. Length 16.0cm Width 6.0cm Thickness 3.0cm
References	-

Museum No.	1947:108
Year of Discovery	1947
Townland	Killestry
County	Clare
Artefact Classification/Type	Stone Axehead.
Notes	Portion of butt end missing and large section of one side all broken with clean edges. Flat cross-section. Battered cutting edge. Riverford type with water rolled surfaces, limestone. Length 9.5cm Width 7.8cm Thickness 2.0cm
References	-

Museum No.	1947:109
Year of Discovery	1947
Townland	Killestry
County	Clare
Artefact Classification/Type	Stone Axehead
Notes	Of Riverford type apparently broken across butt with a straight clean break. The sides are parallel; the curved cutting edge is damaged.

	The cross-section is a flat-oval. The surfaces are water-rolled. Length 10.0cm Width 7.9cm Thickness 2.0cm
References	-

Museum No.	1961:195, 194
Year of Discovery	1961
Townland	Killestry
County	Clare
Artefact Classification/Type	1961:195: Polished stone axehead
Notes	Found in Deerpark. Cutting edge is broken off and missing. The butt rather pointed. Axehead is damaged on both wide faces. Butt also slightly damaged. Oval cross-section. This was found when digging a drain, two axeheads found. Length 13.7cm Width 7.2cm at broken off end Width 1.6cm at butt Max thickness 1.5cm
References	-

Museum No.	1961:195, 194
Year of Discovery	1961
Townland	Killestry
County	Clare
Artefact Classification/Type	1961:194: Polished stone axehead.
Notes	Cutting edge missing. Somewhat rounded butt but extreme end of butt is flattened. It is damaged on both wide faces. Flattish oval cross-section. Length 12.5cm Max width 6.7cm at broken off end Width 1.6cm at butt Max thickness 1.7cm
References	-

Museum No.	1986:23
Year of Discovery	1986
Townland	Killestry
County	Clare
Artefact Classification/Type	Polished stone axehead
Notes	Found in house foundation IA/139/1985 OS 6''Sheet 45
References	-

APPENDIX I

UNDERWATER ARCHAEOLOGY

Underwater Archaeology

1.0 Introduction

1.1 The Scheme

The purpose of the project is to provide a new crossing via a bridge across the River Shannon to link the regional road R463 on the west side of the Shannon to the regional roads R525/R494/R466 on the east side in the vicinity of Killaloe/Ballina and O'Briensbridge/ Montpelier. The routes under consideration are 1, 6, 7a, 7b and 7c as indicated on Figure 3.20 of Volume B.

1.2 Previous Reports

This Appendix should be read in conjunction with Section 4.1.3 of Volume A, Cultural Heritage.

1.3 The Scope of this Report

This section of the report details the interpretation of desktop, geophysical and underwater survey data recorded over and adjacent to the Study Area on the River Shannon at Killaloe/Ballina and O'Briensbridge/Montpelier.

This preliminary assessment and geophysical survey has been undertaken and reported on by Donal Boland & Associates, acting as sub-consultant to RPS Consulting Engineers. The assessment and surveys have been performed under guidelines and acquisition parameters as recommended by the Maritime Unit of The Department of the Environment, Heritage and Local Government.

Licence Numbers: 05R099 05D098

1.4 Data Acquisition Method

1.4.1 Data Acquisition

Geophysical surveys were conducted by Donal Boland from the survey vessel *Niamh* at an average lane-spacing of 37m. Details of the survey suite and operational parameters are provided below.

1.4.2 Side-Scan Sonar Survey

The side-scan sonar survey was conducted using a dual-frequency *GeoAcoustics* Model 159A side-scan sonar towfish and Model SS941 transceiver system at an operational frequency of 500kHz. Data was acquired without slant-range correction, with swath width set at 78 m (39m range per channel). Trackline spacing was fixed at 37m ensuring that in excess of 200% riverbed coverage was achieved throughout the survey. Sonar data was acquired in SEG-Y format, processed in *GeoPro LC* on an Apple Macintosh platform and logged to disk.

1.4.3 Magnetometer Survey

The magnetometer survey was conducted using an *Aquascan* AX2000 proton magnetometer linked to a *Litton Marine* LMX-400 DGPS unit. Magnetic data were acquired in XYZ Raw ASCII files. Trackline spacing followed the same 37m pattern as the side-scan sonar survey, thus ensuring adequate coverage for archaeological survey as recommended by the Maritime Unit, The Department of the Environment, Heritage and Local Government.

1.4.4 Bathymetric Survey

The bathymetric survey was conducted using a single-beam echo-sounder operating at 200 kHz. Positional and bathymetric data was downloaded at 1-second intervals via an RS-232 serial port interface to a laptop. Layback corrections were not required as the DGPS antenna was mounted directly above the echo-sounder.

1.5 Data Processing and Interpretation

1.5.1 Side-Scan Sonar Survey

500- kHz data in SEG-Y format was examined for each survey line Sonar data was processed in *GeoPro LC* on an Apple Macintosh platform. Images were output as GeoTIFFs for inclusion in this report.

1.5.2 Magnetometer Survey

Magnetometer data was processed using *Surfer 8*., gridded in 10m bins using the Kriging interpolation method. 2D contour plots were filtered and examined for anomalies.

1.5.3 Bathymetric Survey

Bathymetric XYZ files were processed using *Surfer 8*. Raw ASCII files were gridded in 2m bins using the Kriging interpolation method. 2D contour plots and 3D surfaces were produced for interpretation and data integration.

1.6 Positional Data

Positional data with a quoted accuracy of 1m – 3m, was provided by a *DGPS MAX* series differential global positioning system with differential corrections supplied by the General Lighthouse Authority (GLA) reference station at Portlinus.

Positional data was downloaded at a 1-second interval via a standard RS-232 serial port interface into *Hypack* software on a PC platform.

The WGS-84 ellipsoid was used as datum.

Parameters utilised for conversion of WGS84 data to Irish Grid.

Semi-major Axis :	6377340.189
1 / Flattening :	299.324964
Latitude of Origin in Degrees :	53.500000
Longitude of Origin in Degrees :	-8.000000
False Easting :	200000.000
False Northing :	250000.000
Scale Factor :	1.000035
Datum Shift DX :	-482.530
Datum Shift DY :	130.596
Datum Shift DZ :	-564.557
Datum Shift RX :	-1.042000
Datum Shift RY :	-0.214000
Datum Shift RZ :	-0.631000
Datum Shift Scale:	8.150000

The track charts resulting from surveys are depicted in Figure I.1 below and Figure I.2 overleaf.

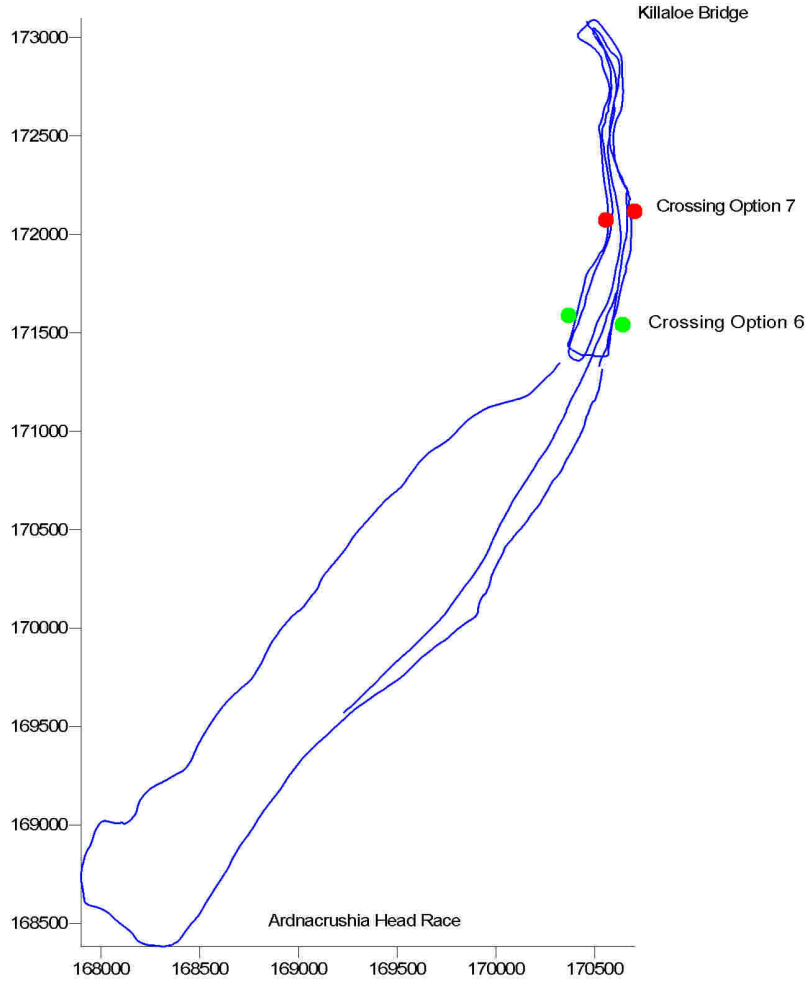

Figure I.1: Track chart resulting from site surveys at Killaloe/Ballina (Scale to Irish Grid, Ireland 65 Datum).

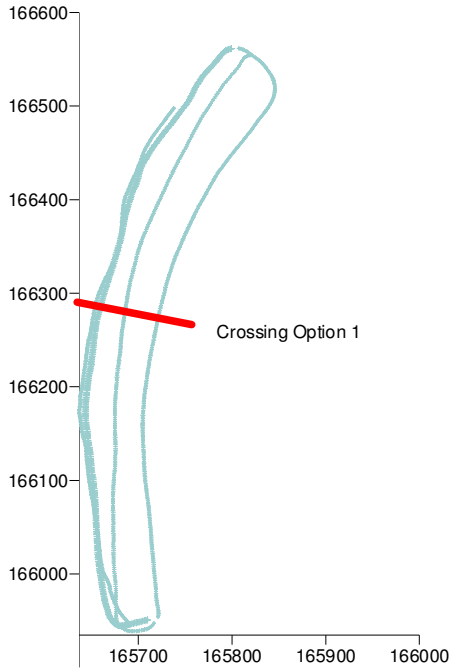

Figure I.2: Track Chart Resulting from Site Surveys at O'Briensbridge/Montpelier (Scale to Irish Grid, Ireland 65 Datum).

2.0 Results of Survey

2.1 Desktop Survey

2.1.1 Historical Background

Refer to Section 4.1.3 of Volume A for historical background.

2.1.2 Archaeological Sites of the Area

There are twenty-nine recorded archaeological sites located within the Study Area. These were listed previously in Table 4.19 of Volume A. (Refer to Appendix E of this Volume).

2.1.3 Ship Wrecks of the Area

The national register of wrecks lists no wreck sites within the Study Area on the River Shannon.

2.1.4 Archaeological Finds of the Area

A Catalogue of the artefacts found within the Study Area can be seen in Appendix H of this Volume.

2.2 Site Surveys

2.2.1 Geology and Riverbed Sediments

The substrate at the sites is characterised by high backscatter, uniform tone returns, indicative of a hard gravel or rock riverbed with areas of medium-to-high returns indicate the presence of mixed gravel and sand.

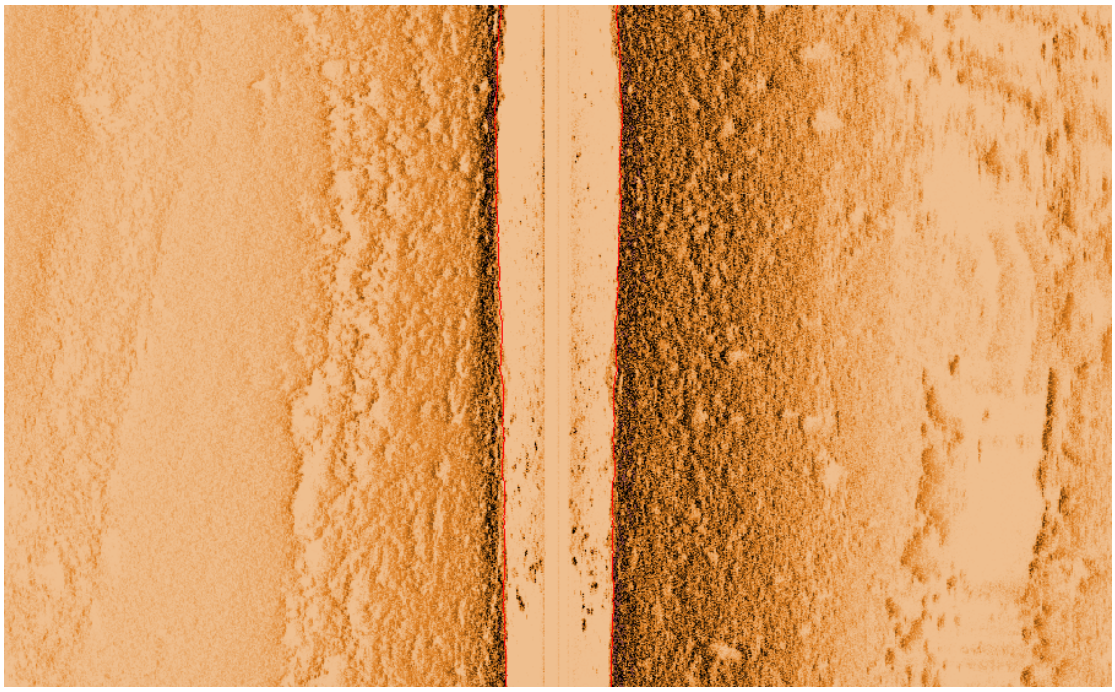

Figure I.3: Sonar Image Displaying the Hard Rock/Gravel Riverbed Within the Study Area.

2.2.2 Results of Bathymetric Survey: Routes 6 & 7

The results of bathymetric survey are displayed as 2-dimensional filled colour contour plots in Figures I.4 and I.5. The results from the full Study Area are provided in Figure I.4 while the results obtained at and adjacent to the zone of proposed impact are provided in Figure I.5. The bathymetric variation recorded in the Study Area ranged from a shallow of 0.5m to a deep of 8.0m. A depth ranging from 4.5m – 5.5m was recorded over the greater area of the site.

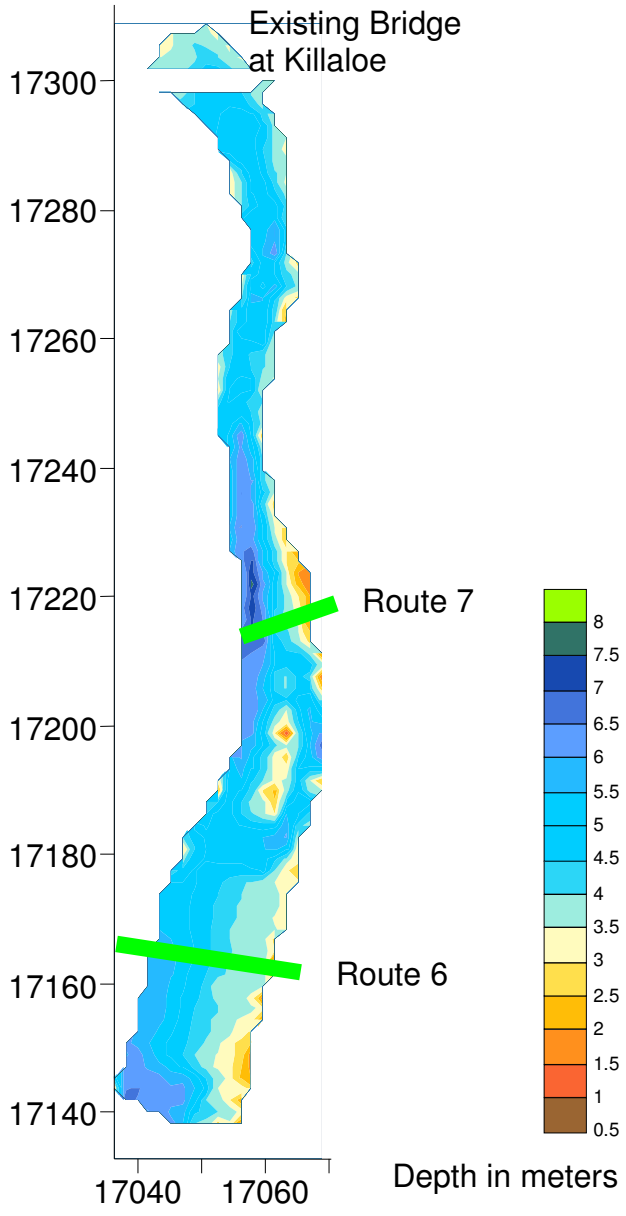

Figure I.4: 2-Dimensional Contour Plot of Bathymetric Data Obtained over the Study Area at Killaloe/Ballina

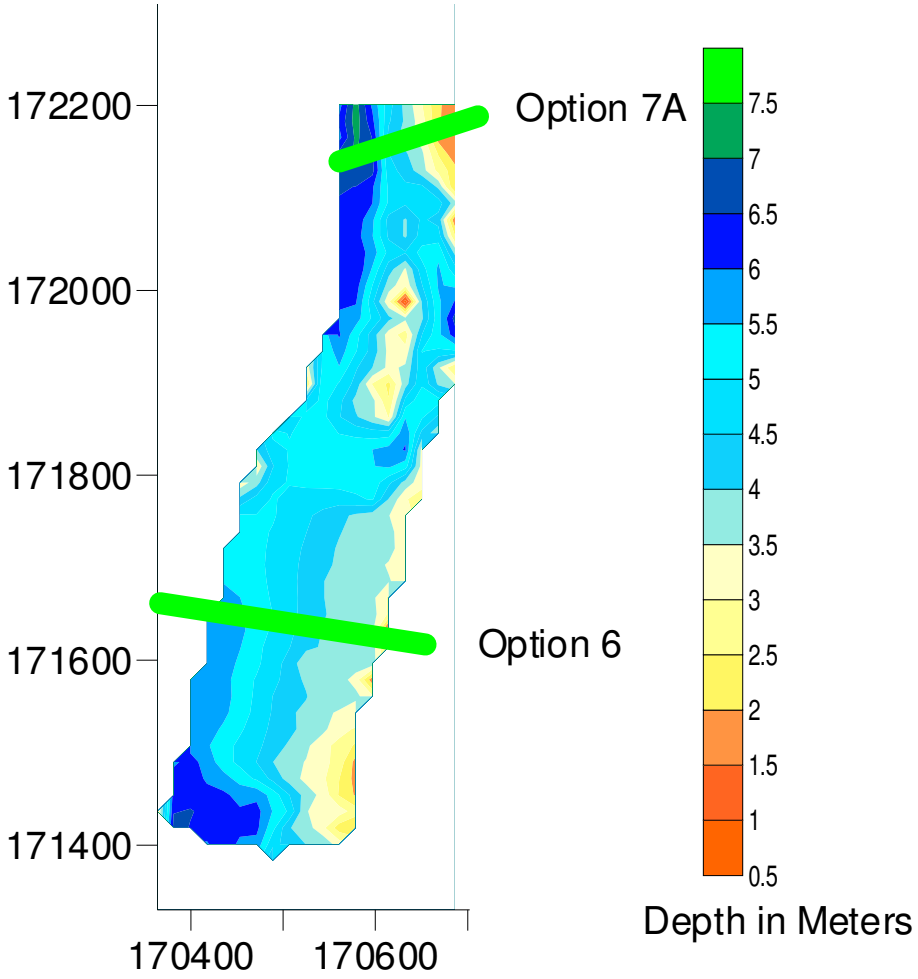

Figure I.5: 2-Dimensional Contour Plot of Bathymetric Data Obtained at and Adjacent to the Zone of Proposed Impact at Killaloe/Ballina

2.2.3 Results of Bathymetric Survey: Route 1.

The results of bathymetric survey are displayed as 2-dimensional filled colour contour plot in Figure I.6. The bathymetric variation recorded in the Study Area ranged from a shallow of 0.1m to a deep of 9m. A depth ranging from 5m – 7m was recorded over the greater area of the site.

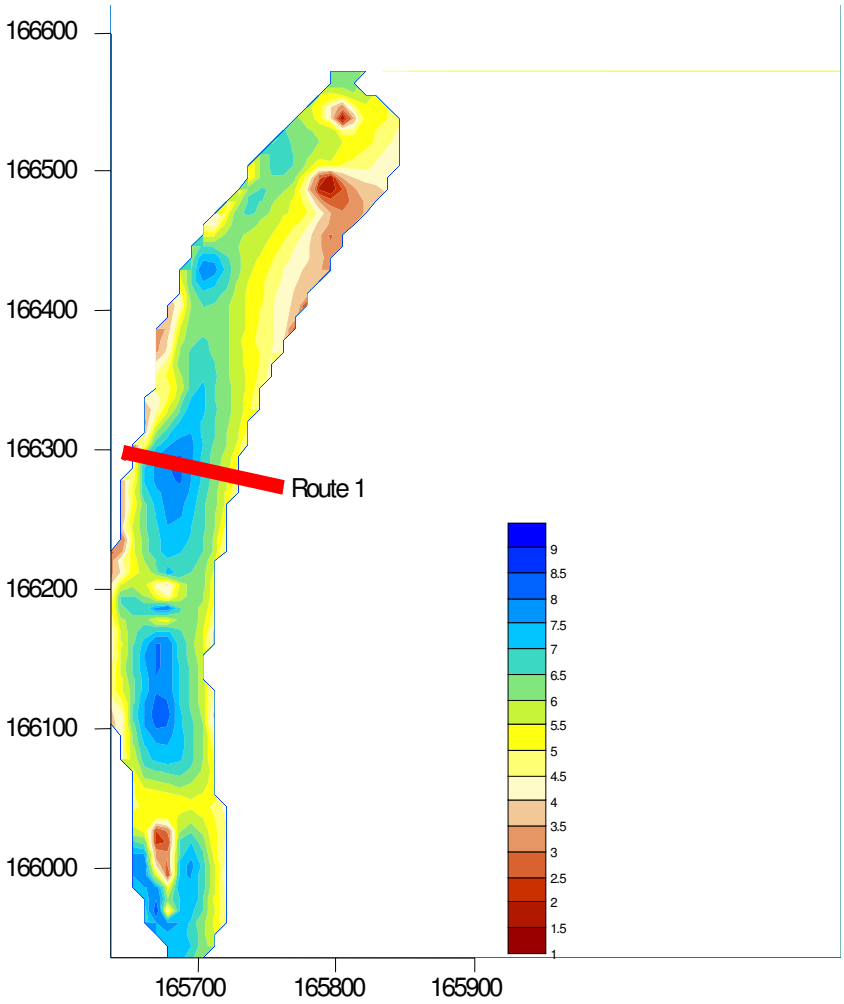

Figure I.6: 2-Dimensional Contour Plot of Bathymetric Data Obtained over the Study Area at O'Briensbridge/Montpelier

2.2.4 Results of Magnetic Survey: Routes 6 & 7.

The results obtained from the magnetometer survey range from +300 nT to –2500 Nt on a background of -200 nt. The results are presented in Figure I.7 as a 2-dimensional contour plot of magnetic deviation

The results are dominated by a large negative reading on the western shoreline identified as M3. Filtering of the recorded data isolated four other locations as displaying a magnetic reading slightly above background level identified as M1, M2, M4 & M5 and noted as areas of possible archaeological potential. The results are presented in Figure I.8 as a 2-dimensional contour plot of magnetic deviation

The identification tag and position of the anomalies are presented in Table I.1. Figure I.9 displays the location of the anomalies overlain on a chart of the survey area.

Table I.1: Co-Ordinates and ID-Tags for the Anomalies Interpreted from the 2-D Contour Plot

ID/Tag	Easting	Northing
M1	170640.3	172724.596
M2	170575.6	172509.068
M3	170579.9	172157.756
M4	170661.8	172112.495
M5	170614.4	171715.923

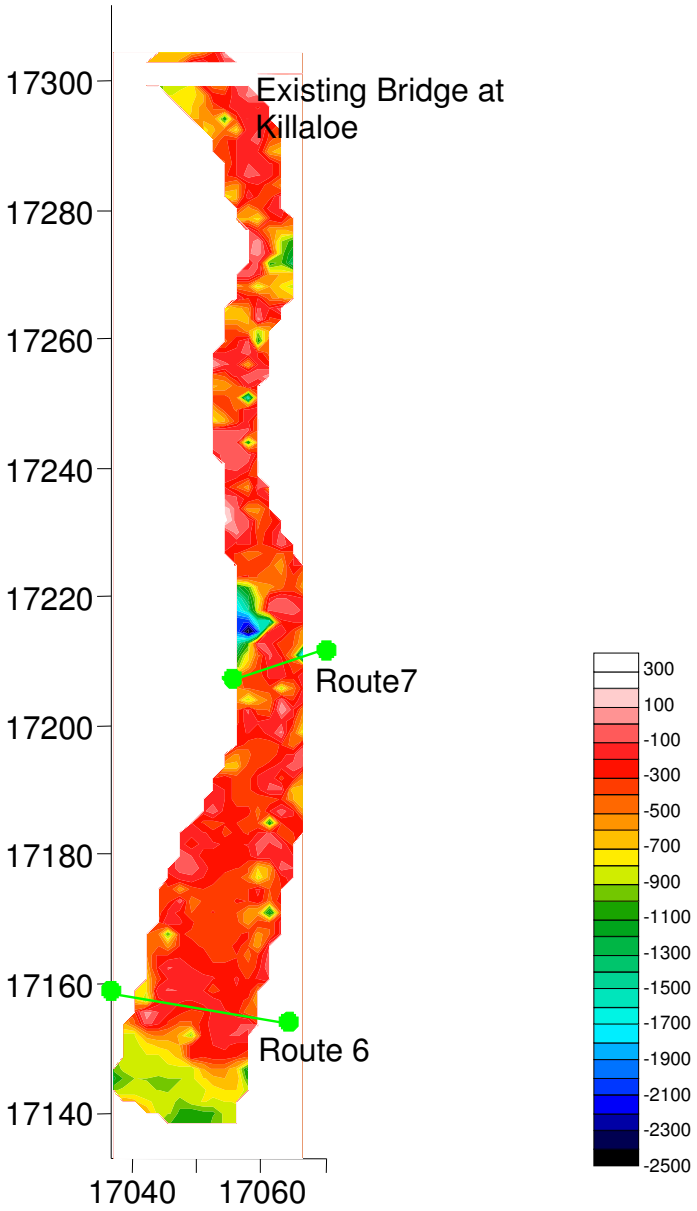

Figure I.7: 2-Dimensional Contour Plot of Magnetic Deviation Acquired from the Site Survey. Data Range from +300 nT to –2500 Nt on a Background of -200 nT

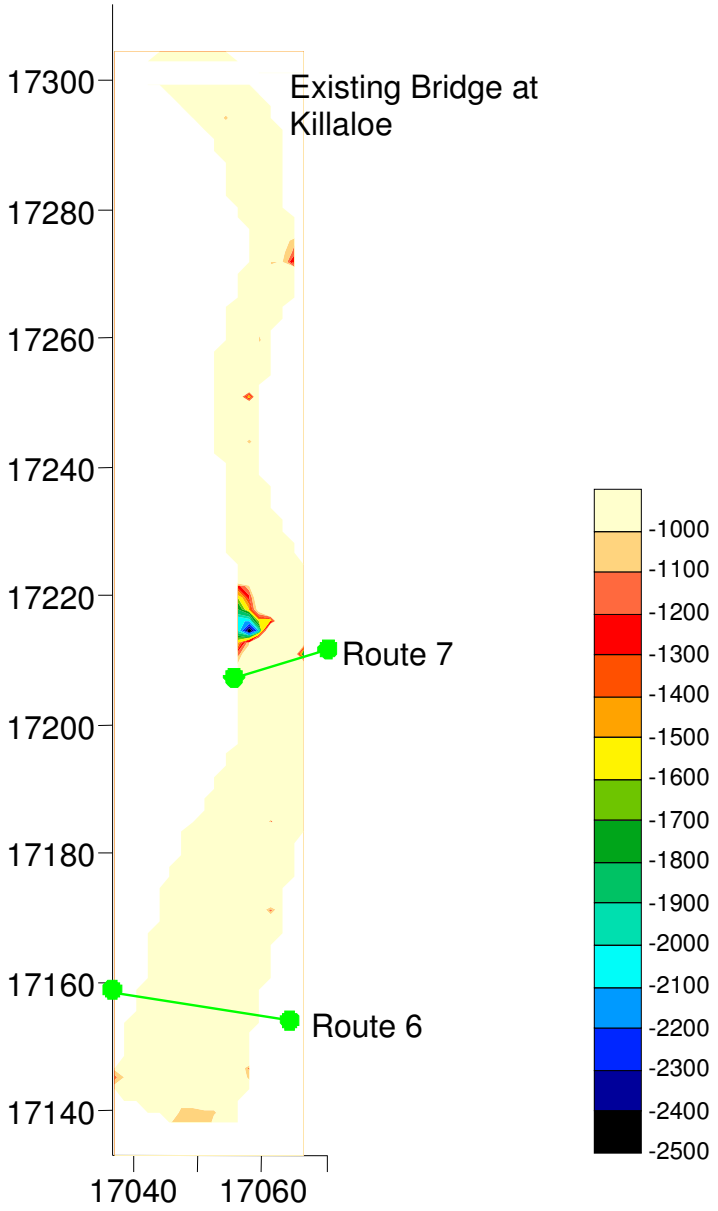

Figure I.8: 2-Dimensional Contour Plot of Magnetic Deviation Acquired from the Site Survey. Data Range from -1000 nT to –2500 Nt on a Background of -1000 nT

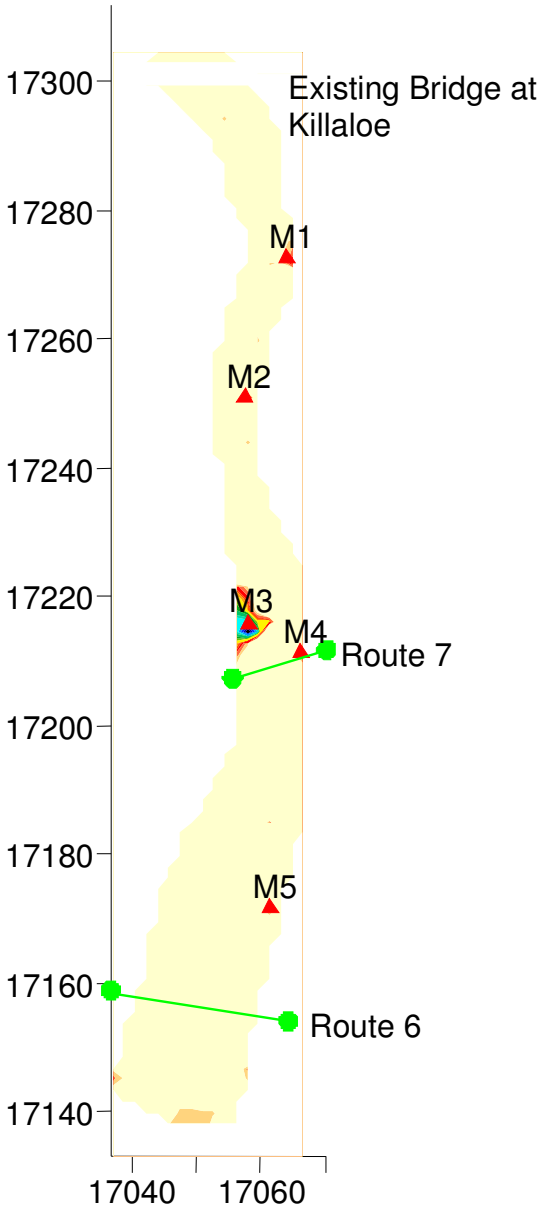

Figure I.9: The Location of Magnetic Anomalies M1-M5

2.2.5 Results of Magnetic Survey: Route 1

The results obtained from the magnetometer survey range from +400 nT to –1700 Nt on a background of 200 nt. The results are presented in Figure I.10 as a 2-dimensional contour plot of magnetic deviation

Filtering of the recorded data isolated nine anomalies identified, as M1-M9 of these M3, M4, M5, M6 & M7 are located within 100m of the proposed crossing. The anomaly M7 was identified as a modern piece of iron, no surface feature was observed at the location of the anomalies M3-M6 noted as areas of possible archaeological potential. The results are presented in Figure I.11 as a 2-dimensional contour plot of magnetic deviation.

The identification tag and position of the anomalies are presented in Table I.2. Figure I.12 displays the location of the anomalies overlain on a chart of the survey area.

Table I.2: Co-Ordinates and ID-Tags for the Anomalies Interpreted from the 2-D Contour Plot

ID/Tag	Easting	Northing
M1	165687.75	166034.0443
M2	165687.75	166172.6837
M3	165647.7208	166204.998
M4	165695.9612	166210.2101
M5	165694.9348	166233.1429
M6	165657.9847	166277.9662
M7	165739.0694	166340.5102
M8	165813.9958	166470.8103
M9	165791.4152	166511.464

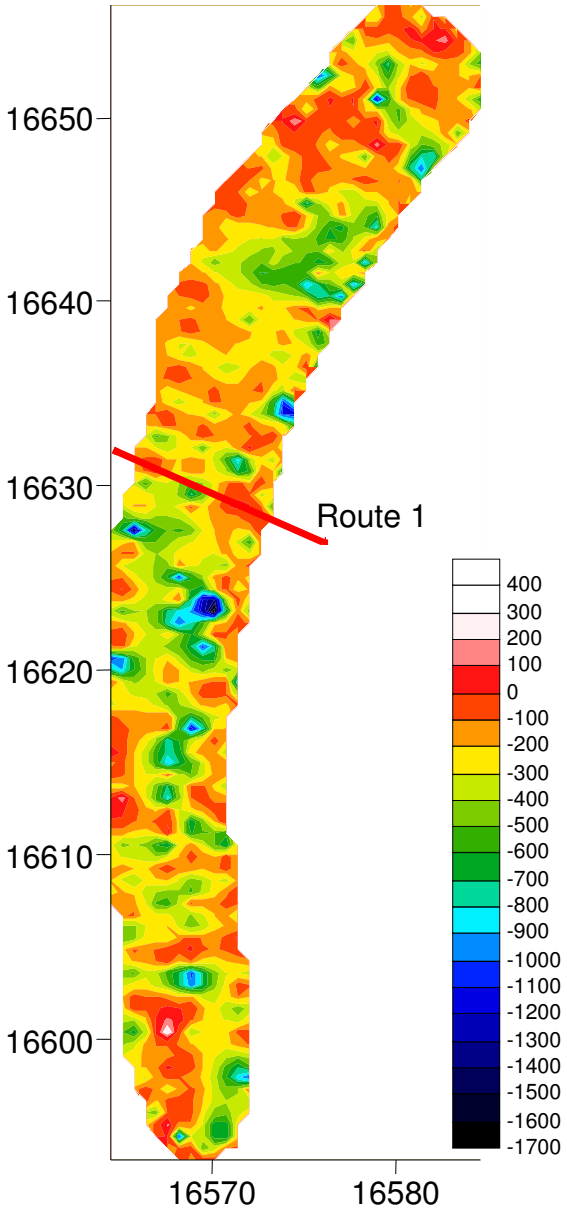

Figure I.10: 2-Dimensional Contour Plot of Magnetic Deviation Acquired from the Site Survey. Data Range from +400 nT to –1700 Nt on a Background of 300 nT

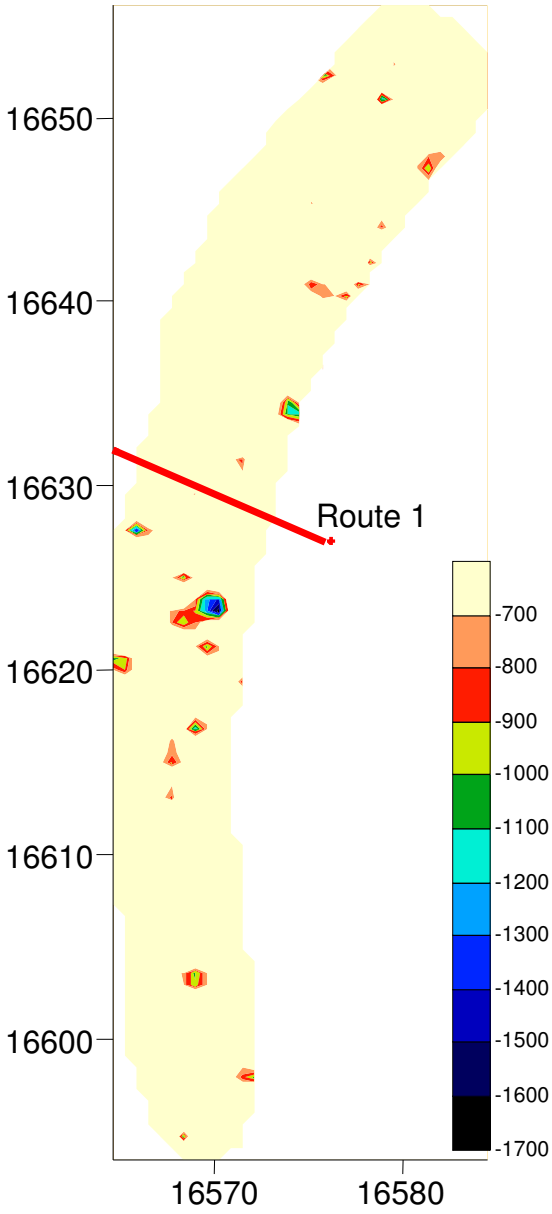

Figure I.11: 2-Dimensional Contour Plot of Magnetic Deviation Acquired from the Site Survey. Data Range from -700 nT to –1700 Nt on a Background of -600 nT

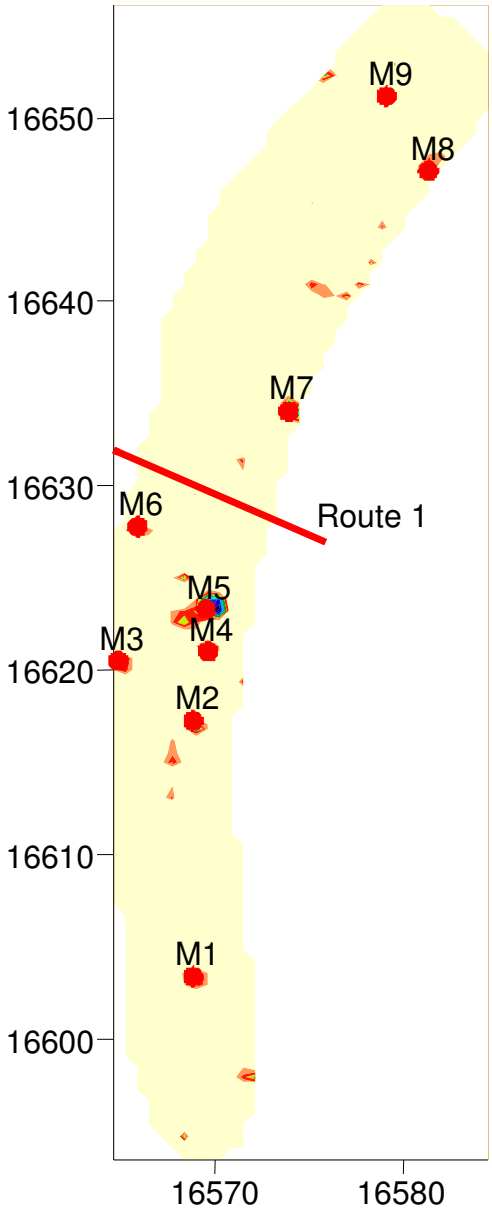

Figure I.12: The Location of Magnetic Anomalies M1-M9

2.2.7 Results of Side-Scan Sonar Survey: Routes 6 & 7

Four anomalies of possible archaeological potential and two sites of previous engineering works were interpreted from the side-scan sonar survey.

The identification tag, interpretation and location of the sites are provided in Table I.3.

Table I.3: Co-Ordinates and ID-Tags for the Sites Interpreted from the Sidescan Sonar Data

Id/Tag	Interpretation	Easting	Northing
SS1	Linear upstanding Anomaly	170546.7	171811.5
SS2	Upstanding area of Riverbed	170631.1	172124.6
SS3	Series of Upstanding Anomalies	170647.6	172002.9
SS4	Sub-Circular Feature	170577.4	171617.9
SS5	Riverbed Crossing	170527	171440.7
SS6	Riverbed Crossing	170591	171569.2

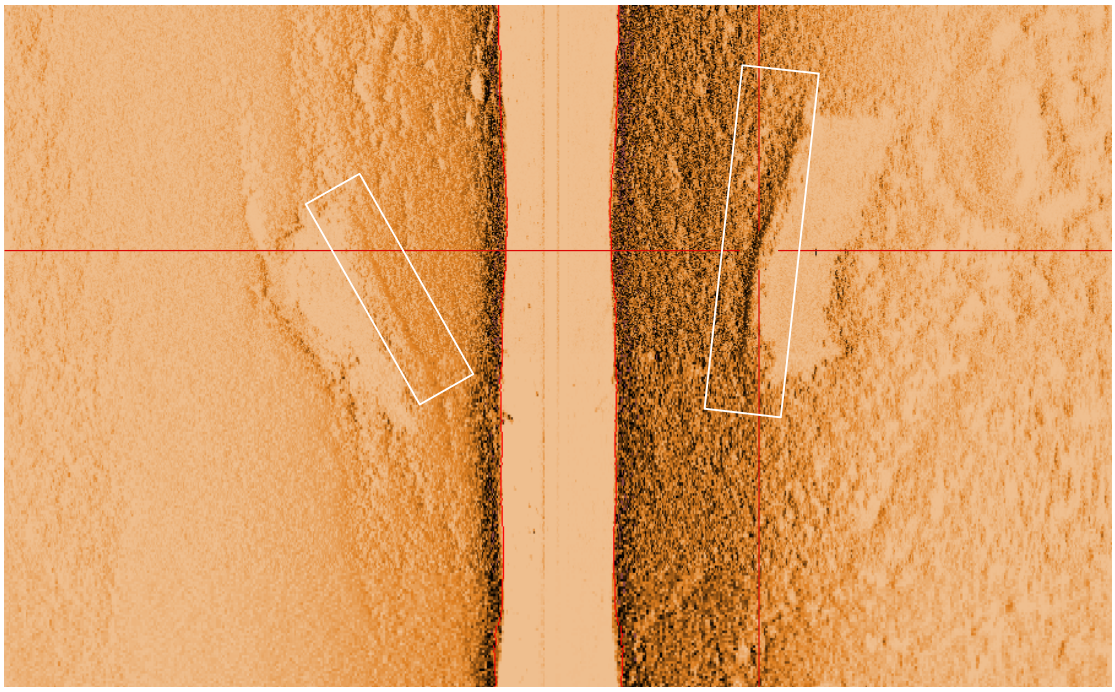

Figure I.13: SS1 Linear Upstanding Anomaly.

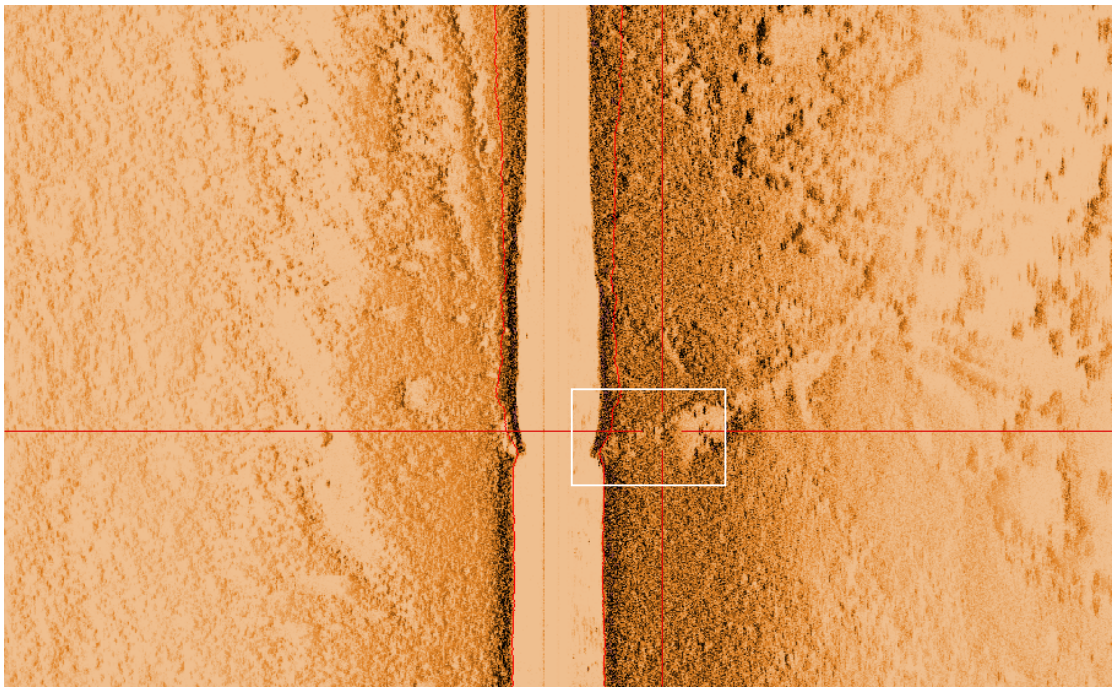

Figure I.14: SS2 Area of Upstanding Riverbed

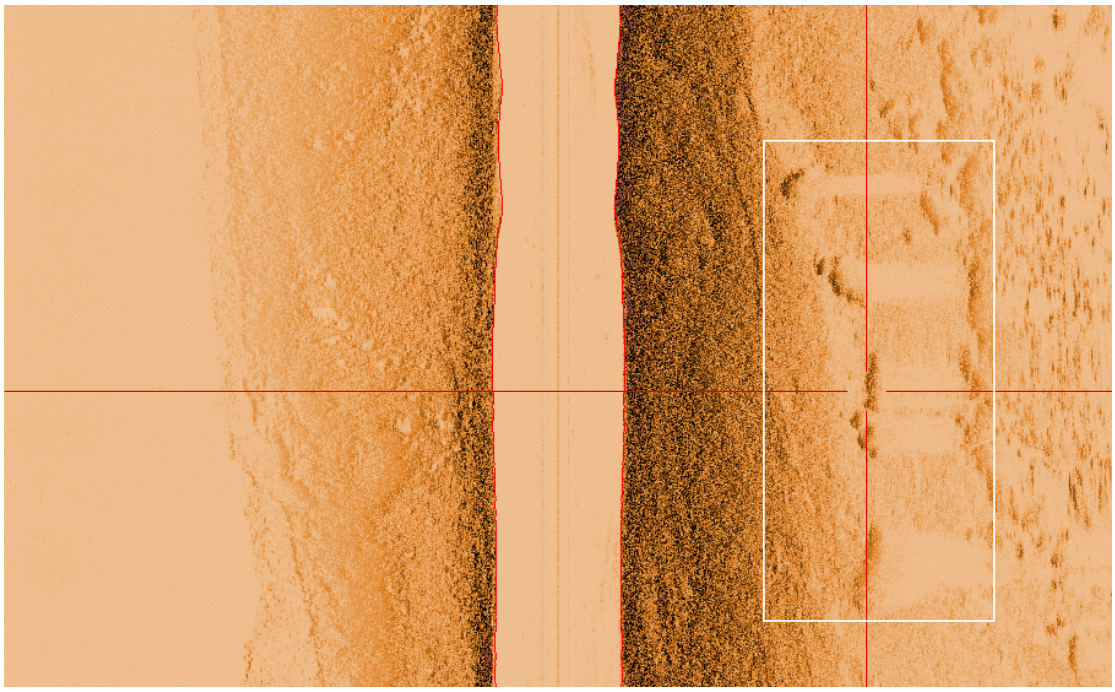

Figure I.15: SS3 Series of Upstanding Anomalies

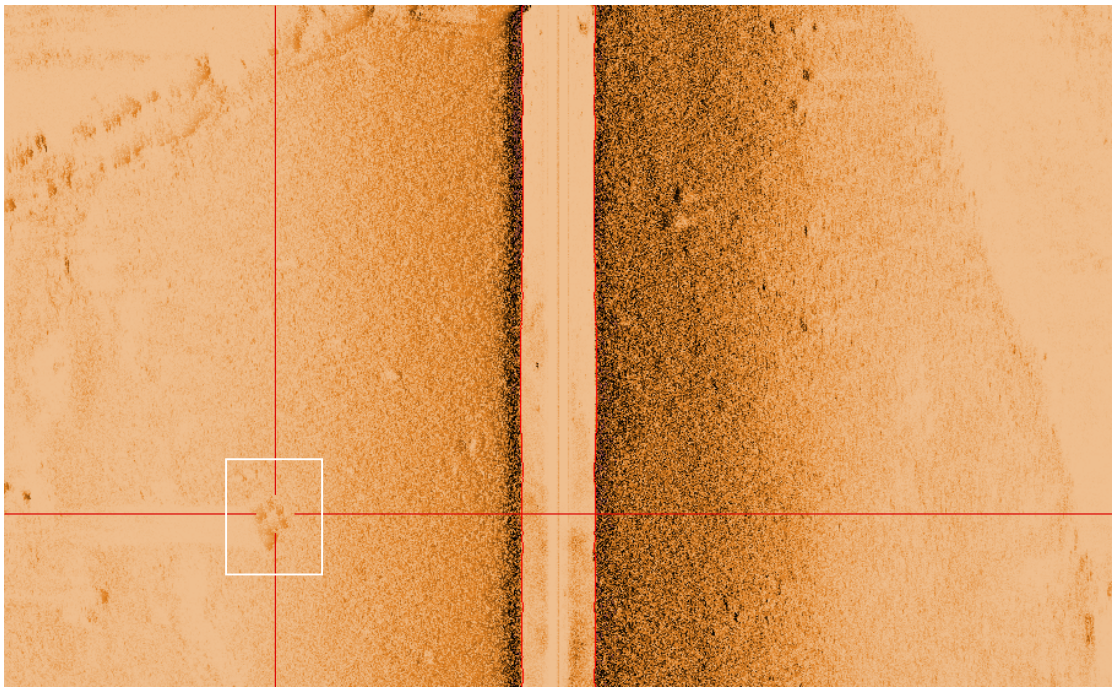

Figure I.16: SS4 Sub-Circular Anomaly

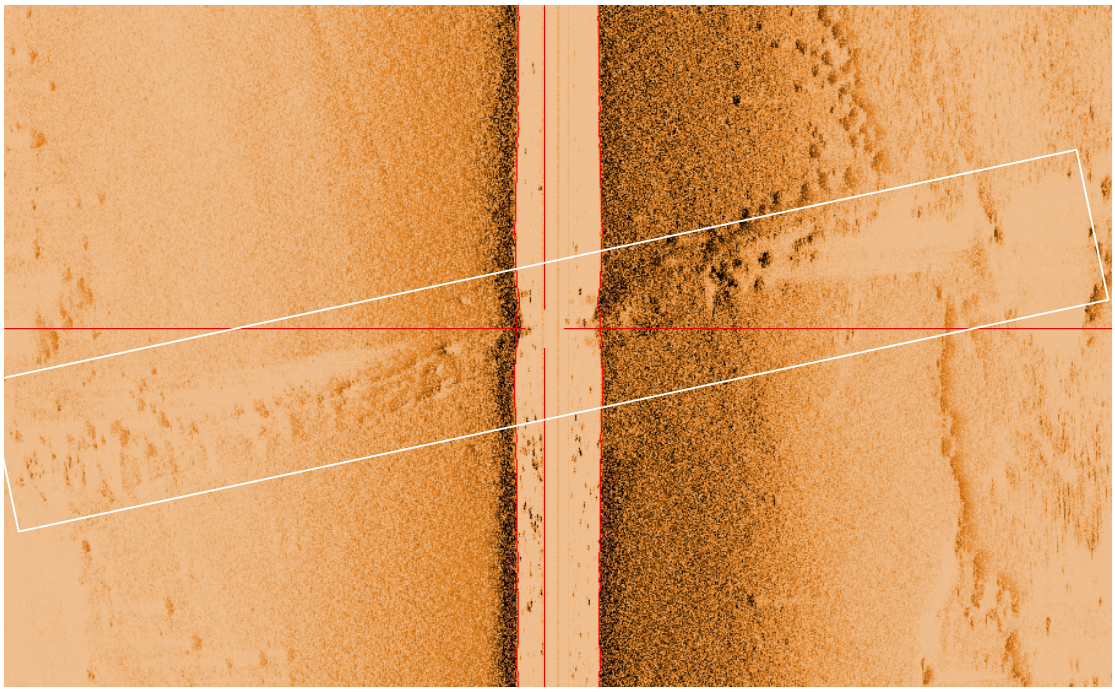

Figure I.17: SS5 Riverbed Crossing

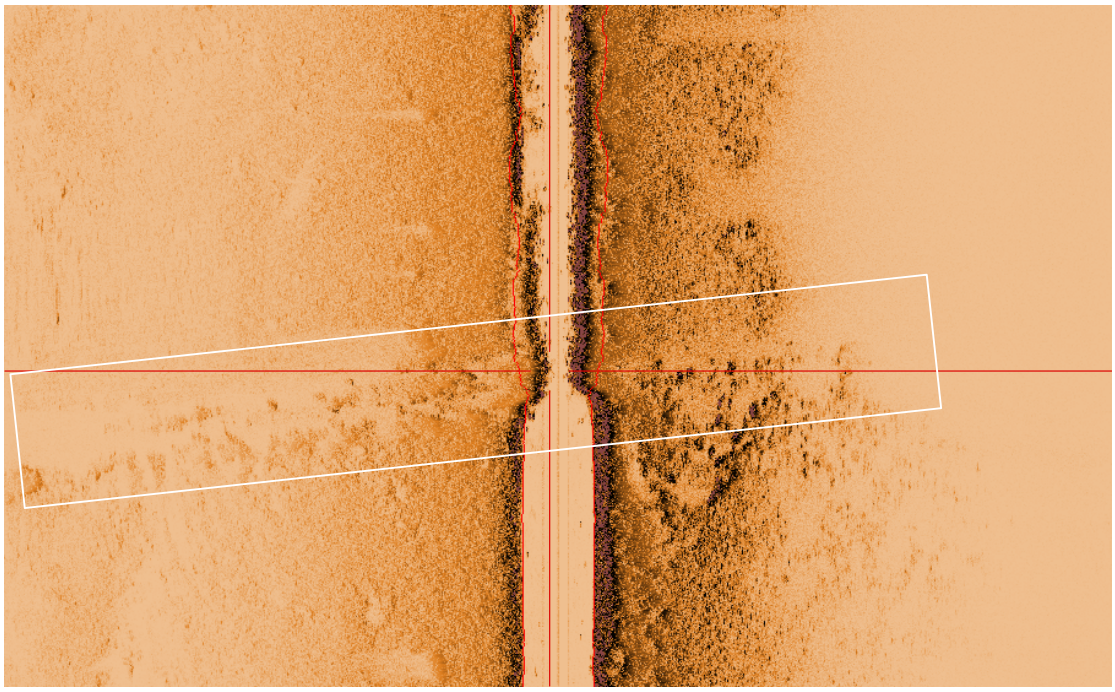

Figure I.18: SS6 Riverbed Crossing

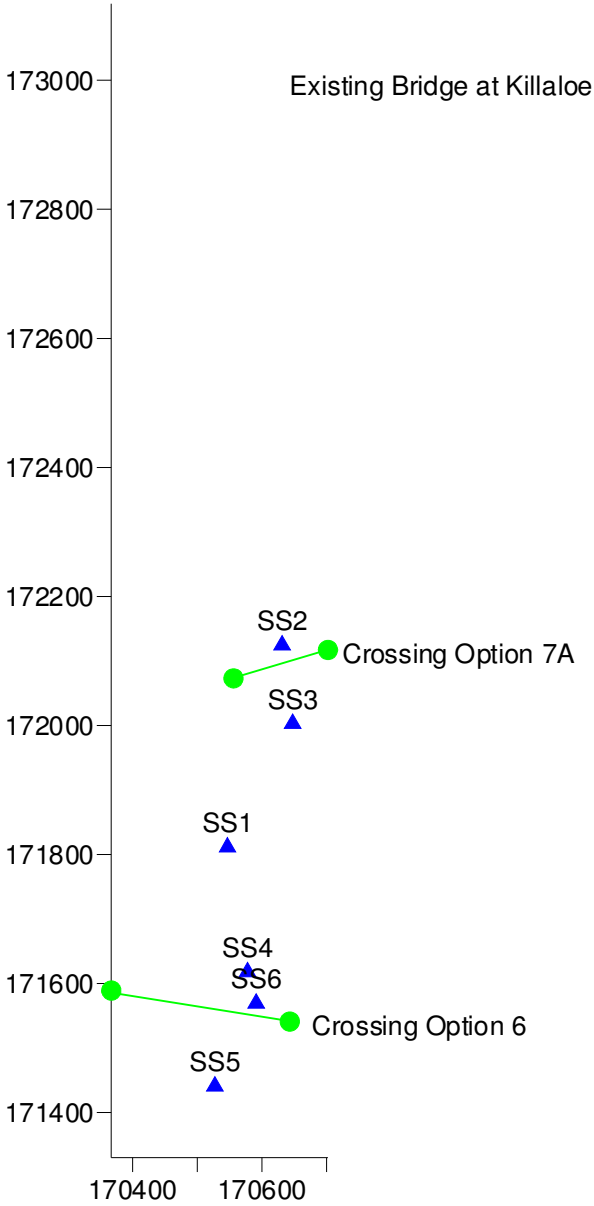

Figure I.19: Location of the Anomalies Interpreted from the Sidescan Record in Relation to the Proposed Crossings (Scale to Irish National Grid)

2.2.8 Results of Side-Scan Sonar Survey: Route 1

No anomalies were interpreted from the sidescan survey record at or adjacent to the location of the proposed crossing Route 1 located at O'Briensbridge/Montpelier.

2.2.9 Data Integration: Routes 6 & 7

The location of the sidescan anomalies SS1-SS6 and the magnetic anomalies M3-M5 are depicted with respect to the proposed crossings in Figure I.20.

The anomalies M3, M4, SS2 and SS3 are within or adjacent to the construction zone of crossing Route 7.

The riverbed crossings SS6, SS5 and the anomaly SS4 are within or adjacent to the construction zone of crossing Route 6.

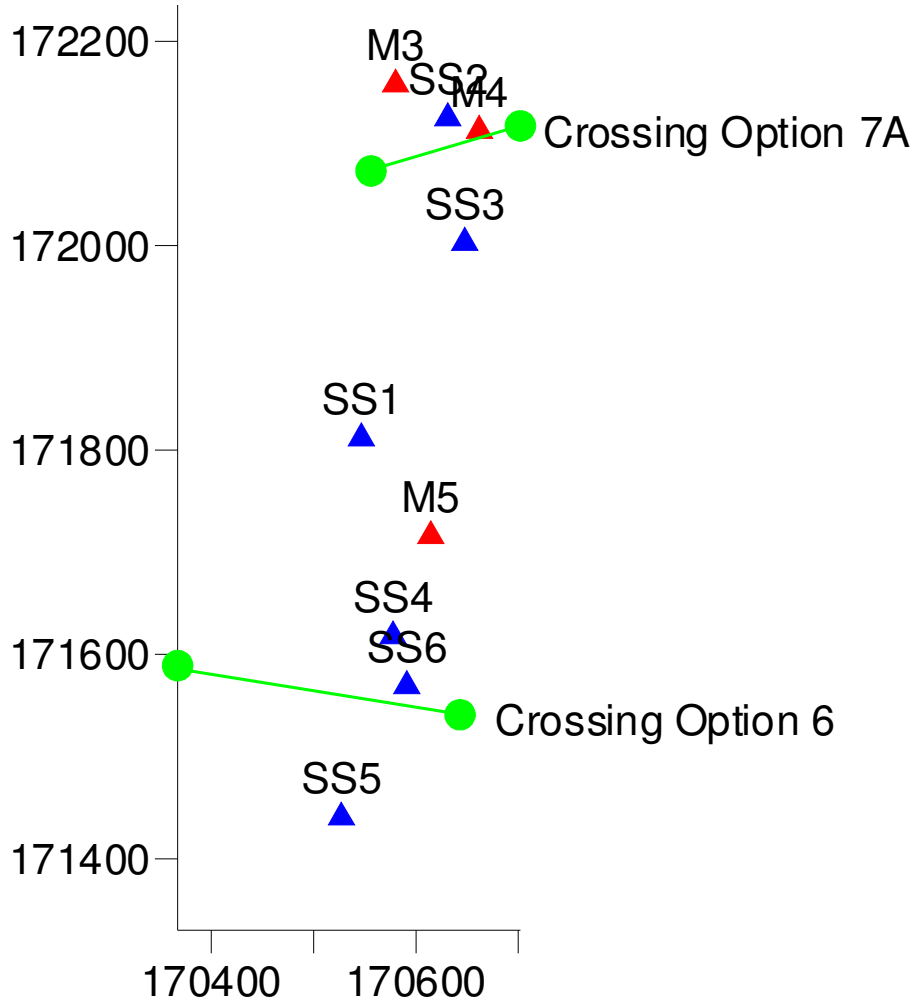

Figure I.20: Location of all Anomalies in Relation to the Proposed Crossings – Routes 6 and 7 (Scale to Irish National Grid)

2.2.10 Data Integration: Route 1

The locations of the magnetic anomalies M1-M9 are depicted with respect to the proposed crossings in Figure I.21.

The anomalies M3-M7 are within or adjacent to the construction zone of crossing Route 1.

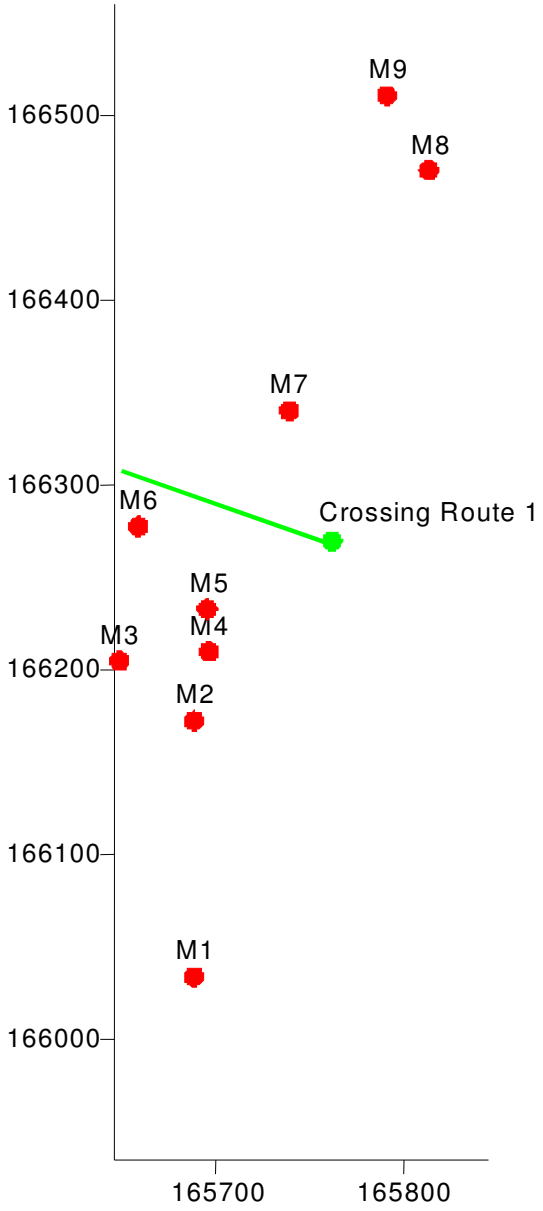

Figure I.21: **Location of all Anomalies in Relation to the Proposed Crossings – Route 1 (Scale to Irish National Grid)**

2.2.11 Underwater Investigations: Routes 6 & 7

Underwater investigation at the location of anomaly SS1 revealed an area of upstanding and collapsed dry-stone walling with associated upright and horizontal wooden poles. This feature may represent the remains of building or boundary wall. (Figures I.22 and I.23)

Underwater investigation at the location of anomaly SS2 revealed an area collapsed dry-stone walling. This feature may represent the remains of building or boundary wall. (Figures I.24 and I.25)

Underwater investigation at the location of anomaly SS3 revealed an area of eroding riverbed. (Figures I.26 and I.27)

Underwater investigation at the location of anomaly SS4 revealed a mooring block.

The location of the riverbed crossings were not investigated.

Underwater investigation at the location of anomaly M1 revealed no surface feature.

Underwater investigation at the location of anomaly M3 revealed no surface feature.

Underwater investigation at the location of anomaly M3 revealed a dry-stone Culvert, possibly a drainage channel from the adjacent canal. (Figure I.28).

Underwater investigation at the location of anomaly M4 revealed no surface feature.

Underwater investigation at the location of anomaly M5 revealed no surface feature.

Figure I.22: Anomaly SS1, Collapsed Stone and Slender Wooden Poles

Figure I.23: Anomaly SS1, Upstanding Dry-Stone Wall and Vertical Wooden Post

Figure I.24: Anomaly SS2, Area of Collapsed Stone

Figure I.25: Anomaly SS2, Area of Collapsed Stone

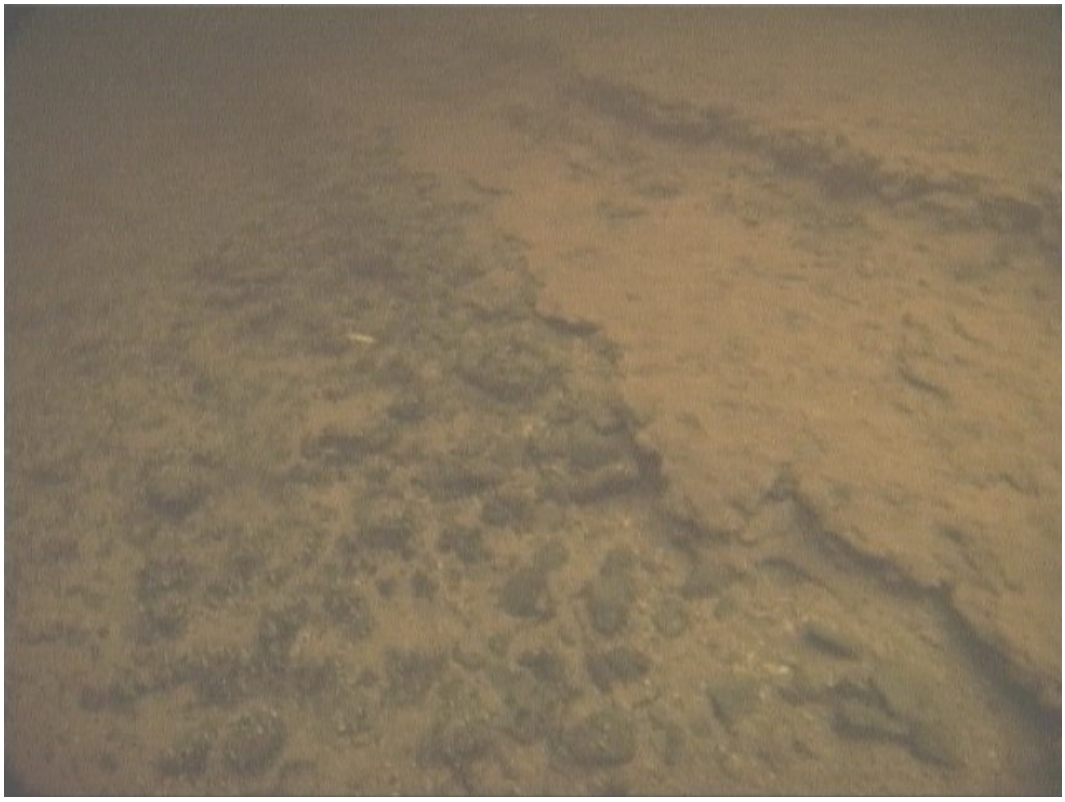

Figure I.26: SS3 Area of Eroding Riverbed

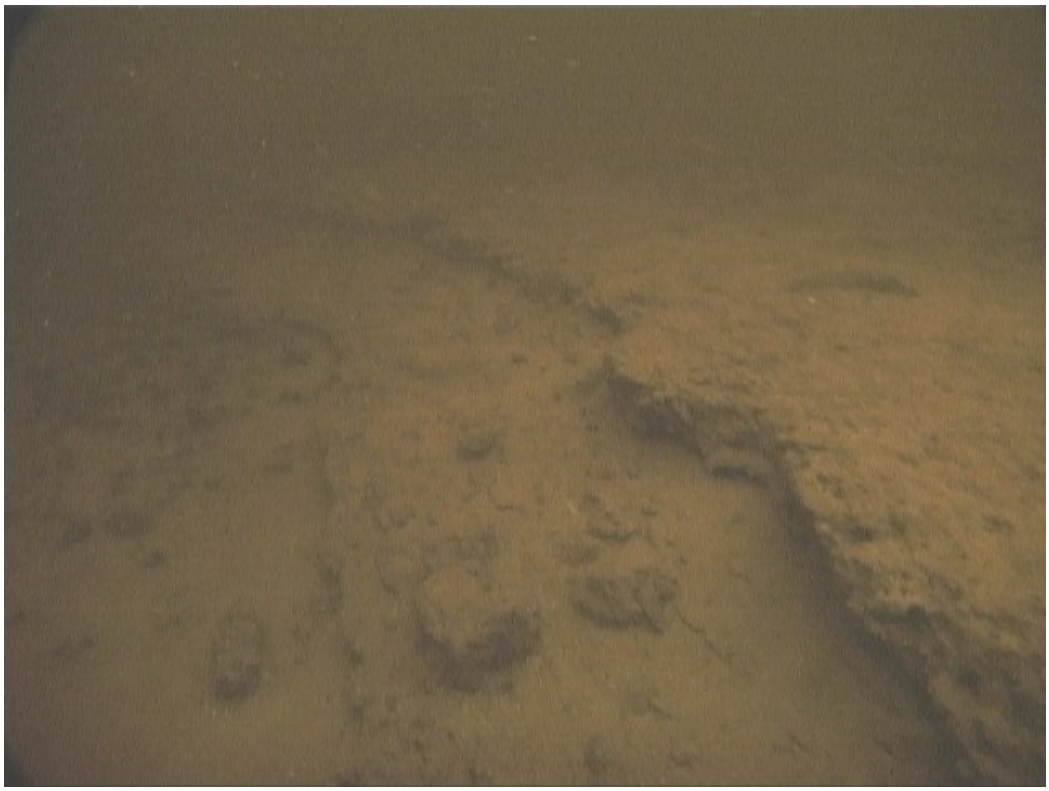

Figure I.27: SS3 Area of Eroding Riverbed

Figure I.28: Dry-Stone Culvert, Possibly a Drainage Channel from the Adjacent Canal

2.2.12 Underwater Investigations: Route 1

Underwater investigation at the location of anomaly M7 revealed a modern piece of iron.

Underwater investigation at the location of anomalies M1-M6, M8 & M9 revealed no surface features.

3.0 Recommendations & Ranking of Proposed Routes

3.1 General

The riverbed at the location of all the proposed crossings should be treated as areas of high archaeological potential.

The flooded landscape at the location of the proposed Routes 6 & 7 should be treated as an area of very high archaeological potential as this area was inundated prior to the development of modern archaeological surveys and records.

The results of the survey revealed no features, which would prohibit the construction of a crossing at any of the locations under consideration.

When the engineering design is complete, it is recommended that the riverbed within the area of impact of the proposed construction works be subject to a further detailed assessment.

3.2 Route 1

Site surveys and investigations at the location of the proposed Route 1 revealed no features, which could be interpreted as being archaeological.

Nine magnetic anomalies M1-M9 were interpreted from the survey record. Of these the anomalies M3-M7 are within or adjacent to the construction zone of the proposed crossing Route 1. The magnetic anomalies M3, M4, M5, M6 and M7 should be treated as areas of possible archaeological potential.

The construction of a crossing at the location of Route 1 will not impact on a flooded landscape, as would be the case for Route 6 or 7.

Consequently, Route 1 is the most preferred location for construction of a crossing.

3.3 Route 6

Site surveys and investigations at the location of the proposed crossing Route 6 revealed no features, which could be interpreted as being archaeological.

Construction of a crossing at the location of Route 6 will impact on or adjacent to an area of riverbed, which has apparently been disturbed by previous modern river crossings, possibly cables or a pipeline.

Route 6 is the second preference location for construction of a crossing.

3.4 Route 7a

Site surveys and investigations at the location of the proposed Route 7a revealed no features, which could be interpreted as being archaeological.

Construction of a crossing at the location of Route 7a will possibly impact on an area of riverbed, which was previously an island on which a holy well was located. No evidence of this holy well was identified by way of the surveys conducted.

Route 7a is the third preference location for the construction of a crossing.

3.5 Route 7b

Construction of a crossing at the location of Route 7b will possibly impact on the feature SS2 (dry-stone wall), which is of archaeological interest, and the unidentified magnetic anomaly M4. The magnetic anomaly M4 should be treated as an area of possible archaeological potential.

Site surveys and investigations at the location of the proposed crossing 7b revealed a feature SS2 (dry-stone wall) which will require further investigation to determine its archaeological importance, prior to it being impacted by engineering works associated with the proposed crossing.

Route 7b at Killaloe/Ballina is the least preferred location for the construction of a crossing.

3.6 Route 7c

Site surveys and investigations at the location of the proposed Route 7c revealed no features, which could be interpreted as being archaeological.

Construction of a crossing at the location of Route 7c will possibly impact on an area of riverbed, which is adjacent to the features M3 (stone culvert) and SS2 (dry-stone wall), which are of

archaeological interest, and the unidentified magnetic anomaly M4. The magnetic anomaly M4 should be treated as an area of possible archaeological potential.

Route 7c is the fourth preference location for the construction of a crossing.

3.7 Ranking Summary

The ranking of routes from most to least preferred is Route 1 – Route 6 – Route 7a – Route 7c – Route 7b.

APPENDIX J

INFORMATION LEAFLET AND QUESTIONNAIRE FROM PUBLIC CONSULTATION

Shannon Bridge Crossing

Public Consultation Meeting No. 2
6th September 2005

Information Leaflet

The Project

Clare County Council, in conjunction with North Tipperary and Limerick County Councils, have commissioned a Feasibility Study and Preliminary Report for a new bridge crossing over the River Shannon within the study area shown on the map overleaf.

The purpose of the proposed bridge is to alleviate the traffic congestion currently being experienced at the existing bridges at Ballina/Killaloe and at O'Briensbridge/Montpelier, both of which are narrow bridges with limited traffic and pedestrian capacity. The bridge and associated approach roads will connect the R463 on the west side of the river to the R525/R466/R494 on the east side.

The Current Phase

The current phase of the project is the Route Selection phase, and follows from the previous Constraints Study phase completed in May 2005. The previous consultation meeting provided input to the Constraints Study, which has since been published. During the Route Selection phase, all potential routes are evaluated in the context of information collected in the Constraints Study and additional information collected relevant to each route considered. At the end of this phase, one route will be selected and taken for further development in the subsequent Preliminary Design phase. The EIS and statutory approval process will follow thereafter.

Routes Considered

Eight route locations, as shown overleaf, have been evaluated during this phase. This evaluation has led to Routes 6 and 7 being selected as the preferred routes for further investigation. In addition, Route 1 is being investigated as a potential route for consideration in the future.

The Purpose of the Public Consultation Meeting

The purpose of this meeting is to:

1. Inform the public of the proposed project.
2. Provide an opportunity to the public to address queries directly to Council officials and their design consultants relating to the project.
3. Receive comments or submissions relating to the project which members of the public wish to be considered in the selection of the preferred route of the crossing.

Future Public Consultation Meetings

A further public consultation meeting shall be held during the Preliminary Design phase of the project.

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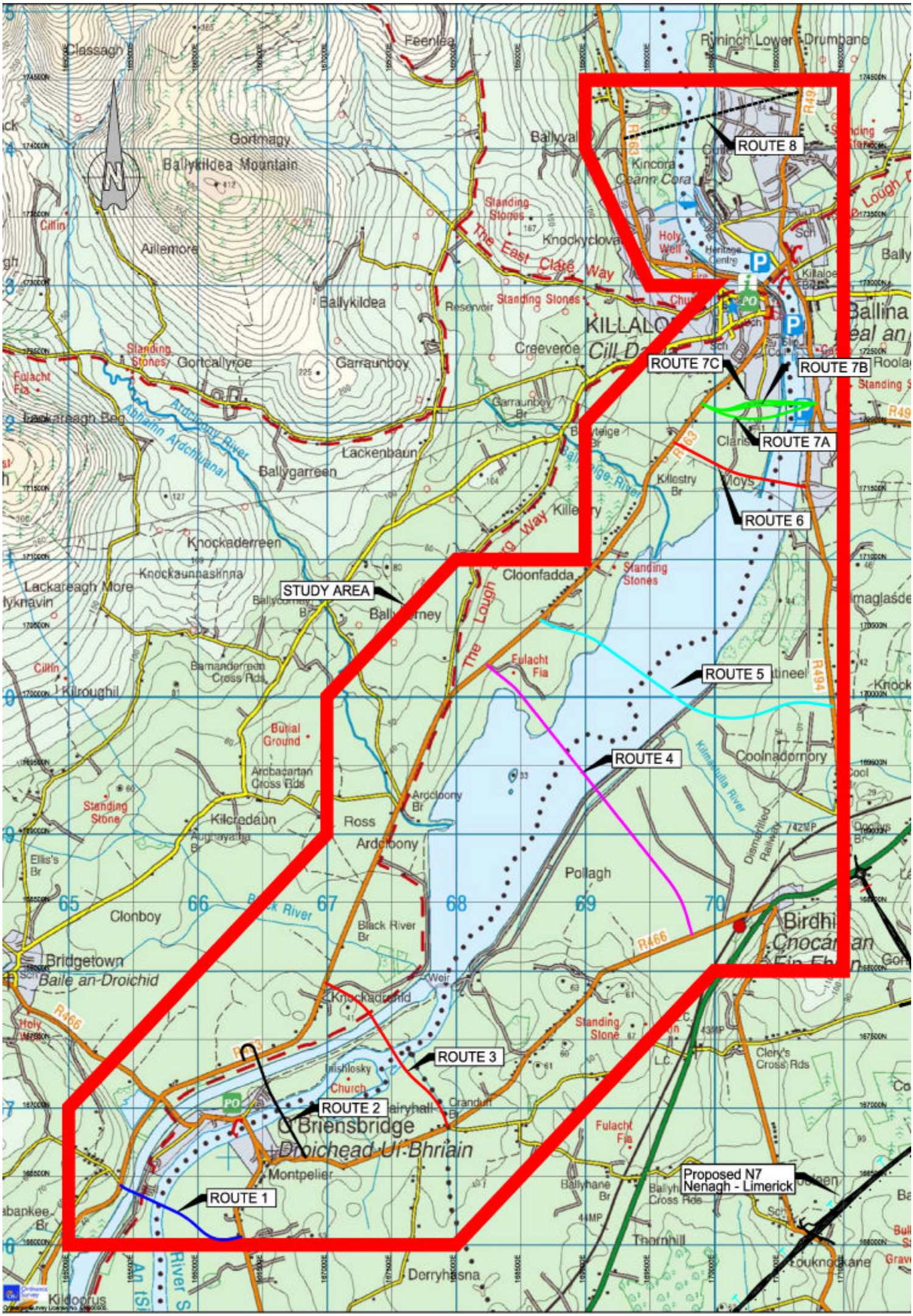
ROUTE 8
ROUTE 7C
ROUTE 7B
ROUTE 7A
ROUTE 6
ROUTE 5
ROUTE 4
ROUTE 3
ROUTE 2
ROUTE 1
STUDY AREA
Proposed N7
Nenagh - Limerick
Classagh
Feenlea
Ryninch Lower
Drumbane
Gortmagy
Ballykildea Mountain
Ballyval
Kincora
Ceann Cora
Standing Stones
The East Clare Way
Knockyclova
Holy Well
Heritage Centre
Killaloe
Ballina
Cillin
Ailemore
Ballykildea
Reservoir
Creeverce
Gortcallyroe
Garraunboy
Fulacht Fia
Lough Derg
Ardcloony River
Abhainn Ardchuanal
Lackenbaun
Ballygarreen
Garraunboy Br
Killestry Br
Moys
Knockaderreen
Knockaunnashinna
Lackareagh More
Cloonfadda
Ballycorney Br
Barnanderreen Cross Rds
Kilroughil
Burial Ground
Ardbacartan Cross Rds
Standing Stone
Kilcredaun
Ardcloony Br
Ross
Ardcloony
Coolnadornory
Kilmastulla River
Dismantled Railway
Ellis's Br
Pollagh
Clonboy
Black River
Black River Br
Bridgetown
Baile an-Droichid
Weir
Knockadrehid
Clery's Cross Rds
Irishlosky Church
Crandun
Fairyhall
O'Briensbridge
Droichead Ui Bhriain
Montpelier
Ballyhane Br
Ballyhane Cross Rds
Thornhill
Derryhasna
Kildorrus
R466
R494
R463
R499

Shannon Bridge Crossing

Public Consultation Meeting No. 2
6th September 2005

Questionnaire

We would greatly appreciate if you would give us your views on the proposed new Shannon Bridge Crossing and any information which you would like to be considered in the selection of the preferred route of the crossing.

Please complete this form and hand it in at the Public Consultation or return it in the envelope provided before 13th September 2005 to:

Clare County Council,
Road Design Office,
Quinn Rd. Business Park,
Quinn Road,
Ennis,
Co. Clare.

1. Do you own, rent or occupy property in the Study Area? (see Information Leaflet)
Yes ☐
No ☐

2. If yes, which route is nearest to your property (See information leaflet) ☐

3. Are you in favour a new bridge crossing in the Study Area
Yes ☐
No ☐
Comment _____

4. Which route would you be in favour of ?
Route 1 ☐
Route 6 ☐
Route 7 ☐

Why? _____

_____

5. Which route would you not be in favour of?
Route 1 ☐
Route 6 ☐
Route 7 ☐

Why? _____

_____

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6. In your opinion, how important in relation to this project are the following? Please tick.

Effect	Very Important	Important	Least Important
Improvement in traffic conditions			
Improvement in road safety			
Impact on community near crossing			
Best value for money			
Effect on business			
Effect on tourism			
Conservation of archaeology			
Conservation of flora and fauna			
Impact on landscape			
(Other)			

Please record below any other comment you may wish to make in connection with any of the proposed crossings and the selection of the preferred route.

Name: _____

Address: _____

_____

Contact No. _____

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APPENDIX K

SUMMARY OF SUBMISSIONS

Submissions were received from a number of groups/individuals after the conclusion of the Second Public Consultation.

The main points included in these submissions have been summarised below. These summaries, by their nature, may not fully or accurately reflect the issues raised and sentiments expressed in the original submissions. The original submissions can be viewed at the offices of Clare County Council.

Alfie Byrne and Una Murphy

- Route 7 cuts across land belonging to St. Anne's School.
- Route 7 passes within 15metres of a residential site that received planning permission within the last 12 months.
- Route 7 passes in front of Clarisford Palace on land consistently protected by An Bord Pleanala.
- Route 7 conflicts with the essence of the Irish Heritage Trust.
- Route 7 could be regarded as a test of commitment and a challenge to the government.
- Route 7 cuts through an environmentally sensitive area.
- Constraints Study is flawed in many areas.

Brian Byrne

- None of the options specified in the drawings and maps appear to have been costed.
- No access works or ancillary infrastructure is being considered.
- Study not making allowances for the re-routing of HGV traffic which will still push its way through the narrow streets of Killaloe.
- No evidence that funding avenues are being considered.
- Existing bridge is adequate to meet local needs; pedestrian boardwalk should take the place of the eel traps; bridge should be weight restricted.
- Killaloe is a heritage town and will only enjoy benefits of tourism provided short-sighted and poor infrastructural planning is nor pursued by the local authorities.

Herman Kikkers

- Present study does not address relieving the traffic, especially heavy articulated traffic from the town.
- Routes 4, 5 and 6 would be strategically stronger since they enable scope for growth, protect existing town structure, and eliminate articulated heavy traffic.

- Routes 7 and 8 would interfere with existing residential areas, have a negative impact on protected structures and archaeological sites, destroy areas of exceptional flora and fauna and have a detrimental affect on the local school.
- In addition it would increase the pollution in the town and the noise levels.
- The selection should bring a solution for both O' Briensbridge and Killaloe/Ballina and this drives the strategic solution towards location 4, 5 and possibly 6.

Unigrund GmbH

- Study Area differs from that which was presented at 1st Public Consultation (April 2005).
- Property owners were disadvantaged because they were not informed that the Study Area had been enlarged.

AGT Services Ltd.

- Routes 6, 7a, 7b and 7c all traverse their property.
- Detailed submission will be submitted at later date.

Clarisford Palace

- Clarisford Palace is listed in the Clare County Development Plan 2005 –2011 on the 'Record of Protected Structures' Reference No. 441.
- A road passing in front of the Palace would severely damage the character of the Palace for future generations.
- Route 7a would pass within 70m of the palace.
- Visual impact, noise and dirt levels would be seriously increased.
- The direct link between the Palace and the Cathedral would be broken.
- Access to and from the Palace would be severely impacted.
- The archaeological significance of the area would be ruined.
- Route 6 would give the Council more options for a 'by-pass' in the medium/long term.
- The visual impact on Killaloe would be lessened the further away the 'new' bridge is from the old bridge.
- Sight distance exiting the bridge will be severely impaired where it meets the R494/R466 and will not meet the required standard.
- Construction of Route 7 would impinge severely on the quality of life of residents during the building phase.
- No consideration has been given to access to both the front and rear of Clarisford.

O'Briensbridge/Montpelier Environmental Protection Group

- Consultation process was misleading and was never designed to alleviate traffic problems in O' Briensbridge.
- Those who attended the public consultation were unaware that a new crossing had already been selected and announced to the local public Representatives at a private session one hour earlier.
- Consultants were acting on the instructions of the three Local Authorities and were told prior to public Consultation where the new crossing should be.
- Surprised and disappointed that Clare County Council failed to represent the people of O' Briensbridge.
- Crossing should be put in place to meet the needs of Montpelier/O' Briensbridge to run in tandem with the new Ballina/Killaloe crossing.

Kevin Grimes

- A new Shannon Bridge Crossing without a new link road bypassing the town (Killaloe) is useless and a waste of money.
- Articulated lorries are holding the town (Killaloe) to ransom.
- Serious risk of road traffic accident or death for students of St. Anne's Secondary School, Killaloe Boys National School, Killaloe Girls National School.
- Traffic chaos due to HGV's trying to negotiate Jones' Corner, the narrow roadway outside the Cathedral and Bank and the sharp corner at Derg House.

Richard O'Toole

- There is strenuous opposition to the utterly crazy notion of Route 7.
- Professional consultants will be engaged to audit the work of RPS and legal professionals will be instructed to fight against Route 7.
- Consultants no longer have a vestige of confidence because:-
  - (a) Their prejudicial efforts to rule out routes other than 1, 6 and 7 without seriously considering the benefits of other routes.
  - (b) The manifest errors in the Constraints Study.
  - (c) Their unsupported assertions about the alleged benefits of Route 7.
- Statements contained in document PC-06 purporting to state the advantages of Route 7 are at complete variance with the facts.
- Route 7 through its impact on Clarisford Palace flies directly in the face of Government policy on heritage.

APPENDIX L

LIST OF FIGURES

1 EXECUTIVE SUMMARY

2 INTRODUCTION AND BACKGROUND TO PROJECT

3 ROUTE OPTIONS – SELECTION AND EVALUATION

4 ROUTE OPTIONS SHORTLIST

APPENDIX M

LIST OF TABLES

1 EXECUTIVE SUMMARY

2 INTRODUCTION AND BACKGROUND TO PROJECT

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