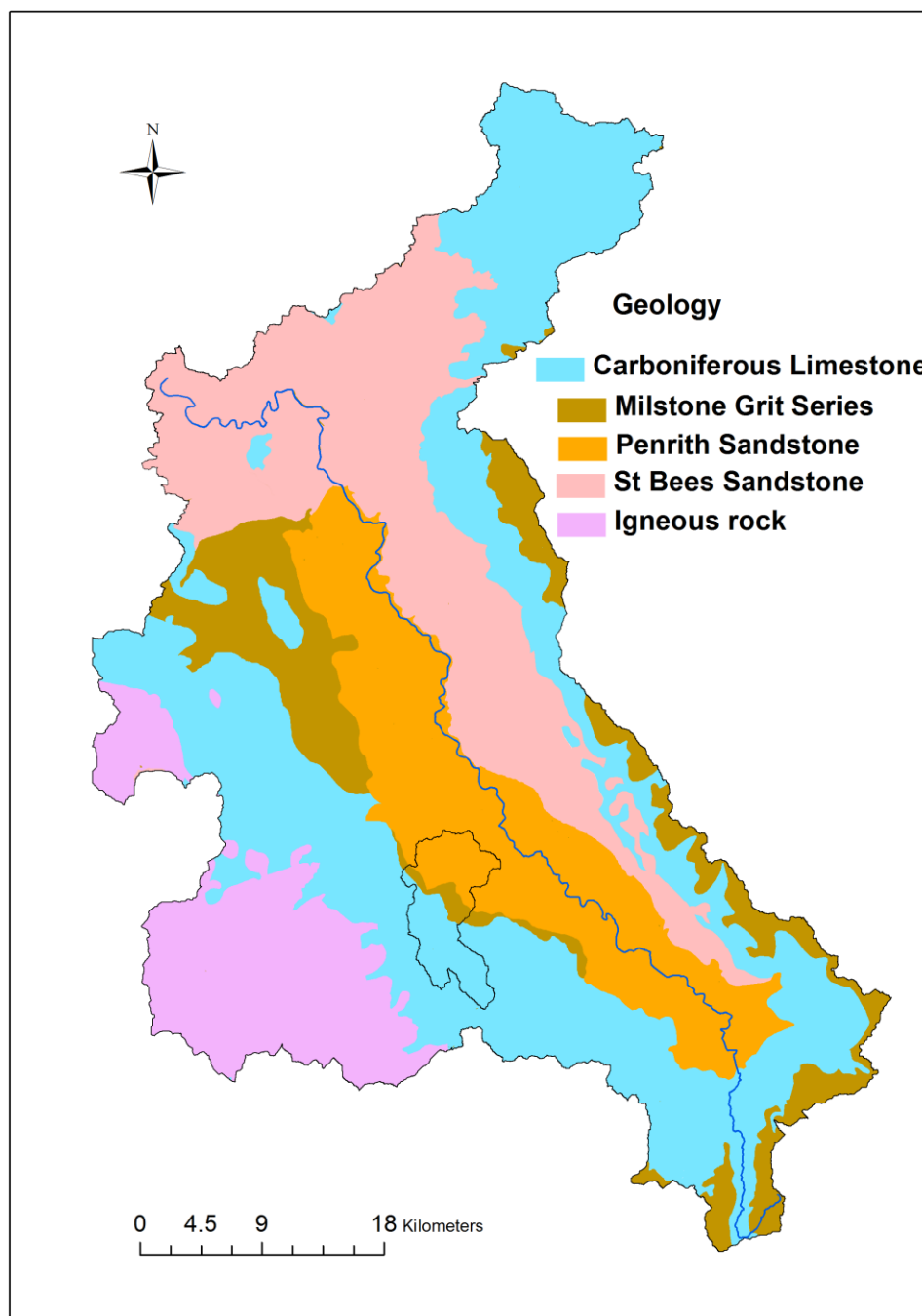




Supporting Figure 1 Main geological units of the River Eden catchment, based on Bedrock Geological Map (BGS, 2010)

Supporting Table 1 Current phosphorus standards to protect WFD ecological status in rivers(DEFRA, 2010). Values expressed as annual mean Soluble Reactive P / Total Reactive P at a sampling point (mg l⁻¹)

River type	Altitude (m a.s.l.)	Annual alkalinity (mg l ⁻¹ CaCO ₃)	Phosphorus concentration (mg l ⁻¹)			
			High	Good	Moderate	Poor
1n	<80	<50	0.03	0.05	0.15	0.50
2n	>80	<50	0.02	0.04	0.15	0.50
3n	<80	>50	0.05	0.12	0.25	1.00
4n	>80	>50	0.05	0.12	0.25	1.00

DEFRA 2010. River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Direction 2010.

Supporting Table 2 The EA routine surface monitoring points in the River Eden catchment sorted by Northings and then Eastings. River type as per Supporting Table 1

Sampling point	EA Number	Name	Eastings	Northings	River type
SW_1	88006314	Butter Burn At Butterburn Bridge	367665	574449	2n
SW_2	88022534	River Irthing U/s Crammel Linn Waterfall	366400	571000	2n
SW_3	88006318	King Water At Kingbridge Ford	357792	567487	4n
SW_4	88006331	River Irthing U/s B6318	363218	566482	2n
SW_5	88006317	King Water At Dovecote Bridge	352718	564330	4n
SW_6	88006313	River Irthing At Lanercost	355370	563326	2n
SW_7	88006337	Trib Of Brunstock Beck At Fordsyke	345740	563215	3n
SW_8	88006339	Highberries Beck At Ny464630	346600	563000	3n
SW_9	88006319	Cam Beck Ptc River Irthing	350951	562540	3n
SW_10	88020082	Brampton Beck D/s Brampton	352150	561350	4n
SW_11	88006321	River Irthing @ Ruleholme Bridge	349318	560161	3n
SW_12	88010167	Cargo Beck At Cargo Beck Cottages	337350	559300	3n
SW_13	88006329	River Gelt At Low Geltside	352001	559154	4n
SW_14	88021071	Eden At Beaumont (new Site)	335800	558800	3n
SW_15	88006332	River Irthing At Newby East	347698	558047	3n
SW_16	88006427	River Eden At Sheeppmount	339046	557146	1n
SW_17	88006340	Brunstock Beck At Rickerby	341125	557018	3n
SW_18	88006424	River Caldew At Bitts Park	339457	556714	3n
SW_19	88006306	River Eden At Warwick Bridge	346898	556699	1n
SW_20	88006382	River Eden At Eden Bridge	340101	556595	3n
SW_21	88006381	River Petteril At Stonyholme	341146	556439	3n
SW_22	88006338	Pow Maughan Beck At Pow Maughan Bridge	344240	556218	3n
SW_23	88006423	Little Caldew At Caldewgate	339500	556000	3n
SW_24	88006421	River Caldew At Holmehead	339830	554554	1n
SW_25	88006307	Cumwhitton Beck At Randlaw Lane	350216	552727	4n
SW_26	88006376	River Petteril At Golden Fleece	343500	551301	3n
SW_27	88006368	Woodside Beck Ptc R.petteril	343236	550584	4n
SW_28	88006419	Pow Beck At Green Lane	338685	550074	4n
SW_29	88006418	River Caldew At The Green Dalston	337073	549748	2n
SW_30	88006297	Croglin Water At Croglin Bridge	357492	546945	4n
SW_31	88006417	River Roe At Gaitsgill	338794	546590	4n
SW_32	88006305	Hall Beck Near Oatlands Cottage	351325	546499	4n
SW_33	88006301	River Eden At Armathwaite	350715	546043	4n
SW_34	88006375	River Petteril At Southwaite	345113	545113	4n
SW_35	88006294	Briggle Beck At Coney Hill Bridge	355793	545004	4n
SW_36	88006403	River Ive At Footbridge Ptc Roe Beck	340253	543302	4n
SW_37	88006296	Croglin Water At Nunnery Walks Bridge	353996	542847	4n
SW_38	88006367	Blackrack Beck At Ny479428	347908	542820	4n
SW_39	88006402	River Ive At Low Braithwaite Bridge	342803	542185	4n
SW_40	88006393	River Caldew At Sebergham	335728	541811	2n
SW_41	88006395	Roe Beck At Roebank Bridge	339332	541754	4n
SW_42	88006290	Raven Beck At The College Fall	355512	541098	4n
SW_43	88006370	River Petteril At Calthwaite Bridge	347513	540802	4n
SW_44	88006374	Calthwaite Beck Ptc River Petteril	347411	540647	4n
SW_45	88006288	River Eden At Lazonby	355096	540499	2n
SW_46	88006392	Cald Beck Downstream Of Caldbeck Village	332594	539896	4n
SW_47	88006289	Glassonby Beck At Daleraven Bridge	356759	539514	4n
SW_48	88006369	River Petteril At Brockley Moor	348971	536894	4n
SW_49	88006268	Robbery Water U/s Eden	356761	535968	4n
SW_50	88006278	Briggle Beck @ Rd Bridge D/s Board Mills	356519	535170	4n
SW_51	88006265	Hole Sike At Ellercow Hill Bridge	361263	534696	4n
SW_52	88020176	Stony Beck At Milburn House	350100	534500	4n
SW_53	88006266	Briggle Beck At Briggle Bridge	358325	534102	4n
SW_54	88006387	River Caldew 50m D/s Grainsgill Beck	332804	532624	2n
SW_55	88006291	Blencarn Beck At Skirwirth Abbey Bridge	361527	532396	4n
SW_56	88006388	River Caldew At Mosedale Bridge	335694	531959	2n
SW_57	88006359	River Petteril At Newton Reigny	347896	531889	4n
SW_58	88006353	River Petteril At Greystoke	344531	531089	4n
SW_59	88006362	Summerground Gill Ptc R. Petteril	344267	530764	4n
SW_60	88006264	River Eamont At Udford	357612	530431	2n
SW_61	88006253	Thacka Beck Ptc R Eamont	352540	529287	4n
SW_62	88006203	Milburn Beck At Mill Lane Bridge	364592	528910	4n
SW_63	88006246	River Eamont At Eamont Bridge	352195	528720	2n
SW_64	88006261	River Lowther At Lowther Bridge	352492	528202	4n
SW_65	88006220	River Eden At Temple Sowerby	360394	528201	4n
SW_66	88019870	Crowdundle Beck 50m U/s Birk Sike	360850	528150	4n
SW_67	88006238	Dacre Beck At A592	347785	526713	4n

SW_68	88006198	Noonhowe Syke At Ny500247	355400	525400	4n
SW_69	88006192	Swindale Beck U/s Billys Beck	368651	525318	4n
SW_70	88006197	Trout Beck At Kirkby Thore	363530	525256	4n
SW_71	88021261	River Leith @ Cliburn D/s Weir	359008	524479	4n
SW_72	88006262	River Eamont At Exit From Ullswater	346997	524449	2n
SW_73	88006202	River Leith U/s River Lyvennet Cliburn	358905	524392	4n
SW_74	88006186	River Eden At Bolton	364194	523496	2n
SW_75	88006212	River Lyvennet Upstream Of River Leith	361200	523200	4n
SW_76	88022535	Morland Beck At Town Head Bridge	360100	522000	4n
SW_77	88010152	End Of Track Opposite Newbewley Castle	365300	521700	2n
SW_78	88010151	River Eden At Colby Laithes	367166	521591	2n
SW_79	88006190	Hoff (ashby) Beck At Colby Hall	366508	520916	4n
SW_80	88006180	River Eden At Appleby	368448	520401	4n
SW_81	88006211	Aira Beck At A592	340088	519780	2n
SW_82	88006185	Hilton Beck At Roman Road Coupland	371081	518914	4n
SW_83	88006258	River Lowther At Bampton Grange	351681	518439	2n
SW_84	88006214	River Leith At Railway Sidings	355500	517700	4n
SW_85	88006244	Haweswater Beck At Bomby Bridge	351878	517545	2n
SW_86	88006213	River Lyvennet At Meaburn Hall	362493	517015	4n
SW_87	88006210	Glenridding Beck At A592	338708	516924	2n
SW_88	88006181	Helm Beck At Little Ormside	370574	516758	4n
SW_89	88009739	Goldrill Beck U/s Ullswater	339400	516500	2n
SW_90	88022198	Hoff Beck At Rutter	368311	515888	4n
SW_91	88022231	Crooks Beck D/s Lowgill Beck	374705	515418	4n
SW_92	88006173	River Eden At Warcop	374291	515086	4n
SW_93	88006241	Swindale Beck At Rosgill Moor Bridge	352594	514956	2n
SW_94	88022536	Swindale Beck Near Swinside Cottages	379800	514700	4n
SW_95	88006187	Scale Beck At Quarry	367261	514512	4n
SW_96	88006453	Argill Beck Bridge Near Argill House	382530	512900	4n
SW_97	88006176	Blind Beck At Intake Bridge	374624	512741	4n
SW_98	88006196	River Belah At Belah Bridge	379333	512059	4n
SW_99	88006452	Scandal Beck At Soulby	375203	510947	4n
SW_100	88006175	Blind Beck At Arklow Hill	372933	509954	4n
SW_101	88022199	Eden At New Bridge Kirkby Stephen	377279	509708	4n
SW_102	88006160	River Eden Upstream Of Kirby Stephen	377300	507508	4n
SW_103	88006163	Scandal Beck At A685 Road Bridge	372210	504350	4n

Supporting Table 3 The EA routine monitoring groundwater points in the River Eden catchment sorted by Northings and then Eastings

	EA Number	Name	Aquifer	Depth (m)	Eastings	Northings
GW_1	88021979	Crosshill	Sherwood Sandstone	29	348080	562710
GW_2	88020691	Toppin Castle Farm	St Bees Sandstone	55	349610	557050
GW_3	88010209	Edenford	St Bees Sandstone	61	349810	552620
GW_4	88010239	Marble Well	Carb.Limestone	0	354940	552580
GW_5	88010238	Halls Tenement Farm	St Bees Sandstone	1	353090	551490
GW_6	88009552	Holmwrangle Hatchery 4	Penrith Sandstone	0	351770	549370
GW_7	88006598	Holmwrangle Hatchery 2	Penrith Sandstone	76	351800	549330
GW_8	88006599	Holmwrangle Hatchery 3	Penrith Sandstone	0	351840	549260
GW_9	88010233	Croft Farm	St Bees Sandstone	79	358120	547200
GW_10	88021533	Selah House	Carb.Limestone	51	361940	542800
GW_11	88009564	Gamblesby 2 (NWW)	St Bees Sandstone	150	361500	541170
GW_12	88006605	Gamblesby 1 (NWW)	St Bees Sandstone	155	361550	541150
GW_13	88010231	Eden Lacy	Penrith Sandstone	33	355950	538440
GW_14	88020692	Broadmeadows	St Bees Sandstone	60	359930	537450
GW_15	88009543	Ousby Moor	Penrith Sandstone	130	359609	535816
GW_16	88020693	Crewgarth Poultry	St Bees Sandstone	40	359760	534980
GW_17	88010227	Frank Bird Poultry	Penrith Sandstone	173	357390	533390
GW_18	88010237	Edenhall (NWW) No. 3	Penrith Sandstone	52	356374	533140
GW_19	88010236	Edenhall (NWW) No. 2	Penrith Sandstone	51	356371	533138
GW_20	88006590	Edenhall (NWW) No. 1	Penrith Sandstone	46	356368	533136
GW_21	88021128	Skirwith Hall	St Bees Sandstone	70	360980	532560
GW_22	88021129	Abbey Farm, Skirwith	St Bees Sandstone	57	360660	532320
GW_23	88021531	Newbiggin Mill	Carb.Limestone	0	364620	529000
GW_24	88022301	Halefield Farm	Sherwood Sandstone	60	363230	526780
GW_25	88010247	Spittals Farm	Penrith Sandstone	100	362170	526340
GW_26	88010234	Cliburn (NWW) No. 2	Penrith Sandstone	62	358594	525944
GW_27	88010235	Cliburn (NWW) No. 3	Penrith Sandstone	62	358596	525940
GW_28	88006587	Cliburn (NWW) No. 1	Penrith Sandstone	62	358593	525940
GW_29	88010246	Crossfell House Farm	Penrith Sandstone	60	363860	525780
GW_30	88010391	Woodhouse Farm	Penrith Sandstone	77	356750	524890
GW_31	88022169	White Stone Farm	Carb.Limestone	108	360560	520200
GW_32	88022170	Low Field Farm	Penrith Sandstone	48	369650	519320
GW_33	88021532	Swindale Grange	Carb.Limestone	0	380120	515130
GW_34	88021968	Low Dalebanks	Carb.Limestone	0	360980	513960
GW_35	88009574	High Griseburn Farm	Carb.Limestone	82	370950	512690
GW_36	88021956	Lady Ings Farm	Penrith Sandstone	0	378160	512020
GW_37	88010252	Hartley Castle	St Bees Sandstone	72	378280	508240
GW_38	88020036	Wharton Hall Farm	Carb.Limestone	66	377150	506230
GW_39	88010392	High Stennerskeugh	Carb.Limestone	0	374750	501250

Supporting Table 4 Descriptive statistics for total reactive phosphorus (TRP) and nitrate-nitrogen (NO₃-N) for the EA surface monitoring sites. N – number of samples, S.D. – standard deviation

Sampling point	Start year	End year	TRP (mg l ¹)					NO ₃ -N (mg l ¹)				
			N	Mean	S.D.	Median	Max	N	Mean	S.D.	Median	Max
SW_1	1992	2013	204	0.02	0.03	0.02	0.32	201	0.30	0.30	0.20	3.30
SW_2	2011	2013	7	0.02	0.00	0.02	0.02	7	0.20	0.00	0.20	0.20
SW_3	1993	2013	90	0.02	0.02	0.02	0.08	88	0.40	0.20	0.40	1.10
SW_4	1992	2010	40	0.02	0.03	0.01	0.13	40	0.40	0.20	0.50	0.90
SW_5	1992	2013	138	0.02	0.02	0.02	0.12	138	1.20	0.50	1.10	2.50
SW_6	1993	2013	180	0.02	0.02	0.02	0.10	180	0.80	0.50	0.70	2.20
SW_7	1993	2013	152	0.16	0.21	0.10	2.26	152	3.00	1.30	2.90	11.90
SW_8	1992	2012	26	0.08	0.05	0.07	0.22	25	6.80	1.50	7.10	9.40
SW_9	1992	2010	152	0.03	0.03	0.02	0.26	150	1.30	0.60	1.30	2.60
SW_10	2000	2006	15	0.18	0.37	0.09	1.51	16	5.20	1.90	6.00	7.70
SW_11	1993	2013	160	0.04	0.03	0.03	0.19	160	1.90	1.00	1.90	4.30
SW_12	1997	2013	94	0.34	0.28	0.25	1.92	94	1.80	0.90	1.60	5.00
SW_13	1990	2013	138	0.02	0.02	0.01	0.14	137	1.90	1.30	1.80	10.50
SW_14	2002	2013	60	0.06	0.03	0.05	0.17	60	2.20	0.70	2.20	3.70
SW_15	1990	2013	77	0.06	0.19	0.03	1.67	79	2.10	1.00	2.20	4.00
SW_16	1991	2013	899	0.05	0.03	0.04	0.19	897	1.10	0.60	1.10	3.90
SW_17	1991	2013	163	0.15	0.08	0.13	0.43	163	5.10	1.30	5.10	9.70
SW_18	1990	2009	74	0.04	0.03	0.04	0.14	74	1.90	1.00	1.70	6.00
SW_19	1990	2013	420	0.03	0.02	0.02	0.17	419	2.00	0.60	1.90	5.80
SW_20	1990	2013	135	0.05	0.03	0.04	0.15	134	2.40	0.70	2.40	4.20
SW_21	1990	2013	182	0.13	0.08	0.11	0.45	183	5.10	2.30	4.50	17.80
SW_22	1993	2013	85	0.15	0.10	0.11	0.49	102	4.80	2.30	4.40	16.30
SW_23	1990	2006	74	0.05	0.04	0.04	0.24	73	1.90	1.20	1.70	6.60
SW_24	1990	2013	110	0.05	0.05	0.05	0.34	107	1.60	0.70	1.50	4.40
SW_25	1992	2013	105	0.13	0.10	0.11	0.77	106	8.20	2.10	8.50	12.00
SW_26	1990	2013	110	0.15	0.09	0.11	0.45	110	5.00	2.00	4.60	15.20
SW_27	1992	2013	120	0.34	0.25	0.26	1.37	140	7.40	5.20	6.60	29.60
SW_28	1992	2013	208	0.33	0.21	0.26	1.69	208	3.90	4.80	2.80	51.60
SW_29	1990	2010	123	0.04	0.03	0.03	0.18	121	1.60	0.70	1.50	5.30
SW_30	1993	2013	86	0.02	0.06	0.00	0.50	86	0.50	0.30	0.50	3.00
SW_31	1990	2013	131	0.12	0.06	0.11	0.32	130	4.00	1.70	3.70	15.70
SW_32	1992	2013	68	0.15	0.07	0.14	0.44	67	6.70	1.70	6.70	9.40
SW_33	1993	2013	139	0.04	0.06	0.03	0.72	138	2.10	1.30	2.00	10.40
SW_34	1990	2013	67	0.11	0.09	0.08	0.50	66	4.30	2.20	3.70	15.60
SW_35	1992	2013	32	0.06	0.01	0.05	0.08	32	4.50	1.00	4.40	7.20
SW_36	1993	2013	91	0.14	0.11	0.11	0.60	90	4.70	3.10	4.30	17.10
SW_37	1992	2013	113	0.03	0.02	0.02	0.12	113	2.40	1.00	2.60	4.70
SW_38	1992	2013	187	0.06	0.05	0.05	0.34	206	8.70	2.50	8.30	18.00
SW_39	1990	2013	122	0.18	0.12	0.14	0.70	119	4.50	2.30	4.10	16.50
SW_40	1993	2013	148	0.03	0.02	0.02	0.16	145	0.80	0.30	0.80	3.40
SW_41	1990	2013	183	0.07	0.08	0.05	0.64	178	2.00	2.30	1.20	14.80
SW_42	1992	2013	65	0.02	0.02	0.01	0.20	64	2.60	1.90	1.90	8.00
SW_43	1990	2013	27	0.14	0.09	0.12	0.32	27	3.60	2.10	3.10	11.40
SW_44	1990	2013	12	0.52	0.37	0.38	1.36	12	4.30	1.10	4.40	6.20
SW_45	1993	2013	331	0.03	0.03	0.02	0.20	329	2.00	0.70	1.90	6.30
SW_46	1990	2013	168	0.03	0.06	0.02	0.50	165	0.70	0.30	0.70	2.10
SW_47	1992	2013	66	0.03	0.02	0.03	0.11	66	4.00	1.10	3.90	6.50
SW_48	1990	2013	90	0.08	0.05	0.06	0.28	89	3.10	1.70	2.40	8.10
SW_49	1992	2013	132	0.04	0.02	0.03	0.11	132	2.90	0.90	2.90	5.30
SW_50	1992	2007	53	0.07	0.03	0.07	0.14	51	6.00	1.00	6.20	8.00
SW_51	1992	2013	148	0.15	0.17	0.12	1.55	163	8.30	1.50	8.50	11.90
SW_52	2000	2013	6	1.04	0.99	0.63	2.88	5	6.60	5.00	7.70	12.70
SW_53	1992	2013	89	0.07	0.08	0.07	0.81	87	5.90	1.00	5.80	11.00
SW_54	1990	2013	217	0.02	0.02	0.01	0.12	211	0.30	0.20	0.20	1.40
SW_55	1992	2007	27	0.05	0.04	0.05	0.14	26	1.80	0.90	1.60	4.30
SW_56	1990	2013	114	0.02	0.05	0.01	0.50	115	0.30	0.20	0.20	0.50
SW_57	1990	2013	123	0.06	0.04	0.05	0.29	123	2.90	0.90	2.70	6.80
SW_58	1990	2013	181	0.04	0.03	0.03	0.19	181	2.30	0.80	2.30	8.00
SW_59	1992	2004	25	0.03	0.02	0.02	0.08	25	1.00	0.70	0.80	3.10
SW_60	1990	2013	338	0.03	0.03	0.02	0.21	335	1.30	0.50	1.20	3.70
SW_61	1990	2008	129	0.21	0.26	0.11	1.61	130	4.80	2.00	4.40	11.20
SW_62	1992	2013	100	0.02	0.01	0.02	0.08	103	1.40	0.70	1.20	5.40
SW_63	1990	2013	196	0.02	0.03	0.01	0.42	194	0.70	0.40	0.70	3.50
SW_64	1990	2013	87	0.02	0.03	0.01	0.26	86	1.30	0.50	1.30	3.20
SW_65	1990	2013	288	0.04	0.05	0.02	0.50	284	1.80	0.70	1.70	5.00
SW_66	1999	2010	40	0.02	0.01	0.02	0.04	40	1.30	0.50	1.30	2.40
SW_67	1991	2013	144	0.04	0.03	0.03	0.23	142	1.60	0.90	1.50	5.30

SW_68	1993	2013	137	0.32	0.30	0.24	2.14	160	5.20	4.60	4.20	25.20
SW_69	1992	2013	174	0.02	0.03	0.01	0.21	172	0.70	0.50	0.60	3.80
SW_70	1990	2013	155	0.03	0.02	0.03	0.15	153	2.00	0.90	1.90	10.00
SW_71	2003	2013	8	0.07	0.05	0.05	0.15	8	3.30	1.00	2.80	5.20
SW_72	1992	2013	153	0.01	0.01	0.00	0.05	147	0.40	0.70	0.30	7.90
SW_73	1991	2013	328	0.07	0.19	0.05	3.24	325	3.10	1.20	2.80	9.70
SW_74	1990	2013	467	0.03	0.04	0.02	0.31	467	1.40	0.60	1.30	3.80
SW_75	1990	2013	74	0.03	0.03	0.02	0.16	73	2.00	1.00	1.90	5.40
SW_76	2011	2013	7	0.04	0.04	0.02	0.13	7	1.60	0.30	1.60	2.10
SW_77	2003	2013	14	0.02	0.01	0.02	0.03	6	1.30	0.10	1.40	1.50
SW_78	1997	2013	13	0.04	0.07	0.02	0.27	3	1.20	0.60	1.40	1.70
SW_79	1992	2013	106	0.02	0.02	0.02	0.11	107	1.70	0.70	1.60	3.90
SW_80	1990	2013	226	0.02	0.01	0.02	0.09	223	1.40	0.60	1.30	3.60
SW_81	1991	2013	117	0.01	0.01	0.00	0.06	116	0.30	0.20	0.20	1.70
SW_82	1992	2013	83	0.02	0.02	0.01	0.15	83	0.90	0.30	0.90	1.60
SW_83	1993	2013	53	0.02	0.01	0.02	0.05	55	0.50	0.40	0.50	2.60
SW_84	1992	2013	122	0.50	0.69	0.22	3.55	120	3.30	1.30	3.00	7.40
SW_85	1992	2013	110	0.03	0.02	0.02	0.10	109	0.80	0.50	0.70	3.70
SW_86	1993	2013	32	0.04	0.08	0.02	0.45	32	1.50	0.60	1.40	2.80
SW_87	1992	2013	269	0.03	0.04	0.02	0.50	268	0.40	0.20	0.40	1.40
SW_88	1992	2013	144	0.05	0.09	0.02	0.58	142	1.20	0.60	1.10	4.00
SW_89	1994	2013	55	0.01	0.03	0.01	0.16	53	0.40	0.10	0.40	0.70
SW_90	2007	2012	6	0.02	0.00	0.02	0.03	6	1.10	0.20	1.10	1.30
SW_91	2007	2013	6	0.07	0.03	0.06	0.11	6	2.20	0.50	2.30	2.80
SW_92	1993	2013	196	0.03	0.04	0.02	0.38	194	1.50	0.60	1.40	4.00
SW_93	1992	2013	138	0.01	0.02	0.00	0.05	136	0.50	1.20	0.20	13.60
SW_94	2013	2013	1	0.02	0.00	0.02	0.02	1	0.30	0.00	0.30	0.30
SW_95	1993	2013	262	0.05	0.43	0.02	7.00	262	0.50	0.30	0.50	3.00
SW_96	1993	2013	66	0.01	0.01	0.01	0.05	66	0.90	0.30	0.90	1.50
SW_97	1992	2013	105	0.08	0.19	0.04	1.80	104	1.50	0.70	1.40	4.50
SW_98	1992	2013	144	0.09	0.27	0.02	1.70	142	1.40	2.10	0.80	12.50
SW_99	1995	2013	17	0.02	0.01	0.02	0.05	17	0.90	0.50	0.80	2.30
SW_100	1992	2006	148	0.13	0.79	0.01	9.37	148	1.30	0.60	1.40	2.80
SW_101	2007	2009	9	0.02	0.00	0.02	0.02	9	0.90	0.50	0.70	1.90
SW_102	1990	2013	222	0.01	0.02	0.01	0.05	219	0.70	0.40	0.60	2.40
SW_103	1993	2013	163	0.03	0.04	0.02	0.50	162	1.00	0.80	0.80	5.90

Supporting Table 5 Descriptive statistics for TRP and NO₃-N for the EA groundwater monitoring sites. N – number of samples, S.D. – standard deviation

Sampling point	Start year	End year	TRP (mg l ⁻¹)					NO ₃ -N (mg l ⁻¹)				
			N	Mean	S.D.	Median	Max	N	Mean	S.D.	Median	Max
GW_1	1997	2013	17	0.93	3.47	0.09	14.40	17	13.04	3.44	13.70	15.70
GW_2	1997	2013	22	0.75	2.70	0.05	12.80	22	6.87	1.58	7.15	7.87
GW_3	1997	2013	29	0.92	3.15	0.17	17.20	29	7.90	1.56	8.18	8.84
GW_4	1997	2013	31	0.28	0.87	0.02	4.84	31	2.14	0.79	2.07	3.99
GW_5	1997	2013	31	0.43	1.68	0.04	9.40	30	10.28	4.61	10.00	27.30
GW_6	1992	2013	6	1.85	4.48	0.02	11.00	6	4.49	2.21	5.28	5.84
GW_7	1992	2013	15	0.79	2.85	0.02	11.10	15	4.65	1.95	5.32	6.14
GW_8	1989	2013	11	1.12	3.31	0.02	11.10	11	4.98	1.69	5.58	5.94
GW_9	1997	2013	31	0.43	1.71	0.03	9.60	31	12.60	4.83	12.70	20.60
GW_10	1997	2013	20	0.39	1.32	0.02	5.93	20	0.46	0.38	0.28	1.35
GW_11	1992	2013	6	1.85	4.48	0.02	11.00	6	4.49	2.21	5.28	5.84
GW_12	1992	2013	26	0.56	1.87	0.05	9.67	27	2.12	1.29	1.99	7.06
GW_13	1997	2013	29	0.39	1.31	0.03	7.11	28	10.07	2.95	10.95	11.90
GW_14	1997	2013	24	0.72	2.71	0.05	13.40	23	7.72	1.72	7.96	9.23
GW_15	1992	2013	26	0.56	1.87	0.05	9.67	27	2.12	1.29	1.99	7.06
GW_16	1997	2013	23	0.61	2.18	0.06	10.60	22	8.77	2.32	9.32	10.90
GW_17	1997	2013	29	0.45	1.77	0.02	9.60	29	1.27	1.87	1.01	10.90
GW_18	1997	2013	-	-	-	-	-	-	-	-	-	-
GW_19	1997	2013	7	1.34	2.85	0.43	7.79	7	5.01	2.27	5.64	6.53
GW_20	1992	2013	30	0.38	1.43	0.03	7.90	30	1.96	0.52	2.04	2.77
GW_21	1997	2013	16	1.08	3.66	0.14	14.80	16	12.11	3.28	12.80	14.10
GW_22	1997	2013	16	1.22	4.29	0.13	17.30	16	13.58	3.74	14.75	15.40
GW_23	1997	2013	21	0.49	1.85	0.07	8.56	21	8.73	3.87	9.31	15.60
GW_24	1997	2013	12	0.80	2.70	0.02	9.37	12	13.24	5.04	14.60	18.20
GW_25	1997	2013	29	0.71	2.97	0.02	16.10	29	7.16	1.50	7.34	8.50
GW_26	1997	2013	12	0.76	2.35	0.02	8.21	12	5.29	1.74	5.82	6.54
GW_27	1997	2013	7	1.34	2.85	0.43	7.79	7	5.01	2.27	5.64	6.53
GW_28	1992	2013	16	0.93	2.38	0.08	9.51	16	4.38	1.28	4.66	5.73
GW_29	1997	2013	29	0.98	1.87	0.64	10.70	29	15.20	3.05	15.40	17.70
GW_30	1997	2013	29	0.38	1.40	0.02	7.58	28	0.67	0.21	0.66	1.00
GW_31	1997	2013	13	0.56	1.92	0.02	6.94	12	0.21	0.14	0.20	0.62
GW_32	1997	2013	15	0.61	2.25	0.02	8.75	15	5.50	1.64	5.82	7.67
GW_33	1997	2013	20	0.33	1.26	0.02	5.67	20	1.87	0.89	1.94	3.21
GW_34	1997	2013	15	0.37	1.33	0.02	5.16	15	0.69	0.69	0.50	2.62
GW_35	1997	2013	29	0.24	0.73	0.02	3.91	29	1.74	1.40	1.79	6.67
GW_36	1997	2013	18	0.23	0.62	0.02	2.37	18	6.97	3.18	7.48	11.00
GW_37	1997	2013	28	0.14	0.29	0.02	1.34	28	1.17	0.56	1.20	2.43
GW_38	1997	2013	25	0.45	1.34	0.02	6.80	25	1.67	0.56	1.82	2.51
GW_39	1997	2013	30	0.20	0.41	0.02	2.10	30	0.55	0.36	0.50	1.51

Supporting Table 6 Linear regression slope, p-value and change in TRP and NO₃-N concentrations per year for the EA surface water monitoring sites. Slopes significant at $\alpha = 0.05$ level

Sampling point	Start	End	TRP			NO ₃ -N		
			Slope	p-value	Change per year (mg l ⁻¹ year ⁻¹)	Slope	p-value	Change per year (mg l ⁻¹ year ⁻¹)
SW_1	1992	2013	-3.9E-06	0.00	-0.001	0.0000	0.00	-0.02
SW_2	2011	2013	-7.0E-21	0.23	0.000	0.0000	0.13	0.00
SW_3	1993	2013	-2.9E-06	0.00	-0.001	0.0000	0.00	-0.02
SW_4	1992	2010	-5.7E-06	0.01	-0.002	0.0000	0.60	0.00
SW_5	1992	2013	-1.4E-06	0.03	-0.001	0.0000	0.28	-0.01
SW_6	1993	2013	-5.1E-06	0.00	-0.002	0.0000	0.90	0.00
SW_7	1993	2013	-2.1E-05	0.02	-0.008	-0.0002	0.00	-0.06
SW_8	1992	2012	9.8E-06	0.03	0.004	0.0003	0.06	0.10
SW_9	1992	2010	-3.7E-06	0.00	-0.001	0.0000	0.49	-0.01
SW_10	2000	2006	8.8E-05	0.44	0.032	0.0000	0.97	0.01
SW_11	1993	2013	-4.6E-06	0.00	-0.002	0.0000	0.42	-0.01
SW_12	1997	2013	-7.1E-06	0.66	-0.003	0.0000	0.64	0.01
SW_13	1990	2013	-1.9E-06	0.01	-0.001	0.0000	0.83	0.00
SW_14	2002	2013	-1.6E-05	0.00	-0.006	-0.0001	0.06	-0.05
SW_15	1990	2013	-1.3E-05	0.15	-0.005	0.0000	0.52	0.01
SW_16	1991	2013	-9.7E-07	0.13	0.000	-0.0002	0.00	-0.07
SW_17	1991	2013	-7.4E-06	0.01	-0.003	0.0000	0.58	-0.01
SW_18	1990	2009	1.9E-06	0.14	0.001	-0.0001	0.06	-0.03
SW_19	1990	2013	-4.8E-06	0.00	-0.002	-0.0001	0.00	-0.02
SW_20	1990	2013	-4.2E-06	0.00	-0.002	0.0000	0.15	0.01
SW_21	1990	2013	-4.1E-06	0.09	-0.001	0.0000	0.45	-0.02
SW_22	1993	2013	-1.5E-05	0.01	-0.005	-0.0003	0.00	-0.10
SW_23	1990	2006	4.1E-06	0.10	0.001	0.0000	0.89	0.00
SW_24	1990	2013	-3.6E-06	0.13	-0.001	0.0000	0.37	0.01
SW_25	1992	2013	-1.8E-07	0.96	0.000	0.0002	0.05	0.06
SW_26	1990	2013	-6.7E-06	0.04	-0.002	-0.0002	0.01	-0.07
SW_27	1992	2013	2.0E-05	0.17	0.007	-0.0011	0.00	-0.39
SW_28	1992	2013	-4.9E-06	0.43	-0.002	-0.0010	0.00	-0.37
SW_29	1990	2010	2.6E-08	0.98	0.000	-0.0001	0.06	-0.02
SW_30	1993	2013	-8.2E-06	0.02	-0.003	0.0000	0.16	-0.01
SW_31	1990	2013	6.9E-07	0.78	0.000	0.0000	0.87	0.00
SW_32	1992	2013	4.2E-06	0.27	0.002	0.0004	0.00	0.14
SW_33	1993	2013	-9.7E-06	0.00	-0.004	-0.0001	0.01	-0.05
SW_34	1990	2013	-6.9E-06	0.13	-0.003	-0.0002	0.08	-0.07
SW_35	1992	2013	-1.1E-06	0.10	0.000	0.0000	0.47	0.02
SW_36	1993	2013	2.0E-06	0.75	0.001	-0.0004	0.01	-0.15
SW_37	1992	2013	-3.0E-06	0.00	-0.001	0.0001	0.00	0.05
SW_38	1992	2013	4.3E-06	0.02	0.002	0.0000	0.77	-0.01
SW_39	1990	2013	-8.4E-06	0.12	-0.003	-0.0001	0.39	-0.03
SW_40	1993	2013	-3.1E-06	0.00	-0.001	0.0000	0.29	-0.01
SW_41	1990	2013	1.2E-06	0.62	0.000	-0.0002	0.01	-0.06
SW_42	1992	2013	-3.1E-06	0.02	-0.001	-0.0005	0.00	-0.19
SW_43	1990	2013	-8.2E-06	0.12	-0.003	-0.0003	0.01	-0.12
SW_44	1990	2013	-3.2E-05	0.45	-0.012	-0.0001	0.28	-0.05
SW_45	1993	2013	-7.1E-06	0.00	-0.003	-0.0001	0.00	-0.04
SW_46	1990	2013	-3.2E-06	0.16	-0.001	0.0000	0.00	-0.01
SW_47	1992	2013	9.7E-07	0.22	0.000	0.0001	0.16	0.03
SW_48	1990	2013	-4.4E-06	0.04	-0.002	-0.0001	0.03	-0.05
SW_49	1992	2013	-2.5E-07	0.72	0.000	0.0000	0.86	0.00
SW_50	1992	2007	6.0E-06	0.00	0.002	0.0002	0.00	0.09
SW_51	1992	2013	1.1E-05	0.19	0.004	0.0000	0.92	0.00
SW_52	2000	2013	-4.0E-04	0.12	-0.145	0.0007	0.70	0.25

SW_53	1992	2013	6.1E-06	0.24	0.002	0.0001	0.08	0.04
SW_54	1990	2013	-1.7E-06	0.00	-0.001	0.0000	0.00	-0.01
SW_55	1992	2007	1.2E-05	0.00	0.004	0.0000	0.81	0.01
SW_56	1990	2013	-3.1E-06	0.13	-0.001	0.0000	0.41	0.00
SW_57	1990	2013	-6.9E-07	0.72	0.000	-0.0001	0.01	-0.04
SW_58	1990	2013	-2.2E-06	0.02	-0.001	-0.0001	0.01	-0.03
SW_59	1992	2004	-1.5E-06	0.72	-0.001	0.0002	0.08	0.09
SW_60	1990	2013	-6.4E-06	0.00	-0.002	-0.0001	0.00	-0.02
SW_61	1990	2008	-1.2E-05	0.34	-0.004	0.0001	0.21	0.04
SW_62	1992	2013	-1.0E-06	0.19	0.000	0.0000	0.61	-0.01
SW_63	1990	2013	-3.4E-07	0.75	0.000	0.0000	0.00	-0.02
SW_64	1990	2013	-2.3E-06	0.13	-0.001	0.0000	0.08	-0.02
SW_65	1990	2013	-6.9E-06	0.00	-0.003	-0.0001	0.00	-0.02
SW_66	1999	2010	-7.6E-07	0.42	0.000	-0.0001	0.26	-0.02
SW_67	1991	2013	-8.6E-07	0.54	0.000	-0.0001	0.05	-0.03
SW_68	1993	2013	-1.7E-05	0.33	-0.006	-0.0008	0.00	-0.28
SW_69	1992	2013	-5.1E-06	0.00	-0.002	-0.0001	0.00	-0.03
SW_70	1990	2013	-9.2E-08	0.88	0.000	0.0000	0.29	-0.01
SW_71	2003	2013	-1.8E-05	0.20	-0.006	-0.0004	0.10	-0.16
SW_72	1992	2013	-5.7E-07	0.23	0.000	0.0000	0.80	0.00
SW_73	1991	2013	-3.1E-06	0.00	-0.001	-0.0001	0.00	-0.04
SW_74	1990	2013	-9.0E-06	0.00	-0.003	-0.0001	0.00	-0.02
SW_75	1990	2013	-3.1E-06	0.07	-0.001	-0.0001	0.02	-0.05
SW_76	2011	2013	-8.0E-05	0.10	-0.029	0.0004	0.27	0.16
SW_77	2003	2013	2.5E-06	0.02	0.001	0.0001	0.22	0.04
SW_78	1997	2013	-1.9E-05	0.05	-0.007	-	-	-
SW_79	1992	2013	-7.6E-07	0.32	0.000	-0.0001	0.03	-0.02
SW_80	1990	2013	-1.4E-07	0.70	0.000	0.0000	0.03	-0.01
SW_81	1991	2013	3.9E-08	0.95	0.000	0.0000	0.21	0.00
SW_82	1992	2013	-3.4E-06	0.00	-0.001	0.0000	0.17	-0.01
SW_83	1993	2013	-2.3E-06	0.01	-0.001	0.0000	0.11	-0.01
SW_84	1992	2013	-9.2E-05	0.00	-0.034	-0.0001	0.02	-0.04
SW_85	1992	2013	-5.1E-07	0.60	0.000	0.0000	0.04	-0.01
SW_86	1993	2013	-1.2E-05	0.07	-0.004	0.0000	0.69	0.01
SW_87	1992	2013	2.5E-06	0.03	0.001	0.0000	0.83	0.00
SW_88	1992	2013	-1.1E-05	0.00	-0.004	-0.0001	0.01	-0.02
SW_89	1994	2013	-9.7E-07	0.54	0.000	0.0000	0.02	-0.01
SW_90	2007	2012	1.1E-06	0.40	0.000	0.0001	0.22	0.04
SW_91	2007	2013	2.8E-05	0.23	0.010	0.0003	0.50	0.09
SW_92	1993	2013	-6.8E-06	0.00	-0.002	0.0000	0.08	-0.02
SW_93	1992	2013	-3.9E-06	0.00	-0.001	0.0000	0.81	0.00
SW_94	2013	2013	-	-	-	-	-	-
SW_95	1993	2013	-1.4E-05	0.37	-0.005	-0.0001	0.00	-0.02
SW_96	1993	2013	-2.0E-06	0.01	-0.001	0.0000	0.04	-0.01
SW_97	1992	2013	-1.5E-05	0.06	-0.006	0.0000	0.75	0.00
SW_98	1992	2013	-3.5E-05	0.00	-0.013	-0.0003	0.00	-0.11
SW_99	1995	2013	-4.7E-06	0.01	-0.002	-0.0001	0.03	-0.05
SW_100	1992	2006	-6.0E-05	0.10	-0.022	0.0001	0.01	0.03
SW_101	2007	2009	5.4E-21	0.35	0.000	-0.0002	0.84	-0.06
SW_102	1990	2013	-4.0E-06	0.00	-0.001	-0.0001	0.00	-0.02
SW_103	1993	2013	-2.5E-06	0.09	-0.001	-0.0001	0.00	-0.04

Supporting Table 7 Linear regression slope, p-value and change in TRP and NO₃-N concentrations per year for the EA groundwater monitoring sites. Slopes significant at $\alpha = 0.05$ level

Sampling point	Start	End	TRP			NO ₃ -N		
			Slope	p-value	Change per year (mg l ⁻¹ year ⁻¹)	Slope	p-value	Change per year (mg l ⁻¹ year ⁻¹)
GW_1	1997	2013	0.0000	0.13	0.00	-0.0005	0.00	-0.18
GW_2	1997	2013	-0.0001	0.00	-0.04	0.0002	0.00	0.08
GW_3	1997	2013	0.0000	0.59	-0.01	0.0002	0.00	0.06
GW_4	1997	2013	0.0000	0.04	-0.02	-0.0002	0.01	-0.06
GW_5	1997	2013	0.0000	0.03	-0.02	0.0007	0.07	0.27
GW_6	1992	2013	0.0000	0.00	0.00	-0.0001	0.59	-0.03
GW_7	1992	2013	0.0000	0.36	-0.01	0.0001	0.12	0.04
GW_8	1989	2013	0.0000	0.57	0.01	0.0001	0.14	0.03
GW_9	1997	2013	0.0000	0.04	-0.02	-0.0009	0.01	-0.34
GW_10	1997	2013	-0.0001	0.01	-0.03	-0.0002	0.04	-0.06
GW_11	1992	2013	0.0000	0.00	0.00	-0.0001	0.59	-0.03
GW_12	1992	2013	0.0000	0.25	-0.01	0.0002	0.06	0.07
GW_13	1997	2013	-0.0001	0.02	-0.02	0.0003	0.00	0.11
GW_14	1997	2013	-0.0001	0.00	-0.04	-0.0001	0.02	-0.05
GW_15	1992	2013	0.0000	0.25	-0.01	0.0002	0.06	0.07
GW_16	1997	2013	-0.0001	0.00	-0.04	0.0000	0.92	0.01
GW_17	1997	2013	0.0000	0.03	-0.02	0.0001	0.63	0.04
GW_18	1997	2013	0.0000	0.00	0.00	0.0000	0.00	0.00
GW_19	1997	2013	-0.0001	0.02	-0.04	0.0004	0.00	0.14
GW_20	1992	2013	0.0000	0.21	-0.01	0.0000	0.26	0.01
GW_21	1997	2013	-0.0001	0.00	-0.02	0.0003	0.01	0.12
GW_22	1997	2013	-0.0001	0.01	-0.02	0.0004	0.05	0.16
GW_23	1997	2013	0.0000	0.12	-0.01	0.0002	0.74	0.09
GW_24	1997	2013	0.0000	0.38	0.00	0.0015	0.28	0.55
GW_25	1997	2013	-0.0001	0.00	-0.03	0.0003	0.00	0.09
GW_26	1997	2013	-0.0001	0.00	-0.03	0.0004	0.00	0.13
GW_27	1997	2013	-0.0001	0.02	-0.04	0.0004	0.00	0.14
GW_28	1992	2013	0.0001	0.27	0.04	0.0003	0.00	0.12
GW_29	1997	2013	0.0000	0.79	0.00	-0.0002	0.01	-0.09
GW_30	1997	2013	0.0000	0.02	-0.02	0.0000	0.18	-0.01
GW_31	1997	2013	0.0000	0.07	0.01	0.0000	0.88	0.00
GW_32	1997	2013	0.0000	0.26	0.00	-0.0006	0.00	-0.20
GW_33	1997	2013	0.0000	0.09	-0.01	-0.0005	0.00	-0.17
GW_34	1997	2013	0.0000	0.27	0.00	-0.0001	0.52	-0.04
GW_35	1997	2013	0.0000	0.05	-0.01	-0.0004	0.01	-0.14
GW_36	1997	2013	0.0000	0.81	-0.01	-0.0018	0.01	-0.64
GW_37	1997	2013	0.0000	0.05	-0.01	-0.0001	0.01	-0.05
GW_38	1997	2013	-0.0001	0.00	-0.04	0.0000	0.69	-0.01
GW_39	1997	2013	-0.0001	0.02	-0.02	-0.0001	0.01	-0.03

Supporting Table 8 The EA routine monitoring points in the River Leith Catchment

Number on Map	Water source	EA Number	Name	Eastings	Northings
I	Groundwater	88021968	Low Dalebanks	360980	513960
II		88022169	White Stone Farm	360600	520200
III		88010221	Low Moor Farm	353410	524620
IV		88010391	Woodhouse Farm	356750	524890
V		88006587	Cliburn BH	358593	525940
VI		88010247	Spittals Farm	362170	526340
1	Surface water	88021255	River Leith at Shap U/s	355800	515780
2		88021256	River Leith at Shap D/s	355700	515940
3		88006214	River Leith at Railway Sidings	355500	517700
4		88021257	River Leith at Great Strickland U/s	355120	522530
5		88021258	River Leith at Great Strickland D/s	355100	524040
6		88021259	River Leith at Melkinthorpe U/s	356800	525260
7		88006202	River Leith U/s River Lyvennet in Cliburn	358905	524392
8		88021261	River Leith at Cliburn D/s weir	359008	524479
9		88006212	River Lyvennet U/s of River Leith	361200	523200

Supporting Table 9 Descriptive statistics for TP, TRP and NO₃N for the EA groundwater (Roman numerals) and surface water monitoring sites (Arabic numerals), grab (GRAB) and high-frequency automated (IN SITU) sampling. N – number of samples. EA water quality grades for mean Phosphate Phosphorus and Nitrate Nitrogen concentration as in Table 1

Point	Start year	Finish year	TP (mg l ⁻¹)					TRP (mg l ⁻¹)					NO ₃ -N (mg l ⁻¹)				
			N	Mean	S.D.	Max	EA grade	N	Mean	S.D.	Max	EA grade	N	Mean	S.D.	Max	EA grade
I	2005	2012	-	-	-	-	-	14	0.03	0.03	0.12	2	14	0.80	0.70	2.60	1
II	2005	2012	-	-	-	-	-	13	0.03	0.04	0.15	2	12	0.20	0.10	0.60	1
III	1997	2013	-	-	-	-	-	30	0.14	0.20	0.50	4	30	6.30	1.80	10.90	4
IV	1997	2013	3	0.03	0.02	0.05	1	29	0.12	0.20	0.50	4	28	0.70	0.20	1.10	1
V	1992	2012	-	-	-	-	-	16	0.34	0.67	2.73	5	16	4.60	0.60	5.70	4
VI	1997	2013	-	-	-	-	-	29	0.16	0.22	0.50	4	29	7.40	0.60	8.50	5
1	2002	2003	19	0.24	0.22	1.02	5	19	0.20	0.16	0.81	5	19	2.50	1.10	3.80	3
2	2002	2003	18	1.53	1.11	4.42	6	19	1.38	0.94	3.56	6	20	5.90	2.70	12.10	4
3	1992	2013	5	0.16	0.09	0.29	4	214	0.45	0.60	3.55	5	213	3.20	1.20	7.40	3
4	2002	2009	35	0.10	0.08	0.34	4	18	0.11	0.08	0.28	4	19	3.80	0.80	5.30	3
5	2002	2009	37	0.10	0.07	0.28	4	20	0.12	0.08	0.26	4	20	3.70	0.80	5.10	3
6	2002	2003	20	0.11	0.06	0.21	4	20	0.10	0.07	0.20	4	20	3.70	1.10	5.50	3
7	1990	2013	299	0.07	0.09	1.00	3	550	0.06	0.15	3.24	3	548	3.00	1.10	9.70	3
8	2002	2013	17	0.32	0.88	3.72	5	59	0.06	0.05	0.24	2	60	3.20	0.90	5.50	3
9	1990	2013	20	0.07	0.12	0.55	3	245	0.03	0.03	0.22	2	245	2.10	1.10	6.60	2
GRAB	2009	2012	108	0.06	0.04	0.24	3	103	0.04	0.03	0.17	2	111	2.43	0.54	3.55	2
IN SITU	2009	2012	15488	0.04	0.06	2.68	2	16956	0.04	0.04	1.18	2	9228	2.57	0.48	5.33	3