Supplementary Information

Table S1. Average (± s.e.m.) discharge, physico-chemistry and macroinvertebrate scores at the studied sites. Shaded rows represent the control sites.

	Q	pH	EC	SS	NH4	NO3	SRP	ASPT	BMWP
	L s^{-1}	unit	µS cm^{-1}	mg L^{-1}	µg N L^{-1}	mg N L^{-1}	µg P L^{-1}	score	score
site 5	22±3	7.2±0.03	146±2	10±3	28±3	3.8±0.1	15±2	6.3±0.1	107±6
site 7	49±6	7.3±0.02	112±3	7±1	26±2	1.4±0.1	8±1	6.8±0.1	110±5
site 8	18±2	7.3±0.03	133±3	15±4	46±12	2.2±0.1	7±1	6.5±0.1	102±4
site 13	92±11	7.2±0.03	213±4	16±4	52±8	4.7±0.1	35±6	6.3±0.1	91±5
site 14	114±14	7.2±0.04	206±6	31±9	44±6	3.4±0.2	28±4	6.2±0.2	85±5
site 16	110±14	7.5±0.03	221±3	16±4	28±3	4.8±0.1	11±1	6.4±0.1	96±4

with Q, discharge, catchment pro rata calculation from Coull gauging station near catchment outlet (52 km^2);
EC, electric conductivity
SS, suspended solids
SRP, soluble reactive phosphorus
ASPT, average score per taxa (macroinvertebrate score)
BMWP, British monitoring working party (macroinvertebrate score)

Table S2. Example of raw data prepared for Random Intervention Analysis for the paired sites restored 13 and control 14 regarding macroinvertebrate indices.

dates	sites	ASPT	BMWP	before	septic	buffer	control	impact
6-Sep-00	13	6.9	103	1	0	0	0	1
29-Aug-01	13	5.9	59	1	0	0	0	1
6-Dec-01	13	5.8	69	1	0	0	0	1
10-Apr-02	13	6.4	89	1	0	0	0	1
15-Jul-02	13	6.2	62	0	1	0	0	1
12-Feb-03	13	6.3	113	0	1	0	0	1
7-May-03	13	5.7	74	0	1	0	0	1
5-Aug-03	13	5.5	94	0	1	0	0	1
13-Nov-03	13	6.9	90	0	1	0	0	1
19-Apr-04	13	6.8	82	0	1	0	0	1
11-Jul-05	13	6.2	99	0	1	1	0	1
18-Oct-05	13	6.2	74	0	1	1	0	1
16-Jan-06	13	6.2	112	0	1	1	0	1
12-Apr-06	13	6.6	119	0	1	1	0	1
11-Jul-06	13	6.5	78	0	1	1	0	1
16-Oct-06	13	6.5	124	0	1	1	0	1
19-Mar-07	13	6.5	129	0	1	1	0	1
09-Jul-07	13	6.5	65	0	1	1	0	1
09-Oct-07	13	6.6	99	0	1	1	0	1
29-Jan-08	13	6.6	118	0	1	1	0	1
6-Sep-00	14	6.6	99	1	0	0	1	0
29-Aug-01	14	7.1	113	1	0	0	1	0
6-Dec-01	14	6.1	104	1	0	0	1	0
10-Apr-02	14	6.4	90	1	0	0	1	0
15-Jul-02	14	5.9	77	0	1	0	1	0
12-Feb-03	14	7.4	81	0	1	0	1	0
7-May-03	14	6.6	92	0	1	0	1	0
5-Aug-03	14	6.1	85	0	1	0	1	0
13-Nov-03	14	6.2	81	0	1	0	1	0
19-Apr-04	14	6.6	93	0	1	0	1	0
11-Jul-05	14	6.4	89	0	1	1	1	0
18-Oct-05	14	6.9	110	0	1	1	1	0
16-Jan-06	14	5.7	68	0	1	1	1	0
12-Apr-06	14	6.4	108	0	1	1	1	0
11-Jul-06	14	6.4	70	0	1	1	1	0
16-Oct-06	14	5.1	86	0	1	1	1	0
19-Mar-07	14	5.9	88	0	1	1	1	0
09-Jul-07	14	6.6	73	0	1	1	1	0
09-Oct-07	14	5.8	76	0	1	1	1	0
29-Jan-08	14	6.5	97	0	1	1	1	0

Table S3. Random intervention analyses on water chemistry. Most important responses are highlighted.

responses	predictors	n	co-variables	r^2	observed F-ratio	*P* value†	magnitude of impact relative to overall average
Paired sites restored 5 - control 7							
ln(SS+1)	after × impact	168	before, after, control, impact	<0.01	F(1,164)=0.3	0.66	13%
NO3	after × impact	168	before, after, control, impact	<0.01	F(1,164)=1.3	0.22	13%
NH4	after × impact	168	before, after, control, impact	0.01	F(1,164)=1.1	0.10	-35%
SRP	after × impact	168	before, after, control, impact	0.01	F(1,164)=1.1	0.12	-46%
Paired sites restored 8 - control 7							
ln(SS+1)	after × impact	168	before, after, control, impact	<0.01	F(1,164)<0.01	1	<-1%
NO3	after × impact	168	before, after, control, impact	0.01	F(1,164)=1.1	0.73	-13%
NH4	after × impact	168	before, after, control, impact	0.01	F(1,164)=1.4	0.56	-95%
SRP	after × impact	168	before, after, control, impact	0.01	F(1,164)=1.8	0.16	-49%
Paired sites restored 13 - control 14							
ln(SS+1)	septic × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.6	0.44	-32%
	buffer × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.7	0.42	32%
NO3	septic × impact	168	before, septic, buffer, control, impact	0.02	F(1,163)=3.4	0.01	-24%
	buffer × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.2	0.82	3%
NH4	septic × impact	168	before, septic, buffer, control, impact	0.03	F(1,163)=5.6	0.01	-109%
	buffer × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.7	0.49	-2%
SRP	septic × impact	168	before, septic, buffer, control, impact	0.06	F(1,163)=11.7	0.01	-160%
	buffer × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.8	0.78	14%
Paired sites restored 13 - control 16							
ln(SS+1)	septic × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.2	0.74	-20%
	buffer × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.6	0.37	24%
NO3	septic × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.2	0.59	3%
	buffer × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.1	0.76	2%
NH4	septic × impact	168	before, septic, buffer, control, impact	0.04	F(1,163)=7.3	0.01	-104%
	buffer × impact	168	before, septic, buffer, control, impact	<0.01	F(1,163)=0.8	0.61	4%
SRP	septic × impact	168	before, septic, buffer, control, impact	0.12	F(1,163)=29.2	0.01	-191%
	buffer × impact	168	before, septic, buffer, control, impact	0.02	F(1,163)=3.6	0.38	-5%

† based on 999 Monte Carlo random permutations restricted for temporal structure (see method section)

Table S4. Random intervention analyses on macroinvertebrate indices. Most important responses are highlighted.

responses	predictors	n	co-variables	r^2	observed F-ratio	*P* value†	magnitude of impact relative to overall average
Paired sites restored 5 - control 7							
ASPT	buffer × impact	40	before, after, control, impact	0.01	F(1,36)=0.3	0.70	-2%
BMWP	buffer × impact	40	before, after, control, impact	0.05	F(1,36)=2.2	0.40	20%
Paired restored 8 - control 7							
ASPT	buffer × impact	40	before, after, control, impact	0.03	F(1,36)=1.1	0.20	5%
BMWP	buffer × impact	40	before, after, control, impact	<0.01	F(1,36)<0.1	1.00	2%
Paired site restored 13 - control 14							
ASPT	septic × impact	40	before, septic, buffer, control, impact	0.03	F(1,35)=1.1	0.50	6%
	buffer × impact	40	before, septic, buffer, control, impact	0.09	F(1,35)=3.4	0.50	10%
	(septic × impact) + (buffer × impact)	40	before, septic, buffer, control, impact	0.09	F(2,34)=1.7	0.70	10%
BMWP	septic × impact	40	before, septic, buffer, control, impact	0.13	F(1,35)=5.4	0.11	35%
	septic × impact‡	20	before, septic, control, impact	0.14	F(1,16)=3.0	0.40	25%
	buffer × impact	40	before, septic, buffer, control, impact	0.11	F(1,35)=4.5	0.09	26%
	buffer × impact§	32	septic, buffer, control, impact	0.04	F(1,28)=1.3	0.34	17%
	(septic × impact) + (buffer × impact)	40	before, septic, buffer, control, impact	0.16	F(2,34)=3.4	0.11	40%
Paired sites restored 13 - control 16							
ASPT	septic × impact	42	before, septic, buffer, control, impact	<0.01	F(1,37)=0.2	0.84	-1%
	buffer × impact	42	before, septic, buffer, control, impact	<0.01	F(1,37)<0.1	0.86	<1%
	(septic × impact) + (buffer × impact)	42	before, septic, buffer, control, impact	0.01	F(2,36)=0.1	0.91	1%
BMWP	septic × impact	42	before, septic, buffer, control, impact	<0.01	F(1,37)<0.1	1.00	-6%
	buffer × impact	42	before, septic, buffer, control, impact	0.01	F(1,37)=0.3	0.56	7%
	(septic × impact) + (buffer × impact)	42	before, septic, buffer, control, impact	0.01	F(2,36)=0.2	0.75	-1%

† based on 999 Monte Carlo random permutations restricted for temporal structure (see method section)

‡ excluding last 10 sampling dates post buffer strip installation

§ excluding first 4 sampling dates pre-septic tank effluent improvement

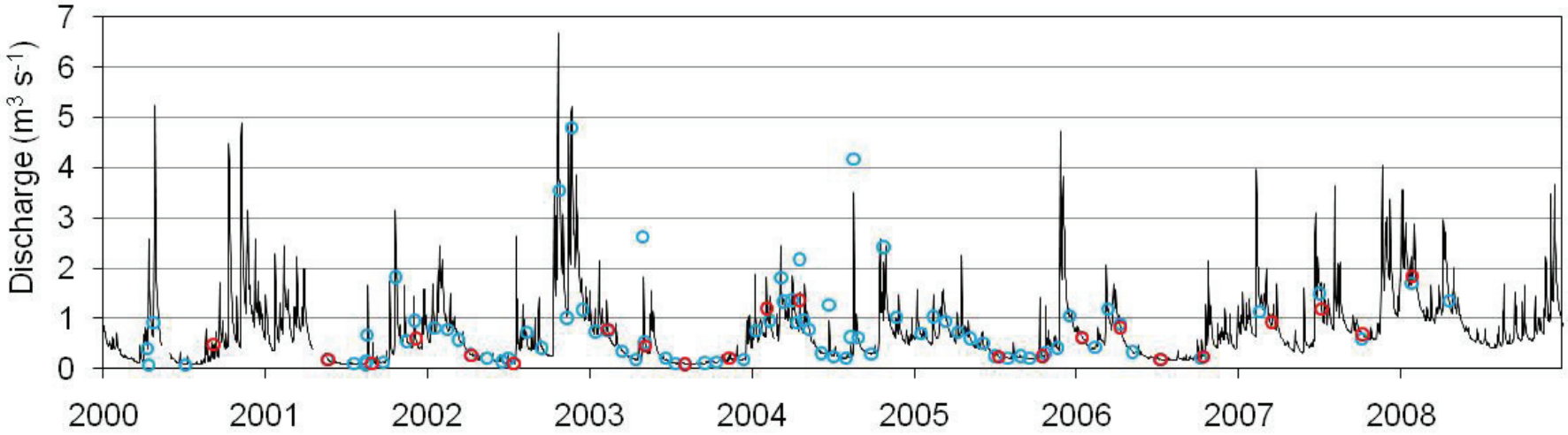

Fig. S1. Discharge (daily average) at Coull (site 1, 52 km^2) with water (blue circles) and macroinvertebrate (red circles) sampling times across the studied sites. Note that water sampling time was plotted against hourly discharge (not daily average discharge).

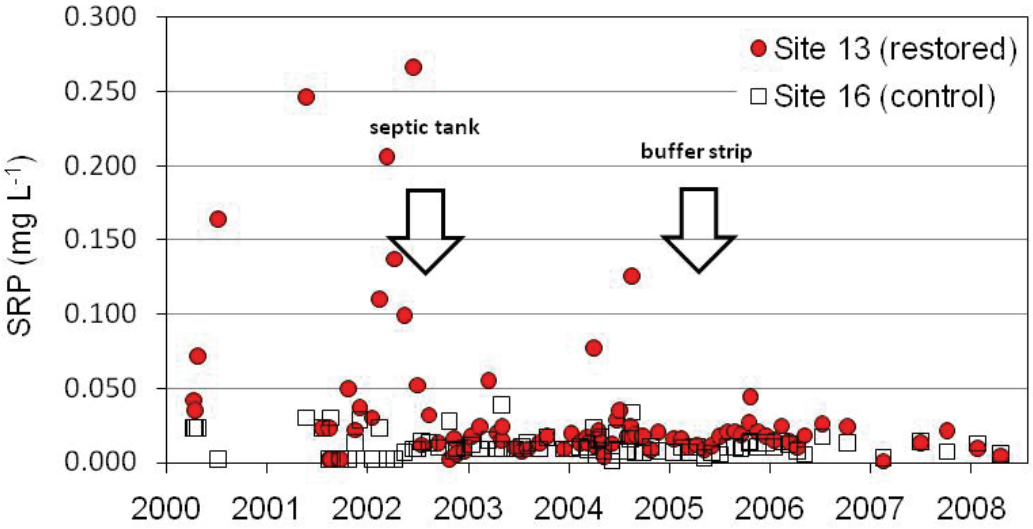

Fig. S2. SRP time series data at site 16 (control site with no buffer strip) and site 13 (restored with septic tank effluent improvements and buffer strip installation as shown by the arrows). The difference in SRP between site 13 and site 16 was used to run the RIA as shown in Figure 4.