

Table S1. Results of PERMDISP tests for homogeneity of group dispersions in fluxes that significantly differed with sediment condition and community treatment. PERMDISP results based on distances among centroids using permutations to determine *P*-values. The F statistic (F), p-value (*P*), and degrees of freedom are provided, with no significant effects ($P \leq 0.05$) emboldened.

Flux	Factor	d.f.1	d.f.2	F	<i>P</i>
Lower estuary					
Dark O ₂	Sediment condition	1	14	0.2147	0.670
Dark alkalinity	Sediment condition	1	14	0.0466	0.831
Light alkalinity	Sediment condition	1	14	0.0550	0.885
Dark N ₂	Community	1	7	4.6221	0.051
Net N ₂	Community	1	6	1.7379	0.447
Upper estuary					
Net DIC	Community	1	7	0.6361	0.593
Dark PO ₄ ³⁻	Sediment condition	1	14	0.2190	0.681
	Community	1	14	0.0775	0.801
Net PO ₄ ³⁻	Sediment condition	1	13	0.4536	0.631
	Community	1	13	1.1157	0.423
Light NO _x	Community	1	14	1.2274	0.334
Net NO _x	Community	1	14	0.2357	0.621
Light DON	Sediment condition	1	14	0.0546	0.832
Light N ₂	Sediment condition	1	12	0.0007	0.952
Net N ₂	Sediment condition	1	11	1.0535	0.342

Table S2. Mean densities (\bar{X}) of taxa 0.1m^{-2} , standard deviation (SD), percentage contribution to total density (%C) and rank of taxa (R) across cores of each sediment condition class in the lower and upper Peel-Harvey Estuary. Taxa that contribute > 5% total density are highlighted grey. Phyla (Ph) are also listed; Annelida (A), Arthropoda (Ar), Mollusca (M), Nematoda (N), Nemertea (Ne), Phoronida (P) and Cnidaria (C). Total density of all macroinvertebrates from all cores and taxon richness (S) are also provided.

Taxa	Ph	Lower estuary						Upper estuary					
		Good sediment			Fair sediment			Good sediment			Poor sediment		
		\bar{X}^{SD}	%C	R	\bar{X}^{SD}	%C	R	\bar{X}^{SD}	%C	R	\bar{X}^{SD}	%C	R
<i>Corophium minor</i>	Ar	1059.9 ^{547.0}	27.6	1	35.3 ^{41.3}	9.6	3						
<i>Mysella</i> sp. 1	M	918.8 ^{491.8}	23.9	2	12.3 ^{20.6}	3.4	6						
<i>Grandidierella propodentata</i>	Ar	481.4 ^{742.3}	12.6	3	19.4 ^{26.1}	5.3	5				8.5 ^{19.0}	1.7	11
<i>Desdemona ornata</i>	A	402.1 ^{312.3}	10.5	4	7.1 ^{20.0}	1.9	8	75.2 ^{49.4}	10.6	4	69.1 ^{117.0}	13.7	3
<i>Capitella capitata</i>	A	313.9 ^{294.3}	8.2	5	3.5 ^{10.0}	1.0	10	16.6 ^{18.8}	2.3	8	35.3 ^{32.1}	7.0	6
<i>Heteromastus filiformis</i>	A	222.2 ^{107.6}	5.8	6	21.2 ^{23.8}	5.7	4						
Oedicerotidae sp. 1	Ar	56.4 ^{111.9}	1.5	7	12.3 ^{29.6}	3.4	6						
<i>Dipolydora socialis</i>	A	54.7 ^{43.6}	1.4	8							7.1 ^{22.3}	1.4	12
<i>Scoloplos normalis</i>	A	47.6 ^{53.8}	1.2	9				40.0 ^{46.7}	5.7	5	31.0 ^{65.8}	6.2	8
<i>Prionospio cirrifera</i>	A	44.1 ^{38.8}	1.2	10	95.2 ^{127.7}	25.8	1						
Cumacea spp.	Ar	37.0 ^{53.3}	1.0	11	8.8 ^{16.8}	2.4	7						
<i>Simplisetia aequisetis</i>	A	24.7 ^{23.5}	0.6	12				79.9 ^{37.5}	11.3	3	49.4 ^{103.5}	9.8	4
<i>Carazziella victoriensis</i>	A	21.2 ^{30.2}	0.6	13									
<i>Brania</i> sp. 1	A	17.6 ^{23.5}	0.5	14									
Mysida spp.	Ar	15.9 ^{19.1}	0.4	15	3.5 ^{10.0}	0.1	10						
Copepoda spp.	Ar	14.1 ^{20.0}	0.4	16	1.8 ^{5.0}	0.5	11	30.6 ^{42.2}	4.3	6	15.5 ^{34.2}	3.1	10
Nematoda spp.	N	14.1 ^{27.2}	0.4	16	1.8 ^{5.0}	0.5	11				2.8 ^{8.9}	0.6	13
<i>Tanais dulongii</i>	Ar	10.6 ^{19.6}	0.3	17	1.8 ^{5.0}	0.5	11						
Chironominae spp.	Ar	8.8 ^{19.9}	0.2	18				261.0 ^{329.1}	36.9	1	33.9 ^{40.6}	6.7	7
<i>Galathowenia</i> sp. 1	A	8.8 ^{19.9}	0.2	18	84.6 ^{130.0}	23.0	2						
Oligochaeta spp.	A	8.8 ^{12.9}	0.2	18	1.8 ^{5.0}	0.5	11	122.3 ^{191.3}	17.3	2	94.5 ^{279.2}	18.8	1
<i>Spisula trigonella</i>	M	8.8 ^{12.9}	0.2	18	35.3 ^{53.9}	9.6	3						
<i>Arthritica semen</i>	M	7.1 ^{7.5}	0.2	19	7.1 ^{20.0}	1.9	8	16.5 ^{16.5}	2.3	8	36.7 ^{63.5}	7.3	5

Taxa	Ph	\bar{X}^{SD}	%C	R	\bar{X}^{SD}	%C	R	\bar{X}^{SD}	%C	R	\bar{X}^{SD}	%C	R
Actiniaria spp.	C	5.3 ^{10.5}	0.1	20									
<i>Tritia burchardi</i>	M	5.3 ^{10.5}	0.1	20									
<i>Assimineia</i> sp. 1	M	3.5 ^{6.5}	0.1	21									
Eusiridae spp.	Ar	3.5 ^{6.5}	0.1	21	1.8 ^{5.0}	0.5	11						
Amphipoda spp.	Ar	1.8 ^{5.0}	0.1	22	5.3 ^{10.5}	1.4	9						
<i>Barnardomelita matilda</i>	Ar	1.8 ^{5.0}	0.1	22									
Bivalvia spp.	M	1.8 ^{5.0}	0.1	22	1.8 ^{5.0}	0.5	11						
<i>Caprella scaura</i>	Ar	1.8 ^{5.0}	0.1	22	1.8 ^{5.0}	0.5	11						
Ephemeroptera spp.	Ar	1.8 ^{5.0}	0.1	22	1.8 ^{5.0}	0.5	11						
Exogoninae spp.	A	1.8 ^{5.0}	0.1	22									
Nemertea spp.	Ne	1.8 ^{5.0}	0.1	22									
<i>Pagurixus</i> sp. 1	Ar	1.8 ^{5.0}	0.1	22									
<i>Paracorophium excavatum</i>	Ar	1.8 ^{5.0}	0.1	22							72.0 ^{152.6}	14.3	2
<i>Phoronis</i> sp. 1	P	1.8 ^{5.0}	0.1	22									
<i>Phyllococe</i> sp. 1	A	1.8 ^{5.0}	0.1	22									
Sphaeromatidae spp.	Ar	1.8 ^{5.0}	0.1	22				4.7 ^{11.5}	0.7	9	1.4 ^{4.5}	0.3	14
<i>Aphelochaeta</i> sp. 1	A				1.8 ^{5.0}	0.5	11						
Trichoptera spp.	Ar				1.8 ^{5.0}	0.5	11						
<i>Boccardiella limnicola</i>	A							30.6 ^{40.3}	4.3	6	15.5 ^{24.4}	3.1	10
<i>Xenostrobus securis</i>	M							21.2 ^{33.1}	3.0	7	18.3 ^{27.5}	3.6	9
<i>Pseudopolydora kemp</i>	A							4.7 ^{7.3}	0.7	9	2.8 ^{8.9}	0.6	13
Collembola spp.	Ar							2.4 ^{5.8}	0.3	10			
Diptera spp.	Ar							2.4 ^{5.8}	0.3	10	2.8 ^{8.9}	0.6	13
<i>Marphysa</i> sp.	A										2.8 ^{8.9}	0.6	13
Synopiidae aff. sp. 1	Ar										1.4 ^{4.5}	0.3	14
Plecoptera spp.	Ar										1.4 ^{4.5}	0.3	14
<i>Sphaerosyllis</i> sp. 1	A										1.4 ^{4.5}	0.3	14
Total density		30,699			2,949			4,246			5,037		
S		39			24			14			21		

Table S3. Results for two-way sediment condition \times community PERMANOVA tests of differing order-of-fits on solute fluxes of benthic metabolism (a-i), nutrient exchange (j-u) and denitrification (v-x) in the lower and upper Peel-Harvey Estuary, which includes the mean squares (MS), pseudo- F ratio, significance level (P), components of variation (COV) and degrees of freedom (d.f.), and the added covariate (i.e. unremoved biomass) for each test. Significant effects ($P \leq 0.05$) are emboldened while tests that became insignificant depending on the order-of-fit are highlighted grey. Chemical symbols and fluxes: oxygen (O_2), dissolved inorganic carbon (DIC), phosphate (PO_4^{3-}), ammonium (NH_4^+), dissolved organic nitrogen (DON), nitrate and nitrite (NO_x), and dinitrogen (N_2).

	Lower estuary					Upper estuary				
	d.f.	MS	Pseudo- F	P	COV	d.f.	MS	Pseudo- F	P	COV
a. Dark O_2 flux										
<u>Order-of-fit 1</u>										
Covariate	1	20500	1.198	0.329	14.55	1	32560	0.078	0.785	-155.34
Sediment condition	1	111330	6.505	0.04	124.71	1	919620	2.197	0.164	301.46
Community	1	33715	1.970	0.199	58.94	1	205710	0.491	0.497	-218.27
Condition x Community	1	80	0.005	0.949	-95.88	1	113380	0.271	0.62	-479.1
Residual	11	17114			130.82	11	418660			647.04
<u>Order-of-fit 2</u>										
Covariate	1	20500	1.198	0.3	14.55	1	32560	0.078	0.785	-155.34
Community	1	87234	5.097	0.056	112.3	1	658340	1.573	0.239	210.57
Sediment condition	1	57812	3.378	0.076	88.42	1	466990	1.115	0.313	102.97
Condition x Community	1	80	0.005	0.959	-95.88	1	113380	0.271	0.64	-479.1
Residual	11	17114			130.82	11	418660			647.04
b. Light O_2 flux										
<u>Order-of-fit 1</u>										
Covariate	1	214530	1.363	0.258	59.77	1	159890	0.757	0.402	-56.64
Sediment condition	1	384020	2.440	0.138	193.43	1	307700	1.457	0.258	132.30
Community	1	64756	0.411	0.584	-139.23	1	26135	0.124	0.702	-203.49
Condition x Community	1	40489	0.257	0.6	-251.15	1	430	0.002	0.971	-398.11
Residual	11	157370			396.70	11	211220			459.59
<u>Order-of-fit 2</u>										
Covariate	1	214530	1.363	0.279	59.77	1	159890	0.757	0.4	-56.64
Community	1	219320	1.394	0.265	105.55	1	7015	0.033	0.855	-194.36
Sediment condition	1	229460	1.458	0.277	117.68	1	326820	1.547	0.243	159.25
Condition x Community	1	40489	0.257	0.594	-251.15	1	430	0.002	0.962	-398.11
Residual	11	157370			396.7	11	211220			459.59
c. Net O_2 flux										
<u>Order-of-fit 1</u>										
Covariate	1	4223	0.686	0.43	-10.99	1	18934	0.503	0.479	-34.23
Sediment condition	1	890	0.144	0.744	-29.49	1	94292	2.503	0.135	101.34
Community	1	713	0.116	0.769	-33.75	1	3246	0.086	0.761	-87.77
Condition x Community	1	603	0.098	0.763	-54.74	1	3777	0.100	0.766	-159.66
Residual	11	6156			78.46	11	37679			194.11
<u>Order-of-fit 2</u>										
Covariate	1	4223	0.686	0.407	-10.99	1	18934	0.503	0.471	-34.23
Community	1	1292	0.210	0.68	-29.58	1	32240	0.856	0.382	-31.72
Sediment condition	1	311	0.050	0.849	-33.51	1	65298	1.733	0.195	77.84
Condition x Community	1	603	0.098	0.773	-54.74	1	3777	0.100	0.783	-159.66
Residual	11	6156			78.46	11	37679			194.11

	Lower estuary					Upper estuary				
	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV
d. Dark DIC flux										
<u>Order-of-fit 1</u>										
Covariate	1	618610	4.915	0.073	221.98	1	13387	0.053	0.848	-163.57
Sediment condition	1	200040	1.589	0.261	143.23	1	499550	1.965	0.255	243.33
Community	1	43229	0.343	0.584	-216.77	1	1315900	5.177	0.081	853.07
Condition x Community	1	517100	4.108	0.077	654.05	1	48114	0.189	0.701	-457.86
Residual	5	125870			354.78	4	254180			504.16
<u>Order-of-fit 2</u>										
Covariate	1	618610	4.915	0.074	221.98	1	13387	0.053	0.832	-163.57
Community	1	2307	0.018	0.897	-250.10	1	130630	0.514	0.532	-213.5
Sediment condition	1	240960	1.914	0.208	189.10	1	1684800	6.629	0.059	800.79
Condition x Community	1	517100	4.108	0.071	654.05	1	48114	0.189	0.695	-457.86
Residual	5	125870			354.78	4	254180			504.16
e. Light DIC flux										
<u>Order-of-fit 1</u>										
Covariate	1	71848	1.18	0.328	32.91	1	408240	0.848	0.435	-90.34
Sediment condition	1	276	0.00	0.961	-129.62	1	611540	1.270	0.305	177.01
Community	1	233410	3.83	0.101	313.08	1	2731000	5.670	0.059	1241.6
Condition x Community	1	77952	1.28	0.293	136.06	1	260690	0.541	0.542	-474.16
Residual	5	61021			247.02	4	481690			694.04
<u>Order-of-fit 2</u>										
Covariate	1	71848	1.177	0.3	32.91	1	408240	0.848	0.419	-90.341
Community	1	202810	3.324	0.14	267.91	1	463990	0.963	0.383	-80.821
Sediment condition	1	30874	0.506	0.525	-96.78	1	2878500	5.976	0.069	1036.5
Condition x Community	1	77952	1.278	0.284	136.06	1	260690	0.541	0.532	-474.16
Residual	5	61021			247.02	4	481690			694.04
f. Net DIC flux										
<u>Order-of-fit 1</u>										
Covariate	1	10537	2.969	0.146	26.44	1	15647	0.311	0.621	-62.12
Sediment condition	1	10654	3.002	0.129	44.33	1	94760	1.881	0.274	103.49
Community	1	1980	0.558	0.517	-29.87	1	336530	6.680	0.05	442.87
Condition x Community	1	9313	2.624	0.164	79.39	1	2066	0.041	0.863	-221.7
Residual	5	3549			59.57	4	50378			224.45
<u>Order-of-fit 2</u>										
Covariate	1	10537	2.969	0.145	26.44	1	15647	0.311	0.617	-62.12
Community	1	5802	1.635	0.272	33.77	1	46864	0.930	0.383	-36.01
Sediment condition	1	6831	1.925	0.217	31.94	1	384430	7.631	0.061	386.95
Condition x Community	1	9313	2.624	0.151	79.39	1	2066	0.041	0.854	-221.70
Residual	5	3549			59.57	4	50378			224.45
g. Dark alkalinity flux										
<u>Order-of-fit 1</u>										
Covariate	1	205070	1.135	0.311	39.00	1	159710	0.189	0.689	-207.26
Sediment condition	1	1205000	6.667	0.03	411.19	1	1424300	1.682	0.221	323.63
Community	1	575220	3.183	0.097	287.34	1	89576	0.106	0.75	-411.63
Condition x Community	1	522760	2.892	0.122	429.62	1	1738400	2.053	0.189	818.7
Residual	11	180740			425.13	11	846980			920.32
<u>Order-of-fit 2</u>										
Covariate	1	205070	1.135	0.291	38.999	1	159710	0.189	0.694	-207.26
Community	1	84892	0.470	0.534	-131.29	1	50322	0.059	0.795	-383.9
Sediment condition	1	1695400	9.380	0.015	539.39	1	1463600	1.728	0.208	367.79
Condition x Community	1	522760	2.892	0.108	429.62	1	1738400	2.053	0.166	818.7
Residual	11	180740			425.13	11	846980			920.32

	Lower estuary					Upper estuary				
	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV
h. Light alkalinity flux										
<u>Order-of-fit 1</u>										
Covariate	1	1593500	7.133	0.027	292.63	1	485390	1.030	0.359	29.85
Sediment condition	1	988540	4.425	0.049	355.39	1	65657	0.139	0.699	-271.22
Community	1	359620	1.610	0.24	168.85	1	9848.8	0.021	0.891	-321.24
Condition x Community	1	7326	0.033	0.853	-341.48	1	119600	0.254	0.639	-514.11
Residual	11	223410			472.66	11	471140			686.39
<u>Order-of-fit 2</u>										
Covariate	1	1593500	7.133	0.034	292.63	1	485390	1.030	0.338	29.85
Community	1	33494	0.150	0.706	-184.81	1	267	0.001	0.981	-295.14
Sediment condition	1	1314700	5.885	0.033	457.85	1	75238	0.160	0.693	-294.71
Condition x Community	1	7326	0.033	0.856	-341.48	1	119600	0.254	0.64	-514.11
Residual	11	223410			472.66	11	471140			686.39
i. Net alkalinity flux										
<u>Order-of-fit 1</u>										
Covariate	1	113530	6.037	0.036	76.94	1	6650.3	0.142	0.716	-50.19
Sediment condition	1	401	0.021	0.903	-55.12	1	30169	0.643	0.429	-55.17
Community	1	250	0.013	0.916	-62.32	1	1029	0.022	0.869	-101.35
Condition x Community	1	23819	1.267	0.276	52.01	1	117120	2.495	0.13	229.7
Residual	11	18807			137.14	11	46948			216.67
<u>Order-of-fit 2</u>										
Covariate	1	113530	6.037	0.034	76.94	1	6650	0.142	0.713	-50.19
Community	1	51	0.003	0.951	-58.08	1	1856	0.040	0.84	-91.33
Sediment condition	1	601	0.032	0.876	-59.14	1	29342	0.625	0.467	-62.15
Condition x Community	1	23819	1.267	0.279	52.01	1	117120	2.495	0.155	229.70
Residual	11	18807			137.14	11	46948			216.67
j. Dark PO₄³⁻ flux										
<u>Order-of-fit 1</u>										
Covariate	1	2.66	0.138	0.728	-1.02	1	6.44	2.357	0.157	0.48
Sediment condition	1	17.52	0.908	0.388	-0.54	1	7.03	2.570	0.132	0.88
Community	1	1.09	0.056	0.838	-1.95	1	22.96	8.400	0.023	2.13
Condition x Community	1	0.02	0.001	0.977	-3.23	1	8.35	3.054	0.103	2.05
Residual	11	19.30			4.39	11	2.73			1.65
<u>Order-of-fit 2</u>										
Covariate	1	2.66	0.138	0.728	-1.02	1	6.44	2.357	0.172	0.48
Community	1	6.44	0.333	0.578	-1.52	1	10.59	3.875	0.071	1.21
Sediment condition	1	12.17	0.631	0.435	-1.17	1	19.39	7.095	0.026	1.91
Condition x Community	1	0.02	0.001	0.979	-3.23	1	8.35	3.054	0.109	2.05
Residual	11	19.30			4.39	11	2.73			1.65
k. Light PO₄³⁻ flux										
<u>Order-of-fit 1</u>										
Covariate	1	0.69	0.165	0.66	-0.47	1	1.67	0.802	0.426	-0.17
Sediment condition	1	0.31	0.074	0.793	-0.80	1	3.05	1.463	0.255	0.44
Community	1	0.12	0.028	0.848	-0.92	1	0.35	0.166	0.677	-0.63
Condition x Community	1	7.21	1.718	0.234	1.28	1	0.41	0.195	0.672	-1.44
Residual	11	4.20			2.05	10	2.09			1.44
<u>Order-of-fit 2</u>										
Covariate	1	0.69	0.165	0.667	-0.47	1	1.67	0.802	0.372	-0.17
Community	1	0.01	0.003	0.961	-0.87	1	0.01	0.006	0.939	-0.63
Sediment condition	1	0.42	0.099	0.73	-0.85	1	3.39	1.623	0.244	0.56
Condition x Community	1	7.21	1.718	0.215	1.28	1	0.41	0.195	0.696	-1.44
Residual	11	4.20			2.05	10	2.09			1.44

	Lower estuary					Upper estuary				
	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV
l. Net PO₄³⁻ flux										
<u>Order-of-fit 1</u>										
Covariate	1	0.01	0.020	0.88	-0.18	1	0.70	5.809	0.027	0.20
Sediment condition	1	0.69	1.264	0.28	0.15	1	0.61	5.073	0.033	0.32
Community	1	0.02	0.034	0.878	-0.33	1	1.26	10.48	0.006	0.51
Condition x Community	1	0.33	0.615	0.475	-0.34	1	0.47	3.865	0.116	0.65
Residual	11	0.54			0.74	10	0.12			0.35
<u>Order-of-fit 2</u>										
Covariate	1	0.01	0.020	0.904	-0.18	1	0.70	5.809	0.035	0.20
Community	1	0.19	0.351	0.605	-0.25	1	0.56	4.624	0.031	0.29
Sediment condition	1	0.52	0.947	0.352	-0.07	1	1.32	10.928	0.009	0.53
Condition x Community	1	0.33	0.615	0.449	-0.34	1	0.47	3.865	0.113	0.65
Residual	11	0.54			0.74	10	0.12			0.35
m. Dark NH₄⁺ flux										
<u>Order-of-fit 1</u>										
Covariate	1	1751	0.098	0.648	-31.80	1	479	0.022	0.89	-36.50
Sediment condition	1	5958	0.332	0.597	-44.46	1	11939	0.548	0.46	-42.27
Community	1	359	0.020	0.902	-60.65	1	13053	0.599	0.428	-44.21
Condition x Community	1	2780	0.155	0.656	-90.43	1	0	0.000	0.996	-127.99
Residual	11	17934			133.92	11	21789			147.61
<u>Order-of-fit 2</u>										
Covariate	1	1751	0.098	0.603	-31.80	1	478.86	0.022	0.894	-36.50
Community	1	129	0.007	0.926	-56.59	1	22305	1.024	0.347	9.77
Sediment condition	1	6188	0.345	0.605	-47.50	1	2686.9	0.123	0.726	-64.74
Condition x Community	1	2780	0.155	0.678	-90.43	1	0	0.000	0.999	-127.99
Residual	11	17934			133.92	11	21789			147.61
n. Light NH₄⁺ flux										
<u>Order-of-fit 1</u>										
Covariate	1	10480	2.931	0.116	20.77	1	5178	0.415	0.534	-21.34
Sediment condition	1	9772	2.733	0.135	31.98	1	35685	2.863	0.134	64.90
Community	1	1278	0.357	0.555	-21.93	1	1891	0.152	0.703	-48.64
Condition x Community	1	428	0.120	0.733	-41.21	1	3788	0.304	0.57	-80.77
Residual	11	3576			59.80	11	12465			111.65
<u>Order-of-fit 2</u>										
Covariate	1	10480	2.931	0.118	20.77	1	5178	0.415	0.517	-21.34
Community	1	15	0.004	0.949	-25.30	1	13954	1.119	0.331	16.59
Sediment condition	1	11035	3.086	0.125	37.85	1	23622	1.895	0.191	49.47
Condition x Community	1	428	0.120	0.744	-41.21	1	3788	0.304	0.589	-80.77
Residual	11	3576			59.80	11	12465			111.65
o. Net NH₄⁺ flux										
<u>Order-of-fit 1</u>										
Covariate	1	180	0.243	0.583	-5.91	1	124	0.143	0.693	-6.81
Sediment condition	1	6	0.008	0.926	-11.00	1	3922	4.525	0.058	23.54
Community	1	28	0.037	0.875	-12.20	1	853	0.985	0.366	-1.72
Condition x Community	1	24	0.033	0.857	-19.64	1	169	0.195	0.667	-22.91
Residual	11	739			27.19	11	867			29.44
<u>Order-of-fit 2</u>										
Covariate	1	180	0.243	0.599	-5.91	1	124	0.143	0.7	-6.81
Community	1	16	0.021	0.904	-11.41	1	2769	3.195	0.102	18.76
Sediment condition	1	18	0.024	0.884	-11.77	1	2007	2.315	0.153	15.81
Condition x Community	1	24	0.033	0.877	-19.64	1	169	0.195	0.662	-22.91
Residual	11	739			27.19	11	867			29.44

	Lower estuary					Upper estuary				
	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV
p. Dark NO_x flux										
<u>Order-of-fit 1</u>										
Covariate	1	0.06	0.046	0.860	-0.27	1	6.240	0.251	0.487	-1.08
Sediment condition	1	1.02	0.822	0.382	-0.19	1	4.577	0.184	0.641	-1.92
Community	1	0.07	0.056	0.818	-0.49	1	1.259	0.051	0.837	-2.30
Condition x Community	1	0.09	0.070	0.814	-0.79	1	2.257	0.091	0.709	-4.13
Residual	11	1.24			1.11	11	24.91			4.99
<u>Order-of-fit 2</u>										
Covariate	1	0.06	0.046	0.858	-0.27	1	6.240	0.251	0.510	-1.08
Community	1	0.39	0.313	0.553	-0.39	1	0.017	0.001	0.976	-2.15
Sediment condition	1	0.70	0.565	0.489	-0.32	1	5.818	0.234	0.670	-2.05
Condition x Community	1	0.09	0.070	0.793	-0.79	1	2.257	0.091	0.699	-4.13
Residual	11	1.24			1.11	11	24.907			4.99
q. Light NO_x flux										
<u>Order-of-fit 1</u>										
Covariate	1	866	0.904	0.341	-2.47	1	1481	0.196	0.673	-19.50
Sediment condition	1	164	0.171	0.674	-11.64	1	4409	0.583	0.466	-23.92
Community	1	2	0.002	0.972	-15.20	1	32488	4.296	0.057	74.67
Condition x Community	1	44	0.046	0.844	-27.79	1	176	0.023	0.882	-74.53
Residual	10	958			30.95	11	7563			86.97
<u>Order-of-fit 2</u>										
Covariate	1	866	0.904	0.337	-2.47	1	1481	0.196	0.679	-19.50
Community	1	21	0.022	0.874	-13.47	1	36685	4.850	0.048	73.40
Sediment condition	1	144	0.150	0.711	-13.17	1	213	0.028	0.867	-40.16
Condition x Community	1	44	0.046	0.832	-27.79	1	176	0.023	0.883	-74.53
Residual	10	958			30.95	11	7563			86.97
r. Net NO_x flux										
<u>Order-of-fit 1</u>										
Covariate	1	0.00	0.013	0.868	-0.12	1	0.11	0.044	0.82	-0.38
Sediment condition	1	0.10	0.486	0.521	-0.13	1	0.17	0.067	0.80	-0.65
Community	1	0.01	0.060	0.826	-0.21	1	27.58	11.170	0.007	2.37
Condition x Community	1	0.04	0.198	0.624	-0.37	1	1.07	0.432	0.53	-1.03
Residual	10	0.20			0.45	11	2.47			1.57
<u>Order-of-fit 2</u>										
Covariate	1	0.00	0.013	0.896	-0.12	1	0.11	0.044	0.842	-0.38
Community	1	0.00	0.009	0.93	-0.20	1	24.45	9.903	0.007	2.02
Sediment condition	1	0.11	0.537	0.502	-0.14	1	3.29	1.334	0.291	0.43
Condition x Community	1	0.04	0.198	0.649	-0.37	1	1.07	0.432	0.54	-1.03
Residual	10	0.20			0.45	11	2.47			1.57
s. Dark DON flux										
<u>Order-of-fit 1</u>										
Covariate	1	62266	0.118	0.717	-170.53	1	483350	0.245	0.618	-305.03
Sediment condition	1	7380	0.014	0.916	-293.03	1	6866300	3.482	0.094	942.27
Community	1	23493	0.045	0.857	-324.8	1	4532400	2.298	0.146	756.81
Condition x Community	1	116840	0.221	0.636	-470.8	1	2491100	1.263	0.258	624.66
Residual	11	527570			726.34	11	1972100			1404.3
<u>Order-of-fit 2</u>										
Covariate	1	62266	0.118	0.736	-170.53	1	483350	0.245	0.58	-305.03
Community	1	30382	0.058	0.815	-299.03	1	9157100	4.643	0.045	1152.9
Sediment condition	1	491	0.001	0.978	-318.19	1	2241600	1.137	0.318	243.15
Condition x Community	1	116840	0.221	0.641	-470.8	1	2491100	1.263	0.258	624.66
Residual	11	527570			726.34	11	1972100			1404.3

	Lower estuary					Upper estuary				
	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV
t. Light DON flux										
<u>Order-of-fit 1</u>										
Covariate	1	4323	0.041	0.859	-79.89	1	38032	0.077	0.791	-168.98
Sediment condition	1	127410	1.197	0.298	58.85	1	4235100	8.557	0.016	823.72
Community	1	207210	1.947	0.19	145.23	1	33037	0.067	0.792	-321.44
Condition x Community	1	382940	3.598	0.085	386.29	1	297810	0.602	0.445	-384.97
Residual	11	106430			326.24	11	494910			703.50
<u>Order-of-fit 2</u>										
Covariate	1	4323	0.041	0.878	-79.89	1	38032	0.077	0.813	-168.98
Community	1	83002	0.780	0.421	-64.92	1	1043300	2.108	0.184	318.50
Sediment condition	1	251620	2.364	0.146	167.00	1	3224800	6.516	0.026	773.88
Condition x Community	1	382940	3.598	0.07	386.29	1	297810	0.602	0.46	-384.97
Residual	11	106430			326.24	11	494910			703.50
u. Net DON flux										
<u>Order-of-fit 1</u>										
Covariate	1	1621	0.083	0.77	-33.46	1	35840	0.381	0.528	-60.34
Sediment condition	1	10567	0.541	0.445	-38.48	1	9187	0.098	0.761	-124.11
Community	1	3314	0.170	0.681	-58.27	1	154660	1.644	0.242	116.40
Condition x Community	1	4423	0.226	0.632	-90.31	1	41450	0.441	0.488	-198.95
Residual	11	19538			139.78	11	94090			306.74
<u>Order-of-fit 2</u>										
Covariate	1	1621	0.083	0.749	-33.46	1	35840	0.381	0.553	-60.34
Community	1	219	0.011	0.914	-58.94	1	158000	1.679	0.237	108.73
Sediment condition	1	13662	0.699	0.42	-33.60	1	5843	0.062	0.816	-139.14
Condition x Community	1	4423	0.226	0.664	-90.31	1	41450	0.441	0.458	-198.95
Residual	11	19538			139.78	11	94090			306.74
v. Dark N₂ flux										
<u>Order-of-fit 1</u>										
Covariate	1	701	0.147	0.68	-21.28	1	6529	1.693	0.21	14.92
Sediment condition	1	16	0.003	0.955	-39.47	1	10662	2.765	0.134	41.58
Community	1	31154	6.524	0.058	112.88	1	3175	0.823	0.425	-15.20
Condition x Community	1	656	0.137	0.749	-64.48	1	992	0.257	0.612	-48.14
Residual	4	4775			69.10	7	3857			62.10
<u>Order-of-fit 2</u>										
Covariate	1	701	0.147	0.697	-21.28	1	6529	1.693	0.225	14.92
Community	1	30700	6.429	0.048	111.34	1	7813	2.026	0.19	34.41
Sediment condition	1	470	0.099	0.77	-37.73	1	6024	1.562	0.254	24.99
Condition x Community	1	656	0.137	0.734	-64.48	1	992	0.257	0.636	-48.14
Residual	4	4775			69.10	7	3857			62.10
w. Light N₂ flux										
<u>Order-of-fit 1</u>										
Covariate	1	0.31	0.156	0.693	-0.46	1	0.00	0.007	0.934	-0.20
Sediment condition	1	0.33	0.168	0.669	-0.88	1	3.65	6.728	0.026	0.86
Community	1	0.00	0.002	0.961	-1.00	1	0.05	0.096	0.778	-0.35
Condition x Community	1	0.08	0.039	0.858	-1.47	1	0.38	0.708	0.437	-0.36
Residual	3	1.98			1.41	9	0.54			0.74
<u>Order-of-fit 2</u>										
Covariate	1	0.31	0.156	0.685	-0.46	1	0.00	0.007	0.956	-0.20
Community	1	0.01	0.003	0.948	-1.00	1	0.98	1.801	0.211	0.30
Sediment condition	1	0.33	0.167	0.657	-0.88	1	2.73	5.023	0.053	0.79
Condition x Community	1	0.08	0.039	0.858	-1.47	1	0.38	0.708	0.393	-0.36
Residual	3	1.98			1.41	9	0.54			0.74

	Lower estuary					Upper estuary				
	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV	d.f.	MS	Pseudo- <i>F</i>	<i>P</i>	COV
x. Net N₂ flux										
<u>Order-of-fit 1</u>										
Covariate	1	0.13	0.967	0.394	-0.02	1	0.23	0.525	0.5	-0.13
Sediment condition	1	0.20	1.549	0.324	0.18	1	3.30	7.678	0.026	0.84
Community	1	1.04	8.05	0.039	0.68	1	0.00	0.006	0.939	-0.34
Condition x Community	1	0.02	0.142	0.742	-0.36	1	0.67	1.565	0.271	0.44
Residual	3	0.13			0.36	8	0.43			0.66
<u>Order-of-fit 2</u>										
Covariate	1	0.13	0.967	0.391	-0.02	1	0.23	0.525	0.515	-0.13
Community	1	1.07	8.244	0.045	0.69	1	0.54	1.247	0.32	0.16
Sediment condition	1	0.18	1.355	0.351	0.15	1	2.76	6.437	0.028	0.82
Condition x Community	1	0.02	0.142	0.718	-0.36	1	0.67	1.565	0.251	0.44
Residual	3	0.13			0.36	8	0.43			0.66

Table S4. Flux responses to individual (marginal) and a combination of (sequential) community metrics using DISTLM, with the pseudo- F statistic, significance level (P), percent variation explained (%V), cumulative percent variation (%C) and R^2 statistic provided. Significant tests ($P \leq 0.05$) are emboldened. Fluxes: dissolved inorganic carbon (DIC), nitrate and nitrite (NO_x), dissolved organic nitrogen (DON), phosphate (PO_4^{3-}) and dinitrogen (N_2). Community metrics: Taxon richness (S), total abundance (N), community biomass, and the community bioturbation potential (BP_c). Note that where a significant effect of sediment condition was also present, tests were split between the two sediment condition classes. Chemical symbols and fluxes: dissolved inorganic carbon (DIC), phosphate (PO_4^{3-}), dissolved organic nitrogen (DON), nitrate and nitrite (NO_x), and dinitrogen (N_2).

Test	Predictor	Pseudo- F	P	%V	%C	R^2
Net DIC flux (Upper estuary)						
Marginal	S	2.819	0.14	28.71		
	N	2.772	0.141	28.37		
	Biomass	2.368	0.18	25.28		
	BP_c	1.657	0.238	19.14		
Sequential	+ S	2.819	0.139	28.71	28.71	0.29
	+ BP_c	0.569	0.487	6.18	34.89	0.35
	+ Biomass	5.463	0.062	34	68.88	0.69
	+ N	0.055	0.76	0.42	69.31	0.69
Dark PO_4^{3-} flux (Upper estuary)						
<i>i. Good sediments</i>						
Marginal	S	0.392	0.637	8.93		
	N	0	0.982	0		
	Biomass	0.933	0.379	18.92		
	BP_c	1.081	0.349	21.27		
Sequential	+ BP_c	1.081	0.312	21.27	21.27	0.21
	+ N	2.385	0.252	34.87	56.14	0.56
	+ S	0	0.959	0	56.14	0.56
	+ Biomass	No test		0	56.14	0.56
<i>ii. Poor sediments</i>						
Marginal	S	6.235	0.039	43.8		
	N	6.813	0.029	45.99		
	Biomass	10.286	0.017	56.25		
	BP_c	1.372	0.291	14.64		
Sequential	+ Biomass	10.286	0.016	56.25	56.25	0.56
	+ BP_c	0.487	0.561	2.85	59.1	0.59
	+ S	1.139	0.334	6.53	65.62	0.66
	+ N	0.041	0.84	0.28	65.9	0.66
Net PO_4^{3-} flux (Upper estuary)						
<i>i. Good sediments</i>						
Marginal	S	0.908	0.549	18.51		
	N	0.348	0.623	8.01		
	Biomass	1.282	0.327	24.27		
	BP_c	1.338	0.265	25.06		
Sequential	+ BP_c	1.338	0.252	25.06	25.06	0.25
	+ N	0.147	0.699	3.5	28.56	0.29
	+ S	0.001	0.934	0.04	28.6	0.29
<i>ii. Poor sediments</i>						
Marginal	S	2.8	0.143	28.57		
	N	2.465	0.117	26.04		
	Biomass	6.623	0.021	48.62		
	BP_c	2.143	0.22	23.44		
Sequential	+ Biomass	6.623	0.028	48.62	48.62	0.49
	+ N	2.648	0.183	15.73	64.35	0.64
	+ S	0.368	0.575	2.45	66.8	0.67
	+ BP_c	0.568	0.519	4.13	70.93	0.71

Test	Predictor	Pseudo- <i>F</i>	<i>P</i>	%V	%C	R ²
Dark DON flux (Upper estuary)						
	<i>S</i>	1.361	0.266	8.86		
Marginal	<i>N</i>	1.44	0.245	9.33		
	Biomass	1.211	0.275	7.96		
	BP _c	0.572	0.468	3.92		
	+ <i>S</i>	1.44	0.213	9.33	9.33	0.09
Sequential	+ BP _c	0.08	0.781	0.56	9.89	0.1
	+ <i>N</i>	0.009	0.926	0.07	9.96	0.1
	+ Biomass	0.013	0.901	0.11	10.06	0.1
Light NO_x flux (Upper estuary)						
	<i>S</i>	2.539	0.124	15.35		
Marginal	<i>N</i>	3.297	0.089	19.06		
	Biomass	8.269	0.012	37.13		
	BP _c	35.771	0.001	71.87		
	+ BP _c	35.771	0.001	71.87	71.87	0.72
Sequential	+ <i>N</i>	0.796	0.395	1.62	73.5	0.73
	+ Biomass	0.217	0.637	0.47	73.97	0.74
	+ <i>S</i>	0.157	0.712	0.37	74.33	0.74
Net NO_x flux (Upper estuary)						
	<i>S</i>	2.983	0.131	17.56		
Marginal	<i>N</i>	0.738	0.377	5.01		
	Biomass	3.469	0.083	19.86		
	BP _c	0.904	0.35	6.06		
	+ Biomass	3.469	0.092	19.86	19.86	0.2
Sequential	+ <i>N</i>	2.325	0.149	12.16	32.02	0.32
	+ BP _c	0.673	0.382	3.61	35.63	0.36
	+ <i>S</i>	0.003	0.957	0.02	35.65	0.36
Dark N₂ flux (Lower estuary)						
	<i>S</i>	1.529	0.225	17.93		
Marginal	<i>N</i>	0.411	0.537	5.54		
	Biomass	0.791	0.374	10.15		
	BP _c	0.502	0.533	6.7		
	+ <i>S</i>	1.529	0.254	17.93	17.93	0.18
Sequential	+ <i>N</i>	1.382	0.259	15.36	33.29	0.33
	+ Biomass	0.06	0.869	0.84	34.13	0.34
	+ BP _c	0	0.994	0	34.13	0.34
Net N₂ flux (Lower estuary)						
	<i>S</i>	0.381	0.561	5.97		
Marginal	<i>N</i>	0.014	0.822	0.24		
	Biomass	0.388	0.562	6.07		
	BP _c	0.045	0.829	0.75		
	+ Biomass	0.388	0.565	6.07	6.07	0.06
Sequential	+ BP _c	0.131	0.771	2.39	8.47	0.08
	+ <i>S</i>	0.445	0.544	9.16	17.62	0.18
	+ <i>N</i>	1.057	0.374	21.46	39.08	0.39