Table S1. Spearman's correlation coefficients between ambient uptake metrics ($S_{w\text{-}amb}$, U_{amb}, and $V_{f\text{-}amb}$), nutrient concentrations and ratios, and in-stream physical and chemical variables. Significant correlations are highlighted in **bold** ($p < 0.05$).

Variables	NO_3 S_w	NH_4 S_w	SRP S_w	NO_3 U_{amb}	NH_4 U_{amb}	SRP U_{amb}	NO_3 $V_{f\text{-}amb}$	NH_4 $V_{f\text{-}amb}$	SRP $V_{f\text{-}amb}$	U DIN : U SRP	Vf NH_4 : Vf SRP	Vf NO_3 : Vf SRP	NO_3 amb	NH_4 amb	SRP amb	DIN	DIN : SRP	DOC	DOC : NO_3	DOC : DIN	TDC	OD	pH	EC	Q	w	v	T	CC	H
NO_3 S_w	1.00																													
NH_4 S_w	0.23	1.00																												
SRP S_w	0.49	0.36	1.00																											
NO_3 U_{amb}	−0.44	−0.54	**−0.74**	1.00																										
NH_4 U_{amb}	−0.15	**−0.73**	−0.46	**0.77**	1.00																									
SRP U_{amb}	−0.29	−0.08	**−0.69**	**0.65**	0.33	1.00																								
NO_3 $V_{f\text{-}amb}$	**−0.56**	−0.50	**−0.66**	**0.92**	**0.75**	**0.61**	1.00																							
NH_4 $V_{f\text{-}amb}$	−0.11	**−0.75**	−0.50	**0.81**	**0.90**	0.46	**0.82**	1.00																						
SRP $V_{f\text{-}amb}$	−0.40	−0.42	**−0.87**	**0.81**	**0.73**	**0.76**	**0.81**	**0.78**	1.00																					
U DIN : U SRP	−0.35	**−0.71**	−0.33	**0.78**	**0.55**	0.04	**0.65**	**0.68**	0.34	1.00																				
Vf NH_4 : Vf SRP	−0.03	**−0.70**	0.22	0.04	0.44	−0.38	0.16	**0.52**	−0.01	**0.54**	1.00																			
Vf NO_3 : Vf SRP	**−0.75**	−0.34	0.05	0.13	−0.04	−0.25	0.24	0.08	−0.11	**0.61**	0.47	1.00																		
NO_3 amb	0.27	0.04	−0.16	0.41	0.24	0.09	0.10	0.14	0.17	0.04	−0.33	−0.45	1.00																	
NH_4 amb	0.04	−0.08	0.06	−0.20	0.19	−0.18	−0.24	−0.19	−0.14	−0.19	−0.17	−0.30	0.20	1.00																
SRP amb	0.20	**0.59**	0.47	**−0.64**	**−0.85**	−0.23	**−0.74**	**−0.82**	**−0.68**	**−0.53**	−0.44	−0.11	0.04	0.06	1.00															
DIN	0.24	0.00	−0.23	0.46	0.28	0.12	0.15	0.18	0.24	0.07	−0.34	−0.46	**0.99**	0.26	−0.02	1.00														
DIN : SRP	−0.08	−0.43	**−0.65**	**0.85**	**0.76**	0.44	**0.64**	**0.72**	**0.74**	**0.55**	−0.03	−0.18	**0.62**	0.05	**−0.64**	**0.68**	1.00													
DOC	0.05	−0.14	−0.14	0.26	0.33	0.11	0.06	0.24	0.24	0.10	0.08	−0.22	**0.63**	−0.05	−0.01	**0.61**	0.46	1.00												
DOC : NO_3	−0.13	−0.07	0.30	−0.37	0.04	−0.20	−0.11	0.05	−0.11	−0.08	**0.56**	0.29	**−0.64**	−0.20	−0.12	**−0.66**	−0.43	0.08	1.00											
DOC : DIN	−0.09	−0.09	0.29	−0.35	0.07	−0.16	−0.10	0.08	−0.08	−0.09	**0.56**	0.26	**−0.62**	−0.21	−0.12	**−0.64**	−0.41	0.11	**1.00**	1.00										
TDC	0.17	0.14	0.04	−0.10	−0.25	0.09	−0.28	−0.15	−0.13	−0.13	−0.08	−0.20	0.30	−0.22	**0.57**	0.26	−0.07	**0.61**	0.05	0.08	1.00									
DO	−0.09	0.10	0.42	−0.33	−0.36	**−0.63**	−0.23	−0.31	**−0.53**	0.25	0.20	**0.60**	−0.37	−0.08	0.03	−0.39	−0.40	**−0.62**	0.01	−0.04	−0.44	1.00								
pH	0.29	0.47	**0.65**	**−0.87**	**−0.72**	**−0.54**	**−0.84**	**−0.80**	**−0.77**	**−0.58**	−0.15	−0.10	−0.06	0.29	**0.84**	−0.10	**−0.75**	−0.01	0.16	0.15	0.39	0.12	1.00							
EC	0.19	0.45	**0.61**	**−0.84**	**−0.77**	**−0.50**	**−0.82**	**−0.82**	**−0.80**	**−0.56**	−0.12	0.03	−0.29	0.13	**0.83**	−0.35	**−0.86**	−0.10	0.27	0.25	0.39	0.20	**0.88**	1.00						
Q	−0.04	−0.38	−0.34	**0.73**	**0.79**	0.44	**0.78**	**0.79**	**0.68**	0.36	0.16	−0.16	0.27	−0.01	**−0.81**	0.31	**0.71**	0.15	−0.07	−0.04	−0.43	−0.26	**−0.72**	**−0.88**	1.00					
w	−0.13	0.20	0.38	**−0.56**	−0.41	**−0.69**	−0.42	−0.43	−0.45	−0.18	0.33	0.32	−0.24	−0.16	0.26	−0.26	**−0.50**	0.05	0.45	0.43	0.17	0.37	**0.53**	0.49	**−0.53**	1.00				
v	0.28	0.00	0.48	**−0.69**	−0.05	**−0.57**	**−0.54**	−0.25	−0.48	−0.20	0.30	0.04	−0.43	0.39	−0.10	−0.45	−0.44	−0.37	0.34	0.31	−0.49	0.43	0.21	0.38	−0.15	0.16	1.00			
T	0.18	−0.14	0.19	0.02	0.29	−0.29	−0.02	0.22	0.00	0.08	0.38	−0.13	0.37	0.05	−0.01	0.38	0.21	**0.64**	0.27	0.29	0.41	−0.32	0.24	−0.06	0.11	0.43	−0.28	1.00		
CC	0.23	−0.18	−0.12	0.25	0.39	0.27	0.12	0.19	0.11	−0.05	−0.17	**−0.51**	0.32	**0.66**	−0.08	0.36	0.33	−0.03	−0.39	−0.39	−0.01	−0.27	−0.14	−0.17	0.26	**−0.62**	0.12	−0.16	1.00	
H	−0.15	−0.22	−0.57	**0.84**	0.49	**0.72**	**0.74**	**0.61**	**0.73**	0.28	−0.18	−0.20	0.50	−0.19	−0.36	**0.54**	**0.73**	0.25	−0.45	−0.40	0.06	−0.44	**−0.59**	**−0.77**	**0.66**	**−0.53**	**−0.78**	0.10	0.25	1.00

Table S2. Statistical parameters of Michaelis–Menten models used to evaluate the relationship between total dynamic uptake rate ($U_{tot-dyn}$) or total dynamic uptake velocity ($V_{f-tot-dyn}$), and total dynamic nutrient concentration ($C_{tot-dyn}$) for both streams. For the Michaelis–Menten model, the maximum uptake rate (U_{max}; $\mu g \cdot m^{-2} \cdot min^{-1}$) and the half saturation constant (K_m; $\mu g \cdot L^{-1}$) are shown. The adjusted R^2 and p-value of fits are reported in brackets.

Stream	Uptake Metric	NO₃–N			NH₄–N			SRP		
		K_m	U_{max}	R^2 (p-value)	K_m	U_{max}	R^2 (p-value)	K_m	U_{max}	R^2 (p-value)
BRO	U_{tot}	1094.7 (±1238.2)	62,156.4 (±39,038.5)	0.085 ($p < 0.05$)	52.13 (±28.56)	3737.6 (±488.8)	0.234 ($p < 0.05$)	1040.6 (±739.6)	14,983.1 (±8248.9)	0.699 ($p > 0.05$)
	V_{f-tot}	114,112.6 (±127,277)	2716.56 (±3857.7)	2E−04 ($p < 0.05$)	37.6 (±8.3)	3216.5 (±410.4)	0.653 ($p < 0.05$)	784.6 (±249.4)	12075.5 (±3216.5)	0.152 ($p < 0.05$)
ESP	U_{tot}	1414.6 (±736.2)	9013.1 (±2766.3)	0.597 ($p < 0.05$)	420.5 (±172.1)	3314.4 (±722.9)	0.657 ($p < 0.05$)	618.9 (±277.6)	7143.8 (±2329.8)	0.796 ($p < 0.05$)
	V_{f-tot}	3290.8 (±2141.9)	16,153.2 (±8427.4)	0.083 ($p < 0.05$)	101.5 (±22.9)	1589.6 (±229.8)	0.594 ($p < 0.05$)	1526.0 (±985.9)	14,860.0 (±8713.8)	0.028 ($p < 0.05$)
TBM	U_{tot}	2179.3 (±1570.8)	5767.9 (±2575.6)	0.375 ($p < 0.05$)	285.1 (±163.5)	901.6 (±194.4)	0.457 ($p < 0.05$)	8704.0 (±20,235)	9687.5 (±20,671.2)	0.631 ($p < 0.05$)
	V_{f-tot}	6018.77 (±5894.6)	12,103.2 (±10,425.2)	0.001 ($p < 0.05$)	354.2 (±108.2)	951.2 (±224.5)	0.458 (p < 0.05)	2737.1 (±1734.8)	3483.1 (±1977.8)	0.029 ($p < 0.05$)
CAN	U_{tot}	*	*	*	1517.8 (±726.8)	2058. 3 (±642.6)	0.666 ($p < 0.05$)	6146.4 (±5576.6)	8298.2 (±6712.9)	0.848 ($p < 0.05$)
	V_{f-tot}	*	*	*	425.4 (±113.4)	916.1 (±168.7)	0.313 ($p < 0.05$)	5883.1 (±5865.6)	7957.8 (±7342.3)	0.002 ($p < 0.05$)

* Fit did not converge due to mutual dependence between parameters.

Table S3. Statistical parameters of the efficiency-loss model ($U = aN^b$) used to evaluate the fit between the relationship between total dynamic uptake rate ($U_{tot-dyn}$), total dynamic uptake velocity ($V_{f-tot-dyn}$), and total dynamic nutrient concentration ($C_{tot-dyn}$) for both streams. For the efficiency-loss model, *a* represents the intercept and *b* is the exponent. The adjusted R^2 and p-value of the fits are also reported in brackets.

Stream	Uptake metric	NO_3–N a	b	R^2 (*p*-value)	NH_4–N a	b	R^2 (*p*-value)	SRP a	b	R^2 (*p*-value)
BRO	U_{tot}	3.20 (1.10)	0.58 (0.18)	0.123 ($p < 0.05$)	5.32 (0.29)	0.23 (0.03)	0.465 ($p < 0.05$)	3.11 (0.17)	0.54 (0.03)	0.787 ($p < 0.05$)
	V_{f-tot}	4.98 (5.02)	−0.24 (0.53)	−0.011 ($p < 0.05$)	7.54 (0.77)	−0.64 (0.06)	0.535 ($p < 0.05$)	3.50 (0.46)	−0.23 (0.08)	0.072 ($p < 0.05$)
ESP	U_{tot}	2.16 (0.32)	0.68 (0.07)	0.697 ($p < 0.05$)	3.42 (0.17)	0.42 (0.03)	0.786 ($p < 0.05$)	2.50 (0.11)	0.65 (0.03)	0.881 ($p < 0.05$)
	V_{f-tot}	4.04 (2.31)	−0.49 (0.30)	0.048 ($p < 0.05$)	6.48 (0.68)	−0.78 (0.06)	0.658 ($p < 0.05$)	2.52 (0.30)	−0.07 (0.07)	1.3E−4 ($p < 0.05$)
TBM	U_{tot}	1.50 (0.24)	0.81 (0.08)	0.595 ($p < 0.05$)	2.18 (0.24)	0.56 (0.06)	0.679 ($p < 0.05$)	1.21 (0.11)	0.89 (0.05)	0.831 ($p < 0.05$)
	V_{f-tot}	2.36 (1.43)	−0.49 (0.32)	0.016 ($p < 0.05$)	4.31 (1.04)	−0.97 (0.15)	0.456 ($p < 0.05$)	1.26 (0.30)	−0.33 (0.14)	0.050 ($p < 0.05$)
CAN	U_{tot}	0.71 (0.14)	1.16 (0.10)	0.733 ($p < 0.05$)	1.63 (0.18)	0.72 (0.06)	0.696 ($p < 0.05$)	1.05 (0.09)	0.98 (0.05)	0.854 ($p < 0.05$)
	V_{f-tot}	0.16 (0.17)	0.71 (0.52)	0.020 ($p < 0.05$)	4.34 (1.03)	−1.03 (0.14)	0.364 ($p < 0.05$)	0.92 (0.27)	−0.08 (0.16)	−0.009 ($p < 0.050$)

Table S4. Statistical parameters of the first-order model (U = a + bN) used to evaluate the fit between the relationship between total dynamic uptake rate ($U_{tot\text{-}dyn}$), total dynamic uptake velocity ($V_{f\text{-}tot\text{-}dyn}$), and total dynamic nutrient concentration ($C_{tot\text{-}dyn}$) for both streams. For the efficiency-loss model, *a* represents the intercept and *b* is the slope. The adjusted R^2 and *p*-value of the fits are also reported in brackets.

Stream	Uptake metric	NO₃–N			NH₄–N			SRP		
		Intercept	Slope	R^2 (*p*-value)	Intercept	Slope	R^2 (*p*-value)	Intercept	Slope	R^2 (*p*-value)
BRO	U_{tot}	3.94	0.87	0.122	5.61	0.42	0.457	3.13	0.86	0.787
		(1.76)	(0.26)	($p < 0.05$)	(0.30)	(0.05)	($p < 0.05$)	(0.25)	(0.05)	($p < 0.05$)
	$V_{f\text{-}tot}$	3.94	−0.12	−0.011	5.61	−0.57	0.607	3.13	−0.13	0.077
		(1.76)	(0.26)	($p > 0.05$)	(0.29)	(0.05)	($p < 0.05$)	(0.25)	(0.05)	($p > 0.05$)
ESP	U_{tot}	2.42	0.83	0.649	3.72	0.59	0.795	2.28	0.96	0.879
		(0.63)	(0.09)	($p < 0.05$)	(0.21)	(0.03)	($p < 0.05$)	(0.20)	(0.04)	($p < 0.05$)
	$V_{f\text{-}tot}$	2.44	−0.13	0.057	3.68	−0.35	0.656	2.45	−0.04	0.031
		(0.50)	(0.07)	($p > 0.05$)	(0.18)	(0.03)	($p < 0.05$)	(0.18)	(0.03)	($p > 0.05$)
TBM	U_{tot}	1.25	0.86	0.596	2.29	0.62	0.673	0.56	0.89	0.831
		(0.57)	(0.08)	($p < 0.05$)	(0.37)	(0.06)	($p < 0.05$)	(0.26)	(0.04)	($p < 0.05$)
	$V_{f\text{-}tot}$	1.44	−0.07	0.015	1.98	−0.20	0.483	0.99	−0.05	0.048
		(0.39)	(0.05)	($p > 0.05$)	(0.17)	(0.03)	($p < 0.05$)	(0.12)	(0.02)	($p < 0.05$)
CAN	U_{tot}	−1.15	1.15	0.733	1.53	0.73	0.702	0.09	1.01	0.854
		(0.69)	(0.09)	($p < 0.05$)	(0.34)	(0.05)	($p < 0.05$)	(0.28)	(0.04)	($p < 0.05$)
	$V_{f\text{-}tot}$	0.18	0.06	0.019	1.62	−0.15	0.320	0.86	−0.01	−0.009
		(0.35)	(0.04)	($p > 0.05$)	(0.16)	(0.02)	($p < 0.05$)	(0.15)	(0.02)	($p > 0.05$)