Water Quality Monitoring and Constituent Load Estimation in the Kings River near Berryville, Arkansas 2009

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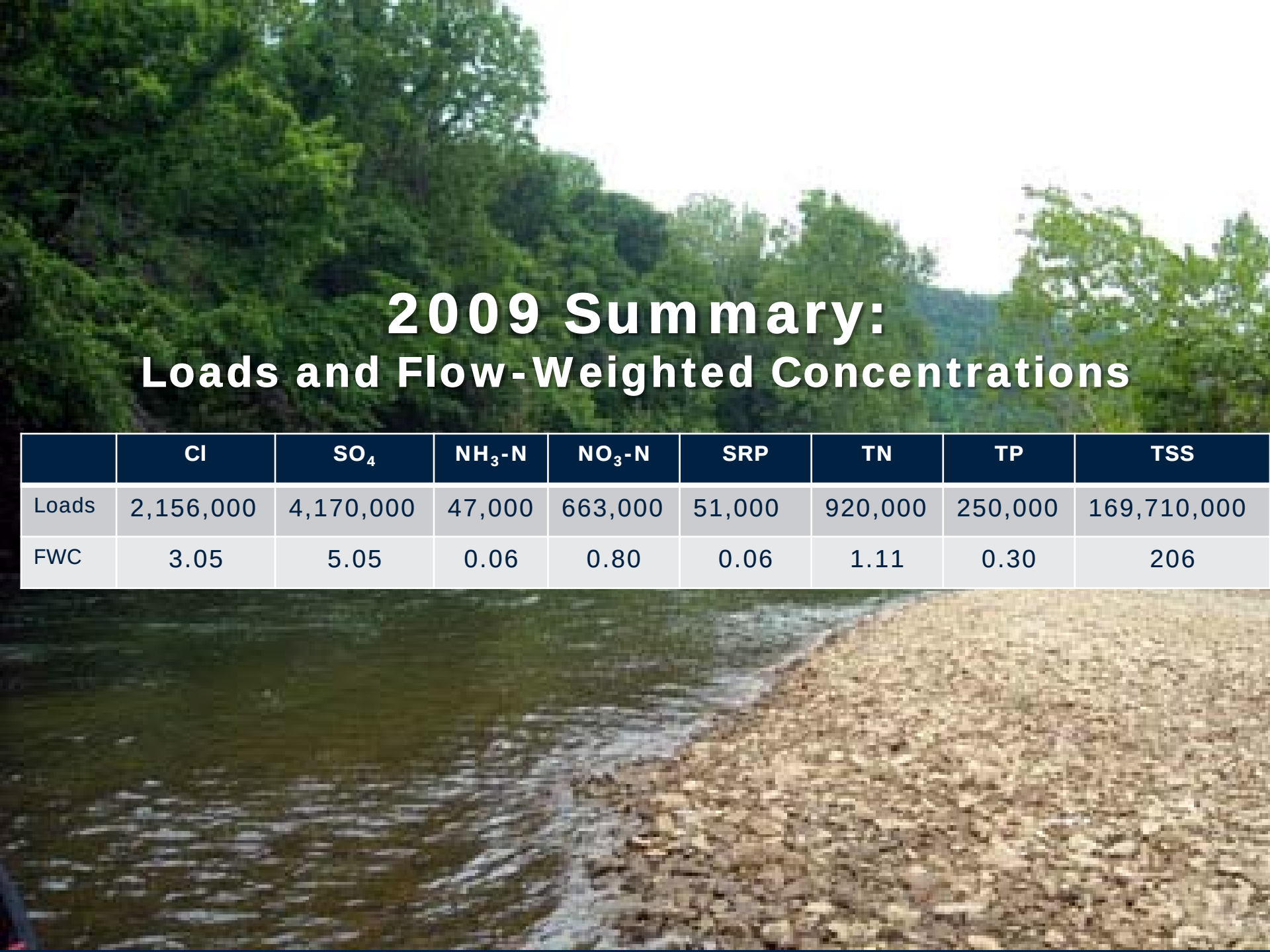
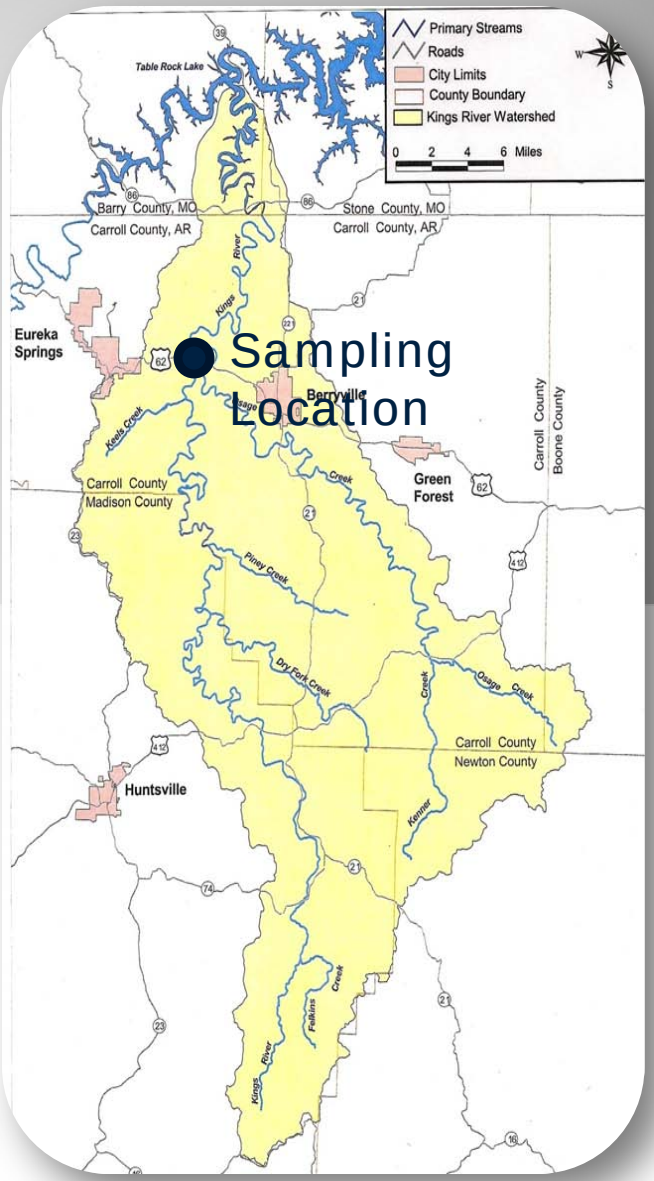


2009 Summary:
Loads and Flow-Weighted Concentrations

	Cl	SO_4	NH_3-N	NO_3-N	SRP	TN	TP	TSS
Loads	2,156,000	4,170,000	47,000	663,000	51,000	920,000	250,000	169,710,000
FWC	3.05	5.05	0.06	0.80	0.06	1.11	0.30	206

Water samples were collected at the Kings River near Berryville, Arkansas

- Stage was recorded in 30 min intervals by the USGS to estimate discharge
- Water samples were collected once a week and targeted storm events
- Water samples were analyzed for nitrate-N, ammonia-N, total N, total P, soluble reactive P, total suspended solids, sulfate and chloride



Load Determination & Mean Concentration

- Linear regression was used to determine the relationship between daily load, flow and seasonal factors:

$$\ln(L_d) = \beta_o + \beta_1 \ln(Q_d)$$

—or—

$$\ln(L_d) = \beta_o + \beta_1 \ln(Q_d) + \beta_2 \sin(2\pi T) + \beta_3 \cos(2\pi T)$$

- BCF was used to remove bias from log transformations:

$$BCF = \frac{\sum e^R}{n}$$

Some constituents exhibited seasonal effects…

Parameter	Regression Equation	Flow Regime	R^2	P
NO_3-N	$\ln(L_d) = -4.98 + 1.90 \ln(Q_d)$	Low	0.96	<0.001
	$\ln(L_d) = 1.44 + 0.90 \ln(Q_d)$	High	0.88	<0.001
SO_4	$\ln(L_d) = 3.29 + 0.90 \ln(Q_d)$	All	0.99	<0.001
Cl	$\ln(L_d) = 4.17 + 0.71 \ln(Q_d)$	All	0.97	<0.001
SRP	$\ln(L_d) = -1.77 + 0.89 \ln(Q_d) - 0.52\sin(2\pi T) - 0.99\cos(2\pi T)$	Low	0.42	<0.001
	$\ln(L_d) = -5.37 + 1.39 \ln(Q_d)$	High	0.73	0.004
TP	$\ln(L_d) = -0.80 + 0.79 \ln(Q_d) - 0.29\sin(2\pi T) - 0.83\cos(2\pi T)$	Low	0.60	<0.001
	$\ln(L_d) = -8.08 + 1.91 \ln(Q_d)$	High	0.84	<0.001
TN	$\ln(L_d) = -2.46 + 1.51 \ln(Q_d)$	Low	0.98	<0.001
	$\ln(L_d) = -5.37 + 1.39 \ln(Q_d)$	High	0.95	<0.001
NH_3-N	$\ln(L_d) = -4.98 + 1.34 \ln(Q_d) - 0.28\sin(2\pi T) - 0.79\cos(2\pi T)$	All	0.87	<0.001
TSS	$\ln(L_d) = 0.54 + 1.24 \ln(Q_d) - 0.32\sin(2\pi T) - 0.98\cos(2\pi T)$	Low	0.78	<0.001
	$\ln(L_d) = -6.92 + 2.49 \ln(Q_d)$	High	0.79	0.001

And, some constituents required hydrograph separation…

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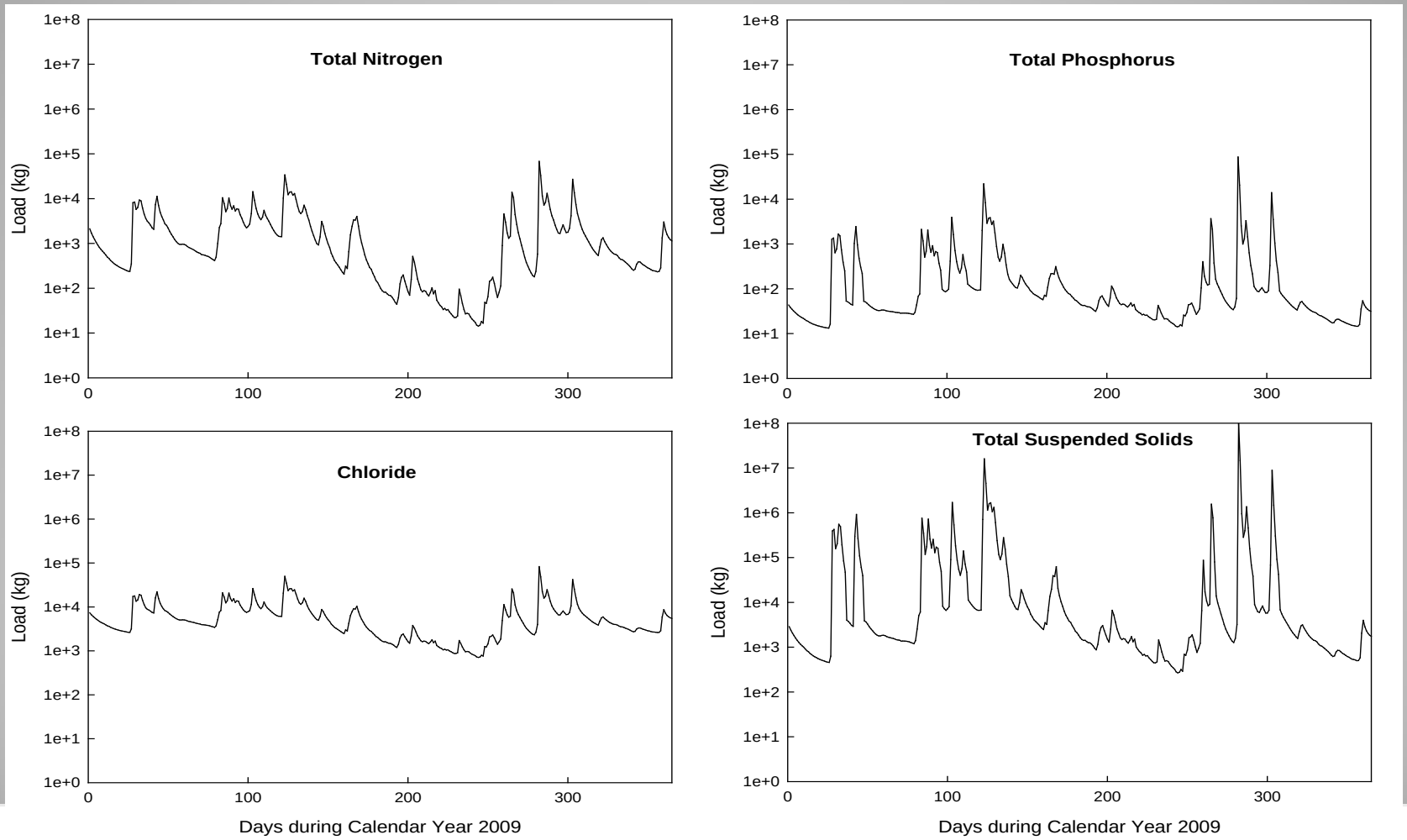
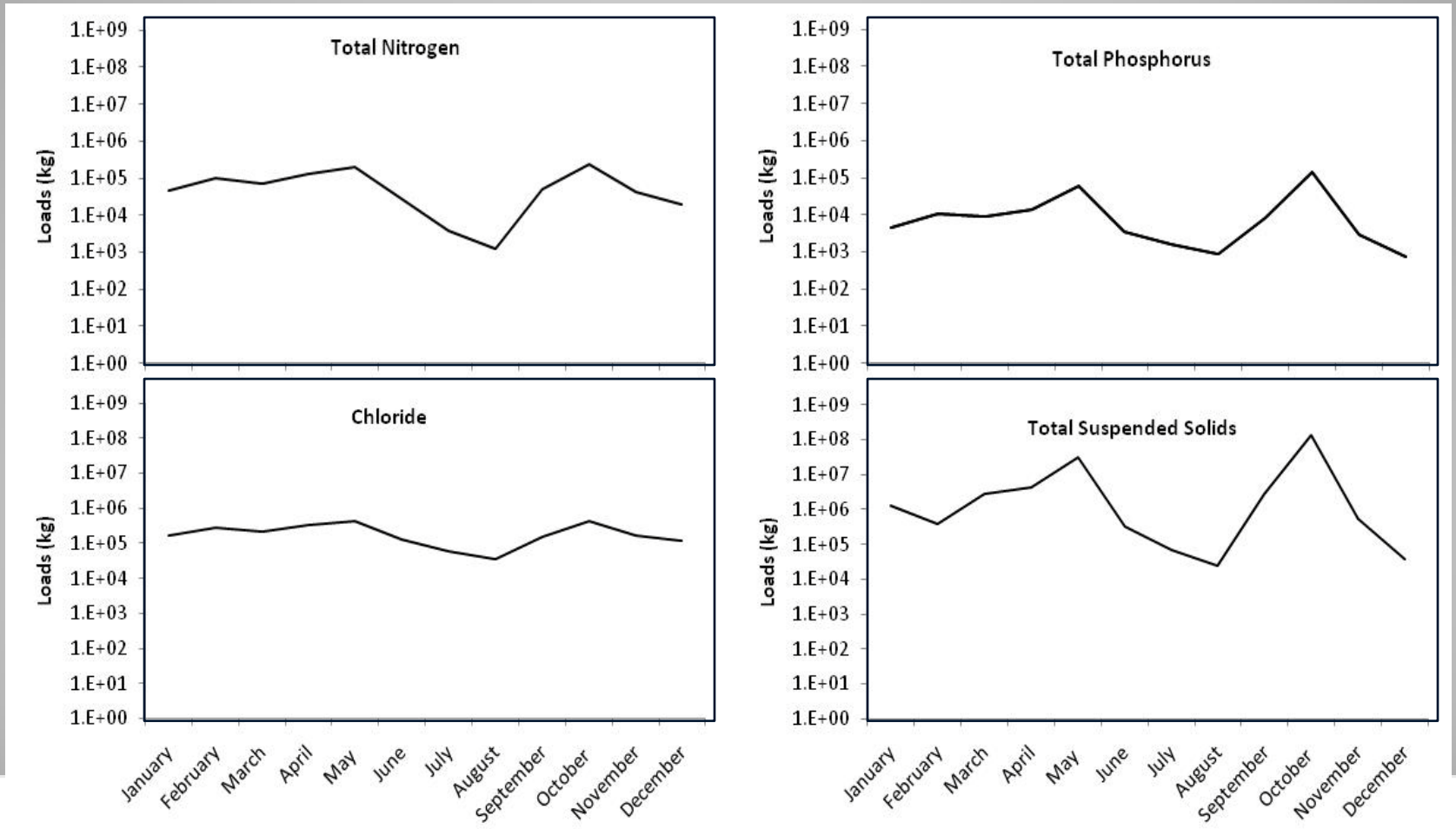
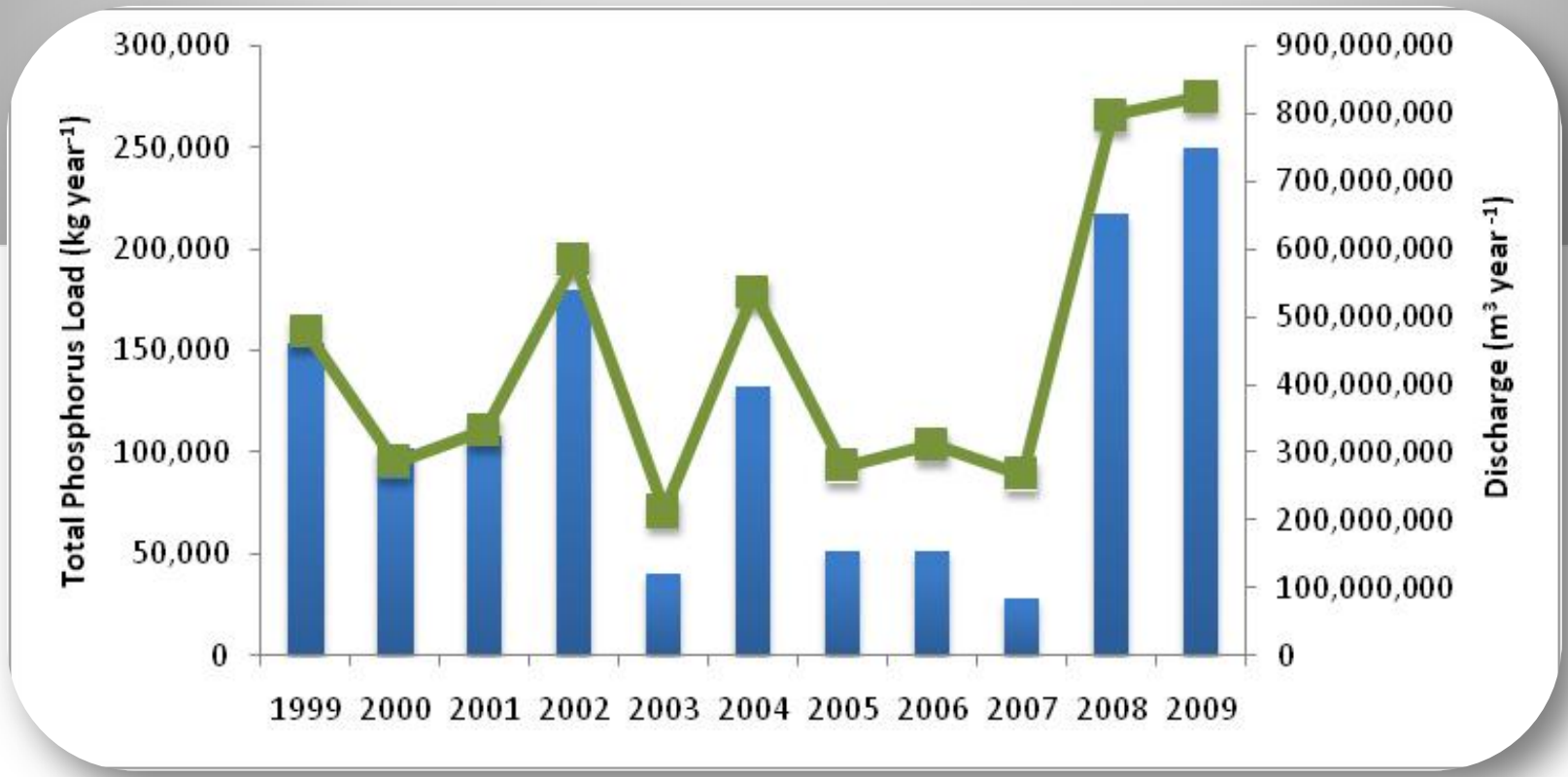
Daily Loads were variable…



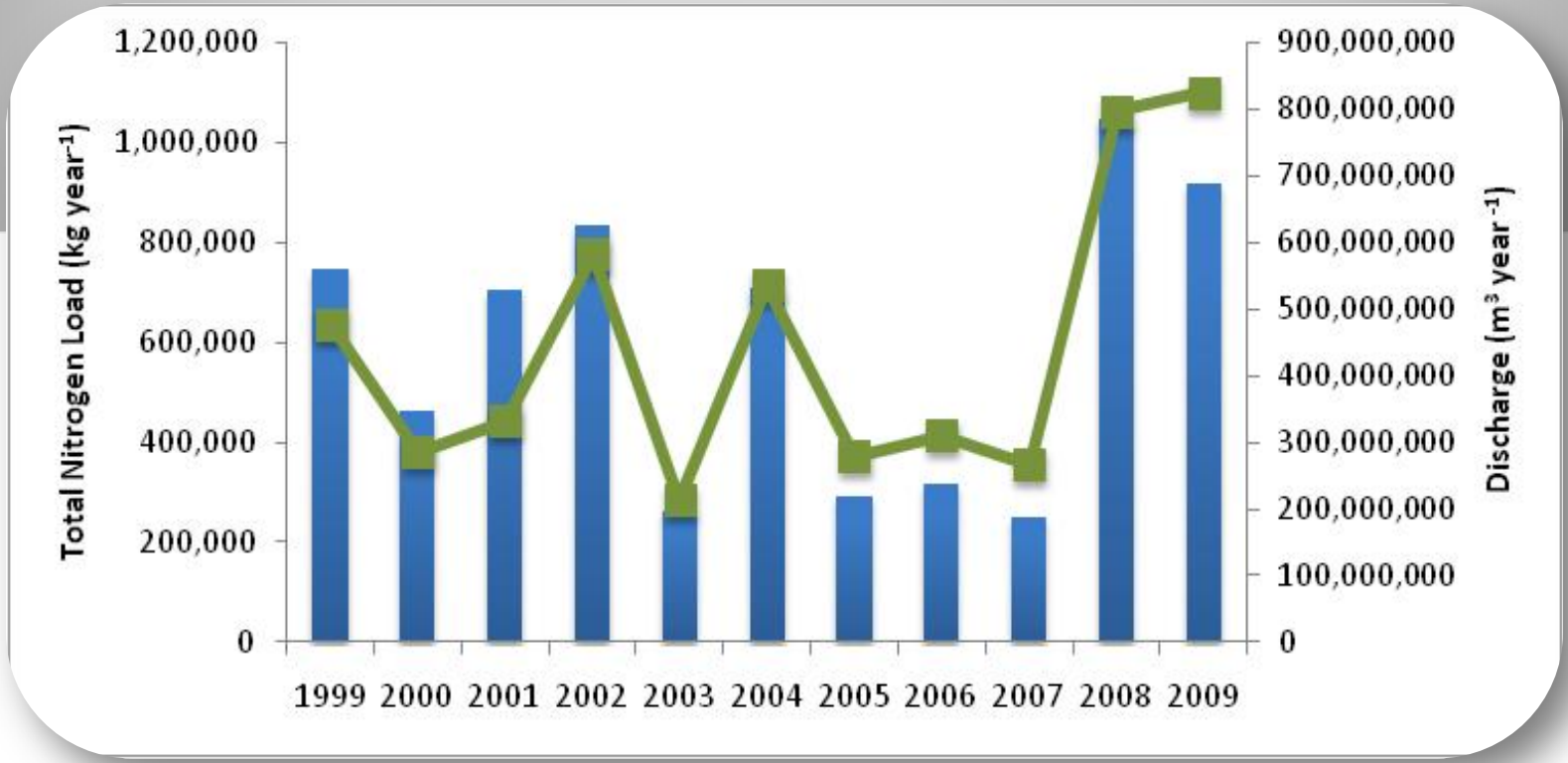
Monthly Loads were least during late summer…



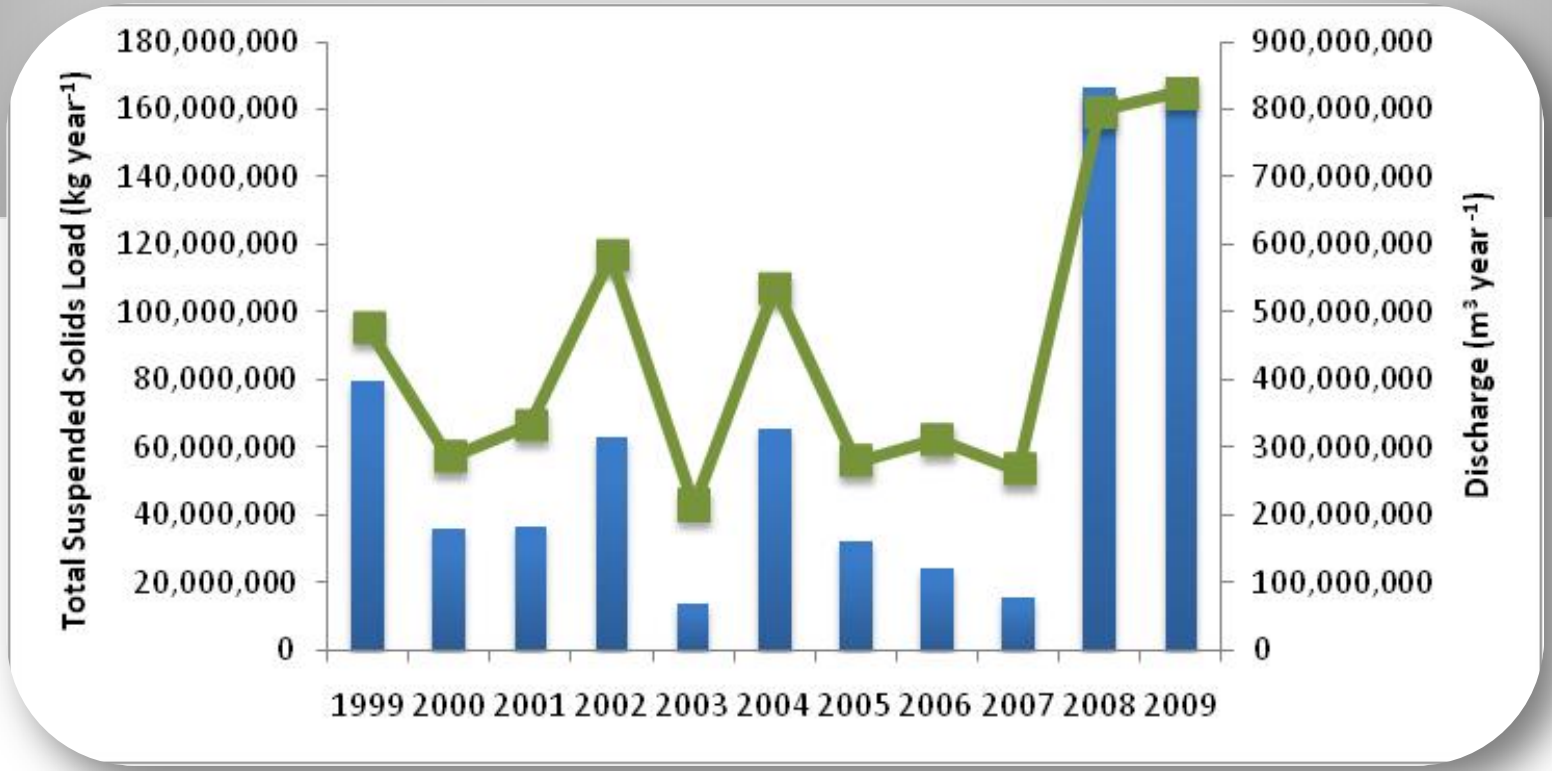
Phosphorus loads have been variable following the general trend in annual discharge.



Nitrogen loads in 2009 were less than that observed in 2008, even though discharge increased.



Total suspended solids loads in 2009 were similar to that observed in 2008.



The new monitoring program was successful at estimating loads at the Kings River.

- The regressions used to estimate loads considered seasonal effects, where appropriate
- And, this site also showed different relations between concentration and discharge at low and high flow