Assessing the performance of the Lake Okaro constructed wetland

Prepared for the Pastoral 21 consortium under contract to AgResearch Limited and for the Bay of Plenty Regional Council

November 2011

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NIWA Client Report No:	HAM2011-120
Report date:	November 2011
NIWA Project:	AGR11221

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Executive summary

The attenuation of contaminant loads by the Lake Okaro constructed wetland was assessed over three full calendar years (January 2008 – December 2010 inclusive). A range of modelling techniques was used to estimate the loads of contaminants entering and leaving the wetland. While these models generally provided complimentary information, care was necessary to ensure that the model predictions accurately replicated the observed flux. The LOADEST suite of models produced by the US Geological Survey reliably replicated total nitrogen, total phosphorus and suspended solids loads, but were less reliable for dissolved nutrients. In some cases it proved necessary to develop a series of composite regression models to accurately quantify nitrate-N, ammoniacal-N and *E. coli* loads.

The Lake Okaro wetland was constructed as one of a series of remedial actions identified in the Lake Okaro Action Plan. The action plan identified performance targets for the wetland in terms of loads of nitrogen and phosphorus that were to be retained within the wetland, thereby reducing the external load to the lake. The performance of the wetland is summarised below on an annual basis for the three years of assessment in terms of total nitrogen and total phosphorus:

Assessment of wetland performance - comparison of measured attenuation with Lake Okaro Action Plan target.

	Water quality variable							
	Total nitrogen				Total phosphorus			
Period	**Mass load to wetland (kg)**	**Mass removed by wetland (kg)**	**Proportion of target retained (%)**	**Proportion of catchment export load retained (%)**	**Mass load to wetland (kg)**	**Mass removed by wetland (kg)**	**Proportion of target retained (%)**	**Proportion of catchment export load retained (%)**
Target		348	-	-		16	-	-
2008	1444	597	171	41	504	302	1900	60
2009	876	146	42	17	251	56.8	355	23
2010	1250	149	42	12	249	30.5	190	12

For TN, wetland performance was exceptional in 2008, when more than 170% of the target mass was retained. Performance was more modest in 2009 and 2010, when 42% of the target was retained. The performance of the wetland is in part determined by the influent load – if the inflow load is large, the amount retained as proportion of the inflow appears large.

The wetland has consistently retained more TP than the target value. The performance of the wetland is in part determined by the influent load.

The proportion of target mass and catchment export mass retained within the wetland appears to have decreased over the assessment period. This apparent deterioration in performance is probably related to the smaller load of material exported from the catchment (because of the hydrological characteristics) and the impact of remedial actions undertaken in the upper catchment. The latter have probably reduced catchment exports (reducing the load entering the wetland), while wetland export has remained reasonably constant. The net effect is an apparent deterioration in performance.

The performance of the wetland is summarised in terms of annual attenuation of loads of a range of variables not identified in the Lake Okaro Action Plan below:

Assessment of wetland performance - measured attenuation of key forms of N and P.

Period	Water quality variable									
	Ammoniacal-N		Nitrate-N		Dissolved reactive phosphate		Suspended solids		*E. coli*	
	Mass (kg)	Prop. (%)[a]	Mass (kg)	Prop. (%)[a]	Mass (kg)	Prop. (%)[a]	Mass (t)	Prop. (%)[a]	(Log red.)	Prop. (%)[a]
2008	-4.7	-8	368.3	77	-12.8	-15	115.1	(87)	>1 log	92
2009	-39.2	-133	225	78	-6.8	-12	111.9	(88)	>1 log	96
2010	-28.9	-70	362.7	80	25.2	30	58.2	(71)	>1 log	89

Note:

[a] Prop. (%) is the proportion of inflow load retained by the wetland expressed as a percentage

The wetland is a net source of ammoniacal-N, but this is a relatively insignificant component of the nitrogen balance, and concentrations are generally low. The wetland retains a significant proportion of the inflowing nitrate-N load, following biogeochemical transformation involving denitrification. In two of the three years of assessment, the wetland was a net source of DRP, but in the third year it retained almost a third of the inflowing load.

Similar trends are evident for suspended solids loads as for TN and TP, with 71% to 88% removal rates. Variability in removal rates is largely related to the variability in inflow loads.

Attenuation of *E. coli* loads was reasonably constant (between 1 and 2 log units), and is influenced to some extent by the hydrological conditions.

In addition to reducing the mass of material leaving the wetland, biogeochemical transformations within the wetland considerably reduce the proportion of readily available nitrogen leaving the wetland. Up to about 40% of the nitrogen load entering the wetland is in soluble, bioavailable forms. This proportion is reduced to between 15% and 21% in the wetland outflow.

Evaluating wetland performance should take place over a sufficiently long period of time, allowing extreme conditions and events to be detected and placed in a longer-term context. The wetland is one of a series of restoration tools that have been applied in the Lake Okaro catchment. Determining the overall performance of the wetland requires consideration of the contributions of within catchment attenuation activities as well.

1 Introduction

One of the goals of the Bay of Plenty Regional Council is improving the quality of the Rotorua lakes, one of which is Lake Okaro. In 2008, Lake Okaro was described as hypertrophic, with the Trophic Level Index (TLI – a measure of the enrichment of a lake) value of about 5.3.

To improve the quality of water in the lake, an Action Plan was developed (EBOP et al. 2005). Four strategies for improving water quality were identified:

- application of a phosphorus absorbent cap to the lake bed
- construction of a wetland to reduce nutrient inputs from the two main tributaries to the lake
- establishment of riparian vegetation along streams draining into the lake, along with riparian fencing
- adoption of best management practices by landowners, including trial of a herd-home to reduce grazing induced nutrient losses during winter.

The last two activities would also contribute to flow attenuation, which would in turn enhance wetland performance. It was anticipated that the implementation of these strategies would reduce the TLI of Lake Okaro to at least five. Achieving this target would require meeting the **catchment** nutrient reduction targets summarised in Table 1-1 and the wetland nutrient reduction targets summarised in Table 1-2:

Table 1-1: Catchment nutrient reduction targets identified in the Lake Okaro Action Plan. From Table 3 of EBOP (2005).

Time period	Lake nutrient concentration (mg/m^3)		Input nutrient load (kg/year)	
	TN	TP	TN	TP
Current (2004/2005)	1281	123	-	-
Target	730	68	910	20
Per cent reduction	43	45	-	-

Table 1-2: Wetland nutrient reduction targets identified in the Lake Okaro Action Plan. From Table 1 of EBOP (2005).

Target nutrient input load (kg/year)	
TN	TP
350	16

The criteria for establishing a constructed wetland and the anticipated nutrient-removal performance was discussed by Tanner (2003) and summarised in Hudson et al. (2010). Predicted nutrient removal targets are summarised in Table 1-3:

Table 1-3: Predicted removal of nitrate-N by constructed wetlands. From Tanner (2003).

Season	Average stream flow	Average nitrate-N conc.	Average outflow nitrate-N conc.	Estimated seasonal nitrate-N removal	Annual wetland loading	Annual wetland removal	Annual nitrate-N removal
	(L/s)	(mg/m^3)		(%)	(kg)		(%)
Summer	34.5	390	190	58	430	190	45
Winter	34.5	390	240	46			

In January 2008, NIWA was engaged by Bay of Plenty Regional Council to:

- collect water samples from wetland inflows and the wetland outflow under a range of flow conditions
- submit these samples for laboratory analysis of soluble and particulate-bound nutrients
- calculate mass loads of nutrient species entering and leaving the wetland, as well as those bypassing the wetland complex
- determine the performance of the wetlands in terms of nutrient removal
- estimate the reduction in nutrient loading to Lake Okaro by the wetland complex.

From March 2009 the scope of assessment was extended with funding from Pastoral 21 through a sub-contract to AgResearch Limited to include assessment of suspended solids and faecal indicator loads, as well as turbidity.

The results for the period ending December 2008 and March 2010 were previously reported (Hudson et al. 2009, Hudson et al. 2010). This report summarises wetland performance for the period January 2008 – December 2011.

2 Materials and methods

The flow monitoring, sample collection and analytical methods were fully described and discussed previously (Hudson et al. 2010). The wetland complex was previously described in detail (Hudson et al. 2009, Hudson et al. 2010). We include a description of the inflows and outflows in Table 2-1, as well as a schematic of the wetland complex showing the location of sampling points in Figure 2-1.

The methods whereby nutrient loads were calculated were fully described and discussed previously (Hudson et al. 2010). In the current report, we followed similar techniques. Nutrient loads were calculated primarily using the LOADEST modelling suite (Runkel et al. 2004), while a series of regression techniques were used to check the estimates of nutrient loads. These included a "bootstrapping" regression technique, which incorporates log-transformation of variables and a "smearing" approach to correct for bias inherent in log-transformations[1].

While emphasis was given to the LOADEST model package for calculating loads, in all cases the load estimates were compared with the instantaneous flux value obtained as the product of measured concentration and flow at the time of sampling. Generally the LOADEST model estimates corresponded tolerably with the measured flux. In a few cases, however, the fit was poor. This was particularly true for the wetland outflow (nitrate-N and DRP) and the wetland inflows (ammoniacal-N). In the case of the wetland outflow, the LOADEST models tended to over-predict the load of nitrate-N to the extent that the wetland appeared to a net source of nitrate-N. In the cases of the inflows and the outflow, the LOADEST model was unable to provide reliable estimates of nitrate-N load for the summer period, where the flux decreased greatly relative to other times of the year.

To overcome these deficiencies, a number of different models were assessed. A reasonable fit between observed and modelled values could only be obtained by using a "composite" model, obtained by selecting a series of regression models that provided reasonable estimates for specific period during the hydrological year. This process is described more fully in Section 4.1.

Local and regional rainfall data were provided by BOPRC. The local data were collected within the wetland catchment ("Birchalls herd home"), while regional rainfall were assessed using data for the Whakarewarewa site (on the outskirts of Rotorua). BOPRC also maintained the flow recorders, providing the data as required.

[1] Dr Kit Rutherford, personal communication.

Table 2-1: Description of wetland inflows and outflows, along with associated monitoring equipment. (Refer to Figure 2-1 for location details).

Site	Description	Details	Equipment
A	Major tributary to lake	Single stream upstream of weir; Continuous flow measurement, automatic sampler, grab samples	
B	Primary inflow to wetland	Inflow via pipe; under low-flow conditions, entire flow enters wetland; Continuous flow measurement, automatic sampler, grab samples	Pipe has rated orifice of finite capacity (184 L/s). An ISCO automatic sampler collects water quality samples from pipe [representing A, B and C] at pre-set time or flow volume interval. A second automatic sampler was installed to collect unpreserved samples for microbiological analyses.
C	Bypass flow	Once water height reaches crest of weir, fraction of total flow begins to bypass wetland and enters lake directly; Continuous flow measurement, automatic sampler, grab samples	Sharp-crested rectangular weir; pressure transducer (to measure water height); logger continuously records water level, stores 15 min average value.
D	Second inflow to wetland	Perennial stream; entire flow enters wetland at all times; Continuous flow measurement, automatic sampler, grab samples	Rated section (flume) with sharp crested weir; pressure transducer (to measure water height): logger continuously records water level, stores 15 min average value; ISCO automatic sampler collects water quality samples. A second automatic sampler was installed to collect unpreserved samples for microbiological analyses.
E	Intermittent inflow	Minor inflow to wetland; grab samples	None; manual water quality samples collected during rainfall events
F	Outflow from upper wetland	Grab samples	None; infrequent manual water quality samples collected during routine sampling.
G	Outflow from wetland complex	Continuous flow measurement, automatic sampler, grab samples	Sharp-crested rectangular weir; pressure transducer (to measure water height): logger continuously records water level, stores 15 min average value; ISCO automatic sampler collects water quality samples. A second automatic sampler was installed to collect unpreserved samples for microbiological analyses.
H	Inflow to lake	Not measured	None – not sampled

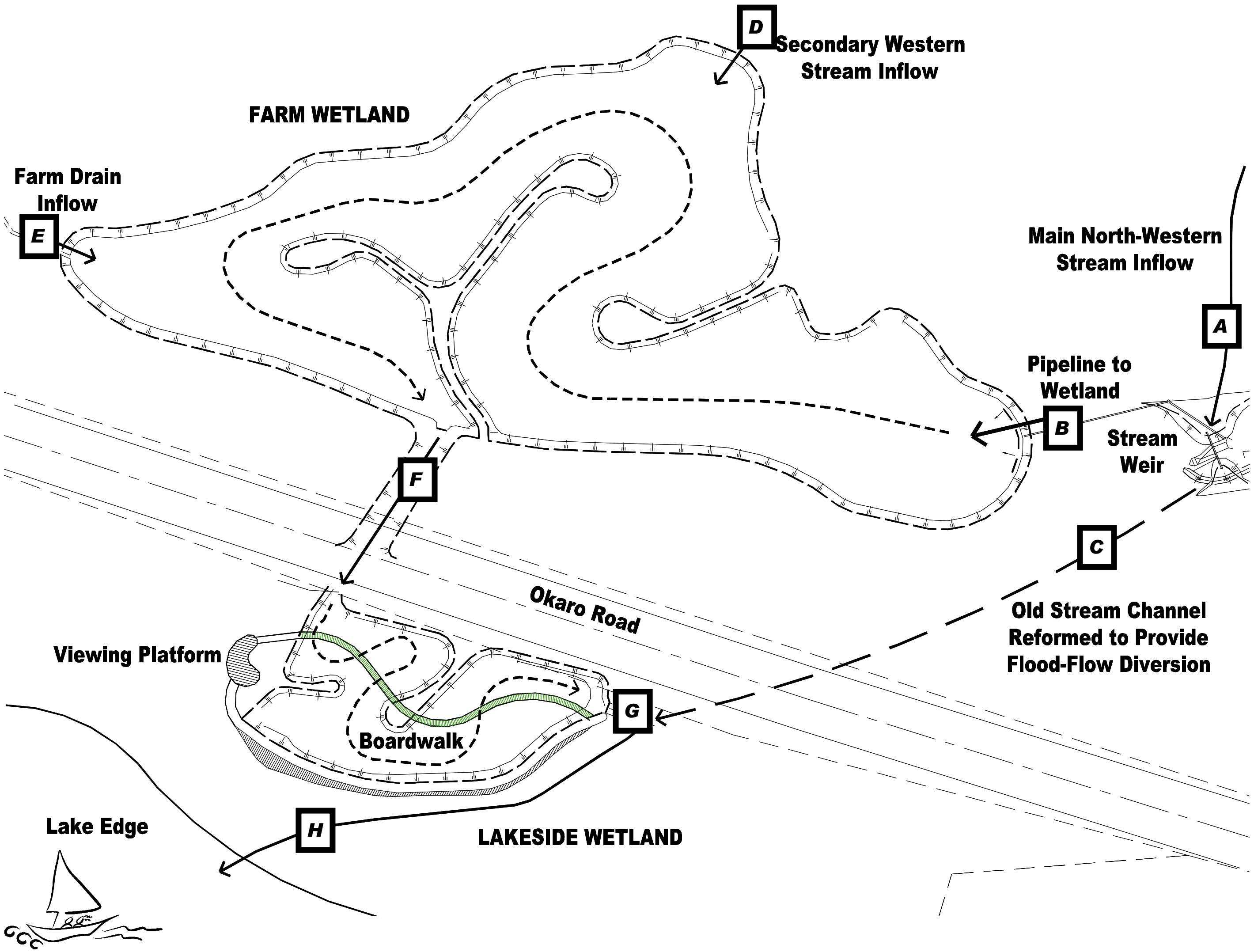

Figure 2-1: Schematic of constructed wetland, identifying inflows, the outflow and the bypass flow. (Refer to Table 2-1 for details).

3 Hydrological characteristics and water balance

Long-term regional monthly rainfall characteristics are compared with rainfall received in the wetland catchment over the three-year period of assessment in Figure 3-1.

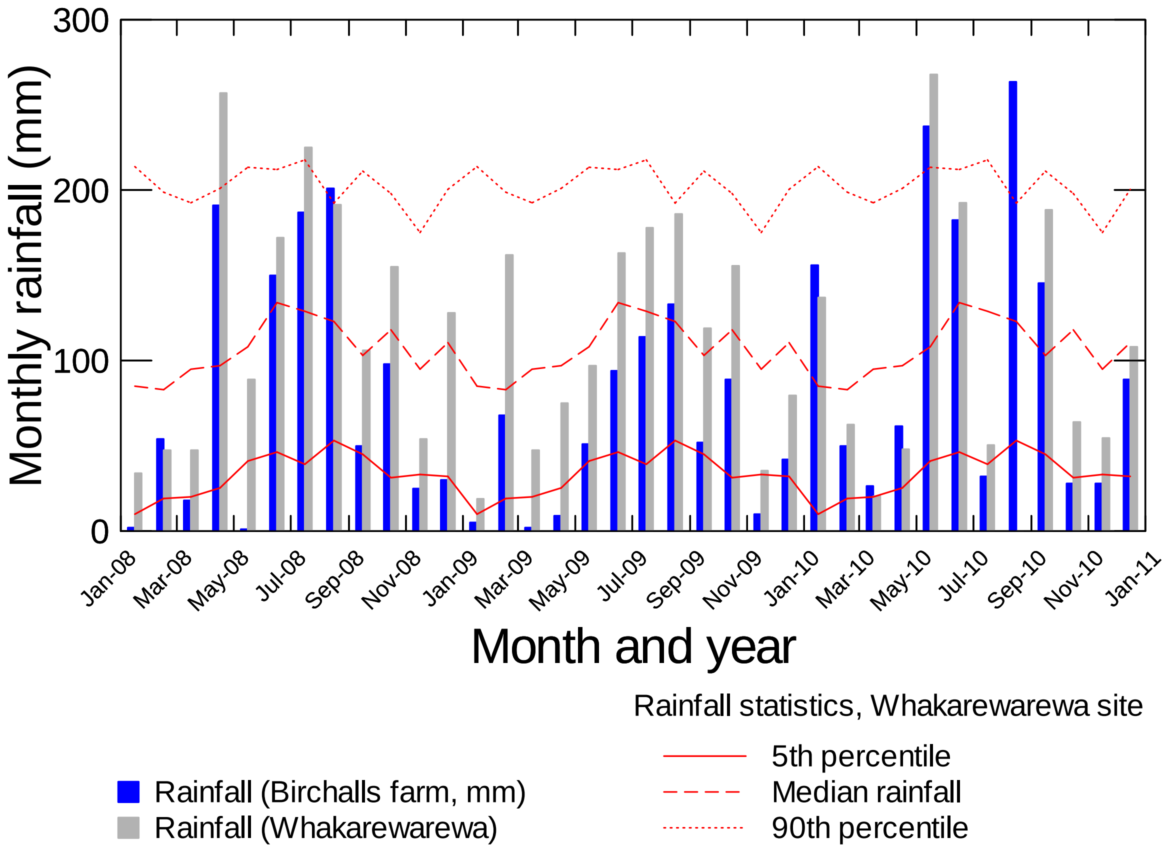

Figure 3-1: Comparison of total monthly rainfall values recorded during the study period with long-term regional rainfall characteristics.

In our previous report we drew attention to the atypical rainfall pattern that occurred in 2008. Figure 3-1 indicates that rainfall during 2010 was also largely atypical, with rainfall generally well above or below average. Particular points to note:

During 2008:

- extremes of wet and dry occurred
- rainfall about equal to the long-term 95th percentile received in three of twelve months
- rainfall about equal to the 5th percentile received in six of twelve months
- about median rainfall was recorded in three of twelve months.

During 2009:

- conditions were generally drier than in 2008

- during seven months, rainfall was about equal to or less than the 5th percentile
- during five months, rainfall was about equal to the median value.

During 2010:

- rainfall was similar to 2008:
  - well-above average rainfall was recorded during a three month period in winter/early spring
  - about or slightly more than median rainfall was recorded during six moths
- during 2010, rainfall recorded in January and December was significantly greater than during these months in the two preceding years.

Generally, extremes of rainfall occurred throughout the three-year assessment period, with generally well below or well-above rainfall occurring. Summers were generally very dry. These conditions occurred throughout the Waikato region, leading to Waikato being proclaimed a drought-affected region during 2007/2008 and 2008/2009.

3.1 Wetland inflow and outflow characteristics

The flow measuring structures were constructed and instrumented during 2007. As flow monitoring has continued, additional gaugings have been conducted, refining the water height-flow relationships over the assessment period. These changes have had the most significant impact of the flows measured at the major wetland inflow (the pipe inflow, B). This pipe has an orifice plate, which restricts the capacity of the pipe. In the first report, the capacity of the pipe inflow was reported as 380 L/s (Hudson et al. 2009). For the second report, this value was revised down to 184 L/s (Hudson et al. 2010).

While the actual volumes of water entering or bypassing the wetland will not have altered, the relative magnitudes of flows have altered slightly. As a consequence, the magnitude of loads of various contaminants calculated from these values will alter. As a result, the numeric values summarised in this report may be different to those previously presented. Generally however, tolerably similar results were obtained.

The time series for discharge measured at the five points associated with wetland inflows and outflow are summarised for the period January 2008 – December 2010 in Figure 3-2 and Figure 3-3. Summary statistics for these data are presented in Table 3-1. Annual summary statistics are provided in Appendix A. The relationship between combined inflows and wetland outflow volumes are shown in Figure 3-4.

Bypass flow occurred during 436 of 26304 hours during which flows were measured between January 2008 and December 2010, about 1.6% of the time. During the remaining 98.4% of the time, the entire flow in the major inflow stream entered the wetland. When considered on an annual basis, the number of bypass occurrences corresponded with rainfall characteristics. Bypass flows occurred during 186, 60 and 167 hours (2.1%, 0.6% and 1.9%) during 2008, 2009 and 2010 respectively. The entire flow from the minor inflow entered the wetland at all times.

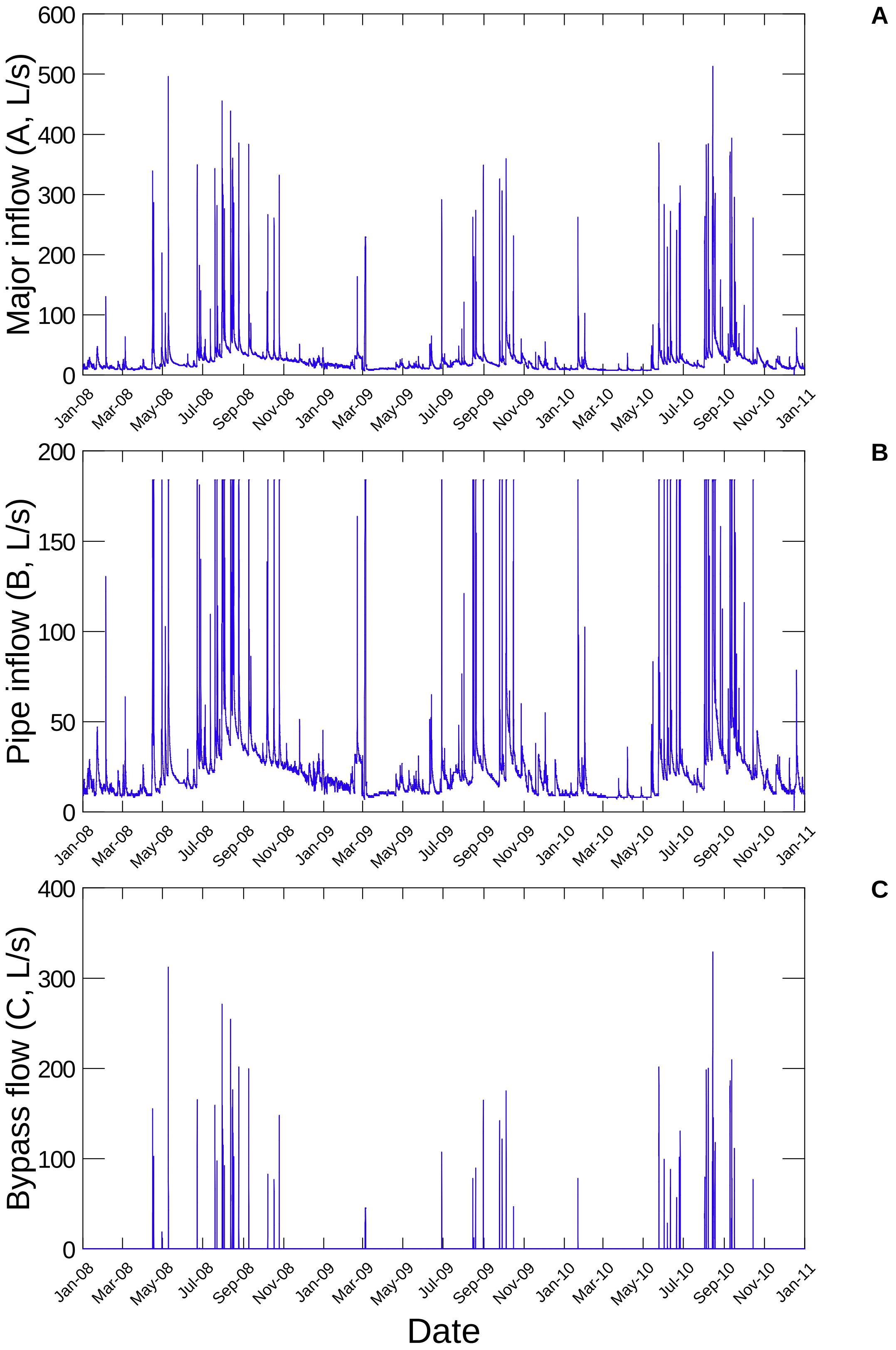

Figure 3-2: Relationship between total flow in major stream flow from catchment (A), wetland pipe inflow (B) and bypass flow (C). Note upper limit to pipe inflow (184 L/s).

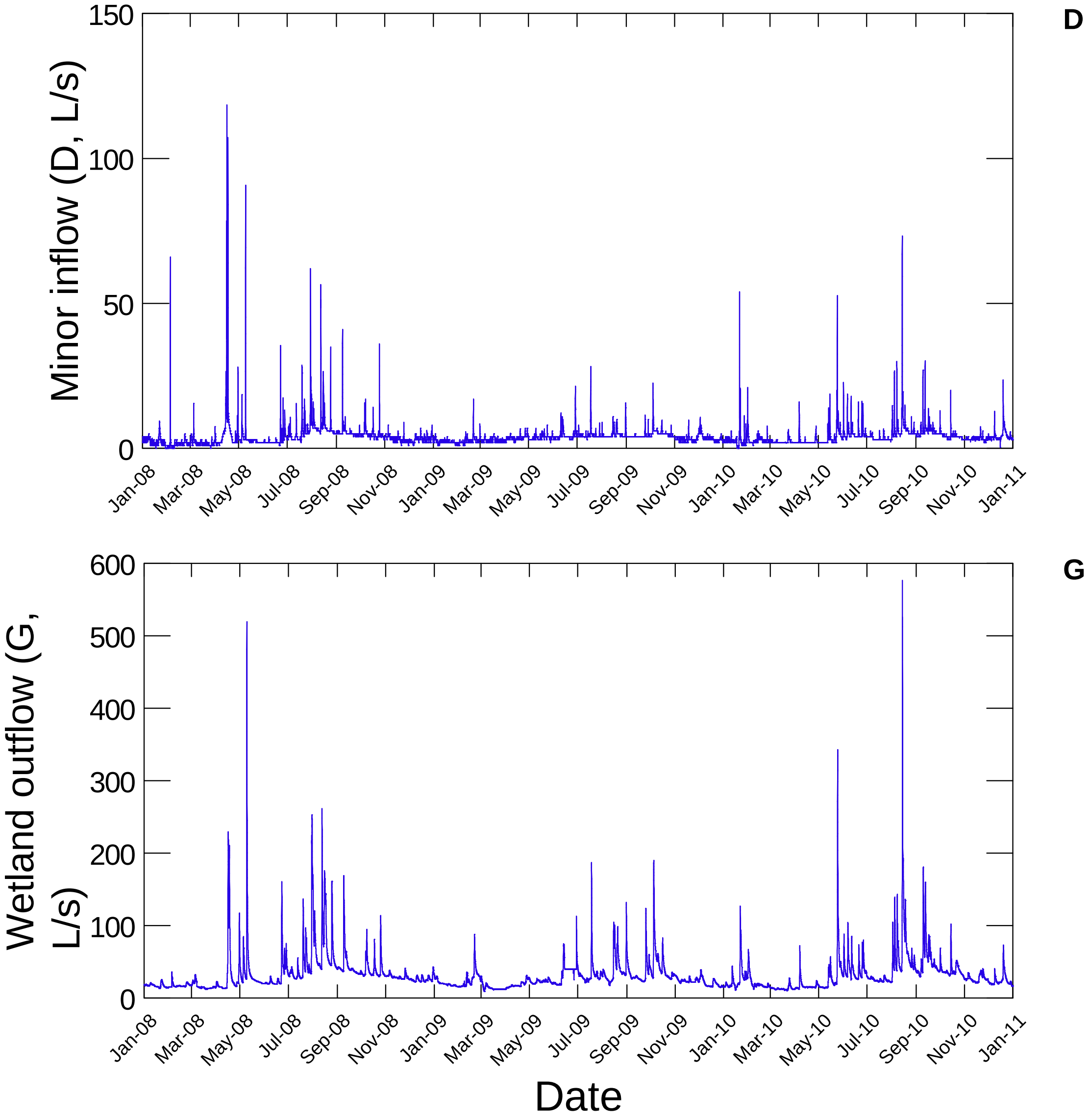

Figure 3-3: Flow in minor inflow stream (D) and wetland outflow (G).

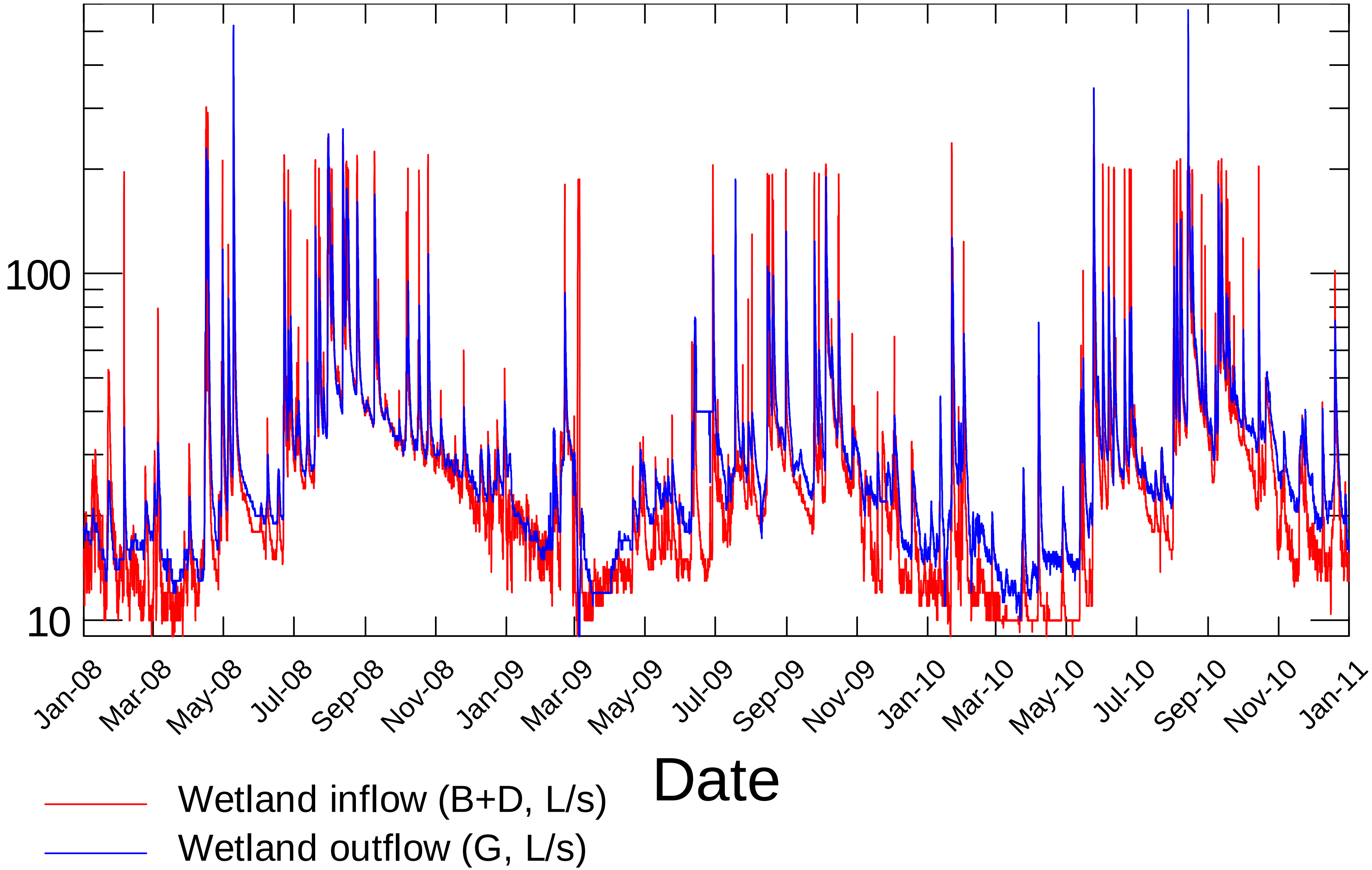

Figure 3-4: Relationship between measured wetland inflow and outflow. Note y-axis has $\log_{10}$ scale.

Table 3-1: Summary statistics for wetland inflows, bypass flows and wetland outflow, January 2008 - December 2010 inclusive. Data summarised as hourly average values.

Statistics	Flow characteristic at measurement point (L/s)				
	Major stream (A)	Pipe inflow (B)	Bypass flow (C)	Minor inflow (D)	Wetland outflow (G)
N of results	26304	26304	436	26304	26304
Minimum	1	1	0.2	0	9
Maximum	513	184	329	118.5	915.5
Median	17.5	17.5	70.6	4	25.8
Mean	25.3	24	79.7	4.1	31.8
SE of mean	0.2	0.2	2.9	0	0.2
Standard deviation	35.2	25.5	60.4	3.6	26.8
Coefficient of variation	1.4	1.1	0.8	0.9	0.8
Percentiles					
1%	8	8	0.7	1	12
5%	8	8	4.1	2	13
10%	9	9	9.6	2	15
20%	10.2	10.2	24.6	2	17
25%	11	11	31.1	2.2	18
30%	12.2	12.2	40.8	3	19.8
40%	15	15	52.4	3	22.5
50%	17.5	17.5	70.6	4	25.8
60%	21	21	85.8	4	28.5
70%	24	24	103.2	4	33
75%	27	27	117.1	5	35.8
80%	29	29	128.6	5	38.8
90%	38.5	38.5	164.7	6	51
95%	52.2	52.2	196	7.5	72.5
99%	234.7	184	256.8	17	147.5

3.2 Assessment of wetland hydrological balance

As noted in Section 3.1, there are differences in measured flow values previously reported (Hudson et al. 2010) and the values observed and summarised in this report. The differences relate to refinement of flow measurement, principally as a consequence of on-going gauging at the various measurement points. These differences necessitated re-calculation of the hydrological balances of the wetland. The revised hydrological balance is summarised in Table 3-2. Overall the hydrological balance is not altered significantly following revision of the flow data, with values in the current report in general differing from those previously reported by less than five per cent.

During drier periods, groundwater becomes an increasingly significant component of the wetland outflow, comprising an estimated 3% to 17% of nominal inflow. At present, the mass load for material introduced to the wetland through groundwater is unknown. While the implications regarding the performance of the wetland in terms of nutrient removal or attenuation are unknown, contributions from groundwater constitute an area of error in the material mass balance.

The estimates of bypass flow (C) as a proportion of the total flow in the major inflow stream (A) are also very similar to those reported previously (Table 3-3).

Table 3-2: Annual hydrological balance for the constructed wetland.

Measurement point		Annual discharge (L x 10^6)		
		2008	2009	2010
Major stream	A	965.3	651.9	777.5
Pipe inflow to wetland	B	908.4	635.0	726.3
Minor stream inflow to wetland	D	132.7	120.7	130.2
Measured precipitation	P	23.1	15.4	29.9
Measured inflows	B+D+P	1064.3	771.2	886.4
Estimated evapotranspiration	E	18.4	18.4	18.4
Net precipitation	NP	4.7	-3.0	11.5
Measured wetland outflow (including net precipitation)	G	1101.3	878.02	1034.1
Additional outflow above inflow plus net precipitation	G-(B+D+P)	37.0	106.9	147.7
Difference between measured inflow and measured outflow as a percentage of inflow (%)	G-(B+D+P)/ (B+D+P)	3%	14%	17%

Table 3-3: Comparison of pipe inflow (B) and bypass flow (C) as proportion of total flow of major inflow stream (A).

Measurement point		Annual discharge (L x 10^6)		
		2008	2009	2010
Major inflow stream	A	965.3	651.9	777.5
Pipe inflow	B	908.4	635.0	726.3
Bypass flow	C	57.0	16.9	51.2
Bypass flow as a percentage of total flow in major inflow stream (%)	(A-C)/A	6%	3%	7%

4 Assessment of Lake Okaro wetland performance

The processes and data manipulation required to estimate loads of materials entering and leaving the wetland complex were described fully in the previous report (Hudson et al. 2010). The largest difference to previously reported activities relate to the variables included in the monitoring programme. Previously we focussed on concentrations of a range of nutrients, suspended solids and microbiological variables. During 2010 however, the monitoring programme focused on suspended solids and *E. coli* concentrations. Relatively few samples were analysed for nutrients. Samples analysed for nutrients were primarily intended for an unrelated internal NIWA project, focussed on evaluating the performance of a continuous UV-visible spectrometer (McKergow et al. 2010). These nutrient concentration data have been included in the current report as well for completeness.

In the previous report we demonstrated that the load estimates provided by either the bootstrapping regression method or the LOADEST modelling suite were generally interchangeable. We have not repeated this comparison including the 2010 data. In the summary tables that follow however, we have provided results for the three modelling techniques where results varied widely.

For selected variables (particularly nitrate-N in the wetland outflow), predicted loads vary from the previous estimates. Following careful checking and recalculation, the differences between previously and currently reported results can be explained primarily as artefacts of the various modelling procedures used. For a number of variables (specifically ammoniacal-N, nitrate-N and DRP, it was necessary to investigate alternative modelling techniques as well. This requirement was identified following comparison of measured and predicted flux estimates derived from the previously-used modelling techniques. It was apparent that none of the models previously used provided reasonable estimates of flux values for these variables under summer, low-flow conditions. This was particularly noticeable for the wetland outflow.

4.1 Estimation of stream contaminant loads

Previously we described the process whereby relatively infrequent measurements of contaminant concentrations are combined with continuously measured stream flow volumes to estimate contaminant flux (instantaneous loads) (Hudson et al. 2010).

Regression techniques generally provide tolerable estimates using relationships of the form:

$$Flux = aQ^b$$ **Equation 4-1:**

where Q is measured stream flow and a and b are regression coefficients. This is a relatively simple “rating table” approach. A plot of log (Flux) against log (Q) should provide a reasonably straight line. More sophisticated methods such as the LOADEST suite of models recognise factors such as seasonality to some extent. During calculation of monthly and annual loads of selected variables, we noted that the wetland appeared to have become a net source of contaminants – this was particularly true for soluble variables, such as ammoniacal-N and nitrate-N. In the case of nitrate-N, the outflow from the wetland appeared to contain considerably more material than the inflow, and in fact the outflow load of Total-N appeared to be almost entirely composed of nitrate-N, which is highly unlikely. The relationship between ammoniacal-N, nitrate-N and total-N flux and wetland outflow is shown in Figure 4-1. There is a very strong, “simple” positive relationship between flow and TN flux – the relationship between ammoniacal-N and nitrate-N flux and flow is obviously more complicated. These relationships are shown on a monthly basis for these three variables in Appendix B. It is clear that for nitrate-N in particular, it is inappropriate to apply a single flux-flow relationship to the entire data set.

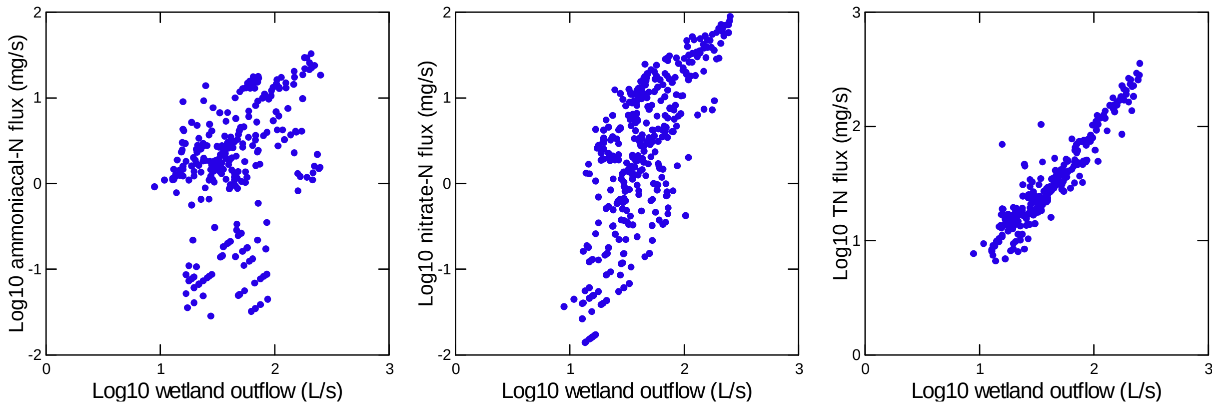

Figure 4-1: Relationship between contaminant flux and wetland outflow. Data excluded where the concentrations were reported as below limit of detection. Data for period January 2008 – December 2010 inclusive.

The consequences of this seasonal variation in flux is evident in Figure 4-2, where the output from two LOADEST model options and a number of other simpler regression models are plotted together with the measured instantaneous flux. This figure indicates that the models predict flux reasonably well except during the summer period. The bootstrapping modification to a regression approach did not overcome the problem either.

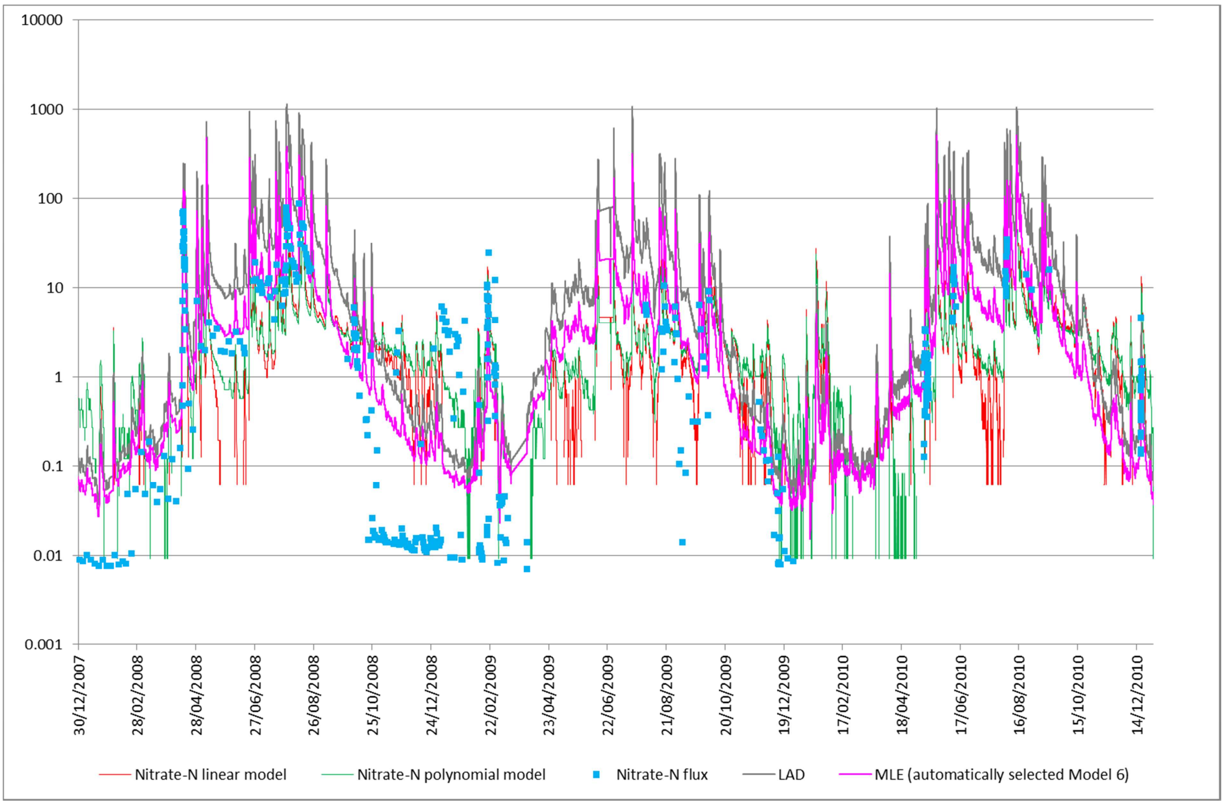

Figure 4-2: Relationship between observed and predicted contaminant flux and wetland outflow using LOADEST and regression models. "LAD" and "MLE" are LOADEST model predictions and "Nitrate-N flux" are observed values. LOADEST and "Nitrate-N" linear and polynomial models based on hourly time-series data. Data excluded where the concentrations were reported as below limit of detection. Data for period January 2008 – December 2010 inclusive.

It was possible to improve the fit between observed and modelled flux values by identifying and applying a more appropriate regression equation to the flow data on a seasonal basis. In the case of nitrate-N, this was done by identifying a better model fit following examination of the relationship between flux and flow on a monthly basis. The results of a model developed in this manner are shown in Figure 4-3. While the model fit is not perfect, it represents a significant improvement on any of the other models trialled. The composite model shown in Figure 4-3 is actually a series of regression models, selected on a monthly basis for the entire assessment period. The selection of a specific model for each month was based on the highest squared correlation coefficient (R^2) value provided, along with visual consideration of "best-fit" to the data.

Use of this series of models applied at monthly interval provided two major benefits:

- the models better represented the observed data throughout the year, reducing the large over-estimation of flux (generally reducing the estimate of nitrate-N exported from the wetland)
- the model provided more realistic estimates of the nitrate-N flux during the summer period, better reflecting the de-nitrification occurring within the wetland during this period.

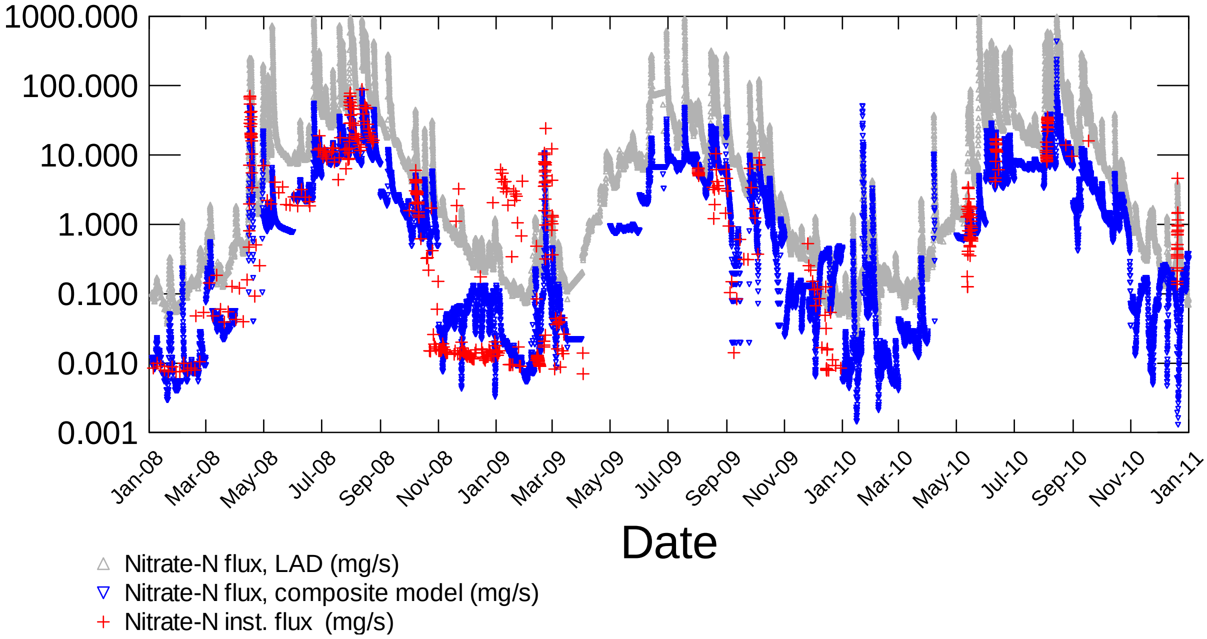

Figure 4-3: Relationship between observed and predicted contaminant flux and wetland outflow using an improved, composite model selected and applied at monthly time-step. "LAD" and "Nitrate-N flux" are the same data shown in Figure 4-2, while "composite model" is the flux predicted by a series of monthly models. Data for period January 2008 – December 2010 inclusive.

The requirement for "monthly fitted models" was assessed by comparing the observed and predicted nutrient flux on a site-by-site and variable-by-variable basis. Where necessary, the choice of model was altered from the default LOADEST LAD model in order to obtain an improved fit between observed and predicted flux.

As noted earlier, relatively few nutrient concentration data were collected during 2010. The limited data that were collected were derived from a series of samples collected over a relatively short period of time to investigate the performance of a field spectrometer (McKergow et al. 2010). These data were limited to a series of event samples collected during winter 2010, principally for nitrate-N.

4.2 Mass balances for the Lake Okaro wetland complex – nutrients, suspended solids and faecal indicators

As noted in our earlier report, it is important to consider the mass of material entering and leaving the wetland as well as the percentage removal values. In some case and at specific times poor performance is indicated (large percentage release from the wetland), whereas the mass of material involved is relatively trivial.

Initially we summarise wetland performance on an annual basis in Table 4 1 through Table 4-7. These data are also summarised graphically as a monthly time-series in Figure E-1 through Figure E-7. These figures allow the timing and relative magnitude of estimates of material in the inflows and outflow to be compared. These figures also provide monthly estimates for two independent modelling techniques, allowing comparison. The attenuation of the wetland indicated by the two techniques at monthly time step is also included.

Other relevant material is included as well:

- the fit between observed and modelled flux estimates (derived from a number of models) are included for each site and variable in Appendix D
- annual estimates derived from the LOADEST LAD and regression model techniques are included in Appendix E
- the output from the LOADEST AMLE method is included for each variable and site in Appendix G. This output includes an estimate of the uncertainty associated with the estimate made over the various periods of assessment (the entire three-year period, each season and each month).

In Table 4-1 through Table 4-6, the estimate provided by the LOADEST LAD model is included where most appropriate. In some cases it was necessary to include estimates derived from other models, because the estimates provided by the LOADEST package inadequately represented the data. Table 4-7 summarises the mass balance for *E. coli* at annual scale. These values were derived from a regression model.

Table 4-1: Efficacy of ammoniacal-N retention by the Lake Okaro wetland. LOADEST LAD technique used to estimate all loads with exception of outflow (G) load for 2010, for which a regression technique was used [a]. Negative values indicate that the wetland was a net source of material.

Assessment point	Ammoniacal-N load balance by year (kg)		
	2008	2009	2010
A load (kg)	56.3	25.6	38.9
B load (kg)	52.7	25.2	36.1
C load (kg)	3.7	0.5	2.8
D load (kg)	6.8	4.3	4.9
Wetland inflow load (B+D) (kg)	59.4	29.4	41.1
Outflow load (G) (kg)	64.1	68.6	70 [a]
Load retained by wetland (kg)	-4.7	-39.2	-28.9
Reduction of inflow load by wetland (%)	-8%	-133%	-70

Table 4-2: Efficacy of nitrate-N retention by the Lake Okaro wetland. LOADEST LAD technique used to estimate inflow loads (A, B, C and D). Outflow (G) loads estimated using a series of monthly regression models. Negative values indicate that the wetland was a net source of material.

Assessment point	Nitrate-N load balance by year (kg)		
	2008	2009	2010
A load (kg)	398.2	192.2	330.3
B load (kg)	368.2	186.6	302.6
C load (kg)	30	5.6	27.7
D load (kg)	110.6	101	153.4
Wetland inflow load (B+D) (kg)	478.8	287.6	456.1
Outflow load (G) (kg)	110.5 [a]	62.6 [a]	93.4 [a]
Load retained by wetland (kg)	368.3	225	362.7
Reduction of inflow load by wetland (%)	77%	78%	80%

Table 4-3: Efficacy of Total-N retention by the Lake Okaro wetland. LOADEST LAD technique used to estimate loads. Negative values indicate that the wetland was a net source of material.

Assessment point	TN load balance by year (kg)		
	2008	2009	2010
A load (kg)	1430.9	781.3	1014.6
B load (kg)	1326.9	760.2	927.9
C load (kg)	103.9	21	86.7
D load (kg)	116.8	115.5	322.1
Wetland inflow load (B+D) (kg)	1443.7	875.7	1250
Outflow load (G) (kg)	846.6	729.5	1100.6
Load retained by wetland (kg)	597.1	146.2	149.4
Reduction of inflow load by wetland (%)	41%	17%	12%

Table 4-4: Efficacy of DRP retention by the Lake Okaro wetland. LOADEST LAD technique used to estimate loads. Negative values indicate that the wetland was a net source of material.

Assessment point	DRP load balance by year (kg)		
	2008	2009	2010
A load (kg)	83.7	51.6	86.1
B load (kg)	78.7	50.6	79.7
C load (kg)	5.1	1.1	6.4
D load (kg)	7	4.6	5.5
Wetland inflow load (B+D) (kg)	85.8	55.4	85.2
Outflow load (G) (kg)	98.6	62.2	60
Load retained by wetland (kg)	-12.8	-6.8	25.2
Reduction of inflow load by wetland (%)	-15%	-12%	30%

Table 4-5: Efficacy of TP retention by the Lake Okaro wetland. LOADEST LAD technique used to estimate loads for 2008 and 2009. 2010 loads estimated using regression technique [a]. Negative values indicate that the wetland was a net source of material.

Assessment point	Total P load balance by year (kg)		
	2008	2009	2010
A load (kg)	519	242.4	262 [a]
B load (kg)	484.3	235.6	233.9 [a]
C load (kg)	34.7	6.8	17.3 [a]
D load (kg)	20	15.5	15.7 [a]
Wetland inflow load (B+D) (kg)	504.4	251.3	249.5 [a]
Outflow load (G) (kg)	201.8	194.5	219 [a]
Load retained by wetland (kg)	302.6	56.8	30.5 [a]
Reduction of inflow load by wetland (%)	60%	23%	12%

Table 4-6: Efficacy of SS retention by the Lake Okaro wetland. LOADEST LAD technique used to estimate loads.

Assessment point	Suspended solids load balance by year (kg)		
	2008	2009	2010
A load (kg)	135885.8	124203.4	84434.8
B load (kg)	127759.4	120654.5	77994.4
C load (kg)	8126.4	3549	6440.4
D load (kg)	4255	5870.7	3637
Wetland inflow load (B+D) (kg)	132014.4	126525.3	81631.3
Outflow load (G) (kg)	16846.8	14574.2	23414.8
Load retained by wetland (kg)	115167.6	111951.1	58216.5
Reduction of inflow load by wetland (%)	87%	88%	71%

Table 4-7: Efficacy of *E. coli* retention by the Lake Okaro wetland. Regression technique used to estimate loads. N represents the number of *E. coli* entering, leaving or retained in the wetland.

Assessment point	*E. coli* load balance by year (N)		
	2008	2009	2010
A load (N)	7.24E+13	3.10E+13	5.96E+13
B load (N)	5.60E+13	2.708E+13	4.478E+13
C load (N)	9.61E+12	2.51E+12	8.65E+12
D load (N)	5.05E+12	2.24E+11	1.28E+12
Wetland inflow load (B+D) (N)	6.11E+13	2.73E+13	4.60E+13
Outflow load (G) (N)	4.67E+12	1.10E+12	5.19E+12
Load retained by wetland (N)	5.64E+13	2.62E+13	4.08E+13
Reduction of inflow load by wetland (%)	92%	96%	89%

Table 4-8: Proportion of nitrogen load at each assessment point. These values were derived from annual total loads from Table 4-1 - Table 4-3.

Assessment point	Period	Proportion of nitrogen load (%)		
		Ammoniacal-N	Nitrate-N	Other forms of N
A load	2008	4	28	68
	2009	3	25	72
	2010	4	33	64
B load	2008	4	28	68
	2009	3	25	72
	2010	4	33	63
C load	2008	4	29	68
	2009	2	27	71
	2010	3	32	65
D load	2008	6	95	-1
	2009	6	87	6
	2010	2	48	51
Wetland inflow load (B+D)	2008	4	33	63
	2009	3	33	64
	2010	3	36	60
Outflow load (G)	2008	8	13	79
	2009	9	9	82
	2010	6	8	85

Table 4-9: Performance of wetland over three-year period in terms of removal of various forms of nitrogen. Per cent removal values are calculated in terms of inflow load.

Assessment point	Mass of each nitrogen fraction measured in wetland inflow and outflow and per cent removal of inflow load							
	Ammoniacal-N		Nitrate-N		Other forms of N		Total-N	
	kg	%	kg	%	kg	%	kg	%
Wetland inflow load (B+D)	130		1222		2217		3569	
Outflow load (G)	203		266		2207		2677	
Load removed (B+D-G)	-73	-56	956	78	10	1	892	25

5 Discussion

5.1 Attenuation of nutrient loads

5.1.1 Ammoniacal-N

Table 4-8 indicates that ammoniacal-N is a consistently minor fraction of the inflow and outflow loads on nitrogen. Mineralisation within the wetland generally increases the proportion of ammoniacal-N in the outflow, but it is still less than 10% of the nitrogen load leaving the wetland.

There is generally good agreement between model estimates of the wetland inflow ammoniacal-N flux (Figure E-1, B and F, Appendix E). Wetland outflow flux estimates were grossly over-predicted by the LOADEST LAD model, particularly during the 2010 assessment period (Figure E-1 C, Appendix E). Selection of a composite regression model greatly improved the fit between observed and estimated flux, providing the wetland performance indicated in (Figure E-1 H, Appendix E). While the wetland is a net source of ammoniacal-N (e.g., Table 4-9), this represents an almost insignificant fraction of the nitrogen load entering the wetland.

5.1.2 Nitrate-N

The requirement to carefully identify and apply an appropriate model to estimate nitrate-N fluxes was discussed previously. The consequences of failing to apply an appropriate model are evident from Figure E-2 B and C (Appendix E). The LOADEST LAD model predicted very large nitrate-N loads in the wetland outflow, particularly during the winter. The magnitude of these loads was improbable for at least two reasons:

- the nitrate-N load predicted in the outflow was of a similar size (and occasionally larger) than that measured and predicted in the wetland inflow (compare Figure E-2 C to Figure E-2 B, Appendix E)
- for the outflow nitrate-N load to achieve this magnitude, almost quantitative nitrification would have to occur throughout the year – this is unlikely for two reasons:
  - nitrification is biologically mediated – it is almost certain that rates of transformation would be lower in winter than summer (owing to the impact of temperature on metabolic reaction rates)
  - the residence time of the predominantly organic, particulate-bound nitrogen load would be inadequate to allow the transformation of the inflow load to occur.

Careful examination of the nitrate-N flux predicted by the LOADEST LAD model and comparison with measurements made for the wetland indicated that the model generally over-predicts nitrate-N flux for the wetland outflow, especially during summer. While the reasons for this poor prediction are not clear at this time, Runkel et al. make the point that nutrient flux model formulation is highly dependent on the selection of explanatory variables, whereas for variables not as subject to biogeochemical influences (such as suspended sediments), a simple model with single explanatory variable (e.g., log stream flow) may suffice (Runkel et al. 2004).

Table 4-8 indicates that the nitrogen load in the wetland inflow is typically about one-third nitrate-N. The outflow nitrate-N load represents between 8% and 13% of the nitrogen load. These values indicate considerable biogeochemical transformation of the nitrogen load entering the wetland.

The composite monthly time-step model produced for nitrate-N indicated that the wetland generally retained nitrate-N (Figure E-2 G and H, Appendix E). Under high inflow conditions, the nitrate-N removal declined and the wetland became a temporary source of nitrate-N (winter conditions). During the spring-summer period, however, the wetland effectively removed the entire inflow load of nitrate-N, while nitrification of the organic nitrogen fraction was also indicated. Table 4-2 and Table 4-9 indicates that the wetland consistently removed about 80% of the influent nitrate-N load over the three-year assessment period, representing an overall reduction of about 950 kg of the nitrate-N load entering the wetland.

It is likely that an additional load of nitrate-N entered the wetland directly in groundwater inflows which annually accounted for 3% to 17% of the measured inflow.

5.1.3 Total nitrogen

Between 60% and 64% of the nitrogen load entering the wetland is in forms other than ammoniacal-N or nitrate-N (Table 4-8). This material is presumably organic and primarily particulate-bound. Table 4-8 also indicates that the inflow load is subject to biogeochemical transformation. As a consequence, between 79% and 85% of the nitrogen load in the wetland outflow is in “other forms” – biomass and other organic forms. The biological availability of these forms of nitrogen in the lake is unknown.

The wetland is subject to a variable TN load, determined mainly by the hydrological conditions. Between 2% and 7% of the total load of TN exported from the catchment enters Lake Okaro directly in the bypass load.

Table 4-3 indicates that the proportion of TN retained within the wetland has decreased over the three-year assessment period from about 40% in 2008 to about 12% in 2010. From Figure E-3 D and H (Appendix E), the overall performance of the wetland in terms of TN removal appears relatively stable, with the monthly performance ranging over time from +50% to -50%, depending on the model used for estimation and the hydrological conditions. Little can be said regarding trends in TN retention because of the relatively short assessment period and the highly variable conditions that occurred over the three years. Overall there was a net reduction of 892 kg of TN in the wetland over the three-year study period, representing about 25% of the load entering the wetland over this period.

During the winter, TN reduction has remained essentially constant. This is consistent with accumulation of particulate material in the wetland in response to the lower velocity, more stable and less turbulent conditions in the wetland.

5.1.4 Dissolved reactive phosphate

The performance of the wetland in terms of DRP retention is also quite sensitive to the model selected for estimating DRP flux. Two examples are presented in Figure E-4 A and E

(Appendix E). Both models indicate higher DRP retention under winter conditions. Limited DRP data are available to calibrate the models for the 2010 year, creating a potential source of inaccuracy. Wetland performance appears to be different in 2010 relative to the earlier two years, with the wetland becoming a net sink of DRP in 2010.

5.1.5 Total phosphorus

The two models provide a similar trend in terms of TP retention. Retention is greatest in the winter, as particulate-bound TP settles in the depositional environment created by the wetland. Both models indicate net export of TP from the wetland in the summer, presumably in the form of biomass. It is important to note the absolute loads of material retained in the wetland in winter relative to those released in the summer. While the proportion of TP released in summer is large, the mass released is considerably lower than that retained during the winter. The incoming TP was far greater in 2008 than in the two subsequent years, and the outflow load remained almost constant. The decreasing difference between inflow and outflow loads creates an impression of decreasing performance. Further years of data would be required to determine whether this was a long-term trend or an anomaly due to changing hydrological or loading regimes.

5.2 Attenuation of suspended solids loads

The relationship between flux and flow for both the major inflow and the wetland outflow was not constant across the three years of assessment, as indicated in Figure 5-1. The flux-flow relationship is slightly different in 2008 relative to the other two years. One explanation for this behaviour was the particularly high rainfall that occurred in May and June 2008. Another reason may be the prolonged storage (frozen) of water samples collected in 2008 prior to analysis. All samples collected in 2008 were only analysed in February 2009. It is possible that the prolonged storage may have altered the sample composition slightly.

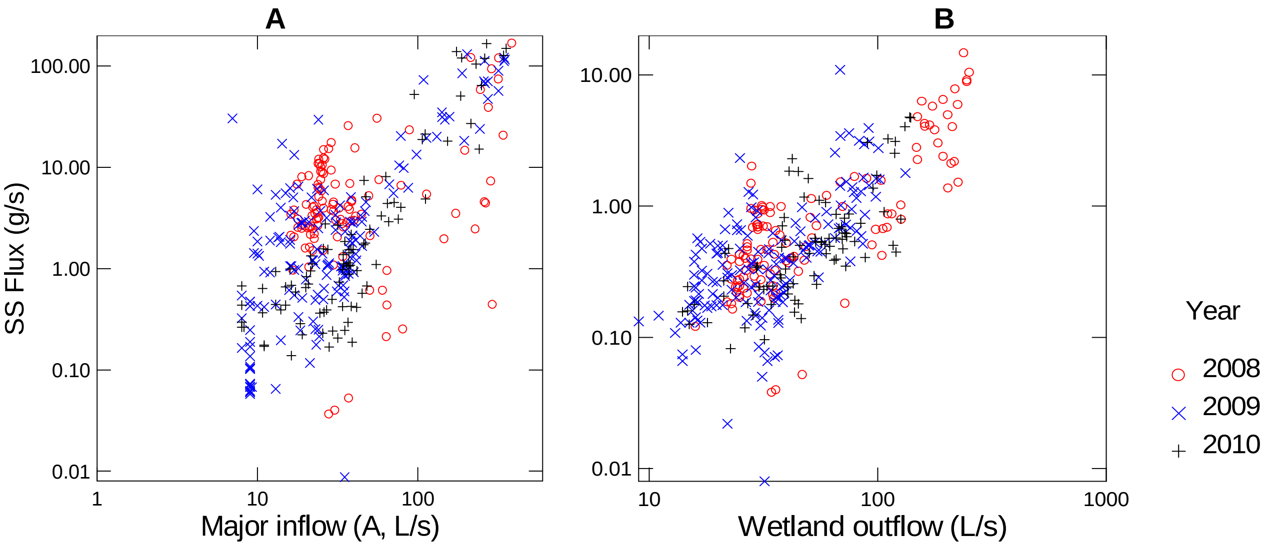

Figure 5-1: Relationship between suspended solids flux and flow for major inflow stream(A) and wetland outflow (B).

A range of models were used to assess the data – none appeared to be without problems. Modelling of particulate fraction of phosphorus and nitrogen (TP and TN) both indicated that the LOADEST LAD model provided a good match between observed and predicted nutrient flux. The decision was made to use this model estimate to calculate the SS flux and loads. Loads predicted using a simpler best-fit regression model are within tolerable agreement with those of the LAD load.

Figure E-6 (A and B) indicate the relative magnitude of wetland inflow and outflow SS loads. There is pronounced seasonality in both inflow and outflow loads, with the inflow loads consistently far greater than the outflow loads. One exception is the estimate for August 2010, where the outflow load is almost half of the inflow load. While this may be an artefact of the modelling procedure, it is worth noting that the highest monthly rainfall for the entire three year assessment period occurred in this month (Figure 3-1). Highest outflow was also recorded during this month (Figure 3-4). It is possible that these exceptional flows were able to mobilise materials that had accumulated within the wetland, giving rise to the large estimates of wetland outflow load.

Both LOADEST LAD and a best-fit regression model indicate that about 75% of the inflow suspended solids load is retained within the wetland. Retention is strongly seasonal, with highest retention occurring in the summer period. The greatest mass of material is retained in the winter, when inflow loads are greatest.

Performance of the wetland was very similar in 2008 and 2009 (about 88% of inflow load retained), falling to about 70% in 2010. It is worth noting that the modelled inflow load was smallest in 2010 and outflow load was greatest. It is possible that this trend was related to restoration works occurring within the catchment (housing of stock within a covered herd home during the winter, construction of a second impoundment on the major inflow stream coupled with riparian fencing and planting), which would reduce the input of particulate material into the stream. The volume of water passing through the wetland was relatively unchanged with the exception of August 2010, when significantly larger flows entered the wetland. The combination of these factors could have led to reduced inputs to the wetland in 2010, but greater mobilisation and export of material from the wetland. The mass balances for TP and TN do not corroborate this hypothesis, with lowest retention rates observed for both variables in 2010.

As noted for TN retention rates, it would be wrong to conclude that the performance of the wetland was deteriorating on the basis of measurements made over a three-year assessment period. A longer term view is required before this judgement can be made.

5.3 Attenuation of *E. coli* loads

E. coli loads were estimated using a regression model. The close correlation between attenuation of SS indicated by the LOADEST LAD model (Figure E-7 B) and SS estimated by a regression model (Figure E-7 F) is of note.

The wetland provides a between one and two log unit attenuation. During periods of high inflow, performance declines. This is consistent with a removal mechanism based on physical deposition and attenuation following extended exposure of microorganisms to UV light. Deposition and exposure to light decrease during periods of high flow.

5.4 Information gaps and areas of uncertainty

Assessment of the wetland performance has centred almost entirely on the difference between estimated inflow and outflow loads. While the models have provided reasonable estimates of inflow and outflow loads, they are subject to error. The estimates of error provided in Appendix G should be recognised.

The estimation procedure has highlighted the sensitivity of wetland performance (in terms of removal of influent load) to the selection and application of models. This must be done with care, comparing observed and modelled values. In some cases a complex model may have to be developed. The output from a "black-box" model (such as the LOADEST suite) should not be accepted without careful scrutiny.

The uptake of dissolved nutrients into plants and algae is also worth consideration. Removal and storage of dissolved nutrients in biomass during the spring and summer may be followed by export of this material from the wetland during the following autumn and winter. It would be informative to quantify nutrient uptake and storage within macrophytes and algae and assess their contribution to nutrient exports.

The three-year assessment has indicated that constructed wetlands are able to attenuate a variety of soluble and particulate materials. Attenuation may be seasonal and is possibly temporary for some variables. The results also indicate that performance may vary considerably from one year to the next. These results indicate that a long term view of wetland performance is required.

The construction of the wetland was one of a number of restoration measures applied in the Lake Okaro catchment. Evaluation of the efficacy of the wetland can only be made if the efficacy of the other remedial measures is also considered. It would be informative to construct a timeline of "remedial actions undertaken in the Lake Okaro catchment". The likely efficacy of these remedial measures is currently not known. Comparison of the predicted decrease in nutrient and sediment export to the wetland could be compared with measurement of inputs to the wetland, validating the efficacy of these remedial measures. Comparison of the inflow and outflow loads would then allow the relative benefits of within catchment restoration measures to be compared with bottom of catchment treatment measures such as constructed wetlands.

6 Conclusions

The Lake Okaro wetland was constructed as one of a series of remedial actions identified in the Lake Okaro Action Plan. The action plan identified performance targets for the wetland in terms of loads of nitrogen and phosphorus that were to be retained within the wetland, thereby reducing the external load to the lake. The performance of the wetland was assessed by measuring inflow and outflow loads for a range of variables, from which the mass of material retained within the wetland could be estimated. A variety of modelling techniques were used to estimate the loads entering and leaving the wetland. Lake Okaro Action Plan (LOAP) targets are compared with measured attenuation in Table 6-1 on an annual basis for the three years of assessment:

Table 6-1: Assessment of wetland performance - comparison of measured attenuation with Lake Okaro Action Plan target. Figures in bold are proportion of target retained by wetland, values in parentheses are proportion of inflow load (%) retained by the wetland.

Period	Water quality variable					
	Total N			Total P		
	(kg)	% of target	(%) of inflow	(kg)	% of target	(%) of inflow
Target	348		-	16		-
2008	597	**171**	(41)	302	**1900**	(60)
2009	146	**42**	(17)	56.8	**355**	(23)
2010	149	**42**	(12)	30.5	**190**	(12)

For TN, wetland performance was exceptional in 2008, when more than 170% of the target mass was retained. Performance was more modest in 2009 and 2010, when 42% of the target was retained. The performance of the wetland is in part determined by the influent load – if the inflow load is large, the amount retained as proportion of the inflow appears large, particularly for the particulate-bound components.

Considerable biogeochemical transformation of the nitrogen in the inflow indicates that the wetland probably exceeds anticipated performance. About 33% of the inflow nitrogen load is nitrate-N. The proportion of nitrogen leaving the wetland as nitrate-N is reduced to less than 13%. The mass of nitrogen immediately available for aquatic plant growth is therefore reduced by the wetland. This is particularly true during the summer, when algal blooms are more likely.

The wetland has consistently retained more TP than the target value. The performance of the wetland is in part determined by the influent load.

The proportion of target mass and catchment export mass retained within the wetland appears to have decreased over the assessment period. This apparent deterioration in performance is probably related to the smaller load of material exported from the catchment (because of the hydrological characteristics) and the impact of remedial actions undertaken in the upper catchment. The latter have probably reduced catchment exports (reducing the load entering the wetland), while wetland export has remained reasonably constant. The net effect is an apparent deterioration in performance. It is also possible that the very large load of particulate-associated organic forms entering the wetland in the first year (2008) have been slowly mineralised and gradually processed in subsequent years, influencing apparent removal rates during 2009 and 2010.

The assessment programme included a range of variables not identified in the Lake Okaro Action Plan. The performance of the wetland is summarised in terms of the load attenuated annually in Table 6-2:

Table 6-2: Assessment of wetland performance - measured attenuation of variables not identified in Lake Okaro Action Plan. Figures in bold are proportion of target retained by wetland, values in parentheses are proportion of inflow load (%) retained by the wetland.

Period	Water quality variable									
	Ammoniacal-N		Nitrate-N		DRP		Suspended solids		*E. coli*	
	Mass (kg)	Prop. (%)	Mass (kg)	Prop. (%)	Mass (kg)	Prop. (%)	Mass (t)	Prop. (%)	(Log red.)	Prop. (%)
2008	-4.7	**-8**	368.3	**77**	-12.8	**-15**	115.1	(87)	>1 log	(92)
2009	-39.2	**-133**	225	**78**	-6.8	**-12**	111.9	(88)	>1 log	(96)
2010	-28.9	**-70**	362.7	**80**	25.2	**30**	58.2	(71)	>1 log	(89)

The wetland is a net source of ammoniacal-N, but this is a relatively insignificant component of the nitrogen balance, and concentrations are generally low. The wetland retains a significant proportion of the inflowing nitrate-N load, presumably as a consequence of denitrification. In two of the three years of assessment, the wetland was a net source of DRP, but in the third year it retained almost a third of the inflowing load.

Similar trends are evident for suspended solids loads as for TN and TP. The mass of material retained has decreased and the proportion of material retained also decreased, particularly for the last year of assessment. The extremely high rainfall that occurred during August 2010 probably mobilised material that accumulated during the preceding years – this caused an apparent decrease in attenuation.

Attenuation of *E. coli* loads was reasonably constant (between 1 and 2 log units), and is influenced to some extent by the hydrological conditions.

Evaluating wetland performance should take place over a sufficiently long period of time, allowing extreme conditions and events to be detected and placed in a longer-term context. Factors such as inflows of reduced groundwater, seasonal uptake and release of nutrients and suspended materials by wetland plants and algae should also be taken into consideration. It is also important to remember that the wetland is one of a series of restoration tools that have been applied in the Lake Okaro catchment. Determining the overall performance of the wetland requires consideration of the contributions of within catchment attenuation activities.

7 Acknowledgements

We express our appreciation to:

- The Birchall family for allowing the team free access to their property, making this assessment possible.
- The Hydrology team of Bay of Plenty Regional Council for maintaining the flow recorders and providing high quality data "on demand."
- The Pastoral 21 consortium for funding the SS and *E. coli* component of the assessment.
- Bay of Plenty Regional Council for funding the nutrient component of the assessment.

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Appendix A Annual summary statistics for flows

Table A-1: Summary statistics for 2008 calendar year. Data summarised as hourly average values.

Statistic		Measured flow at location (L/s)				
		Major inflow (A)	Pipe inflow (B)	Bypass flow (C)	Minor inflow (D)	Wetland outflow (G)
No. of Cases		8784	8784	186	8784	8784
Minimum		8	8	0.25	0	12
Maximum		496.3	184	312.3	118.5	519.5
Median		22.3	22.3	77.1	3	27
Arithmetic Mean		30.5	28.7	85	4.2	34.8
Standard Error of Arithmetic Mean		0.4	0.3	4.5	0.1	0.3
Mode		10	10		2	15
Standard Deviation		39.7	28.1	61.6	4.9	31.2
Percentiles		0	0	0	0	0
	1	9	9	0.5	0	13
	5	9.5	9.5	3.1	1	14
	10	10	10	10	1.8	15
	20	13	13	25.9	2	17
	25	14.8	14.8	38	2	19
	30	16	16	46.8	2	20
	40	19	19	58	3	23.5
	50	22.3	22.3	77.1	3	27
	60	25.5	25.5	94.9	4	30.2
	70	29	29	114.7	5	34.3
	75	31.8	31.8	125.5	5	38
	80	34.8	34.8	133.5	5	41
	90	45	45	164.4	7	56.3
	95	64.8	64.8	199.9	8.5	88.3
	99	266.9	184	265.2	21.3	171.1

Table A-2: Summary statistics for 2009 calendar year. Data summarised as hourly average values.

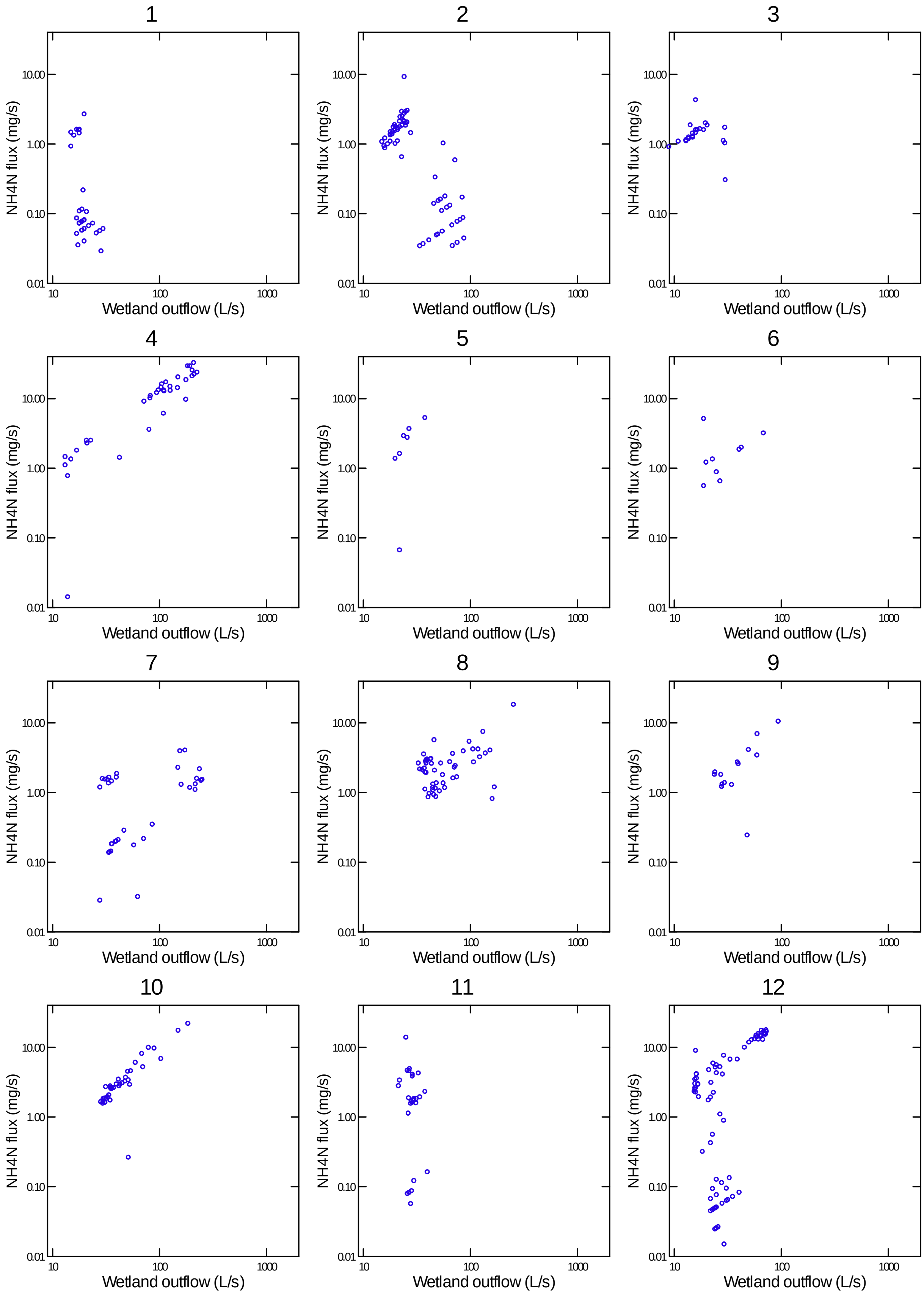
Statistic	Measured flow at location (L/s)				
	Major inflow (A)	Pipe inflow (B)	Bypass flow (C)	Minor inflow (D)	Wetland outflow (G)
No. of Cases	8763	8763	60	8760	8760
Minimum	7	7	1	1	9
Maximum	359.3	229.3	175.3	28.3	190
Median	16	16	61	4	24
Arithmetic Mean	20.8	20.3	69.3	3.8	27.8
Standard Error of Arithmetic Mean	0.3	0.2	6.7	0	0.2
Mode	11	11		4	12
Standard Deviation	25.5	21.1	51.9	1.7	16.4
Percentiles	0	0	0	0	0
1	8	8	1.3	1.5	12
5	9	9	5	2	12
10	10	10	6.1	2	15.8
20	11	11	15.9	3	17
25	11	11	23.5	3	18
30	12	12	27.8	3	19.5
40	14	14	48.6	3.3	22
50	16	16	61	4	24
60	18	18	77.6	4	26.8
70	20	20	93.6	4	29.8
75	22	22	102.8	4	31
80	23.5	23.5	126	4.5	34
90	30.8	30.8	147.1	5	40
95	37.3	37.3	163	6	56.3
99	163.8	161.3	174.8	10	96.2

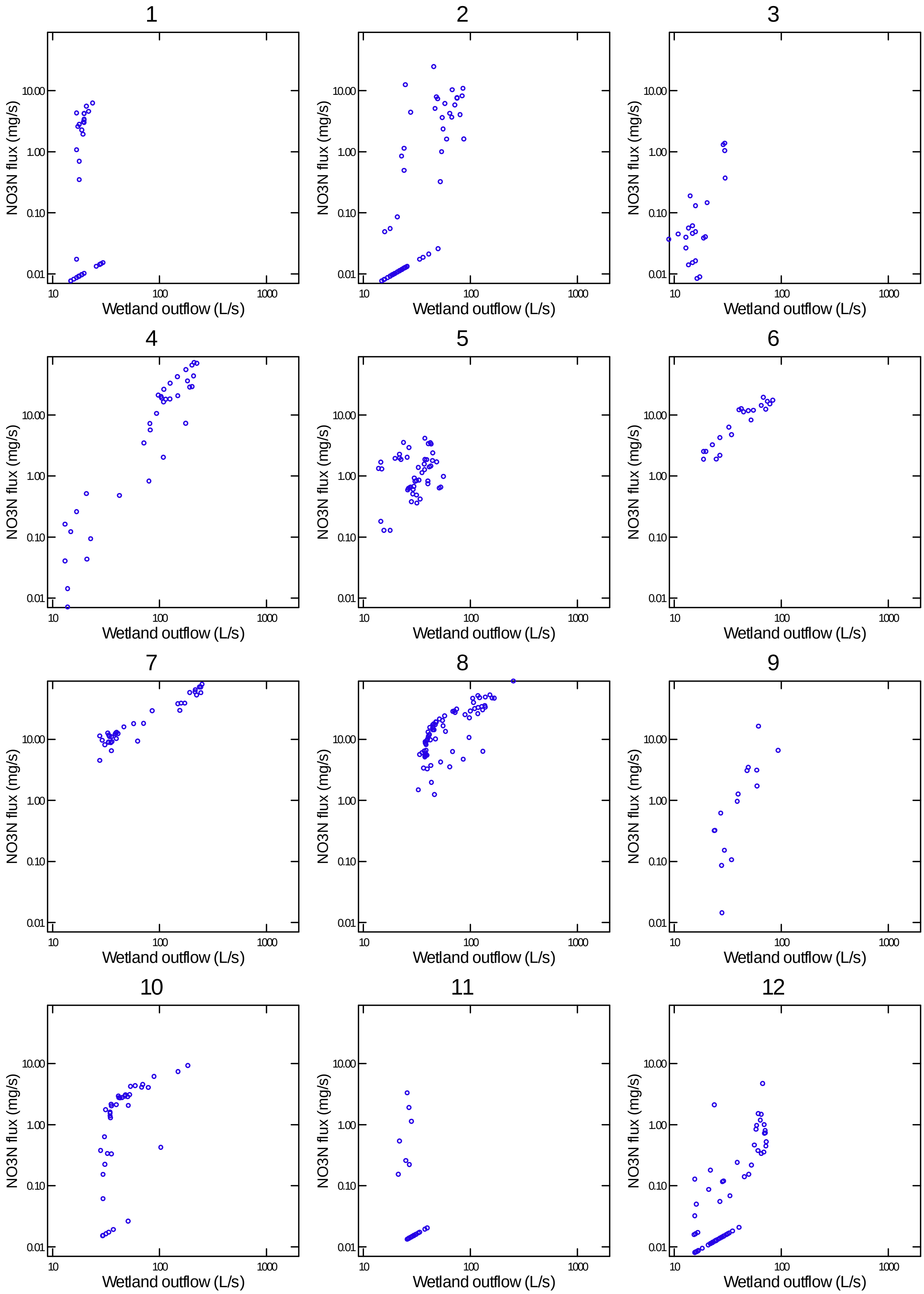
Table A-3: Summary statistics for 2010 calendar year. Data summarised as hourly average values.

Statistic	Measured flow at location (L/s)				
	Major inflow (A)	Pipe inflow (B)	Bypass flow (C)	Minor inflow (D)	Wetland outflow (G)
No. of Cases	8760	8760	167	8220	8760
Minimum	1	1	0.5	0	10
Maximum	513	184	329	73.3	915.5
Median	15	15	77.5	3	26
Arithmetic Mean	24.7	23	85.2	4.1	32.8
Standard Error of Arithmetic Mean	0.4	0.3	4.9	0	0.3
Mode	8	8		2	15
Standard Deviation	38.2	27	63.2	3.4	29.6
Percentiles	0	0	0	0	0
1	8	8	1.2	1	11.5
5	8	8	4.7	2	12.5
10	8	8	10.8	2	14.3
20	9	9	26.7	2	15.8
25	9	9	35.3	2	17.5
30	10	10	42.2	3	19.3
40	12	12	62.9	3	22.5
50	15	15	77.5	3	26
60	20	20	87.9	4	29.8
70	23	23	103.5	4	35.3
75	26	26	120.5	5	37.3
80	29	29	131	5	41.1
90	39	39	174.7	6	55.3
95	53.6	53.6	200.5	8	75.1
99	260.1	184	304.6	18.8	140.7

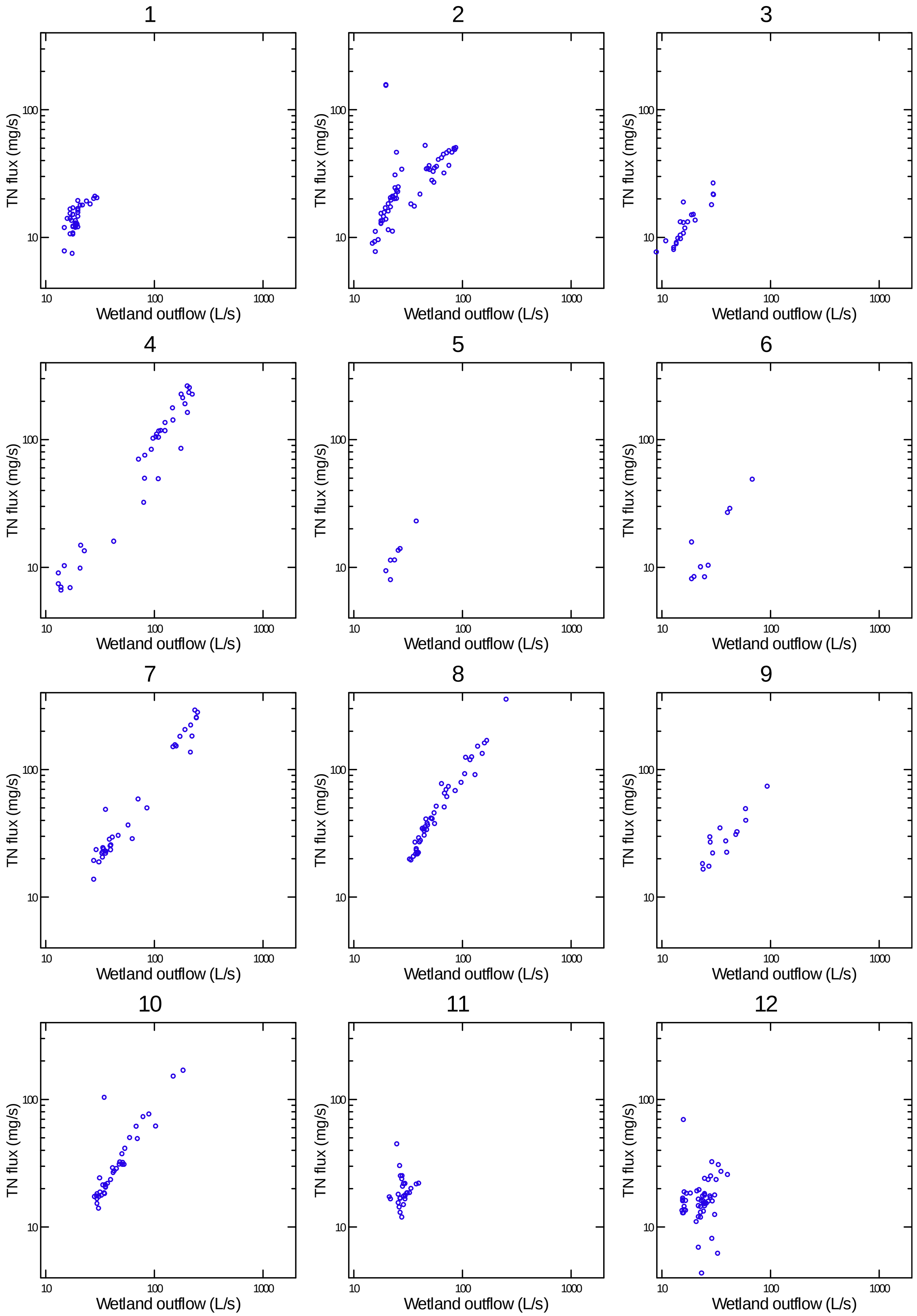
Appendix B Relationship between flux and wetland outflow on the basis of calendar month for nitrogen species

The numbers 1 to 12 in this Appendix refer to months of the year.


1
2
3
4
5
6
7
8
9
10
11
12
NH4N flux (mg/s)
10.00
1.00
0.10
0.01
10
100
1000
Wetland outflow (L/s)

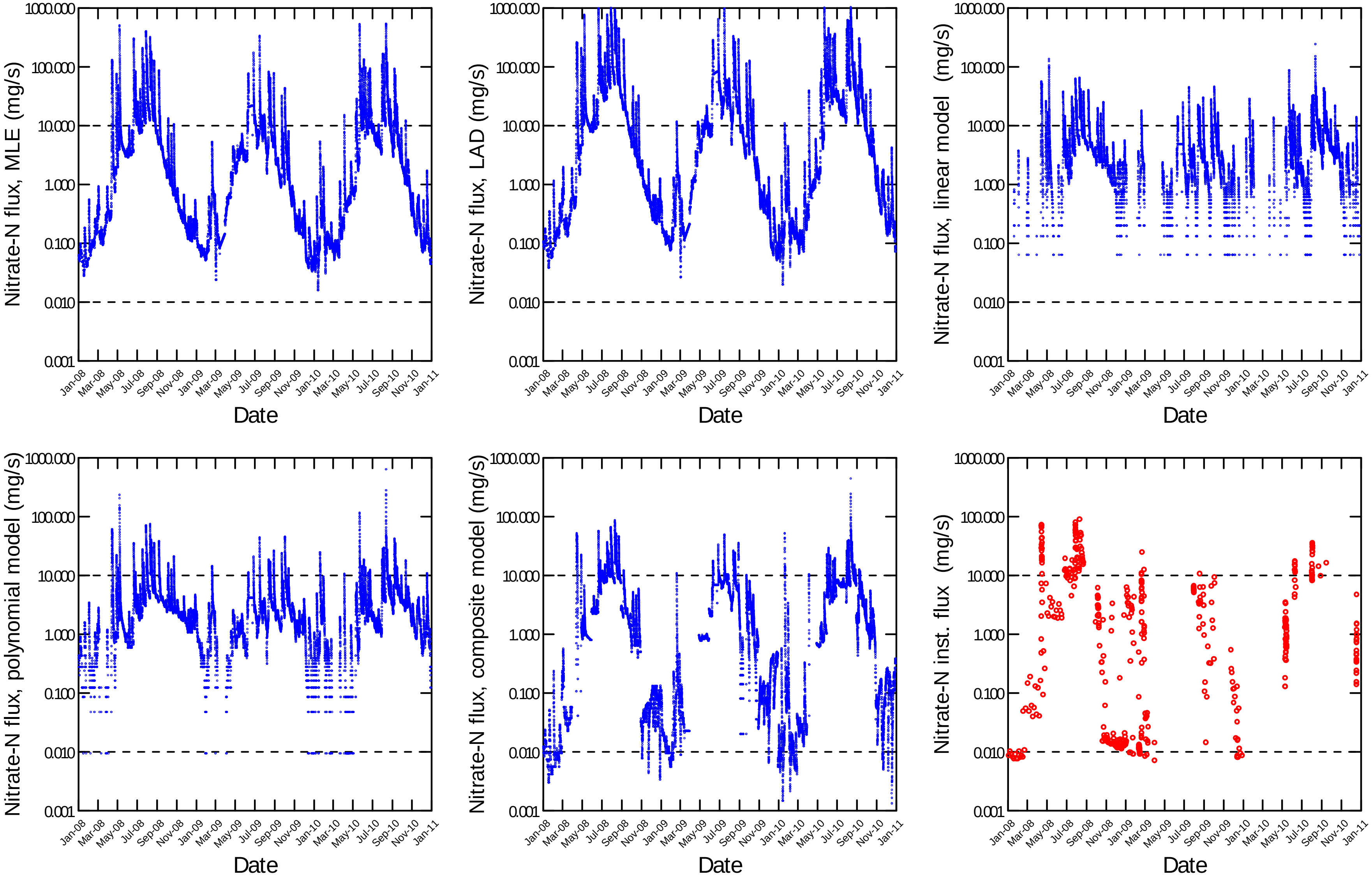


1
2
3
4
5
6
7
8
9
10
11
12
NO3N flux (mg/s)
10.00
1.00
0.10
0.01
10
100
1000
Wetland outflow (L/s)


1
2
3
4
5
6
7
8
9
10
11
12
TN flux (mg/s)
Wetland outflow (L/s)
10
100
1000

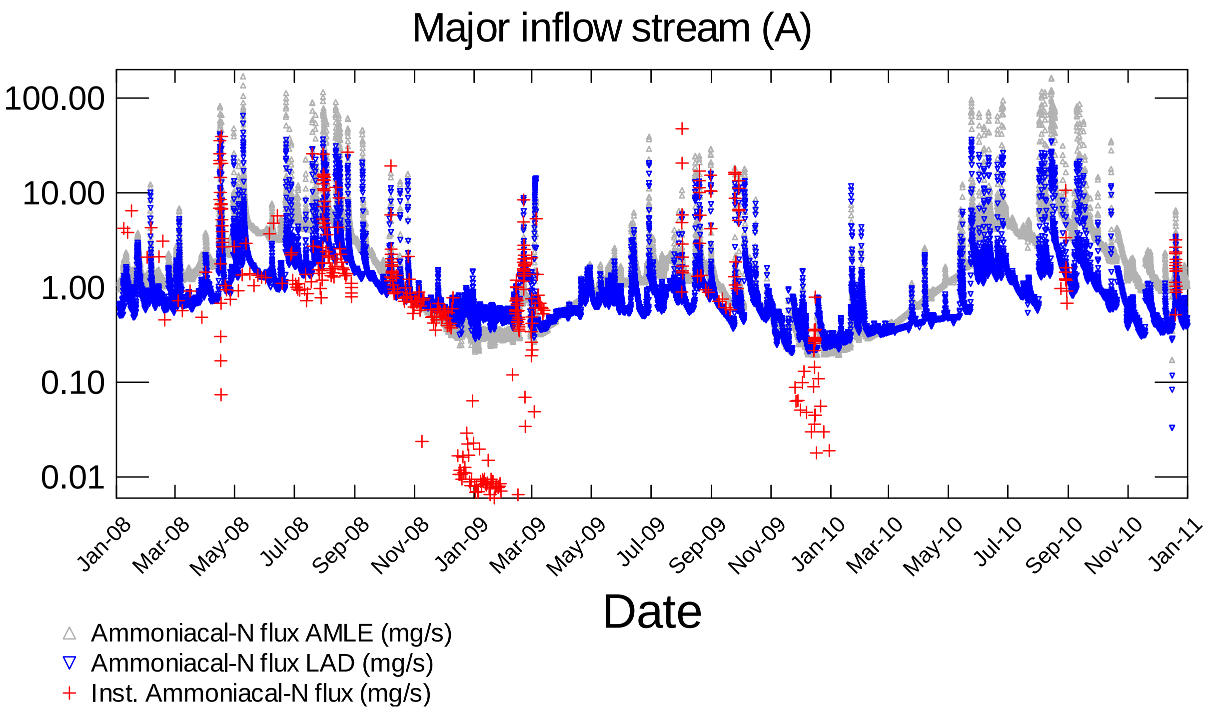
Appendix C Various models of wetland outflow nitrate flux

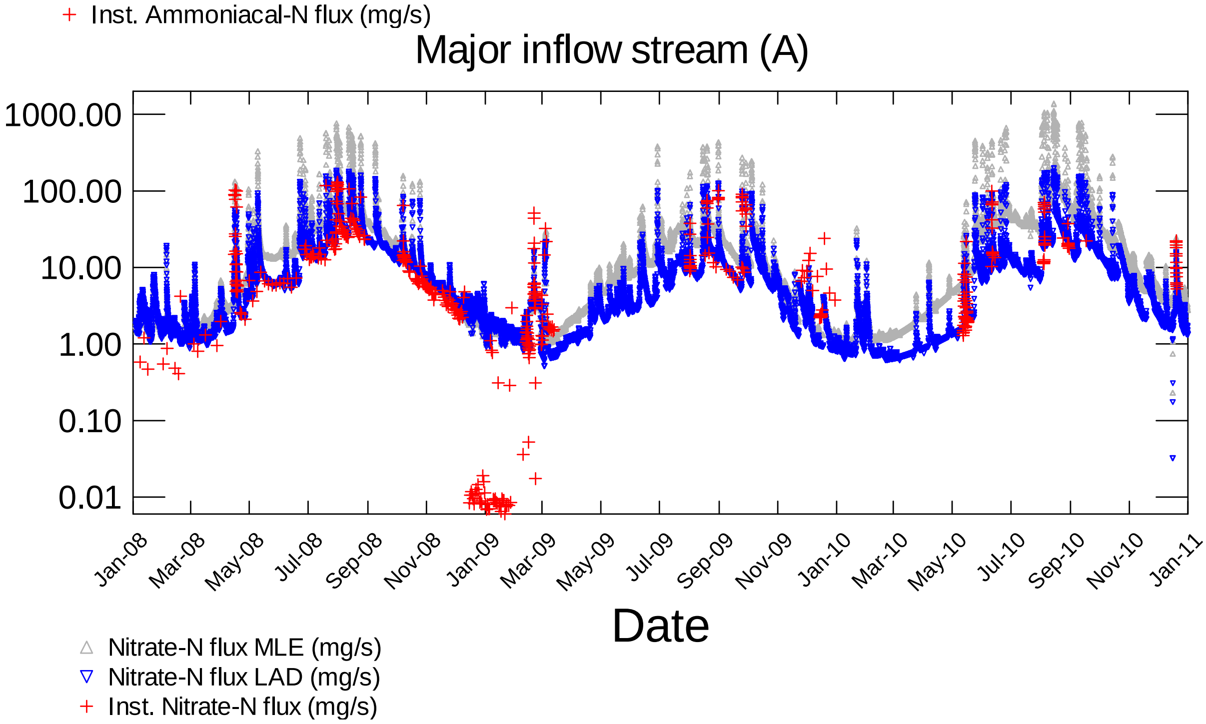
Data in this Appendix are plotted at hourly time-step.

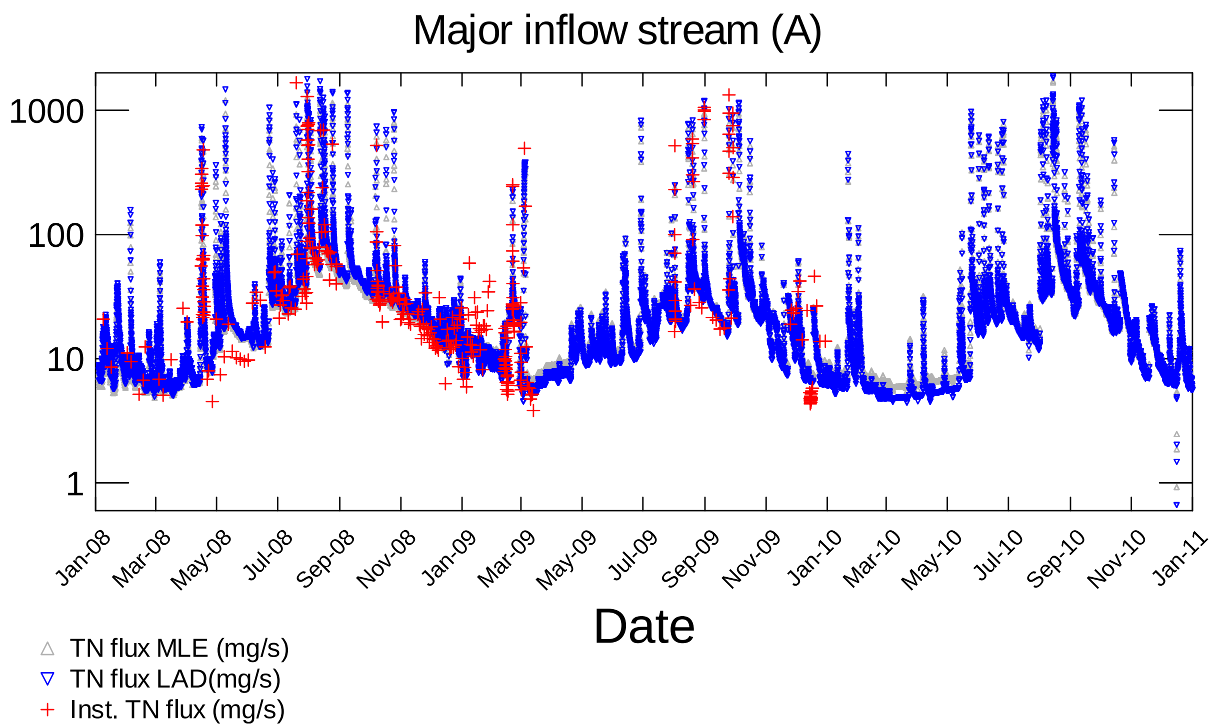

Nitrate-N flux, MLE (mg/s)
Nitrate-N flux, LAD (mg/s)
Nitrate-N flux, linear model (mg/s)
Nitrate-N flux, polynomial model (mg/s)
Nitrate-N flux, composite model (mg/s)
Nitrate-N inst. flux (mg/s)
1000.000
100.000
10.000
1.000
0.100
0.010
0.001
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date

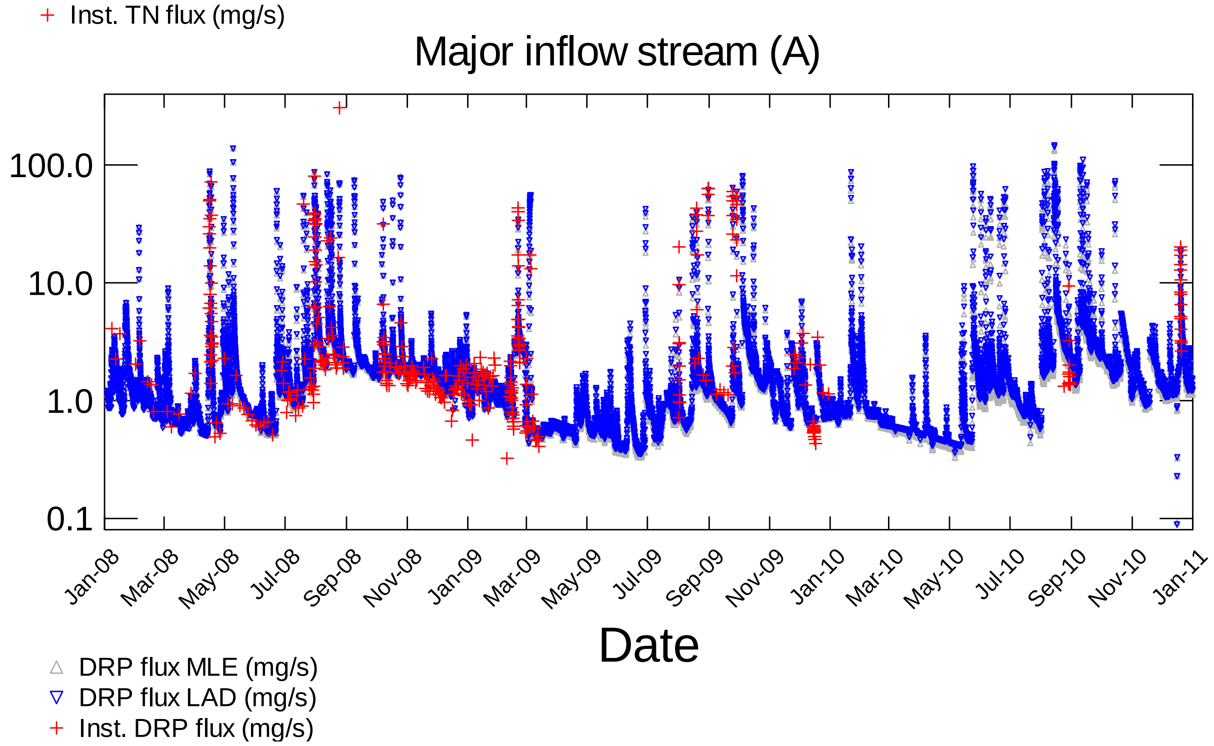
Appendix D Comparison of observed flux and flux predicted by various models

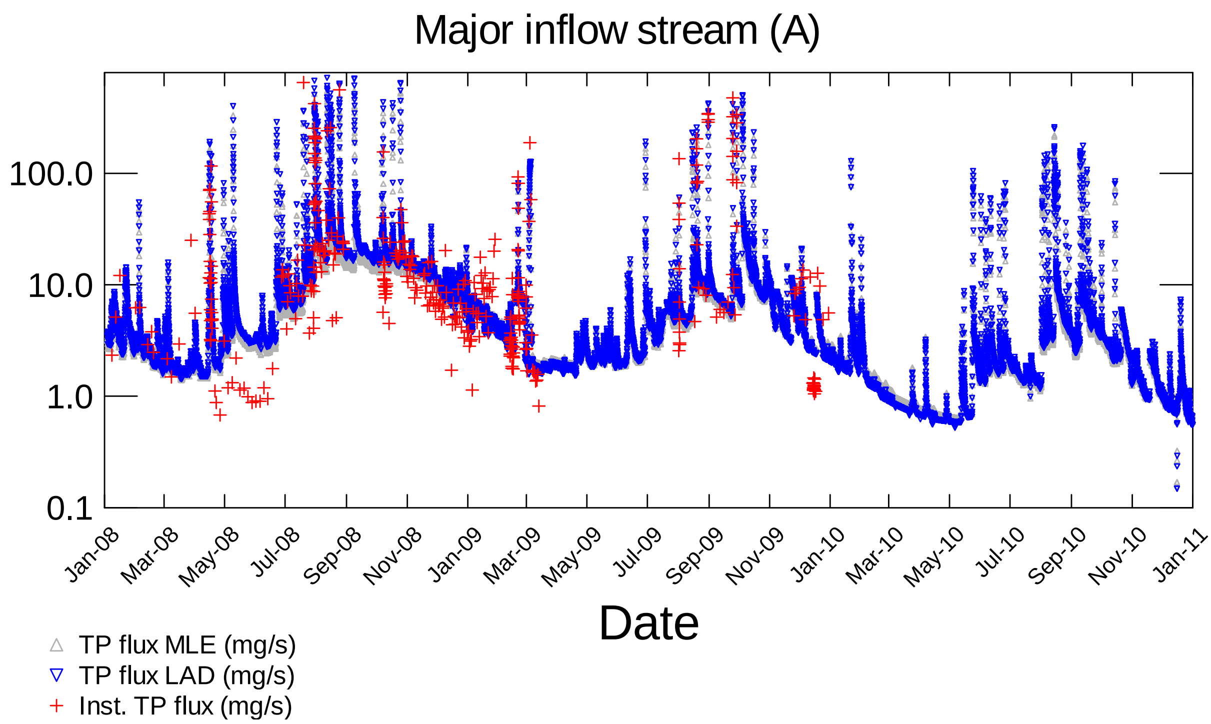
Major inflow stream (Sites A, B and C)

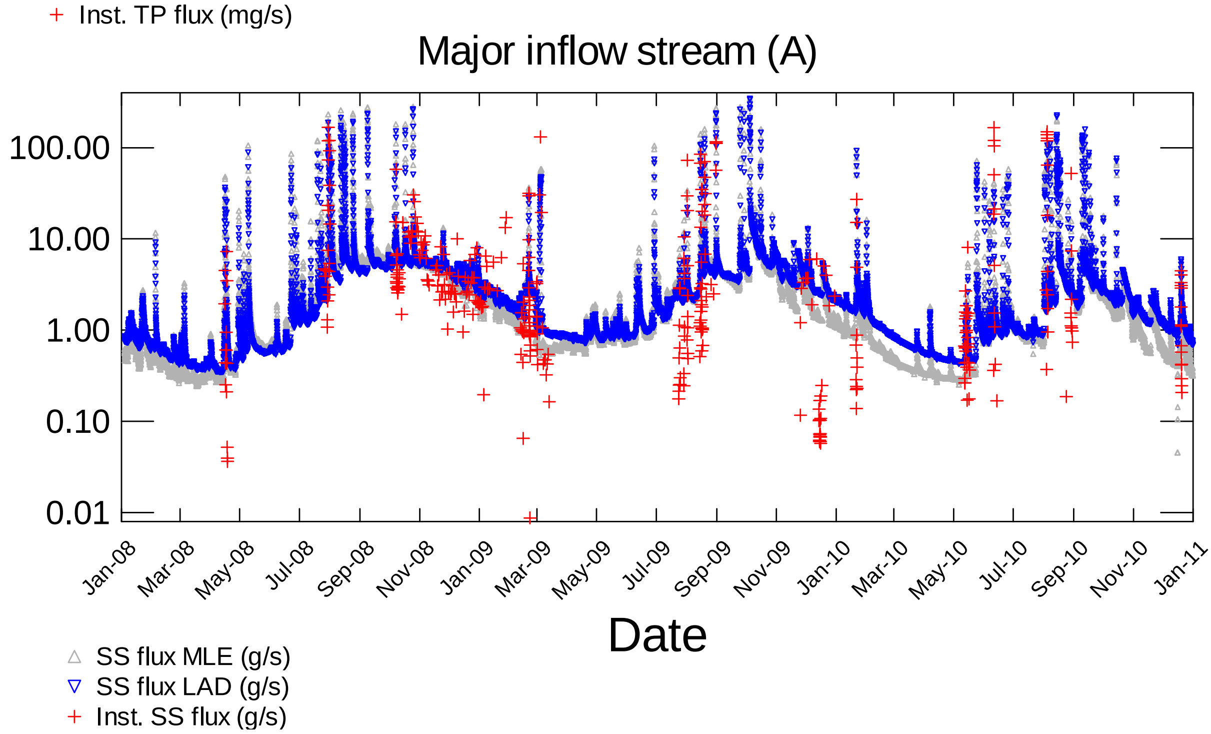


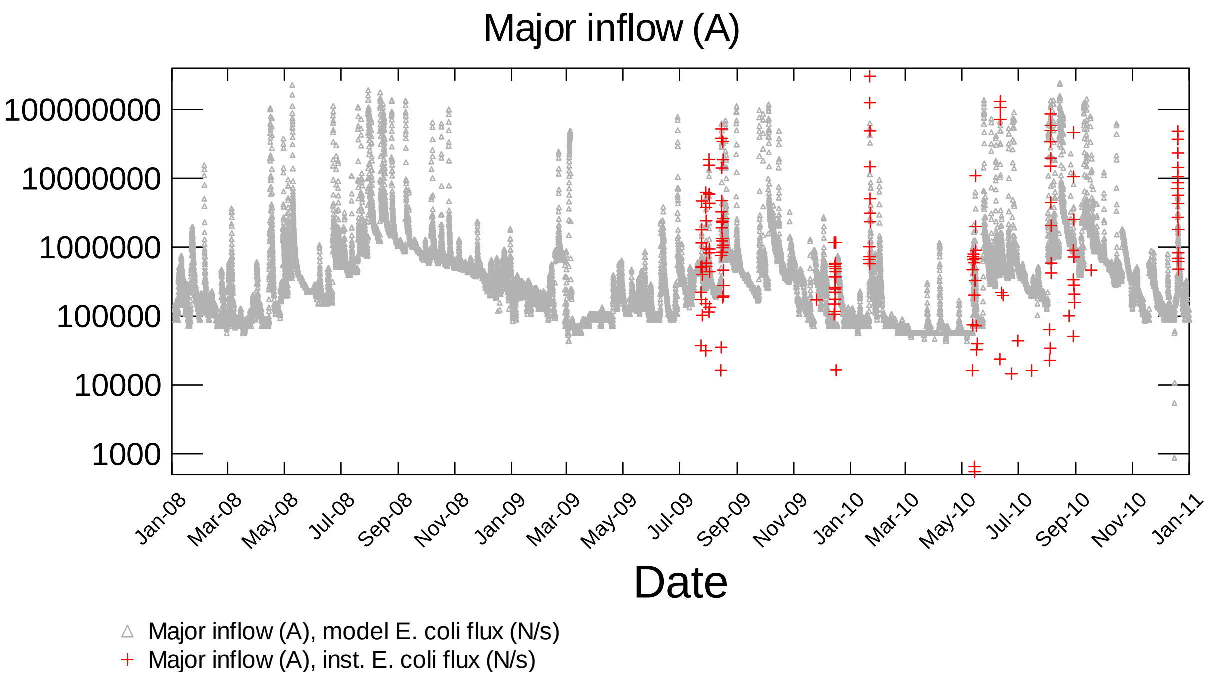


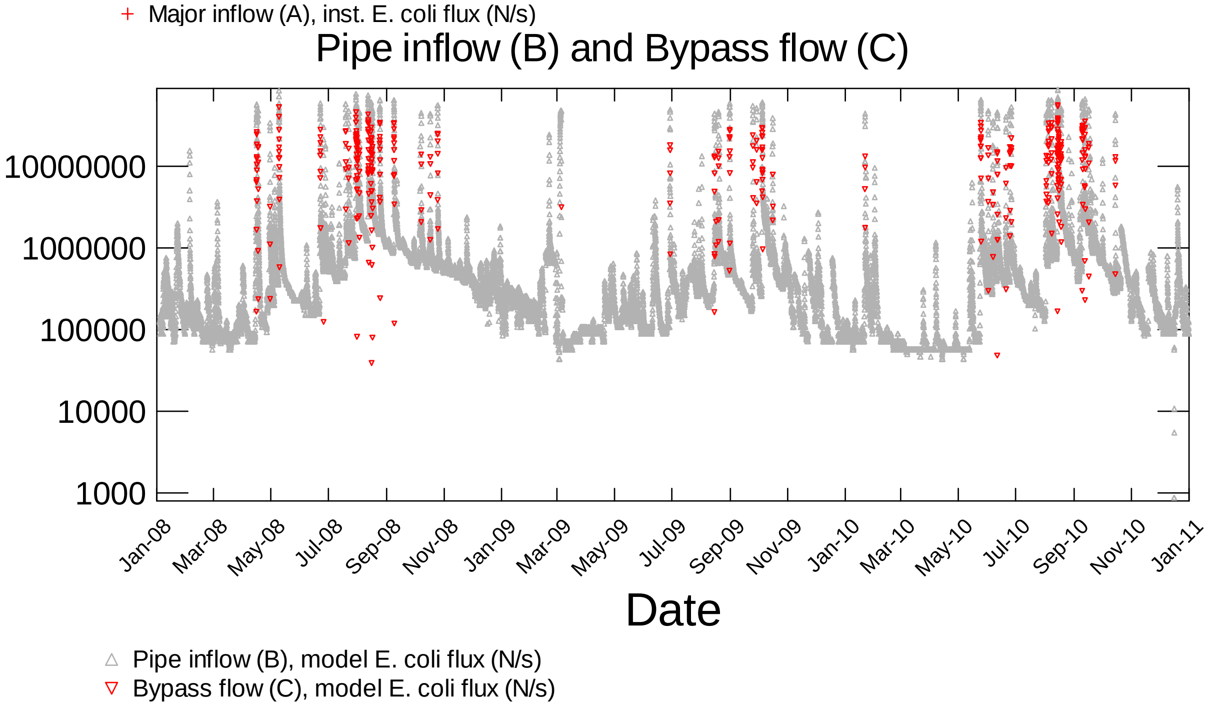

Major inflow stream (A)
1000
100
10
1
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
TN flux MLE (mg/s)
TN flux LAD(mg/s)
Inst. TN flux (mg/s)


Major inflow stream (A)
100.0
10.0
1.0
0.1
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
DRP flux MLE (mg/s)
DRP flux LAD (mg/s)
Inst. DRP flux (mg/s)

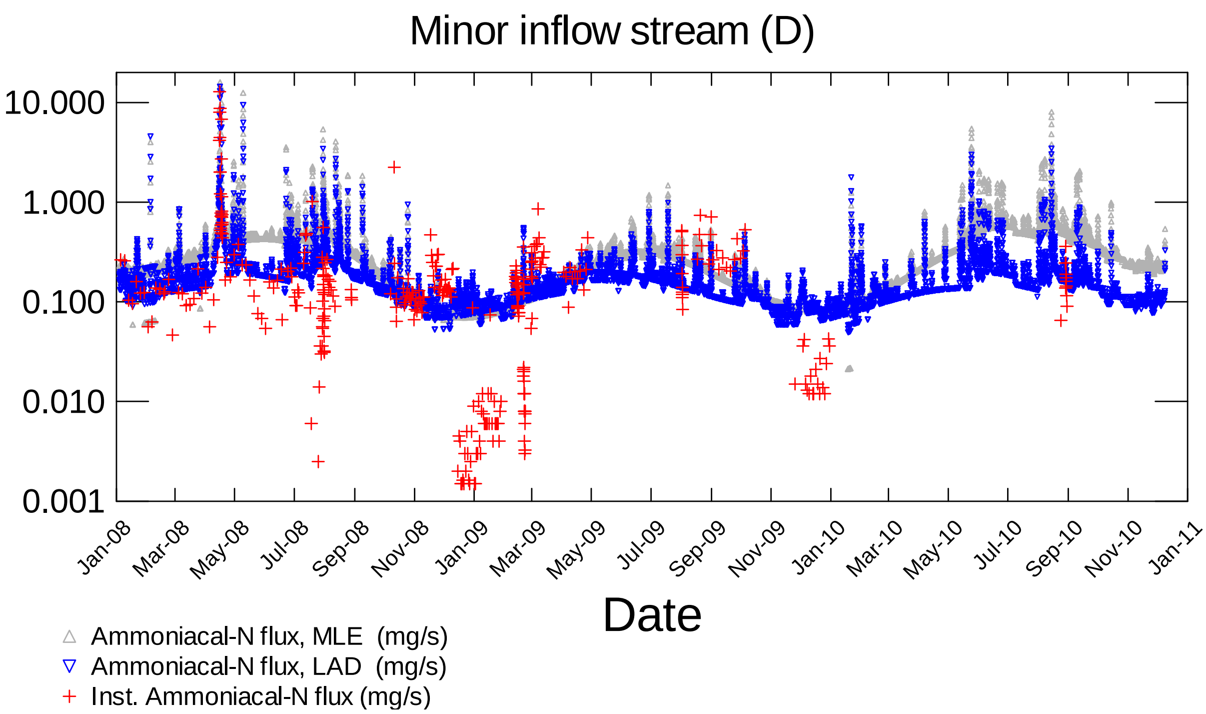

Major inflow stream (A)
100.0
10.0
1.0
0.1
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
TP flux MLE (mg/s)
TP flux LAD (mg/s)
Inst. TP flux (mg/s)

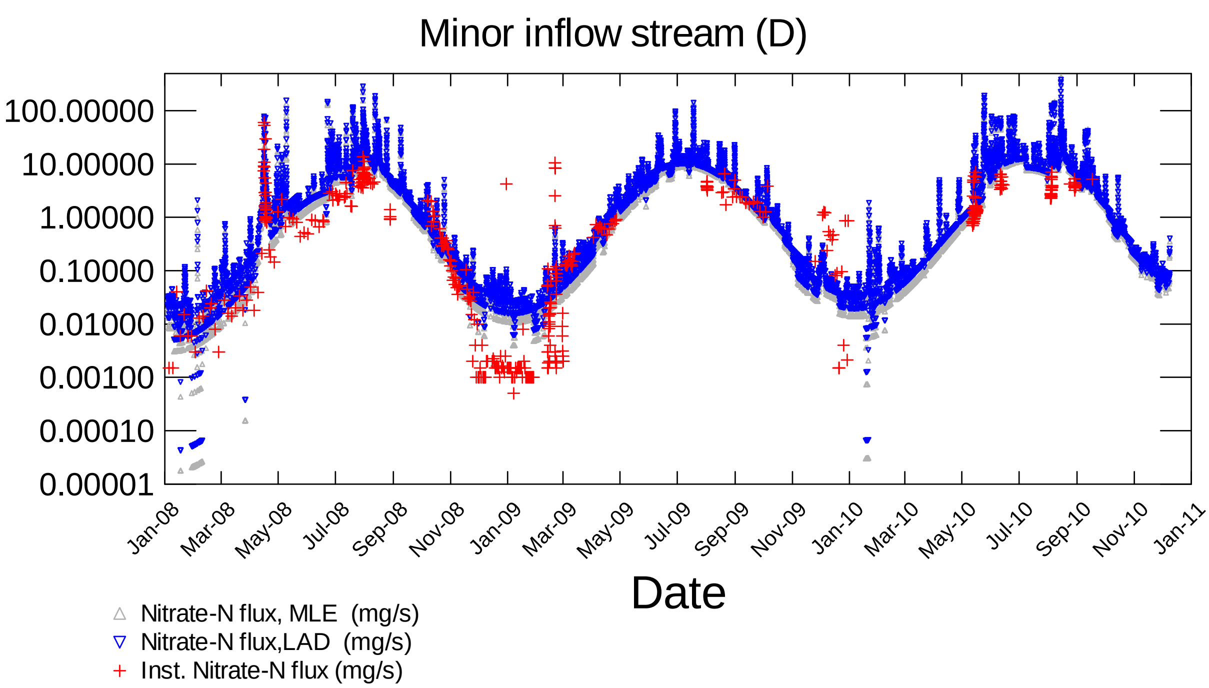

Major inflow stream (A)
100.00
10.00
1.00
0.10
0.01
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
SS flux MLE (g/s)
SS flux LAD (g/s)
Inst. SS flux (g/s)

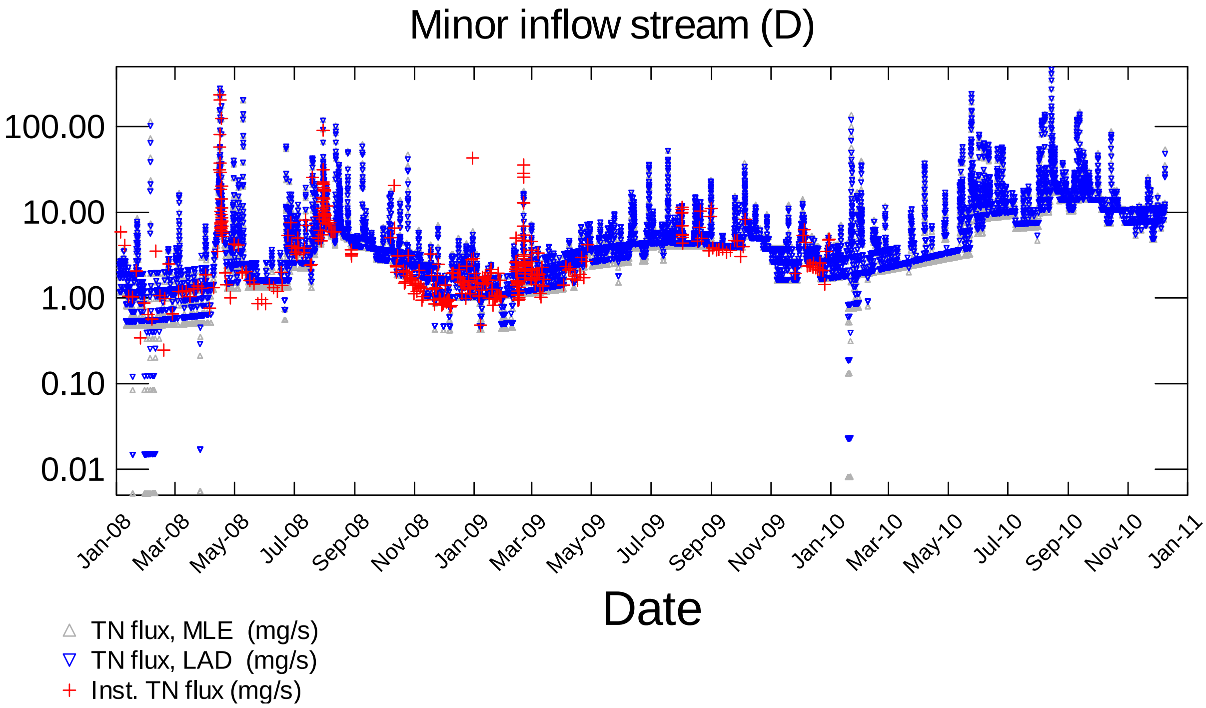

Major inflow (A)
100000000
10000000
1000000
100000
10000
1000
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
Major inflow (A), model E. coli flux (N/s)
Major inflow (A), inst. E. coli flux (N/s)

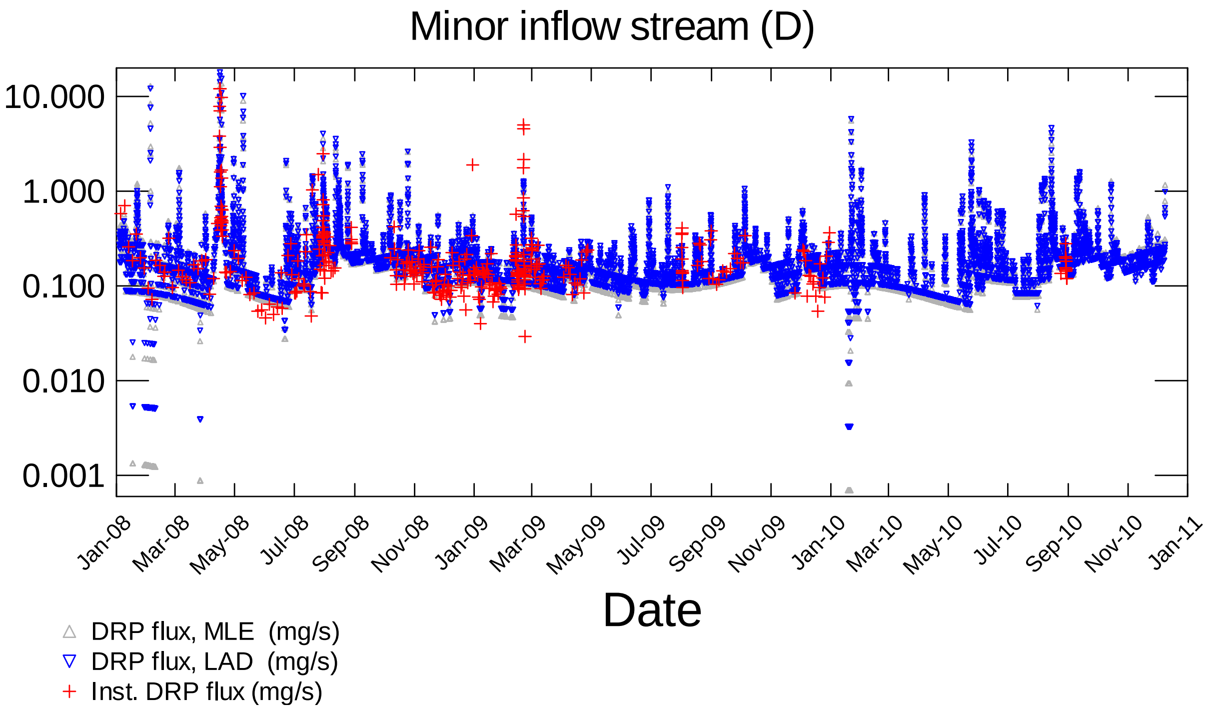

Pipe inflow (B) and Bypass flow (C)
10000000
1000000
100000
10000
1000
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
Pipe inflow (B), model E. coli flux (N/s)
Bypass flow (C), model E. coli flux (N/s)

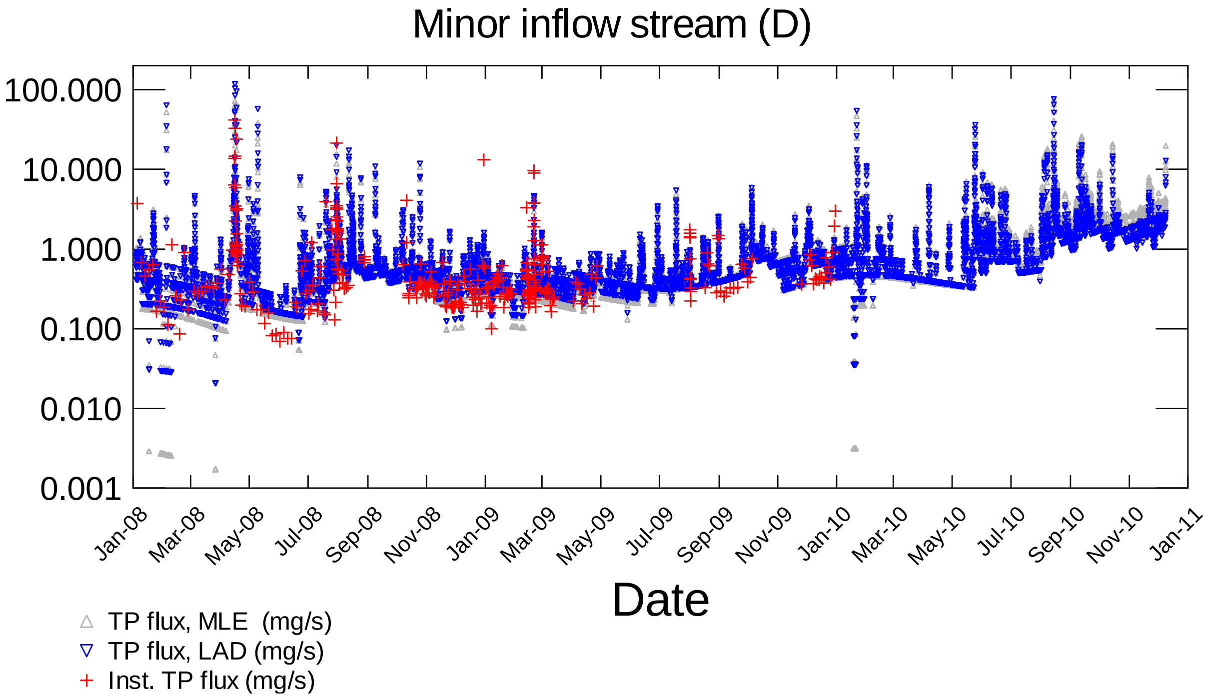
Minor wetland inflow (site D)



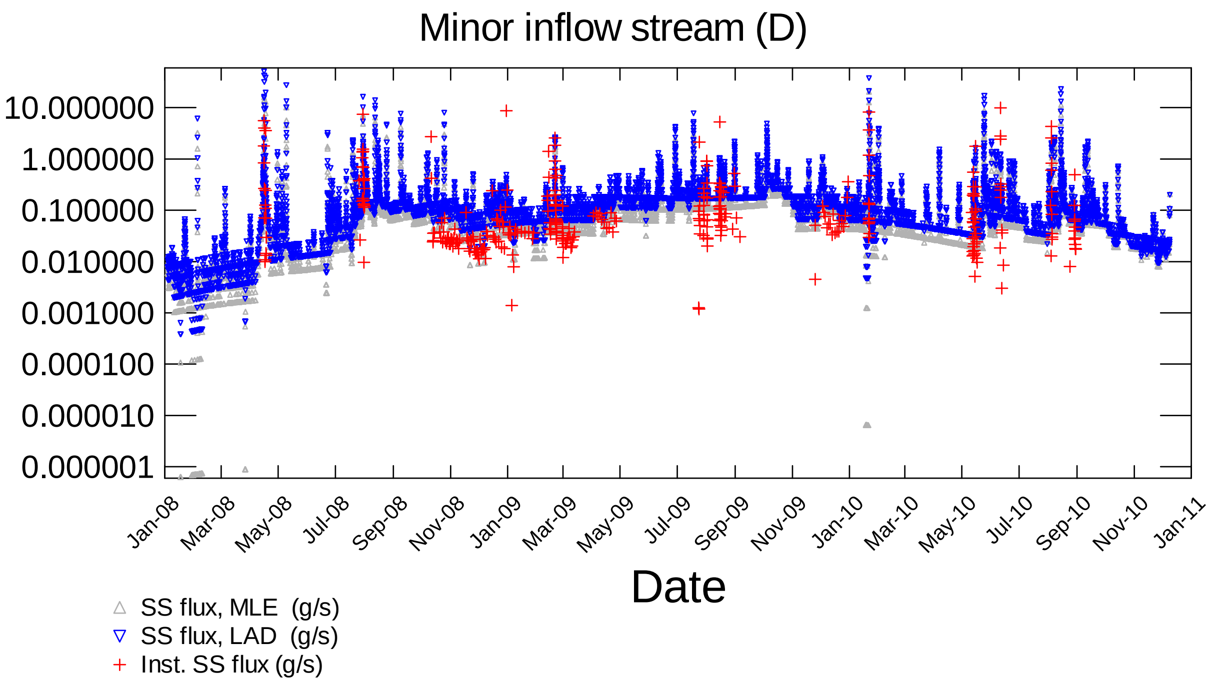



Minor inflow stream (D)
100.00
10.00
1.00
0.10
0.01
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
TN flux, MLE (mg/s)
TN flux, LAD (mg/s)
Inst. TN flux (mg/s)

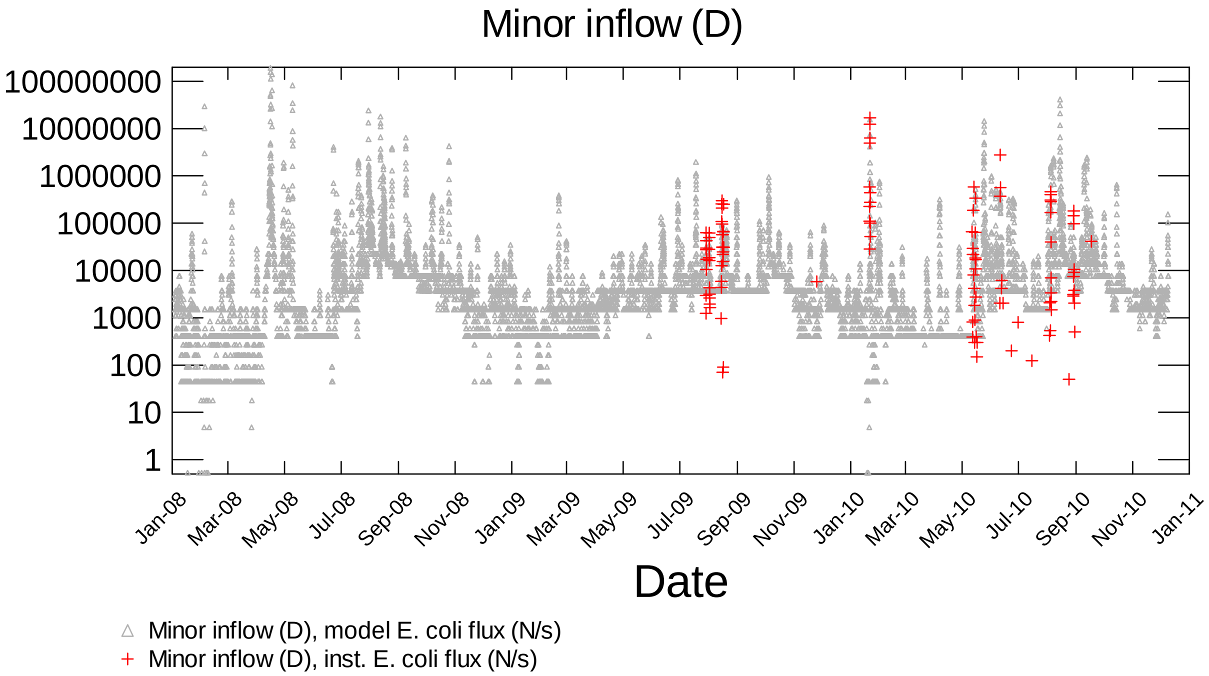

Minor inflow stream (D)
10.000
1.000
0.100
0.010
0.001
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
DRP flux, MLE (mg/s)
DRP flux, LAD (mg/s)
Inst. DRP flux (mg/s)



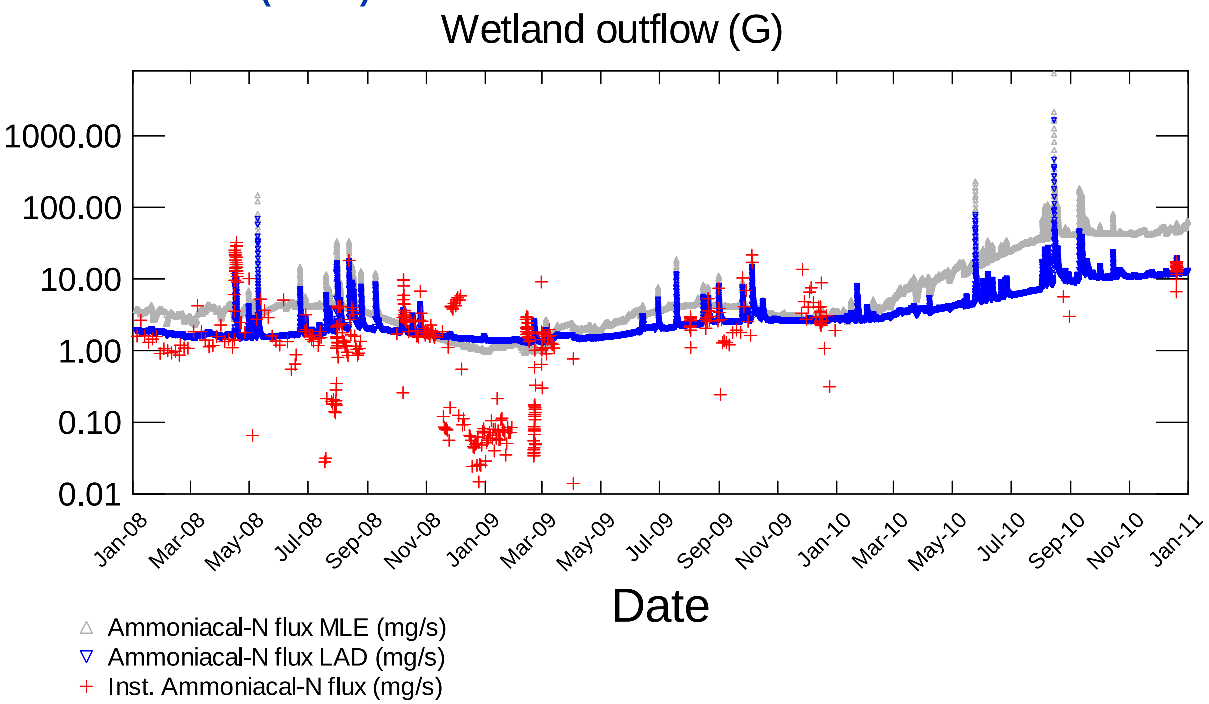
Minor inflow stream (D)
100.000
10.000
1.000
0.100
0.010
0.001
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
TP flux, MLE (mg/s)
TP flux, LAD (mg/s)
Inst. TP flux (mg/s)

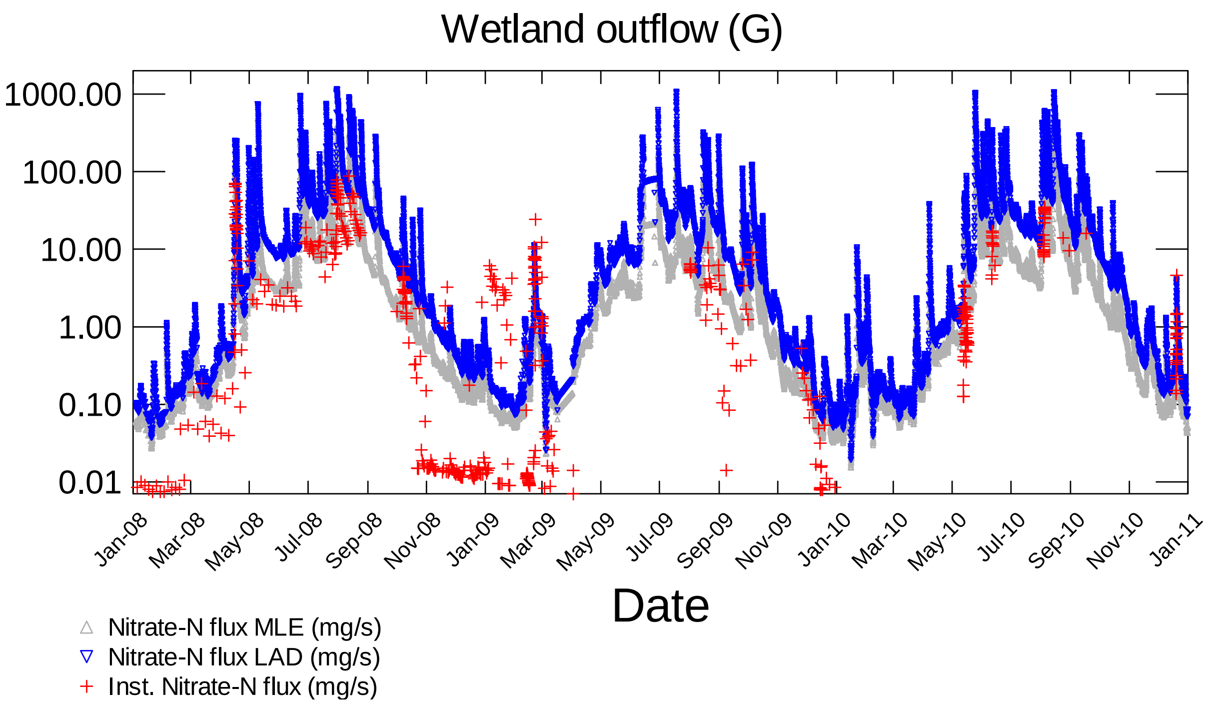


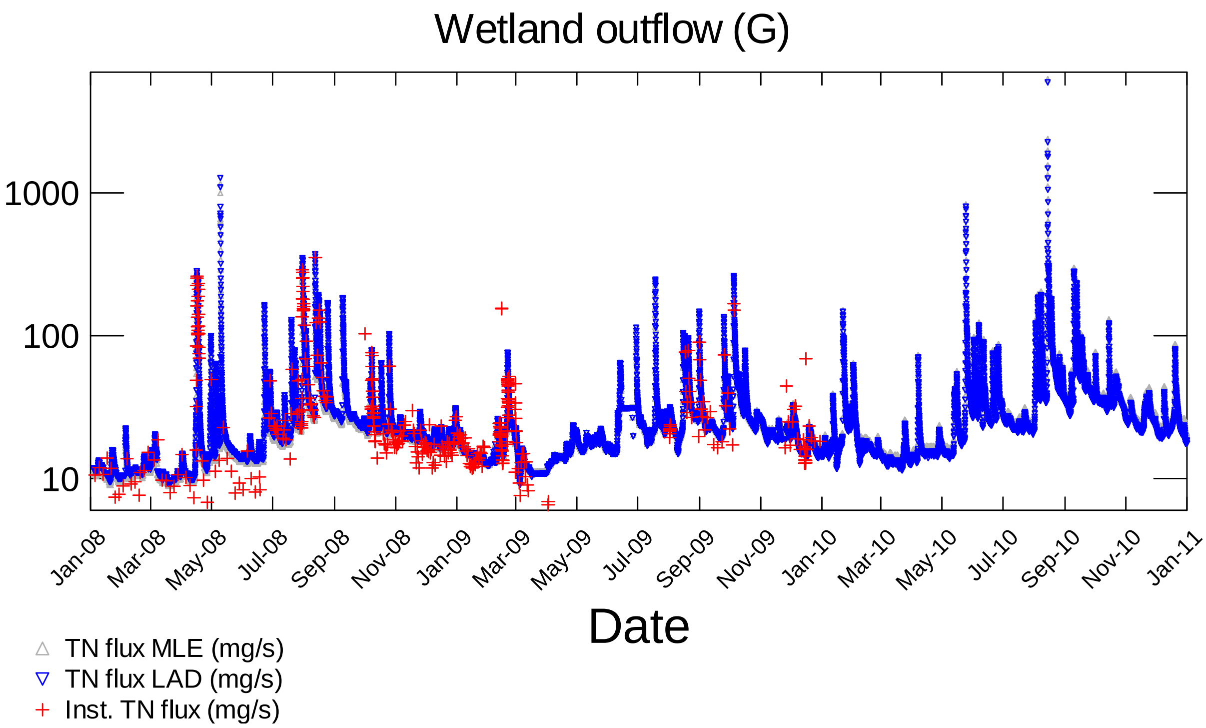
Minor inflow stream (D)
10.000000
1.000000
0.100000
0.010000
0.001000
0.000100
0.000010
0.000001
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
SS flux, MLE (g/s)
SS flux, LAD (g/s)
Inst. SS flux (g/s)

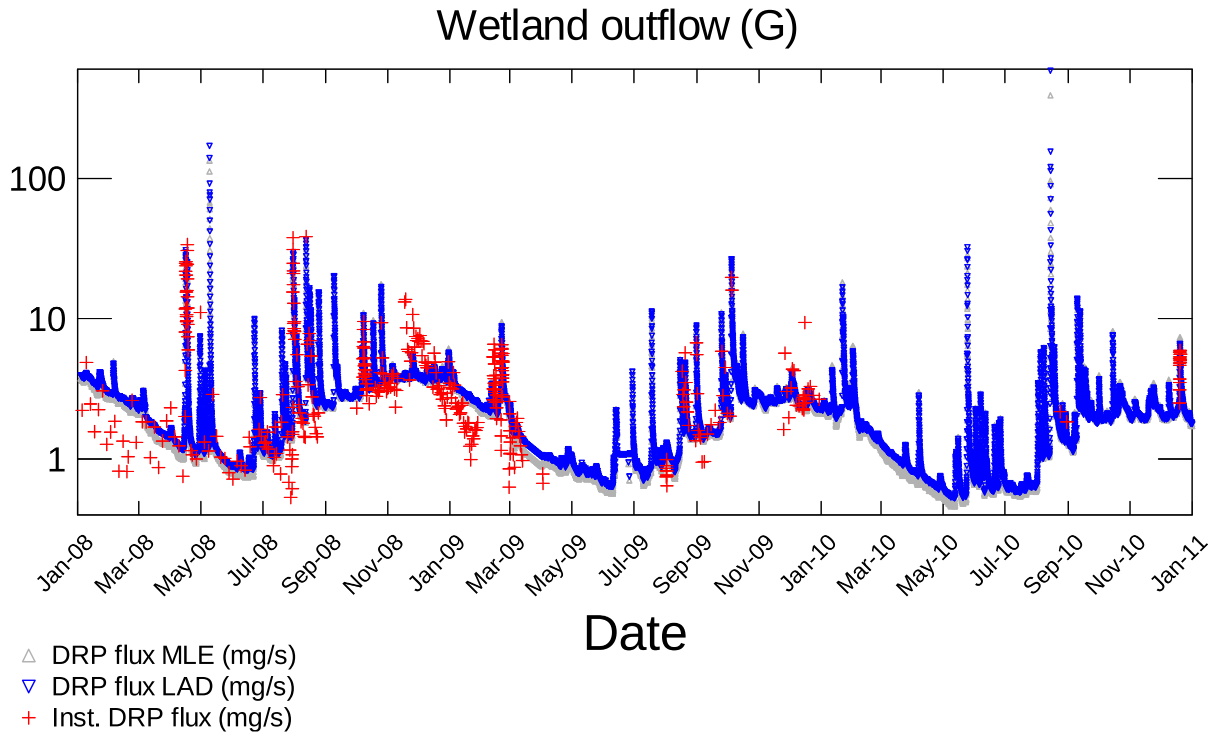


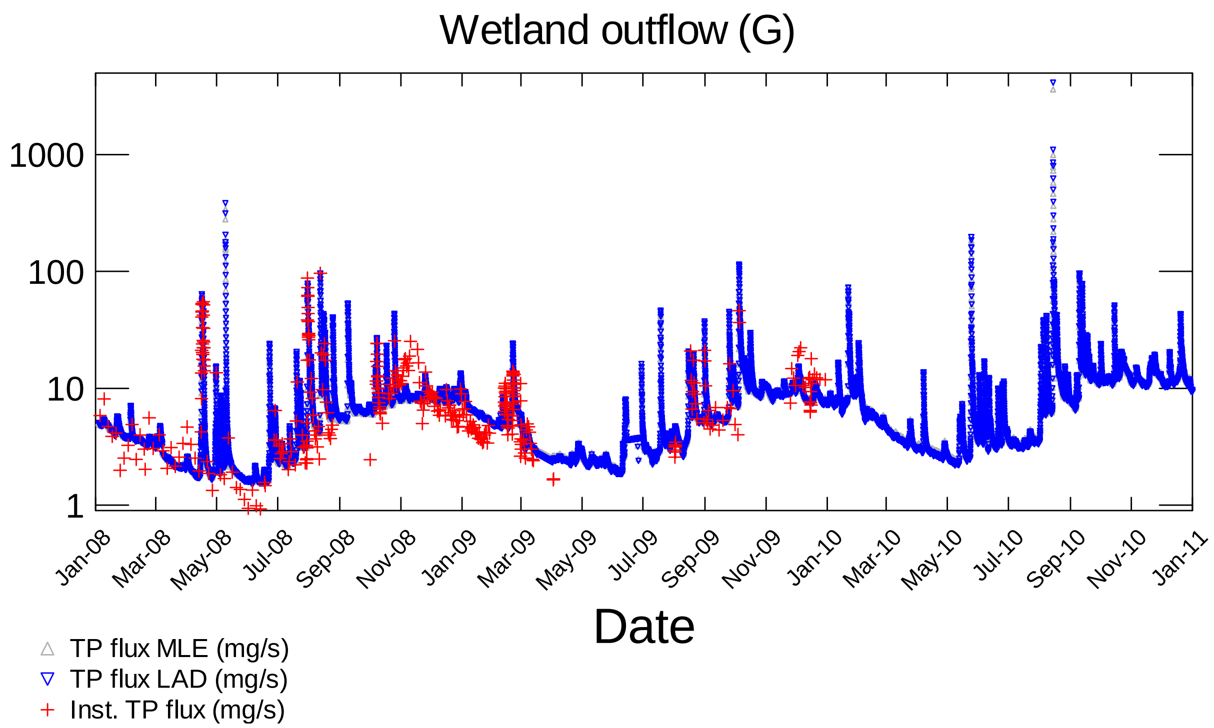
Wetland outflow (site G)

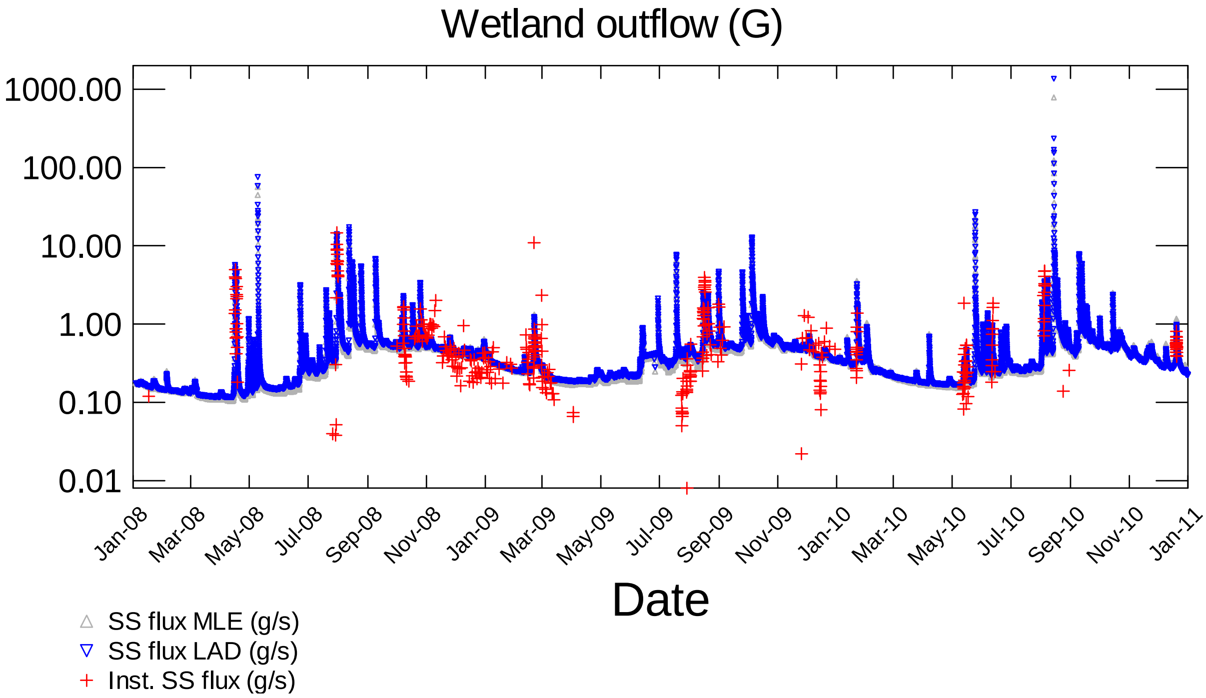



Wetland outflow (G)
1000.00
100.00
10.00
1.00
0.10
0.01
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
Nitrate-N flux MLE (mg/s)
Nitrate-N flux LAD (mg/s)
Inst. Nitrate-N flux (mg/s)

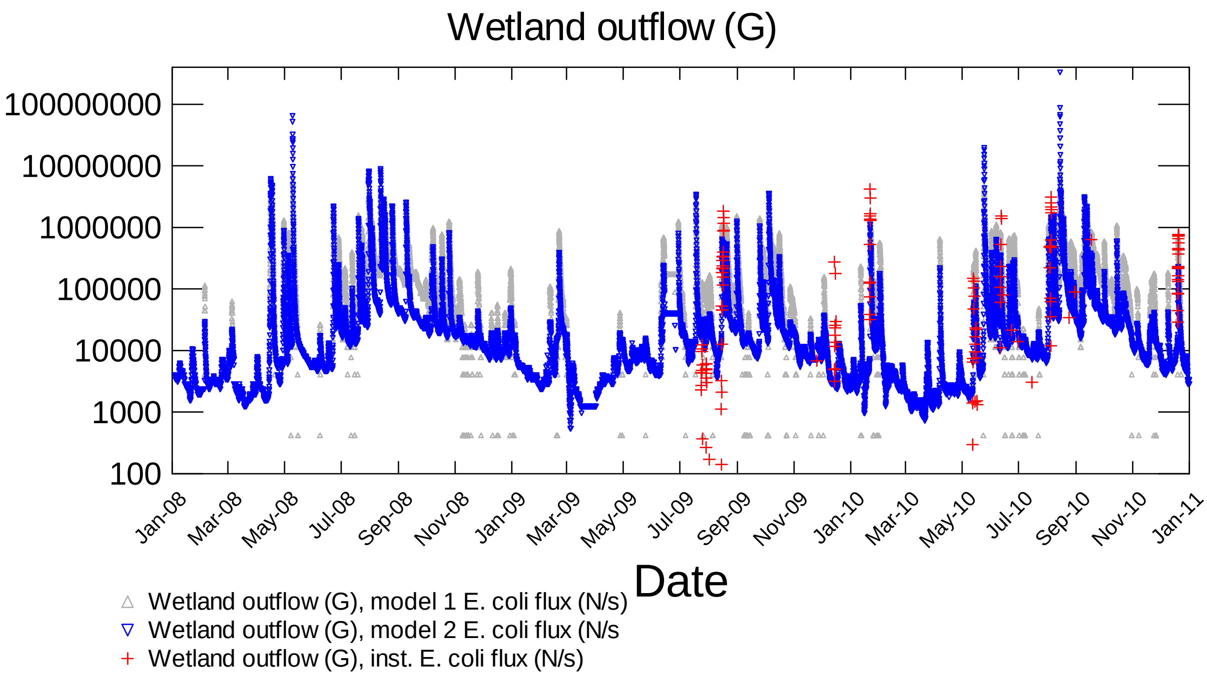

Wetland outflow (G)
1000
100
10
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
TN flux MLE (mg/s)
TN flux LAD (mg/s)
Inst. TN flux (mg/s)


Wetland outflow (G)
100
10
1
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
DRP flux MLE (mg/s)
DRP flux LAD (mg/s)
Inst. DRP flux (mg/s)


Wetland outflow (G)
1000
100
10
1
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
TP flux MLE (mg/s)
TP flux LAD (mg/s)
Inst. TP flux (mg/s)



Wetland outflow (G)
1000.00
100.00
10.00
1.00
0.10
0.01
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
SS flux MLE (g/s)
SS flux LAD (g/s)
Inst. SS flux (g/s)



Wetland outflow (G)
100000000
10000000
1000000
100000
10000
1000
100
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Date
Wetland outflow (G), model 1 E. coli flux (N/s)
Wetland outflow (G), model 2 E. coli flux (N/s
Wetland outflow (G), inst. E. coli flux (N/s)

Appendix E Comparison of wetland inflow and outflow contaminant loads derived from LOADEST LAD and composite regression models

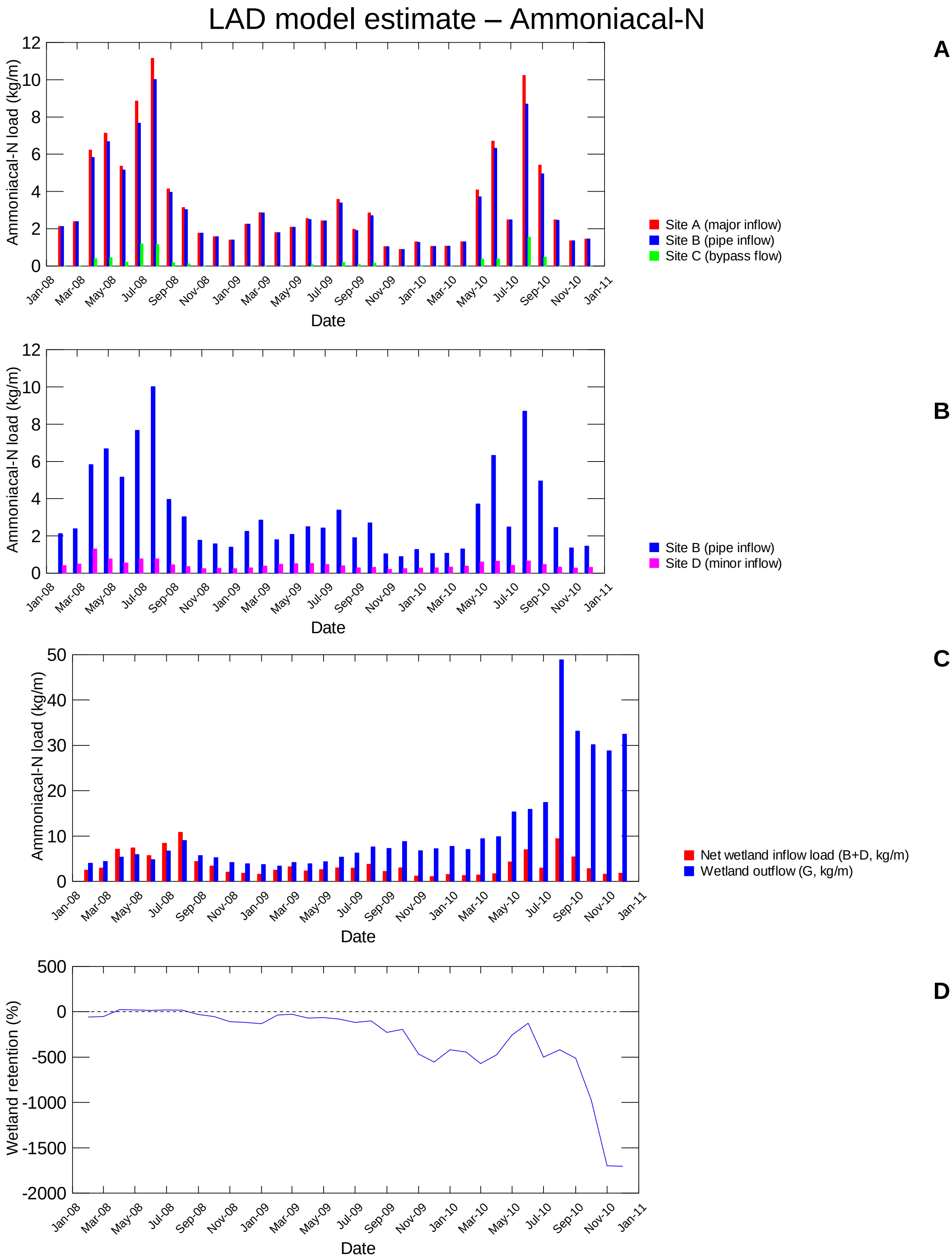


Figure E-1: Trend in ammoniacal-N flux in wetland inflows and outflow, as well as net wetland attenuation (A-D). "LAD" technique is one of the options available in the LOADEST model suite, and the "Regression model estimate" is based on the best fit obtained. Data for period January 2008 – December 2010 inclusive.

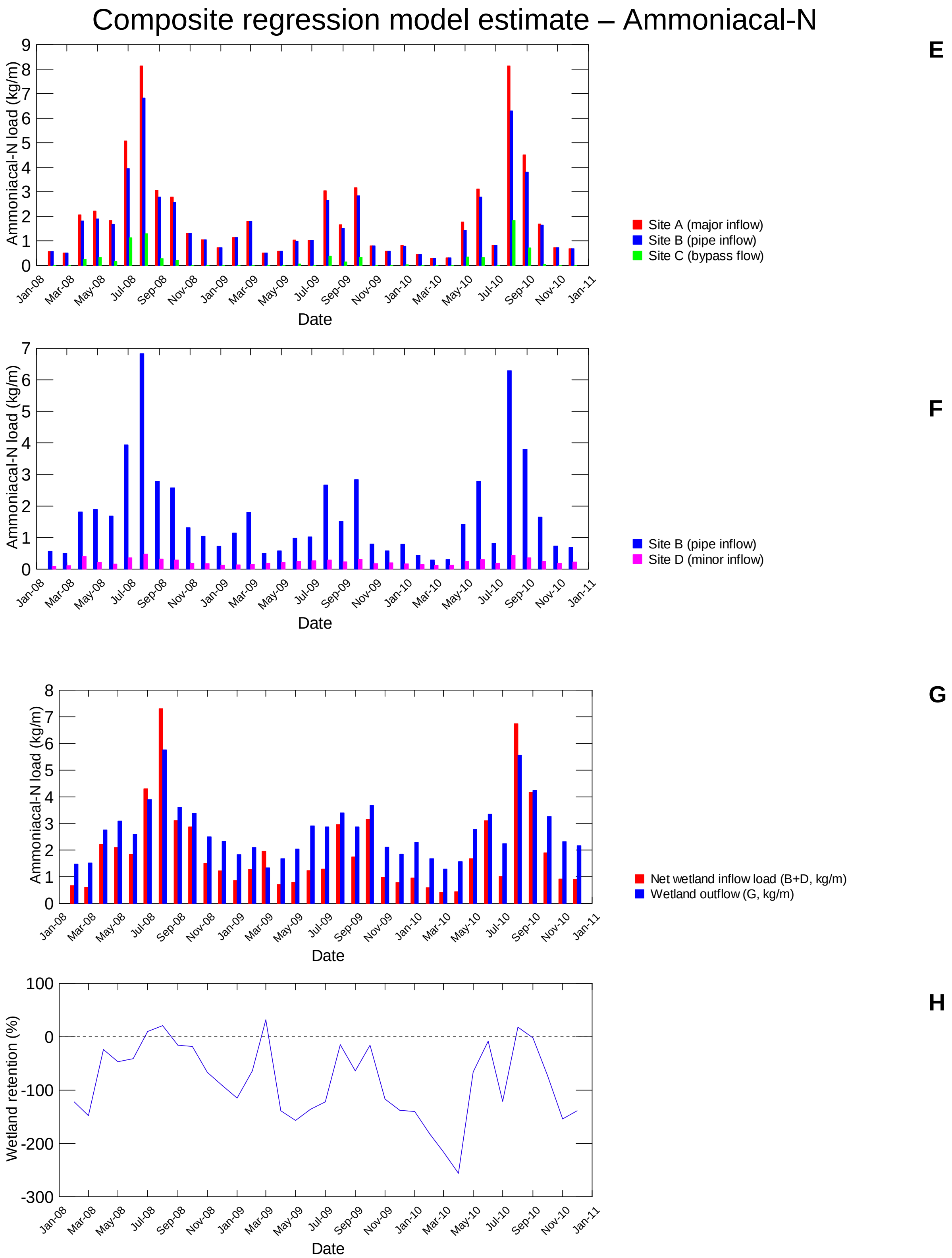


Figure E-1: (Continued)

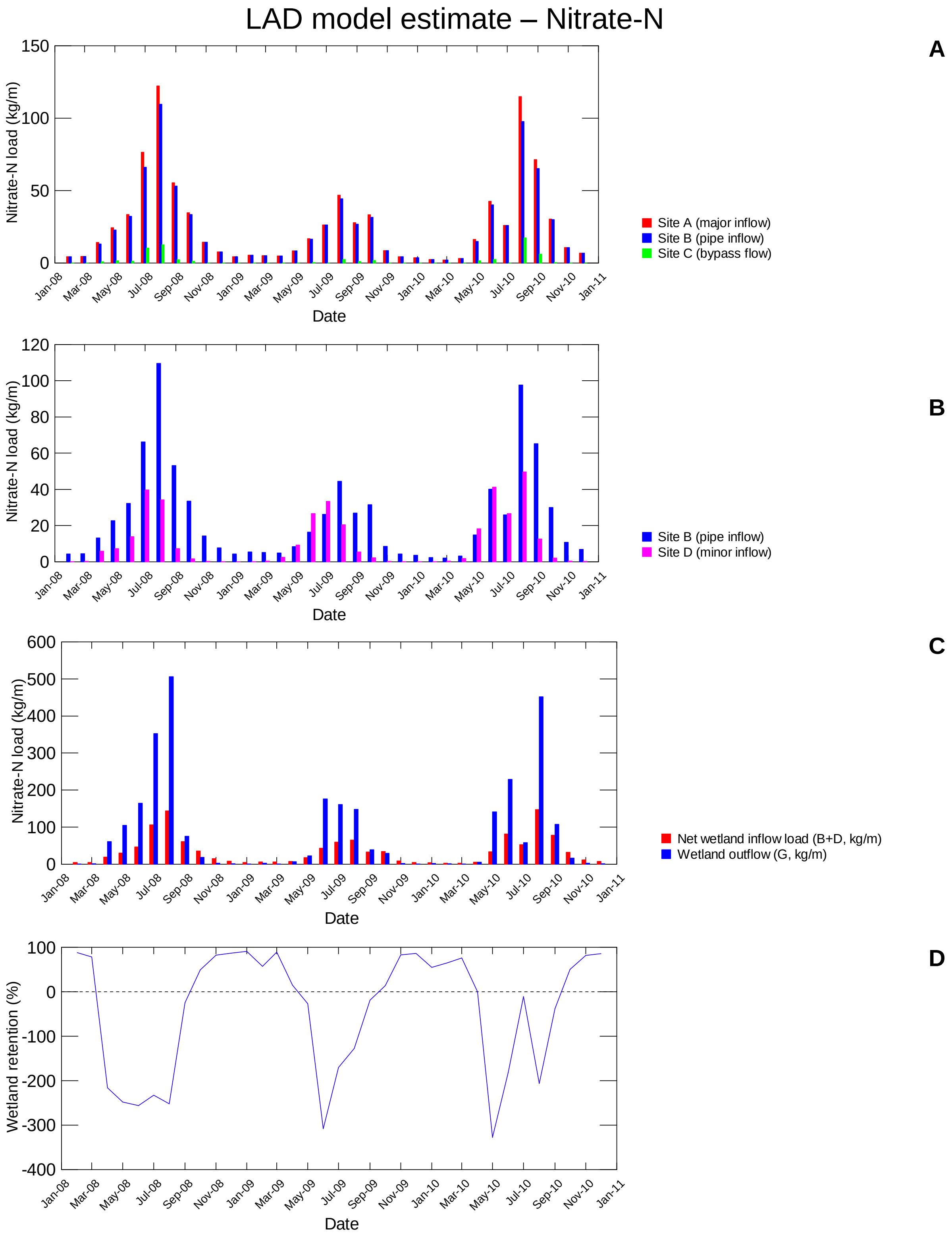


Figure E-2: Trend in nitrate-N flux in wetland inflows and outflow, as well as net wetland attenuation. "LAD" technique is one of the options available in the LOADEST model suite, and the "Regression model estimate" is based on the best fit obtained. Data for period January 2008 – December 2010 inclusive.

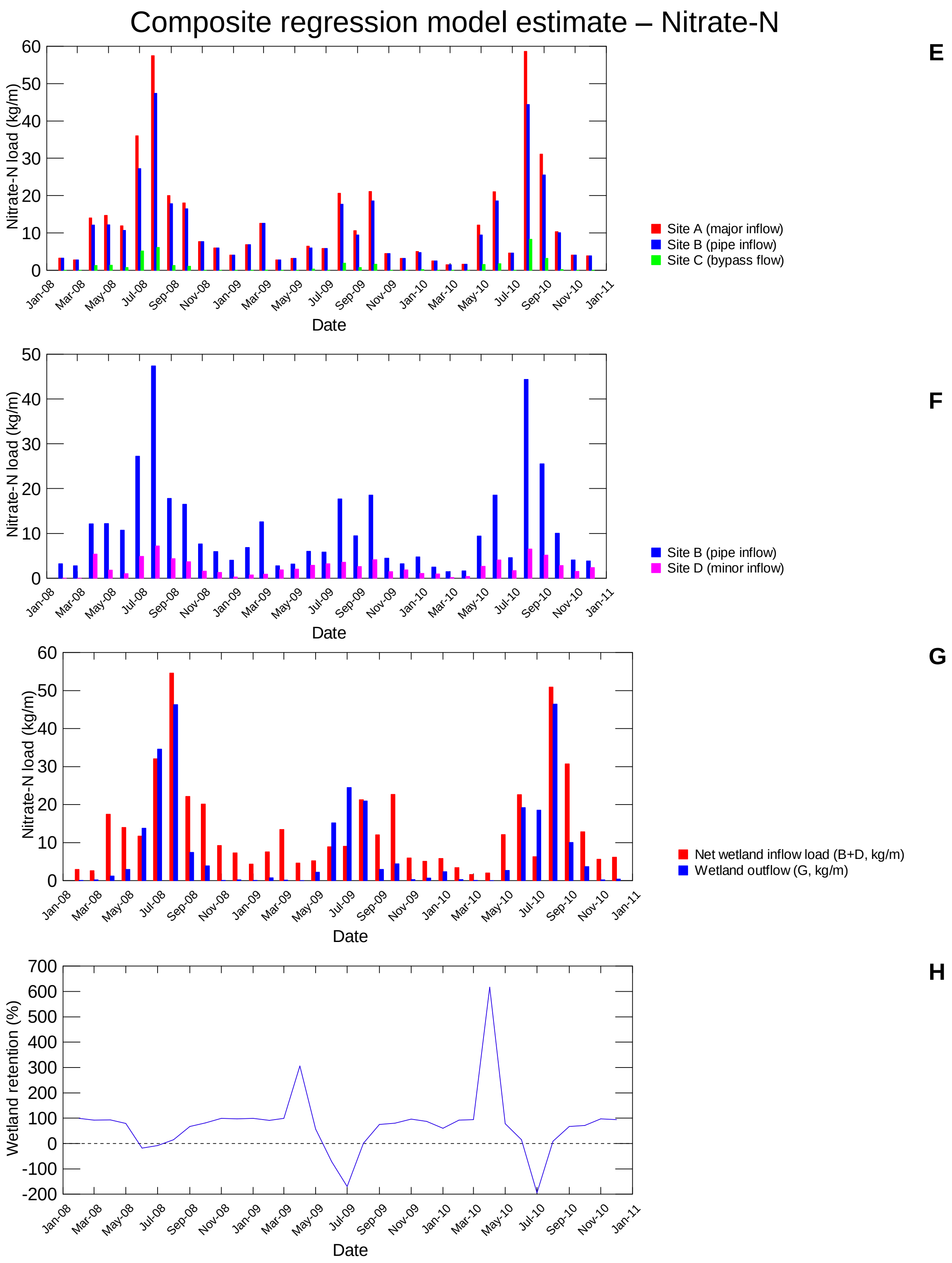


Figure E-2: (Continued).

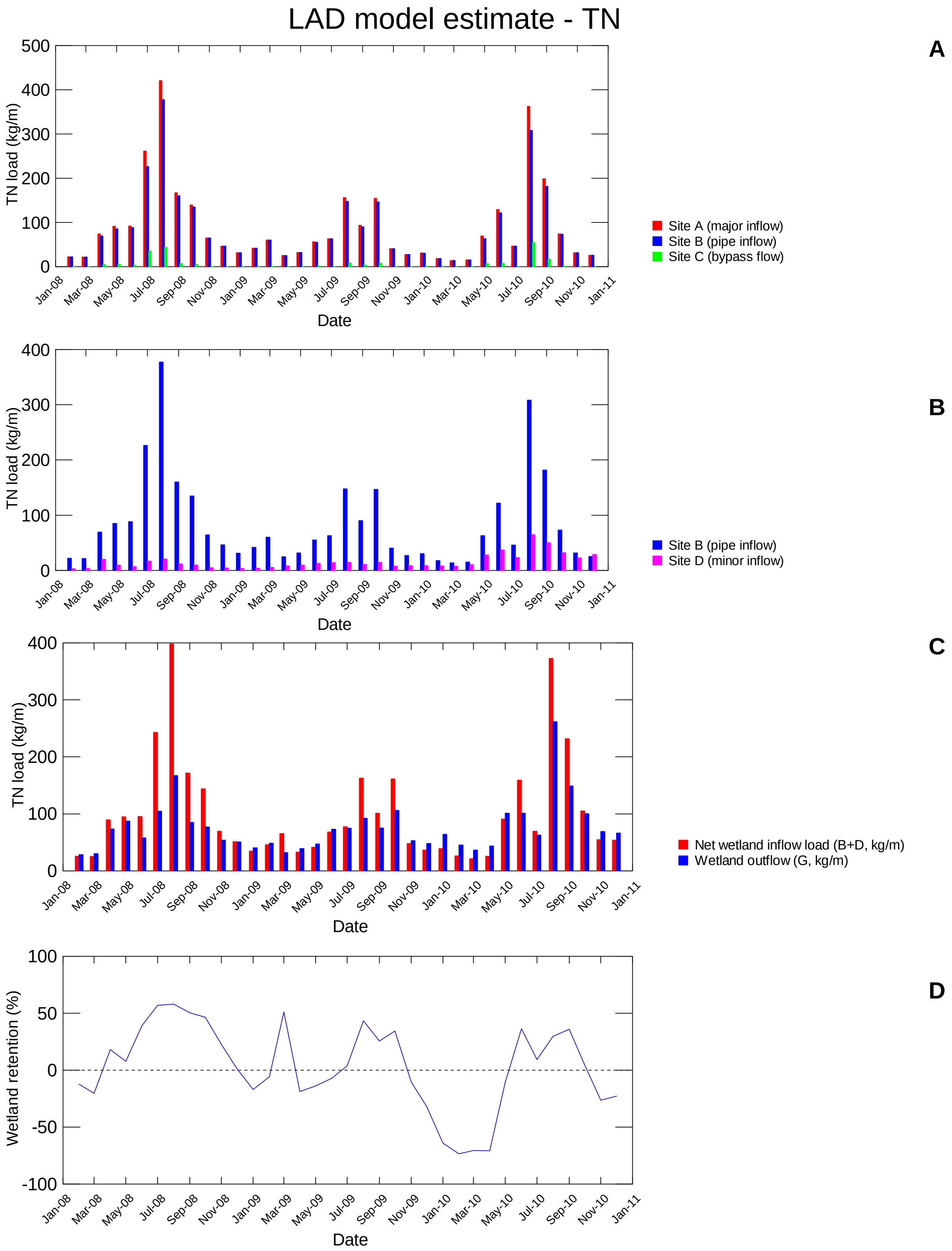


Figure E-3: Trend in TN flux in wetland inflows and outflow, as well as net wetland attenuation. "LAD" technique is one of the options available in the LOADEST model suite, and the "Regression model estimate" is based on the best fit obtained. Data for period January 2008 – December 2010 inclusive.

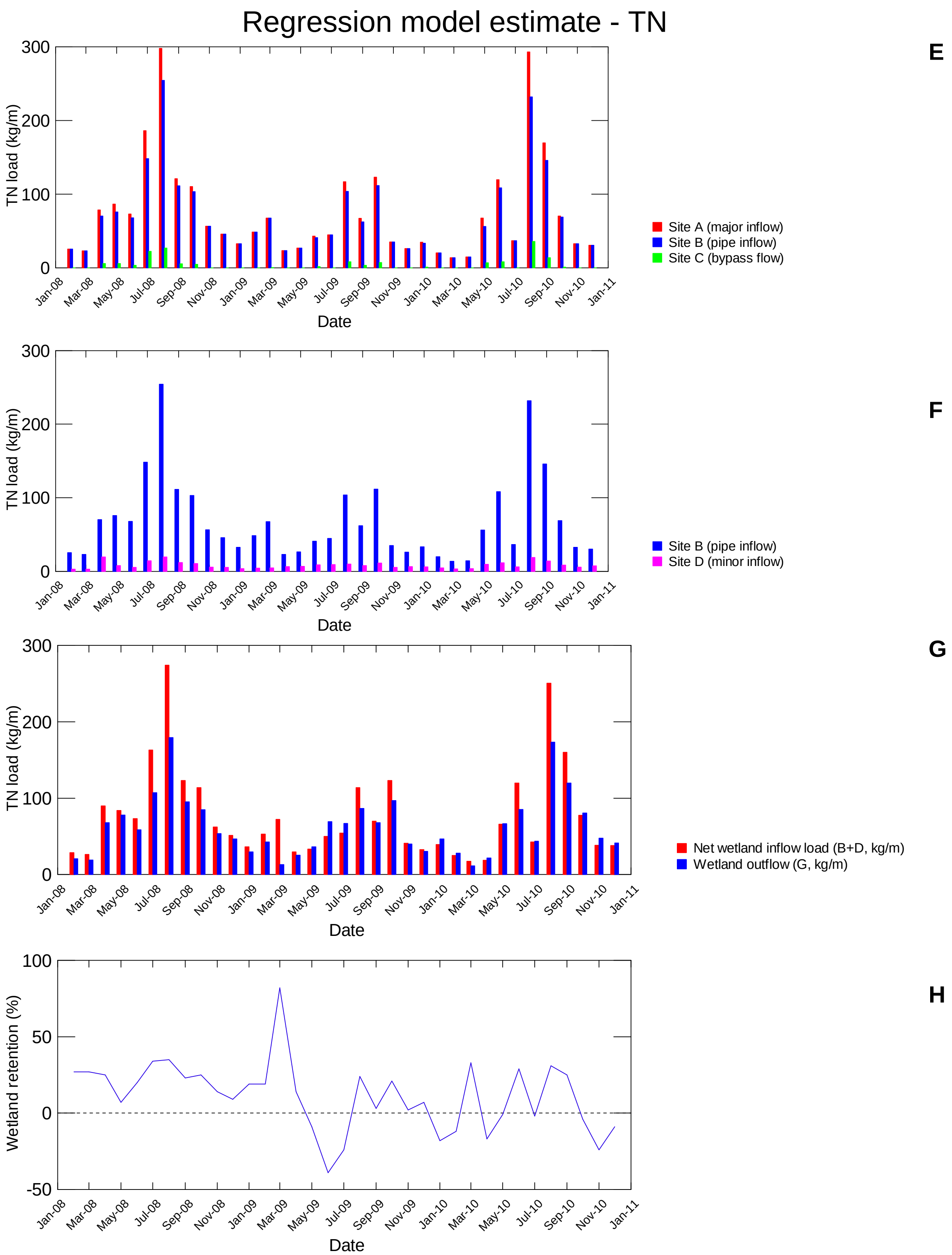


Figure E-3: (Continued).

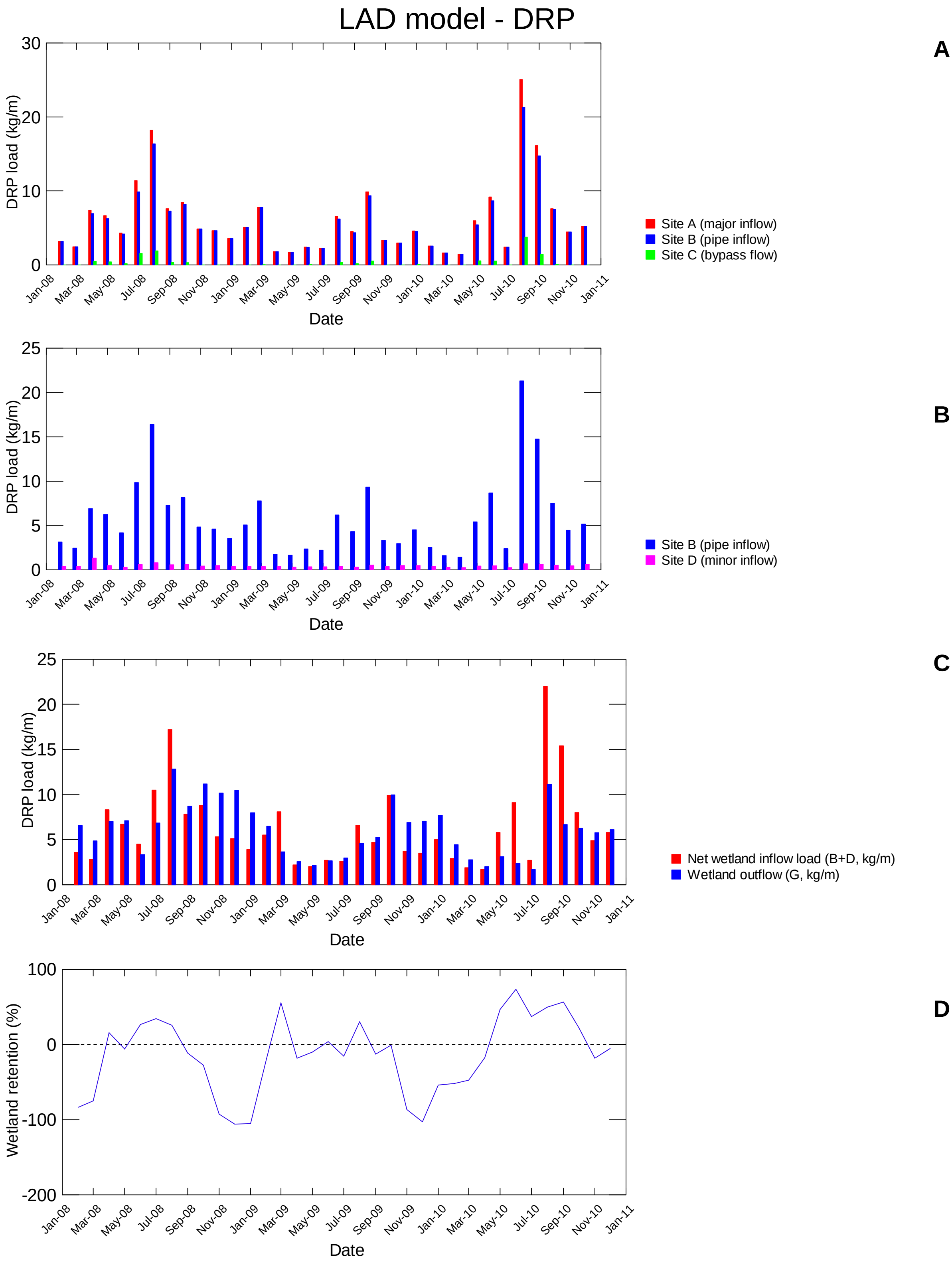


Figure E-4: Trend in DRP flux in wetland inflows and outflow, as well as net wetland attenuation. "LAD" technique is one of the options available in the LOADEST model suite, and the "Regression model estimate" is based on the best fit obtained. Data for period January 2008 – December 2010 inclusive.

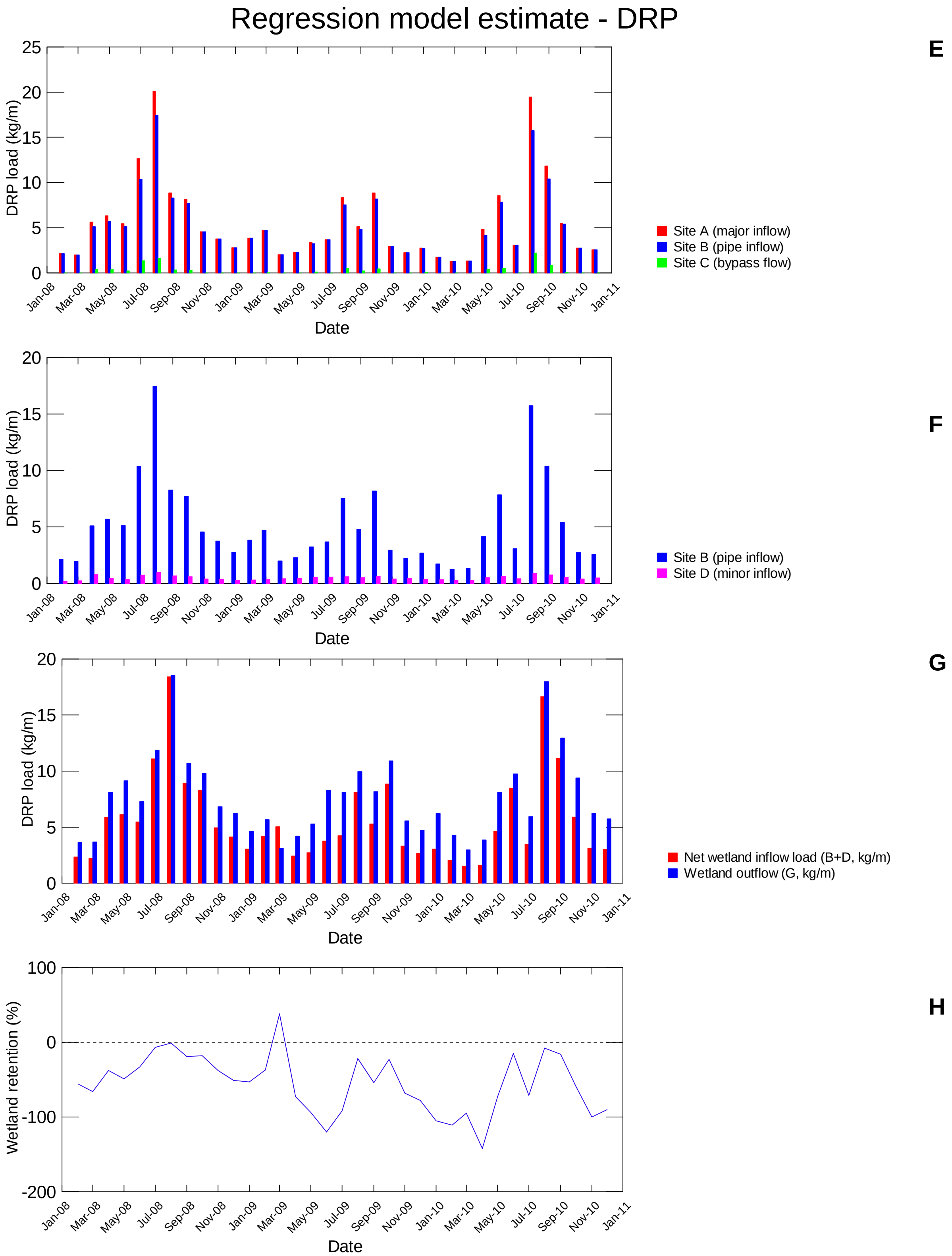


Figure E-4: (Continued).

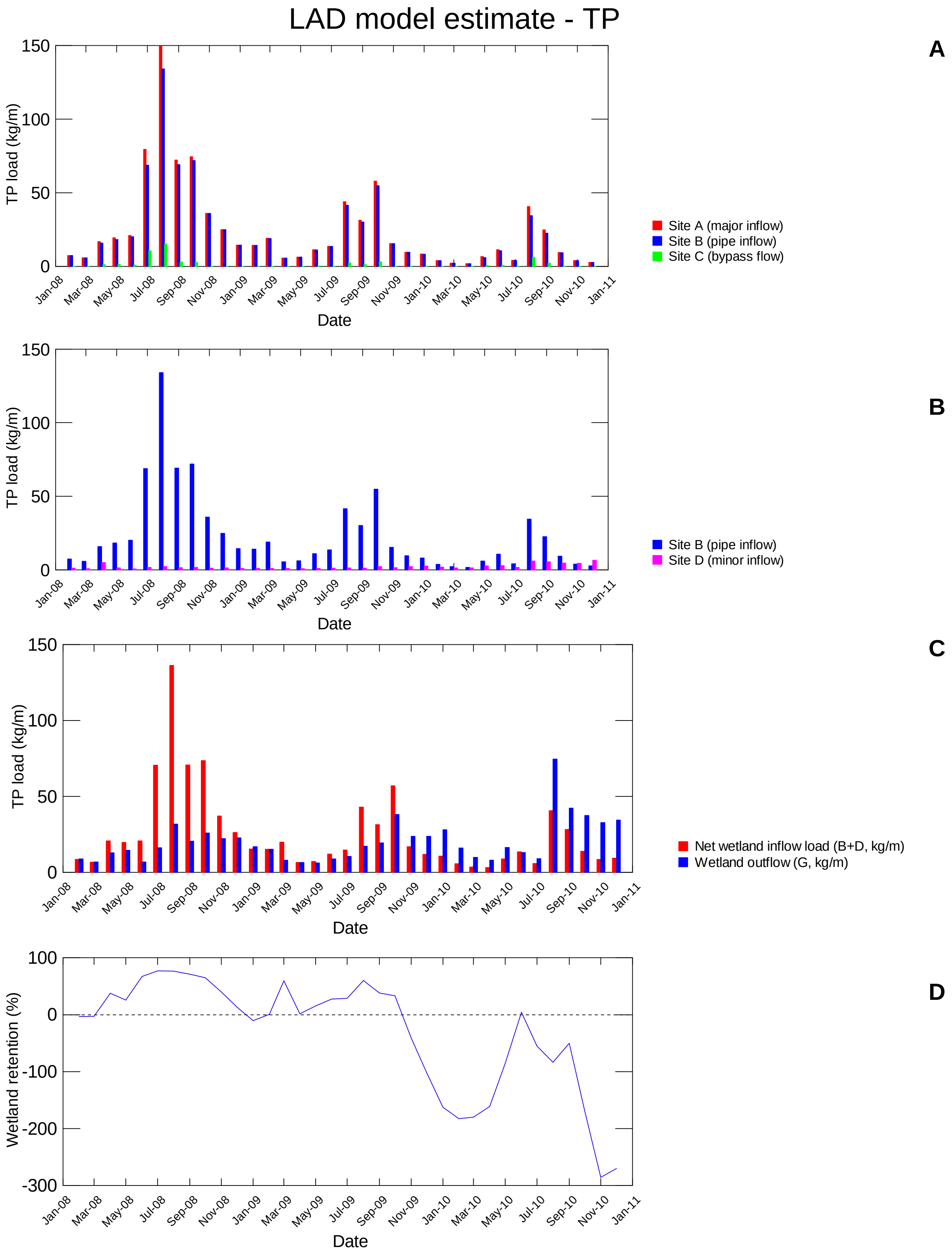


Figure E-5: Trend in TP flux in wetland inflows and outflow, as well as net wetland attenuation. "LAD" technique is one of the options available in the LOADEST model suite, and the "Regression model estimate" is based on the best fit obtained. Data for period January 2008 – December 2010 inclusive.

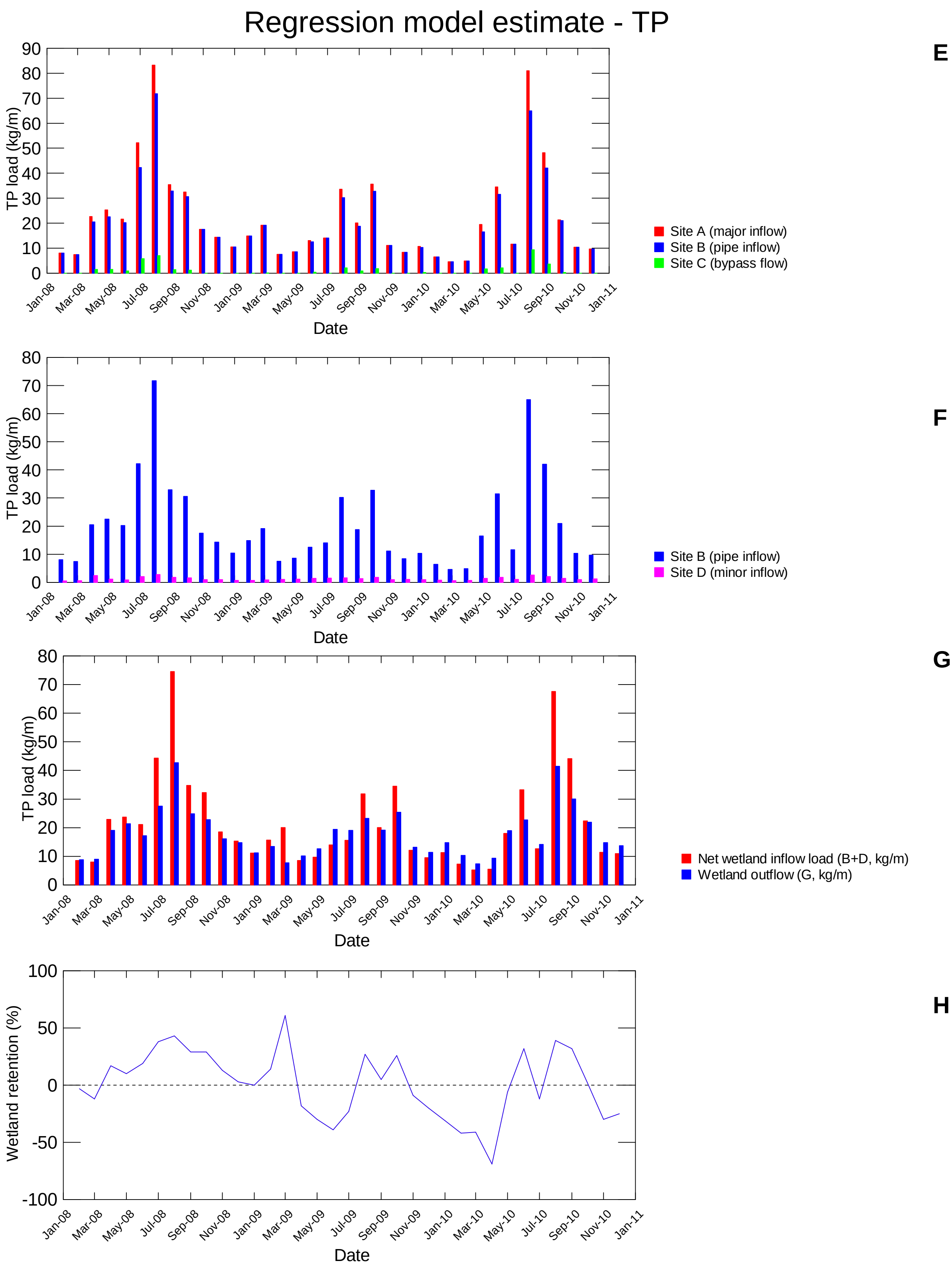


Figure E-5: (Continued).

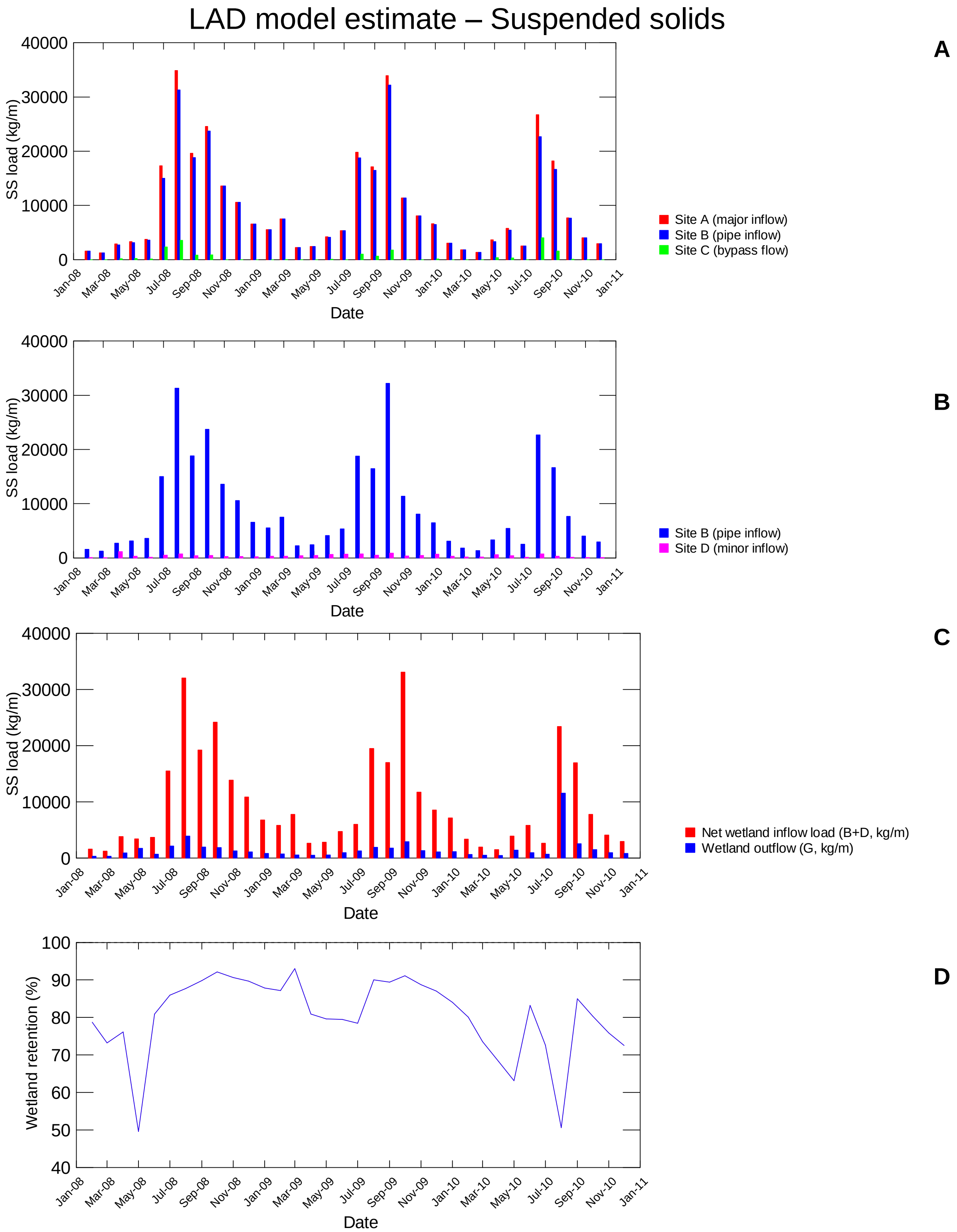


Figure E-6: Trend in SS flux in wetland inflows and outflow, as well as net wetland attenuation. "LAD" technique is one of the options available in the LOADEST model suite, and the "Regression model estimate" is based on the best fit obtained. Data for period January 2008 – December 2010 inclusive.

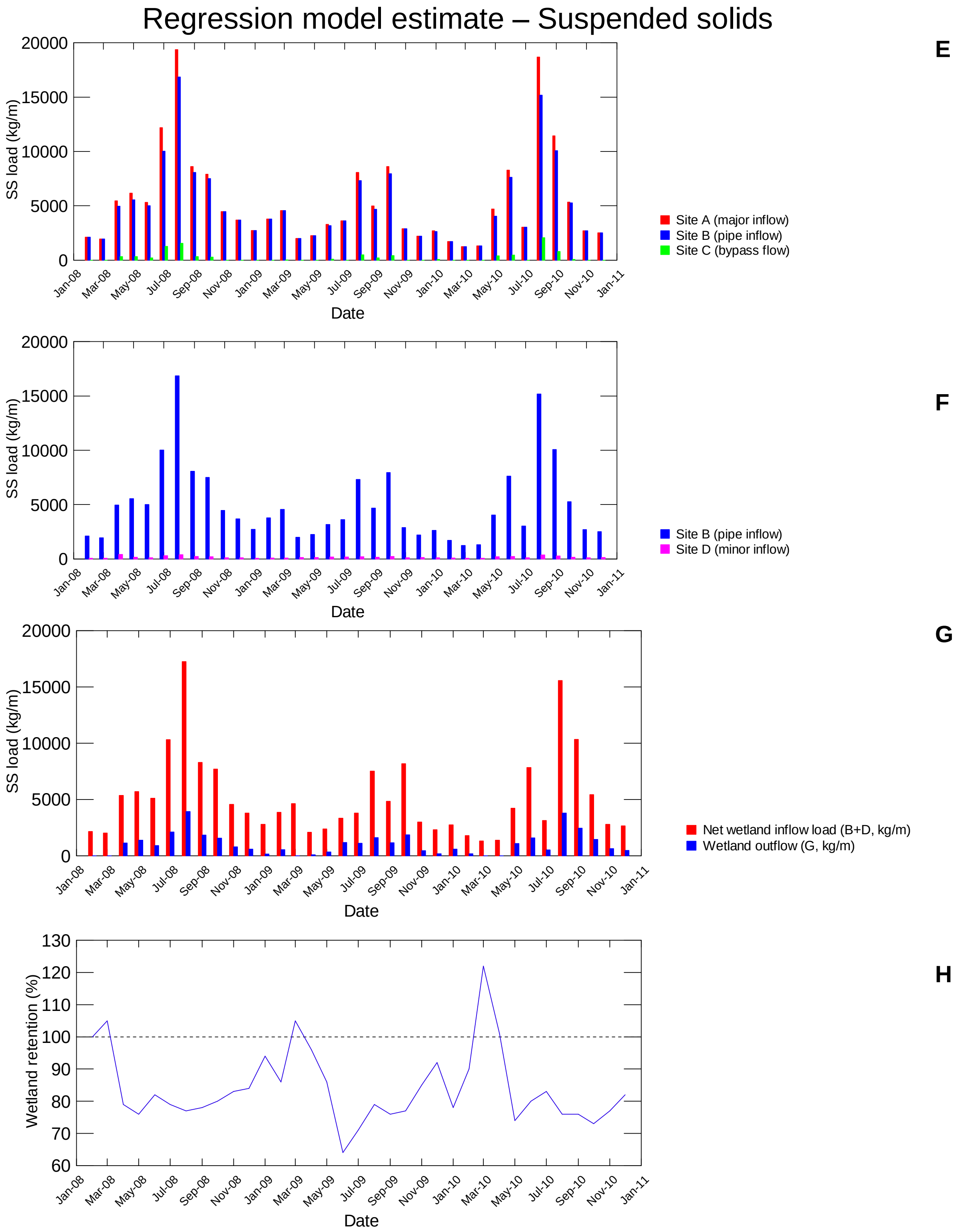


Figure E-6: (Continued).

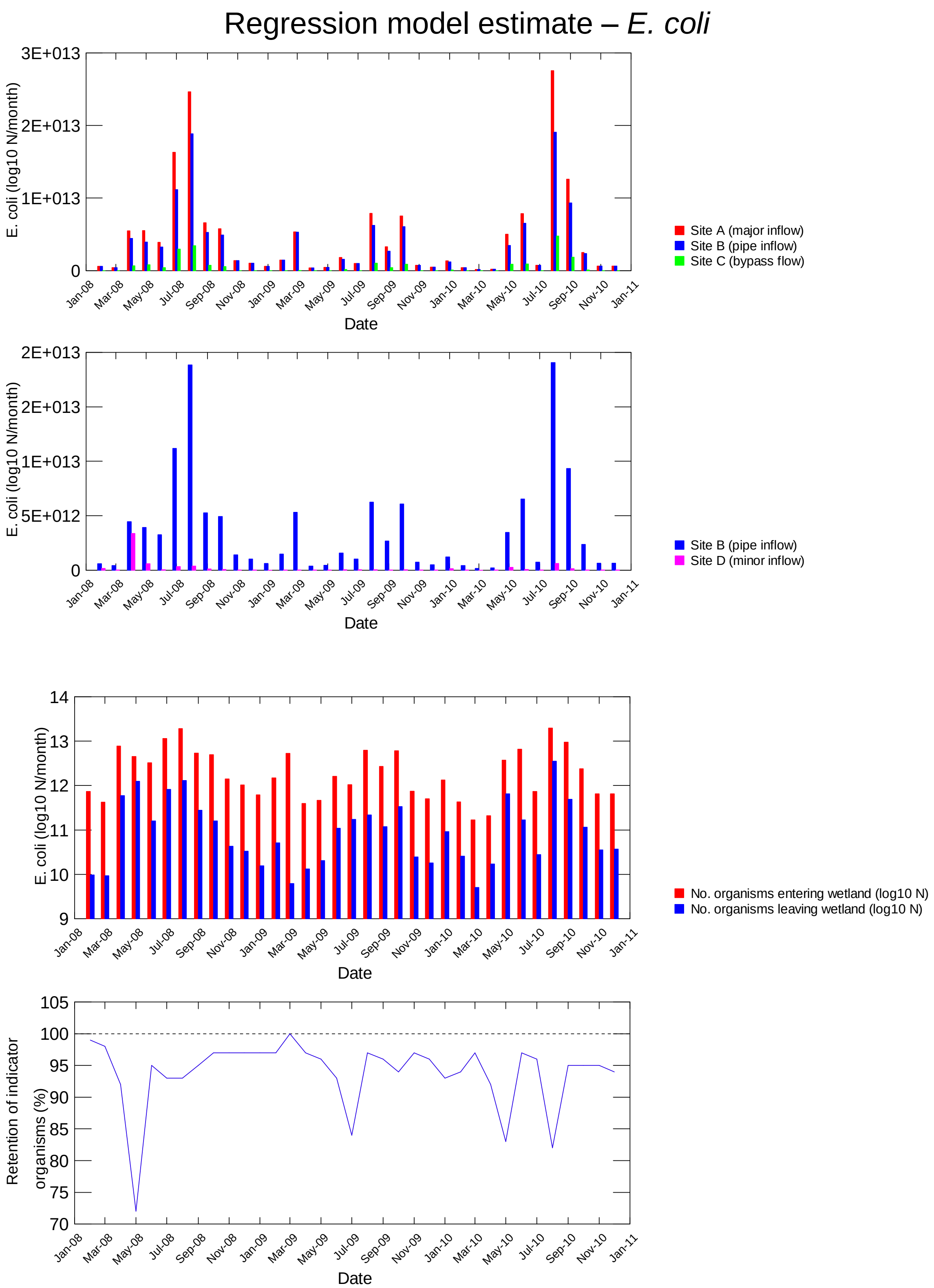


Figure E-7: Trend in *E. coli* flux in wetland inflows and outflow, as well as net wetland attenuation. A simple regression model (selected on the basis of the best fit to observed data) was used. Data for period January 2008 – December 2010 inclusive.

Appendix F Annual estimates derived from the LOADEST LAD and regression model techniques

LAD model load estimates

Variable	DRP	DRP	DRP	DRP	DRP
YEAR	2007	2008	2009	2010	2011
A load (kg)	10.1	83.7	51.6	86.1	58
B load (kg)	10.1	78.7	50.6	79.7	51.2
C load (kg)	0	5.1	1.1	6.4	6.8
D load (kg)	1.3	7	4.6	5.5	0
Wetland inflow load (kg)	11.3	85.8	55.4	85.2	51.2
Outflow load (kg)	25.6	98.6	62.2	60	57.5
Load retained by wetland	-14.3	-12.8	-6.8	25.2	-6.3
Percent of inflow load retained by wetland	-127%	-15%	-12%	30%	-12%

Variable	TP	TP	TP	TP	TP
YEAR	2007	2008	2009	2010	2011
A load (kg)	37.7	519	242.4	119.4	12.3
B load (kg)	37.7	484.3	235.6	109.7	10.8
C load (kg)	0	34.7	6.8	9.7	1.5
D load (kg)	3.3	20	15.5	41.8	0
Wetland inflow load (kg)	41	504.4	251.3	151.7	10.7
Outflow load (kg)	34.2	201.8	194.5	322	412.9
Load retained by wetland	6.8	302.6	56.8	-170.3	-402.2
Percent of inflow load retained by wetland	17%	60%	23%	-112%	-3759%

Variable	NH4N	NH4N	NH4N	NH4N	NH4N
YEAR	2007	2008	2009	2010	2011
A load (kg)	5.2	56.3	25.6	38.9	12.1
B load (kg)	5.2	52.7	25.2	36.1	11
C load (kg)	0	3.7	0.5	2.8	1.1
D load (kg)	0.8	6.8	4.3	4.9	0
Wetland inflow load (kg)	6	59.4	29.4	41.1	11
Outflow load (kg)	11.8	64.1	68.6	256.1	175.3
Load retained by wetland	-5.8	-4.7	-39.2	-215	-164.3
Percent of inflow load retained by wetland	-97%	-8%	-133%	-523%	-1494%

Variable	NO3N	NO3N	NO3N	NO3N	NO3N
YEAR	2007	2008	2009	2010	2011
A load (kg)	28.8	398.2	192.2	330.3	29.3
B load (kg)	28.8	368.2	186.6	302.6	26.8
C load (kg)	0	30	5.6	27.7	2.5
D load (kg)	0.2	110.6	101	153.4	0
Wetland inflow load (kg)	29	478.8	287.6	456.1	26.8
Outflow load (kg)	3.3	1286.1	586.2	1014.7	11.4
Load retained by wetland	25.7	-807.3	-298.6	-558.6	15.4
Percent of inflow load retained by wetland	89%	-169%	-104%	-122%	57%

Variable	TN	TN	TN	TN	TN
YEAR	2007	2008	2009	2010	2011
A load (kg)	87.9	1430.9	781.3	1014.6	171.6
B load (kg)	87.9	1326.9	760.2	927.9	152.4
C load (kg)	0	103.9	21	86.7	19.2
D load (kg)	10.4	116.8	115.5	322.1	0
Wetland inflow load (kg)	98.3	1443.7	875.7	1250	152.4
Outflow load (kg)	84.2	846.6	729.5	1100.6	464.2
Load retained by wetland	14.1	597.1	146.2	149.4	-311.8
Percent of inflow load retained by wetland	14%	41%	17%	12%	-205%

Variable	SS	SS	SS	SS	SS
YEAR	2007	2008	2009	2010	2011
A load (kg)	6961.5	135885.8	124203.4	84434.8	11032.4
B load (kg)	6961.5	127759.4	120654.5	77994.4	9606
C load (kg)	0	8126.4	3549	6440.4	1426.4
D load (kg)	32.8	4255	5870.7	3637	0
Wetland inflow load (kg)	6994.3	132014.4	126525.3	81631.3	9606.1
Outflow load (kg)	1235.6	16846.8	14574.2	23414.8	25058.3
	5758.7	115167.6	111951.1	58216.5	-15452.2
	82%	87%	88%	71%	-161%

Regression model load estimates

Variable	DRP	DRP	DRP	DRP	DRP
YEAR	2007	2008	2009	2010	2011
A load (kg)	7.2	82.5	50.1	65.5	18.3
B load (kg)	7.2	75.1	48.2	58.8	15.9
C load (kg)	0	4.5	1.2	4	1.4
D load (kg)	0.7	6	5.4	5.8	0
Wetland inflow load (kg)	7.9	81.1	53.6	64.6	15.9
Outflow load (kg)	12.2	99.7	78.6	93.4	22.5
Load retained by wetland	-4.4	-18.6	-25	-28.8	-6.6
Percent of inflow load retained by wetland	-55%	-23%	-47%	-45%	-41%

Variable	TP	TP	TP	TP	TP
YEAR	2007	2008	2009	2010	2011
A load (kg)	27.6	331.5	196.6	262.7	74.6
B load (kg)	27.6	299.5	188.4	233.9	64.2
C load (kg)	0	19.3	5.3	17.3	6.1
D load (kg)	1.7	16.6	14.2	15.7	0
Wetland inflow load (kg)	29.3	316.1	202.6	249.5	64.2
Outflow load (kg)	29	233.8	185.8	219.6	52.3
Load retained by wetland	0.2	82.3	16.7	30	11.9
Percent of inflow load retained by wetland	1%	26%	8%	12%	19%

Variable	NH4N	NH4N	NH4N	NH4N	NH4N
YEAR	2007	2008	2009	2010	2011
A load (kg)	2	29.4	16.1	23.3	7
B load (kg)	2	25.8	15.2	20	5.8
C load (kg)	0	3.6	0.9	3.3	1.2
D load (kg)	0.3	2.9	2.6	2.8	0
Wetland inflow load (kg)	2.3	28.7	17.7	22.8	5.8
Outflow load (kg)	4.6	34.5	28.7	32.7	7.2
Load retained by wetland	-2.2	-5.8	-10.9	-9.9	-1.4
Percent of inflow load retained by wetland	-96%	-20%	-62%	-43%	-24%

Variable	NO3N	NO3N	NO3N	NO3N	NO3N
YEAR	2007	2008	2009	2010	2011
A load (kg)	11.6	196.4	101.7	156.3	48.2
B load (kg)	11.6	168.2	94.6	130.8	39
C load (kg)	0	16.9	4.5	15.2	5.4
D load (kg)	1.9	31	25.5	29.3	0

Wetland inflow load (kg)	13.5	199.2	120.1	160.1	39
Outflow load (kg)	0.4	110.6	62.6	93.4	7.2
Load retained by wetland	13.1	88.6	57.4	66.7	31.7
Percent of inflow load retained by wetland	97%	44%	48%	42%	81%

Variable	TN	TN	TN	TN	TN
YEAR	2007	2008	2009	2010	2011
A load (kg)	88.1	1140.4	654.4	902.8	262.2
B load (kg)	88.1	1018.2	623.1	792.7	222.5
C load (kg)	0	73.5	20.1	66	23.2
D load (kg)	9.9	111.6	85.7	100.2	0
Wetland inflow load (kg)	98	1129.7	708.8	892.9	222.5
Outflow load (kg)	91.7	833.1	605.6	765.7	203.4
Load retained by wetland	6.3	296.7	103.2	127.2	19.1
Percent of inflow load retained by wetland	6%	26%	15%	14%	9%

Variable	SS	SS	SS	SS	SS
YEAR	2007	2008	2009	2010	2011
A load (kg)	7082.1	80145.7	48934.4	63617.6	17687.1
B load (kg)	7082.1	73118.5	47118.3	57289.2	15413.5
C load (kg)	0	4247.1	1168.8	3814.9	1336.1
D load (kg)	185.3	2200.4	1623	1939	0
Wetland inflow load (kg)	7267.5	75318.8	48741.3	59228.2	15413.5
Outflow load (kg)	1172.9	14170.3	8449.7	12477.2	4018.8
Load retained by wetland	6094.6	61148.5	40291.6	46750.9	11394.7
Percent of inflow load retained by wetland	84%	81%	83%	79%	74%

Variable	Ecoli	Ecoli	Ecoli	Ecoli	Ecoli
YEAR	2007	2008	2009	2010	2011
A load (kg)	2.07E+12	7.24E+13	3.10E+13	5.96E+13	1.98E+13
B load (kg)	2.07E+12	5.60E+13	2.708E+13	4.478E+13	1.44E+13
C load (kg)	0	9.61E+12	2.51E+12	8.65E+12	3.09E+12
D load (kg)	2.16E10	5.05E+12	2.24E+11	1.28E+12	0
Wetland inflow load (kg)	2.09E+12	6.11E+13	2.73E+13	4.60E+13	1.44E+13
Outflow load (kg)	6.60E10	4.67E+12	1.10E+12	5.19E+12	1.06E+13
Load retained by wetland	2.02E+12	5.64E+13	2.62E+13	4.08E+13	3.78E+12
Percent of inflow load retained by wetland	97%	92%	96%	89%	26%

Appendix G AMLE load estimates

Ammoniacal-N

Site A

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	28824	262.52	194.18	347.21	39.14	38.14
Season 1	11184	121.71	75.04	186.99	28.74	27.96
Season 2	6624	201.40	138.51	283.25	37.06	33.98
Season 3	6624	572.37	403.07	789.25	98.84	93.78
Season 4	7272	191.72	134.62	265.00	33.37	31.60
Nov. 2007	720	231.11	108.48	434.40	84.43	82.08
Dec. 2007	744	172.87	90.42	300.83	54.28	52.34
Jan. 2008	744	126.08	72.65	204.15	33.82	32.13
Feb. 2008	696	119.76	72.49	186.67	29.32	27.07
Mar. 2008	744	140.72	87.64	214.48	32.55	30.39
Apr. 2008	720	417.05	252.04	650.84	102.43	73.90
May 2008	744	556.51	347.58	846.28	127.97	92.90
June 2008	720	529.58	341.45	785.13	113.77	85.46
July 2008	744	828.	540.	1216.	173.	124.
Aug. 2008	744	893.	605.	1273.	171.	132.
Sep. 2008	720	259.60	175.60	370.15	49.83	36.00
Oct. 2008	744	127.66	87.26	180.46	23.87	18.58
Nov. 2008	720	52.30	37.46	71.09	8.61	7.49
Dec. 2008	744	34.13	25.01	45.49	5.24	4.48
Jan. 2009	744	27.92	20.73	36.81	4.11	3.47
Feb. 2009	672	48.11	33.23	67.42	8.75	7.27
Mar. 2009	744	67.10	40.14	105.53	16.80	12.02
Apr. 2009	720	68.54	42.54	104.76	15.97	14.90
May 2009	744	102.96	61.36	162.42	25.97	24.63
June 2009	720	160.26	93.45	257.12	42.08	35.79
July 2009	744	159.73	99.63	243.15	36.83	34.52
Aug. 2009	744	211.11	136.58	312.13	45.01	34.88
Sep. 2009	720	102.12	68.22	147.11	20.21	15.65
Oct. 2009	744	105.85	69.67	154.33	21.70	15.55
Nov. 2009	720	31.96	22.87	43.47	5.27	4.54
Dec. 2009	744	22.81	16.10	31.40	3.92	3.42
Jan. 2010	744	30.36	19.91	44.39	6.27	4.77
Feb. 2010	672	32.95	21.04	49.22	7.23	6.58
Mar. 2010	744	45.12	24.83	75.63	13.08	12.57
Apr. 2010	720	82.35	41.99	145.97	26.85	25.98
May 2010	744	331.08	163.25	601.17	113.22	91.34
June 2010	720	692.	371.	1182.	209.	185.
July 2010	744	334.49	179.34	571.63	101.12	97.58
Aug. 2010	744	1332.	735.	2228.	384.	337.
Sep. 2010	720	649.	363.	1074.	183.	157.
Oct. 2010	744	240.21	136.79	392.42	65.77	61.07
Nov. 2010	720	120.56	64.81	205.63	36.30	34.92
Dec. 2010	744	112.11	56.85	199.54	36.85	35.58
Jan. 2011	744	506.	207.	1042.	218.	198.
Feb. 2011	312	454.12	201.55	886.97	177.98	168.92

Site D

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	95% Conf.Intervals Upper	Std Error Prediction	Standard Error
Est. Period	27216	25.40	0.96	135.92	50.29	50.29
Season 1	9576	12.85	0.02	86.13	129.05	129.05
Season 2	6624	29.99	7.46	82.68	20.27	20.21
Season 3	6624	41.41	27.55	59.85	8.28	8.16
Season 4	7272	18.84	11.36	29.47	4.65	4.61
Nov. 2007	720	22.23	10.74	40.95	7.81	7.59
Dec. 2007	744	20.49	10.69	35.73	6.46	6.22
Jan. 2008	744	17.22	0.00	86.07	754.79	754.79
Feb. 2008	696	19.30	0.00	99.64	753.12	753.12
Mar. 2008	744	24.77	0.07	169.10	171.74	171.73
Apr. 2008	720	61.48	33.97	102.73	17.71	14.05
May 2008	744	46.28	29.33	69.56	10.32	8.40
June 2008	720	41.30	25.88	62.65	9.44	8.65
July 2008	744	49.17	33.31	70.02	9.40	8.08
Aug. 2008	744	42.66	28.72	61.08	8.29	7.19
Sep. 2008	720	22.27	15.04	31.80	4.30	3.77
Oct. 2008	744	13.71	9.28	19.55	2.63	2.34
Nov. 2008	720	8.32	5.79	11.57	1.48	1.30
Dec. 2008	744	7.03	5.04	9.54	1.15	0.99
Jan. 2009	744	6.79	4.87	9.22	1.11	0.96
Feb. 2009	672	9.04	6.41	12.41	1.53	1.30
Mar. 2009	744	12.28	8.37	17.40	2.31	2.07
Apr. 2009	720	18.88	12.30	27.75	3.96	3.62
May 2009	744	24.27	15.24	36.76	5.52	5.14
June 2009	720	29.28	18.40	44.30	6.65	6.14
July 2009	744	27.36	17.58	40.68	5.93	5.44
Aug. 2009	744	22.01	14.68	31.75	4.37	3.97
Sep. 2009	720	14.65	9.96	20.81	2.78	2.49
Oct. 2009	744	12.26	8.32	17.45	2.34	2.09
Nov. 2009	720	7.67	5.20	10.93	1.47	1.32
Dec. 2009	744	7.59	5.03	11.02	1.53	1.40
Jan. 2010	744	8.39	0.00	48.61	207.83	207.83
Feb. 2010	672	11.18	6.61	17.75	2.86	2.68
Mar. 2010	744	15.20	8.07	26.16	4.66	4.49
Apr. 2010	720	23.66	11.56	43.23	8.19	7.93
May 2010	744	43.51	20.85	80.59	15.46	14.72
June 2010	720	56.46	27.45	103.54	19.68	19.03
July 2010	744	44.16	20.30	84.20	16.57	16.16
Aug. 2010	744	60.35	27.03	117.16	23.39	22.50
Sep. 2010	720	41.58	17.62	83.75	17.21	16.78
Oct. 2010	744	26.04	9.93	56.17	12.10	11.89
Nov. 2010	720	19.85	6.55	46.78	10.62	10.48
Dec. 2010	192	20.63	5.94	52.56	12.42	11.95

Site G

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	28824	1571.	417.	4184.	1010.	979.
Season 1	11184	2195.	304.	7932.	2193.	2106.
Season 2	6624	525.09	303.63	847.84	139.94	137.04
Season 3	6624	1554.	629.	3228.	678.	614.
Season 4	7272	1424.	831.	2283.	373.	367.
Nov. 2007	720	517.45	248.78	956.45	183.14	176.34
Dec. 2007	744	344.29	181.10	596.70	107.19	102.18
Jan. 2008	744	307.57	174.23	504.44	84.96	79.92
Feb. 2008	696	265.97	162.75	411.04	63.75	58.30
Mar. 2008	744	302.61	184.35	469.28	73.16	67.34
Apr. 2008	720	367.33	237.25	543.84	78.61	67.85
May 2008	744	416.70	233.76	688.50	117.04	83.35
June 2008	720	400.47	256.46	596.96	87.33	78.00
July 2008	744	467.08	310.14	676.16	93.79	74.67
Aug. 2008	744	514.27	345.26	737.82	100.57	82.44
Sep. 2008	720	279.84	192.11	394.18	51.75	43.11
Oct. 2008	744	189.71	130.41	266.92	34.96	29.97
Nov. 2008	720	127.68	88.37	178.63	23.11	19.65
Dec. 2008	744	99.31	70.03	136.80	17.09	14.33
Jan. 2009	744	98.22	69.17	135.43	16.96	14.25
Feb. 2009	672	97.17	67.22	136.01	17.61	14.76
Mar. 2009	744	168.03	94.80	276.43	46.74	43.91
Apr. 2009	720	175.25	104.32	276.72	44.30	41.04
May 2009	744	220.78	128.30	355.14	58.32	54.51
June 2009	720	302.22	179.36	478.33	76.83	71.18
July 2009	744	371.54	226.95	574.99	89.36	81.49
Aug. 2009	744	415.53	269.09	613.86	88.40	79.01
Sep. 2009	720	368.09	245.33	531.25	73.26	64.21
Oct. 2009	744	336.87	229.00	478.37	63.87	53.81
Nov. 2009	720	261.66	178.53	370.44	49.15	42.39
Dec. 2009	744	267.17	176.01	389.25	54.65	48.54
Jan. 2010	744	276.29	183.53	399.84	55.43	48.85
Feb. 2010	672	349.62	212.64	542.90	84.81	77.33
Mar. 2010	744	647.	315.	1188.	226.	217.
Apr. 2010	720	874.	424.	1604.	305.	294.
May 2010	744	1549.	742.	2869.	550.	510.
June 2010	720	1893.	951.	3391.	630.	604.
July 2010	744	2747.	1312.	5099.	980.	946.
Aug. 2010	744	6810.	1440.	20386.	5183.	4523.
Sep. 2010	720	4524.	2437.	7704.	1357.	1274.
Oct. 2010	744	3803.	2027.	6526.	1160.	1104.
Nov. 2010	720	3828.	1942.	6809.	1257.	1203.
Dec. 2010	744	4369.	2094.	8092.	1552.	1497.
Jan. 2011	744	19404.	1089.	94536.	31627.	30267.
Feb. 2011	312	6195.	2563.	12679.	2635.	2479.

Nitrate-N

Site A

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	28824	2014.	1526.	2608.	277.	260.
Season 1	11184	365.69	235.72	542.28	78.61	76.55
Season 2	6624	687.83	482.29	951.90	120.21	101.44
Season 3	6624	5504.	4028.	7348.	849.	764.
Season 4	7272	1992.	1398.	2756.	348.	316.
Nov. 2007	720	580.	258.	1130.	227.	216.
Dec. 2007	744	343.95	172.22	617.71	115.11	108.33
Jan. 2008	744	193.65	105.11	327.94	57.41	53.09
Feb. 2008	696	161.64	90.50	267.45	45.55	40.50
Mar. 2008	744	201.36	117.71	322.44	52.63	47.52
Apr. 2008	720	825.	455.	1379.	238.	160.
May 2008	744	1610.	971.	2517.	397.	285.
June 2008	720	2727.	1643.	4264.	673.	457.
July 2008	744	6393.	3847.	10010.	1583.	1055.
Aug. 2008	744	8893.	5700.	13246.	1935.	1429.
Sep. 2008	720	3096.	1984.	4612.	674.	474.
Oct. 2008	744	1422.	931.	2082.	295.	213.
Nov. 2008	720	467.92	322.19	657.43	85.84	68.97
Dec. 2008	744	215.75	151.02	299.02	37.89	30.15
Jan. 2009	744	126.89	88.92	175.69	22.21	17.75
Feb. 2009	672	189.21	122.22	280.08	40.48	31.54
Mar. 2009	744	235.39	127.93	398.26	69.65	44.07
Apr. 2009	720	314.54	200.64	470.34	69.18	58.67
May 2009	744	659.81	415.89	996.08	148.85	130.52
June 2009	720	1578.	912.	2549.	421.	294.
July 2009	744	2284.	1459.	3412.	501.	436.
Aug. 2009	744	3752.	2319.	5752.	881.	622.
Sep. 2009	720	1886.	1196.	2833.	420.	309.
Oct. 2009	744	1727.	1056.	2670.	414.	280.
Nov. 2009	720	369.63	248.17	530.26	72.27	58.54
Dec. 2009	744	171.83	114.51	248.02	34.21	27.60
Jan. 2010	744	148.86	92.05	228.15	34.93	24.02
Feb. 2010	672	127.53	82.07	189.35	27.51	22.13
Mar. 2010	744	152.38	92.34	237.28	37.22	33.46
Apr. 2010	720	316.39	189.11	498.00	79.36	71.15
May 2010	744	1856.	984.	3199.	571.	337.
June 2010	720	5364.	3235.	8384.	1323.	939.
July 2010	744	3403.	2153.	5122.	762.	672.
Aug. 2010	744	14927.	8719.	23916.	3907.	3023.
Sep. 2010	720	7400.	4201.	12119.	2037.	1594.
Oct. 2010	744	2269.	1284.	3725.	628.	553.
Nov. 2010	720	726.	384.	1251.	224.	208.
Dec. 2010	744	406.22	202.36	732.22	136.93	128.66
Jan. 2011	744	1000.	396.	2103.	446.	390.
Feb. 2011	312	905.	397.	1781.	360.	327.

Site D

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	95% Conf.Intervals Upper	Std Error Prediction	Standard Error
Est. Period	27216	291.69	222.65	375.42	39.05	36.79
Season 1	9576	3.91	2.91	5.13	0.57	0.55
Season 2	6624	135.19	92.31	191.25	25.34	18.97
Season 3	6624	951.	715.	1242.	135.	125.
Season 4	7272	99.50	70.40	136.66	16.96	15.49
Nov. 2007	720	2.76	1.77	4.12	0.60	0.53
Dec. 2007	744	2.12	1.37	3.15	0.46	0.36
Jan. 2008	744	1.10	0.74	1.57	0.21	0.17
Feb. 2008	696	1.62	0.68	3.27	0.67	0.26
Mar. 2008	744	4.32	2.85	6.28	0.88	0.70
Apr. 2008	720	151.72	67.85	294.80	58.91	35.88
May 2008	744	178.32	83.31	336.25	65.53	29.84
June 2008	720	375.36	217.12	605.94	99.98	64.30
July 2008	744	1140.	704.	1748.	268.	190.
Aug. 2008	744	1011.	643.	1516.	224.	171.
Sep. 2008	720	215.51	137.12	322.92	47.66	34.85
Oct. 2008	744	44.36	29.52	64.10	8.86	7.01
Nov. 2008	720	6.87	4.73	9.65	1.26	1.01
Dec. 2008	744	2.28	1.62	3.12	0.38	0.31
Jan. 2009	744	1.26	0.91	1.71	0.21	0.16
Feb. 2009	672	3.23	2.14	4.69	0.65	0.42
Mar. 2009	744	9.24	6.58	12.61	1.54	1.23
Apr. 2009	720	60.90	42.72	84.26	10.63	8.23
May 2009	744	234.93	164.69	325.19	41.08	33.41
June 2009	720	765.	523.	1081.	143.	104.
July 2009	744	969.	668.	1360.	177.	133.
Aug. 2009	744	613.47	432.29	845.48	105.75	86.29
Sep. 2009	720	167.04	116.45	232.28	29.65	24.78
Oct. 2009	744	66.01	43.36	96.41	13.60	10.67
Nov. 2009	720	8.10	5.48	11.56	1.56	1.30
Dec. 2009	744	3.87	2.56	5.62	0.79	0.66
Jan. 2010	744	2.86	1.45	5.10	0.94	0.58
Feb. 2010	672	4.14	2.68	6.13	0.88	0.71
Mar. 2010	744	8.98	5.89	13.12	1.85	1.57
Apr. 2010	720	44.16	28.18	66.02	9.70	7.68
May 2010	744	519.32	278.03	888.45	157.35	92.10
June 2010	720	1250.	831.	1809.	251.	201.
July 2010	744	788.	523.	1141.	159.	140.
Aug. 2010	744	1636.	955.	2622.	428.	311.
Sep. 2010	720	415.22	253.19	643.45	100.21	81.71
Oct. 2010	744	63.11	38.51	97.74	15.21	13.05
Nov. 2010	720	10.21	6.21	15.84	2.47	2.27
Dec. 2010	192	6.17	3.30	10.57	1.87	1.46

Site G

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	95% Conf.Intervals Upper	Std Error Prediction	Standard Error
Est. Period	28824	688.08	487.51	943.95	116.81	107.35
Season 1	11184	29.28	16.13	49.04	8.48	7.66
Season 2	6624	481.48	261.37	815.29	142.72	104.38
Season 3	6624	2183.	1522.	3035.	387.	347.
Season 4	7272	265.94	184.27	371.69	47.98	40.46
Nov. 2007	720	30.43	20.17	44.12	6.14	4.54
Dec. 2007	744	12.90	8.75	18.35	2.46	1.83
Jan. 2008	744	5.27	3.49	7.65	1.07	0.83
Feb. 2008	696	10.17	6.66	14.88	2.11	1.54
Mar. 2008	744	18.22	11.65	27.19	3.99	3.08
Apr. 2008	720	838.	380.	1613.	320.	180.
May 2008	744	1372.	502.	3037.	665.	386.
June 2008	720	1530.	791.	2685.	489.	229.
July 2008	744	3108.	1640.	5376.	963.	569.
Aug. 2008	744	4227.	2542.	6623.	1048.	748.
Sep. 2008	720	661.	381.	1071.	178.	102.
Oct. 2008	744	171.40	107.76	259.27	38.87	26.29
Nov. 2008	720	31.88	21.42	45.71	6.22	4.74
Dec. 2008	744	15.23	10.35	21.63	2.89	2.16
Jan. 2009	744	8.01	5.41	11.42	1.54	1.13
Feb. 2009	672	41.34	23.20	68.27	11.60	6.91
Mar. 2009	744	11.73	7.17	18.16	2.82	2.27
Apr. 2009	720	92.48	57.28	141.56	21.63	15.40
May 2009	744	270.93	175.30	400.53	57.75	47.12
June 2009	720	1590.	988.	2427.	369.	251.
July 2009	744	1386.	718.	2429.	441.	207.
Aug. 2009	744	1176.	729.	1799.	275.	174.
Sep. 2009	720	340.81	208.52	526.74	81.70	51.15
Oct. 2009	744	280.69	153.44	472.84	82.28	47.05
Nov. 2009	720	19.81	13.17	28.66	3.97	3.02
Dec. 2009	744	8.92	5.78	13.19	1.90	1.29
Jan. 2010	744	26.97	13.66	48.03	8.88	4.63
Feb. 2010	672	17.00	9.85	27.42	4.52	2.45
Mar. 2010	744	12.08	7.01	19.47	3.21	2.35
Apr. 2010	720	74.92	40.69	126.82	22.19	11.87
May 2010	744	1629.	651.	3410.	720.	358.
June 2010	720	2110.	1324.	3196.	480.	333.
July 2010	744	531.48	341.59	789.95	114.98	95.18
Aug. 2010	744	3945.	2025.	6960.	1274.	979.
Sep. 2010	720	952.	561.	1515.	245.	154.
Oct. 2010	744	151.67	97.51	225.39	32.79	23.17
Nov. 2010	720	26.02	17.42	37.41	5.12	3.86
Dec. 2010	744	14.55	8.92	22.46	3.48	2.09
Jan. 2011	744	152.36	31.87	458.57	116.86	104.50
Feb. 2011	312	69.24	39.92	112.06	18.55	12.62

Manually selected model 3 option

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	28824	4499.	296.	20983.	6764.	2020.
Season 1	11184	6935.	197.	39328.	15822.	3711.
Season 2	6624	1717.	142.	7472.	2291.	563.
Season 3	6624	5148.	179.	28069.	10643.	1881.
Season 4	7272	978.	393.	2039.	430.	210.
Nov. 2007	720	141.21	62.22	277.17	55.83	33.15
Dec. 2007	744	94.71	42.00	185.08	37.15	21.82
Jan. 2008	744	31.85	13.98	62.66	12.64	7.67
Feb. 2008	696	36.58	14.14	78.21	16.75	8.42
Mar. 2008	744	31.87	11.92	69.59	15.10	7.18
Apr. 2008	720	3091.	335.	12272.	3560.	920.
May 2008	744	7112.	175.	41353.	17382.	2797.
June 2008	720	788.	76.	3261.	969.	182.
July 2008	744	4416.	457.	17820.	5217.	1298.
Aug. 2008	744	6835.	1578.	19592.	4887.	1802.
Sep. 2008	720	1416.	201.	5067.	1394.	313.
Oct. 2008	744	751.	204.	1977.	475.	140.
Nov. 2008	720	187.30	90.77	344.25	65.58	32.29
Dec. 2008	744	139.29	64.84	263.34	51.44	24.02
Jan. 2009	744	63.66	28.36	124.02	24.83	11.61
Feb. 2009	672	271.37	52.59	847.08	219.32	45.55
Mar. 2009	744	24.80	8.76	56.12	12.45	4.90
Apr. 2009	720	57.89	24.46	116.84	24.04	10.57
May 2009	744	88.62	43.42	161.65	30.57	15.91
June 2009	720	574.	160.	1492.	356.	99.
July 2009	744	1000.	64.	4694.	1521.	222.
Aug. 2009	744	1207.	303.	3314.	811.	235.
Sep. 2009	720	670.	128.	2106.	547.	125.
Oct. 2009	744	2021.	265.	7457.	2083.	459.
Nov. 2009	720	122.21	58.11	227.67	43.90	23.30
Dec. 2009	744	86.98	34.43	183.21	38.85	16.97
Jan. 2010	744	546.	66.	2074.	588.	115.
Feb. 2010	672	151.27	27.54	486.03	127.43	29.24
Mar. 2010	744	23.31	8.51	51.64	11.31	5.61
Apr. 2010	720	95.23	10.93	370.08	106.12	19.61
May 2010	744	4866.	195.	25739.	9385.	1661.
June 2010	720	1062.	322.	2628.	612.	241.
July 2010	744	148.24	68.06	282.90	55.70	34.75
Aug. 2010	744	29885.	438.	187195.	93980.	13567.
Sep. 2010	720	3534.	670.	11144.	2898.	995.
Oct. 2010	744	709.	218.	1737.	403.	177.
Nov. 2010	720	210.15	87.76	427.46	88.46	54.92
Dec. 2010	744	222.93	50.17	647.22	162.37	59.34
Jan. 2011	744	101638.	2743.	581827.	237780.	55557.
Feb. 2011	312	864.	246.	2219.	526.	242.

Total nitrogen

Site A

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	28824	2736.	2366.	3147.	199.	199.
Season 1	11184	1333.	1064.	1651.	150.	150.
Season 2	6624	1453.	1301.	1619.	81.	78.
Season 3	6624	5372.	4673.	6145.	376.	370.
Season 4	7272	3143.	2680.	3662.	251.	248.
Nov. 2007	720	1137.	912.	1400.	125.	123.
Dec. 2007	744	1197.	986.	1439.	116.	114.
Jan. 2008	744	887.	756.	1033.	71.	69.
Feb. 2008	696	724.24	631.94	826.15	49.57	47.11
Mar. 2008	744	660.81	585.79	742.72	40.05	38.48
Apr. 2008	720	2176.	1913.	2466.	141.	111.
May 2008	744	2644.	2344.	2972.	160.	121.
June 2008	720	2779.	2490.	3093.	154.	119.
July 2008	744	7295.	6508.	8151.	419.	335.
Aug. 2008	744	11613.	10525.	12783.	576.	495.
Sep. 2008	720	4940.	4491.	5422.	237.	189.
Oct. 2008	744	4033.	3658.	4435.	198.	164.
Nov. 2008	720	2046.	1882.	2220.	86.	81.
Dec. 2008	744	1487.	1376.	1605.	59.	54.
Jan. 2009	744	1054.	977.	1136.	40.	37.
Feb. 2009	672	1538.	1403.	1682.	71.	63.
Mar. 2009	744	1929.	1677.	2209.	136.	105.
Apr. 2009	720	943.	830.	1068.	61.	59.
May 2009	744	1163.	1011.	1332.	82.	80.
June 2009	720	2002.	1737.	2296.	143.	123.
July 2009	744	2196.	1930.	2487.	142.	138.
Aug. 2009	744	4982.	4436.	5576.	291.	242.
Sep. 2009	720	3147.	2807.	3516.	181.	147.
Oct. 2009	744	4863.	4303.	5476.	299.	258.
Nov. 2009	720	1440.	1284.	1610.	83.	80.
Dec. 2009	744	972.	857.	1098.	62.	59.
Jan. 2010	744	1080.	910.	1273.	93.	85.
Feb. 2010	672	741.99	620.86	879.78	66.11	64.26
Mar. 2010	744	540.99	438.24	660.55	56.78	56.21
Apr. 2010	720	622.56	486.92	784.29	75.98	75.34
May 2010	744	2379.	1749.	3163.	362.	342.
June 2010	720	4455.	3199.	6042.	728.	714.
July 2010	744	1644.	1161.	2260.	281.	280.
Aug. 2010	744	11162.	7633.	15772.	2084.	2059.
Sep. 2010	720	6311.	4126.	9252.	1314.	1299.
Oct. 2010	744	2361.	1468.	3604.	548.	546.
Nov. 2010	720	1087.	652.	1706.	271.	270.
Dec. 2010	744	849.	481.	1391.	234.	234.
Jan. 2011	744	3431.	1750.	6079.	1118.	1110.
Feb. 2011	312	1965.	954.	3608.	686.	685.

Site D

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	27216	469.43	384.25	567.83	46.88	46.83
Season 1	9576	256.47	210.16	309.92	25.48	25.43
Season 2	6624	349.11	304.50	398.38	23.96	23.54
Season 3	6624	730.32	593.38	889.34	75.59	75.34
Season 4	7272	571.39	434.15	738.33	77.76	77.67
Nov. 2007	720	136.61	115.29	160.72	11.60	11.44
Dec. 2007	744	213.00	182.37	247.28	16.57	16.18
Jan. 2008	744	134.55	118.45	152.22	8.62	8.34
Feb. 2008	696	112.93	96.58	131.24	8.85	6.06
Mar. 2008	744	111.40	101.31	122.22	5.34	4.91
Apr. 2008	720	670.85	574.89	778.17	51.89	43.65
May 2008	744	284.72	251.58	320.98	17.71	12.37
June 2008	720	208.40	189.68	228.45	9.89	8.56
July 2008	744	514.14	471.32	559.77	22.57	19.44
Aug. 2008	744	663.78	609.12	721.99	28.80	26.07
Sep. 2008	720	396.95	364.63	431.34	17.02	15.55
Oct. 2008	744	317.66	291.13	345.94	13.99	12.93
Nov. 2008	720	178.76	165.21	193.12	7.12	6.66
Dec. 2008	744	158.83	147.75	170.53	5.81	5.37
Jan. 2009	744	109.90	102.77	117.39	3.73	3.41
Feb. 2009	672	149.96	139.38	161.12	5.55	4.78
Mar. 2009	744	161.25	148.98	174.24	6.45	6.07
Apr. 2009	720	247.86	226.15	271.07	11.46	10.95
May 2009	744	282.26	254.91	311.71	14.49	14.00
June 2009	720	396.91	357.77	439.12	20.76	19.74
July 2009	744	428.83	386.80	474.15	22.29	21.22
Aug. 2009	744	461.85	418.07	508.93	23.18	22.23
Sep. 2009	720	370.12	334.44	408.55	18.91	18.23
Oct. 2009	744	501.34	449.32	557.69	27.65	26.68
Nov. 2009	720	263.47	234.27	295.28	15.57	15.14
Dec. 2009	744	304.54	266.62	346.32	20.34	19.89
Jan. 2010	744	298.55	251.07	352.37	25.86	24.00
Feb. 2010	672	294.17	245.18	350.06	26.78	26.22
Mar. 2010	744	231.46	186.44	284.05	24.93	24.73
Apr. 2010	720	312.87	244.29	394.74	38.45	38.01
May 2010	744	845.	636.	1101.	119.	116.
June 2010	720	1150.	851.	1519.	171.	170.
July 2010	744	671.72	481.75	912.09	110.11	109.75
Aug. 2010	744	2063.	1436.	2874.	368.	365.
Sep. 2010	720	1698.	1144.	2428.	329.	328.
Oct. 2010	744	1056.	687.	1556.	223.	222.
Nov. 2010	720	790.	491.	1205.	183.	183.
Dec. 2010	192	971.	585.	1520.	240.	239.

Site G

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	28824	2709.	2477.	2956.	122.	121.
Season 1	11184	2458.	2137.	2814.	173.	166.
Season 2	6624	1788.	1680.	1901.	56.	54.
Season 3	6624	3642.	3366.	3934.	145.	140.
Season 4	7272	2751.	2558.	2953.	101.	100.
Nov. 2007	720	1331.	1222.	1447.	57.	55.
Dec. 2007	744	1206.	1113.	1305.	49.	47.
Jan. 2008	744	932.	855.	1013.	40.	39.
Feb. 2008	696	966.	892.	1046.	39.	37.
Mar. 2008	744	930.	856.	1008.	39.	37.
Apr. 2008	720	2266.	2105.	2436.	85.	67.
May 2008	744	2619.	2363.	2895.	136.	102.
June 2008	720	1817.	1720.	1917.	50.	41.
July 2008	744	3164.	2970.	3367.	101.	79.
Aug. 2008	744	5045.	4738.	5365.	160.	140.
Sep. 2008	720	2698.	2560.	2841.	72.	60.
Oct. 2008	744	2387.	2271.	2508.	60.	51.
Nov. 2008	720	1745.	1668.	1825.	40.	34.
Dec. 2008	744	1609.	1540.	1681.	36.	30.
Jan. 2009	744	1311.	1246.	1379.	34.	30.
Feb. 2009	672	1725.	1648.	1805.	40.	32.
Mar. 2009	744	1060.	973.	1152.	46.	44.
Apr. 2009	720	1325.	1249.	1405.	40.	36.
May 2009	744	1549.	1469.	1632.	42.	37.
June 2009	720	2442.	2305.	2585.	71.	64.
July 2009	744	2434.	2288.	2587.	76.	66.
Aug. 2009	744	3011.	2814.	3218.	103.	94.
Sep. 2009	720	2560.	2390.	2739.	89.	82.
Oct. 2009	744	3480.	3219.	3755.	137.	126.
Nov. 2009	720	1849.	1716.	1989.	70.	66.
Dec. 2009	744	1638.	1507.	1777.	69.	66.
Jan. 2010	744	2174.	1993.	2366.	95.	90.
Feb. 2010	672	1735.	1580.	1900.	82.	78.
Mar. 2010	744	1290.	1139.	1455.	81.	79.
Apr. 2010	720	1586.	1422.	1764.	87.	85.
May 2010	744	3459.	3035.	3925.	227.	208.
June 2010	720	3590.	3208.	4006.	204.	198.
July 2010	744	2209.	1972.	2465.	126.	123.
Aug. 2010	744	8968.	7460.	10690.	825.	764.
Sep. 2010	720	5330.	4660.	6068.	359.	350.
Oct. 2010	744	3535.	3098.	4016.	234.	230.
Nov. 2010	720	2553.	2232.	2907.	172.	169.
Dec. 2010	744	2397.	2083.	2746.	169.	167.
Jan. 2011	744	12699.	8913.	17561.	2214.	2104.
Feb. 2011	312	4091.	3503.	4750.	319.	309.

Dissolved reactive phosphate

Site A

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	95% Conf.Intervals Upper	Std Error Prediction	Standard Error
Est. Period	28824	220.52	205.25	236.62	8.00	7.82
Season 1	11184	219.75	197.18	244.17	11.99	11.57
Season 2	6624	126.57	115.93	137.92	5.61	5.10
Season 3	6624	275.92	253.48	299.81	11.82	11.27
Season 4	7272	224.44	209.29	240.40	7.94	7.56
Nov. 2007	720	147.89	124.08	174.94	12.99	12.80
Dec. 2007	744	201.30	172.90	233.00	15.34	15.04
Jan. 2008	744	156.57	137.64	177.37	10.14	9.85
Feb. 2008	696	116.30	103.18	130.62	7.00	6.40
Mar. 2008	744	79.97	71.84	88.76	4.32	4.09
Apr. 2008	720	241.23	211.89	273.48	15.72	11.51
May 2008	744	208.02	182.57	236.00	13.64	9.14
June 2008	720	138.54	124.20	154.08	7.62	5.26
July 2008	744	359.34	321.64	400.20	20.05	15.37
Aug. 2008	744	578.99	527.55	634.05	27.18	22.65
Sep. 2008	720	251.38	229.24	275.07	11.69	8.46
Oct. 2008	744	275.51	250.16	302.70	13.41	10.15
Nov. 2008	720	163.43	151.89	175.61	6.05	5.62
Dec. 2008	744	150.23	140.47	160.49	5.11	4.67
Jan. 2009	744	114.95	107.92	122.31	3.67	3.33
Feb. 2009	672	175.95	161.34	191.52	7.70	6.65
Mar. 2009	744	242.79	210.36	278.77	17.46	13.02
Apr. 2009	720	55.45	49.62	61.78	3.10	3.00
May 2009	744	49.92	44.21	56.15	3.05	2.97
June 2009	720	74.01	64.75	84.21	4.97	3.89
July 2009	744	66.02	59.14	73.48	3.66	3.54
Aug. 2009	744	197.97	177.62	219.99	10.81	8.00
Sep. 2009	720	143.36	128.40	159.57	7.95	5.13
Oct. 2009	744	305.68	277.20	336.27	15.07	11.32
Nov. 2009	720	106.93	99.43	114.84	3.93	3.60
Dec. 2009	744	92.95	86.18	100.09	3.55	3.24
Jan. 2010	744	141.43	125.74	158.52	8.36	5.59
Feb. 2010	672	85.93	77.72	94.77	4.35	3.88
Mar. 2010	744	48.12	41.84	55.06	3.37	3.31
Apr. 2010	720	43.44	37.25	50.36	3.35	3.28
May 2010	744	168.95	141.56	200.07	14.94	11.75
June 2010	720	266.13	229.22	307.26	19.92	17.72
July 2010	744	67.69	58.44	77.99	4.99	4.91
Aug. 2010	744	723.36	626.50	830.87	52.16	47.65
Sep. 2010	720	486.35	422.57	556.98	34.31	30.27
Oct. 2010	744	222.73	194.52	253.84	15.14	14.06
Nov. 2010	720	136.82	118.27	157.43	10.00	9.80
Dec. 2010	744	152.70	130.36	177.74	12.10	11.81
Jan. 2011	744	1182.	955.	1447.	126.	117.
Feb. 2011	312	544.70	451.87	650.93	50.83	49.40

Site D

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	27216	15.84	14.75	16.99	0.57	0.57
Season 1	9576	16.75	15.21	18.41	0.81	0.81
Season 2	6624	15.01	13.59	16.53	0.75	0.71
Season 3	6624	14.25	12.95	15.65	0.69	0.68
Season 4	7272	16.69	14.94	18.58	0.93	0.93
Nov. 2007	720	18.08	14.91	21.72	1.74	1.71
Dec. 2007	744	31.63	26.42	37.57	2.85	2.78
Jan. 2008	744	21.51	18.51	24.85	1.62	1.57
Feb. 2008	696	15.56	13.09	18.36	1.35	0.98
Mar. 2008	744	13.03	11.61	14.57	0.75	0.69
Apr. 2008	720	44.51	37.52	52.42	3.80	3.22
May 2008	744	15.71	13.70	17.92	1.08	0.79
June 2008	720	9.02	8.04	10.08	0.52	0.47
July 2008	744	18.79	16.94	20.78	0.98	0.86
Aug. 2008	744	25.12	22.66	27.77	1.30	1.19
Sep. 2008	720	18.62	16.83	20.56	0.95	0.88
Oct. 2008	744	19.42	17.51	21.48	1.01	0.94
Nov. 2008	720	14.52	13.24	15.89	0.68	0.63
Dec. 2008	744	15.54	14.29	16.87	0.66	0.60
Jan. 2009	744	11.37	10.51	12.27	0.45	0.41
Feb. 2009	672	13.04	11.97	14.18	0.57	0.49
Mar. 2009	744	11.23	10.20	12.33	0.54	0.51
Apr. 2009	720	11.82	10.57	13.18	0.67	0.64
May 2009	744	9.60	8.49	10.82	0.60	0.57
June 2009	720	10.09	8.93	11.36	0.62	0.59
July 2009	744	9.67	8.61	10.83	0.57	0.54
Aug. 2009	744	10.76	9.69	11.91	0.57	0.54
Sep. 2009	720	10.38	9.40	11.43	0.52	0.49
Oct. 2009	744	17.03	15.40	18.79	0.87	0.81
Nov. 2009	720	11.99	10.85	13.22	0.61	0.57
Dec. 2009	744	15.84	14.21	17.61	0.87	0.82
Jan. 2010	744	15.23	13.19	17.50	1.10	0.97
Feb. 2010	672	13.76	11.95	15.76	0.97	0.93
Mar. 2010	744	8.58	7.26	10.08	0.72	0.71
Apr. 2010	720	8.04	6.68	9.60	0.75	0.73
May 2010	744	13.17	10.80	15.91	1.31	1.24
June 2010	720	14.64	12.06	17.59	1.41	1.38
July 2010	744	7.89	6.42	9.61	0.82	0.81
Aug. 2010	744	22.03	17.74	27.03	2.37	2.31
Sep. 2010	720	21.81	17.34	27.07	2.49	2.45
Oct. 2010	744	17.68	13.73	22.42	2.22	2.20
Nov. 2010	720	17.20	12.93	22.44	2.43	2.42
Dec. 2010	192	23.10	16.90	30.84	3.57	3.48

Site G

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf. Intervals Lower	95% Conf. Intervals Upper	Std Error Prediction	Standard Error
Est. Period	28824	240.31	219.41	262.65	11.03	10.60
Season 1	11184	344.41	301.90	391.19	22.79	21.46
Season 2	6624	117.78	107.37	128.91	5.50	5.28
Season 3	6624	168.02	152.54	184.64	8.19	7.75
Season 4	7272	280.99	264.26	298.49	8.73	8.60
Nov. 2007	720	420.51	373.20	472.10	25.24	24.47
Dec. 2007	744	415.61	372.32	462.52	23.02	22.21
Jan. 2008	744	291.47	263.72	321.32	14.70	14.07
Feb. 2008	696	219.71	201.07	239.60	9.83	9.25
Mar. 2008	744	142.99	130.40	156.47	6.65	6.30
Apr. 2008	720	222.91	201.23	246.28	11.50	9.52
May 2008	744	208.43	177.19	243.56	16.94	12.68
June 2008	720	104.58	95.34	114.47	4.88	4.41
July 2008	744	211.02	191.47	232.01	10.35	8.47
Aug. 2008	744	407.38	373.23	443.79	18.00	16.14
Sep. 2008	720	291.20	268.91	314.82	11.71	10.47
Oct. 2008	744	369.75	340.95	400.32	15.15	13.91
Nov. 2008	720	345.15	319.69	372.09	13.37	12.36
Dec. 2008	744	344.05	320.92	368.40	12.11	11.03
Jan. 2009	744	252.63	236.41	269.65	8.48	7.62
Feb. 2009	672	232.43	216.64	249.05	8.27	7.34
Mar. 2009	744	105.51	94.18	117.83	6.04	5.83
Apr. 2009	720	79.19	70.80	88.29	4.46	4.31
May 2009	744	65.19	57.88	73.16	3.90	3.78
June 2009	720	85.82	76.71	95.70	4.85	4.65
July 2009	744	92.44	83.12	102.51	4.95	4.58
Aug. 2009	744	147.87	135.10	161.51	6.74	6.21
Sep. 2009	720	176.45	162.19	191.61	7.51	6.86
Oct. 2009	744	332.34	306.29	360.00	13.71	12.23
Nov. 2009	720	231.85	214.02	250.76	9.37	8.73
Dec. 2009	744	225.70	207.11	245.49	9.79	9.21
Jan. 2010	744	254.31	233.27	276.71	11.08	10.12
Feb. 2010	672	156.52	141.26	172.97	8.09	7.64
Mar. 2010	744	79.71	67.89	92.99	6.41	6.30
Apr. 2010	720	61.28	52.30	71.36	4.87	4.77
May 2010	744	95.10	79.94	112.29	8.26	7.53
June 2010	720	79.19	67.79	91.95	6.17	6.03
July 2010	744	51.79	44.03	60.53	4.21	4.15
Aug. 2010	744	324.56	249.15	415.66	42.56	37.09
Sep. 2010	720	229.83	202.53	259.77	14.61	13.97
Oct. 2010	744	211.25	187.84	236.76	12.49	12.07
Nov. 2010	720	199.20	176.79	223.64	11.96	11.58
Dec. 2010	744	203.22	179.41	229.28	12.73	12.34
Jan. 2011	744	1375.	856.	2098.	319.	297.
Feb. 2011	312	238.16	204.20	276.11	18.36	17.50

Total phosphorus

Site A

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	28824	678.25	599.54	764.36	42.06	41.22
Season 1	11184	414.87	350.03	488.20	35.28	35.09
Season 2	6624	288.62	247.97	334.01	21.96	20.21
Season 3	6624	1117.	963.	1289.	83.	79.
Season 4	7272	992.	858.	1140.	72.	69.
Nov. 2007	720	492.49	346.83	679.06	85.03	84.07
Dec. 2007	744	537.53	394.97	714.96	81.84	80.60
Jan. 2008	744	359.69	279.33	455.99	45.15	44.13
Feb. 2008	696	248.92	200.07	306.07	27.08	25.48
Mar. 2008	744	179.31	148.06	215.18	17.14	16.39
Apr. 2008	720	498.72	400.37	613.88	54.54	40.77
May 2008	744	545.23	438.86	669.55	58.92	40.36
June 2008	720	579.65	479.68	694.26	54.79	39.06
July 2008	744	2021.	1649.	2452.	205.	158.
Aug. 2008	744	3783.	3197.	4445.	319.	266.
Sep. 2008	720	1957.	1662.	2290.	160.	120.
Oct. 2008	744	2043.	1727.	2399.	172.	134.
Nov. 2008	720	1102.	965.	1254.	74.	69.
Dec. 2008	744	789.12	696.71	890.30	49.41	45.43
Jan. 2009	744	483.29	427.97	543.71	29.54	27.07
Feb. 2009	672	529.26	457.53	609.00	38.66	33.91
Mar. 2009	744	619.75	488.12	775.95	73.54	55.06
Apr. 2009	720	192.94	157.34	234.17	19.62	19.01
May 2009	744	202.50	162.15	249.82	22.40	21.84
June 2009	720	350.61	276.90	437.92	41.14	33.60
July 2009	744	403.43	328.98	489.66	41.04	39.73
Aug. 2009	744	1237.	1016.	1492.	122.	94.
Sep. 2009	720	942.	772.	1137.	93.	69.
Oct. 2009	744	1700.	1388.	2061.	172.	142.
Nov. 2009	720	516.37	430.63	614.13	46.86	44.88
Dec. 2009	744	332.24	272.20	401.55	33.03	31.78
Jan. 2010	744	294.59	223.55	381.09	40.27	35.98
Feb. 2010	672	156.02	117.38	203.33	21.97	21.23
Mar. 2010	744	80.56	57.70	109.52	13.26	13.12
Apr. 2010	720	67.06	45.31	95.70	12.91	12.79
May 2010	744	208.07	125.85	324.51	51.02	47.50
June 2010	720	353.74	206.59	566.86	92.62	90.32
July 2010	744	126.34	71.88	206.55	34.65	34.51
Aug. 2010	744	1134.	610.	1934.	341.	336.
Sep. 2010	720	721.	358.	1300.	244.	240.
Oct. 2010	744	278.07	126.26	534.74	105.96	105.33
Nov. 2010	720	129.38	55.17	259.56	53.17	53.07
Dec. 2010	744	88.74	34.17	190.24	40.81	40.74
Jan. 2011	744	282.90	89.17	684.86	157.66	156.52
Feb. 2011	312	115.63	32.99	296.19	70.16	70.01

Site D

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	27216	75.44	55.12	100.82	11.69	11.68
Season 1	9576	70.83	51.68	94.77	11.02	11.00
Season 2	6624	51.50	42.44	61.92	4.98	4.81
Season 3	6624	76.53	55.14	103.51	12.38	12.32
Season 4	7272	108.44	69.35	161.83	23.72	23.69
Nov. 2007	720	45.26	35.29	57.17	5.59	5.51
Dec. 2007	744	79.64	63.38	98.79	9.05	8.81
Jan. 2008	744	48.55	40.27	58.03	4.53	4.38
Feb. 2008	696	37.89	28.61	49.22	5.27	3.19
Mar. 2008	744	26.45	22.97	30.30	1.87	1.69
Apr. 2008	720	131.46	100.26	169.32	17.65	14.59
May 2008	744	39.56	31.68	48.81	4.38	2.82
June 2008	720	20.72	17.99	23.75	1.47	1.23
July 2008	744	52.08	45.51	59.33	3.53	2.93
Aug. 2008	744	73.23	64.28	83.07	4.79	4.25
Sep. 2008	720	52.55	46.31	59.39	3.34	3.01
Oct. 2008	744	55.30	48.54	62.75	3.63	3.30
Nov. 2008	720	38.31	34.13	42.86	2.23	2.08
Dec. 2008	744	39.87	35.84	44.23	2.14	1.97
Jan. 2009	744	27.45	24.87	30.22	1.37	1.25
Feb. 2009	672	32.30	28.98	35.89	1.76	1.50
Mar. 2009	744	27.26	24.29	30.50	1.59	1.49
Apr. 2009	720	30.63	26.79	34.86	2.06	1.96
May 2009	744	26.68	22.98	30.79	1.99	1.92
June 2009	720	32.31	27.75	37.41	2.47	2.33
July 2009	744	34.39	29.55	39.80	2.62	2.47
Aug. 2009	744	42.78	36.96	49.25	3.14	2.99
Sep. 2009	720	43.65	37.62	50.37	3.26	3.13
Oct. 2009	744	79.53	67.73	92.79	6.40	6.16
Nov. 2009	720	54.44	45.82	64.20	4.69	4.56
Dec. 2009	744	74.74	61.50	89.97	7.27	7.10
Jan. 2010	744	80.40	61.71	102.98	10.55	9.54
Feb. 2010	672	68.06	52.06	87.45	9.05	8.81
Mar. 2010	744	42.03	30.59	56.35	6.59	6.53
Apr. 2010	720	44.17	30.67	61.62	7.92	7.82
May 2010	744	96.94	63.41	142.06	20.16	19.62
June 2010	720	113.44	72.57	169.24	24.79	24.62
July 2010	744	64.44	39.23	100.01	15.61	15.56
Aug. 2010	744	253.30	146.55	408.81	67.44	66.74
Sep. 2010	720	266.53	147.04	445.95	76.98	76.65
Oct. 2010	744	222.19	115.63	388.09	70.30	70.13
Nov. 2010	720	225.60	109.27	414.85	79.06	78.93
Dec. 2010	192	321.67	148.14	612.61	120.41	119.69

SiteG

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	28824	926.	764.	1112.	89.	85.
Season 1	11184	1406.	1066.	1819.	192.	181.
Season 2	6624	329.08	296.15	364.65	17.48	17.00
Season 3	6624	663.80	572.08	765.98	49.49	45.18
Season 4	7272	925.	849.	1005.	40.	39.
Nov. 2007	720	556.48	489.26	630.30	36.00	35.12
Dec. 2007	744	548.85	488.19	614.90	32.34	31.41
Jan. 2008	744	401.18	359.68	446.11	22.06	21.34
Feb. 2008	696	320.93	291.82	352.14	15.39	14.67
Mar. 2008	744	228.61	207.29	251.51	11.28	10.81
Apr. 2008	720	415.85	375.81	458.97	21.22	17.47
May 2008	744	446.00	374.52	527.10	38.96	28.87
June 2008	720	227.11	207.16	248.44	10.53	9.52
July 2008	744	503.75	456.48	554.56	25.03	20.33
Aug. 2008	744	979.	898.	1065.	43.	38.
Sep. 2008	720	667.81	617.91	720.62	26.21	23.35
Oct. 2008	744	818.30	756.82	883.39	32.30	29.65
Nov. 2008	720	741.46	688.80	797.04	27.62	25.55
Dec. 2008	744	737.76	689.69	788.26	25.15	22.94
Jan. 2009	744	560.73	525.75	597.40	18.28	16.49
Feb. 2009	672	549.16	510.67	589.75	20.18	18.21
Mar. 2009	744	276.39	247.43	307.79	15.40	14.90
Apr. 2009	720	228.47	204.77	254.15	12.60	12.18
May 2009	744	206.54	183.61	231.53	12.23	11.89
June 2009	720	298.26	266.06	333.25	17.15	16.51
July 2009	744	341.41	306.29	379.41	18.66	17.34
Aug. 2009	744	555.82	505.12	610.19	26.81	25.06
Sep. 2009	720	651.68	595.48	711.72	29.66	27.58
Oct. 2009	744	1215.	1106.	1333.	58.	53.
Nov. 2009	720	812.93	743.35	887.22	36.71	34.87
Dec. 2009	744	794.25	720.69	873.22	38.92	37.28
Jan. 2010	744	926.	829.	1031.	52.	49.
Feb. 2010	672	598.84	529.82	674.29	36.87	35.59
Mar. 2010	744	341.64	289.43	400.50	28.35	27.95
Apr. 2010	720	287.61	242.80	338.26	24.37	23.98
May 2010	744	528.83	434.18	637.92	52.03	47.94
June 2010	720	444.64	372.21	527.00	39.52	38.90
July 2010	744	306.78	257.31	362.95	26.97	26.63
Aug. 2010	744	2284.	1671.	3050.	353.	305.
Sep. 2010	720	1407.	1199.	1640.	113.	110.
Oct. 2010	744	1229.	1055.	1424.	94.	93.
Nov. 2010	720	1132.	969.	1314.	88.	87.
Dec. 2010	744	1156.	980.	1354.	96.	94.
Jan. 2011	744	10929.	6538.	17192.	2737.	2553.
Feb. 2011	312	1438.	1166.	1754.	150.	147.

Suspended solids

Site A

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	95% Conf.Intervals Upper	Std Error Prediction	Standard Error
Est. Period	28824	327130.	259621.	406817.	37605.	35475.
Season 1	11184	162425.	127037.	204621.	19824.	19261.
Season 2	6624	101717.	70973.	141344.	18014.	15387.
Season 3	6624	567817.	413540.	761005.	88880.	80149.
Season 4	7272	527563.	401295.	681049.	71511.	63277.
Nov. 2007	720	93711.	34733.	205770.	44817.	44329.
Dec. 2007	744	105995.	46227.	209480.	42424.	41725.
Jan. 2008	744	68527.	32568.	127695.	24629.	24117.
Feb. 2008	696	46948.	22848.	86039.	16345.	15448.
Mar. 2008	744	33689.	16987.	60203.	11164.	10844.
Apr. 2008	720	126432.	63053.	227720.	42554.	32465.
May 2008	744	147804.	72737.	268748.	50679.	35773.
June 2008	720	181679.	99305.	306075.	53264.	37681.
July 2008	744	810439.	457266.	1333238.	225424.	165456.
Aug. 2008	744	1633718.	1038448.	2449897.	362047.	291166.
Sep. 2008	720	842421.	535142.	1263904.	186936.	125319.
Oct. 2008	744	912821.	593116.	1344898.	192739.	126387.
Nov. 2008	720	444519.	333686.	580469.	63095.	55783.
Dec. 2008	744	302861.	231490.	389327.	40344.	35051.
Jan. 2009	744	173379.	132235.	223300.	23277.	20316.
Feb. 2009	672	197134.	138727.	271989.	34109.	27383.
Mar. 2009	744	263170.	141361.	449132.	79326.	51689.
Apr. 2009	720	68699.	47544.	96116.	12436.	11519.
May 2009	744	78491.	53978.	110396.	14447.	13484.
June 2009	720	170798.	98476.	276395.	45756.	24994.
July 2009	744	203684.	145867.	276912.	33531.	30391.
Aug. 2009	744	799488.	490918.	1232193.	190307.	116443.
Sep. 2009	720	604914.	360618.	954085.	152480.	84319.
Oct. 2009	744	1161232.	718392.	1779222.	272293.	185902.
Nov. 2009	720	292393.	214984.	388698.	44428.	39327.
Dec. 2009	744	174456.	127308.	233415.	27141.	23735.
Jan. 2010	744	154971.	93102.	242963.	38496.	22665.
Feb. 2010	672	73879.	51200.	103245.	13325.	10547.
Mar. 2010	744	34614.	22527.	50934.	7283.	6928.
Apr. 2010	720	29802.	19155.	44293.	6446.	6083.
May 2010	744	130160.	66467.	230489.	42350.	22807.
June 2010	720	239960.	149614.	365400.	55377.	37064.
July 2010	744	77291.	52431.	109945.	14732.	13849.
Aug. 2010	744	957463.	575913.	1499684.	237288.	190354.
Sep. 2010	720	607786.	353513.	976988.	160301.	121900.
Oct. 2010	744	208132.	125936.	324495.	50995.	43513.
Nov. 2010	720	84388.	49630.	134499.	21814.	21022.
Dec. 2010	744	53958.	30214.	89274.	15202.	14604.
Jan. 2011	744	203220.	91407.	393335.	78353.	68209.
Feb. 2011	312	71644.	37236.	125259.	22713.	21359.

Site D

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 Load Estimates [G/DAY]
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AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	Upper	Std Error Prediction	Standard Error
Est. Period	27216	7934.	6540.	9536.	765.	718.
Season 1	9576	5291.	4002.	6865.	732.	628.
Season 2	6624	6973.	4687.	9996.	1360.	1158.
Season 3	6624	10791.	8470.	13551.	1298.	1182.
Season 4	7272	8219.	6422.	10364.	1007.	968.
Nov. 2007	720	204.42	71.28	466.05	103.81	103.02
Dec. 2007	744	643.	258.	1340.	282.	276.
Jan. 2008	744	488.54	217.28	952.82	190.98	186.96
Feb. 2008	696	1054.	252.	2968.	735.	333.
Mar. 2008	744	561.36	285.00	998.21	184.19	170.19
Apr. 2008	720	16045.	5504.	36945.	8276.	6285.
May 2008	744	4515.	1432.	10888.	2502.	1308.
June 2008	720	2046.	1121.	3440.	597.	393.
July 2008	744	9599.	5763.	15057.	2387.	1594.
Aug. 2008	744	14929.	9769.	21870.	3102.	2293.
Sep. 2008	720	9504.	6456.	13504.	1805.	1306.
Oct. 2008	744	10329.	7111.	14514.	1896.	1397.
Nov. 2008	720	5755.	4377.	7430.	780.	695.
Dec. 2008	744	6346.	4902.	8084.	813.	709.
Jan. 2009	744	4142.	3216.	5252.	520.	459.
Feb. 2009	672	6769.	4840.	9216.	1120.	765.
Mar. 2009	744	5796.	4358.	7559.	819.	748.
Apr. 2009	720	8443.	6171.	11281.	1307.	1212.
May 2009	744	8350.	5968.	11371.	1382.	1300.
June 2009	720	12833.	8985.	17783.	2252.	1916.
July 2009	744	13668.	9541.	18985.	2418.	1964.
Aug. 2009	744	15229.	11267.	20138.	2269.	2008.
Sep. 2009	720	12004.	9033.	15642.	1690.	1525.
Oct. 2009	744	21126.	15136.	28711.	3474.	3093.
Nov. 2009	720	9134.	6782.	12041.	1345.	1226.
Dec. 2009	744	11066.	8057.	14835.	1734.	1583.
Jan. 2010	744	14481.	6527.	27989.	5569.	3247.
Feb. 2010	672	7676.	5118.	11075.	1526.	1089.
Mar. 2010	744	3290.	2315.	4541.	570.	535.
Apr. 2010	720	3724.	2499.	5345.	729.	547.
May 2010	744	12270.	6744.	20587.	3565.	2224.
June 2010	720	9514.	6804.	12948.	1572.	1285.
July 2010	744	2954.	2022.	4171.	550.	524.
Aug. 2010	744	16087.	8676.	27374.	4819.	3630.
Sep. 2010	720	8470.	5077.	13303.	2113.	1899.
Oct. 2010	744	3502.	1941.	5838.	1003.	962.
Nov. 2010	720	1819.	902.	3292.	618.	609.
Dec. 2010	192	2075.	933.	4017.	800.	757.

Site G

Load Estimates [G/DAY]

AMLE Load Estimates

	N	Mean Load	95% Conf.Intervals Lower	95% Conf.Intervals Upper	Std Error Prediction	Standard Error
Est. Period	28824	59272.	36105.	91928.	14334.	13667.
Season 1	11184	69652.	29936.	139010.	28364.	26562.
Season 2	6624	23575.	18901.	29054.	2593.	2366.
Season 3	6624	72202.	46349.	107421.	15662.	13236.
Season 4	7272	54908.	48159.	62331.	3617.	3546.
Nov. 2007	720	21851.	13017.	34483.	5515.	5479.
Dec. 2007	744	19455.	12334.	29235.	4336.	4300.
Jan. 2008	744	14311.	9320.	21045.	3006.	2978.
Feb. 2008	696	12368.	8351.	17661.	2385.	2357.
Mar. 2008	744	10496.	7140.	14898.	1987.	1965.
Apr. 2008	720	29393.	22074.	38367.	4166.	3645.
May 2008	744	47323.	28501.	74048.	11699.	8569.
June 2008	720	21122.	16123.	27185.	2828.	2655.
July 2008	744	60460.	47367.	76055.	7330.	5889.
Aug. 2008	744	112545.	92503.	135630.	11014.	9786.
Sep. 2008	720	60091.	50202.	71352.	5400.	4795.
Oct. 2008	744	58916.	50160.	68754.	4747.	4338.
Nov. 2008	720	42895.	37016.	49438.	3171.	2923.
Dec. 2008	744	36998.	32299.	42183.	2523.	2296.
Jan. 2009	744	26916.	23239.	31007.	1983.	1829.
Feb. 2009	672	27671.	23705.	32106.	2145.	1945.
Mar. 2009	744	16330.	12885.	20415.	1924.	1867.
Apr. 2009	720	15885.	13009.	19207.	1583.	1516.
May 2009	744	17108.	14112.	20551.	1644.	1572.
June 2009	720	29579.	24870.	34917.	2565.	2380.
July 2009	744	37071.	31138.	43800.	3233.	2679.
Aug. 2009	744	56626.	48343.	65915.	4486.	3987.
Sep. 2009	720	55549.	47485.	64584.	4365.	3909.
Oct. 2009	744	91600.	75175.	110540.	9031.	8049.
Nov. 2009	720	43894.	37412.	51171.	3513.	3280.
Dec. 2009	744	36530.	30713.	43125.	3169.	2991.
Jan. 2010	744	39349.	33036.	46514.	3441.	3121.
Feb. 2010	672	25106.	21077.	29679.	2196.	2038.
Mar. 2010	744	16381.	12513.	21069.	2187.	2138.
Apr. 2010	720	15606.	12471.	19290.	1742.	1676.
May 2010	744	43338.	30878.	59175.	7241.	5604.
June 2010	720	31751.	26484.	37755.	2878.	2687.
July 2010	744	21631.	17287.	26734.	2413.	2335.
Aug. 2010	744	274703.	100633.	607595.	132928.	110312.
Sep. 2010	720	84835.	67765.	104894.	9485.	8778.
Oct. 2010	744	52033.	40977.	65154.	6177.	5976.
Nov. 2010	720	36152.	27524.	46634.	4885.	4773.
Dec. 2010	744	30056.	22362.	39550.	4395.	4303.
Jan. 2011	744	630758.	158904.	1728280.	422513.	395169.
Feb. 2011	312	31707.	22814.	42935.	5148.	4943.