Technical Report No. 1

Revision of the country allocation of nutrient reductions in the Baltic Sea Action Plan

Section A: Hydrological adjusted riverine loads and atmospheric loads from different countries averaged for 2000 - 2006

Compilation June 5, 2009

Fredrik Wulff, Christoph Humborg,
Miguel Rodriguez Medina, Magnus Mörth,
Oleg Savchuk, Alexander Sokolov

Baltic Nest Institute

The Baltic Nest Institute

The Baltic Nest Institute host the Nest model, a decision support system aimed at facilitating adaptive management of environmental concern in the Baltic Sea.

Nest can be used to calculate required actions needed to attain politically agreed targets for the Baltic Sea ecosystem. By modeling the entire drainage area, Nest is a novel tool for implementing the ecosystem approach in a large marine ecosystem. The main focus of the model is on eutrophication and the flows of nutrients from land to sea.

Reducing the nutrient input to the sea and thus decreasing the negative enviromental impacts is a politically prioritized area of international cooperation. Baltic Nest Institute can contribute to this process by formulating policies that are fair, transparent and cost-efficient. The main target group for the Nest Decision Support System is HELCOM and regional water directors in the riparian countries.

Technical Report No. 1
Revision of country allocation of nutrient reductions in the Baltic Sea Action Plan
- Section A: Hydrological adjusted riverine loads and atmospheric loads from different countries averaged for 2000 - 2006. Compilation June 5, 2009
Authors: Fredrik Wulff, Christoph Humborg, Miguel Rodriguez Medina, Magnus Mörth, Oleg Savchuk, Alexander Sokolov
ISBN: 978-91-86655-00-6
Layout: Marmar Nekoro

Baltic Nest Institute
Stockholm Resilience Centre, Stockholm University
Address: Baltic Nest Institute, Stockholm University, SE-106 91 Stockholm, Sweden
www.balticnest.org

Revision of the country allocation of nutrient reductions in the Baltic Sea Action Plan

Section A: Hydrological adjusted riverine loads and atmospheric loads from different countries averaged for 2000 - 2006

Compilation June 5, 2009

Fredrik Wulff, Christoph Humborg,
Miguel Rodriguez Medina, Magnus Mörth,
Oleg Savchuk, Alexander Sokolov

1. BACKGROUND

HELCOM has asked BNI to revise the country-wise nutrient allocations of the Baltic Sea Action Plan using the new data available on atmospheric loads (EMEP) and more recent calculations on loads from the drainage basins (PLC5).

We are here reporting the most recent and updated data on loads from the drainage basins, averaged for 2000-2006 and 1997-2003, based on data supplied by the HELCOM member states for the preparation of the Fifth Pollution Load compilation (PLC5). The nutrient load data for 1997-2003, the period used for the original country allocation sceme of BSAP as signed in Krakow 2007, have been updated as well as new estimates for 2000-2006. The latter period has been suggested by HELOM as the foundation for an updated BSAP. However, these periods include several very dry or wet years. Drastic changes of the inputs seen in these data may therefore partly reflect these hydrological variations rather than real changes of loads due to efforts by the countries to reduce emissions. We therefore found it necessary to normalise these values, taking into account variations in riverine flows.

Russian data were found to be very incomplete and we therefore had to re-evaluate and compute new estimates, beyond those available in the PLC5 database.

We also report recent calculations on atmospheric loads to the different Baltic sub basins, averaged for 1997-2003 and 2000-2006, made available on the Internet by EMEP and integrated into NEST. The loads are now source allocated to the different HELCOM countries and other sources in order to be used in the revision of the country allocation scheme of BSAP.

2. FLOW NORMALISATION

Because rivers water discharge varies with time as a result of mainly variations in temperature and rainfall it is difficult to compare one year with another. The river discharge is also in most cases the main cause for variations in load of nitrogen and phosphorus, which then means that loads cannot be compared without evening out differences in discharges between years. In the current compilation loads of N and P have been log normalized by doing a regression between the log value of load and discharge, giving slope (b) and intercept (a), for observed data in the time period 1994 to 2006. The log average flow for 1994 to 2006 ($q_{average}$) was thereafter put into the regression equation and was divided with the same regression equation, but using the log discharge observed for a particular year (q_{year}), thus giving a ratio, see equation (1).

$$(1)\quad L_{normalized\_year} = L_{year} \cdot \frac{a + b \cdot q_{average}}{a + b \cdot q_{year}}$$

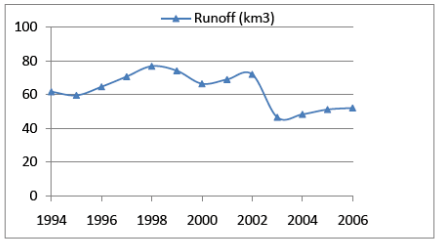
L – Load of N or P, a – intercept, b – slope, q – water discharge. Used period for $q_{average}$ is 1994 – 2006.

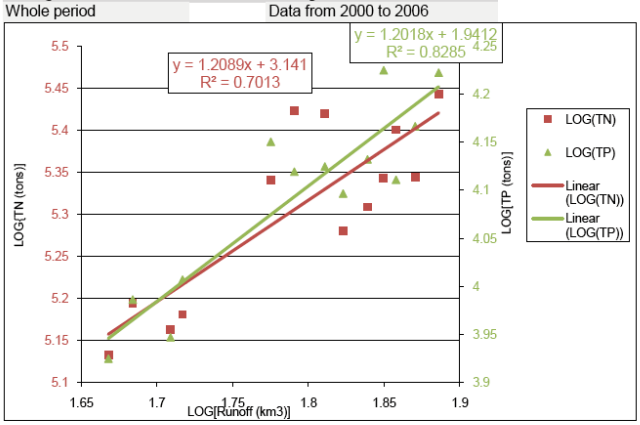
The ratio was multiplied with the observed load for a particular year (L_{year}). This procedure follows the recommendations outlined by Silgram and Schoumans (2004). After calculating normalised loads for all years the average values were taken for the period 2000 – 2006.

An example is show in Fig 1. These calculations, made for each country and sub basin are shown in the Appendix.

Basin	PL_BP							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	61.7468794	264762.6	13168.26	269180.2	13383.31	1.79061501	5.422857	4.119528
1995	59.5823691	219201.6	14144.68	232740.4	15020.56	1.77511777	5.340844	4.150593
1996	64.682474	262730	13331.47	252269.5	12811.33	1.81078662	5.41951	4.124878
1997	70.7304732	220206.7	16792.91	190089	14463.8	1.84960656	5.342831	4.225126
1998	76.8961874	277349.6	16694.92	215985	13021.87	1.88590481	5.443028	4.222584
1999	74.196279	221210.9	14682.7	180450.4	11978.5	1.87038213	5.344806	4.166806
2000	66.5012435	190811	12493.23	177448.9	11620.35	1.82282977	5.280603	4.096675
2001	69.012228	203596.9	13560.73	181104.9	12062.73	1.83892605	5.308771	4.132283
2002	72.0699418	251565.6	12914.38	211997.1	10926.56	1.85775417	5.400651	4.111073
2003	46.5545605	135844.5	8408.545	193914.9	11975.48	1.66796223	5.133042	3.924721
2004	48.3010341	156579.5	9689.238	214375.4	13249.2	1.68395643	5.194735	3.98629
2005	51.1574408	145414.5	8849.802	185144.6	11242.28	1.70890881	5.162608	3.946934
2006	52.1009947	151684	10163.61	189013.2	12669.37	1.71684601	5.18094	4.007048
Average flow	62.5793927		Average	193285.6	11963.71			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous





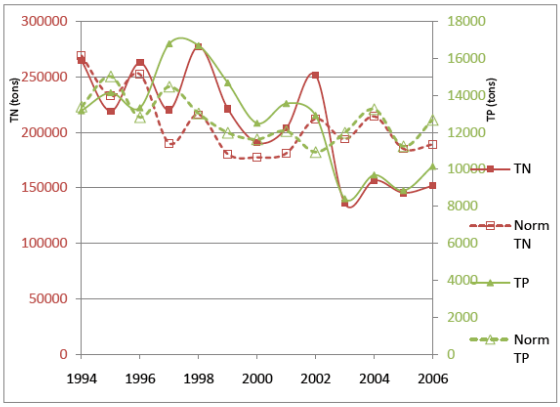


Figure 1. An example of the flow averaging calculation using the EUROHARP method, here for nutrient loads from Poland to the Baltic proper (PL_BP). The complete data sets are found in the Appendix.

3. RECALCULATION OF NUTRIENT LOADS FROM RUSSIA

Gulf of Finland

River Neva discharges: Reconstruction and flow-normalisation of the nutrient loads was made with time-series of water discharges registered at Novosaratovka site upstream of the Neva River delta, i.e. before its branching. These water flows (km^3 $year^{-1}$) are about 10% larger than those contained in PLC5 data during all the 1994-2006 years except 2001 and 2002.

Reconstruction of time series of TN and TP nutrient loads was made in three steps. Firstly, realistic annual inputs were estimated from joint measurements made by the Regional Environment Centre of South-eastern Finland and St. Petersburg Water Research and Control Centre at the mouths of all 5 Neva's branches in 2000 (11 samples), 2001 (14 samplings), 2002 (17 samplings), 2005 (6 samplings), and 2006 (4 samplings - Apr, Jul, Nov twice). Annual average concentrations at each of the five mouths were multiplied by a fixed fraction of annual water runoff discharged via this particular mouth, and then the five inputs were summed up.

Next, linear regressions were established between annual water discharges and TN, and TP inputs for 2000-2002 and 2005. Data for 2006 have been excluded from the regression due to both unrepresentative seasonal coverage (compared to other

years) and because the South-Western WWTP was launched in the end of 2005 that now collects a fraction of untreated wastewaters previously emitted into the Neva River and after treatment discharges directly into the Neva Bay. Finally, TN and TP annual loads were computed from these regressions for 1994-1999, 2003, 2004, and 2006.

Following the suggestion by SYKE (Seppo Knuuttila), both water discharges and nutrient loads from the Narva River have consistently been split between Russia and Estonia in 70% and 30%, proportions, corresponding to their watershed areas.

Finally, water discharges and nutrient loads from Neva, Narva and Luga have been summed up and used in the flow-normalisation procedure as riverine contributions from Russia into the Gulf of Finland (See Section 2 and Appendix for details)

Data for “coastal areas” were available only for 2000, while data for sixteen small rivers were available only for 2003, which made their usage for the flow normalisation impossible. Therefore, these inputs were treated as invariable between years and summed up with the inputs from direct point sources.

Russian input to the Baltic Proper

For this area, besides estimates of point sources, PLC5 contains data only from River Pregolia, for water flows only in 2000-2006 and for TN inputs in 2004-2006. Thus, TP inputs are entirely missing, while TN data are incomplete, which makes flow-normalisation impossible. At the same time, data in the Baltic Environment Database (BED) available through DSS Nest contain all the necessary information for 1994-2000 both in Pregolia River and for diffuse sources.

The reconstruction was therefore made in the following way.

1) TN input from Pregolia River was averaged for 2004-2006 and assumed invariable for 2000-2006.

2) TP inputs from Pregolia River in 2000-2006 were reconstructed from a linear regression between annual water discharges and TP loads using data for the same river available for 1994-2000.

3) Nutrient “diffuse” inputs from Kaliningrad area into the Baltic Proper were reconstructed from Pregolia inputs with using the ratios between these inputs as established for 1994-2000.

4) Finally, these invariate non-normalised inputs from the watershed were summed up together with the direct point sources.

4. DRAINAGE BASIN LOADS - RESULTS

The results from all these calculations, averaged for these two time periods are found in Table 1 - XX. Riverine inputs, not flow normalised, are presented in Table 1-3. The corresponding coastal point sources, essentially unaltered from the PLC5 compilations, except for Russia are shown in Table 4-6, and total loads in Table 7-9. The differences in total loads to the previous calculation for 1997-2003 are shown in Table 4.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB				28,456					19,691	48,147
BS				22,126					29,114	51,240
BP	6,903	2,179	1,034		50,398	10,243	4,580	214,369	27,950	317,657
GF			10,712	13,129			54,548			78,389
GR			11,727			65,104				76,831
DS	12,362	23,140							4,628	40,130
KT		28,818							33,899	62,717
SUM	19,265	54,137	23,473	63,710	50,398	75,347	59,129	214,369	115,282	**675,110**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB				1,482					997	2,479
BS				1,097					1,047	2,144
BP	161	40	18		2,561	239	636	13,650	741	18,046
GF			427	492			2,748			3,667
GR			250			1,734				1,985
DS	351	597							73	1,021
KT		730							686	1,417
SUM	512	1,368	696	3,072	2,561	1,973	3,384	13,650	3,544	**30,759**

Table 1. Riverine loads of nutrients (tonnes per year), averaged for 1997-2003. Not flow normalised.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB				30,408					19,053	49,461
BS				23,383					27,426	50,809
BP	6,249	1,780	1,046		37,667	8,217	4,580	176,499	25,626	261,664
GF			9,900	13,953			54,837			78,690
GR			12,153			56,874				69,027
DS	11,143	21,105							4,013	36,261
KT		26,600							31,363	57,964
SUM	17,392	49,485	23,099	67,744	37,667	65,091	59,418	176,499	107,481	**603,875**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	1,417	0	0	0	0	860	2,277
BS	0	0	0	1,072	0	0	0	0	870	1,942
BP	143	32	20	0	2,005	262	636	10,869	653	14,619
GF	0	0	423	510	0	0	2,736	0	0	3,669
GR	0	0	243	0	0	1,939	0	0	0	2,182
DS	314	579	0	0	0	0	0	0	71	963
KT	0	697	0	0	0	0	0	0	689	1,386
SUM	457	1,308	686	2,999	2,005	2,200	3,372	10,869	3,142	**27,038**

Table 2. Riverine loads of nutrients (tonnes per year), averaged for 2000-2006. Not flow normalised.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	1,952	0	0	0	0	-638	1,314
BS	0	0	0	1,257	0	0	0	0	-1,688	-431
BP	-654	-400	11	0	-12,731	-2,026	0	-37,870	-2,324	-55,993
GF	0	0	-812	824	0	0	289	0	0	301
GR	0	0	427	0	0	-8,230	0	0	0	-7,803
DS	-1,219	-2,035	0	0	0	0	0	0	-615	-3,869
KT	0	-2,218	0	0	0	0	0	0	-2,536	-4,754
SUM	-1,873	-4,652	-374	4,033	-12,731	-10,256	289	-37,870	-7,801	**-71,235**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	-65	0	0	0	0	-137	-203
BS	0	0	0	-25	0	0	0	0	-176	-202
BP	-18	-8	2	0	-556	23	0	-2,781	-88	-3,427
GF	0	0	-4	18	0	0	-12	0	0	2
GR	0	0	-7	0	0	204	0	0	0	197
DS	-37	-19	0	0	0	0	0	0	-2	-58
KT	0	-33	0	0	0	0	0	0	2	-31
SUM	-55	-60	-10	-72	-556	227	-12	-2,781	-402	**-3,721**

Table 3. Differences in riverine loads of nitrogen and phosphorus (tonnes per year), between 2000-0006 and updated and averaged data for 1997-2003. These data are not flow normalised.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB				2,293					1,088	3,381
BS				2,445					3,059	5,505
BP	140	78	4		490	204	1,573	981	4,179	7,650
GF			1,533	2,902			17,679			22,114
GR			72			1,463				1,535
DS	1,467	2,484							1,047	4,997
KT		809							2,083	2,892
SUM	1,607	3,371	1,609	7,640	490	1,667	19,252	981	11,457	**48,073**
Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB				71					41	112
BS				123					197	320
BP	6	11	1		59	27	145	68	126	442
GF			63	93			2,206			2,362
GR			10			189				198
DS	17	329							32	378
KT		88							95	183
SUM	23	428	74	287	59	215	2,351	68	491	**3,995**

Table 4. Coastal point source loads of nitrogen and phosphorus (tonnes per year), averaged for 1997-2003.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	2,095	0	0	0	0	1,048	3,144
BS	0	0	0	2,261	0	0	0	0	3,200	5,461
BP	108	66	3	0	297	191	1,509	926	3,678	6,777
GF	0	0	1,231	2,173	0	0	17,451	0	0	20,855
GR	0	0	76	0	0	1,481	0	0	0	1,557
DS	939	2,120	0	0	0	0	0	0	760	3,820
KT	0	666	0	0	0	0	0	0	1,819	2,485
SUM	1,047	2,852	1,309	6,529	297	1,672	18,960	926	10,506	**44,098**
Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	61	0	0	0	0	39	100
BS	0	0	0	112	0	0	0	0	202	315
BP	6	10	1	0	30	24	247	51	118	486
GF	0	0	59	85	0	0	2,663	0	0	2,807
GR	0	0	11	0	0	182	0	0	0	193
DS	14	268	0	0	0	0	0	0	28	310
KT	0	58	0	0	0	0	0	0	85	143
SUM	20	336	70	258	30	206	2,910	51	472	**4,353**

Table 5. Coastal point source loads of nitrogen and phosphorus (tonnes per year), averaged for 2000-2006.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	-197	0	0	0	0	-40	-237
BS	0	0	0	-184	0	0	0	0	141	-44
BP	-32	-12	-2	0	-193	-14	-64	-55	-501	-873
GF	0	0	-302	-729	0	0	-228	0	0	-1,259
GR	0	0	4	0	0	18	0	0	0	22
DS	-527	-364	0	0	0	0	0	0	-287	-1,178
KT	0	-143	0	0	0	0	0	0	-264	-407
SUM	-560	-519	-300	-1,111	-193	5	-292	-55	-951	**-3,975**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	-9	0	0	0	0	-3	-12
BS	0	0	0	-11	0	0	0	0	6	-5
BP	0	-1	0	0	-29	-3	102	-17	-8	44
GF	0	0	-4	-9	0	0	457	0	0	444
GR	0	0	1	0	0	-6	0	0	0	-5
DS	-3	-61	0	0	0	0	0	0	-4	-68
KT	0	-29	0	0	0	0	0	0	-10	-40
SUM	-3	-92	-3	-29	-29	-9	559	-17	-19	**358**

Table 6. Differences in coastal point source loads of nitrogen and phosphorus (tonnes per year), between 2000-0006 and updated data averaged for 1997-2003. These data are not flow normalised.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	30,748	0	0	0	0	20,780	51,528
BS	0	0	0	24,571	0	0	0	0	32,173	56,744
BP	7,043	2,257	1,039	0	50,888	10,447	6,153	215,350	32,129	325,306
GF	0	0	12,245	16,030	0	0	72,227	0	0	100,503
GR	0	0	11,799	0	0	66,567	0	0	0	78,365
DS	13,829	25,624	0	0	0	0	0	0	5,674	45,128
KT	0	29,627	0	0	0	0	0	0	35,983	65,610
SUM	20,872	57,508	25,082	71,350	50,888	77,014	78,381	215,350	126,739	**723,184**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	1,553	0	0	0	0	1,038	2,591
BS	0	0	0	1,220	0	0	0	0	1,243	2,463
BP	167	51	20	0	2,620	265	883	13,717	867	18,590
GF	0	0	490	585	0	0	5,399	0	0	6,474
GR	0	0	260	0	0	1,923	0	0	0	2,183
DS	367	926	0	0	0	0	0	0	105	1,399
KT	0	818	0	0	0	0	0	0	782	1,600
SUM	535	1,795	769	3,359	2,620	2,188	6,282	13,717	4,035	**35,301**

Table 7. Total loads (riverine and coastal point sources averaged, tonnes per year), for 1997-2003. Not flow normalised.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	32,504	0	0	0	0	20,101	52,605
BS	0	0	0	25,643	0	0	0	0	30,626	56,270
BP	6,357	1,845	1,048	0	37,964	8,408	6,089	177,425	29,304	268,441
GF	0	0	11,131	16,125	0	0	72,288	0	0	99,544
GR	0	0	12,229	0	0	58,355	0	0	0	70,584
DS	12,082	23,226	0	0	0	0	0	0	4,773	40,081
KT	0	27,266	0	0	0	0	0	0	33,183	60,449
SUM	18,439	52,337	24,408	74,272	37,964	66,763	78,378	177,425	117,987	**647,973**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	1,479	0	0	0	0	898	2,377
BS	0	0	0	1,184	0	0	0	0	1,073	2,257
BP	149	42	21	0	2,035	286	883	10,919	771	15,105
GF	0	0	482	595	0	0	5,399	0	0	6,476
GR	0	0	254	0	0	2,121	0	0	0	2,375
DS	327	846	0	0	0	0	0	0	99	1,273
KT	0	756	0	0	0	0	0	0	774	1,530
SUM	476	1,644	756	3,258	2,035	2,407	6,282	10,919	3,615	**31,391**

Table 8. Total loads (riverine and coastal point sources, tonnes per year), averaged for 2000-2006. Not flow normalised.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	1,755	0	0	0	0	-678	1,077
BS	0	0	0	1,072	0	0	0	0	-1,547	-475
BP	-686	-412	10	0	-12,924	-2,040	-64	-37,925	-2,825	-56,866
GF	0	0	-1,114	95	0	0	61	0	0	-959
GR	0	0	430	0	0	-8,212	0	0	0	-7,781
DS	-1,747	-2,398	0	0	0	0	0	0	-902	-5,047
KT	0	-2,361	0	0	0	0	0	0	-2,800	-5,161
SUM	-2,433	-5,171	-674	2,923	-12,924	-10,251	-3	-37,925	-8,752	**-75,210**
Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	-74	0	0	0	0	-140	-214
BS	0	0	0	-36	0	0	0	0	-171	-207
BP	-18	-9	1	0	-585	20	0	-2,798	-96	-3,485
GF	0	0	-8	9	0	0	0	0	0	2
GR	0	0	-6	0	0	198	0	0	0	192
DS	-40	-80	0	0	0	0	0	0	-6	-126
KT	0	-62	0	0	0	0	0	0	-8	-70
SUM	-58	-151	-13	-101	-585	218	0	-2,798	-420	**-3,910**

Table 9.. Differences in total loads (tonnes per year, riverine and coastal point sources) between 2000-2006 and 1997-2003. Not flow normalised.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB				27,801					18,523	46,324
BS				22,375					26,592	48,967
BP	6,733	2,096	1,093		49,847	9,808	10,214	192,999	26,939	299,728
GF			10,612	13,816			57,401			81,829
GR			12,500			65,386				77,887
DS	12,010	23,037							4,672	39,719
KT		28,155							31,992	60,148
SUM	18,743	53,289	24,205	63,992	49,847	75,194	67,615	192,999	108,719	**654,601**
Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB				1,442					944	2,386
BS				1,082					940	2,022
BP	167	38	20		2,568	235	636	12,293	711	16,668
GF			431	531			2832			3,794
GR			272			1,767				2,039
DS	347	602							76	1,025
KT		713							642	1,354
SUM	514	1,352	723	3,054	2,568	2,002	3,468	12,293	3,312	**29,287**

Table 10. Riverine flow normalised loads of nitrogen and phosphorus (tonnes per year), averaged for 1997-2003.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	30,550	0	0	0	0	18,395	48,945
BS	0	0	0	23,813	0	0	0	0	26,349	50,162
BP	7,397	1,917	1,085	0	45,236	8,328	10,214	193,286	25,740	293,203
GF	0	0	10,330	14,244	0	0	56,725	0	0	82,513
GR	0	0	12,791	0	0	60,529	0	0	0	73,320
DS	11,324	21,552	0	0	0	0	0	0	4,254	37,130
KT	0	25,566	0	0	0	0	0	0	30,662	56,228
SUM	18,721	49,035	24,207	68,607	45,236	68,856	66,939	193,286	105,400	**641,502**
Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	1,424	0	0	0	0	816	2,239
BS	0	0	0	1,078	0	0	0	0	807	1,885
BP	162	33	21	0	2,383	265	636	11,964	654	16,118
GF	0	0	438	520	0	0	2,794	0	0	3,752
GR	0	0	261	0	0	2,059	0	0	0	2,320
DS	315	592	0	0	0	0	0	0	74	981
KT	0	670	0	0	0	0	0	0	672	1,342
SUM	477	1,296	720	3,022	2,383	2,325	3,430	11,964	3,023	**28,638**

Table 11. Riverine flow normalised loads of nitrogen and phosphorus (tonnes per year), averaged for 2000-2006.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	2,749	0	0	0	0	-128	2,621
BS	0	0	0	1,438	0	0	0	0	-243	1,195
BP	664	-179	-8	0	-4,610	-1,480	0	287	-1,199	-6,525
GF	0	0	-282	428	0	0	-676	0	0	-530
GR	0	0	291	0	0	-4,858	0	0	0	-4,567
DS	-685	-1,486	0	0	0	0	0	0	-418	-2,589
KT	0	-2,589	0	0	0	0	0	0	-1,330	-3,920
SUM	-21	-4,254	1	4,615	-4,610	-6,337	-676	287	-3,319	**-14,314**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	-18	0	0	0	0	-128	-146
BS	0	0	0	-4	0	0	0	0	-133	-137
BP	-6	-5	1	0	-184	30	0	-329	-56	-549
GF	0	0	7	-11	0	0	-38	0	0	-41
GR	0	0	-11	0	0	293	0	0	0	281
DS	-31	-10	0	0	0	0	0	0	-2	-43
KT	0	-42	0	0	0	0	0	0	30	-12
SUM	-37	-57	-4	-32	-184	323	-38	-329	-290	**-648**

Table 12. Differences in riverine loads of nitrogen and phosphorus (tonnes per year), flow averaged for 2000-2006 and 1997-2003

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	30,094	0	0	0	0	19,611	49,705
BS	0	0	0	24,820	0	0	0	0	29,651	54,472
BP	6,873	2,174	1,097	0	50,337	10,012	11,787	193,980	31,118	307,378
GF	0	0	12,145	16,718	0	0	75,080	0	0	103,942
GR	0	0	12,572	0	0	66,849	0	0	0	79,421
DS	13,477	25,521	0	0	0	0	0	0	5,718	44,716
KT	0	28,964	0	0	0	0	0	0	34,076	63,040
SUM	20,350	56,659	25,814	71,632	50,337	76,861	86,867	193,980	120,175	**702,674**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	1,512	0	0	0	0	985	2,497
BS	0	0	0	1,205	0	0	0	0	1,137	2,342
BP	173	49	21	0	2,626	262	883	12,360	837	17,212
GF	0	0	494	624	0	0	5,457	0	0	6,575
GR	0	0	282	0	0	1,956	0	0	0	2,238
DS	363	931	0	0	0	0	0	0	109	1,402
KT	0	800	0	0	0	0	0	0	737	1,537
SUM	537	1,780	797	3,341	2,626	2,218	6,340	12,360	3,804	**33,803**

Table 13. Total load (tonnes per year, coastal point sources and flow normalised riverine inputs) averaged for 1997-2003.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	32,646	0	0	0	0	19,443	52,089
BS	0	0	0	26,073	0	0	0	0	29,549	55,622
BP	7,505	1,983	1,087	0	45,534	8,519	11,723	194,211	29,418	299,981
GF	0	0	11,561	16,416	0	0	74,176	0	0	102,154
GR	0	0	12,867	0	0	62,010	0	0	0	74,877
DS	12,264	23,672	0	0	0	0	0	0	5,014	40,950
KT	0	26,232	0	0	0	0	0	0	32,481	58,713
SUM	19,769	51,887	25,515	75,136	45,534	70,528	85,899	194,211	115,906	**685,599**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	1,485	0	0	0	0	854	2,339
BS	0	0	0	1,190	0	0	0	0	1,009	2,199
BP	168	43	22	0	2,413	289	883	12,015	772	16,604
GF	0	0	497	605	0	0	5,457	0	0	6,559
GR	0	0	271	0	0	2,242	0	0	0	2,513
DS	329	860	0	0	0	0	0	0	103	1,291
KT	0	728	0	0	0	0	0	0	757	1,485
SUM	496	1,631	790	3,280	2,413	2,531	6,340	12,015	3,495	**32,992**

Table 14. Total load (tonnes per year, coastal point sources and flow normalised riverine inputs) averaged for 2000-2006.

Nitrogen	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	2,552	0	0	0	0	-168	2,384
BS	0	0	0	1,253	0	0	0	0	-102	1,151
BP	632	-191	-10	0	-4,803	-1,493	-64	232	-1,700	-7,398
GF	0	0	-584	-301	0	0	-904	0	0	-1,789
GR	0	0	295	0	0	-4,839	0	0	0	-4,545
DS	-1,213	-1,849	0	0	0	0	0	0	-704	-3,766
KT	0	-2,732	0	0	0	0	0	0	-1,595	-4,327
SUM	-581	-4,773	-299	3,504	-4,803	-6,333	-968	232	-4,269	**-18,289**

Phosphorus	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	0	0	0	-27	0	0	0	0	-131	-158
BS	0	0	0	-15	0	0	0	0	-128	-142
BP	-6	-6	0	0	-213	27	0	-346	-64	-608
GF	0	0	3	-19	0	0	0	0	0	-16
GR	0	0	-10	0	0	286	0	0	0	276
DS	-34	-71	0	0	0	0	0	0	-6	-111
KT	0	-72	0	0	0	0	0	0	20	-52
SUM	-40	-149	-7	-61	-213	314	0	-346	-309	**-812**

Table 15. Difference in total load (tonnes per year, coastal point sources and flow normalised riverine inputs) averaged for 1997-2003 and 2000-2006.

	97-03		00-06		Difference	
	N	P	N	P	N	P
Total load	723,184	35,301	647,973	31,391	-75,210	-3,910
Log normalised total load	702,674	33,803	685,599	32,992	-17,075	-812

Table 16. Total loads of nitrogen and phosphorus (tonnes per year) to the entire Baltic Sea calculated for the two time periods considered for the update of the eutrophication section of the Baltic Sea Action Plan. Riverine input are either summarised directly or normalised, considering variations in river flows.

5. Source allocated atmospheric nutrient loads

Atmospheric loads are consided in the original country allocation sceme calculated by BNI and adopted by HELCOM as a part of the BSAP agreement, signed in Krakow in November 2007 but were treated as a 'background' load which include contributions from all HELCOM countries as well as other sources, see Table 5.

Basin	P land	N land	Atm N	N land+atm
BB	2,585	51,436	8,820	60,256
BS	2,457	56,786	27,197	83,983
BP	6,746	233,259	129,048	362,306
GP	4,860	106,680	12,828	119,508
GR	1,430	78,403	10,015	88,419
DS	1,409	30,893	23,711	54,604
KT	1,573	44,257	20,364	64,621
SUM	21,059	601,714	231,982	833,696

Table 17. Allowable inputs of phosphorus (P land) and nitrogen (N land) from the drainages basins and nitrogen via atmoshere (Atm N) in the original BSAP calculations.

The contributions by the different countries of atmospheric nitrogen were ignored because there were no data available for such a sceme. The source allocated atmospheric loads, calculated by EMEP are now available on the Internet and accessable via NEST, see figure 2. Table 18 and 19 summarise these calculations.

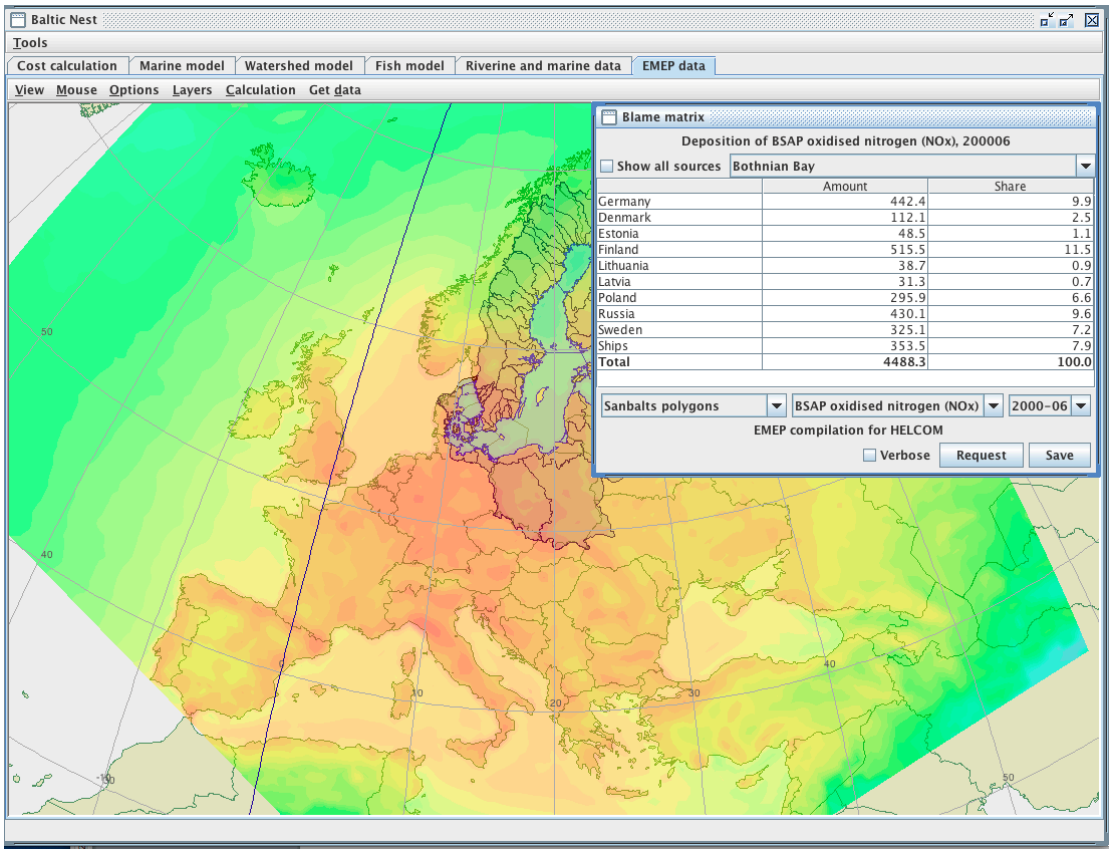


Figure 2. The EMEP data on atmospheric loads, available on the Internet, as seen using the NEST system.

N	Other Countries	Ships	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	2,998	354	778	209	78	1,617	110	59	684	613	675	8,176
BS	10,145	1,387	2,827	704	219	1,898	449	234	1,302	2,567	2,171	23,903
BP	43,881	5,864	21,785	7,016	471	1,484	2,109	802	3,079	16,803	7,002	110,295
GF	4,975	655	1,260	295	571	782	271	179	1,516	1,077	448	12,029
GR	3,824	471	1,151	294	190	177	409	405	379	1,106	347	8,753
DS	6,870	621	7,602	5,462	10	37	51	19	109	752	316	21,849
KT	6,145	548	2,833	4,852	11	48	51	19	111	795	816	16,229
TUM	78,839	9,899	38,236	18,831	1,550	6,042	3,450	1,719	7,179	23,713	11,775	201,234

Table 18. Atmospheric loads from HELCOM countries and other sources (oxidised and reduced componens combined, tons per year) to the Baltic Sea sub basins and averaged for 2000-2006, compiled from EMEP

N	Other Count-ries	Ships	DE	DK	EE	FI	LT	LV	RU	PL	SE	SUM
BB	-61	26	59	2	-9	-139	-6	-4	-60	-36	-46	-274
BS	-565	77	59	-67	-70	-283	-34	-18	-132	-192	-244	-1,469
BP	-2,556	219	-754	-650	-52	-190	-65	5	-97	-1,215	-836	-6,190
GF	-2	52	9	-26	-45	-58	21	7	-51	5	-52	-140
GR	-119	33	-27	-34	-27	-27	16	7	-15	42	-37	-189
DS	-395	19	-246	-369	0	-2	5	1	5	-110	-27	-1,120
KT	-314	-2	-167	-402	-2	-7	-4	-1	-6	-158	-85	-1,148
SUM	-4,011	425	-1,068	-1,547	-206	-706	-68	-2	-356	-1,664	-1,327	-10,530

Table 19. The differences in averaged atmospheric nitrogen loads between the periods 1997-2003 and 2000-2003 to the Baltic Sea sub basins.

6. Conclusions

Apparently, there has been a reduction of loads between the period 1997-2003 and 2000-2006, even if variations in river flows are considered. The flow normalisation procedure reduce the differences between the two time periods substantially, when the variations in river flows are considered (Table 16).

The flow normalised calculations presented here consider effects of variable water flows only; there might be other climatic factors influencing nutrient loads and the trends seen here might not only be dependent on changes in human induced emissions. Since the data on riverine loads are annual estimates and agreggated for all sub basins of each country draining into each Baltic marine sub basin, more sophisticated approaches cannot be used. However, these inconsistencies do not affect maximum allowable inputs which remain the same as in the original BSAP.

These calculations must now be evaluated and approved by HELCOM and particularily the country delegates of the PLC5 team before we can make the final calculation of country allocations in the revised BSAP.

Transboundary loads are not considered in these computations. For instance the loads via River Daugava are still allocated to Latvia. This will be corrected in the BSAP calculations.

The atmospheric contributions are considerable, representing about a quarter of the total nitrogen load to the Baltic Sea. The HELCOM countries contribute more than half of the atmospheric loads. A small reduction of the atmosperic load has occurred between the two periods, about 10,500 tons.

7. References

Silgram, M., and Schoumans, O.F. (eds.), 2004**. "**Modelling approaches: Model parameterisation, calibration and performance assessment methods in the EUROHARP project". EUROHARP report 8-2004, NIVA report SNO 4740-2003, Oslo, 18 pp. (also available at http://euroharp.org/diss/store/rep/eh-report8-WEB.pdf)

The NEST decision support system is available at http://nest.su.se/nest/

8. Abbreviations

BB = Bothnian Bay
BS = Bothnian Sea
BP = Baltic proper
GF = Gulf of Finland
GR = Gulf of Riga
DS = Danish Straits
KT = Kattegat

DE = Germany
DK = Denmark
EE = Estonia
FI = Finland
LT = Lithuania
LV = Latvia
RU = Russia

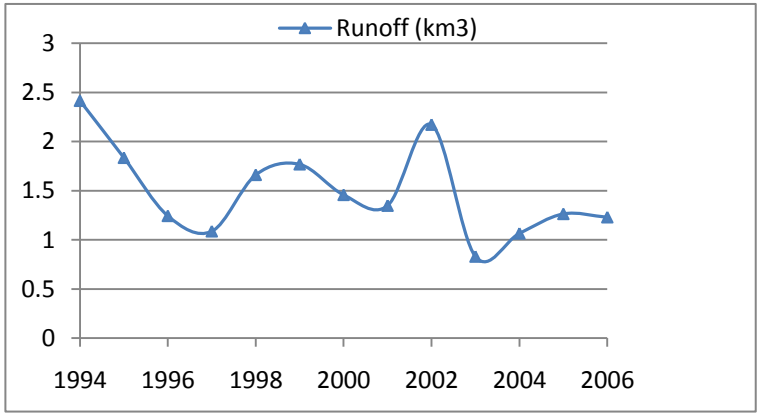
PL = Poland
Se = Sweden

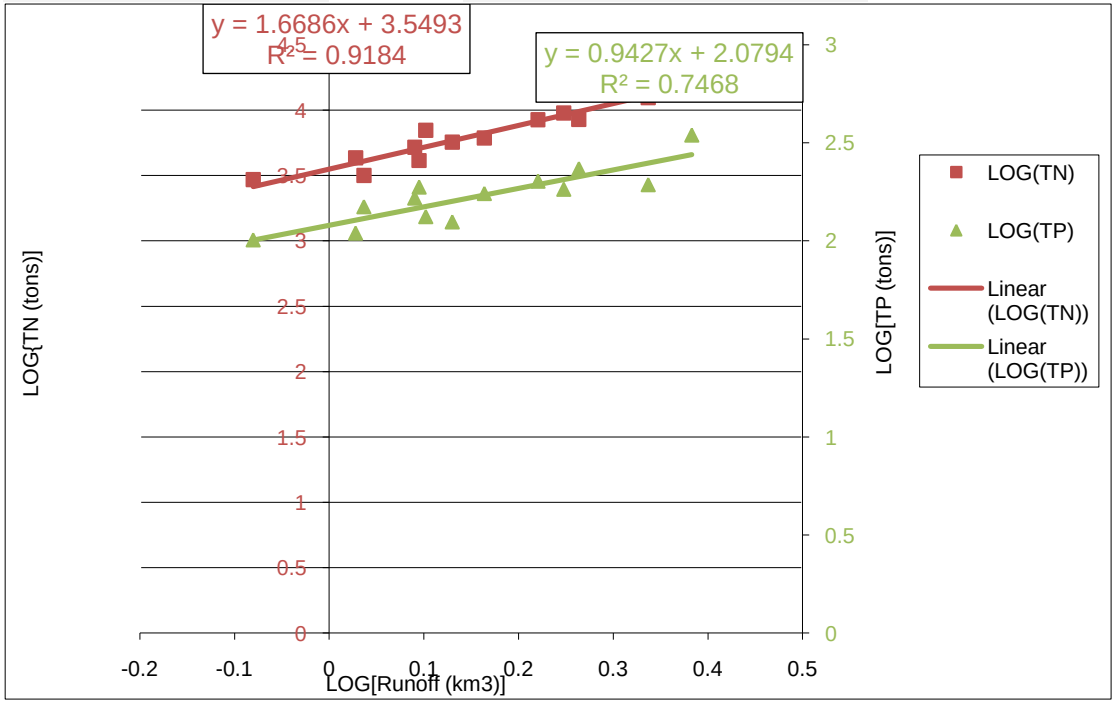
APPENDIX: Flow normalised calculations

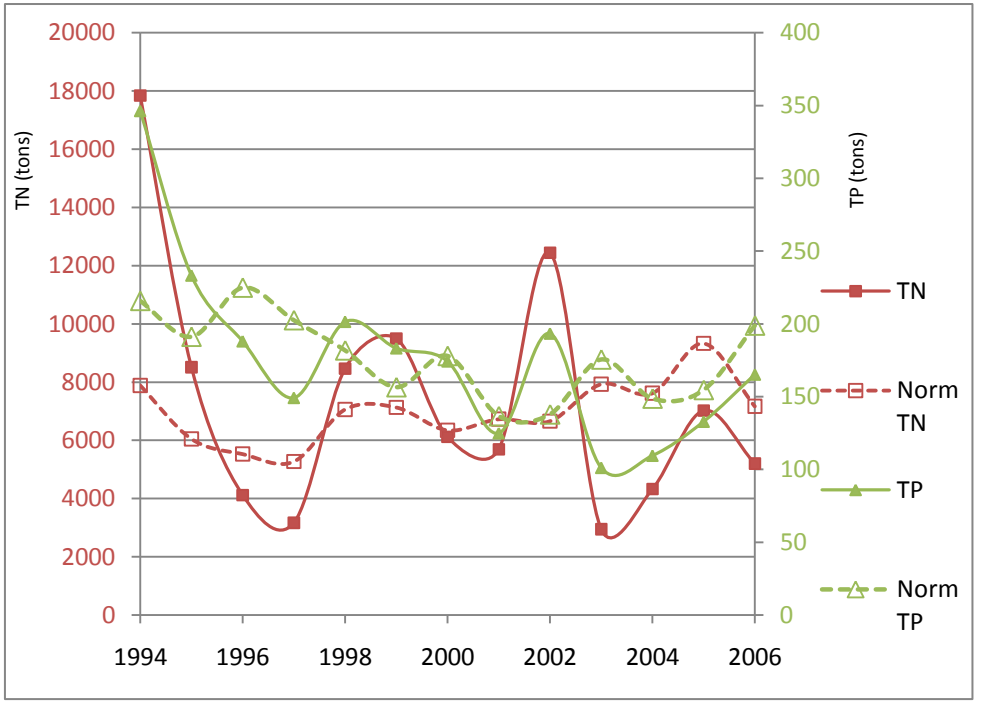
Data from 1994 to 2006		N				P				Average streamflow	Norm AVG from 2000 to 2006	
CatchmentName	CatchmensCode	r2	kx	m	No	r2	kx	m	No	AVG Runoff km3	TN AVG (tons)	TP AVG (tons)
DE_BP	DE_BP	0.92	1.67	3.55	12.00	0.75	0.94	2.08	12.00	1.49	7397.058357	161.5023153
DE_DS	DE_DS	0.95	1.37	3.58	12.00	0.87	0.94	2.18	12.00	2.34	11324.41645	315.3059476
DK_BP	DK_BP	0.83	1.06	3.93	12.00	0.64	0.90	2.10	12.00	0.27	1917.348854	33.34396406
DK_DS	DK_DS	0.94	1.11	3.74	12.00	0.78	0.79	2.36	12.00	3.62	21551.69481	591.9754349
DK_KT	DK_KT	0.83	1.11	3.63	12.00	0.91	1.11	2.03	12.00	5.42	25565.82743	670.1955664
EE_BP	EE_BP	0.64	0.71	3.27	12.00	0.58	1.14	1.75	12.00	0.42	1084.886296	20.82043622
EE_GF	EE_GF	0.83	1.11	3.11	12.00	0.71	0.87	1.92	12.00	6.36	10330.36318	438.0383668
EE_GR	EE_GR	0.46	0.59	3.65	12.00	0.60	0.96	1.76	12.00	4.87	12791.34434	260.9364234
FI_BB	FI_BB	0.76	1.08	2.67	12.00	0.77	1.02	1.48	12.00	43.92	30550.37372	1423.660078
FI_BS	FI_BS	0.59	0.83	3.40	12.00	0.80	1.27	1.60	12.00	13.46	23812.79994	1077.853773
FI_GF	FI_GF	0.58	0.72	3.34	12.00	0.71	1.26	1.34	12.00	12.78	14243.54874	520.3028832
LT_BP	LT_BP	0.67	0.83	3.56	12.00	0.44	0.84	2.22	12.00	21.30	45236.26417	2383.283398
LV_BP	LV_BP	0.39	0.81	3.56	12.00	0.48	0.76	1.96	12.00	3.55	8327.951326	265.4125888
LV_GR	LV_GR	0.66	1.08	3.26	12.00	0.58	1.10	1.67	12.00	27.39	60528.53832	2059.456267
PL_BP	PL_BP	0.70	1.21	3.14	12.00	0.83	1.20	1.94	12.00	62.58	193285.5795	11963.71083
RU_GF	RU_GF	0.86	1.08	2.68	12.00	0.34	0.53	2.43	12.00	85.79	57939.57145	2944.699036
SE_BB	SE_BB	0.97	1.30	1.97	12.00	0.52	1.26	0.74	12.00	58.62	18394.78583	815.663897
SE_BP	SE_BP	0.91	1.13	3.00	12.00	0.92	1.35	1.13	12.00	18.32	25740.23482	654.2497643
SE_BS	SE_BS	0.94	1.06	2.41	12.00	0.69	1.29	0.52	12.00	77.27	26348.94927	806.9181825
SE_DS	SE_DS	0.87	1.11	3.78	12.00	0.91	1.09	2.01	12.00	0.79	4254.032407	74.10329593
SE_KT	SE_KT	0.88	0.91	3.20	12.00	0.79	1.06	1.31	12.00	27.53	30662.02463	671.5971233

Basin	DE_BP							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	2.41465465	17842	346.3	7885.845	215.8216	0.38285503	4.251444	2.539452
1995	1.83505962	8512	233.3	6051.432	191.1994	0.26365018	3.930032	2.367915
1996	1.24440879	4120	188.1	5529.52	224.9246	0.09496307	3.614897	2.274389
1997	1.08798693	3167	149.235	5273.807	202.5686	0.03662368	3.500648	2.173871
1998	1.6615035	8464	201.51	7062.577	181.8331	0.22050126	3.927576	2.304297
1999	1.76882185	9492.5	183.292	7131.072	156.5773	0.2476841	3.977381	2.263144
2000	1.45826729	6116.254	174.325	6345.696	178.0378	0.16383714	3.786486	2.24136
2001	1.34874509	5692.49	124.928	6726.969	136.7041	0.12992988	3.755302	2.09666
2002	2.17200239	12441.91	193.4059	6659.083	137.9066	0.3368603	4.094887	2.28647
2003	0.83124222	2945.525	101.18	7930.73	175.5878	-0.0802724	3.469163	2.005095
2004	1.06621246	4325.54	109.5131	7617.884	148.754	0.02784375	3.63604	2.039466
2005	1.26464302	7021.54	132.89	9330.234	154.6405	0.10196795	3.846432	2.123492
2006	1.23106003	5199.45	165.27	7168.811	198.8854	0.09027923	3.715957	2.218194
Average flow	1.49112368		Average	7397.058	161.5023			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

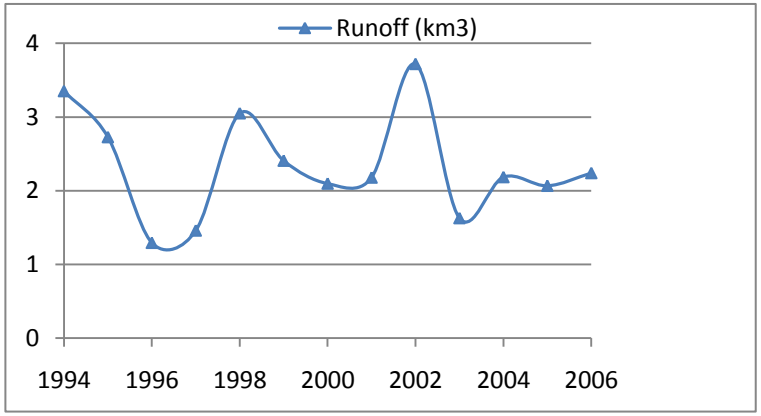


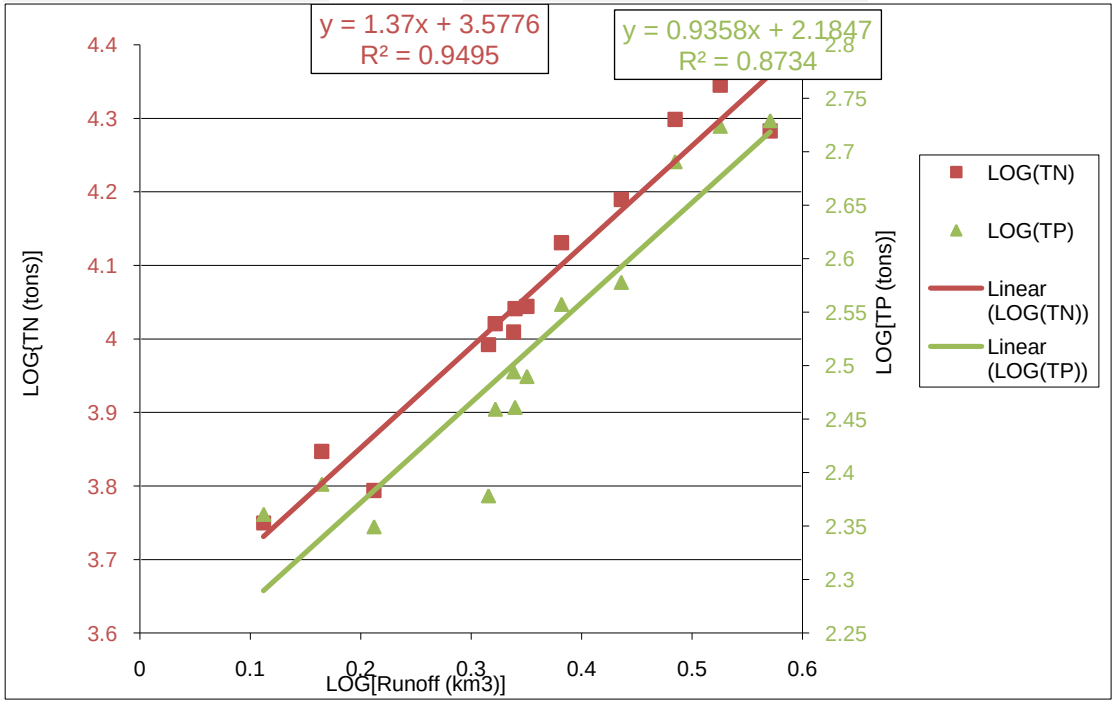


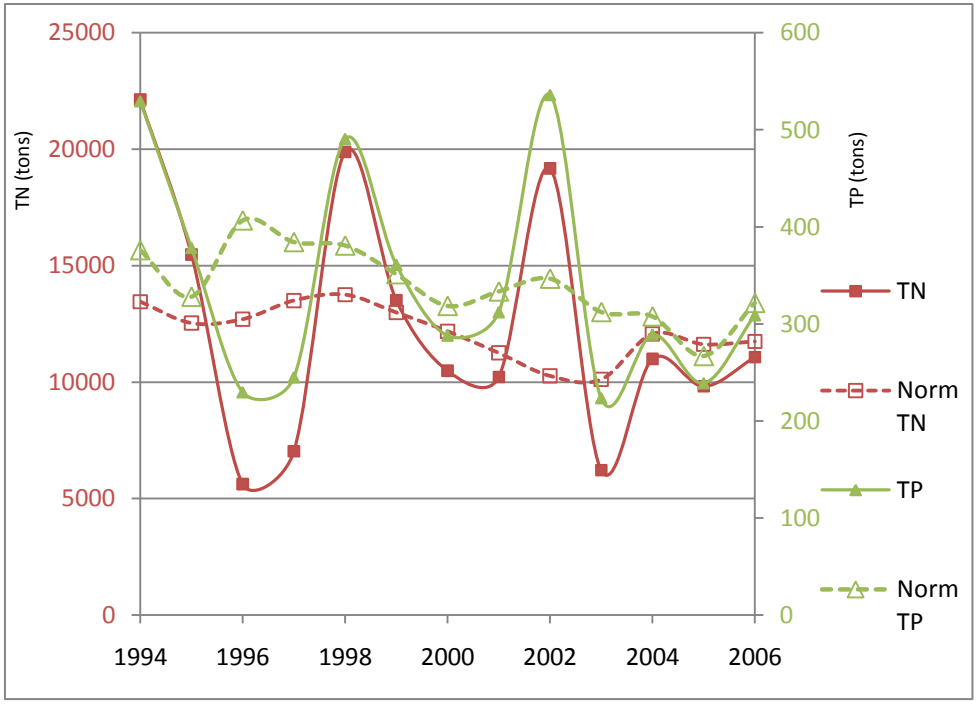


Basin	DE_DS							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	3.35226494	22134	529.5	13450.36	375.9524	0.52533833	4.34506	2.723866
1995	2.72786151	15476.7	378.36	12532.57	328.0112	0.43582232	4.189678	2.577905
1996	1.29431581	5620.1	229.62	12699.43	406.5755	0.11204025	3.749744	2.36101
1997	1.46099992	7029.62	244.98	13500.77	384.2738	0.16465019	3.846932	2.389131
1998	3.05146338	19883.04	490.57	13751.33	380.7334	0.48450816	4.298483	2.690701
1999	2.40835242	13514.89	360.8757	12986.65	351.1929	0.38172004	4.130813	2.557358
2000	2.09799399	10490.68	287.9395	12182.56	318.5339	0.32180424	4.020804	2.459301
2001	2.179527	10220.31	312.096	11255	333.457	0.33836225	4.009464	2.494288
2002	3.72075277	19177.21	535.8806	10271.49	346.5998	0.57063081	4.282785	2.729068
2003	1.62909909	6221.749	223.5626	10120.27	312.2137	0.2119475	3.793912	2.349399
2004	2.18578633	10995.95	289.0723	12070.43	307.7621	0.33960771	4.041233	2.461006
2005	2.06802069	9822.2	238.96	11623.68	266.9586	0.31555488	3.992209	2.378325
2006	2.2406154	11072.97	308.9573	11747.49	321.6166	0.35036732	4.044264	2.489898
Average flow	2.33977333		Average	11324.42	315.3059			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

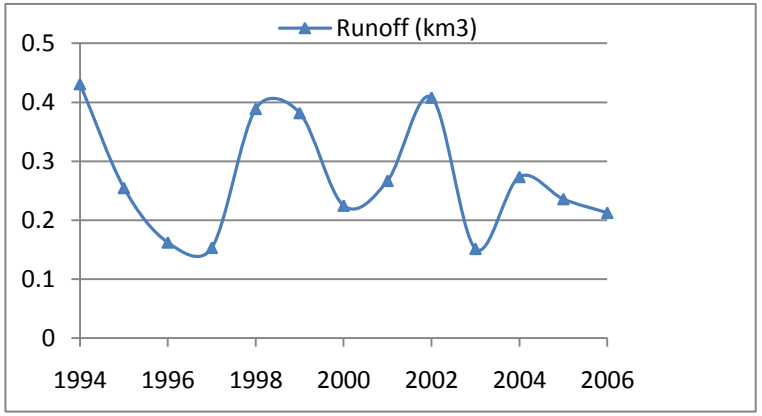


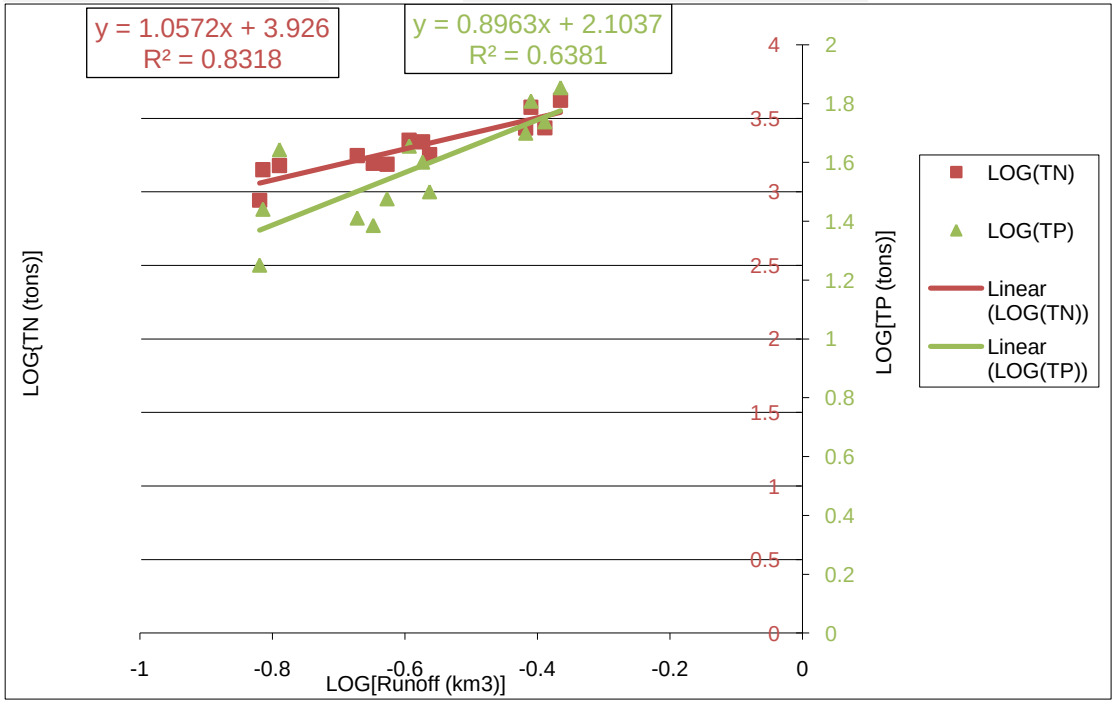


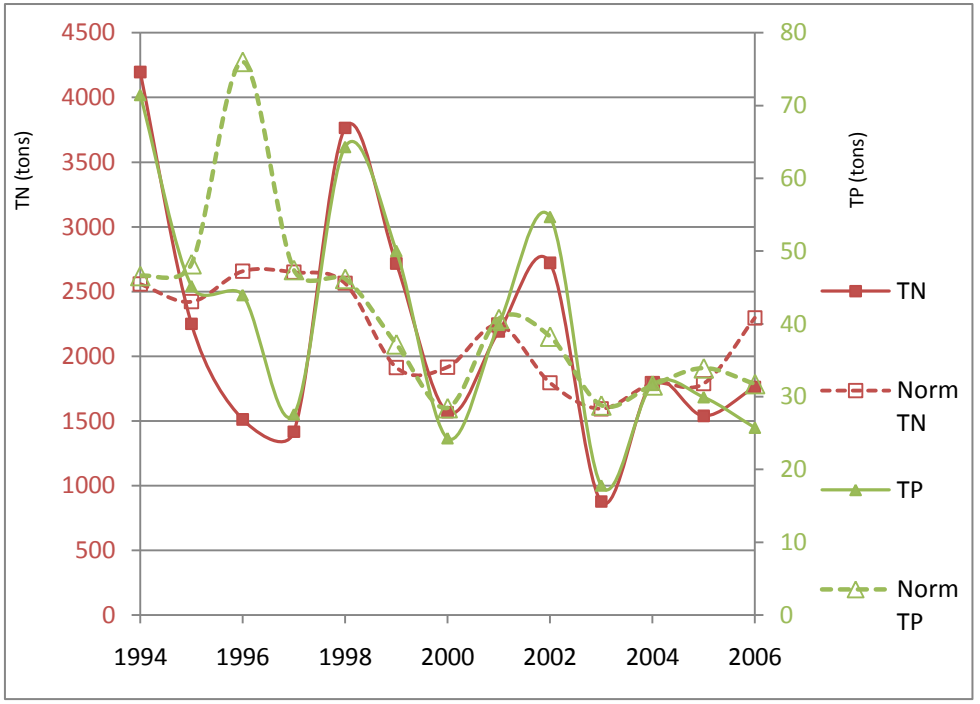


Basin	DK_BP							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	0.43118783	4196.766	71.469	2558.108	46.58222	-0.3653335	3.622915	1.854118
1995	0.25492723	2250.944	45.207	2421.705	48.20632	-0.5935838	3.352365	1.655206
1996	0.1624498	1512.184	43.971	2657.81	75.9907	-0.7892808	3.179605	1.643166
1997	0.15337004	1416.386	27.584	2649.424	47.40681	-0.8142595	3.151182	1.440657
1998	0.38907213	3764.82	64.321	2564.449	46.18863	-0.4099699	3.575744	1.808353
1999	0.38206923	2716.471	50.04	1912.936	37.20203	-0.4178579	3.434005	1.699317
2000	0.22499338	1566.911	24.3	1915.935	28.44065	-0.6478303	3.195044	1.385606
2001	0.26705117	2190.578	39.9	2241.476	40.68523	-0.5734055	3.340559	1.600973
2002	0.40824518	2721.894	54.70726	1795.198	38.26041	-0.3890789	3.434871	1.738045
2003	0.15160411	876.8113	17.8059	1593.881	28.8074	-0.819289	2.942906	1.250564
2004	0.27358752	1794.969	31.631	1790.174	31.56219	-0.5629037	3.254057	1.500113
2005	0.23606122	1539.269	29.94	1787.786	33.90584	-0.6269754	3.187315	1.476252
2006	0.21281875	1761.748	25.74926	2296.993	31.74603	-0.6719901	3.245944	1.410765
Average flow	0.27287981		Average	1917.349	33.34396			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

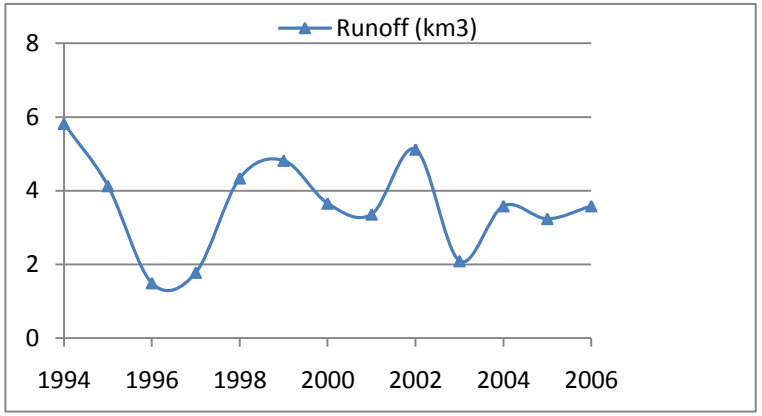


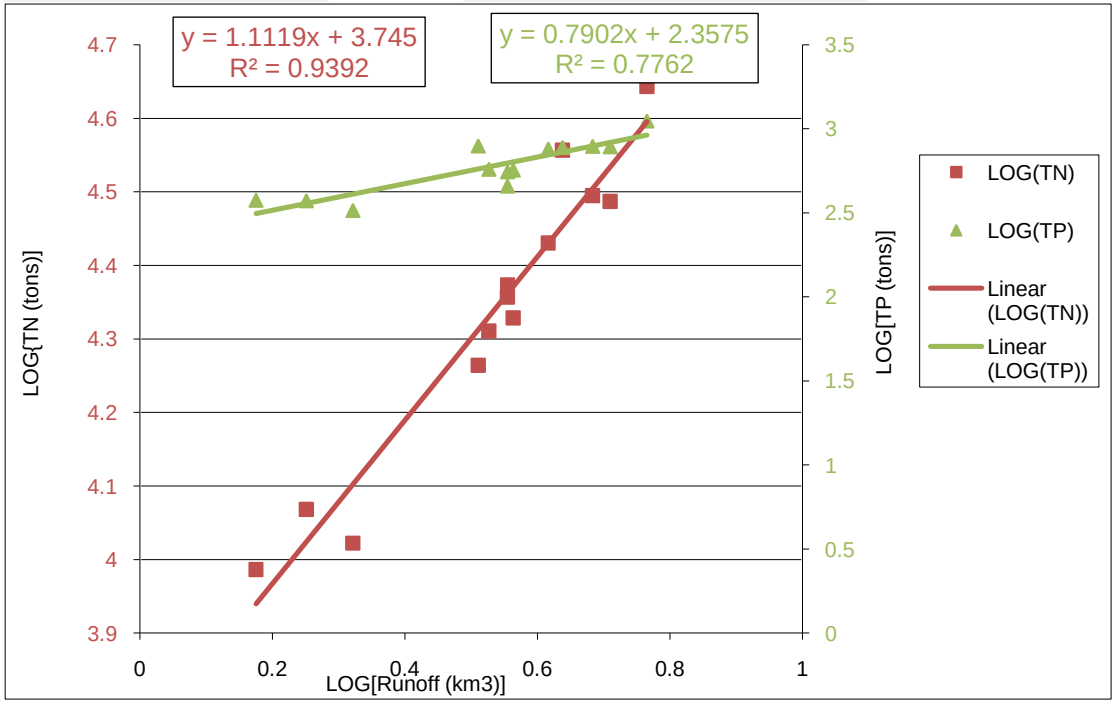


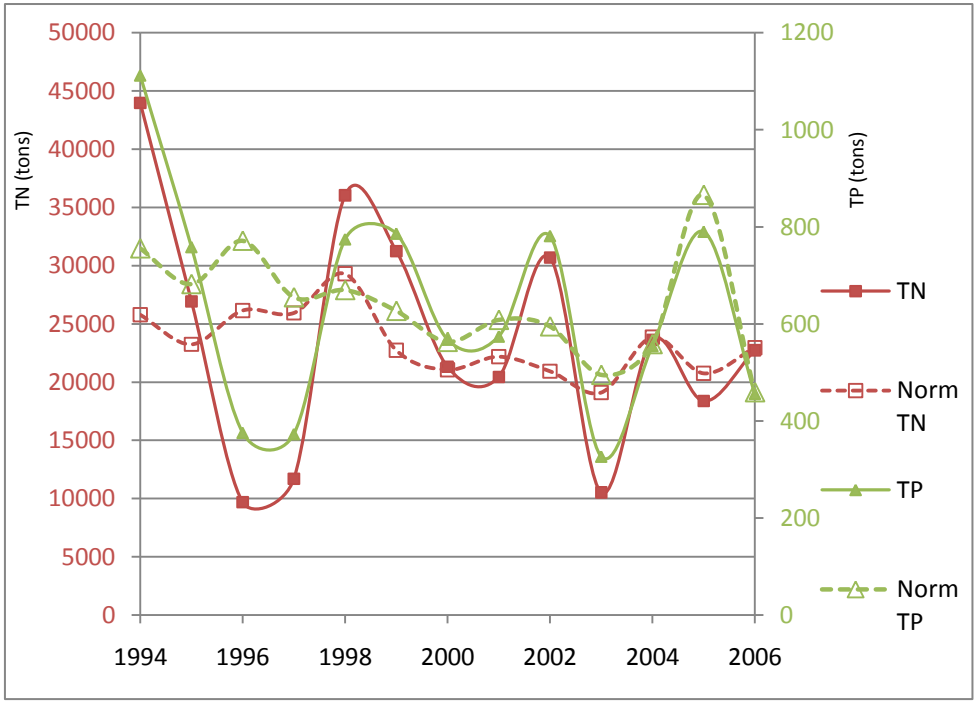


Basin	DK_DS							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	5.82180551	43981.56	1111.79	25785.77	755.6	0.76505769	4.643271	3.046023
1995	4.13219732	26936.31	758.251	23246.71	681.9984	0.61618105	4.430338	2.879813
1996	1.49711412	9688.039	375.581	26155.18	771.2881	0.17525491	3.986236	2.574704
1997	1.78302733	11705.03	372.907	25943.33	654.7361	0.251158	4.068372	2.571601
1998	4.34188973	36047.56	774.268	29306.86	669.6376	0.63767879	4.556876	2.888891
1999	4.82115633	31245.34	785.987	22732.51	626.7529	0.68315121	4.494785	2.895415
2000	3.65899628	21316.52	567.599	21063.22	562.8341	0.56336197	4.328716	2.754042
2001	3.3622833	20446.52	573.9209	22184.58	608.1541	0.5266343	4.310619	2.758852
2002	5.12488426	30690.62	781.034	20931.87	594.7954	0.70968406	4.487006	2.89267
2003	2.09610976	10528.32	326.5718	19098.5	494.8143	0.32141402	4.022359	2.513979
2004	3.58737155	23630.41	554.387	23866.38	558.2319	0.55477636	4.373471	2.743813
2005	3.23990461	18373.19	789.939	20753.11	865.9566	0.51053222	4.264185	2.897594
2006	3.58658104	22732.46	455.902	22964.21	459.0417	0.55468065	4.356646	2.658871
Average flow	3.61948624		Average	21551.69	591.9754			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

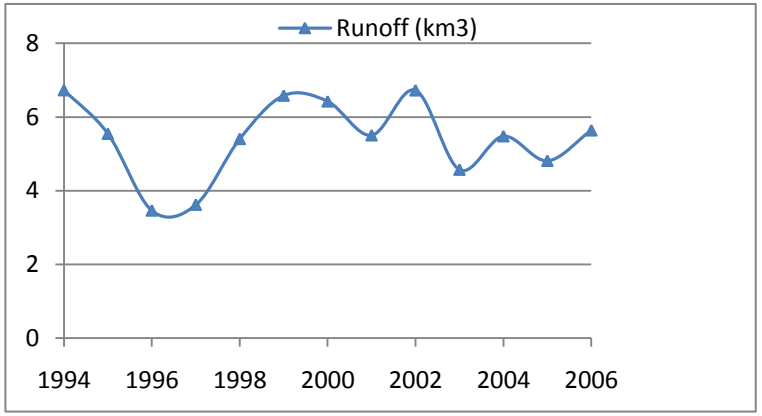


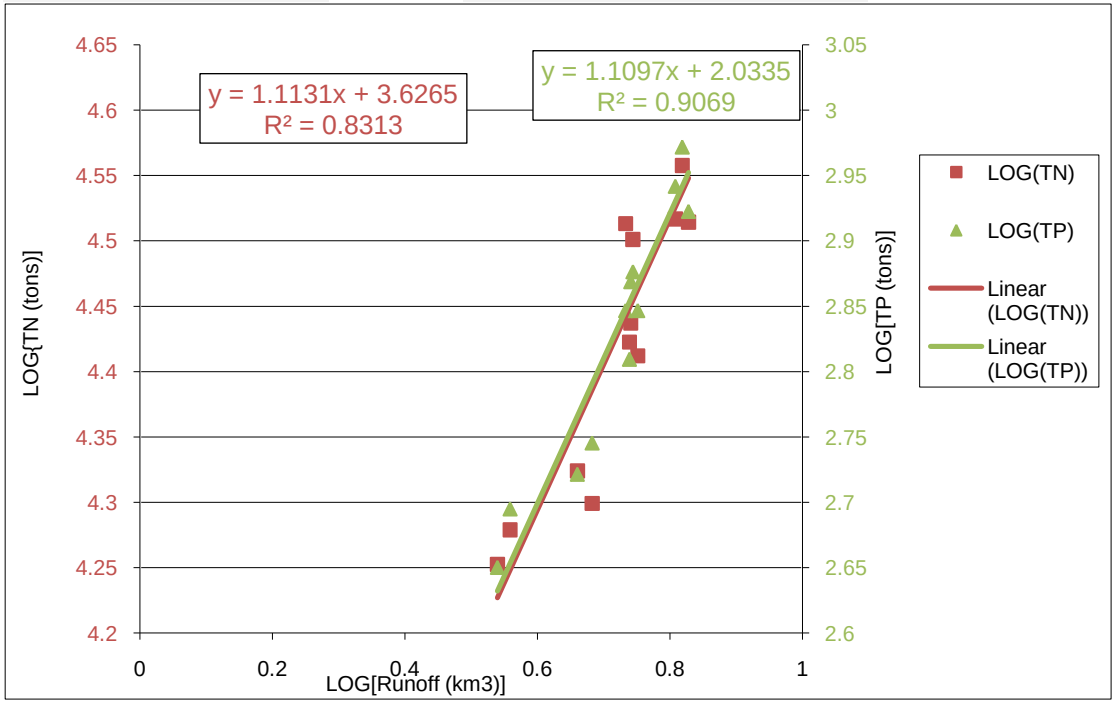


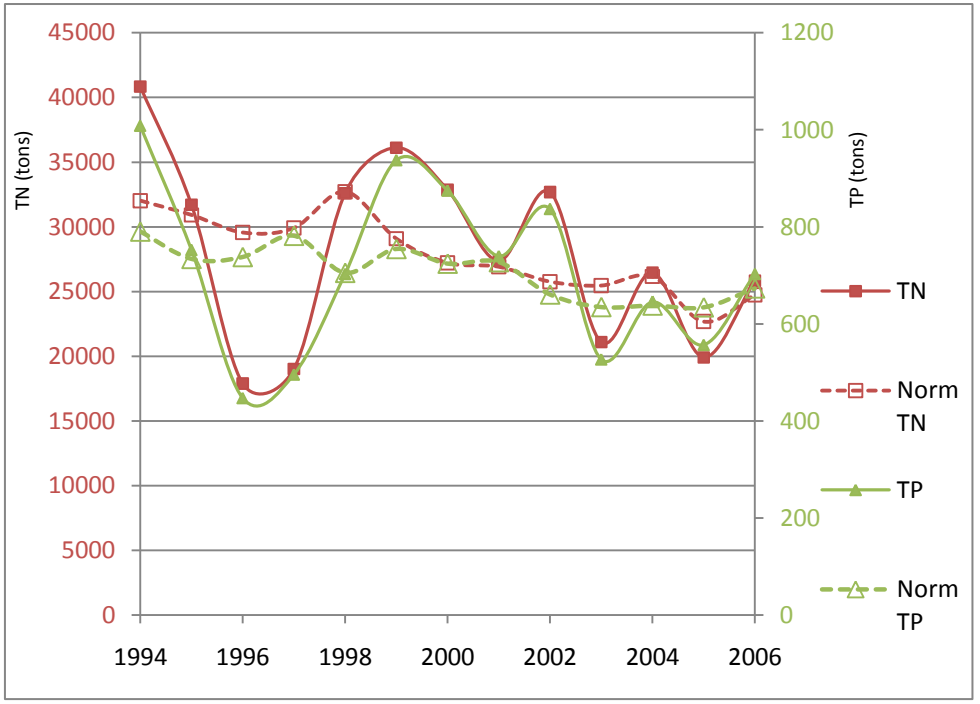


Basin	DK_KT							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	6.7294228	40846.92	1008.255	32023	790.3674	0.82797782	4.611159	3.00357
1995	5.54610078	31704.4	752.391	30920.24	733.9168	0.74398776	4.501119	2.876444
1996	3.46357932	17889.09	446.967	29560.94	737.773	0.53952514	4.252588	2.650275
1997	3.61986004	19009.83	495.479	29913.83	781.5755	0.55869178	4.278978	2.695025
1998	5.40683793	32598.57	702.659	32715.39	705.1298	0.73294335	4.513199	2.846745
1999	6.58295746	36117.64	937.307	29086.2	754.3849	0.81842105	4.557719	2.971882
2000	6.42582979	32861.34	874.671	27221.61	724.1487	0.80792922	4.516685	2.941845
2001	5.50482739	27362.91	739.361	26917.28	727.263	0.74074371	4.437162	2.868857
2002	6.7268118	32685	836.784	25766.31	660.5425	0.82780928	4.514349	2.922613
2003	4.57230811	21090.81	526.6333	25465.91	634.6045	0.66013549	4.324093	2.721508
2004	5.47959904	26461.16	644.909	26164.05	637.7582	0.73874878	4.422609	2.809498
2005	4.81327713	19913.2	556.484	22684.99	633.9938	0.68244087	4.299141	2.745453
2006	5.64017131	25828.02	702.6773	24740.63	673.0583	0.75129229	4.412091	2.846756
Average flow	5.42396792		Average	25565.83	670.1956			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

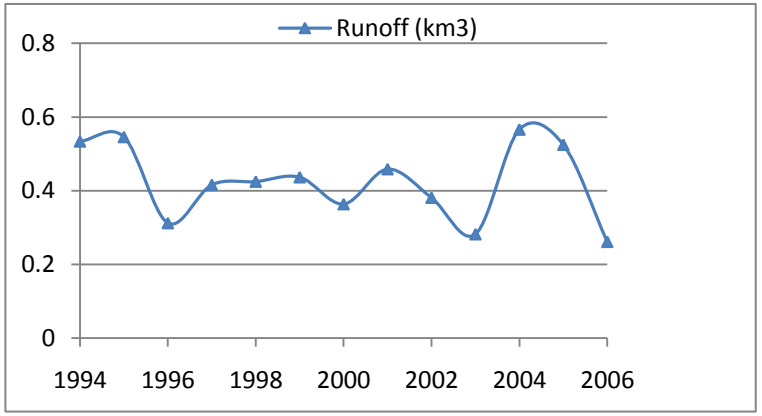


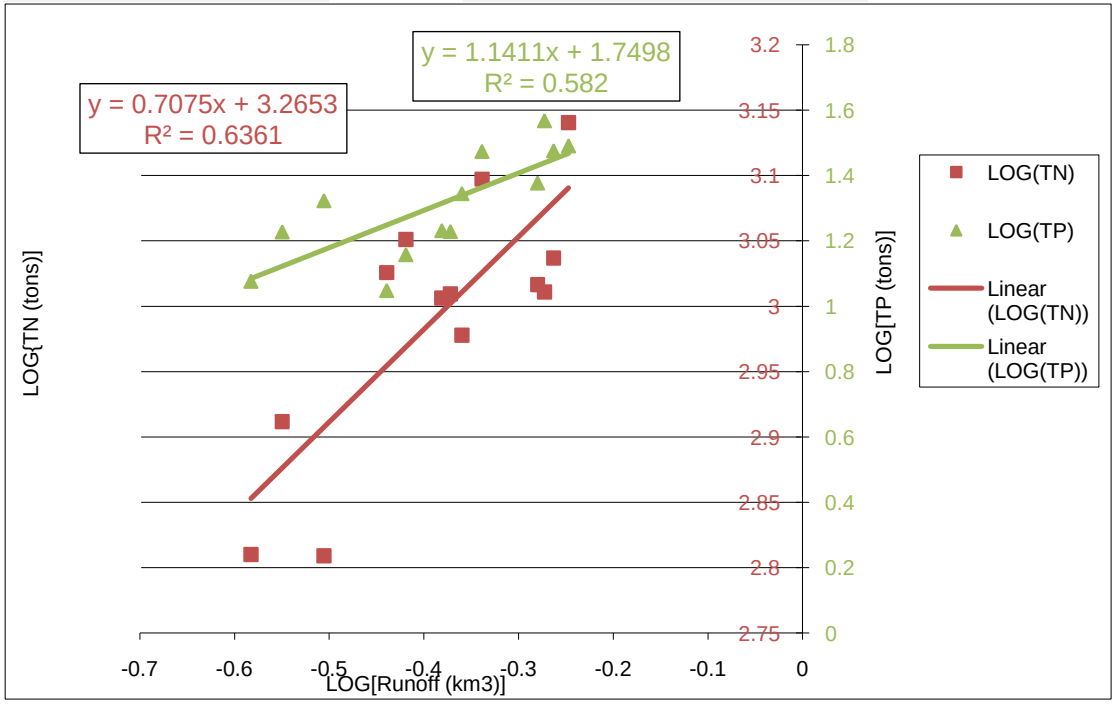


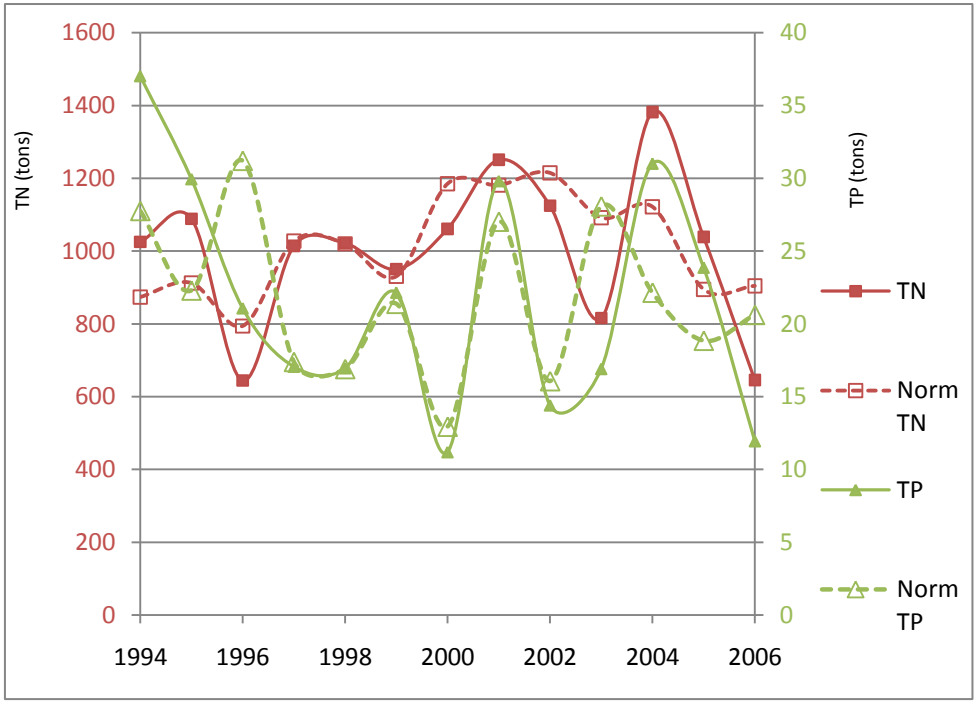


Basin	EE_BP							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	0.53380166	1025.495	37.01364	873.579	27.76017	-0.2726201	3.010934	1.568362
1995	0.54580946	1088.636	29.9375	912.1497	22.29895	-0.2629589	3.036883	1.476216
1996	0.31220301	644.4727	21.06511	793.924	31.20384	-0.5055629	2.809205	1.323564
1997	0.41590681	1014.384	17.05723	1027.655	17.39437	-0.381004	3.006202	1.231909
1998	0.42463976	1021.978	16.94932	1020.189	16.90504	-0.3719793	3.009442	1.229152
1999	0.43664757	950.4315	22.14315	930.4545	21.38582	-0.359869	2.977921	1.345239
2000	0.3636576	1061.05	11.186	1185.058	12.94738	-0.4393073	3.025736	1.048675
2001	0.4585248	1251	29.8	1181.227	27.02396	-0.3386372	3.097257	1.474216
2002	0.38104992	1125	14.4	1214.992	16.07475	-0.4190181	3.051153	1.158362
2003	0.28207181	816	16.9	1091.823	28.0742	-0.5496403	2.91169	1.227887
2004	0.56604096	1382	31	1122.002	22.15023	-0.2471521	3.140508	1.491362
2005	0.52493184	1039	23.86	894.95	18.84876	-0.2798971	3.016616	1.37767
2006	0.261404	645.8923	11.93703	904.1523	20.62377	-0.5826878	2.81016	1.076896
Average flow	0.42359148		Average	1084.886	20.82044			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

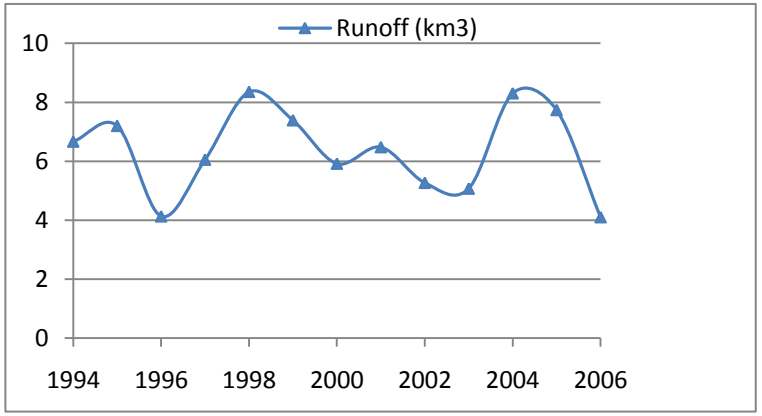


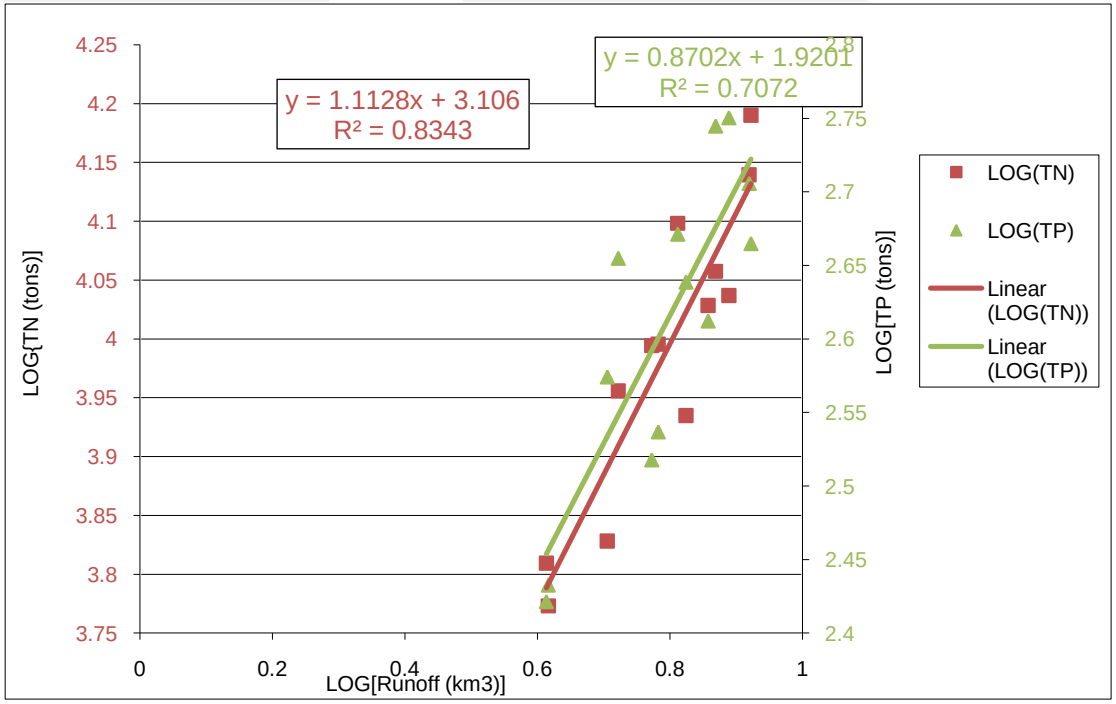


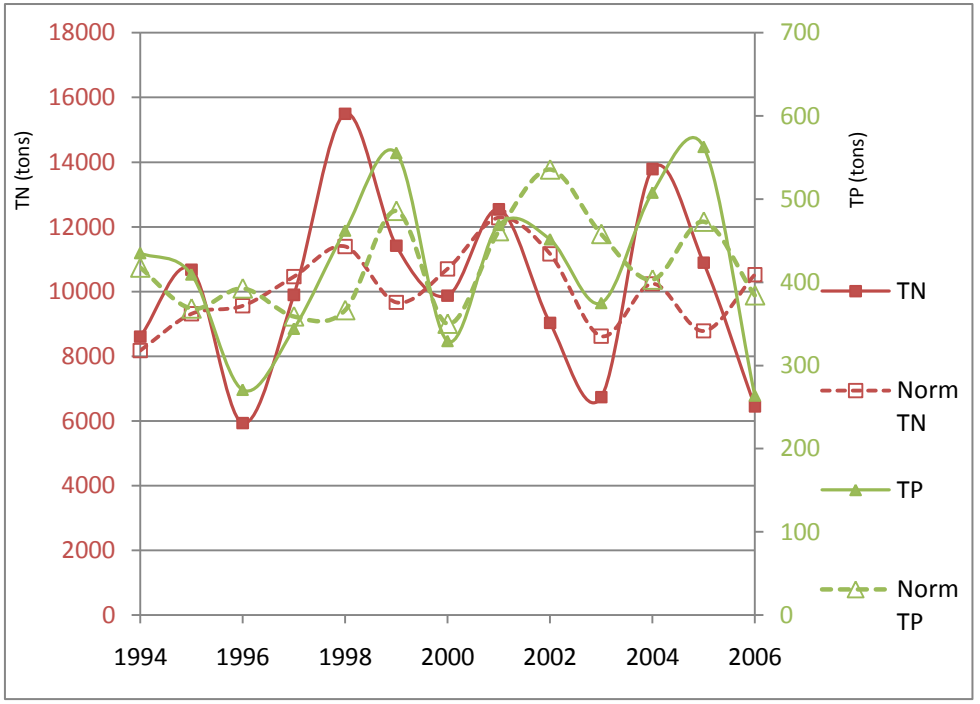


Basin	EE_GF							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	6.66759784	8608.414	435.2314	8178.275	417.7455	0.8239694	3.934923	2.63872
1995	7.19996675	10677.28	409.529	9312.003	368.4703	0.85733049	4.02846	2.612285
1996	4.13371273	5930.635	270.8337	9557.811	392.653	0.61634029	3.773101	2.432703
1997	6.05532551	9898.532	344.2613	10458.67	358.9517	0.78213749	3.995571	2.536888
1998	8.35443555	15495.29	462.2837	11391.65	366.4809	0.92191711	4.1902	2.664909
1999	7.39056278	11414.27	555.6715	9665.165	486.0243	0.86867751	4.057448	2.744818
2000	5.91921018	9869.803	329.497	10698.93	350.1617	0.77226376	3.994308	2.517851
2001	6.47899987	12539.27	469.135	12279.54	461.5565	0.81150797	4.098272	2.671298
2002	5.27024531	9034.46	451.793	11165.71	535.7952	0.72183083	3.955902	2.654939
2003	5.07420979	6733.25	375.19	8623.489	458.1623	0.70536842	3.828225	2.574251
2004	8.30361549	13785.9	507.92	10240.07	403.2717	0.91926723	4.139435	2.705795
2005	7.73773885	10889.13	562.9449	8782.865	472.9825	0.88861407	4.036993	2.750466
2006	4.10577571	6447.186	263.9107	10521.94	384.3387	0.61339522	3.80937	2.421457
Average flow	6.36087664		Average	10330.36	438.0384			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

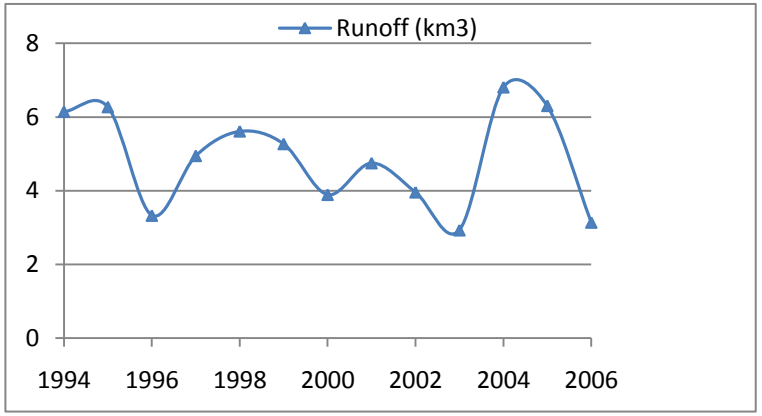


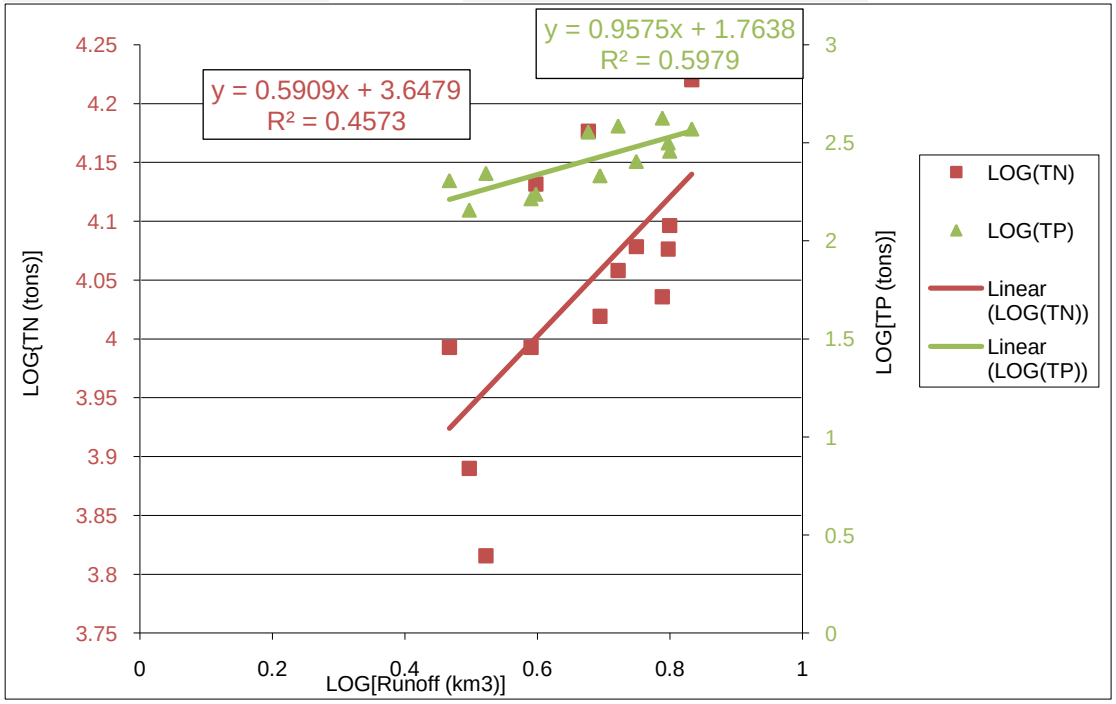


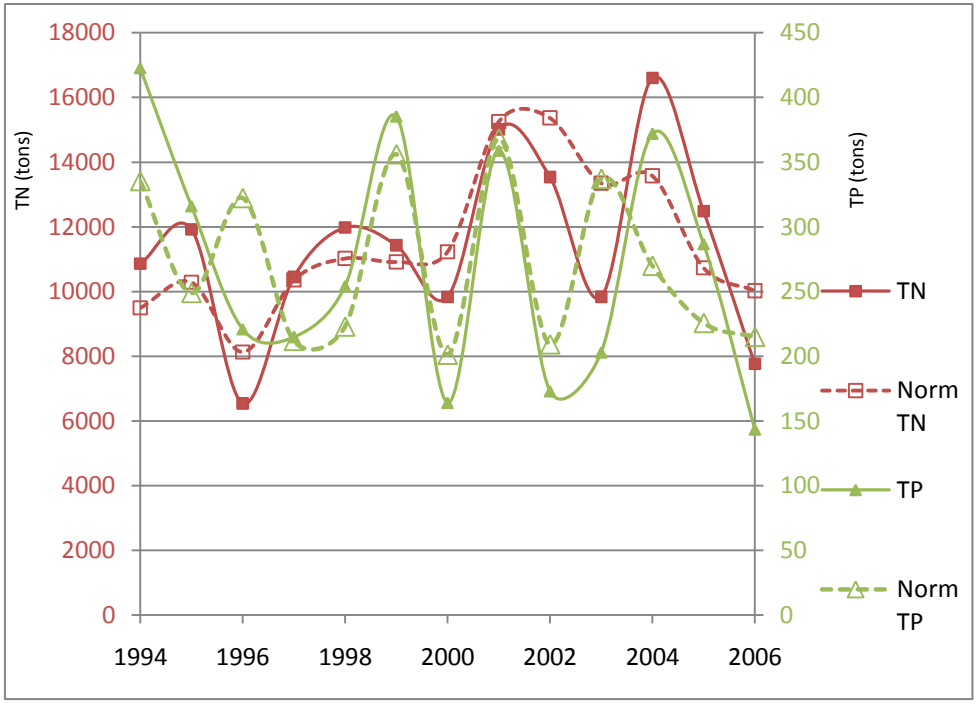


Basin	EE_GR							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	6.14333161	10861.04	422.6808	9496.03	335.4009	0.78840396	4.035871	2.626013
1995	6.2689509	11921.07	315.9749	10288.1	248.903	0.79719487	4.076315	2.499653
1996	3.32838349	6542.985	220.8656	8130.554	322.3051	0.52223336	3.815776	2.344128
1997	4.94644312	10451.71	214.8056	10360.45	211.8663	0.69429302	4.019187	2.332046
1998	5.6113246	11978.58	254.1569	11023.07	222.9571	0.74906539	4.078405	2.405102
1999	5.2686555	11431.65	385.3306	10918.14	356.145	0.7216998	4.058109	2.585834
2000	3.89271744	9835.08	163.966	11229.3	201.1694	0.59025288	3.992778	2.214754
2001	4.74968448	15013	358.94	15249.21	368.3854	0.67666476	4.176467	2.555022
2002	3.95912448	13539	172.93	15367.94	209.2168	0.59759916	4.131587	2.23787
2003	2.93139648	9838	202.92	13354.16	337.18	0.46707456	3.992907	2.307325
2004	6.80450803	16602.39	372.02	13577.66	269.9037	0.83279673	4.220171	2.570566
2005	6.30171187	12484.6	286.71	10734.23	225.7104	0.79945854	4.096375	2.457443
2006	3.14111296	7761.755	143.4161	10026.91	214.9892	0.49708355	3.88996	2.156598
Average flow	4.87287269		Average	12791.34	260.9364			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

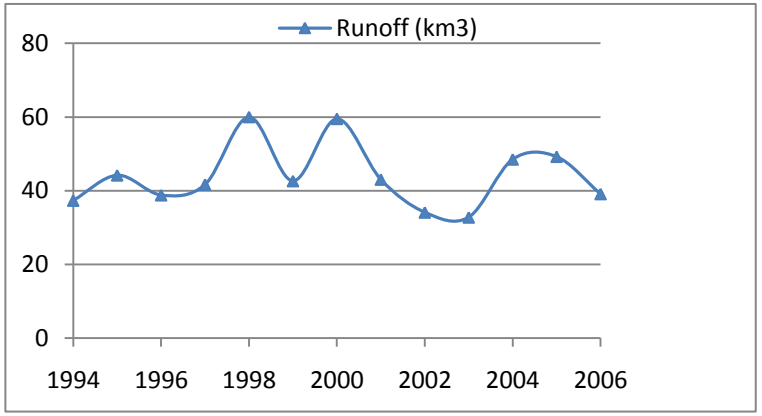


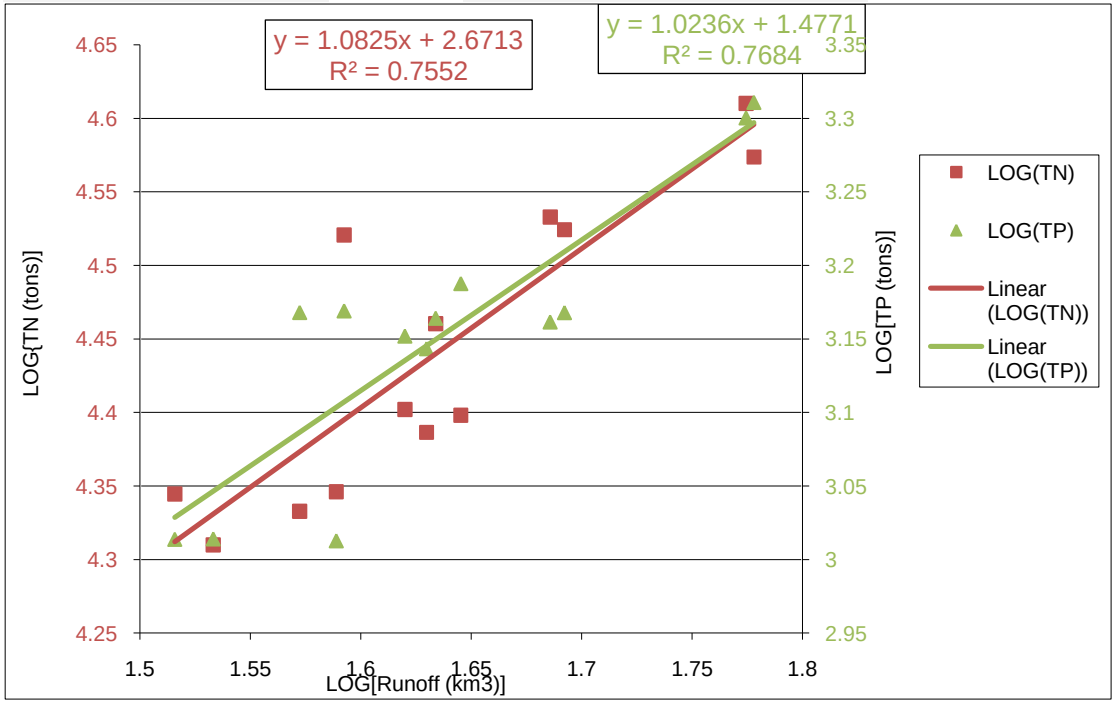


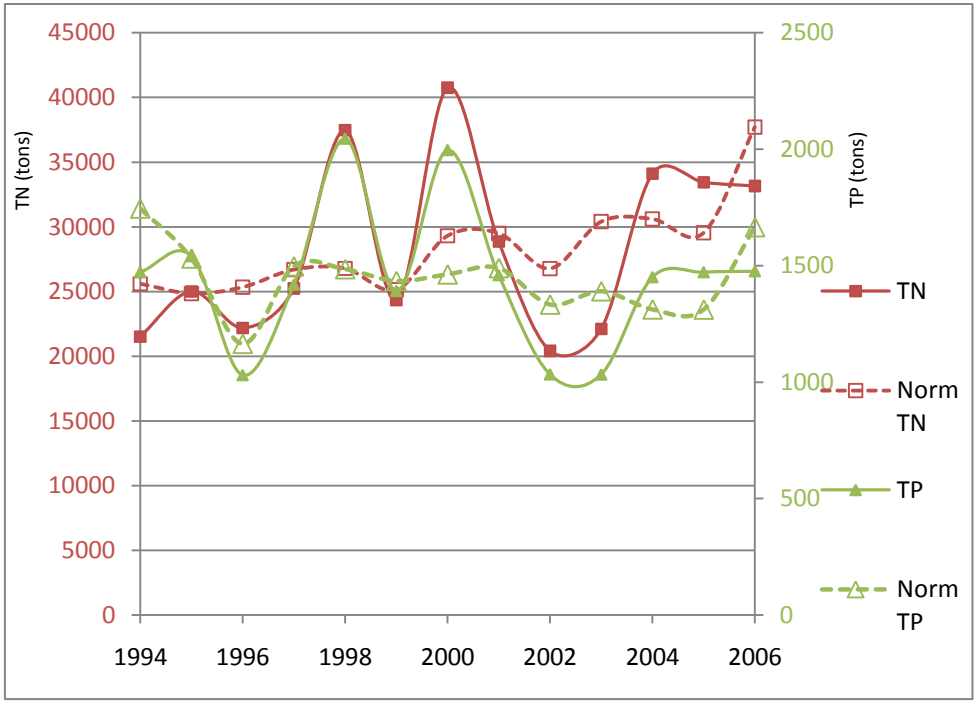


Basin	FI_BB							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	37.3557941	21520.17	1472.4	25600.56	1745.402	1.57235797	4.332846	3.168026
1995	44.1879401	25009.68	1540.557	24847.91	1530.937	1.64530376	4.398108	3.187678
1996	38.8079896	22189.75	1030.04	25335.76	1164.831	1.58892114	4.346152	3.012854
1997	41.6841733	25235.54	1419.064	26696.5	1497.472	1.61997119	4.402013	3.152002
1998	59.9750438	37469	2045.6	26786.77	1485.062	1.77797057	4.573672	3.310821
1999	42.6361973	24350	1391.3	25136.08	1434.19	1.62977846	4.386499	3.143421
2000	59.4880589	40753	1996.6	29306.93	1462.638	1.7744298	4.61016	3.300291
2001	43.0444109	28862	1459.2	29501.42	1489.753	1.63391677	4.460326	3.164115
2002	34.1379619	20413	1033.1	26778.42	1333.417	1.53323759	4.309907	3.014142
2003	32.7946424	22108	1032.45	30402.52	1390.256	1.5158029	4.344549	3.013869
2004	48.4992749	34108	1450.7	30609.49	1312.377	1.68573525	4.532856	3.161578
2005	49.2297523	33442	1472.1	29538.82	1311.78	1.69222765	4.524292	3.167937
2006	39.1263955	33160.76	1476.083	37715.01	1665.401	1.59246984	4.520624	3.169111
Average flow	43.9205873		Average	30550.37	1423.66			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

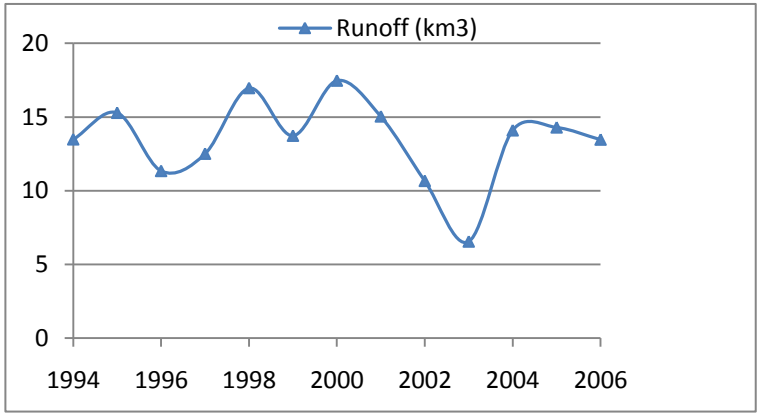


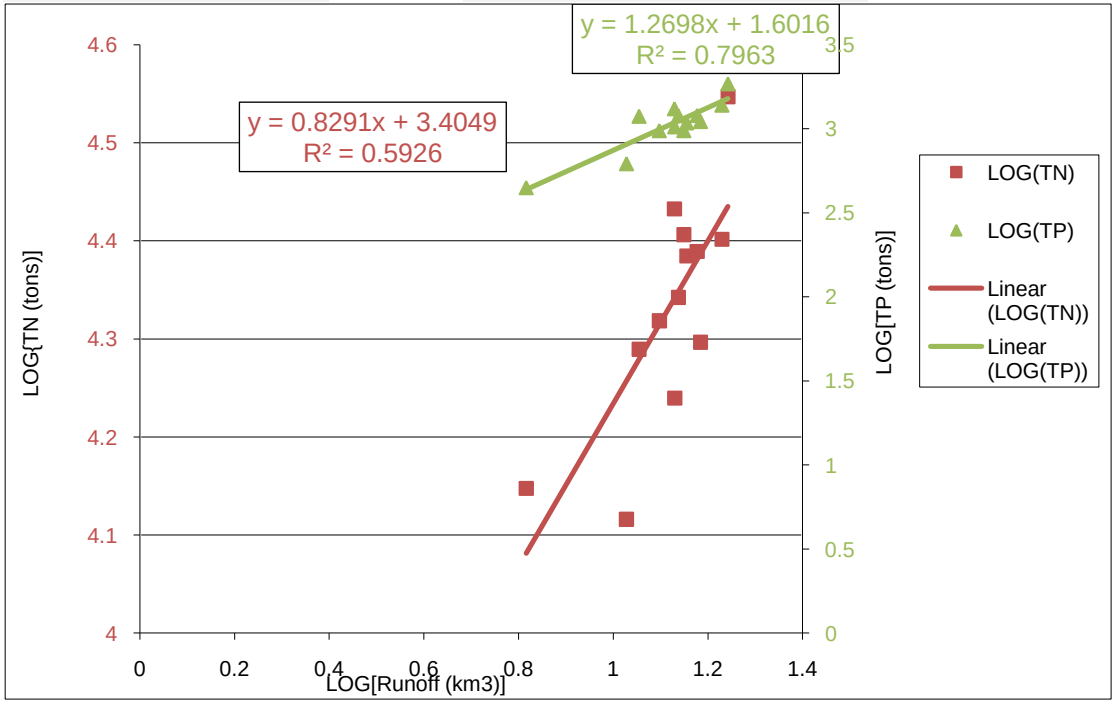


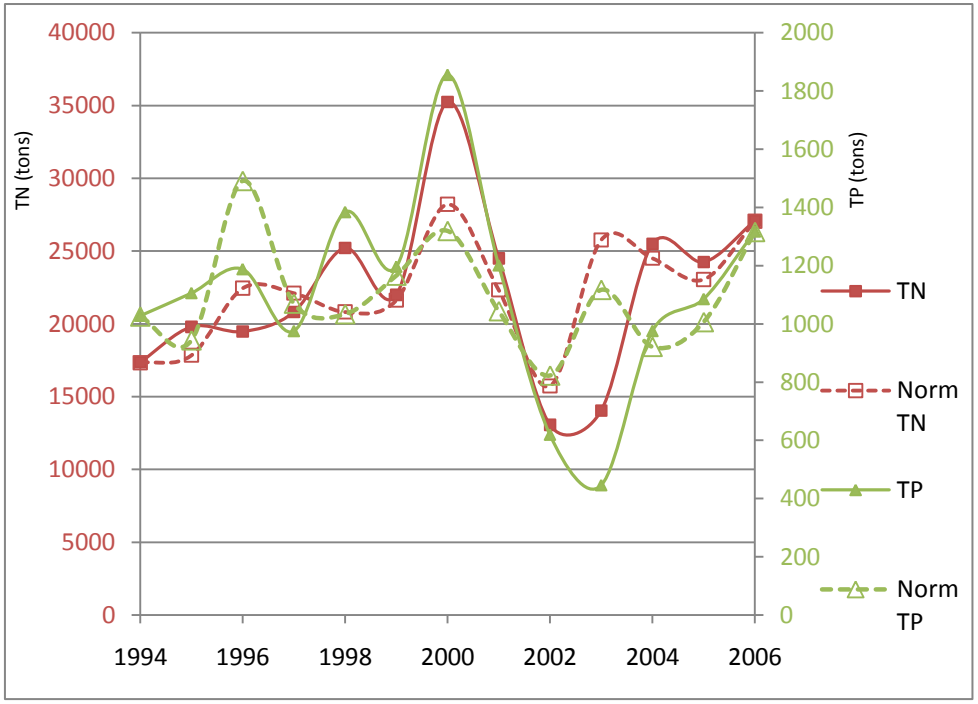


Basin	FI_BS							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	13.4867322	17365	1028.1	17333.87	1025.234	1.12990674	4.239675	3.012035
1995	15.2908534	19798	1106	17847.02	943.4114	1.18443172	4.296621	3.043755
1996	11.3407729	19477	1188.2	22452.73	1491.207	1.05464266	4.289522	3.07489
1997	12.5134264	20819	975.5	22113.32	1069.63	1.09737624	4.31846	2.989227
1998	16.9690226	25211	1384.3	20822.08	1033.305	1.22965683	4.40159	3.14123
1999	13.7337981	21997	1196.7	21629.13	1165.831	1.13779066	4.342363	3.077985
2000	17.4767518	35241	1855.9	28220.14	1319.369	1.24246072	4.547048	3.268555
2001	15.0434081	24503	1201.3	22336.55	1043.585	1.17734624	4.389219	3.079651
2002	10.6675004	13063	619.5	15736.38	822.3768	1.02806267	4.116043	2.792041
2003	6.54899904	14046.8	445.81	25767.48	1116.804	0.81617493	4.147577	2.64915
2004	14.1004282	25495	975.86	24515.84	920.9326	1.1492323	4.406455	2.989388
2005	14.296487	24248	1085.5	23055.48	1006.03	1.15522933	4.384676	3.03563
2006	13.4711424	27082	1317.7	27057.71	1315.879	1.12940443	4.432681	3.119817
Average flow	13.456871		Average	23812.8	1077.854			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

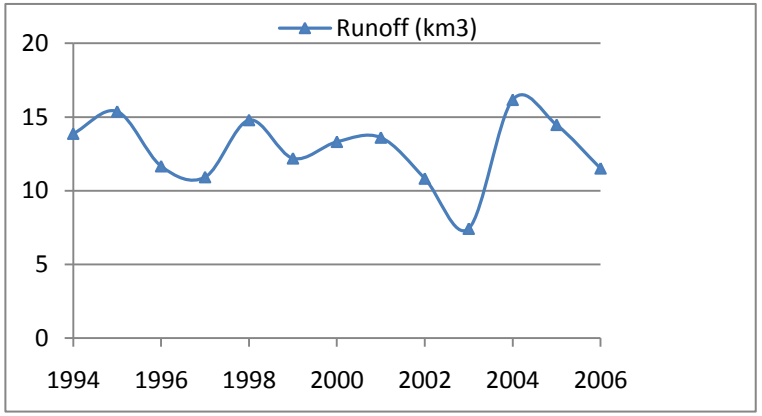


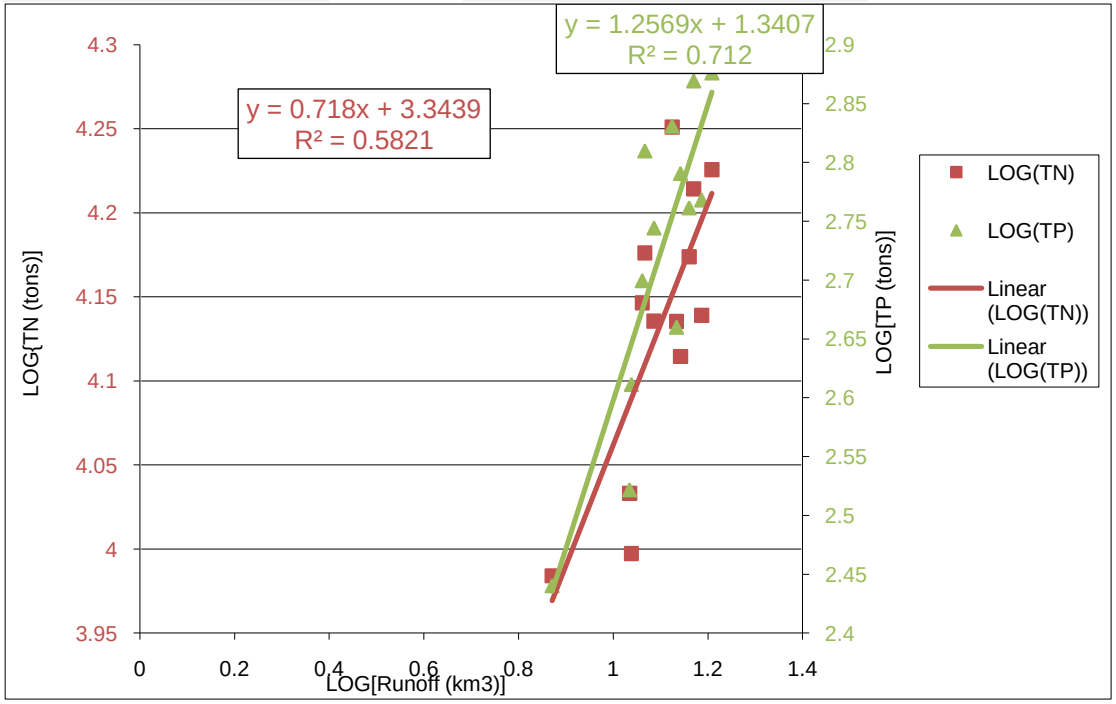


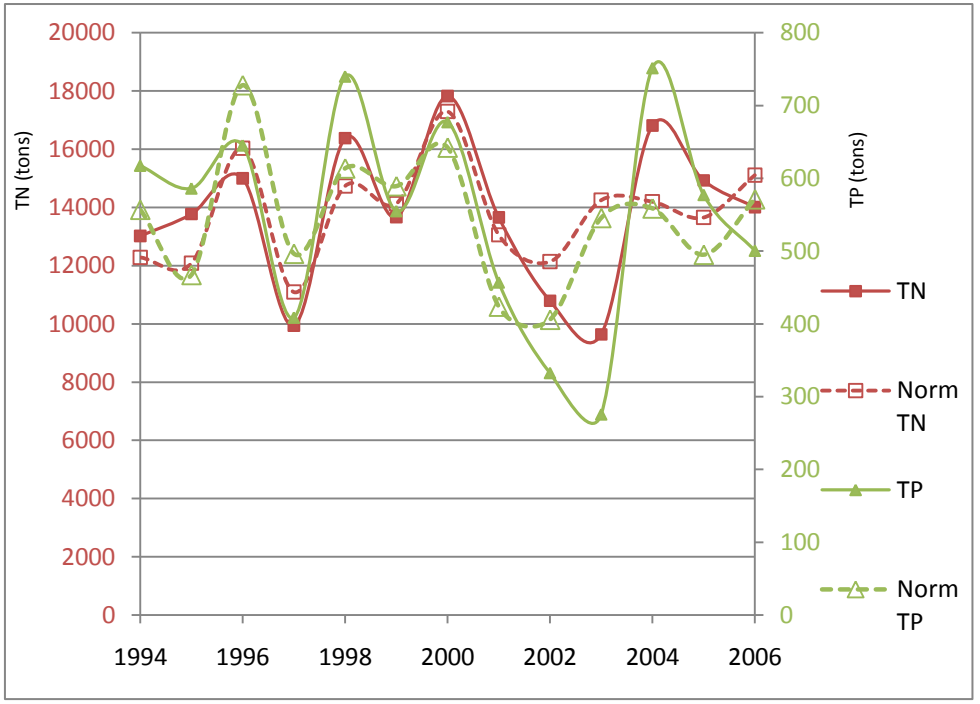


Basin	FI_GF							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	13.8693	13018.95	617.4867	12284.78	556.8467	1.14205454	4.114576	2.790628
1995	15.3720914	13774	586.2	12085.15	467.2155	1.18673296	4.13906	2.768046
1996	11.662183	15001	645.36	16036.73	728.0248	1.06677985	4.17612	2.809802
1997	10.9237367	9939	408.6	11096.17	496.4119	1.03837122	3.997343	2.611298
1998	14.7897016	16379	740.1	14737.07	613.6354	1.16995941	4.214287	2.86929
1999	12.194388	13665	555.02	14134.24	589.2064	1.08616001	4.13561	2.744309
2000	13.3168251	17827	677.41	17295.54	642.3245	1.1244007	4.251078	2.830852
2001	13.6045889	13657	457	13060.48	423.7223	1.13368542	4.135355	2.659916
2002	10.8275098	10793	332.47	12138.26	405.6563	1.03452858	4.033142	2.521752
2003	7.43063155	9640	275.58	14249.21	545.5398	0.87102573	3.984077	2.440248
2004	16.1622086	16815	751.68	14198.22	558.6288	1.20850071	4.225697	2.876033
2005	14.467248	14926	577.3	13655.26	495.0117	1.16038593	4.173943	2.761402
2006	11.5168781	14010	500.6	15107.87	571.2367	1.06133477	4.146438	2.699491
Average flow	12.7797916		Average	14243.55	520.3029			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

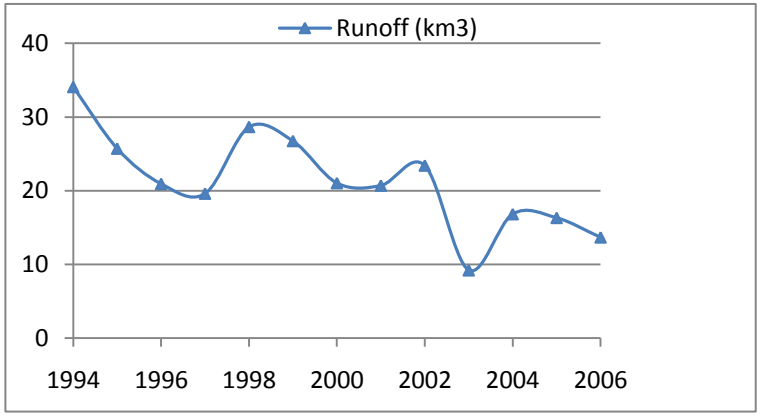


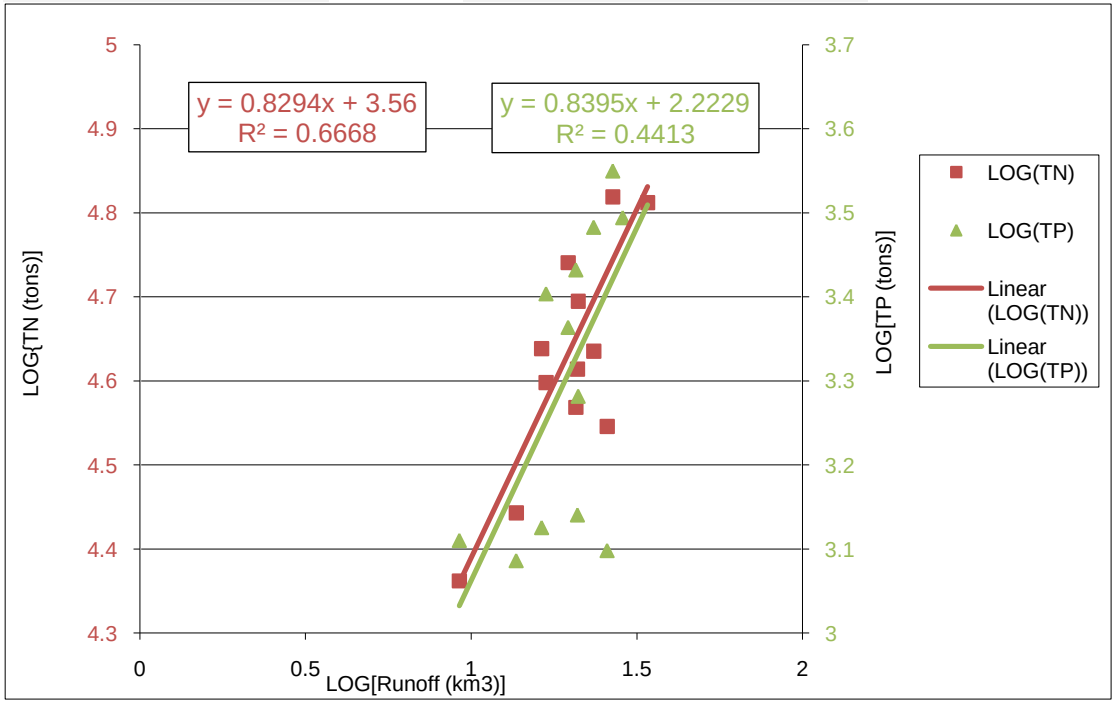


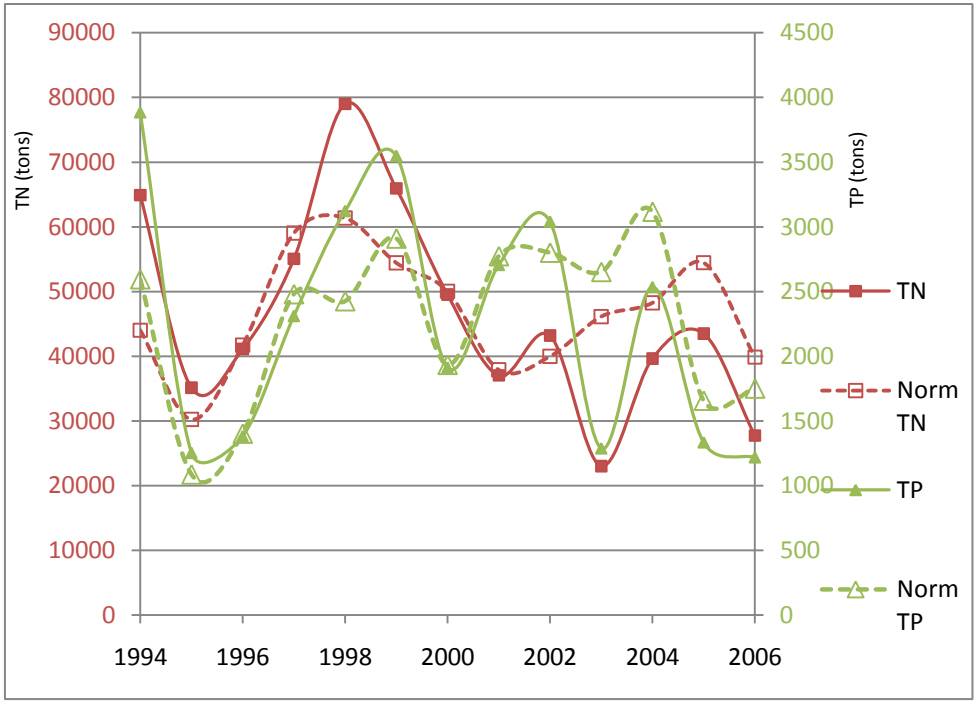


Basin	LT_BP							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	34.0779839	64901.59	3884.527	44025.02	2595.203	1.53247389	4.812255	3.589338
1995	25.7176557	35139.63	1253.45	30241.97	1085.627	1.41023138	4.545797	3.098107
1996	20.9316604	41115.79	1381.939	41715.88	1401.35	1.32080368	4.614009	3.140489
1997	19.6155153	55044.82	2311	59041.33	2479.763	1.29259972	4.740716	3.3638
1998	28.6612511	79014.7	3121.86	61370.21	2425.204	1.45729514	4.897708	3.494413
1999	26.747425	65941.22	3547.97	54436.37	2910.013	1.42728198	4.819157	3.54998
2000	21.0377048	49536.43	1913.42	50059.94	1933.406	1.32299836	4.694925	3.28181
2001	20.7022634	37027.38	2705.55	37901.61	2773.497	1.31601783	4.568523	3.432256
2002	23.4210752	43204.78	3040.56	39979.93	2800.796	1.36960683	4.635532	3.482954
2003	9.21476736	23015.47	1288.61	46137.14	2651.435	0.96448438	4.36202	3.110121
2004	16.8272277	39644.15	2533.88	48255.38	3117.436	1.22601257	4.598179	3.403786
2005	16.3207317	43503.22	1334.813	54453.86	1656.15	1.21273963	4.638521	3.12542
2006	13.6752552	27734.31	1219.231	39865.99	1750.264	1.13593544	4.443017	3.086086
Average flow	21.3038859		Average	45236.26	2383.283			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

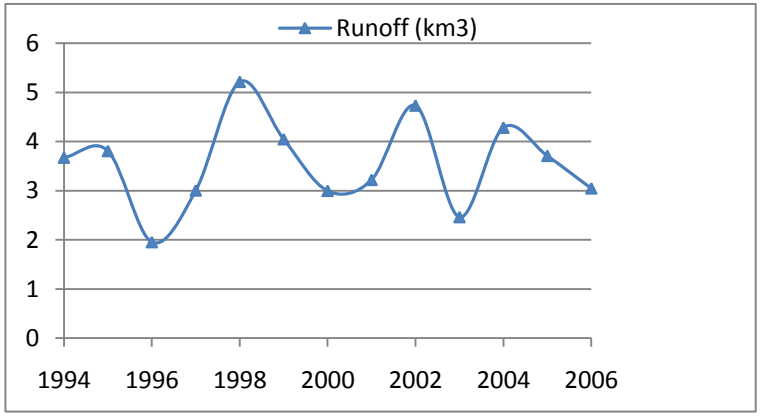


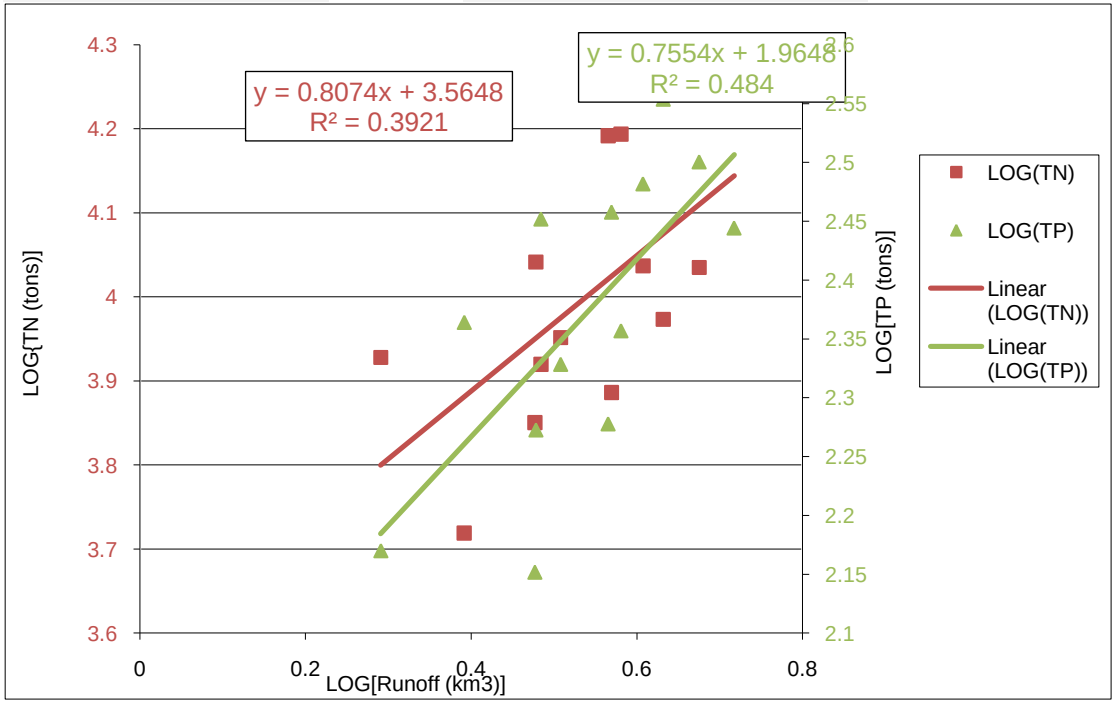


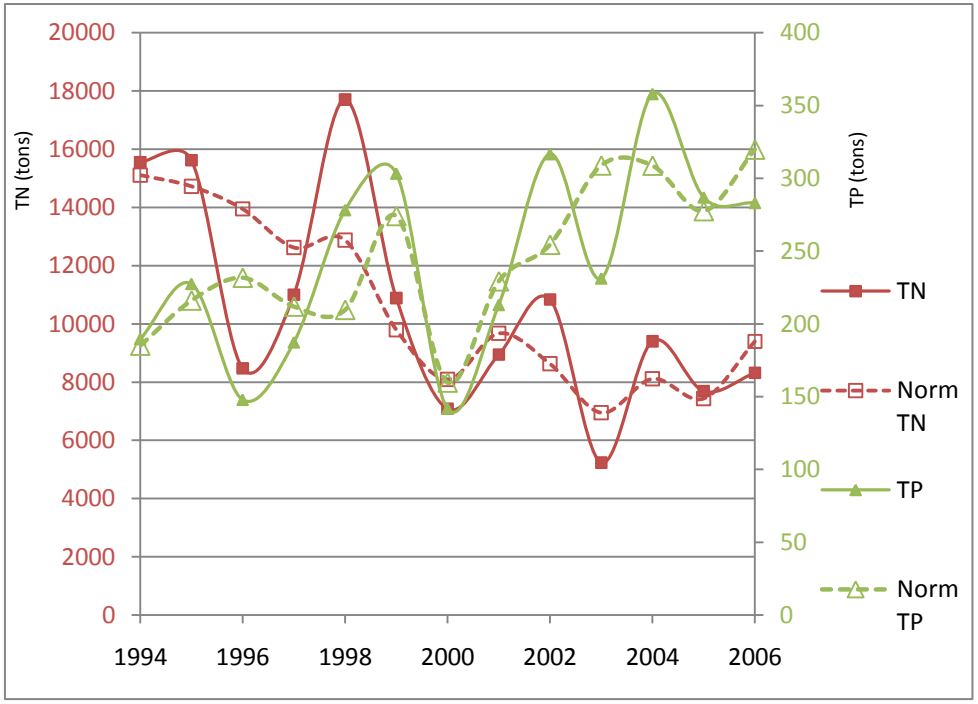


Basin	LV_BP							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	3.6748391	15554.15	189.625	15113.3	185.0212	0.56523833	4.191846	2.277896
1995	3.80891808	15619.9	227.52	14728.6	216.023	0.58080163	4.193678	2.35702
1996	1.95334727	8470.75	147.93	13951.07	231.6751	0.29077946	3.927922	2.170056
1997	3.00672104	11002.93	187.386	12624.86	211.889	0.47809314	4.041508	2.272737
1998	5.2168422	17705.75	278.24	12879.38	209.6044	0.7174077	4.248114	2.44442
1999	4.04883723	10887.48	303.351	9798.79	274.0982	0.60733032	4.036927	2.481945
2000	2.99780352	7085.35	141.84	8096.278	159.6809	0.47680317	3.850361	2.151799
2001	3.22074144	8944.775	213.059	9674.678	229.2396	0.50795586	3.951569	2.3285
2002	4.73387328	10839.2	316.7	8631.088	254.3204	0.67521663	4.034997	2.500648
2003	2.46338496	5235.87	231.303	6948.642	308.8093	0.39153229	3.718989	2.364181
2004	4.28450246	9404.154	358.0125	8112.657	308.6862	0.6319004	3.97332	2.553898
2005	3.7100685	7693.528	287.0034	7435.814	277.4421	0.56938193	3.886126	2.457887
2006	3.0485132	8315.95	283.1719	9396.502	319.7096	0.48408808	3.919912	2.45205
Average flow	3.55141479		Average	8327.951	265.4126			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

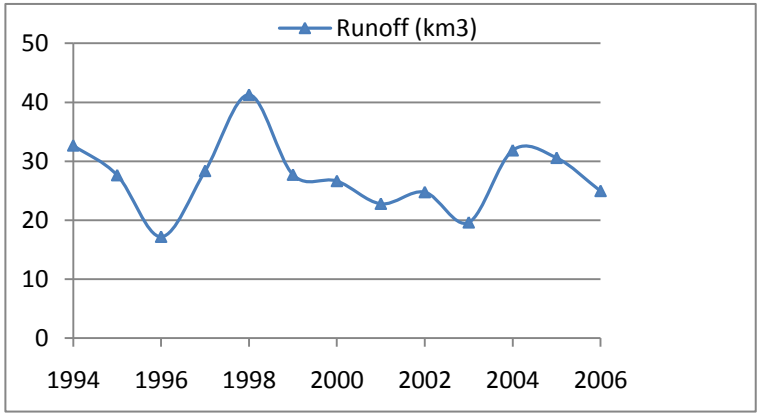


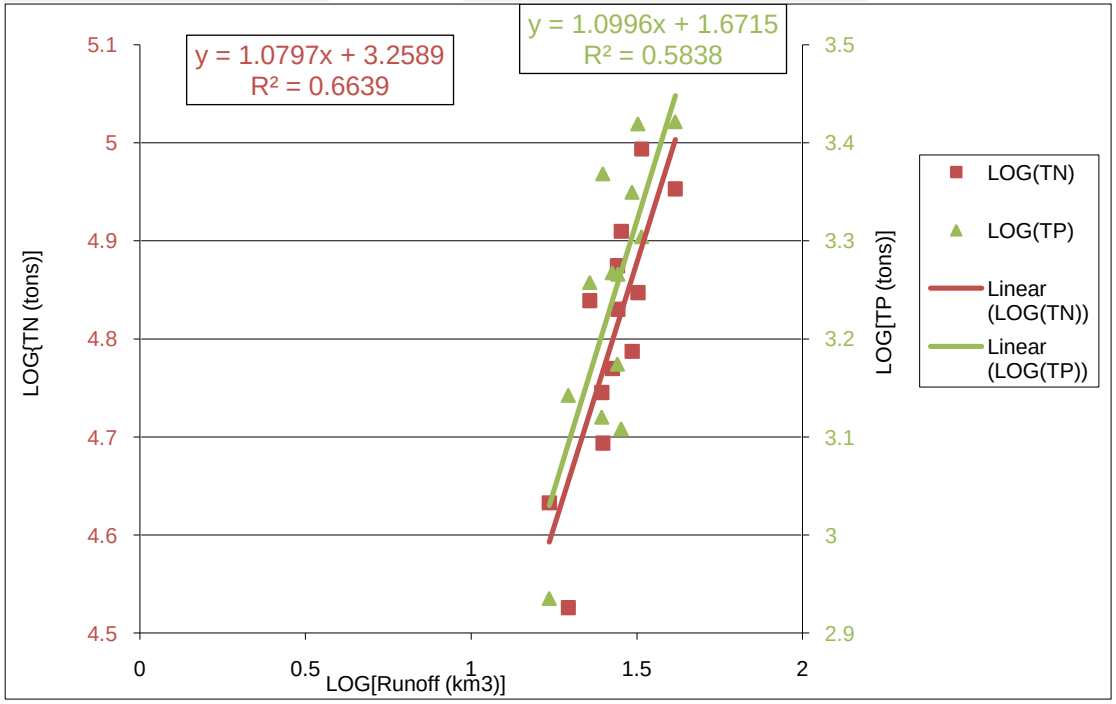


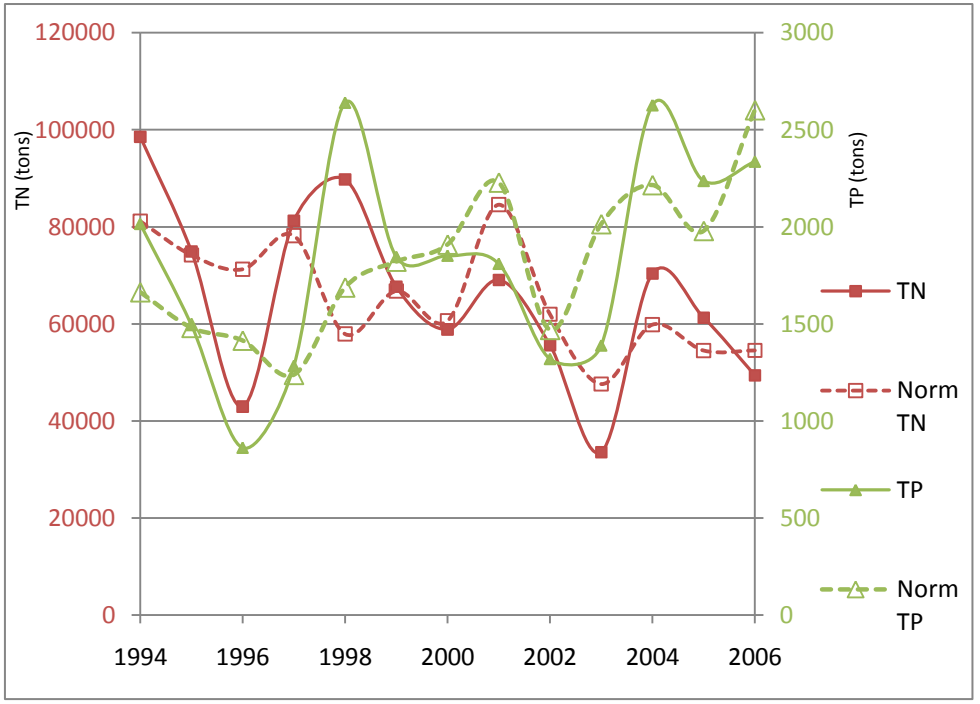


Basin	LV_GR							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	32.6743824	98566.54	2015.55	81169.33	1663.532	1.51420739	4.99373	3.304394
1995	27.6362067	74914	1494.1	74197.11	1480.077	1.44147843	4.874563	3.17438
1996	17.2040086	42942.56	861.66	71270.33	1414.258	1.23562965	4.632888	2.935336
1997	28.3569445	81235.45	1283.71	78211.73	1238.171	1.45265943	4.909746	3.108467
1998	41.279881	89765.47	2640.46	57912.3	1687.984	1.61573844	4.953109	3.42168
1999	27.7228521	67647.51	1845.29	66779.49	1821.187	1.44283791	4.830252	3.266065
2000	26.6513587	58856.4	1851.7	60618.74	1909.03	1.42571935	4.769794	3.267571
2001	22.7965882	69031.13	1809.897	84580.5	2228.266	1.35786985	4.839045	3.257654
2002	24.7666637	55626.8	1319.2	61998.25	1469.607	1.39386751	4.745284	3.120311
2003	19.6375104	33564.12	1388.626	47603.15	2014.108	1.29308643	4.525875	3.142585
2004	31.8533938	70353.9	2627.197	59851.02	2215.19	1.50315571	4.847288	3.419493
2005	30.579435	61281.21	2237.214	54519.07	1979.091	1.48542946	4.787327	3.349708
2006	24.9646199	49403.24	2336.442	54529.03	2600.902	1.39732496	4.693755	3.368555
Average flow	27.3941419		Average	60528.54	2059.456			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

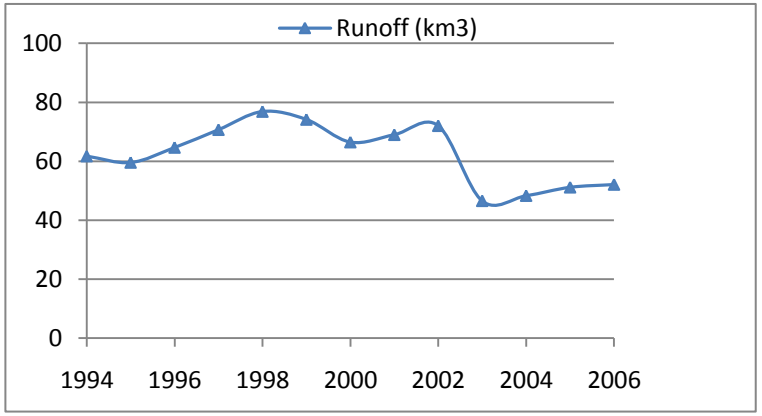


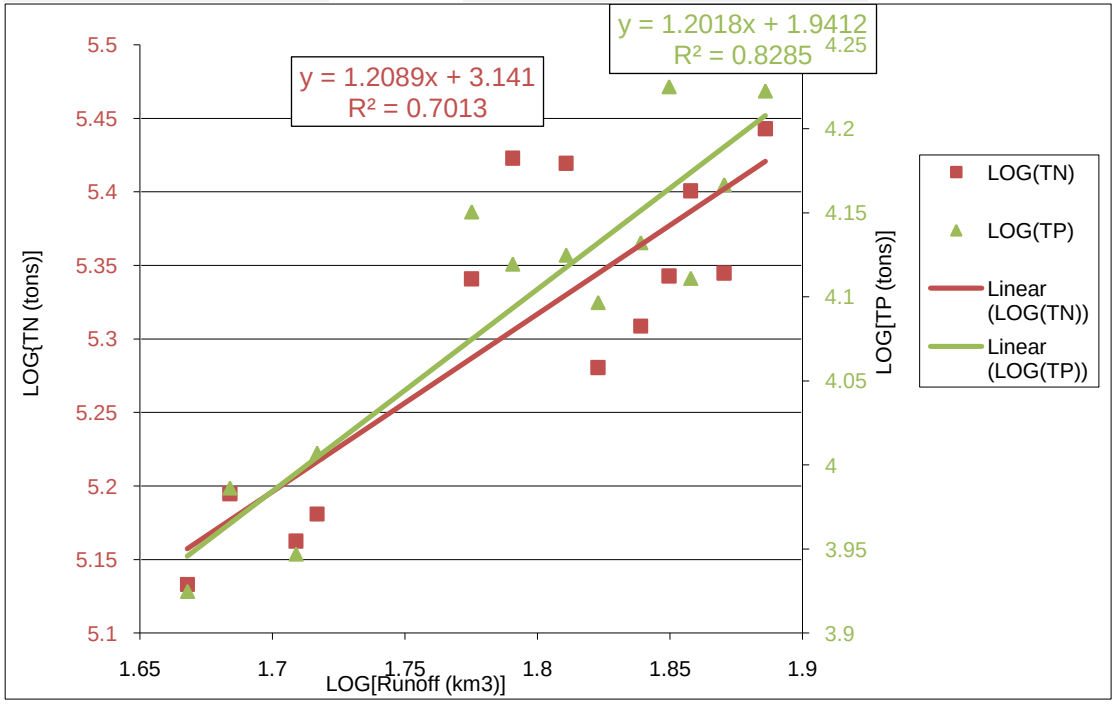


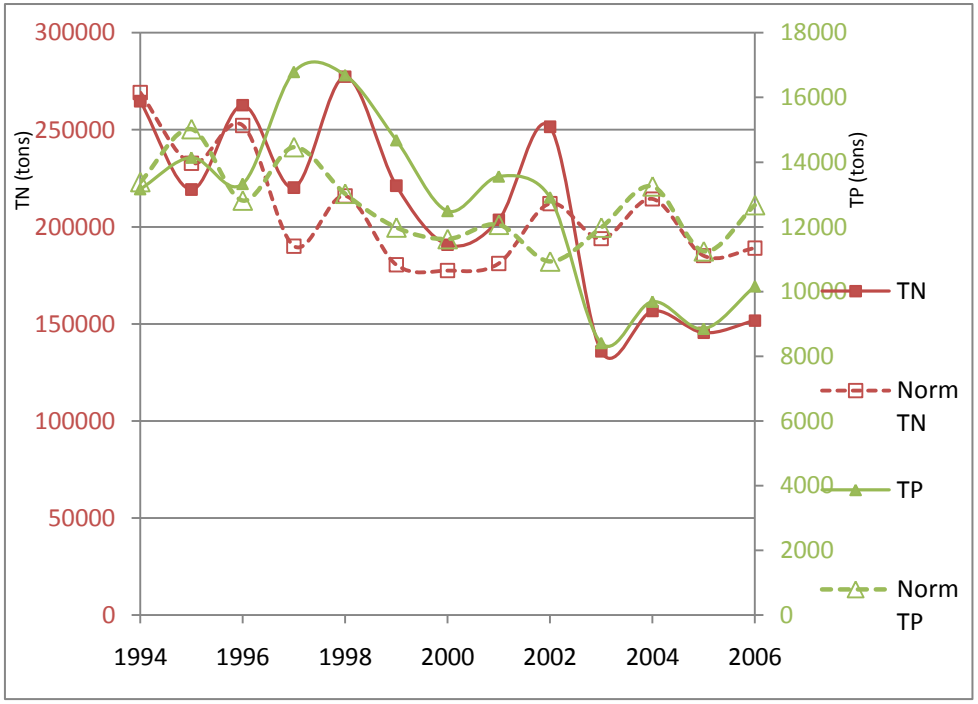


Basin	PL_BP							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	61.7468794	264762.6	13168.26	269180.2	13383.31	1.79061501	5.422857	4.119528
1995	59.5823691	219201.6	14144.68	232740.4	15020.56	1.77511777	5.340844	4.150593
1996	64.682474	262730	13331.47	252269.5	12811.33	1.81078662	5.41951	4.124878
1997	70.7304732	220206.7	16792.91	190089	14463.8	1.84960656	5.342831	4.225126
1998	76.8961874	277349.6	16694.92	215985	13021.87	1.88590481	5.443028	4.222584
1999	74.196279	221210.9	14682.7	180450.4	11978.5	1.87038213	5.344806	4.166806
2000	66.5012435	190811	12493.23	177448.9	11620.35	1.82282977	5.280603	4.096675
2001	69.012228	203596.9	13560.73	181104.9	12062.73	1.83892605	5.308771	4.132283
2002	72.0699418	251565.6	12914.38	211997.1	10926.56	1.85775417	5.400651	4.111073
2003	46.5545605	135844.5	8408.545	193914.9	11975.48	1.66796223	5.133042	3.924721
2004	48.3010341	156579.5	9689.238	214375.4	13249.2	1.68395643	5.194735	3.98629
2005	51.1574408	145414.5	8849.802	185144.6	11242.28	1.70890881	5.162608	3.946934
2006	52.1009947	151684	10163.61	189013.2	12669.37	1.71684601	5.18094	4.007048
Average flow	62.5793927		Average	193285.6	11963.71			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

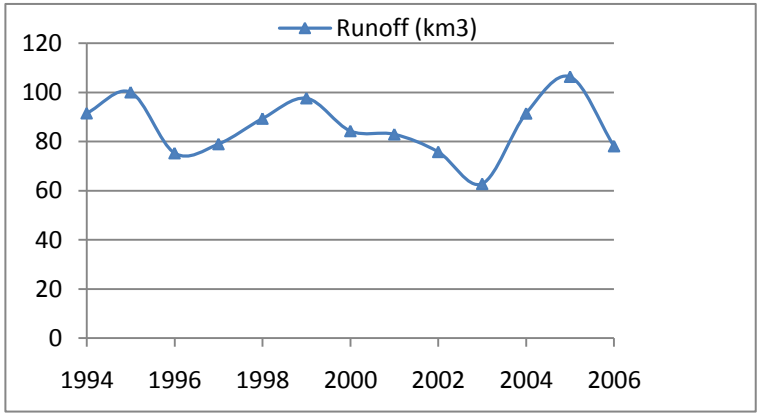


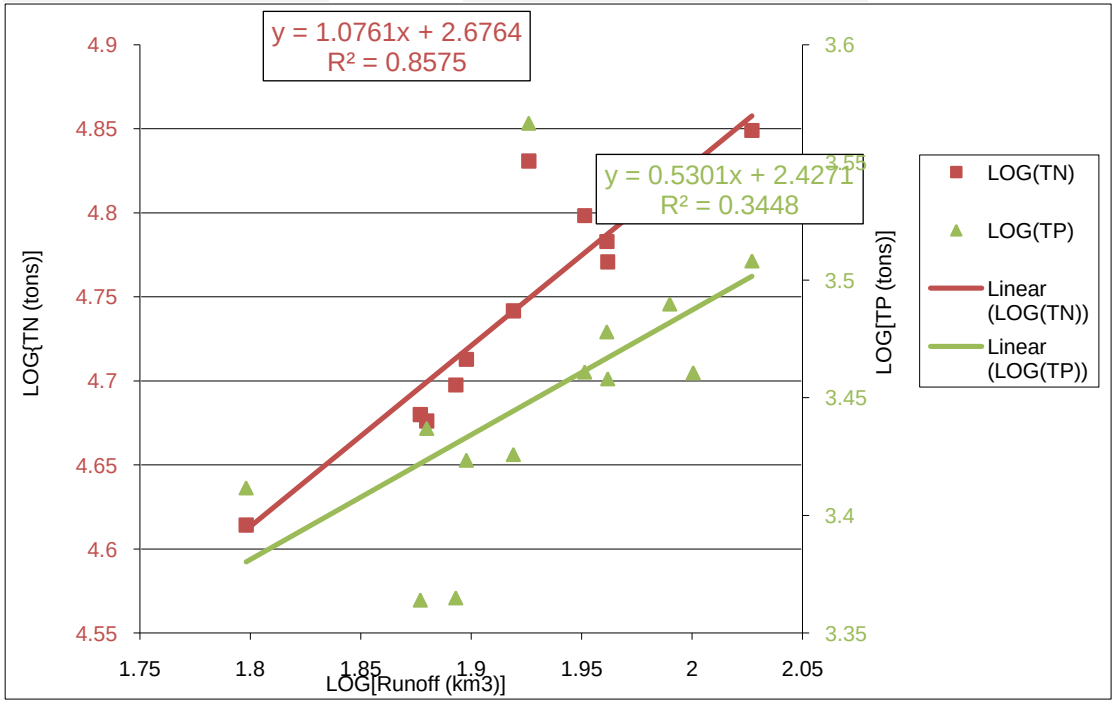


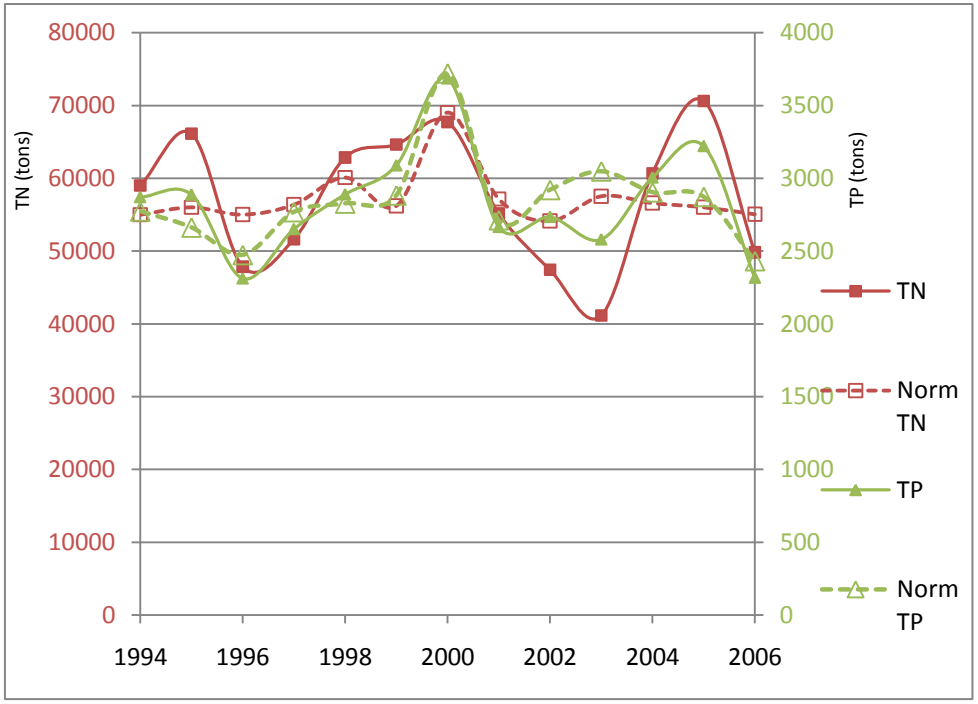


Basin	RU_GF							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	91.5772225	58998	2871	55006.44	2773.535	1.96178747	4.770837	3.458033
1995	100.111145	66131	2888	56022.74	2662.695	2.00048243	4.820405	3.460597
1996	75.3307489	47866	2312	55025.08	2474.008	1.87697229	4.680027	3.363988
1997	79.0320024	51623	2651	56379.66	2768.441	1.89780299	4.712843	3.42341
1998	89.4012056	62856	2890	60112.78	2827.464	1.95134338	4.798347	3.460898
1999	97.6892888	64634	3089	56211.64	2882.951	1.98984695	4.810461	3.489818
2000	84.3371352	67745.67	3686.66	69020.94	3721.259	1.92601884	4.830882	3.566633
2001	82.9995544	55173	2666	57169.06	2712.825	1.91907576	4.741727	3.42586
2002	75.8311768	47441	2735	54140	2920.553	1.8798478	4.676154	3.436957
2003	62.8284009	41145.8	2580.32	57541.09	3048.177	1.79815601	4.614326	3.411674
2004	91.4893589	60662	3006	56605.85	2904.849	1.96137058	4.782917	3.477989
2005	106.428328	70634	3222	56030.6	2873.399	2.02705724	4.849014	3.508126
2006	78.1653555	49840	2317	55069.46	2431.832	1.89301431	4.697578	3.364926
Average flow	85.7862248		Average	57939.57	2944.699			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

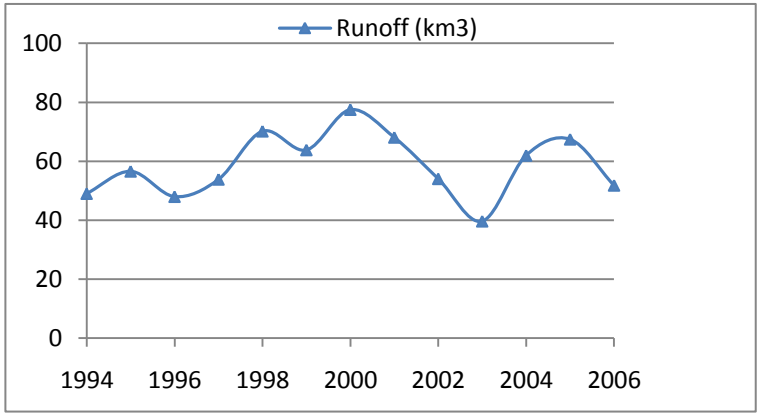


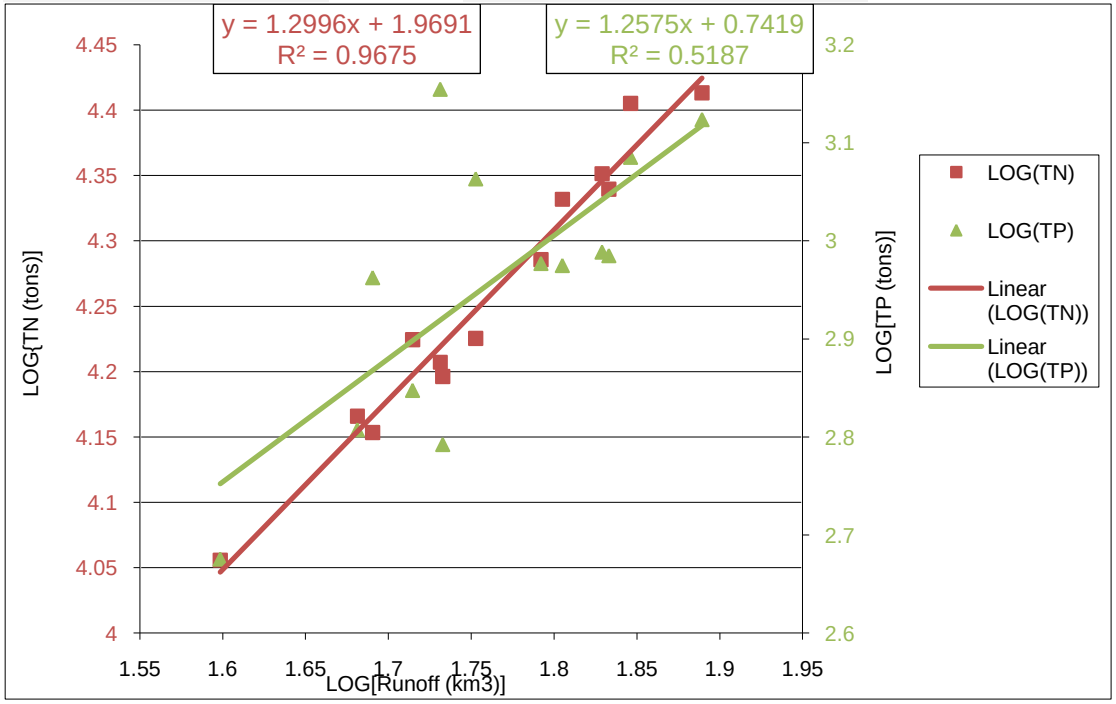


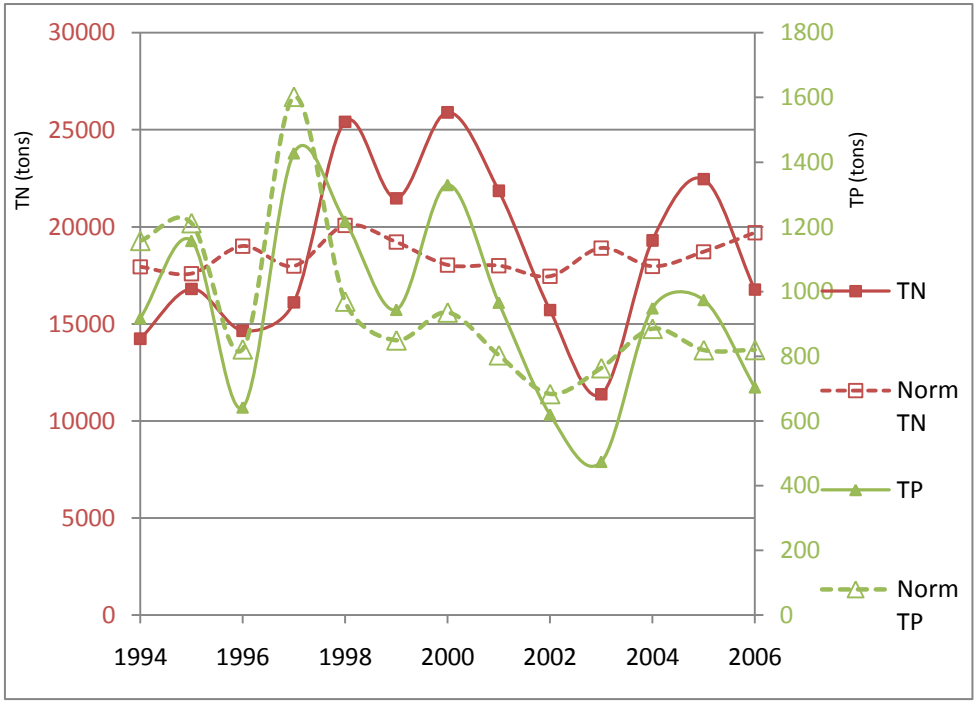


Basin	SE_BB							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	49.0391275	14234.9	917.42	17938.53	1156.828	1.69054273	4.153354	2.962568
1995	56.5913299	16805	1157.07	17588.76	1211.657	1.7527499	4.225439	3.06336
1996	48.0059654	14651	641.85	19008.4	821.6365	1.68129521	4.165867	2.807434
1997	53.8665411	16111.9	1428.02	17978.78	1602.016	1.73131909	4.207147	3.154734
1998	70.1756776	25415	1217.24	20077.33	969.2408	1.84618661	4.40509	3.085376
1999	63.829532	21469.7	943.97	19213.37	849.2734	1.80502166	4.331826	2.974958
2000	77.5033402	25900	1329.95	18034.73	935.5214	1.88932042	4.4133	3.123835
2001	68.0925139	21855.1	966.11	17999.46	803.351	1.83309937	4.339553	2.985027
2002	54.0553306	15714.9	620	17450.87	683.4925	1.73283853	4.196312	2.792392
2003	39.6797875	11371.9	473.76	18906.2	763.42	1.59856934	4.055833	2.675558
2004	61.9609306	19302.2	948.53	17965.26	885.0863	1.79211793	4.285607	2.977051
2005	67.4505792	22460	974.22	18712.63	819.1895	1.82898568	4.35141	2.988657
2006	51.8354381	16766.9	704	19694.36	819.5866	1.71462677	4.224453	2.847573
Average flow	58.6220072		Average	18394.79	815.6639			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

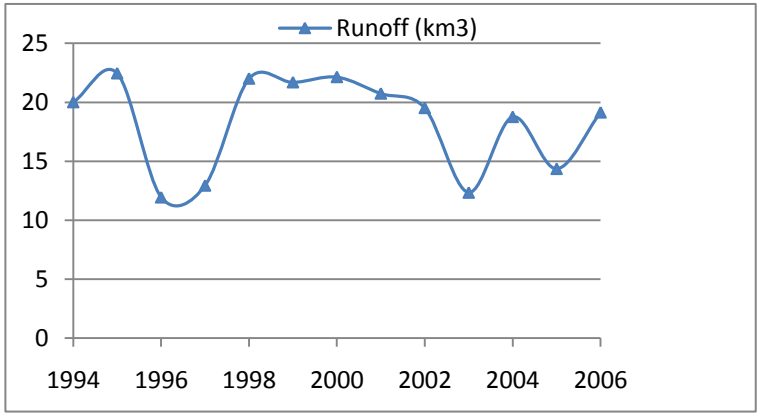


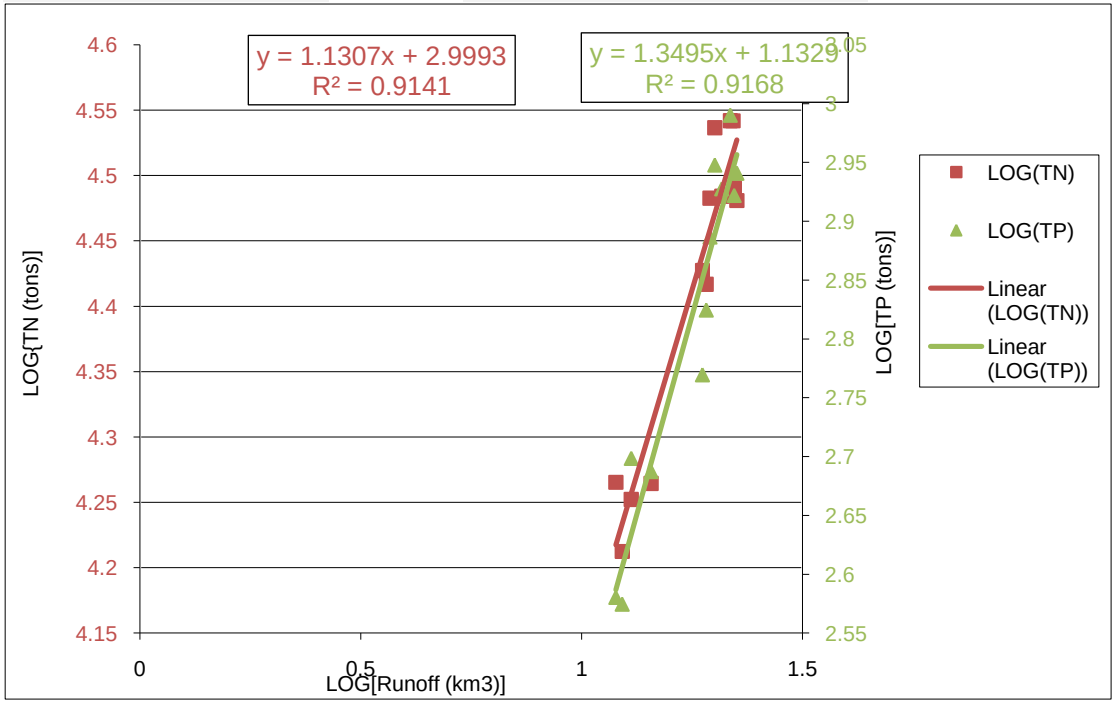


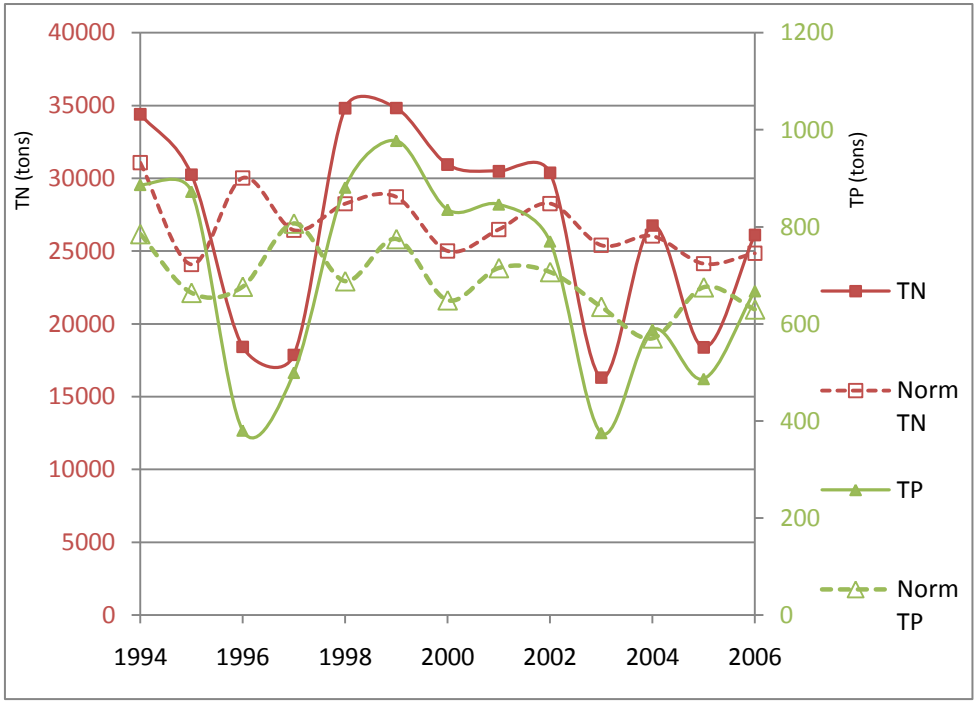


Basin	SE_BP							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	20.0128683	34399	886.89	31074.11	785.0283	1.30130934	4.536546	2.94787
1995	22.4582285	30256	872.8	24083.76	663.8288	1.3513755	4.480812	2.940915
1996	11.9491563	18422.9	380.6	30024.48	676.3752	1.07733724	4.265358	2.580469
1997	12.9506377	17871.7	499.56	26435.47	806.736	1.11229115	4.252166	2.698588
1998	22.0107715	34818	881.38	28254.26	687.785	1.34263527	4.541804	2.945163
1999	21.6954962	34827	977.71	28720.07	774.7258	1.33636959	4.541916	2.99021
2000	22.1420045	30949	835.69	25009.59	648.4156	1.34521693	4.490647	2.922045
2001	20.7458755	30488	846.57	26485.99	714.8466	1.31693177	4.484129	2.927663
2002	19.5198751	30387	770.38	28265.68	706.7032	1.29047703	4.482688	2.886705
2003	12.3517094	16308.8	375.54	25404.67	634.9969	1.09172707	4.212422	2.574656
2004	18.7647322	26753	588.29	26032.71	569.919	1.27334237	4.427372	2.769591
2005	14.3628941	18386	486.81	24136.55	675.2613	1.15724196	4.264487	2.687359
2006	19.144201	26111	667.79	24846.45	629.6058	1.28203724	4.416824	2.82464
Average flow	18.3160346		Average	25740.23	654.2498			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

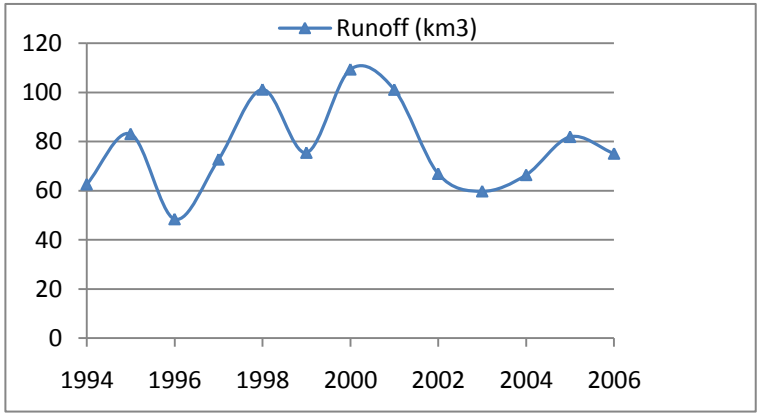


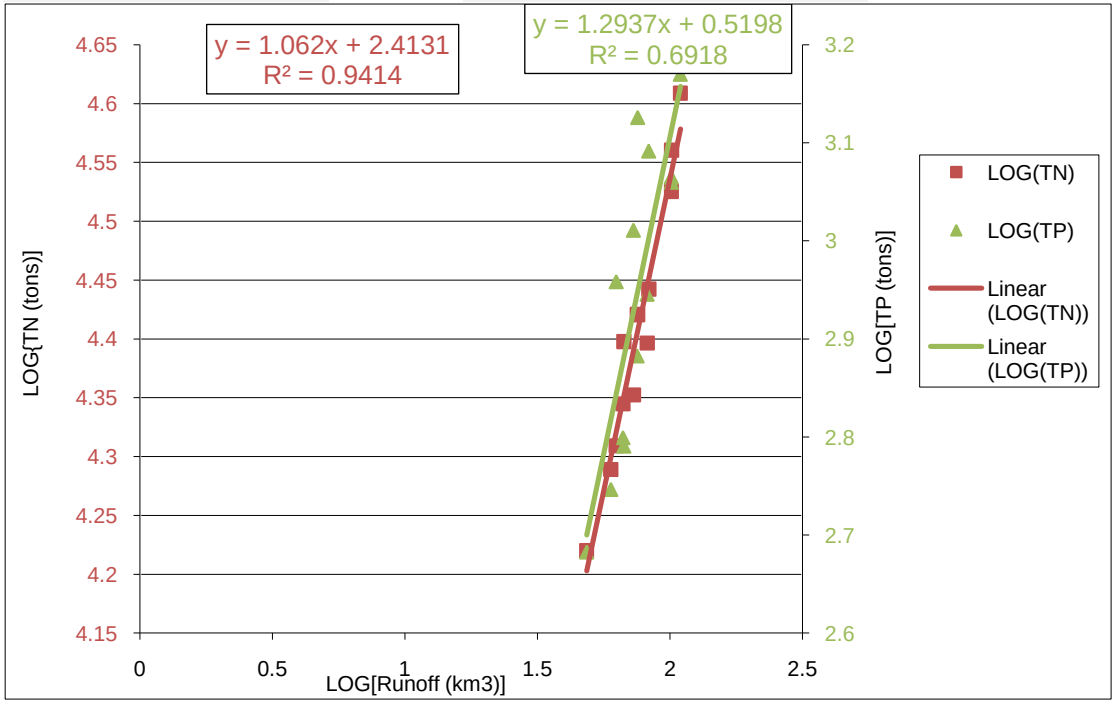


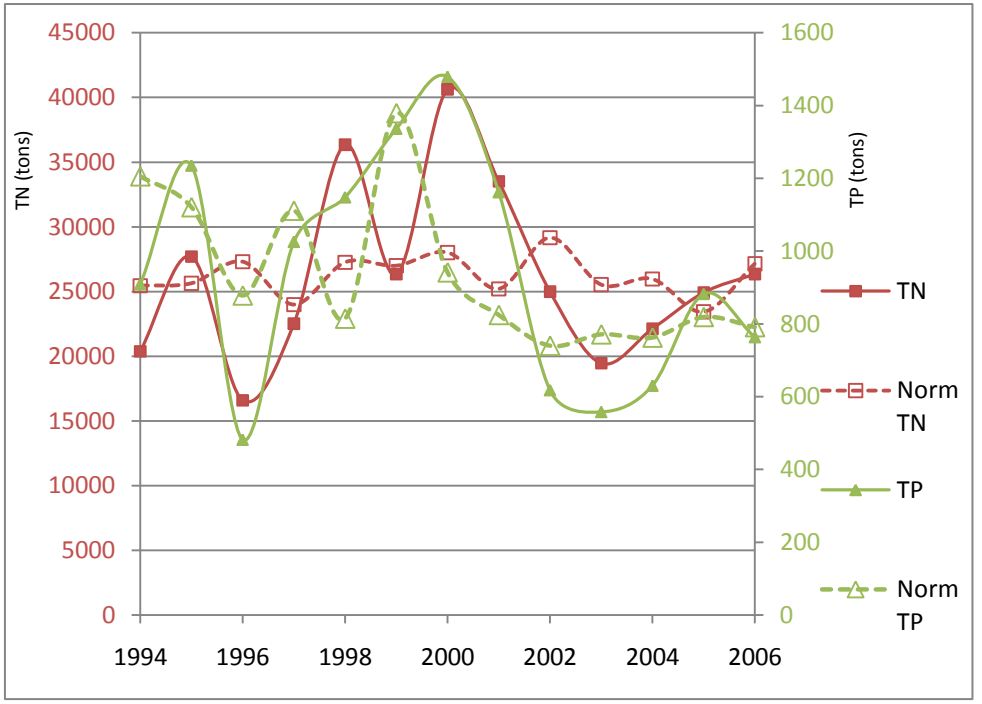


Basin	SE_BS							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	62.6408122	20376.9	908.82	25450.34	1205.498	1.79685738	4.309138	2.958478
1995	83.1226406	27696.3	1234.93	25635.8	1120.597	1.91971933	4.442422	3.091642
1996	48.4493115	16596.6	481.776	27302.98	877.9446	1.68528761	4.220019	2.682845
1997	72.7577709	22514.5	1025.46	23988.34	1110.99	1.86187939	4.352462	3.010919
1998	101.235951	36352	1147.71	27256.75	814.1964	2.00533477	4.560528	3.059832
1999	75.5079667	26334	1336.18	26990.72	1379.228	1.87799278	4.420517	3.125865
2000	109.413504	40630.6	1478.89	28015.56	941.4342	2.03907093	4.608853	3.169936
2001	101.169544	33517	1161.78	25204.1	824.3436	2.00504979	4.525265	3.065124
2002	66.9319718	24993	617.86	29159.98	739.7384	1.82563362	4.397818	2.79089
2003	59.7947962	19455.7	558.04	25528.34	771.0576	1.77666339	4.289047	2.746665
2004	66.4418246	22120.9	630.19	25965.87	762.1319	1.82244155	4.344803	2.799472
2005	81.9526118	24916.4	882.35	23424.75	818.778	1.9135628	4.396485	2.945641
2006	75.1506336	26349.7	763.53	27144.05	790.9434	1.87593265	4.420776	2.882826
Average flow	77.2745646		Average	26348.95	806.9182			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous

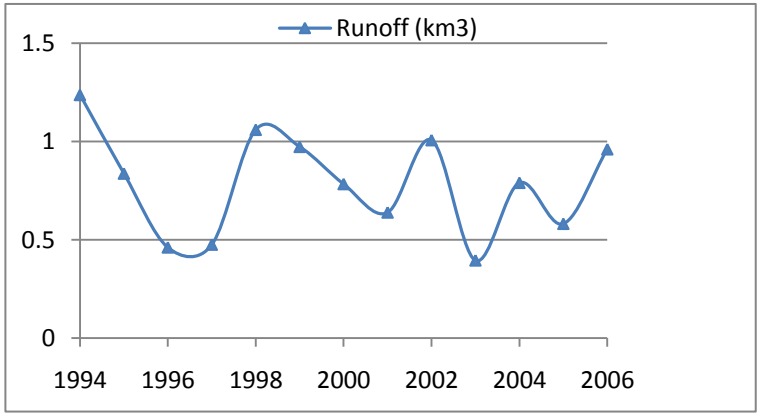


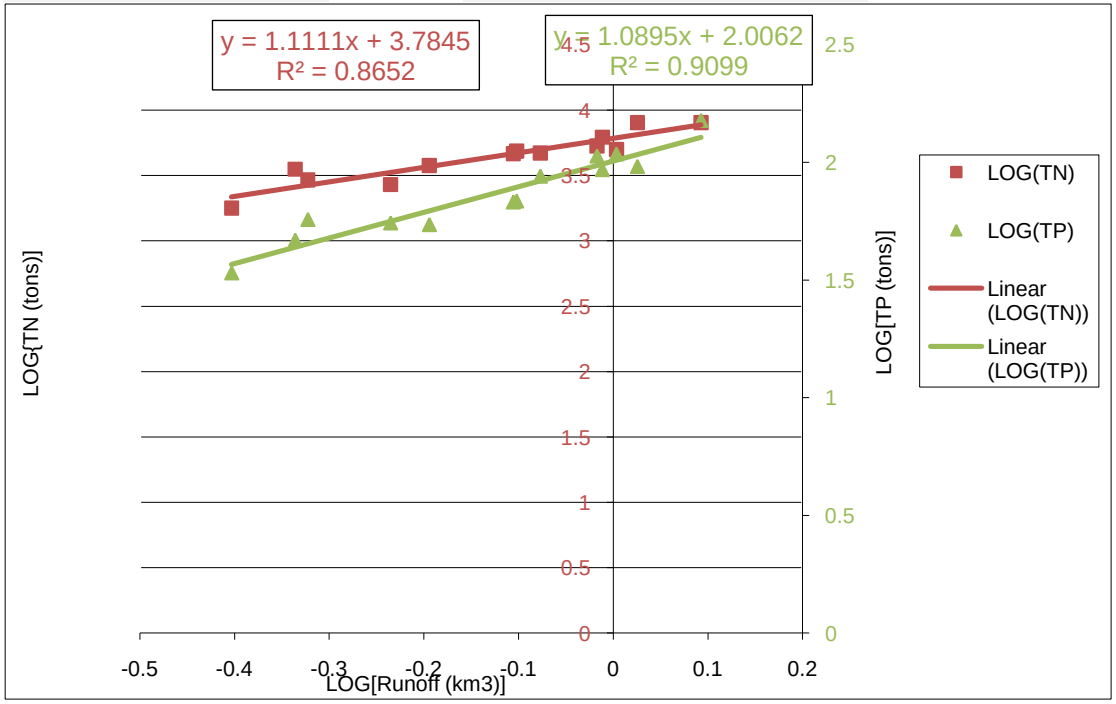


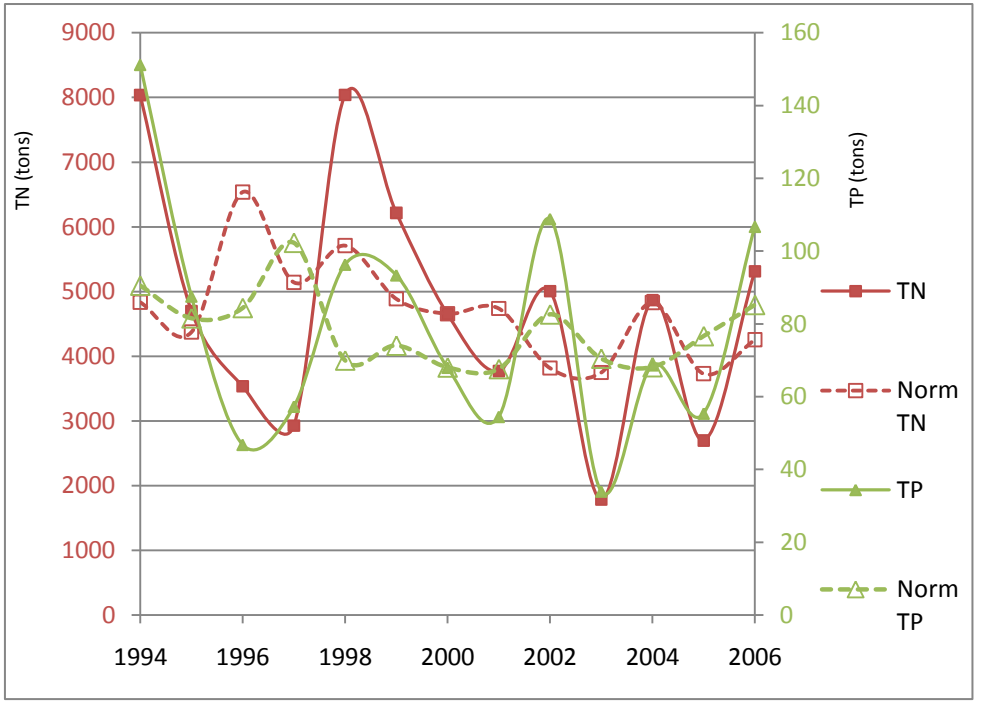


Basin	SE_DS							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	1.23818542	8037	151.2	4834.383	90.50148	0.09278569	3.905094	2.179552
1995	0.8375925	4697	87.54	4374.156	81.53409	-0.0769672	3.671821	1.942207
1996	0.46138466	3536	46.77	6537.574	84.36203	-0.3359368	3.548512	1.669967
1997	0.47578203	2928	57.26	5142.583	102.2579	-0.322592	3.466571	1.757851
1998	1.06068412	8039	96.3	5709.406	69.96269	0.02558607	3.905202	1.983626
1999	0.97379472	6216	93.36	4887.11	74.04808	-0.0115326	3.793511	1.970161
2000	0.78423552	4651	67.96	4657.5	68.05022	-0.1055535	3.667546	1.832253
2001	0.63940493	3770	54.45	4738.924	67.61307	-0.194224	3.576341	1.735998
2002	1.00780589	5006	108.81	3818.466	82.60454	0.00337689	3.699491	2.036669
2003	0.39528	1783	33.94	3748.561	70.46476	-0.4030952	3.251151	1.530712
2004	0.79056	4867	68.63	4830.339	68.14075	-0.1020652	3.687261	1.836514
2005	0.58185216	2697	55.36	3730.19	76.64547	-0.2351873	3.430881	1.743196
2006	0.96132096	5314	106.7	4254.248	85.20427	-0.0171316	3.725422	2.028164
Average flow	0.78522176		Average	4254.032	74.1033			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous







Basin	SE_KT							
Year	Runoff (km3)	TN (tons)	TP (tons)	TN Norm	TP Norm	LOG(Runoff)	LOG(TN)	LOG(TP)
1994	28.6938505	36910	800.6	35534.3	765.664	1.45778883	4.567144	2.903416
1995	29.5226176	33907	729.98	31822.51	677.9511	1.47015486	4.530289	2.863311
1996	14.2009874	18795	332.68	34449.68	669.5505	1.15231854	4.274042	2.522027
1997	21.4080486	24093	512.9	30243.45	669.0173	1.33057708	4.381891	2.710033
1998	29.2502226	40679	907.83	38462.29	849.5509	1.46612918	4.60937	2.958005
1999	36.7667251	43619	873.24	33495.99	644.4273	1.56545495	4.639676	2.941134
2000	36.6120985	38057	750.84	29432.37	560.179	1.56362462	4.580435	2.875547
2001	36.3701871	38091	811.28	29630.4	607.1923	1.56074554	4.580822	2.909171
2002	26.3246993	32212	568.9	33556.77	595.9691	1.42036342	4.508018	2.755036
2003	18.6856762	20545	378.92	29126.04	564.5641	1.27150882	4.312706	2.578548
2004	26.0922747	31200	648.89	32763.06	686.8988	1.41651194	4.494155	2.812171
2005	24.494711	25018	698.25	27780.71	792.5314	1.38907232	4.398253	2.844011
2006	29.4784013	34420	963.87	32344.83	893.8452	1.46950393	4.536811	2.984018
Average flow	27.5308077		Average	30662.02	671.5971			
Whole period			Data from 2000 to 2006					

TN=Total nitrogen
TP=Total phosphorous