Impact of rainfall characteristics on runoff quality from the M1

Julia S. Zakharova

University of Birmingham

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Edinburgh

Objectives:

- the concentrations of metals (part of catchment model)
- seasonal variations in the solubility of metals
- the performance of the existing treatment SuDS lagoon

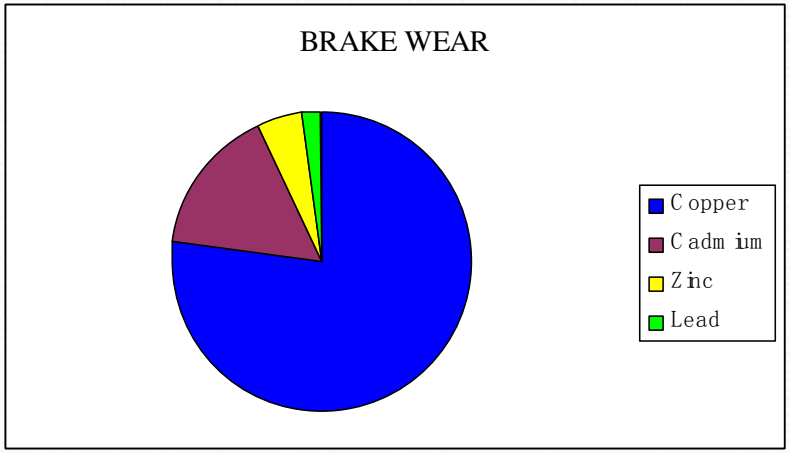
Climatic factors:

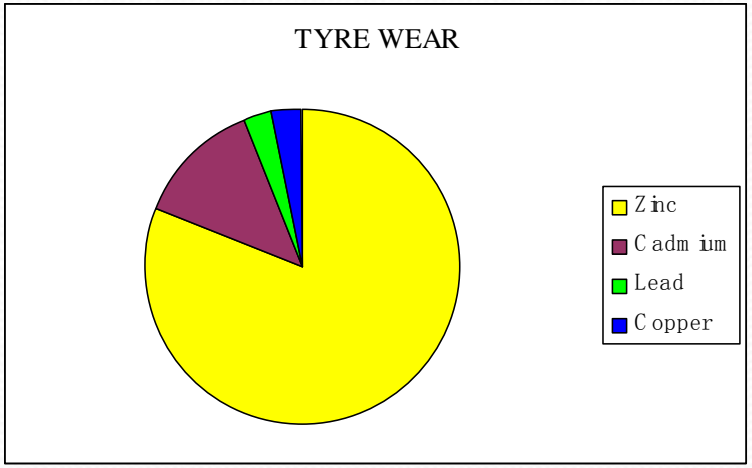
- ✓ Rainfall intensity;
- ✓ Rainfall duration;
- ✓ ADWP

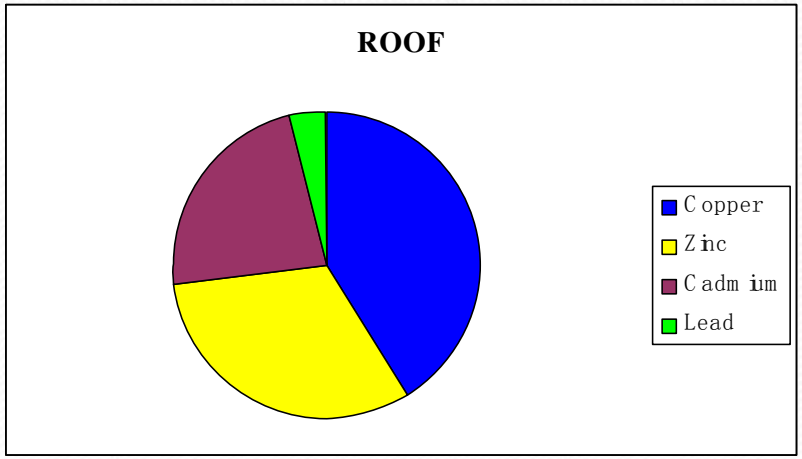
Catchment area characteristics:

- ✓ Type pollutants;
- ✓ Type of surface;
- ✓ Size of drainage area

Pollutant Sources







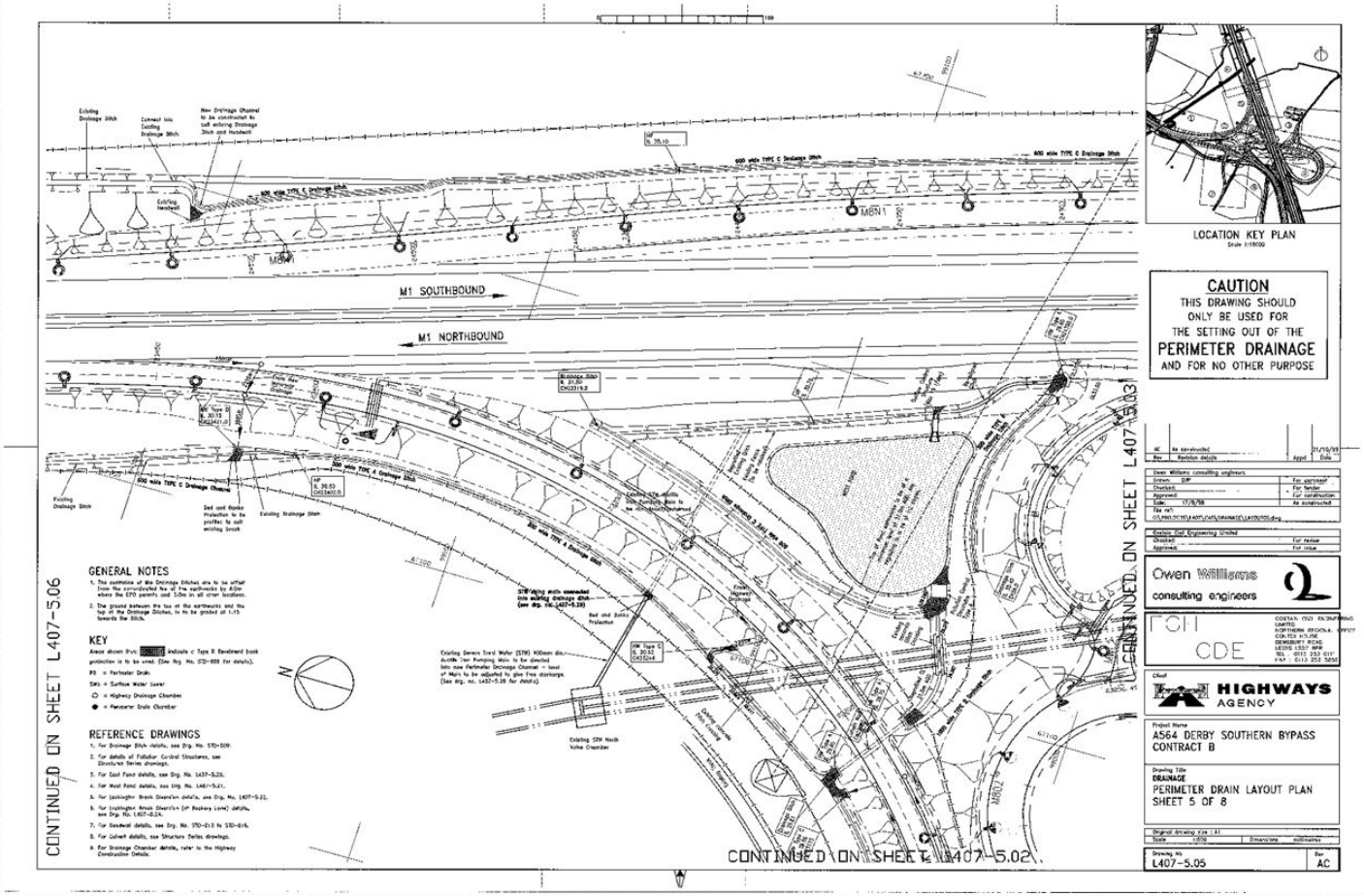
Environmental Quality Standards

Metal in the dissolved form apart form Zn	Annual average value, mg/L
Suitable for all fishlife	
Copper	0.01
Nickel	0.15
Suitable for Cyprind (coarse) fish	
Zinc (total)	0.075
Chromium	0.2
Iron	1.0

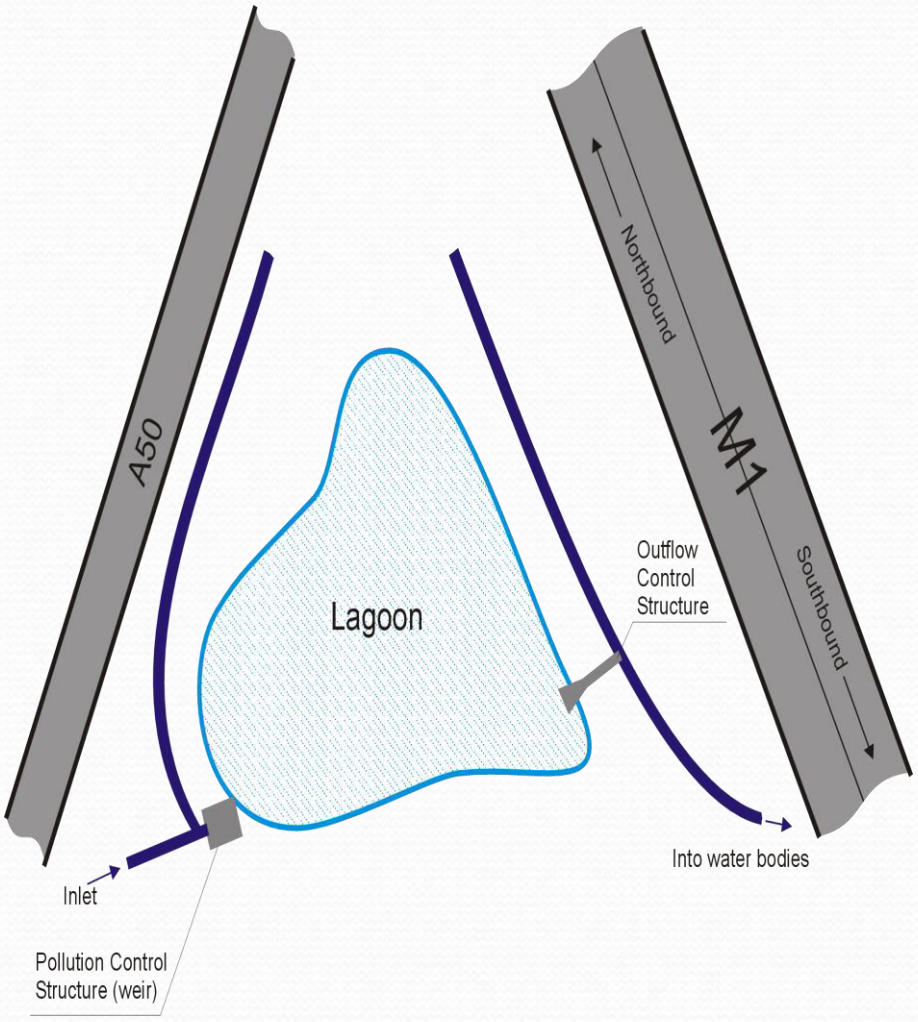
M1 (J24)/A50/M42:

catchment area 0.3 ha;

30,000 vehicles/peak hour



J24


A50
Northbound
M1
Southbound
Lagoon
Outflow
Control
Structure
Into water bodies
Inlet
Pollution Control
Structure (weir)

M1 inlet

Some rainfall characteristics for observed rainfall events

Event	11/07	09/09	22/01	03/07	13/11	21/11	07/12
Runoff duration, min	n/a	n/a	n/a	n/a	390	135	180
Observed amount of rainfall, mm	6	1 0.7	6.5	9.1 5	n/a	2	2
Mean rainfall intensity, mm/Hr	4	0.25 0.3	2.17	3.1 2.5	n/a	1.34	1.14
Peak flow, l/s	n/a	n/a	n/a	n/a	31.93	3.2	12.1
Observed rainfall duration, min	90	15 25	180	180 120	n/a	90	105
Number of samples	5 2	3 4	3 3	5 3	2 3	7 3	8 3

Inlet concentrations comparison of two rainfall events with dry weather samples

Pollutant, mg/l	Rainfall Event 21/11 – 7 samples				Rainfall Event 07/12 – 8 samples				Dry weather* – 10 samples	
	Mean, mg/l	EMC, mg/l	Range	Max observed load, g	Mean, mg/l	EMC, mg/l	Range	Max observed load, g	Average conc, mg/l	Range
TSS	38.93	41.98	6-119.5	102.0	10.75	9.44	9-14	89.0	112	12-231.8
TOC	7.29	7.55	5.85-8.66	22.6	5.36	5.52	3.19-10.31	54.7	11.1	6.95-15.538
Fe_{tot}	1.47	1.523	0.659-3.76	3.34	0.696	0.679	0.632 – 0.728	6.41	1.934	0.597 – 5.89
Fe_{dis}	0.196	0.194	0.07-0.94	0.21	0.088	0.073	0.068 – 0.143	0.66	0.058	0.008 – 0.086
Zn_{tot}	0.121	0.121	0.081-0.273	0.28	0.084	0.092	0.068 – 0.102	0.92	0.117	0.086 – 0.264
Zn_{dis}	0.026	0.026	0.024-0.028	0.08	0.045	0.052	0.038 – 0.056	0.51	0.026	0.005 – 0.141
Na	56.88	57.28	55.8 – 60.49	164	71.36	75.56	59.37 – 99.43	878	50.65	22.09 – 164.55
Cu_{tot} /Cu_{dis}	Negligible values for both rainfall events and dry weather conditions									

Dry weather

Contaminant, mg/L	Range	Mean value	SD
Fe tot	0.177 – 0.526	0.269	0.085
Fe dis	0.029 – 0.066	0.049	0.026
Cu tot	0.003 – 0.041	0.014	0.013
Cu dis	Traces – 0.006	0.003	0.002
Zn tot	0.033 – 0.08	0.05	0.015
Zn dis	0.005 – 0.069	0.023	0.017
TSS	3.2 – 23.95	14.1	13.1
EC, uS/cm	370 - 1070	725	282

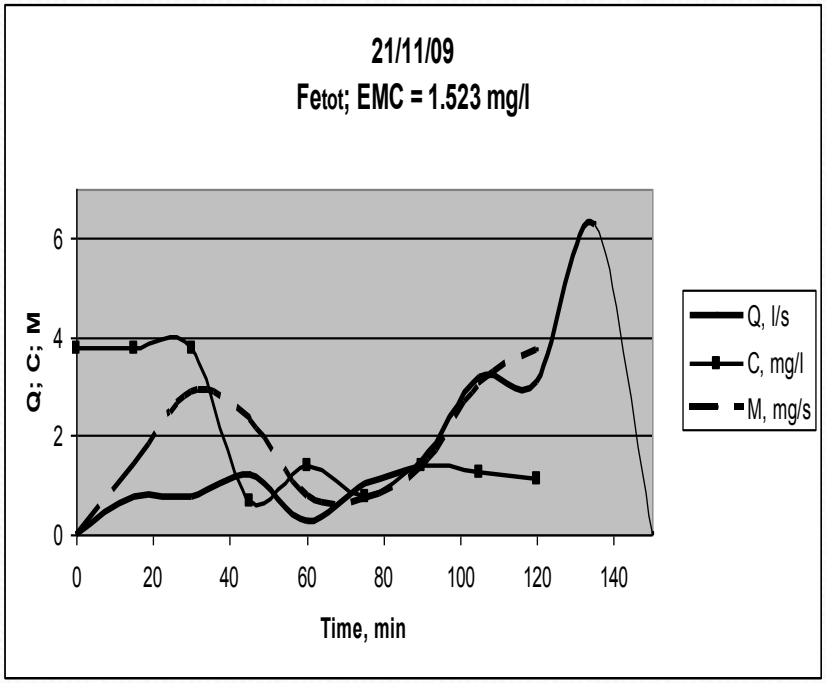
Zn_{tot} is 0.075 mg/L

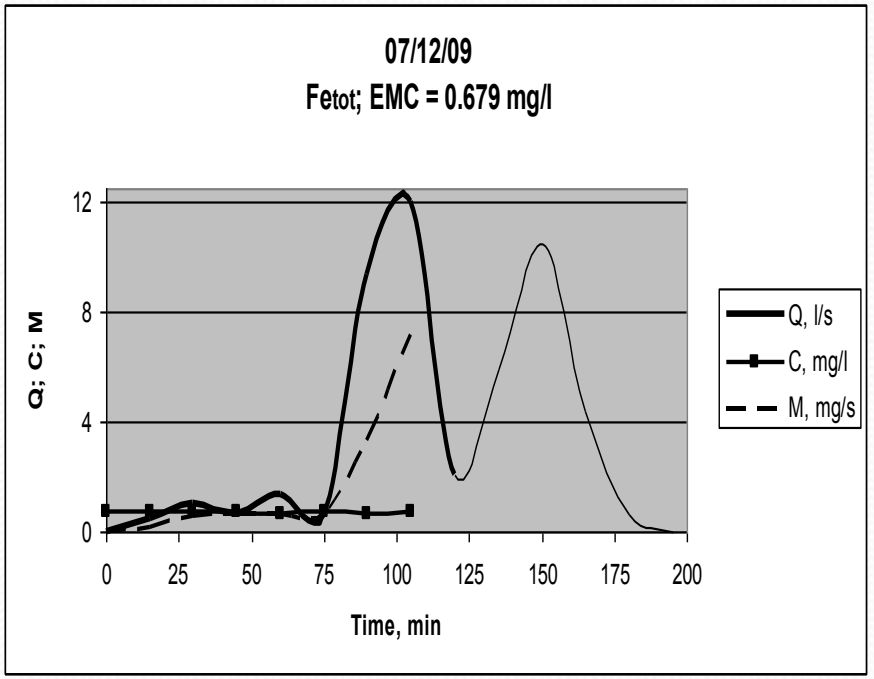
Cu_{dis} is 0.01 mg/L

Wet weather

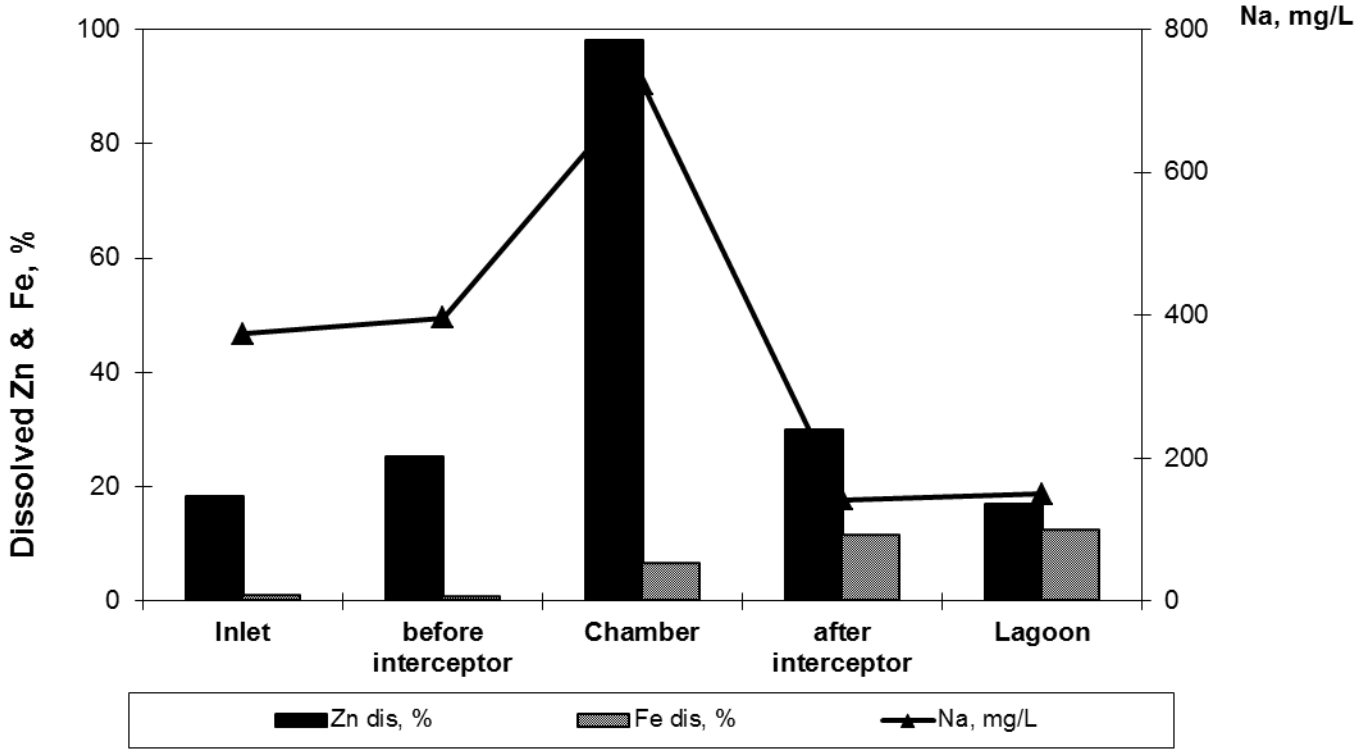
Contaminant, mg/L	Range	Mean value	SD
Fe tot	1.133 – 1.212	1.164	0.038
Fe dis	0.018 – 0.212	0.111	0.107
Cu tot	Traces – 0.161	0.068	0.079
Cu dis	Traces		
Zn tot	0.123 – 0.201	0.159	0.042
Zn dis	0.02 – 0.036	0.029	0.007
TSS	8.5 - 40	23.7	17.08
EC, uS/cm	280 - 2000	1053.8	877

Hydrograph, pollutograph and mass-pollutant graph for two rainfall events obtained for Fe_{tot}





De-icer application



Conclusions

- Pollutants were increased by dry weather (ADWP) both as a result of evaporation but also from re-solubilisation from the sediments.
- Prolonged rainfall events dilute pollutants concentrations but…
- The lagoon was able to achieve background concentration of metals.
- The proportion of dissolved metal during rainfall events is lower compared to the dry weather, probably due to increased TSS concentration.
- There is evidence of a link between dissolved Zn and Na.

Thank you

Any questions?