Table 1: Summary of selected road and highway runoff regression studies

Reference	Study details	Regression relationships
Chui et al., 1982	1979–1981 data from 9 sites (*n*=500) in Washington State, USA.	TSS (load, kg/curb-km) = K (VDS) (RC) K= runoff rate factor depends on location, range 1.8–8.5, VDS= vehicles during storm (x10^{-3} vehicles) when roadway is wet, RC= average runoff coefficient (<1)
Irish et al., 1998	1993–1995 data from MoPac Expressway in Austin, Texas during storms and rainfall application by a simulator (*n*=58)	TSS (load,g/m^2): = 0.2556 + 0.3068(R) + 2.0181(RI) + 0.0037(ADP) - 2.9856(PINT) R= total runoff volume per unit area (L/m^2), RI= runoff intensity (L/m^2-min), antecedent dry period (ADP, hr) and the runoff intensity of the previous storm (PINT, L/m^2-min)
Kerri et al., 1985	1975–1981 data from 3 sites in California, USA	FR (load, g) = 5360+0.140(VDS) FR = filterable residue, VDS= vehicles during storm(#vehicles/event)
Thomson et al., 1997	1976–1983 data from a concrete 10-lane highway (AADT=114 000) located in north Minneapolis (*n*=416)	TSS (EMC, mg/L) = 0.0039 $(TCB)^{1.047}$ $(RI)^{0.236}$ TCB = traffic count before the runoff event (#vehicles), RI= runoff intensity (inches/hr).
Kayhanian et al. 2007	2000–2003 data from 34 sites (*n*=634) in California, USA	TSS (EMC, mg/L)= 72 $(SCR^{1/3})^{-0.099}$ $(AADT)^{4.934}$ $TER^{-0.124}$ $ADP^{0.102}$ TER=total event rainfall (mm), ADP= antecedent dry period (day), $SCR^{1/3}$=cube root of seasonal cumulative rainfall (mm), AADT=average annual daily traffic (x10^{-6} vehicles/day). The type of surrounding land use was also a factor, with EMC increasing if the site is surrounded by agriculture or commercial uses.

Table 2: Details of impervious surfaces monitored at Toowoomba

Surface Type	Description	Area (m^2)
Roof	Corrugated galvanised iron roof with Colorbond ® gutter	51.8
Road	Asphalt pavement with concrete kerb, no gutter. Average daily traffic = 3500 vehicles/day	450
Carpark	Four-bay concrete carpark with concrete kerb	56.2

Table 3: Statistical criteria used to identify significant explanatory variable models for NCP EMC

Method	Source	Criterion function	Comment
Akaike's An Information Criterion (AIC)	Akaike (1974)	$AIC = n\log(RSS/n) + 2(p+1)$	Smaller AIC values indicate better models
Bayesian Information Criterion (BIC)	Schwarz (1978)	$BIC = n\log(RSS/n) + (p+1)\log n$	Smaller BIC values indicate better models
Predicted REsidual Sum of Squares (PRESS)	Weisberg (1985)	$\sum_{i=1}^{n} \hat{e}_{(i)}$, where $\hat{e}_{(i)}$ is the error made when predicting response y_i from the model constructed without observation *i*	Smaller PRESS values indicate better models.
Adjusted R^2	Weisberg (1985)	$\overline{R}^2 = 1 - \left(\frac{n-1}{n-(p+1)} \right)(1-R^2)$	Larger $\overline{R}^2$ values indicate better models

The statistical criteria are used to assess how close the predictions from a model $\hat{\mu}_i$ are to the responses y_i over all observations *i*. *p* is the number of explanatory variables in the model and *n* is the sample size. RSS is the residual sums-of-squares $RSS = \sum_{i=1}^{n} (y_i - \hat{\mu}_i)^2$

Table 4: Correlations (*r*) between log of NCP EMC and the log of rainfall explanatory variables for monitored storms at Toowoomba for each surface. Values of |*r*| > 0.4 shown in **bold**.

Variable	Carpark	Road	Roof
log AR	-0.35	-0.26	-0.20
log ADP	0.17	0.15	0.27
log ED	**-0.44**	**-0.50**	**-0.56**
log SD	**-0.61**	**-0.64**	**-0.73**
log RD	**-0.50**	**-0.48**	**-0.66**
log MI	0.30	0.34	0.28
log PI	0.27	0.19	0.20

Table 5: Correlations (*r*) between log of rainfall explanatory variables for monitored storms at Toowoomba for carparks. Values of |*r*| > 0.4 shown in **bold**.

	log ADP	log ED	log SD	log RD	log MI	log PI
log AR	-0.08	0.04	0.27	0.18	-0.17	-0.09
log ADP	1	0.03	-0.08	-0.15	-0.04	0.08
log ED		1	**0.72**	**0.66**	-0.28	-0.14
log SD			1	**0.63**	**-0.66**	-0.31
log RD				1	0.16	0.32
log MI					1	**0.70**
log PI						1

Table 6: Results of statistical analysis of carpark, road and roof NCP EMC data. (All variables are analysed on the logarithmic scale, but the logarithms are omitted from the table for readability.) The top four models for each statistical method and surface are shown in **bold**, with the highest performing model marked by an *, but do not necessarily indicate statistically significant differences.

Variable combination	AIC	BIC	PRESS	Adj R^2
Carpark NCP EMC data				
AR	85.7	89.9	29.1	0.090
ADP	88.8	93.0	32.3	-0.006
ED	83.1	87.3	25.6	0.167
SD	**75.6**	**79.8**	**20.3**	0.351
RD	80.7	84.9	23.9	0.231
PI	87.4	91.6	30.3	0.039
SD+AR	**75.4**	**81.0**	**20.4**	**0.374**
SD+ ED	77.6	83.2	23.5	0.327
ED+ RD	81.8	87.4	25.0	0.227
SD+RD	76.3	**81.9**	21.0	**0.356**
RD+PI	**73.6***	**79.2***	**18.9***	**0.410***
SD+ADP	77.0	82.6	22.0	0.340
SD+PI	77.4	83.0	20.9	0.331
SD+RD+PI	**75.1**	82.1	**20.0**	**0.399**
Road NCP EMC data				
AR	56.3	60.6	10.5	0.037
ADP	57.8	62.1	10.9	-0.011
ED	48.5	52.8	7.93	0.252
SD	**42.0***	**46.3***	**6.64***	**0.392**
RD	48.2	52.5	8.02	0.258
PI	57.4	61.7	11.1	0.002
SD+AR	43.2	48.9	6.98	0.387
SD+ ED	**42.9**	**48.6**	7.24	**0.393**
ED+ RD	46.2	51.9	7.34	0.326
SD+RD	**42.7**	**48.4**	**6.75**	**0.397***
RD+PI	**42.9**	**48.7**	**6.81**	**0.392**
SD+ADP	43.8	49.6	7.21	0.374
SD+PI	44.0	49.7	7.01	0.371
SD+RD+PI	43.6	50.7	**6.95**	**0.397***
Roof NCP EMC data				
AR	84.0	88.2	27.1	0.008
ADP	82.9	87.1	26.3	0.041
ED	71.4	75.7	17.6	0.346
SD	62.5	**66.8**	13.0	0.514
RD	67.3	71.6	15.1	0.430
PI	84.1	88.4	27.7	0.001
SD+AR	63.7	69.3	13.6	0.509

SD+ ED	64.3	69.9	14.0	0.501
ED+ RD	65.9	71.5	14.6	0.473
SD+RD	**60.5**	**66.1**	**12.6**	**0.560**
RD+PI	**55.9***	**61.5***	**10.2***	**0.622***
SD+ADP	**61.4**	67.1	**12.8**	**0.545**
SD+PI	64.4	70.1	13.6	0.497
SD+RD+PI	**56.8**	**63.8**	**10.6**	**0.622***

Table 7: *P*-values from sequential analysis of variance tests, using interactions between surface and the explanatory variables

	Model with interactions between surface and explanatory variables		Model without interactions between surface and explanatory variables	
Explanatory variable	Degrees of freedom	*P*-value	Degrees of freedom	*P*-value
Intercept by surface	2	<0.001	2	<0.001
log(RD)	1	<0.001	1	<0.001
log(PI)	1	<0.001	1	<0.001
log(SD)	1	0.164		
log(RD) by surface	2	0.126		
log(PI) by surface	2	0.305		
log(SD) by surface	2	0.983		

Table 8: Regression statistics for common model to estimate NCP EMC for all surfaces of the log-form given in Equation 3.

Explanatory variable	Parameter	Coefficient	Standard error	P-value	95% confidence interval
Constant for carpark	β_0	3.8958	0.3230	<0.0001	3.25 to 4.54
Constant for road	β_0	5.3633	0.3287	<0.0001	4.71 to 6.02
Constant for roof	β_0	2.4581	0.3265	<0.0001	1.81 to 3.11
log RD	β_1	-0.7355	0.08556	<0.0001	-0.906 to -0.565
log PI	β_2	0.5618	0.0986	<0.0001	0.366 to 0.758

Table 9. The R^2 and adjusted R^2 for the common model, for all data considered together and separated into subgroups by surface, evaluated on the log-scale

	Overall	Carpark	Road	Roof
R^2	0.845	0.586	0.592	0.555
Adjusted R^2	0.838	0.567	0.574	0.535

Table 10. The results from the BMA analysis: the posterior probability of the variable being among the top 41 models, and the posterior mean and standard deviation of the estimates for each potential predictor

Variable	Posterior probability the variable is in the model	Posterior mean	Posterior standard deviation
Intercept (value for Carkpark)	100%	4.08	0.482
- Adjusted intercept for Road	84.2%	1.21	0.576
- Adjusted intercept for Roof	70.2%	-0.856	0.625
Log(RD)	80.1%	-0.502	0.288
Log(MI)	19.2%	-0.0392	0.175
Log(PI)	92.5%	0.402	0.170
Log(SD)	29.4%	-0.127	0.234
Log(AR)	55.8%	-0.0663	0.0720
Log(ADP)	3.9%	0.00160	0.0118
Log(ED)	0.0%	0.0000	0.0000
Surface(Road).log(RD)	20.4%	0.0934	0.2009
Surface(Roof).log(RD)	20.8%	-0.109	0.2148
Surface(Road).log(MI)	0.9%	0.00189	0.0241
Surface(Roof).log(MI)	0.3%	0.0203	0.0855
Surface(Road).log(SD)	10.0%	0.0229	0.0826
Surface(Roof).log(SD)	60.1%	-0.199	0.188
Surface(Road).log(PI)	1.6%	-0.00181	0.02798
Surface(Roof).log(PI)	8.9%	-0.02745	0.0896