

Table 3-10. A research summary of pollutant reductions using permeable pavements (after Drake 2013 and Eisenberg 2015)

Study	Type	Site Location	Sampled Events	Concentration (C) or Mass (M)	% Average Removal Efficiency												
					NH3	NO3,2	TKN	TN	OP	TP	TSS	Cd	Pb	Zn	Cu	TPH-D	
Bean 2007	PICP	Goldsboro, NC	6-14	C	84	-47	60	42	42	63	33			88	62		
Boving 2008	PA	Kingston, RI	14	C				27		27				90	90		
Brattebo 2003	PICP	Renton, WA	9	C										69	89		
Collins 2010	PC	Kinston, NC	20	C	85	-152	42	-2									
Collins 2010	PICP	Kinston, NC	19	C	85	-331	50	-40									
Collins 2010	PICP	Kinston, NC	19	C	85	-210	50	-11									
Gilbert 2006	PICP	Waterford, CT	1 year	C	72	50	91			34	67		67	71	65		
Dierks 2010	PICP	Ann Arbor, MI	5	C					31	56	12			6	0		
Fassman 2011	PICP	Auckland, NZ	3-13	C							49			93	57		
Pagatto 2000	PA	Nantes, France	25	C	73	69	43				81	69	78	66	35		
Rankin 2004	PICP	Port Adelaide, Australia	9	C			59			43	40		22	43	8		
Roseen 2009	PA	Durham, NH	24 mos.	C						25	96			80		99	
Roseen 2011	PA	Durham, NH	13-16	C		-87				20	89			75		92	
Roseen 2013	PICP	Durham, NH	18	C	95	95	95	95	95	95	95			95		95	
Rushton 2001	PC	Tampa, FL	12-30	C	0	48		28	55	56	31		58	36	58		
Rushton 2001	PC	Tampa, FL	12-30	C	0	36		26	32	39	62		69	53	67		
Smolek 2016	PICP	Durham, NC	19 - 29	C	37			68		96	98		93	90	79		
Van Seters 2007	PICP	North York, ON	27-40	C		-68	53			53	81			73	13		
Drake 2012	PICP	Vaughan, ON	31-45	C	90	-4	89		82	86	89		27		75		
Drake 2012	PICP	Vaughan, ON	45	C	90	-18	87		82	86	87		-20	78	71		
Drake 2012	PC	Vaughan, ON	30-45	C	90	21	78		38	52	79		-5	87	49		
Fassman 2011	PICP	Auckland, NZ	3-13	M							65			93	79		
Legret 1999	PA	Reze, France	11	M							59	77	84	73			
Pagatto 2000	PA	Nantes, France	25	M							77	62	74	59	21		
Rushton 2001	PC	Tampa, FL	12-30	M							91		85	75	81		
Winston 2015	PICP	Willoughby Hills, OH	18	M		-23	42	23	1	30	#		-55	37	13		
Winston 2015	PICP	Willoughby Hills, OH	12	M		42	56	52	22	40	##		-47	53	30		
Winston 2017	PICP	Huron, OH	16	M			67	63	-56	82	100		15	40	14		
Average Concentration Removal																	
					80.7	-42.7	66.3	25.9	57.0	55.4	68.1	69.0	43.1	70.1	58.4	95.3	
Average Mass Removal																	
						9.5	55.0	46.1	-10.9	50.5	78.3	69.5	26.1	61.5	39.7		

NH3: Ammonium; NO3, 2: Nitrate & Nitrite; TKN: Total Kjeldahl Nitrogen; OP: Ortho-phosphate; TP: Total Phosphate; TSS: Total Suspended Solids; Cd: Cadmium; Pb: Lead; Zn: Zinc; Cu: Copper; TPH-D: Total Petroleum Hydrocarbons as Diesel

-525% and ## -328% due to sediment export from reservoir

Table 3-11. Permeable pavement volume reductions from various research papers (after Drake 2013 and Eisenberg 2015).

Author	Type	Location	Events	CDA Ratio, %	Soil	Underdrains	Mean Volume Reduction, %
Bean 2007	PICP	Goldsboro, NC	14	0	sand	No	100
Bean 2007*	PICP	Swansboro, NC	16	0	sand	No	100
Boving	PA	Kingston, RI	14	0	gravel	No	100
Brattebo 2003*	PICP	Renton, WA	15	0	NR	No	100
Booth 1996*	PICP	Renton, WA	3	0	NR	No	100
Collins 2010	PC	Kinston, NC	51	0	sandy clay	Yes	13
Collins 2010	PICP	Kinston, NC	50	0	loam	Yes	48
Collins 2010	PICP	Kinston, NC	46	0	sandy clay	Yes	3
Gilbert 2006	PICP	Waterford, CT	1 year	Varied	sandy clay	No	72
Dierks 2010*	PICP	Ann Arbor, MI	14	300	NR	Yes	80
Fassman 2010	PICP	Auckland, NZ	44	100	silty clay	Yes	28
Rankin 2002*	PICP	Port Adelaide, Australia	22	45	sandy	No	93
James 1997	PICP	Guelph, ON	9	0	NR	NR	38
James 1997	PICP	Guelph, ON	9	0	NR	NR	61
Legret 1999	PA	Reze, France	40	37	NR	Yes	97
Roseen 2013	PICP	Durham, NH	18	0	sandy clay	Yes	100
Roseen 2012	PA	Durham, NH	17	0	HSG C	No	25
Rushton 2001	PC	Tampa, FL	30	0	sandy	No	29
Rushton 2001	PC	Tampa, FL	30	0	sandy	No	32
Smolek 2016	PICP	Durham, NC	29	300	HSG D	Yes	22
Van Seters 2008	PICP	North York, ON	71	0	clay loam	Yes	90
Drake 2012	PICP	Vaughan, ON	185	0	silty clay	Yes	45
Drake 2012	PICP	Vaughan, ON	185	0	silty clay	Yes	45
Drake 2012	PC	Vaughan, ON	185	0	silty clay	Yes	45
Winston 2015*	PICP	Willoughby Hills, OH	77	220	silt loam HSG D	Yes	32
Winston 2015*	PICP	Willoughby Hills, OH	77	720	silt loam HSG D	Yes	16
Winston 2015*	PICP	Orange Village, OH	77	0	silt loam HSG D	Yes	99
Winston 2015*	PC	Perkins Township, OH	87	60	silty clay HSG C/D	Yes	53
Winston 2017*	PICP	Huron, OH	59	170	silt loam HSG D	Yes**	18

NR = Not reported

*Not paired impervious/permeable pavement studies; instead compared rainfall to runoff/infiltration/outflow

**Cistern collection under 10% of the PICP area