

A Comparison of Three Types of Permeable Pavements for Urban Runoff Mitigation in the Semi-Arid South Texas, U.S.A

The following supplementary materials can be found in this document:

- **Table S1.** NVR, %volume reduction, and Normalized Peak Flow results of the Porous Concrete Pavement (PCP) for the City of Brownsville (COB) site.
- **Table S2.** NVR, %volume reduction, and Normalized Peak Flow results of the Traditional Asphalt Pavement (TAP) for the City of Brownsville (COB) site.
- **Table S3.** NVR, %volume reduction, and Normalized Peak Flow results of the Permeable Interlocking Concrete Pavement (PICP) for Cameron County Drainage District#1 (CCDD#1) site.
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Data Availability

Table S1. NVR, %volume reduction, and Normalized Peak Flow results of the Porous Concrete Pavement (PCP) for the City of Brownsville (COB) site.

Date	Rainfall (mm)	PCP Volume onto Surface (m ³)	PCP Observed flow Volume(m ³)	PCP Observed Normalized Volume Reduction (m ³ /m ² /mm)	PCP % Observed Volume Reduction	PCP Normalized Peak Flow (× 10 ⁻⁵ m ³ /s/m ²)
09/05/2014	8	1.00	0.25	0.0024	75	0.000
09/12/2014	18	2.12	0.09	0.0031	96	0.118
09/13/2014	67	7.95	1.80	0.0025	77	1.765
09/20/2014	14	1.69	1.19	0.0009	30	1.216
09/25/2014	10	1.24	0.08	0.0030	93	0.151
09/28/2014	4	0.48	0.00	0.0032	100	0.000
10/18/2014	13	1.54	0.01	0.0032	99	0.030
10/21/2014	6	0.76	0.00	0.0032	100	0.000
10/22/2014	53	6.29	2.14	0.0021	66	3.132
11/05/2014	4	0.45	0.00	0.0032	100.0	0.000
11/06/2014	27	3.24	0.00	0.0032	100.0	0.000
11/07/2014	34	4.05	0.00	0.0032	100.0	0.000
11/12/2014	7	0.78	0.000	0.0032	100.0	0.000

Table S2. NVR, %volume reduction, and Normalized Peak Flow results of the Traditional Asphalt Pavement (TAP) for the City of Brownsville (COB) site.

Date	Rainfall (mm)	TAP Volume onto Surface (m ³)	TAP Observed flow Volume(m ³)	TAP Observed Normalized Volume Reduction (m ³ /m ² /mm)	TAP % Observed Volume Reduction	TAP Normalized Peak Flow (× 10 ⁻⁵ m ³ /s/m ²)
09/05/2014	8	1.29	0.16	0.0009	87	0.018
09/12/2014	18	2.73	1.36	0.0005	50	2.251
09/13/2014	67	10.25	32.62	-0.0022	-218	7.385
09/20/2014	14	2.18	1.28	0.0004	41	0.828
09/25/2014	10	1.60	0.41	0.0007	74	0.091
09/28/2014	4	0.62	0.31	0.0005	50	0.091
10/18/2014	13	1.99	1.73	0.0001	13	0.959
10/21/2014	6	0.97	0.76	0.0002	22	0.483
10/22/2014	53	8.11	15.64	-0.0009	-93	2.270
11/05/2014	4	0.58	0.38	0.0003	34	0.183
11/06/2014	27	4.17	2.61	0.0004	38	0.163
11/07/2014	34	5.22	11.90	-0.0013	-128	0.424
11/12/2014	7	1.01	0.00000	0.0010	100	0.111

Table S3. NVR, %volume reduction, and Normalized Peak Flow results of the Permeable Interlocking Concrete Pavement (PICP) for Cameron County Drainage District#1 (CCDD#1) site.

Date	Rainfall (mm)	PICP Volume onto Surface (m ³)	PICP Observed flow Volume (m ³)	PICP Observed Normalized Volume Reduction (m ³ /m ² /mm)	PICP % Observed Volume Reduction	PICP Normalized Peak Flow (× 10 ⁻⁵ m ³ /s/m ²)
08/14/2014	2	1.23	0.01	0.00161	99	0.000
09/03/2014	55	33.41	0.12	0.00162	100	0.027
09/07/2014	5	2.93	0.74	0.00122	75	0.153
09/11/2014	6	3.39	0.00	0.00163	100	0.000

09/13/2014	67	40.49	13.70	0.00108	66	1.147
09/14/2014	20	12.01	9.74	0.00031	19	1.448
09/15/2014	34	20.32	16.97	0.00027	17	1.660
09/16/2014	5	3.23	0.00	0.00163	100	0.000
09/27/2014	6	3.85	0.00	0.00163	100	0.000
10/18/2014	67	40.65	15.94	0.00099	61	1.541
10/22/2014	17	10.32	0.88	0.00149	92	0.104
10/31/2014	7	4.00	0.00	0.00163	100	0.193
11/06/2014	25	15.09	0.00	0.00163	100	0.000
11/07/2014	39	23.71	0.00	0.00163	100	0.000
12/07/2014	18	10.93	0.01	0.00163	100	0.000
12/08/2014	16	9.55	0.02	0.00163	100	0.005
01/10/2015	47	28.48	22.79	0.00033	20	0.000
02/03/2015	16	5.39	2.92	0.00042	46	0.000
02/04/2015	2	1.39	0.03	0.00160	98	0.000
03/09/2015	5	3.08	0.00	0.00163	100	0.000

Table S4. NVR, %volume reduction, and Normalized Peak Flow results of the Interlocking Block Pavement with Gravel (IBPG) for the City of La Feria (COLF) site.

Date	Rainfall (mm)	IBPG Volume onto Surface (m ³)	IBPG Observed flow Volume(m ³)	IBPG Observed Normalized Volume Reduction (m ³ /m ² /mm)	% IBPG Observed Reduction	IBPG Normalized Peak Flow (× 10 ⁻⁵ m ³ /s/m ²)
05/9/2014	18.54	9.61	0.55	0.0023	94	0.032
05/28/2014	23.37	12.12	4.13	0.0016	66	0.573
06/25/2014	5.84	3.03	0.08	0.0024	97	0.025
07/10/2014	17.53	9.09	2.8	0.0017	69	0.296
07/18/2014	25.4	13.17	2.44	0.0020	81	0.202
08/29/2014	11.18	5.8	3.83	0.0008	34	0.151
09/2/2014	6.6	3.42	0.3	0.0023	91	0.069
09/12/2014	22.86	11.85	1.49	0.0022	87	0.097
09/13/2014	70.1	36.35	17.26	0.0013	53	0.480
09/20/2014	2.54	1.32	0.03	0.0024	98	0.000
10/11/2014	11.94	6.19	0.9	0.0021	85	0.087
10/21/2014	7.11	3.69	0	0.0025	100	0.000
11/12/2014	20.32	10.54	0	0.0025	100	0.000
11/22/2014	4.32	2.24	0.02	0.0025	99	0.007
11/23/2014	27.69	14.36	7.75	0.0011	46	0.480
12/6/2014	17.02	8.82	0.35	0.0024	96	0.025
12/28/2014	8.89	4.61	0.01	0.0025	100	0.004
01/10/2015	28.96	15.01	9.23	0.0010	39	0.188
03/9/2015	16.51	8.56	0.32	0.0024	96	0.025
03/21/2015	6.86	3.56	0.03	0.0025	99	0.007
04/10/2015	3.81	1.98	0	0.0025	100	0.025
04/11/2015	2.29	1.19	0.01	0.0025	99	0.011
04/12/2015	10.92	5.66	1.23	0.0019	78	0.144
04/21/2015	11.68	6.06	0.09	0.0024	98	0.036
04/25/2015	6.1	3.16	0.11	0.0024	96	0.018
05/12/2015	20.32	10.54	3.92	0.0016	63	0.090
05/13/2015	4.32	2.24	0	0.0025	100	0.036
05/21/2015	8.64	4.48	0.77	0.0021	83	0.029
09/1/2015	3.81	1.98	0	0.0025	100	0.004
09/3/2015	8.13	4.21	0	0.0025	100	0.072
09/12/2015	5.33	2.77	0	0.0025	100	0.025
09/29/2015	2.79	1.45	0	0.0025	100	0.007

09/30/2015	2.79	1.45	0	0.0025	100	0.018
10/8/2015	3.3	1.71	0	0.0025	100	0.007
10/10/2015	2.29	1.19	0	0.0025	100	0.011
10/17/2015	2.54	1.32	0	0.0025	100	0.025
10/22/2015	14.22	7.38	0	0.0025	100	0.397
10/25/2015	16.51	8.56	0	0.0025	100	0.036
10/30/2015	16.26	8.43	0	0.0025	100	0.866
11/20/2015	14.73	7.64	0	0.0025	100	0.032
11/25/2015	3.05	1.58	0	0.0025	100	0.029
01/1/2016	2.79	1.45	0.46	0.0017	68	0.014

Table S5. NVR, %volume reduction, and Normalized Peak Flow results of the Traditional Block Pavement (TBP) for the City of La Feria (COLF) site.

Date	Rainfall (mm)	TBP Volume onto Surface (m ³)	TBP Observed Flow Volume(m ³)	TBP Observed Normalized Volume Reduction	% TBP Observed Reduction	TBP Normalized Peak Flow (× 10 ⁻⁵ m ³ /s/m ²)
05/9/2014	18.54	12.61	1.17	0.0013	91	0.102
05/28/2014	23.37	17.23	7.13	0.0009	59	0.881
06/25/2014	5.84	4.31	0.79	0.0012	82	0.105
07/10/2014	17.53	12.92	9.6	0.0004	26	0.992
07/18/2014	25.4	18.72	11.68	0.0006	38	0.738
08/29/2014	11.18	8.24	7.84	0.0001	5	0.143
09/2/2014	6.6	4.49	3.9	0.0002	13	0.220
09/12/2014	22.86	16.85	12.39	0.0004	26	0.459
09/13/2014	70.1	51.68	46.64	0.0001	10	0.837
09/20/2014	2.54	1.87	1.77	0.0001	5	0.025
10/11/2014	11.94	8.8	5.55	0.0006	37	0.527
10/21/2014	7.11	5.24	1.86	0.0010	65	0.031
11/12/2014	20.32	14.98	6.52	0.0009	56	0.112
11/22/2014	4.32	3.18	0.8	0.0011	75	0.065
11/23/2014	27.69	20.41	8.91	0.0009	56	0.561
12/6/2014	17.02	12.54	2.04	0.0013	84	0.133
12/28/2014	8.89	6.55	2.57	0.0009	61	0.143
01/10/2015	28.96	21.34	17.72	0.0003	17	0.270
03/9/2015	16.51	18.84	3.34	0.0019	82	0.109
03/21/2015	6.86	7.82	2.17	0.0017	72	0.236
04/10/2015	3.81	4.35	0.1	0.0023	98	0.264
04/11/2015	2.29	2.61	0.54	0.0019	79	0.223
04/12/2015	10.92	12.46	3.83	0.0016	69	0.174
04/21/2015	11.68	13.33	3.26	0.0018	76	0.109
04/25/2015	6.1	6.95	6.37	0.0002	8	0.025
05/12/2015	20.32	23.18	6.03	0.0017	74	0.465
05/13/2015	4.32	4.93	1.45	0.0017	71	0.062
05/21/2015	8.64	9.85	6.76	0.0007	31	0.208
09/1/2015	3.81	4.35	4.36	0.0000	0	0.028
09/3/2015	8.13	9.27	1.98	0.0019	79	0.109
09/12/2015	5.33	6.09	0.54	0.0022	91	0.174
09/29/2015	2.79	3.19	0.07	0.0023	98	0.025
09/30/2015	2.79	3.19	0.1	0.0023	97	0.037
10/8/2015	3.3	3.77	0.89	0.0018	76	0.065
10/10/2015	2.29	2.61	1.34	0.0012	49	0.025
10/17/2015	2.54	2.9	0.34	0.0021	88	0.053
10/22/2015	14.22	16.23	8.02	0.0012	51	2.264
10/25/2015	16.51	18.84	4.54	0.0018	76	1.333

10/30/2015	16.26	18.55	11.76	0.0009	37	2.288
11/20/2015	14.73	16.81	2.82	0.0020	83	0.552
11/25/2015	3.05	3.48	1.94	0.0010	44	0.310
01/1/2016	2.79	3.19	0.53	0.0020	84	0.028

Table S6. TSS Concentration and NLR results of the Porous Concrete Pavement (PCP) and Traditional Asphalt Pavement (TAP) for the City of Brownsville (COB) site.

Date	Rainfall (mm)	COB - TSS			
		PCP Observed concentration (mg/L)	PCP Normalized Observed Load Reduction (kg/m ² /mm)	TAP Observed concentration (mg/L)	TAP Normalized Observed Load Reduction (kg/m ² /mm)
10/21/2014	0.25	412	0.001315	500	0.000110
10/23/2014	2.08	2120	0.004459	3980	0.000792
11/07/2014	1.34	488	0.001558	405	0.000121
11/13/2014	0.07	755	0.002416	1300	0.000900

Table S7. BOD₅ Concentration and NLR results of the Porous Concrete Pavement (PCP) and Traditional Asphalt Pavement (TAP) for the City of Brownsville (COB) site.

Date	Rainfall (mm)	COB – BOD ₅			
		PCP Observed concentration (mg/L)	PCP Normalized Observed Load Reduction (kg/m ² /mm)	TAP Observed concentration (mg/L)	TAP Normalized Observed Load Reduction (kg/m ² /mm)
10/21/2014	0.25	7	0.000022	26	0.0000057
10/23/2014	2.08	23.3	0.000049	16	0.0000032
11/07/2014	1.34	6	0.000019	15.3	0.0000046
11/13/2014	0.07	16.8	0.000054	10.7	0.0000074

Table S8. TSS and BOD₅ Concentration and NLR results of the Permeable Interlocking Concrete Pavement (PICP) for the Cameron County Drainage District#1 (CCDD#1) site.

Date	Rainfall (mm)	CCDD#1-TSS		CCDD#1- BOD ₅	
		Observed concentration (mg/L)	Normalized Observed Load Reduction (kg/m ² /mm)	Observed concentration (mg/L)	Normalized Observed Load Reduction (kg/m ² /mm)
10/21/2014	0.67	960	0.00143	7.44	1.1059E-05
10/23/2014	2.10	477	0.00078	8.33	1.3536E-05
11/07/2014	1.54	173	0.00028	8.75	1.4263E-05
11/13/2014	0.07	252	0.00041	13	2.1139E-05
06/09/2015	0.01	13	0.00002	48.9	8.0200E-05

Table S9. TSS Concentration and NLR results of the Interlocking Block Pavement with Gravel (IBPG) and Traditional Block Pavement (TBP) for the City of Brownsville (COB) site.

Date	Rainfall (mm)	COLF-TSS			
		IBPG Observed concentration (mg/L)	IBPG Normalized Observed Load Reduction (kg/m ² /mm)	TBP Observed concentration (mg/L)	TBP Normalized Observed Load Reduction (kg/m ² /mm)
05/09/2014	18.54	58	0.00014	80	0.0001
05/13/2014	29.97	161	0.00033	762	0.0009
05/28/2014	23.37	48	0.00008	65	0.0001
06/25/2014	5.84	85	0.00020	26.2	0.0000

07/10/2014	17.53	422	0.00072	672	0.0003
08/29/2014	11.18	74	0.00006	206	0.0000
09/02/2014	6.60	10	0.00002	26	0.0000
10/21/2014	7.11	990	0.00245	79	0.0001
11/08/2014	0.25	17	0.00004	10	0.0000
11/12/2014	11.94	112	0.00047	101	0.0001
03/09/2015	16.51	45	0.00011	2	0.0000
03/20/2015	1.78	156	0.00039	187	0.0004
08/20/2015	55.63	773	0.00152	N/A	N/A
09/15/2015	0.76	N/A	N/A	96	0.0000
09/23/2015	2.03	454	0.00112	12.5	0.0000
03/09/2016	29.46	74	0.00002	848	0.0019
05/15/2016	1.02	152	0.00038	22.5	0.0000
05/20/2016	1.02	62	0.00015	795	0.0000
05/21/2016	0.76	50	0.00012	454	0.0010
06/01/2016	7.11	64	0.00016	1230	0.0000
06/02/2016	6.10	50	0.00012	937	0.0000
06/04/2016	18.29	40	0.00010	631	0.0000
06/08/2016	3.81	46	0.00011	192	0.0000
06/21/2016	4.57	163	0.00040	772	0.0000

N/A = Data not available.

Table S10. BOD₅ Concentration and NLR results of the Interlocking Block Pavement with Gravel (IBPG) and Traditional Block Pavement (TBP) for the City of Brownsville (COB) site.

Date	Rainfall (mm)	COLF- BOD ₅			
		IBPG Observed concentration (mg/L)	IBPG Normalized Observed Load Reduction (kg/m ² /mm)	TBP Observed concentration (mg/L)	TBP Normalized Observed Load Reduction (kg/m ² /mm)
05/09/2014	18.54	N/A	N/A	N/A	N/A
05/13/2014	29.97	11.80	0.0000241	18.1	0.0000444
05/28/2014	23.37	29.30	0.0000477	55.1	0.0000982
06/25/2014	5.84	48.00	0.0001154	128	N/A
07/10/2014	17.53	25.60	0.0000437	41.4	0.0000323
08/29/2014	11.18	N/A	N/A	N/A	N/A
09/02/2014	6.60	136.00	0.0003062	24.1	0.0000089
10/21/2014	7.11	22.70	0.0000561	16.5	0.0000324
11/08/2014	0.25	4.37	0.0000109	3.17	0.0000080
11/12/2014	11.94	8.51	0.0000358	9.95	0.0000291
03/09/2015	16.51	4.04	0.0000096	4.24	0.0000164
03/20/2015	1.78	22.30	0.0000551	14.1	0.0000663
08/20/2015	55.63	100.00	0.0001962	155	N/A
09/15/2015	0.76	71.10	0.0001753	5.15	0.0000000
09/23/2015	2.03	11.10	0.0000274	7.68	0.0000362
03/09/2016	29.46	130.00	0.0000415	45.7	0.0002067
05/15/2016	1.02	25.60	0.0000633	11	0.0000467
05/20/2016	1.02	24.10	0.0000578	77.7	0.0000000
05/21/2016	0.76	27.40	0.0000675	23.2	0.0001071
06/01/2016	7.11	21.50	0.0000531	40.3	0.0000000
06/02/2016	6.10	8.03	0.0000198	25.70	0.0000000
06/04/2016	18.29	20.40	0.0000504	42.7	0.0000000
06/08/2016	3.81	17.80	0.0000440	41	0.0000000
06/21/2016	4.57	N/A	N/A	N/A	N/A

N/A = Data not available.