Monitoring Report for the Wilmore Walk Porous Pavement Monitoring Study

Prepared for City of Charlotte Stormwater Services

Prepared by Craig J. Allan[1] and Megan Gray[1]

1. Department of Geography and Earth Sciences, UNC Charlotte

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Introduction

Investigators from UNC Charlotte's Department of Geography and Earth Sciences have been monitoring the performance of a porous pavement stormwater Best Management Practice (BMP) installed in the Wilmore Walk neighborhood in central Charlotte since March 2007. The monitoring study has three major objectives: 1. Quantify the water table response in the storage reservoir underlying the porous pavement to precipitation inputs of different magnitude; 2. Evaluate the long term (2 year) performance of the structure with regard to changes in percolation (clogging) and drainage (infiltration); and 3. Characterize water quality constituents and their concentrations in infiltrating stormwater beneath the structure. The study is designed to provide the City's stormwater management engineers and planners with a comprehensive long term performance database with which to assess the utility of permeable pavement as a Stormwater BMP in an urbanized Piedmont setting.

Methods

Hydrologic

Three Global Water Instrumentation Inc. (GW) pressure transducers were installed into three access wells situated in the porous pavement structure. The access wells were installed during the initial construction of the BMP by the contractor and City in 2006. The GW devices measure changes in pressure (water level) above the sensor every five minutes and the data is stored on an internal datalogger. Data is retrieved from the GW devices on an event or monthly basis with a laptop computer. Owing to noisy output from the GW devices (see appendix 1) three Odyssey Capacitance type water level recorders were installed alongside the GW recorders in the September 2007. Precipitation inputs are measured and recorded with a HOBO RG3 recording rain gauge. Three periods of missing precipitation records (March-April , December 2007, and July-August 2008) during the current monitoring period are reported from National Weather Service Data (NWS) recorded at Charlotte Douglas Airport or nearby USGS rain gauge data. Air temperature and relative humidity were also recorded at the monitoring location with a HOBO combination temperature/RH logger but those data are not presented here.

Water Quality

Water samples were obtained with a peristaltic pump from each of the three monitoring wells after each rain event where a sufficient water table response permitted sampling. Samples were withdrawn from fixed sampling lines installed in each well. An aquarium type "air stone" attached to the well end of each sampling line served as a prefilter for the well samples. Atmospheric dry and wet deposition is sampled with a bulk collector suspended from a pole above the pavement surface. The collector consists of a five gallon plastic pail with a plastic bag liner that is exchanged after each precipitation event. Bulk precipitation and well samples are poured off into acid washed Nalgene bottles and transported to the UNC Charlotte Hydrology and Biogeochemistry Laboratory. Samples were analyzed for pH, conductivity and filtered within 24 hours of collection. After initial sample analyses all samples were frozen for later analysis for major ions and nutrients.

All observation well water samples are filtered with glass fiber filter papers (nominal pore size 0.45μm) before analyses. Bulk precipitation samples are passed through a nytex prefilter when particulates were prevalent in a sample. Temperature corrected specific conductance and pH determinations are made with suitable meters standardized to appropriate buffers or standard solutions. Major cations (NH_4^+-N) and anions (PO_4^{-3}, NO_3-N and Cl^-) are measured by ion chromatography with a Dionex DX-500 IC system. Total Nitrogen is measured with a Shimadzu TOC/TN analyzer. Total phosphorus determinations are made colormetrically on acid/persulphate digested samples reacted with pre prepared HACH TP kits. Random quintuplet samples are analyzed during each run to assess the analytical variability for each method.

Calculations and Definitions

Porosity (η): for this report porosity is defined as the void space within the crushed rock reservoir. These voids between the individual crushed rock fragments are filled with either air or water depending upon the water level within the reservoir.

The porosity within the crushed rock reservoir was estimated from the rainfall/water level response in the following manner:

$$\eta = \text{Precipitation depth (inches)/Maximum Water Level Increase (inches)} \quad (1)$$

Corrected and Uncorrected Infiltration Rates: for this report we present both an 'uncorrected' and 'corrected 'infiltration rate for the decline in water level over time within the crushed rock reservoir. The uncorrected infiltration rate simply expresses the rate of water level decline over time in the crush rock reservoir. This value is of interest because it directly relates to how fast the water level in the crushed rock storage reservoir will drain. However, strictly speaking this is an overestimate of how most engineers and hydrologists think of infiltration because the water depth in the crushed rock reservoir is a function of both the water and solid (rock) volume. For example if the crushed rock reservoir has a porosity of 40% with a 6" water level, the actual depth of water is 2.4" as the remaining 3.6" is occupied by the volume of the rock fragments. The corrected infiltration rate is thus calculated from the decline of the actual water only depth over time. This infiltration rate can then be directly related to precipitation depth.

Infiltration Rate Uncorrected (IR_u) The uncorrected infiltration rate for each rain event was calculated by:

$$IR_u = \text{Maximum Water Level Increase (Inches)/Drainage Duration (hours)} \quad (2)$$

Note the period selected for the drainage duration was either the time until complete recovery to the initial water level prior to the precipitation event for solitary events, or the maximum drainage duration until interruption by a subsequent precipitation event.

Infiltration Rate Corrected (IR_c) The correctedinfiltration rate for each rain event was calculated by:

IR_c= Maximum Water Level Increase (Inches)* η /Drainage Duration (hours) (3)

As above the period selected for the drainage duration was either the time until complete recovery to the initial water level prior to the precipitation event for solitary events or the maximum drainage duration until interruption by a subsequent precipitation event.

Results

Hydrologic Data

Hydrologic data for each precipitation event monitored from March 27, 2007 to June 1, 2009 are presented in Appendix 1. Bulk precipitation data for events or periods wear insufficient precipitation occurred to produce a water level response in the porous pavement storage reservoir is presented in Appendix 1 as well. A summary of the precipitation events that occurred during the study and the water table response, estimated η and average corrected and uncorrected infiltration rate for the event is presented in Table 1. The water level response to precipitation inputs for each monitoring well is presented in Figures 1, 2, 3.

Note the positioning of the wells left, right and center is from the perspective of one facing the upslope end of the pavement surface. Although each of the GW level recorders exhibits a highly significant positive correlation with the magnitude of the precipitation input there is considerable noise in the data record for such a controlled installation. In part this may be due to some precipitation data from March, April, December 2007, and July, August 2008 having to be estimated from airport and other local USGS rain gauges when the HOBO precipitation gauge failed to log data. However, there appears to be several instances of erratic output from one or more of the GW pressure transducers (see appendix 1). We believe this is in part due to air bubbles being trapped in the pressure transducer housing as the wells fill after complete dryness. This can alter the pressure response of the sensor until the bubble is either dislodged or dissolved. In an attempt to improve the accuracy of the water level record we installed an Odyssey capacitance water level recorder alongside each GW device in the three monitoring wells in September 2007. After both water level recorders were installed the mean response from the "best" water level record(s) for each event was used as the event response. Data from one to five water level recorders was used to calculate the mean for each event.

During this study we have monitored thirty one precipitation events ranging from 0.03" to 5.70" that have produced a water level response in the porous pavement storage reservoir. The single largest water level response has been in the order of 14.63". The porosity (η) for the pavement crushed rock storage reservoir as determined from the precipitation water level response averages 38.5% ± 10.5% n= 64 using the water level response of all GW and Odyssey sensors. Slight differences exist in porosity determined from data from each of the three separate wells: 40.2% ± 10.1% n= 23 (Left Well), 36.8% ± 8.2% n= 5 (Center Well) and 38.2% ± 12.6% n=22 (Right Well). The average measured uncorrected infiltration rate (IR_u) for the data set is 0.105 inches/hour ± 0.068 inches/hour. The average (IR_u) results obtained from this study have a wider range (0.02-0.32inches/hour) than the range (0.06-0.09 inches/hour) reported by C. Estes under semi dry and

Table 1. Summary of Precipitation Evemts, Water Table Response, Estimated η and corrected and uncorrected infiltration rates from March 25, 2007 to June 1, 2009.

Date	Rainfall Total (Inches)	Duration (Hours)	Average Intensity (Inches/Hour)	Peak 5 min Intensity (Inches/Hour)	Water Table Response (Inches)	Porosity (η)	Uncorrected Infiltration Rate (Inches/Hour)	Corrected Infiltration Rate (Inches/Hour)
3/29/2007	0.02	---	---	---	NA	NA	NA	NA
3/30/2007	**0.03**	**---**	**---**	**---**	**0.71**	**0.12**	**0.23**	**0.03**
4/1/2007	0.17	---	---	---	NA	NA	NA	NA
4/11/2007	**0.91**	**---**	**---**	**---**	**1.66**	**0.58**	**0.10**	**0.06**
4/14/2007	**1.29**	**---**	**---**	**---**	**3.30**	**0.39**	**0.10**	**0.04**
4/15/2007	0.11	---	---	---	NA	NA	NA	NA
4/19/2007	**0.53**	**---**	**---**	**---**	**1.33**	**0.42**	**0.12**	**0.05**
4/27/2007	0.33	---	---	---	NA	NA	NA	NA
5/4/2007	0.06	---	---	---	NA	NA	NA	NA
5/5/2007	0.20	---	---	---	NA	NA	NA	NA
5/12/2007	0.12	---	---	---	NA	NA	NA	NA
6/4/2007	0.09	---	---	---	NA	NA	NA	NA
6/5/2007	0.04	2.35	0.02	0.00	NA	NA	NA	NA
6/6/2007	0.02	0.08	0.28	0.00	NA	NA	NA	NA
6/11/2007	0.26	5.12	0.05	0.03	NA	NA	NA	NA
6/12/2007	**0.69**	**6.82**	**0.10**	**0.03**	**1.50**	**0.46**	**0.32**	**0.15**
6/13/2007	0.23	4.83	0.05	0.01	NA	NA	NA	NA
6/14/2007	0.27	4.20	0.06	0.01	NA	NA	NA	NA
6/19/2007	0.03	0.40	0.08	0.00	NA	NA	NA	NA

Storm events which produce a water level response are highlighted in **bold** and underline

--- = No Data NA = Not Applicable

Table 1. Continued summary of Precipitation Evemts, Water Table Response, Estimated η and corrected and uncorrected infiltration rates from March 25, 2007 to June 1, 2009.

Date	Rainfall Total (Inches)	Duration (Hours)	Average Intensity (Inches/Hour)	Peak 5 min Intensity (Inches/Hour)	Water Table Response (Inches)	Porosity (η)	Uncorrected Infiltration Rate (Inches/Hour)	Corrected Infiltration Rate (Inches/Hour)
6/20/2007	0.02	0.85	0.03	0.00	NA	NA	NA	NA
6/24/2007	0.05	0.55	0.09	0.00	NA	NA	NA	NA
6/24/2007	0.67	3.75	0.18	0.06	NA	NA	NA	NA
6/25/2007	0.10	18.98	0.01	0.00	NA	NA	NA	NA
6/29/2007	0.20	1.42	0.14	0.01	NA	NA	NA	NA
6/30/2007	0.02	2.15	0.01	0.00	NA	NA	NA	NA
7/2/2007	0.17	2.62	0.06	0.01	NA	NA	NA	NA
7/9/2007	0.83	1.18	0.71	0.04	NA	NA	NA	NA
7/11/2007	0.16	0.25	0.63	0.02	NA	NA	NA	NA
7/15/2007	0.43	4.52	0.10	0.02	NA	NA	NA	NA
7/17/2007	0.35	3.00	0.12	0.02	NA	NA	NA	NA
7/27/2007	**1.98**	**2.20**	**0.90**	**0.11**	**6.03**	**0.34**	**0.12**	**0.04**
7/30/2007	0.13	0.42	0.30	0.01	NA	NA	NA	NA
8/22/2007	0.34	0.78	0.43	0.02	NA	NA	NA	NA
8/23/2007	0.07	0.32	0.22	0.00	NA	NA	NA	NA
8/26/2007	0.05	1.28	0.04	0.00	NA	NA	NA	NA
8/30/2007	0.20	3.67	0.06	0.01	NA	NA	NA	NA
8/31/2007	0.23	0.08	2.74	0.00	NA	NA	NA	NA
9/10/2007	0.06	0.10	0.55	0.01	NA	NA	NA	NA
9/14/2007	**1.60**	**18.97**	**0.08**	**0.04**	**3.09**	**0.58**	**0.09**	**0.05**
9/30/2007	0.03	0.08	0.38	0.00	NA	NA	NA	NA
10/4/2007	0.20	2.40	0.09	0.02	NA	NA	NA	NA
10/19/2007	0.36	0.98	0.37	0.02	NA	NA	NA	NA
10/23/2007	0.03	2.68	0.01	0.00	NA	NA	NA	NA
10/24/2007	0.62	2.40	0.26	0.02	NA	NA	NA	NA

Storm events which produce a water level response are highlighted in **bold** and underline

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Table 1. Continued summary of Precipitation Evemts, Water Table Response, Estimated η and corrected and uncorrected infiltration rates from March 25, 2007 to June 1, 2009.

Date	Rainfall Total (Inches)	Duration (Hours)	Average Intensity (Inches/Hour)	Peak 5 min Intensity (Inches/Hour)	Water Table Response (Inches)	Porosity (η)	Uncorrected Infiltration Rate (Inches/Hour)	Corrected Infiltration Rate (Inches/Hour)
10/25/2007	0.67	22.82	0.03	0.01	NA	NA	NA	NA
10/26/2007	**0.54**	**4.75**	**0.11**	**0.00**	**3.18**	**0.59**	**0.06**	**0.04**
11/15/2007	0.23	---	---	---	NA	NA	NA	NA
11/22/2007	0.11	---	---	---	NA	NA	NA	NA
11/25/2007	0.12	---	---	---	NA	NA	NA	NA
11/26/2007	0.09	---	---	---	NA	NA	NA	NA
12/15/2007	**1.12**	---	---	---	**3.00**	**0.38**	**0.07**	**0.02**
12/16/2007	0.07	---	---	---	NA	NA	NA	NA
12/21/2007	0.30	6.93	0.04	0.00	NA	NA	NA	NA
12/23/2007	0.22	4.25	0.05	0.01	NA	NA	NA	NA
12/26/2007	**0.48**	**9.00**	**0.05**	**0.01**	**0.00**	**0.40**	**0.06**	**0.00**
12/28/2007	**0.60**	**10.38**	**0.06**	**0.02**	**0.00**	**0.35**	**0.15**	**0.00**
12/29/2007	0.06	0.13	0.41	0.01	NA	NA	NA	NA
12/30/2007	**0.93**	**13.18**	**0.07**	**0.01**	**2.63**	**0.37**	**0.07**	**0.03**
1/10/2008	0.17	2.35	0.07	0.02	NA	NA	NA	NA
1/11/2008	0.10	2.18	0.05	0.00	NA	NA	NA	NA
1/17/2008	0.90	13.72	0.07	0.01	NA	NA	NA	NA
1/19/2008	0.29	8.48	0.03	0.00	NA	NA	NA	NA
1/23/2008	0.12	14.07	0.01	0.00	NA	NA	NA	NA
1/30/2008	0.09	3.98	0.02	0.00	NA	NA	NA	NA
1/31/2008	0.04	0.40	0.10	0.00	NA	NA	NA	NA
2/1/2008	**1.15**	**12.07**	**0.10**	**0.02**	**2.63**	**0.45**	**0.04**	**0.02**
2/6/2008	0.11	6.60	0.02	0.01	NA	NA	NA	NA
2/12/2008	0.08	12.07	0.01	0.01	NA	NA	NA	NA
2/13/2008	0.51	19.93	0.03	0.04	NA	NA	NA	NA

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Table 1. Continued summary of Precipitation Evemts, Water Table Response, Estimated η and corrected and uncorrected infiltration rates from March 25, 2007 to June 1, 2009.

Date	Rainfall Total (Inches)	Duration (Hours)	Average Intensity (Inches/Hour)	Peak 5 min Intensity (Inches/Hour)	Water Table Response (Inches)	Porosity (η)	Uncorrected Infiltration Rate (Inches/Hour)	Corrected Infiltration Rate (Inches/Hour)
2/17/2008	0.08	1.30	0.06	0.00	NA	NA	NA	NA
2/18/2008	0.03	3.03	0.01	0.00	NA	NA	NA	NA
2/22/2008	0.39	16.23	0.02	0.00	NA	NA	NA	NA
2/26/2008	0.39	1.87	0.21	0.03	NA	NA	NA	NA
3/4/2008	**1.36**	**7.45**	**0.18**	**0.02**	**3.19**	**0.46**	**0.07**	**0.03**
3/8/2008	0.50	24.82	0.02	0.01	NA	NA	NA	NA
3/16/2008	**1.24**	**13.67**	**0.09**	**0.03**	**2.74**	**0.46**	**0.06**	**0.03**
3/19/2008	**0.66**	**2.18**	**0.30**	**0.03**	**2.39**	**0.28**	**0.05**	**0.01**
3/31/2008	0.17	20.35	0.01	0.00	NA	NA	NA	NA
4/1/2008	0.06	4.30	0.01	0.00	NA	NA	NA	NA
4/2/2008	0.02	0.93	0.03	0.00	NA	NA	NA	NA
4/3/2008	0.35	9.13	0.04	0.01	NA	NA	NA	NA
4/4/2008	0.44	15.28	0.03	0.04	NA	NA	NA	NA
4/5/2008	0.20	14.37	0.01	0.00	NA	NA	NA	NA
4/12/2008	0.20	12.88	0.02	0.01	NA	NA	NA	NA
4/14/2008	0.06	5.78	0.01	0.00	NA	NA	NA	NA
4/26/2008	0.41	3.70	0.11	0.02	NA	NA	NA	NA
4/27/2008	0.36	7.23	0.05	0.05	NA	NA	NA	NA
4/28/2008	**0.85**	**13.58**	**0.06**	**0.03**	**2.24**	**0.38**	**0.08**	**0.03**
5/9/2008	0.07	11.00	0.01	0.00	NA	NA	NA	NA
5/11/2008	0.33	8.13	0.04	0.00	NA	NA	NA	NA
5/16/2008	0.28	10.30	0.03	0.00	NA	NA	NA	NA
5/18/2008	0.09	11.32	0.01	0.01	NA	NA	NA	NA
5/20/2008	0.07	0.52	0.14	0.00	NA	NA	NA	NA
5/24/2008	0.04	1.38	0.03	0.00	NA	NA	NA	NA

Storm events which produce a water level response are highlighted in **bold** and underline

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Table 1. Continued summary of Precipitation Evemts, Water Table Response, Estimated η and corrected and uncorrected infiltration rates from March 25, 2007 to June 1, 2009.

Date	Rainfall Total (Inches)	Duration (Hours)	Average Intensity (Inches/Hour)	Peak 5 min Intensity (Inches/Hour)	Water Table Response (Inches)	Porosity (η)	Uncorrected Infiltration Rate (Inches/Hour)	Corrected Infiltration Rate (Inches/Hour)
5/28/2008	1.06	19.70	0.05	0.04	NA	NA	NA	NA
6/2/2008	0.06	0.27	0.21	0.01	NA	NA	NA	NA
6/5/2008	0.14	1.03	0.14	0.02	NA	NA	NA	NA
6/20/2008	0.12	0.33	0.35	0.01	NA	NA	NA	NA
6/21/2008	0.62	0.62	1.01	0.03	NA	NA	NA	NA
6/22/2008	**1.19**	**3.90**	**0.30**	**0.05**	**2.65**	**0.45**	**0.08**	**0.04**
6/26/2008	0.65	1.63	0.40	0.05	NA	NA	NA	NA
6/30/2008	0.04	0.15	0.26	0.00	NA	NA	NA	NA
7/4/2008	0.31	2.18	0.14	0.02	NA	NA	NA	NA
7/6/2008	0.11	12.73	0.01	0.01	NA	NA	NA	NA
7/6/2008	0.03	1.63	0.02	0.00	NA	NA	NA	NA
7/8/2008	**1.53**	**2.32**	**0.66**	**0.07**	**3.98**	**0.39**	**0.08**	**0.03**
7/11/2008	0.24	---	---	---	NA	NA	NA	NA
7/14/2008	0.65	---	---	---	NA	NA	NA	NA
7/23/2008	0.72	---	---	---	NA	NA	NA	NA
7/28/2008	0.00	---	---	---	NA	NA	NA	NA
7/30/2008	0.07	---	---	---	NA	NA	NA	NA
8/1/2008	0.14	---	---	---	NA	NA	NA	NA
8/13/2008	0.46	---	---	---	NA	NA	NA	NA
8/16/2008	0.40	---	---	---	NA	NA	NA	NA
8/17/2008	0.86	17.82	0.05	0.04	NA	NA	NA	NA
8/25/2008	0.43	5.80	0.07	0.03	NA	NA	NA	NA
8/26/2008	**3.69**	**22.60**	**0.16**	**0.03**	**14.33**	**0.48**	**0.18**	**0.09**
8/27/2008	**2.01**	**20.97**	**0.10**	**0.07**		**0.40**	**0.18**	**0.09**
8/31/2008	**0.57**	**6.72**	**0.08**	**0.06**	**1.79**	**0.40**	**0.10**	**0.04**

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Table 1. Continued summary of Precipitation Evemts, Water Table Response, Estimated η and corrected and uncorrected infiltration rates from March 25, 2007 to June 1, 2009.

Date	Rainfall Total (Inches)	Duration (Hours)	Average Intensity (Inches/Hour)	Peak 5 min Intensity (Inches/Hour)	Water Table Response (Inches)	Porosity (η)	Uncorrected Infiltration Rate (Inches/Hour)	Corrected Infiltration Rate (Inches/Hour)
9/5/2008	0.02	0.95	0.02	0.00	NA	NA	NA	NA
9/8/2008	0.12	0.30	0.39	0.02	NA	NA	NA	NA
9/11/2008	0.80	9.03	0.09	0.03	NA	NA	NA	NA
9/12/2008	0.06	4.67	0.01	0.00	NA	NA	NA	NA
9/16/2008	0.70	4.67	0.15	0.01	NA	NA	NA	NA
9/17/2008	0.09	4.67	0.02	0.00	NA	NA	NA	NA
9/26/2008	**1.54**	**22.08**	**0.07**	**0.01**	**3.34**	**0.46**	**0.08**	**0.04**
9/27/2008	0.24	4.67	0.05	0.00	NA	NA	NA	NA
10/8/2008	0.77	11.12	0.07	0.01	NA	NA	NA	NA
10/9/2008	0.02	10.47	0.00	0.00	NA	NA	NA	NA
10/17/2008	0.44	9.45	0.05	0.01	NA	NA	NA	NA
10/18/2008	0.06	2.00	0.03	0.00	NA	NA	NA	NA
10/24/2008	0.02	4.67	0.01	0.00	NA	NA	NA	NA
10/25/2008	0.17	6.43	0.03	0.00	NA	NA	NA	NA
11/3/2008	0.21	21.52	0.01	0.00	NA	NA	NA	NA
11/13/2008	0.08	12.12	0.01	0.00	NA	NA	NA	NA
11/14/2008	0.59	17.02	0.03	0.00	NA	NA	NA	NA
11/15/2008	0.20	4.67	0.04	0.00	NA	NA	NA	NA
11/24/2008	0.07	5.37	0.01	0.00	NA	NA	NA	NA
11/29/2008	0.26	4.67	0.06	0.00	NA	NA	NA	NA
11/30/2008	**0.98**	**17.08**	**0.06**	**0.01**	**2.77**	**0.38**	**0.06**	**0.02**
12/9/2008	0.02	0.03	0.71	0.00	NA	NA	NA	NA
12/10/2008	0.59	10.65	0.06	0.01	NA	NA	NA	NA
12/11/2008	**1.07**	**23.92**	**0.04**	**0.01**	**4.39**	**0.32**	**0.08**	**0.02**
12/12/2008	0.30	2.92	0.10	0.01	NA	NA	NA	NA

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12/14/2008	0.17	2.75	0.06	0.00	NA	NA	NA	NA
12/20/2008	0.21	6.98	0.03	0.01	NA	NA	NA	NA
12/21/2008	0.13	9.08	0.01	0.01	NA	NA	NA	NA
12/25/2008	0.06	6.88	0.01	0.00	NA	NA	NA	NA
12/27/2008	0.05	5.57	0.01	0.00	NA	NA	NA	NA
12/28/2008	0.08	10.50	0.01	0.00	NA	NA	NA	NA
1/4/2009	**0.53**	**5.47**	**0.10**	**0.01**		**0.40**	**0.30**	**0.00**
1/6/2009	**1.33**	**20.75**	**0.06**	**0.02**	**3.44**	**0.40**	**NC**	**NC**
1/7/2009	**0.29**	**2.37**	**0.12**	**0.03**	**1.66**	**0.44**	**0.11**	**0.05**
1/11/2009	0.09	5.78	0.01	0.01	NA	NA	NA	NA
1/29/2009	0.24	10.70	0.02	0.01	NA	NA	NA	NA
2/3/2009	0.29	15.00	0.02	0.00	NA	NA	NA	NA
2/11/2009	0.15	0.27	0.56	0.02	NA	NA	NA	NA
2/14/2009	0.08	13.47	0.01	0.00	NA	NA	NA	NA
2/15/2009	0.03	0.75	0.04	0.00	NA	NA	NA	NA
2/16/2009	0.23	4.12	0.06	0.00	NA	NA	NA	NA
2/19/2009	0.50	17.48	0.03	0.02	NA	NA	NA	NA
2/27/2009	0.15	3.23	0.05	0.00	NA	NA	NA	NA
2/28/2009	0.86	15.07	0.06	0.00	NA	NA	NA	NA
3/1/2009	**1.39**	**15.08**	**0.09**	**0.01**	**6.45**	**0.22**	**NC**	**NC**
3/2/2009	**0.56**	**2.50**	**0.22**	**0.01**	**0.97**	**0.30**	**0.09**	**0.04**
3/13/2009	0.13	6.50	0.02	0.00	NA	NA	NA	NA
3/14/2009	0.38	15.67	0.02	0.00	NA	NA	NA	NA
3/15/2009	**0.53**	**17.38**	**0.03**	**0.00**	**1.99**	**0.29**	**0.09**	**0.02**
3/17/2009	0.10	10.93	0.01	0.00	NA	NA	NA	NA

Storm events which produce a water level response are highlighted in **bold** and underline

--- = No Data NA = Not Applicable NC = Not Calculated

Table 1. Continued summary of Precipitation Evemts, Water Table Response, Estimated η and corrected and uncorrected infiltration rates from March 25, 2007 to June 1, 2009.

Date	Rainfall Total (Inches)	Duration (Hours)	Average Intensity (Inches/Hour)	Peak 5 min Intensity (Inches/Hour)	Water Table Response (Inches)	Porosity (η)	Uncorrected Infiltration Rate (Inches/Hour)	Corrected Infiltration Rate (Inches/Hour)
3/19/2009	0.20	3.48	0.06	0.00	NA	NA	NA	NA
3/22/2009	0.02	0.18	0.13	0.00	NA	NA	NA	NA
3/25/2009	0.21	13.92	0.02	0.00	NA	NA	NA	NA
3/26/2009	0.14	14.37	0.01	0.01	NA	NA	NA	NA
3/27/2009	0.23	10.55	0.02	0.01	NA	NA	NA	NA
3/28/2009	**0.94**	**8.03**	**0.12**	**0.01**	**2.75**	**0.35**	**0.06**	**0.02**
4/2/2009	0.10	12.88	0.01	0.00	NA	NA	NA	NA
4/11/2009	**0.80**	**19.22**	**0.04**	**0.03**	**1.94**	**0.41**	**0.05**	**0.02**
4/13/2009	0.24	3.43	0.07	0.01	NA	NA	NA	NA
4/14/2009	0.23	13.33	0.02	0.01	NA	NA	NA	NA
4/20/2009	0.57	6.85	0.08	0.02	NA	NA	NA	NA
5/2/2009	0.43	2.37	0.18	0.02	NA	NA	NA	NA
5/4/2009	0.34	4.98	0.07	0.02	NA	NA	NA	NA
5/5/2009	**2.61**	**18.67**	**0.14**	**0.06**	**9.58**	**0.28**	**0.12**	**0.03**
5/6/2009	0.13	5.67	0.02	0.01	NA	NA	NA	NA
5/7/2009	0.06	1.52	0.05	0.00	NA	NA	NA	NA
5/11/2009	0.15	11.95	0.01	0.01	NA	NA	NA	NA
5/17/2009	0.33	14.95	0.02	0.00	NA	NA	NA	NA
5/24/2009	**0.70**	**12.43**	**0.06**	**0.02**	**0.52**	**0.29**	**0.02**	**0.00**
5/25/2009	0.24	2.43	0.10	0.01	NA	NA	NA	NA
5/28/2009	0.34	6.18	0.05	0.02	NA	NA	NA	NA

Storm events which produce a water level response are highlighted in **bold** and underline

--- = No Data NA = Not Applicable

Figure 1

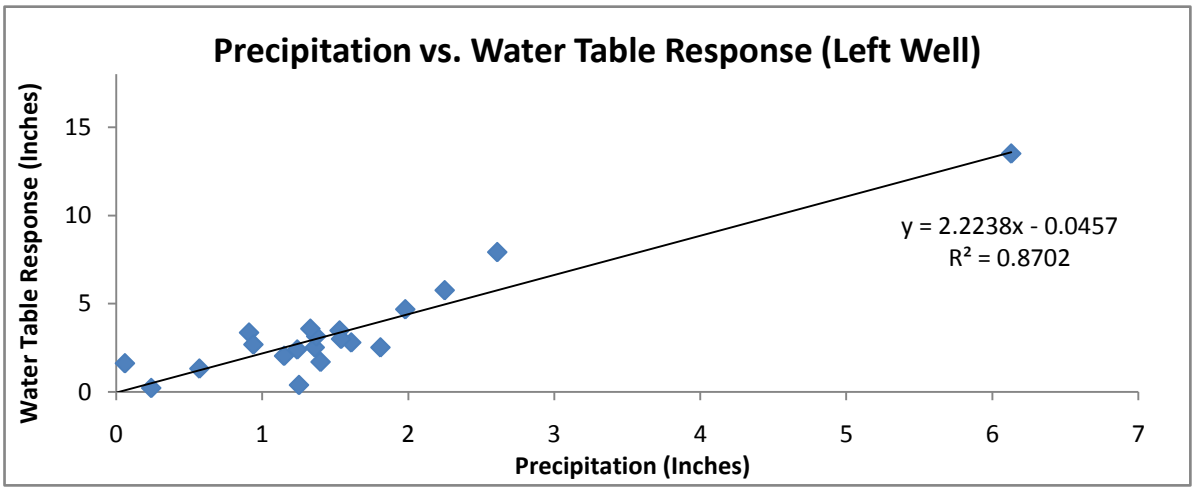


Figure 2

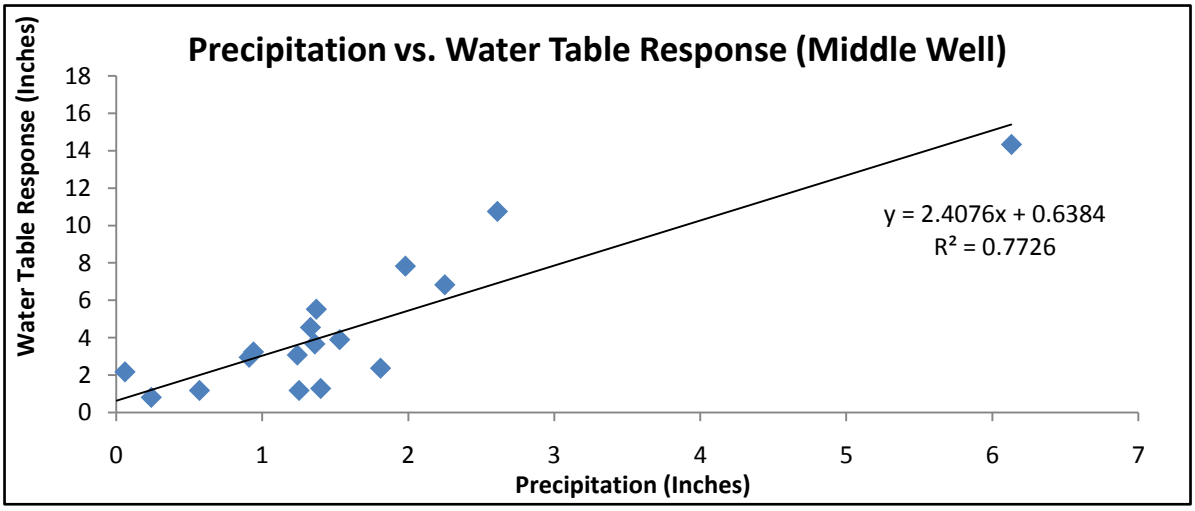
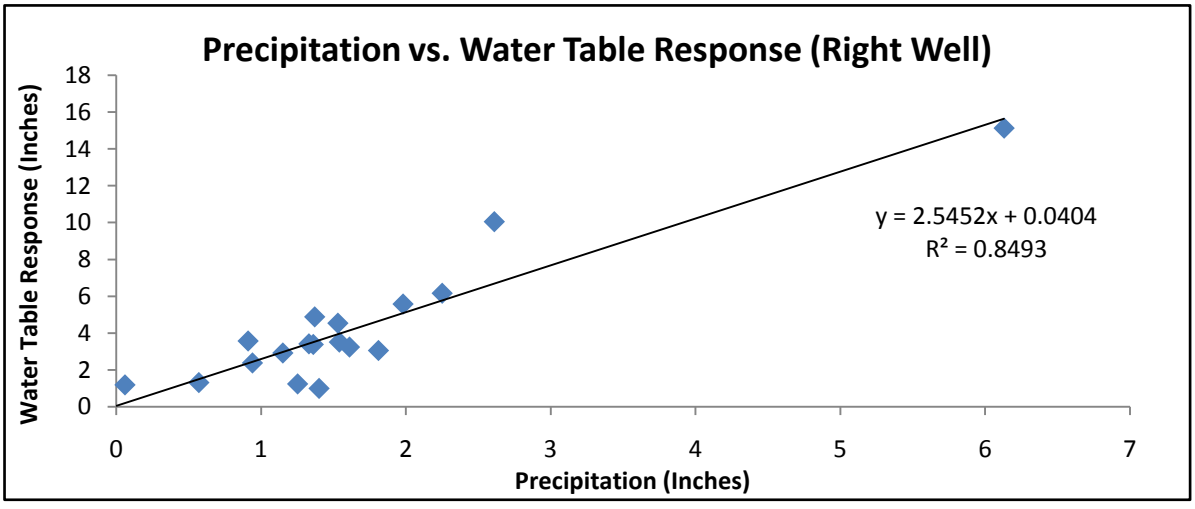


Figure 3



wet conditions for this site (C. Estes personnel communications). The highest measured IR_u was 0.585 inches/hour (this range (0.06-0.09 inches/hour) reported by C. Estes under semi dry and wet conditions for this site (C. Estes personnel communications). The highest measured IR_u was 0.585 inches/hour (this includes a portion of the August 26-27 2008 where overflow drainage likely occurred) and the minimum measured was 0.020 inches/hour. The average corrected infiltration rate IR_c for the dataset is 0.036 inches/hour ± 0.029 inches/hour, excluding the 5.70" event overflow. The highest measured IR_c was 0.15 inches/hour and the minimum measured was 0.005 inches/hour. From the average IR_c it is estimated that it would take approximately 27.8 hours to infiltrate a 1" rainstorm from the structure. Estimated water table responses and drainage times to 1, 2, 10 and 100 year 24 hour rainfall events are presented in Table 2. In this analysis we use the lower (0.38) and upper (0.40) estimates for our porosity (η) values. To estimate the drainage time we use the average uncorrected infiltration rate (IR_u) 0.105 inches/hour. Note that the 18" crushed rock storage reservoir is estimated to accommodate all rainfall porosity combinations except for the 100 year event in combination with the lower porosity limit where overflow drainage could be expected to occur.

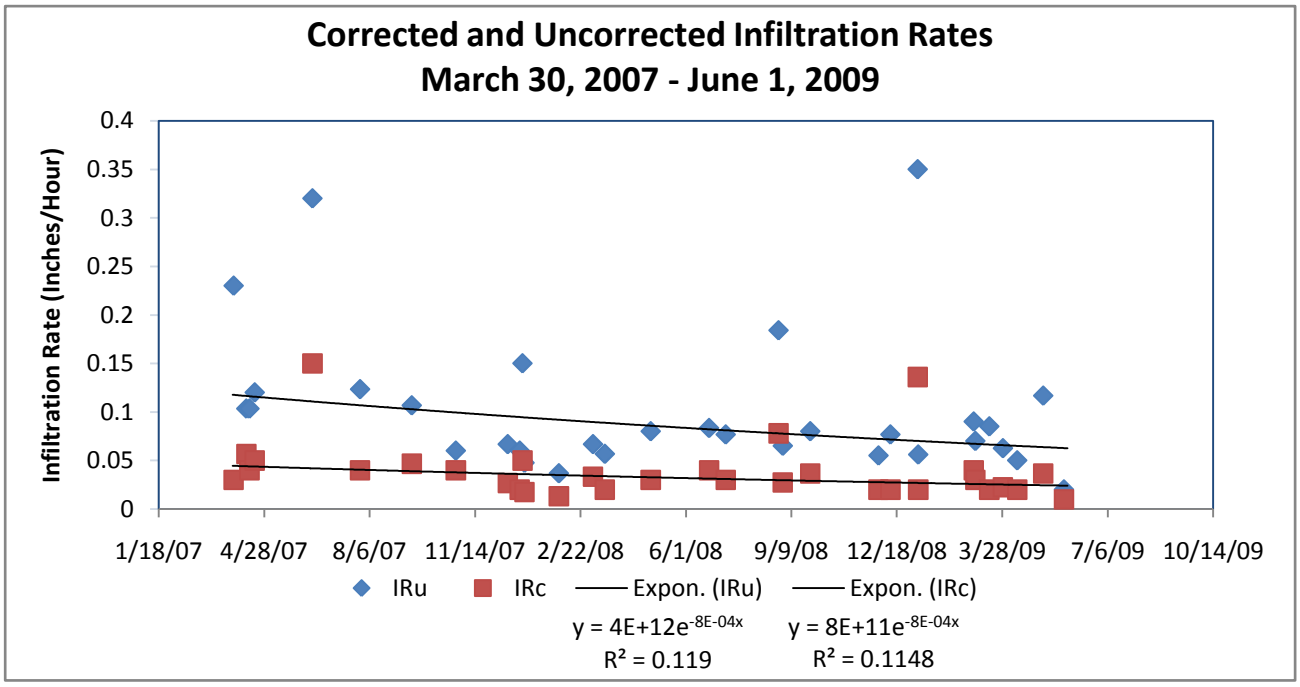
Table 2. Estimated water table responses and infiltration times for 1" and 1, 2, 10, and 100 year 24 hour rainfall events.

Return Interval	Depth	Water Level Response	Infiltration Time (Hours)
<1 year	1.00"	2.5"-2.63"	23.8 - 25.0
1 year	2.58"	6.45"-6.79"	61.4 - 64.7
2 year	3.12"	7.8"-8.2"	74.3 - 78.1
10 year	4.80"	12"-12.6"	114.3 – 120.0
100 year	6.96"	17.4"-18.3"	165.7 – 174.3

Of central importance to the study is to obtain some measure of the long term performance of the porous pavement BMP. Of particular interest is whether any change in the infiltration capacity of the pavement is occurring over time or whether the infiltration capacity of the underlying subsoil is declining. At present we can detect no change in the rainfall water table response and therefore have no indication that the infiltration capacity of the porous pavement surface is declining. We did note in fall 2007 that in several places the upper surface of the porous pavement was degrading through the process of "raveling". At present this appears to be confined to the surface layers of the pavement and is estimated to have impacted less than 10% of the surface. These observations were communicated to City officials in fall 2007. In terms of declines in infiltration capacity there is some suggestion that the infiltration rate of the underlying subsoil may be declining over time (Figure 4). At present there is still considerable scatter in the estimated infiltration rates and the ranges if infiltration rates exhibit overlap over time.

A few of the outliers in Figure 4 can explain some of the scatter that is occurring. The first outlier shown represents the (IR_u) of 0.23 inches/hour for a 0.06" rainfall that occurred on 3/30/07. The small amount of precipitation caused a half inch rise within the wells. The second event on 6/12/07 had a water level response of 1.50" to 0.69" of rainfall and only took approximately two hours to

Figure 4



infiltrate into the subsoil. The short duration of infiltration is the cause for the high infiltration rate. The third outlier is for the biggest storm event of the study with approximately 5.70" of rainfall within two days starting 8/26/08. This event caused an average water level rise of 14.63". Our survey data indicates that this is below the elevation of the overflow outflow pipes. It is possible that stored water exited the system via undocumented leakage from the structure below the overflow pipes inlet which led to a higher infiltration rate for the early part of this event. The fourth outlier represents a storm event that occurred on 1/6/09 where 1.33" of rainfall occurred. There was a well rise response of 3.44" – however, the infiltration duration was interrupted by a 0.29" storm event the following day resulting in an extremely short period over which infiltration was estimated. The overall (IR_u) and IR_c for the two events are 0.06 inches/hour and 0.02 inches/hour respectively.

Water Quality Data

Water quality data of each bulk precipitation and reservoir sample (Left, Middle, and Right Wells) collected for each precipitation event monitored from March 27, 2007 to June 1, 2009 are summarized below in Tables 3-6. There were 81 Bulk Precipitation samples collected and 47 Reservoir event samples (average of Left, Middle, Right Wells) collected. An overall load of atmospheric deposition on site between significant rain events was determined by finding the sum of the Bulk Precipitation samples that did not have a reservoir response. Tables 7 and 8 summarize the bulk precipitation load and the reservoir concentrations in kg/m^3. The change in the concentrations between the bulk precipitation and the reservoir is presented in Table 9. A visual comparison using box-whisker plots displaying the differences between the bulk precipitation and the reservoir for each chemical component are shown in Figures 5-12.

Note that the Reservoir always exhibits increased conductivity compared to bulk precipitation. Possible sources of ionic materials that might lead to this increase include the washoff of dry deposition and automobile and pet source materials from the pavement surface, dissolution of the pavement itself and mobilization of dissolved ions from the reservoir itself. Inspection of major cation data not reported indicate increased Ca^{2+}, Mg^{2+}, Na^{+} levels suggesting a pavement or reservoir source of material. The stormwater pH becomes less acidic in the reservoir most likely due to the reaction between precipitation and the lime that has been used within the Portland cement in the pavement surface and/or it becomes neutralized within the crushed rock reservoir itself. Of all the components shown, it does appear that ammonium NH_4^+ may be oxidizing within the reservoir and converting to into Nitrate NO_3-N. The other compounds do not appear to have consistent differences between the bulk precipitation concentrations and the reservoir. In Table 9, the percent difference in change is shown for individual rainfall events. Reservoir conductivity, pH, Cl^-, and NO_3-N typically increase within the reservoir over levels in precipitation for each event, but there is no indication that there is an accumulation of dissolved material over time. Ammonium NH_4^+ is shown in Table 9 to consistently decrease in the reservoir compared to the bulk precipitation sample.

It appears that there are minimal additional contributions of Cl or the nutrients measured in this study beyond what is contributed to the parking surface by atmospheric deposition. The water quality treatment is minimal for this site since there is no offsite NPS runoff running onto the permeable pavement structure. It is quite possible that if the measurement of other water quality constituents such as oil & grease and metals were included in this study some contribution from vehicles and human activities on the pavement surface might have been detected. An important result that has been determined from the study thus far is that there does not appear to be an accumulation of compounds within the structure suggesting that it passes through to the subsoil instead of accumulating within the reservoir.

Table 3. Bulk Precipitation Water Quality Results

Date	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
4/16/07	17.0	5.11	0.49	0.48	0.12	1.44	0.03	0.68
5/17/07	38.9	5.73	1.60	0.72	0.84	9.85	0.22	1.31
6/4/07	15.7	4.91	0.67	0.28	0.26	0.17	0.04	0.29
6/12/07	23.8	3.12	0.33	1.58	0.26	0.87	0.05	0.36
7/12/07	46.1	4.10	---	3.80	---	2.44	---	3.65
8/31/07	45.5	5.00	1.09	0.55	0.01	0.01	0.05	0.57
9/15/07	0.0	5.23	1.14	0.66	0.16	0.23	0.01	0.25
10/21/07	15.6	5.62	1.55	0.53	0.15	0.08	0.00	1.62
10/24/07	11.3	4.98	16.47	1.08	1.36	0.15	0.21	0.17
10/26/07	8.3	5.52	0.21	0.41	0.13	0.21	0.00	0.15
11/27/07	35.7	5.23	3.25	4.02	0.60	0.80	0.31	1.81
12/16/07	6.3	5.03	0.30	0.47	0.15	0.19	0.01	0.14
12/26/07	4.9	4.56	0.12	0.24	0.08	0.06	0.01	0.12
12/31/07	7.4	5.18	0.47	0.32	0.11	0.15	<DL	0.12
1/12/08	14.6	6.12	0.48	0.92	0.24	0.48	0.01	0.17
1/23/08	32.1	4.62	8.76	0.97	0.38	0.50	0.04	0.19
1/30/08	24.3	5.73	0.77	0.82	0.30	0.40	0.00	0.19
2/1/08	12.9	5.63	0.87	0.51	0.47	0.30	0.00	0.13
2/7/08	31.9	5.40	0.94	0.94	0.42	0.37	0.01	0.25
2/14/08	12.8	6.25	0.39	0.59	0.24	0.31	<DL	0.16
2/19/08	56.5	5.75	1.74	4.74	0.54	2.19	0.87	3.64
2/24/08	40.3	5.62	0.94	1.30	0.27	0.15	0.01	0.34
2/27/08	16	5.46	0.29	0.75	0.30	0.38	<DL	0.21
3/5/08	11.7	5.62	0.63	1.42	0.08	0.34	0.23	1.14
3/9/08	13.8	5.66	0.26	0.81	0.28	0.43	<DL	0.18
3/16/08	19.5	6.85	0.11	0.72	0.17	0.53	0.02	0.21
3/20/08	27.5	7.09	1.00	0.62	0.14	0.32	<DL	0.33
			--- = No Data	<DL = Below Detectable Levels				

Table 3. Continued Bulk Precipitation Water Quality Results

Date	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
4/2/08	25.3	6.26	0.99	1.46	0.36	0.68	<DL	0.32
4/4/08	19.8	6.15	0.27	1.75	0.37	0.61	<DL	0.87
4/6/08	14.6	6.31	0.39	0.57	0.16	0.22	<DL	0.25
4/14/08	68.5	6.22	1.36	5.78	0.34	3.19	0.48	3.64
4/28/08	---	6.26	0.30	0.35	0.14	<DL	0.06	0.29
4/29/08	200	6.69	1.18	0.67	0.28	<DL	0.05	0.54
5/9/08	92.3	5.68	2.88	4.92	3.41	0.41	<DL	1.28
5/12/08	17.8	5.79	0.09	0.60	0.20	0.13	<DL	0.28
5/19/08	31.1	5.99	0.78	1.26	0.57	0.79	0.02	0.19
5/22/08	21.8	5.74	0.42	1.60	0.54	0.93	0.06	0.47
5/30/08	23.5	5.81	2.38	1.03	0.52	0.03	0.03	0.60
6/12/08	43.4	6.40	0.56	3.00	1.21	1.26	0.12	1.25
6/23/08	17.4	4.10	0.20	0.93	0.38	0.56	0.01	0.10
7/9/08	19.3	5.93	0.16	1.87	0.24	1.06	0.14	0.63
7/11/08	32.5	5.63	1.46	1.72	0.66	0.00	0.04	0.27
7/14/08	13.7	3.97	0.11	0.67	0.19	0.53	0.00	0.16
7/23/08	17.4	4.60	0.19	1.23	0.43	0.36	0.03	0.38
7/30/08	19.3	5.74	0.32	1.02	0.38	0.10	0.00	0.18
8/1/08	27.7	6.00	0.42	1.20	0.52	0.19	0.00	0.27
8/13/08	83.1	5.73	2.27	10.12	0.51	4.32	1.34	---
8/16/08	1.5	4.59	1.15	3.13	0.68	0.88	0.11	0.74
8/17/08	13.6	4.11	0.09	0.85	0.35	0.33	0.00	0.02
8/26/08	11.3	4.79	0.20	1.00	0.09	0.00	0.07	0.44
8/28/08	66.5	4.79	0.13	0.43	0.08	0.04	0.01	0.12
9/2/08	18.5	5.49	0.15	1.86	0.41	1.50	0.08	0.44
9/11/08	9.1	5.68	0.22	0.52	0.19	0.27	0.04	0.21
9/14/08	38.8	5.71	---	---	---	---	---	1.25
9/19/08	13.5	4.61	0.29	0.94	0.38	0.67	0.00	0.29

--- = No Data <DL = Below Detectable Levels

Table 3. Continued Bulk Precipitation Water Quality Results

Date	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
10/8/08	15.2	3.97	0.28	1.21	0.54	0.87	0.03	0.15
10/11/08	11.5	5.72	1.08	0.97	0.24	0.81	0.06	0.51
10/26/08	17.4	5.03	2.45	0.74	0.15	0.14	0.01	0.18
11/15/08	8.4	4.46	0.53	0.41	0.15	0.20	0.00	0.11
11/25/08	26.7	4.52	0.60	0.94	0.42	0.49	0.00	0.19
12/1/08	6.2	4.25	0.11	0.33	0.12	0.12	0.00	-0.02
12/12/08	6.5	4.38	0.52	0.25	0.09	0.08	0.00	0.00
12/19/08	62	3.94	0.85	1.87	0.93	0.97	0.05	0.35
12/25/08	14.7	4.95	1.33	0.81	0.34	0.50	0.00	0.04
12/27/08	1.5	5.48	0.99	1.42	0.43	1.34	0.00	0.09
12/30/08	2.5	5.96	3.34	1.55	0.47	1.63	0.02	0.26
1/7/09	11.9	6.29	0.29	0.31	0.09	0.27	0.00	0.02
1/11/09	27.3	6.15	0.75	1.05	0.37	0.86	0.00	0.12
1/30/09	34.2	5.46	3.32	2.54	1.02	2.48	0.01	0.24
2/4/09	87.2	5.83	2.14	1.20	0.00	0.17	0.00	1.14
2/13/09	18.1	5.74	1.62	0.99	0.34	0.77	0.00	0.27
2/17/09	27.5	5.73	0.29	1.44	0.54	1.08	0.01	0.19
2/20/09	11.2	5.74	8.45	0.54	0.38	0.19	0.04	0.13
3/2/09	5.5	6.13	0.45	0.29	0.23	0.23	0.01	0.04
3/17/09	22.2	5.13	0.85	2.14	0.44	1.43	0.20	1.10
3/26/09	21.8	4.74	0.31	1.93	0.89	1.26	0.03	0.24
3/30/09	13.5	5.41	0.90	0.91	0.31	0.58	0.07	0.37
4/5/09	1.1	4.78	0.64	3.95	0.37	4.15	0.41	3.04
4/11/09	26.7	4.88	0.68	1.88	0.30	1.71	0.15	0.71
4/23/09	56.9	4.93	3.16	6.39	0.60	0.14	0.31	3.76
5/7/09	7.3	4.44	0.01	0.14	1.02	0.19	0.00	0.23

Table 4. Left Well Reservoir Water Quality Results

Date	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
12/31/07	141	6.81	0.53	0.57	0.33	0.00	0.03	0.45
2/1/08	194.5	6.43	16.66	1.51	1.31	0.11	0.21	0.80
3/5/08	129	6.69	0.84	1.23	0.42	<DL	0.07	0.56
3/16/08	185.7	6.94	0.96	1.04	0.63	<DL	0.02	0.35
6/23/08	191	6.25	2.03	2.71	2.46	0.00	0.09	0.28
7/9/08	139.1	6.32	1.08	1.50	1.26	0.08	0.06	0.33
8/28/08	93.8	6.03	0.56	0.52	0.29	0.02	0.04	0.20
9/27/08	1.2	6.32	0.64	1.16	0.98	0.00	0.06	0.33
12/12/08	115.6	6.20	0.76	0.54	0.40	0.00	0.04	0.22
1/7/09	105.6	6.10	3.13	1.53	1.00	0.00	0.17	0.61
3/2/09	90.2	6.30	0.20	0.20	0.13	0.00	0.01	0.19
5/7/09	3.2	5.71	0.03	0.24	15.63	1.58	4.87	0.09

<DL = Below Detectable Levels

Table 5. Middle Well Reservoir Water Quality Results

Date	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
4/16/07	159.2	6.83	0.44	0.42	0.16	0.31	<DL	0.17
9/15/07	0.4	6.27	1.07	1.15	0.58	0.15	<DL	0.18
10/26/07	218	6.64	0.77	1.05	0.64	0.00	<DL	0.05
12/31/07	108.8	6.44	0.44	0.27	0.17	0.00	0.01	0.18
1/20/08	128.2	6.48	0.50	0.43	0.22	0.00	<DL	0.08
2/1/08	147.4	6.23	3.43	0.52	0.33	<DL	<DL	0.14
3/5/08	162.5	6.76	0.61	1.15	0.25	<DL	<DL	0.18
3/16/08	122.7	6.81	0.42	0.49	0.29	<DL	<DL	0.14
3/20/08	172	7.02	0.50	0.66	0.37	<DL	<DL	0.12
4/6/08	152.2	6.76	0.84	0.86	0.57	<DL	<DL	0.20
4/29/08	92.9	6.15	0.96	0.82	0.49	<DL	0.03	0.27
6/23/08	206	6.50	0.53	0.85	0.68	0.00	0.00	0.06
7/9/08	175.2	6.90	0.43	0.63	0.47	0.00	0.00	0.14
8/28/08	96.3	6.41	0.74	0.54	0.38	0.00	0.01	0.06
9/27/08	0.4	6.58	0.48	0.55	0.39	0.00	---	0.13
12/12/08	196.4	6.51	0.75	0.25	0.17	0.00	0.00	0.05
1/7/09	123.1	6.38	0.98	0.32	0.22	0.00	0.00	0.04
		--- = No Data		<DL = Below Detectable Levels				

Table 6. Right Well Reservoir Water Quality Results

Date	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
4/16/07	169.0	6.69	0.98	0.98	0.49	<DL	<DL	0.33
9/15/07	155.7	6.21	1.80	1.42	0.75	0.20	0.04	0.51
10/26/07	131.1	6.25	1.87	1.95	1.11	0.06	0.16	1.05
12/16/07	119.3	6.14	3.16	1.52	0.40	0.20	0.16	0.82
12/31/07	78.3	6.92	0.98		0.18	0.00	0.20	1.02
1/20/08	51.7	6.33	---	---	---	---	---	---
2/1/08	69.8	6.22	6.66	1.37	0.36	0.03	0.40	2.07
3/5/08	83.4	6.43	0.56	2.07	0.23	0.58	0.10	0.63
3/16/08	98.7	6.76	0.54	1.40	0.81	<DL	0.09	0.55
3/20/08	6.75	134.50	1.07	1.81	1.13	<DL	0.07	0.58
6/23/08	122	7.03	2.82	1.69	1.44	0.00	0.14	0.49
7/9/08	97	6.98	1.44	1.22	0.86	0.00	0.16	0.72
8/28/08	52.1	7.21	0.71	0.49	0.29	0.00	0.11	0.45
9/27/08	84.4	6.72	1.62	0.69	0.22	0.00	0.16	0.72
12/12/08	83.4	6.57	2.49	0.48	0.15	0.00	0.19	0.43
1/7/09	12.3	6.10	3.71	1.17	0.10	0.00	0.23	0.91
3/2/09	34.8	6.26	0.08	0.25	0.00	0.00	0.01	0.36
5/7/09	59.5	5.72	0.06	0.15	6.40	1.04	2.12	0.23

--- = No Data <DL = Below Detectable Levels

Table 7. Bulk Precipitation Load Summary

Date	Conductivity (µs/cm)	pH	Cl^- (kg/m3)	TN	NO_3-N (kg/m3)	NH_4^+-N (kg/m3)	PO_4-P (kg/m3)	TP (PO_4-3) (kg/m3)
4/16/07	17.0	5.11	0.00	0.00	0.00	0.00	0.00	0.00
9/15/07	28.3	4.68	0.05	0.12	0.01	0.09	0.00	0.09
10/26/07	11.7	5.37	0.21	0.03	0.02	0.01	0.00	0.02
12/16/07	21.0	5.13	0.02	0.03	0.01	0.01	0.00	0.01
12/31/07	6.2	4.87	0.01	0.01	0.00	0.01	0.00	0.01
1/20/08	14.6	6.12	0.00	0.00	0.00	0.00	0.00	0.00
2/1/08	23.1	5.33	0.02	0.02	0.00	0.01	0.00	0.00
3/4/08	28.2	5.68	0.03	0.07	0.01	0.02	0.01	0.04
3/15/08	16.7	6.26	0.00	0.02	0.01	0.02	0.00	0.01
3/19/08	27.5	7.09	0.01	0.01	0.00	0.00	0.00	0.00
4/6/08	19.9	6.24	0.01	0.03	0.01	0.01	0.00	0.01
4/29/08	200.0	6.48	0.03	0.04	0.01	0.02	0.00	0.03
7/9/08	19.3	5.93	0.00	0.05	0.01	0.03	0.00	0.02
8/27/08	28.7	5.00	0.06	0.25	0.04	0.06	0.02	0.05
9/27/08	16.9	5.26	0.01	0.05	0.02	0.03	0.00	0.02
12/12/08	13.1	4.62	0.04	0.04	0.02	0.02	0.00	0.00
1/7/09	18.5	5.32	0.02	0.02	0.01	0.02	0.00	0.00
3/2/09	30.1	5.83	0.13	0.05	0.02	0.04	0.00	0.01
5/7/09	21.4	4.90	0.08	0.17	0.09	0.09	0.01	0.10

Table 8. Reservoir Load Summary

Date	Conductivity (µs/cm)	pH	Cl^- (kg/m3)	TN	NO_3-N (kg/m3)	NH_4^+-N (kg/m3)	PO_4-P (kg/m3)	TP (PO_4-3) (kg/m3)
4/16/07	164.1	6.76	0.00	0.00	0.00	0.00	0.00	0.00
9/15/07	78.1	6.24	0.04	0.04	0.02	0.01	0.00	0.01
10/26/07	174.6	6.45	0.03	0.03	0.02	0.00	0.00	0.01
12/16/07	119.3	6.14	0.06	0.03	0.01	0.00	0.00	0.02
12/31/07	109.4	6.72	0.02	0.01	0.01	0.00	0.00	0.02
1/20/08	90.0	6.41	0.01	0.00	0.00	0.00	0.00	0.00
2/1/08	137.2	6.29	0.21	0.03	0.02	0.00	0.00	0.02
3/4/08	125.0	6.63	0.02	0.04	0.01	0.00	0.00	0.01
3/15/08	135.7	6.84	0.01	0.02	0.01	0.00	0.00	0.01
3/19/08	153.3	6.89	0.01	0.01	0.01	0.00	0.00	0.00
4/6/08	152.2	6.76	0.02	0.02	0.01	0.00	0.00	0.00
4/29/08	92.9	6.15	0.03	0.02	0.01	0.00	0.00	0.01
7/9/08	137.1	6.73	0.03	0.03	0.02	0.00	0.00	0.01
8/27/08	80.7	6.55	0.08	0.06	0.04	0.00	0.01	0.03
9/27/08	28.7	6.54	0.03	0.03	0.02	0.00	0.00	0.01
12/12/08	131.8	6.43	0.05	0.02	0.01	0.00	0.00	0.01
1/7/09	80.3	6.19	0.10	0.04	0.02	0.00	0.01	0.02
3/2/09	62.5	6.28	0.01	0.01	0.00	0.00	0.00	0.01
5/7/09	68.9	5.80	0.00	0.01	0.82	0.09	0.27	0.01

Table 9. Percent Change in Concentration from Bulk Precipitation to Reservoir

Date	Conductivity (µs/cm) % Change	pH	Cl^- (kg/m3) % Change	TN % Change	NO_3-N (kg/m3) % Change	NH_4^+-N (kg/m3) % Change	PO4-P (kg/m3) % Change	TP (PO_4^{-3}) (kg/m3) % Change
4/16/07	*-865.3	**-1.65	-44.9	-45.8	-170.8	89.2	100.0	63.2
9/15/07	-175.5	-1.56	11.9	69.1	-109.8	94.1	62.4	88.4
10/26/07	-1387.6	-1.07	86.2	-30.4	3.6	90.5	29.3	50.0
12/16/07	-468.1	-1.01	-247.5	-24.2	-52.4	41.2	-134.9	-103.7
12/31/07	-1678.3	-1.85	-38.3	34.4	-106.1	100.0	0.0	-217.1
1/20/08	-516.1	-0.29	-131.3	-3.8	-103.6	100.0	100.0	100.0
2/1/08	-494.1	-0.97	-933.4	-71.8	-1068.5	87.6	-5423.9	-521.4
3/4/08	-343.1	-0.94	48.2	45.5	23.2	76.8	81.3	72.8
3/15/08	-715.0	-0.58	-198.6	6.5	-104.2	100.0	-83.3	-22.8
3/19/08	-457.3	0.21	21.5	-99.2	-435.7	100.0	0.0	-6.1
4/6/08	-664.8	-0.52	-139.2	42.3	-74.4	100.0	0.0	71.5
4/29/08	53.6	0.32	2.0	43.2	-82.9	100.0	77.2	73.1
7/9/08	-610.4	-0.80	-514.6	40.3	-259.7	97.5	47.6	37.0
8/27/08	-181.7	-1.56	-25.8	76.5	0.4	98.8	67.5	48.7
9/27/08	-69.6	-1.28	-145.6	45.9	-6.3	100.0	-72.7	20.6
12/12/08	-903.9	-1.81	-9.6	65.5	49.4	100.0	-471.6	-86.3
1/7/09	-333.8	-0.87	-315.1	-60.1	-97.4	100.0	-2227.0	-638.6
3/2/09	-107.3	-0.45	94.6	77.2	86.4	100.0	48.0	-13.1
5/7/09	-222.6	-0.90	97.5	91.3	-764.5	-8.9	-2431.4	89.3

* A positive % change means the Reservoir sample shows a decrease in concentration in relation to bulk precipitation values

** A negative % change means the Reservoir sample shows an increase beyond bulk precipitation inputs

Figure 5

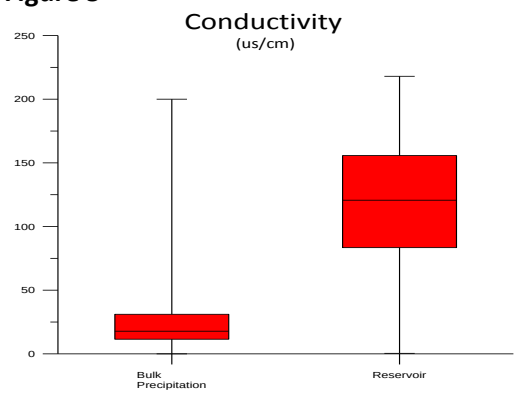


Figure 6

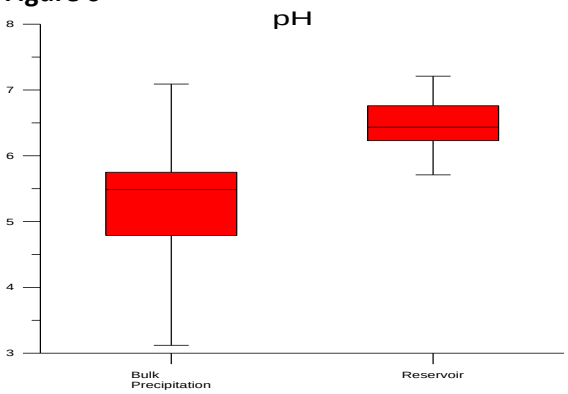


Figure 7

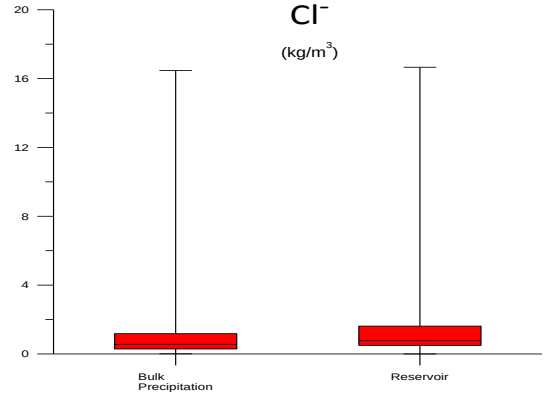


Figure 8

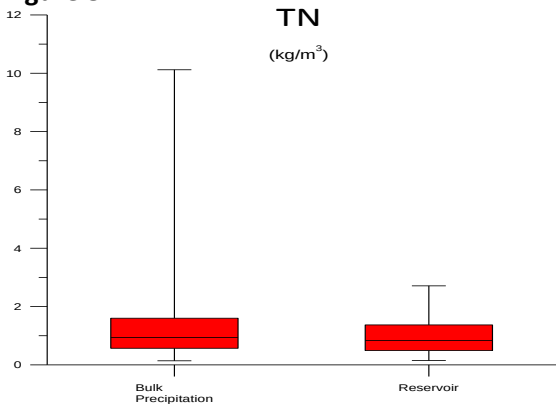


Figure 9

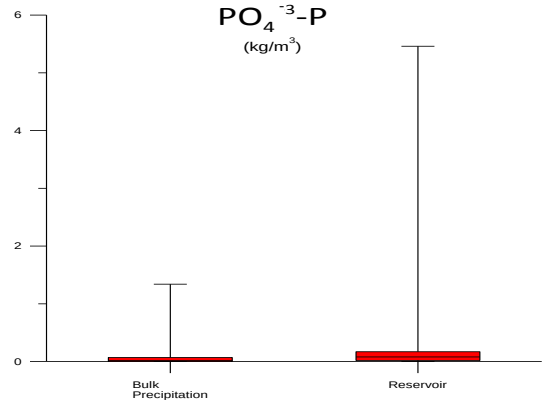


Figure 10

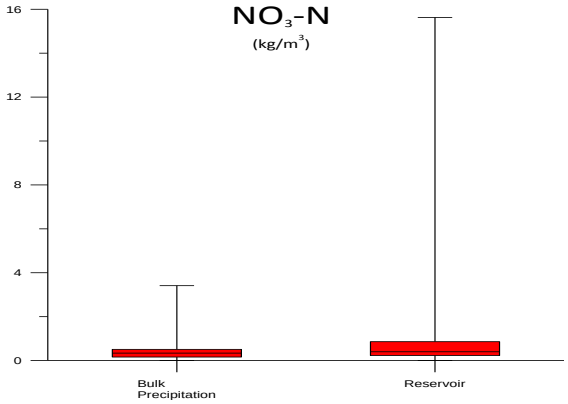


Figure 11

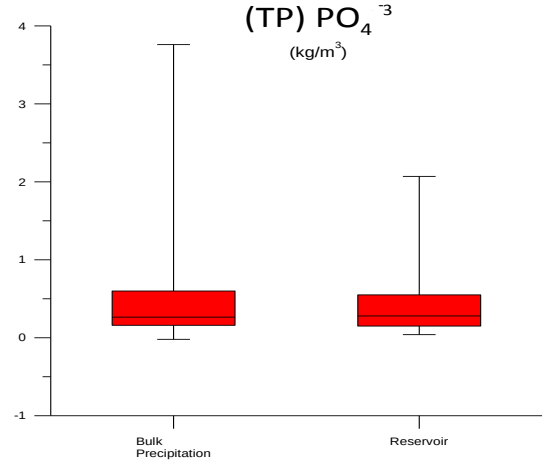
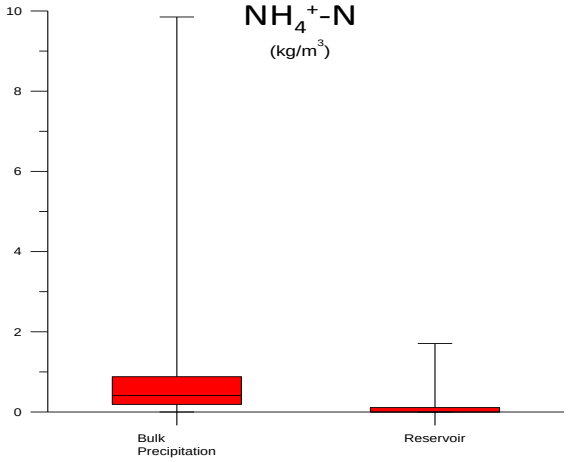


Figure 12



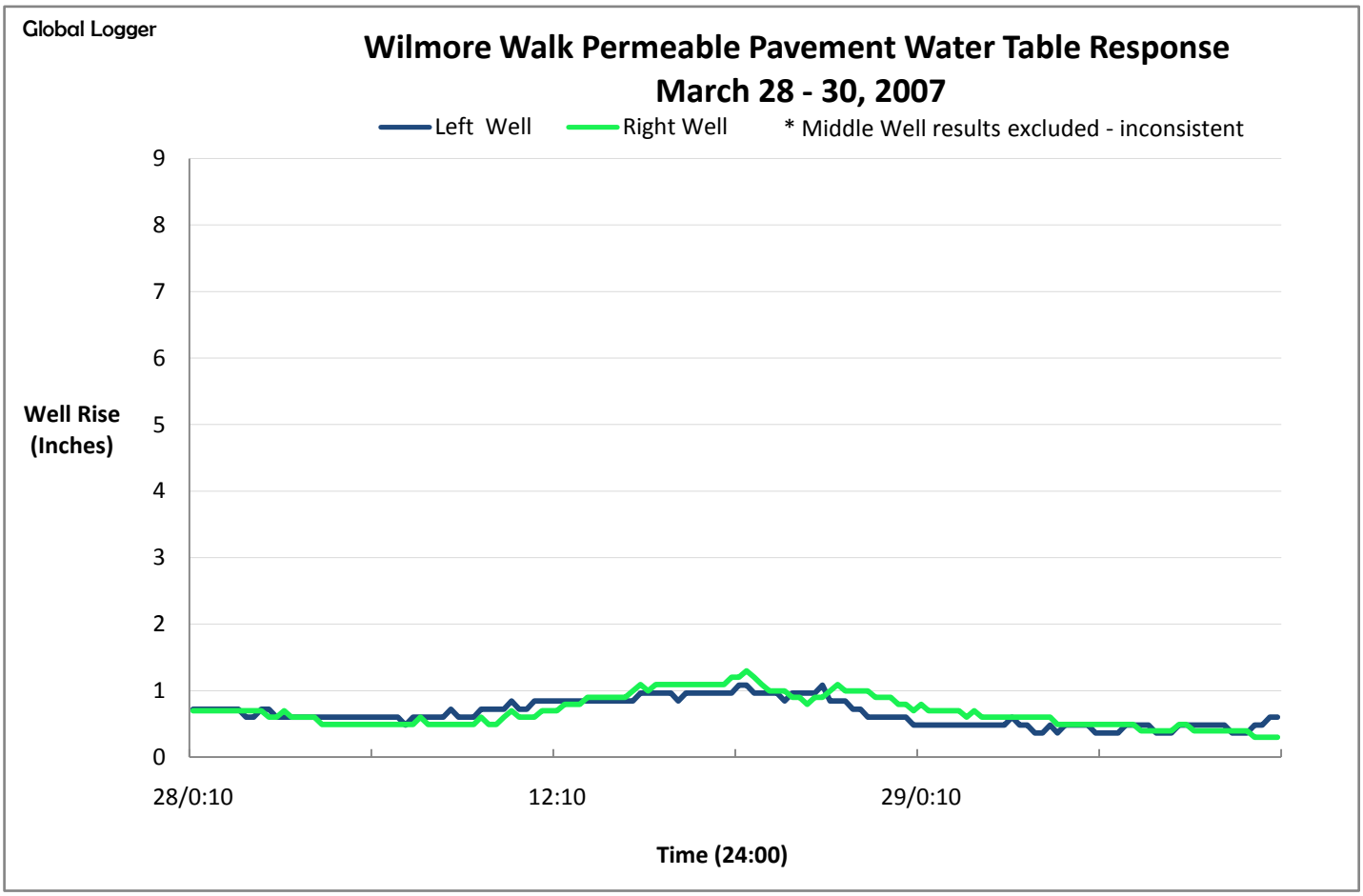
Conclusions

The study of the permeable structure at Wilmore Walk has indicated there may be a slight decline in the infiltration performance of the subsoil below the structure. More long term data would be necessary to determine if the infiltration capacity of the soil will decline further or if it has leveled off.

We have determined the estimated porosity (η) of the crushed rock reservoir to be 38.5% ± 10.5%. At the average measured corrected infiltration rate IR_c at 0.036 inches/hour ± 0.029 inches/hour it would take approximately 27.7 hours to infiltrate a 1" precipitation event. A crushed rock reservoir averaging 6" in thickness would accommodate a rainfall event of approximately 2.3" before significant storm drainage overflow would occur.

The treatment of water quality is minimal at this site because it is treating only the precipitation that hits the pavement surface. Further studies could be conducted to study a wider suite of compounds including O&G, trace metals and bacterial contamination to measure chemical and biological inputs from parked automobiles and other human activities on the pavement surface. In addition there did not appear to be an accumulation of nutrients and Cl within the structure over time.

Appendix 1: Individual Storm Event Hydrological and Water Quality Results


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
March 28 - 30, 2007
Left Well
Right Well
* Middle Well results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
28/0:10
12:10
29/0:10
Time (24:00)

Rain Event Details for 3/28-30/07

Precipitation Total (Inches)	0.05
Duration (Hours)	---
Peak 5 min Intensity (Inches/Hour)	---
Average Intensity (Inches/Hour)	---

--- = No Data

Wilmore Walk Well Rise Results

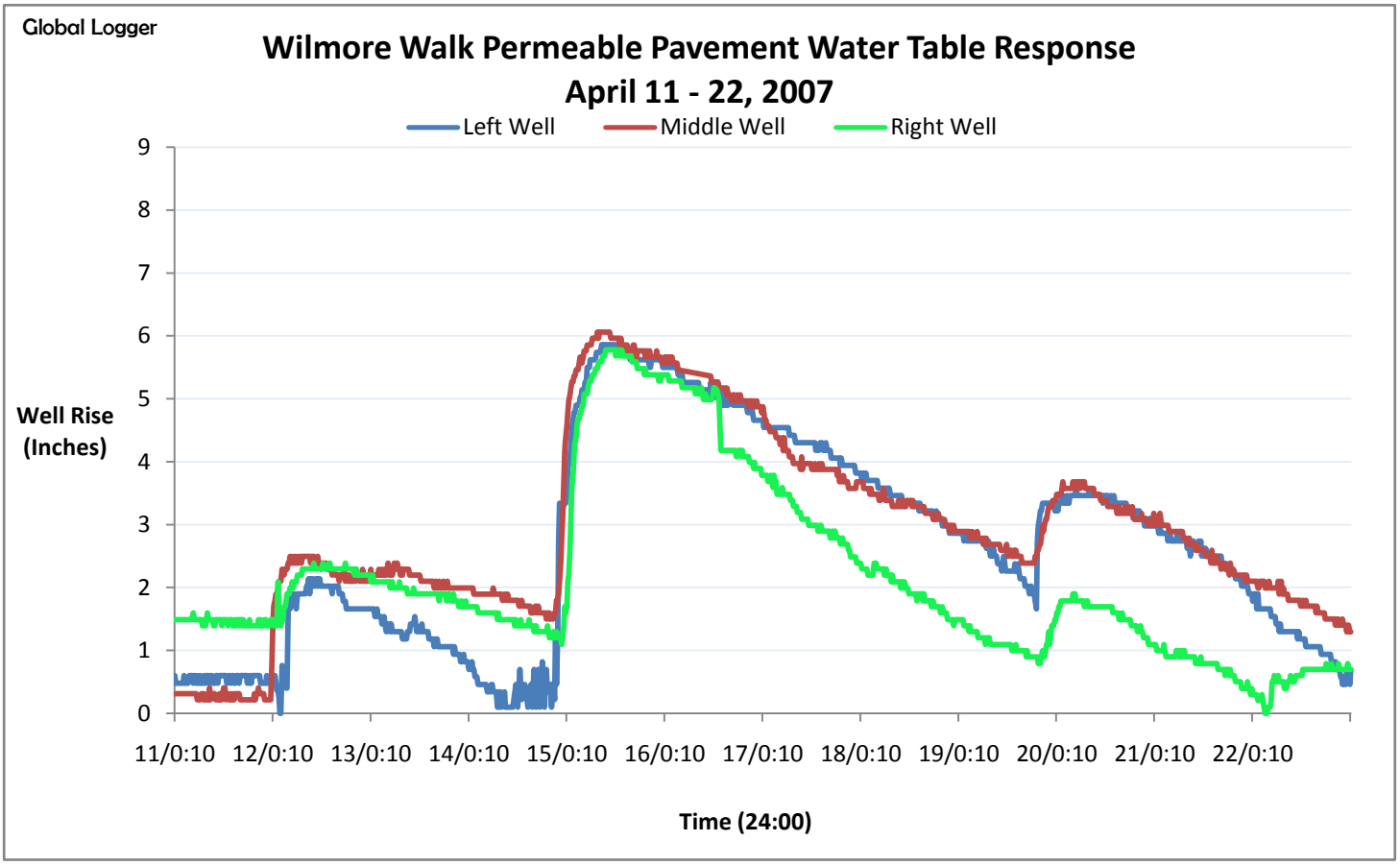
Global Logger	**Left Well**	**Middle Well**	**Right Well**	**Average**
Total Rise (Inches)	0.72	---	0.70	0.71
Porosity	NC	---	NC	NC
Infiltration Uncorrected (Inches/Hour)	0.15	---	0.31	0.23
Infiltration Corrected (Inches/Hour)	0.02	---	0.03	0.03

--- = No Data NC = Not Calculated

Wilmore Walk March 28, 2007 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	---	---	---	---	---	---	---	---
Reservoir (Wells)	---	---	---	---	---	---	---	---

--- = No Data


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
April 11 - 22, 2007
Left Well
Middle Well
Right Well
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
11/0:10
12/0:10
13/0:10
14/0:10
15/0:10
16/0:10
17/0:10
18/0:10
19/0:10
20/0:10
21/0:10
22/0:10
Time (24:00)

Rain Event Details for 4/11/07

Precipitation Total (Inches)	0.91
Duration (Hours)	---
Peak 5 min Intensity (Inches/Hour)	---
Average Intensity (Inches/Hour)	---

Wilmore Walk Well Rise Results

	Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	1.62	2.18	1.19	1.66	
Porosity	0.56	0.42	0.77	0.58	
Infiltration Uncorrected (Inches/Hour)	0.12	0.12	0.07	0.10	
Infiltration Corrected (Inches/Hour)	0.07	0.05	0.05	0.06	

Rain Event Details for 4/14/07

Precipitation Total (Inches)	1.29
Duration (Hours)	---
Peak 5 min Intensity (Inches/Hour)	---
Average Intensity (Inches/Hour)	---

	Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	3.36	2.96	3.57	3.30	
Porosity	0.38	0.44	0.36	0.39	
Infiltration Uncorrected (Inches/Hour)	0.10	0.10	0.11	0.10	
Infiltration Corrected (Inches/Hour)	0.04	0.04	0.04	0.04	

Rain Event Details for 4/19/07

Precipitation Total (Inches)	1.29
Duration (Hours)	---
Peak 5 min Intensity (Inches/Hour)	---
Average Intensity (Inches/Hour)	---

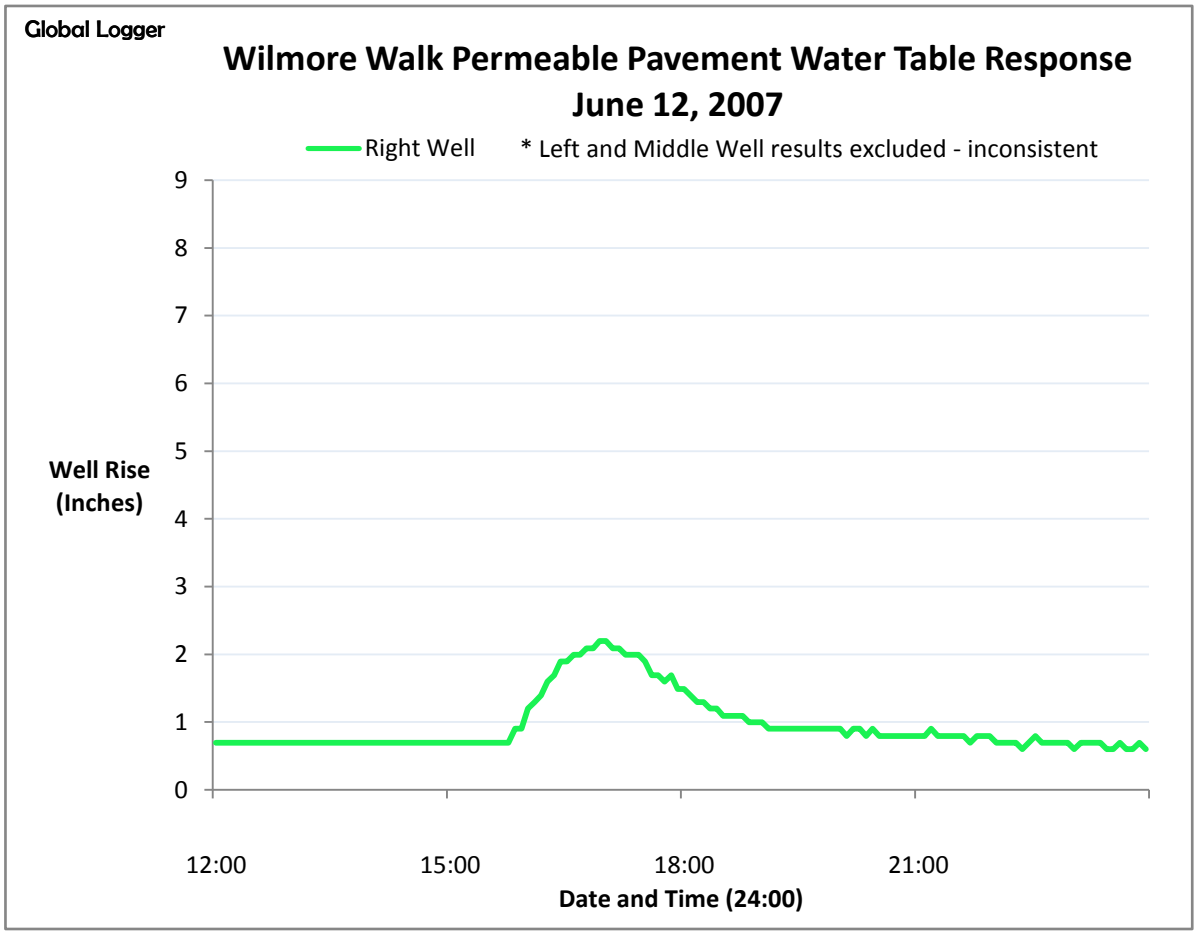
	Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	1.70	1.30	1.00	1.33	
Porosity (Inches/Hour)	0.31	0.41	0.53	0.42	
Infiltration Uncorrected (Inches/Hour)	0.13	0.12	0.11	0.12	
Infiltration Corrected (Inches/Hour)	0.04	0.05	0.06	0.05	

--- = No Data

Wilmore Walk April 11, 2007 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	17.0	5.11	0.49	0.48	0.12	1.44	0.03	0.68
Left Well	---	---	---	---	---	---	---	---
Middle Well	159.2	6.83	0.44	0.42	0.16	0.31	<DL	0.17
Right Well	169.0	6.69	0.98	0.98	0.49	<DL	<DL	0.33

--- = No Data


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
June 12, 2007
Right Well
* Left and Middle Well results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
12:00
15:00
18:00
21:00
Date and Time (24:00)

Rain Event Details for 6/12/07	
Precipitation Total (Inches)	0.69
Duration (Hours)	---
Peak 5 min Intensity (Inches/Hour)	---
Average Intensity (Inches/Hour)	---

Wilmore Walk Well Rise Results				
Global Logger	**Left Well**	**Middle Well**	**Right Well**	**Average**
Total Rise (Inches)	---	---	1.50	1.50
Porosity	---	---	0.46	0.46
Infiltration Uncorrected (Inches/Hour)	---	---	0.32	0.32
Infiltration Corrected (Inches/Hour)	---	---	0.15	0.15

--- = No Data

Wilmore Walk June 12, 2007 Water Quality Results

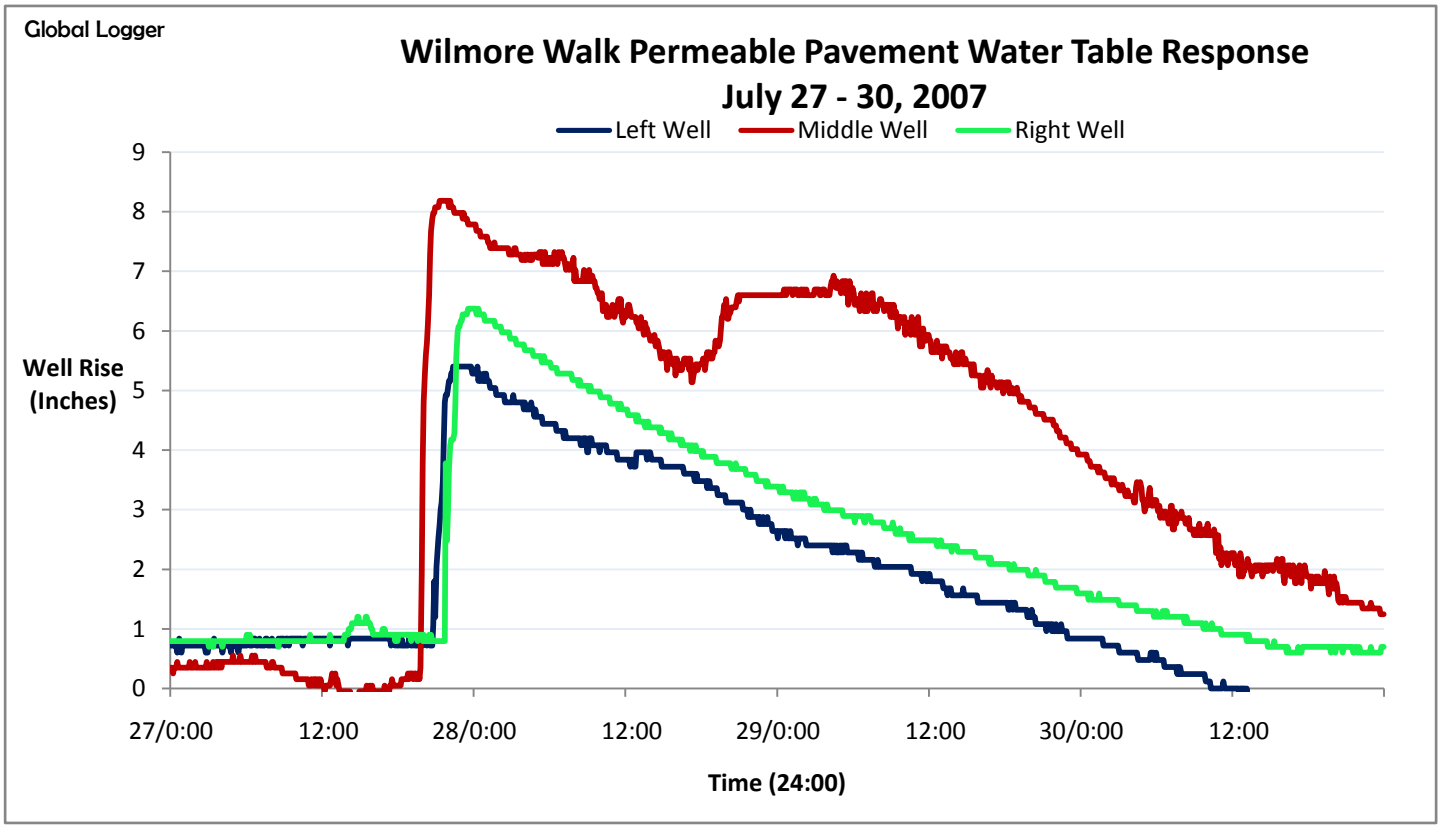
Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	23.8	3.12	0.33	1.58	0.26	0.87	0.05	0.36
Reservoir (Wells)	---	---	---	---	---	---	---	---

--- = No Data

Wilmore Walk June 2007 Water Quality Results

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
6/4	Bulk Precipitation	15.7	4.91	---	0.28	---	0.17	---	0.29

--- = No Data


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
July 27 - 30, 2007
Left Well
Middle Well
Right Well
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
27/0:00
12:00
28/0:00
12:00
29/0:00
12:00
30/0:00
12:00
Time (24:00)

Rain Event Details for 7/27/07

Precipitation Total (Inches)	1.98
Duration (Hours)	2.20
Peak 5 min Intensity (Inches/Hour)	0.90
Average Intensity (Inches/Hour)	0.11

Wilmore Walk Well Rise Results

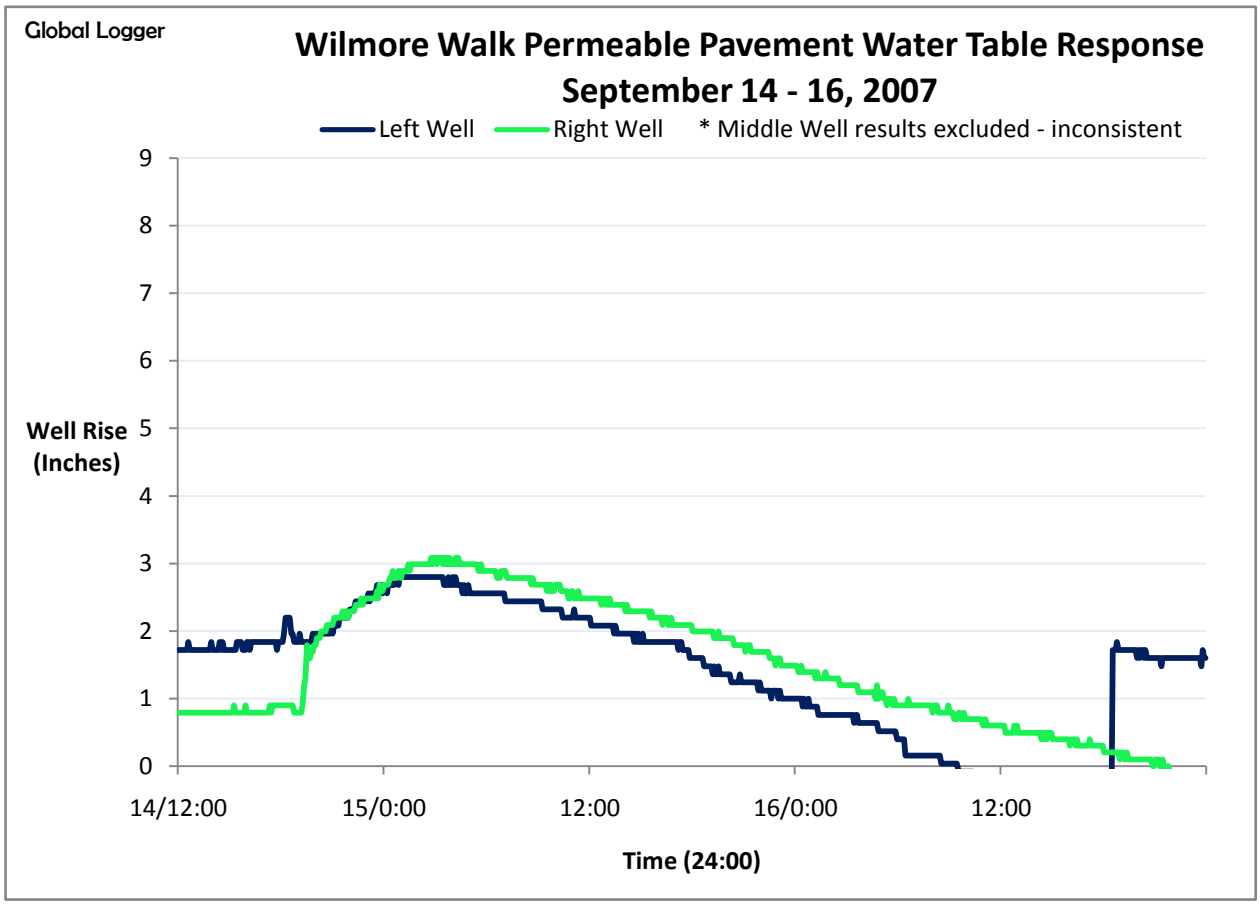
Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	4.68	7.84	5.58	6.03
Porosity	0.42	0.25	0.36	0.34
Infiltration Uncorrected (Inches/Hour)	0.09	0.19	0.09	0.12
Infiltration Corrected (Inches/Hour)	0.04	0.05	0.03	0.04

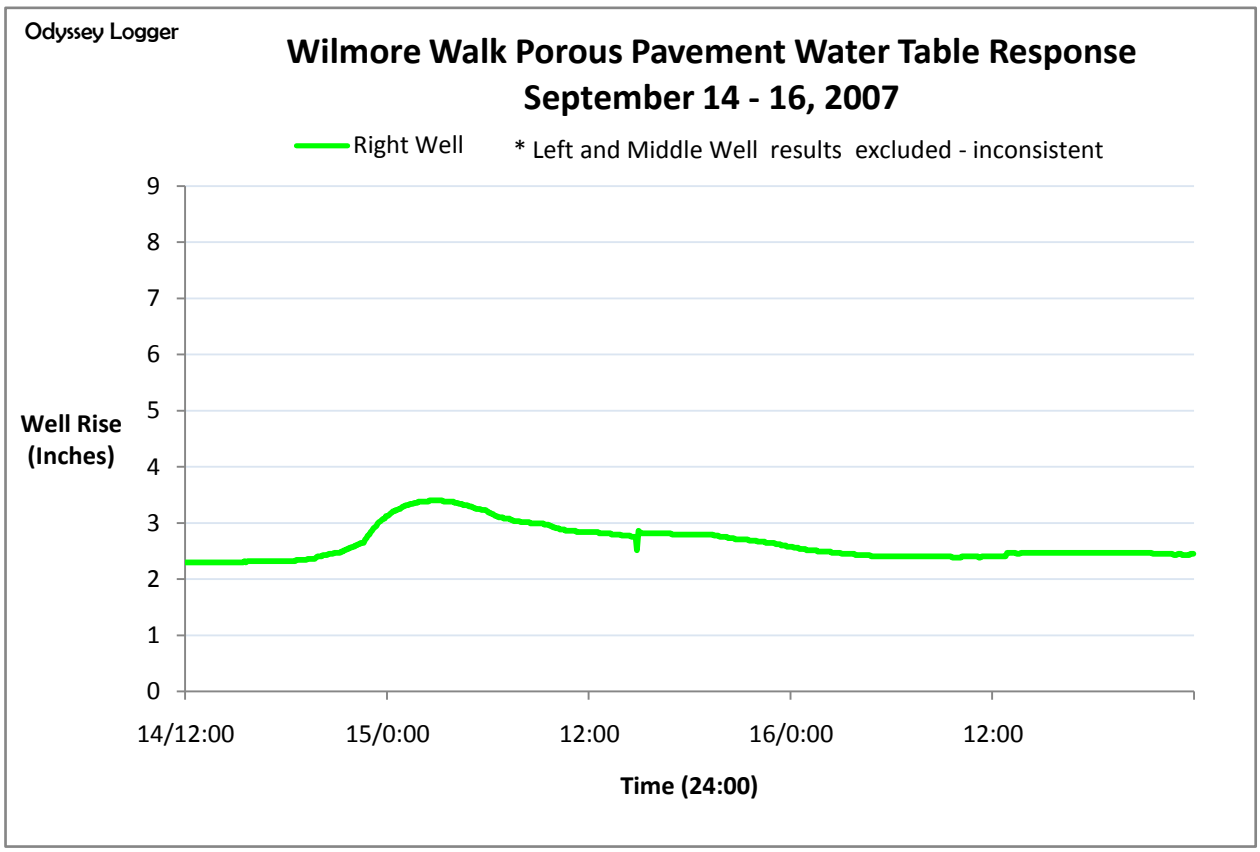
--- = No Data

Wilmore Walk July 27, 2007 Water Quality Results

Sample	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	---	---	---	---	---	---	---	---
Reservoir (Wells)	---	---	---	---	---	---	---	---

--- = No Data


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
September 14 - 16, 2007
Left Well
Right Well
* Middle Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
14/12:00
15/0:00
12:00
16/0:00
12:00
Time (24:00)


Odyssey Logger
Wilmore Walk Porous Pavement Water Table Response
September 14 - 16, 2007
Right Well
* Left and Middle Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
14/12:00
15/0:00
12:00
16/0:00
12:00
Time (24:00)

Rain Event Details for 9/14/07

Precipitation Total (Inches)	1.61
Duration (Hours)	18.95
Peak 5 min Intensity (Inches/Hour)	0.08
Average Intensity (Inches/Hour)	0.04

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.80	---	3.08	2.94
Porosity	0.57	---	0.52	0.55
Infiltration Uncorrected (Inches/Hour)	0.07	---	0.08	0.08
Infiltration Corrected (Inches/Hour)	0.04	---	0.04	0.04

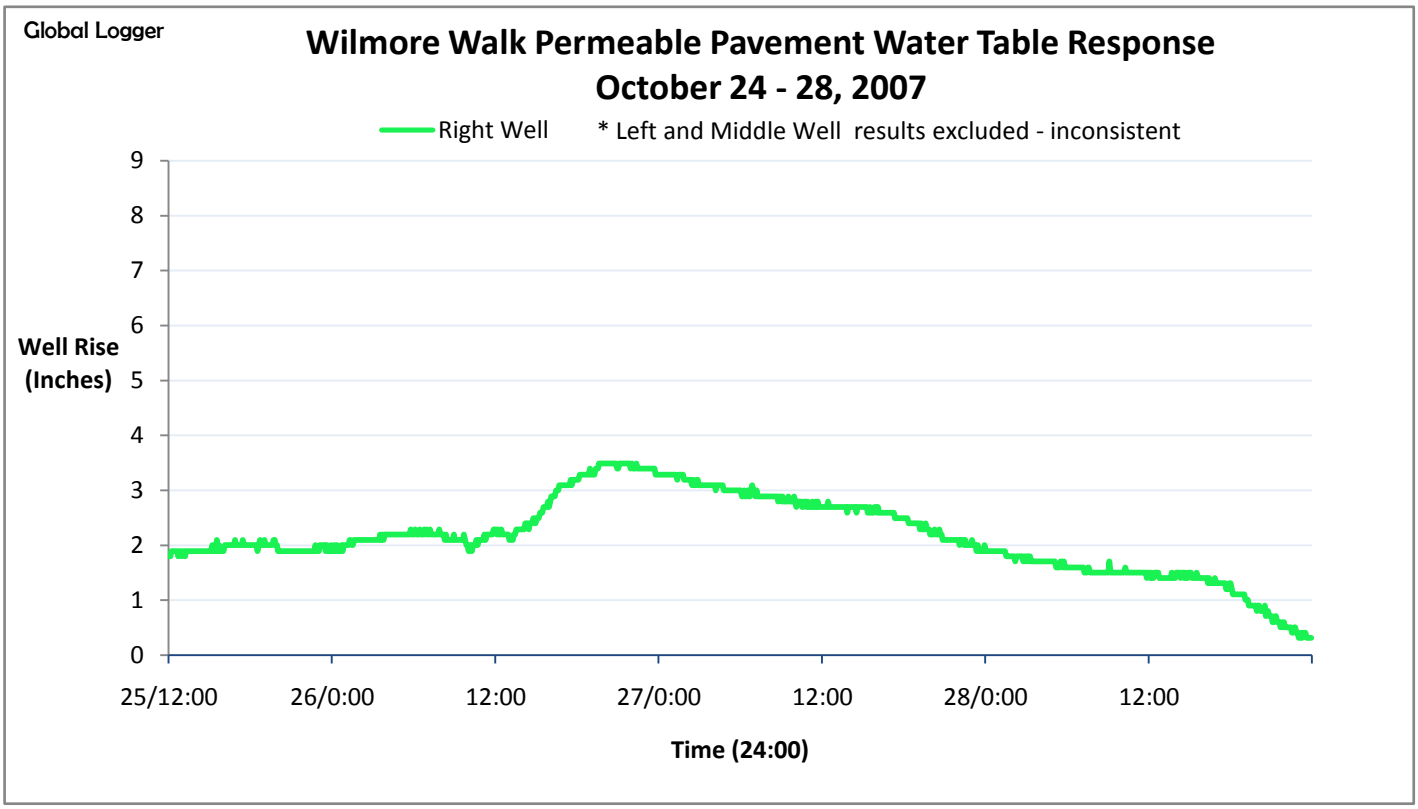
Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	---	3.40	3.09
Porosity	---	---	0.47	0.52
Infiltration Uncorrected (Inches/Hour)	---	---	0.13	0.09
Infiltration Corrected (Inches/Hour)	---	---	0.06	0.05

--- = No Data

Wilmore Walk September 14, 2007 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	0.0	5.23	1.14	0.66	0.16	0.23	0.01	0.25
Left Well	---	---	---	---	---	---	---	---
Middle Well	0.4	6.27	1.07	1.15	0.58	0.15	<DL	0.18
Right Well	155.7	6.21	1.80	1.42	0.75	0.20	0.04	0.51

--- = No Data


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
October 24 - 28, 2007
Right Well
* Left and Middle Well results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
25/12:00
26/0:00
12:00
27/0:00
12:00
28/0:00
12:00
Time (24:00)

Rain Event Details for 10/24-26/07

Precipitation Total (Inches)	1.83
Duration (Hours)	29.97
Peak 5 min Intensity (Inches/Hour)	0.11
Average Intensity (Inches/Hour)	0.02

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	---	3.18	3.18
Porosity	---	---	0.58	0.58
Infiltration Uncorrected (Inches/Hour)	---	---	0.06	0.06
Infiltration Corrected (Inches/Hour)	---	---	0.04	0.04

--- = No Data

Wilmore Walk October 26, 2007 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	8.3	5.52	0.21	0.41	0.13	0.21	0.00	0.15
Left Well	---	---	---	---	---	---	---	---
Middle Well	218	6.64	0.77	1.05	0.64	0.00	<DL	
Right Well	131.1	6.25	1.87	1.95	1.11	0.06	0.16	

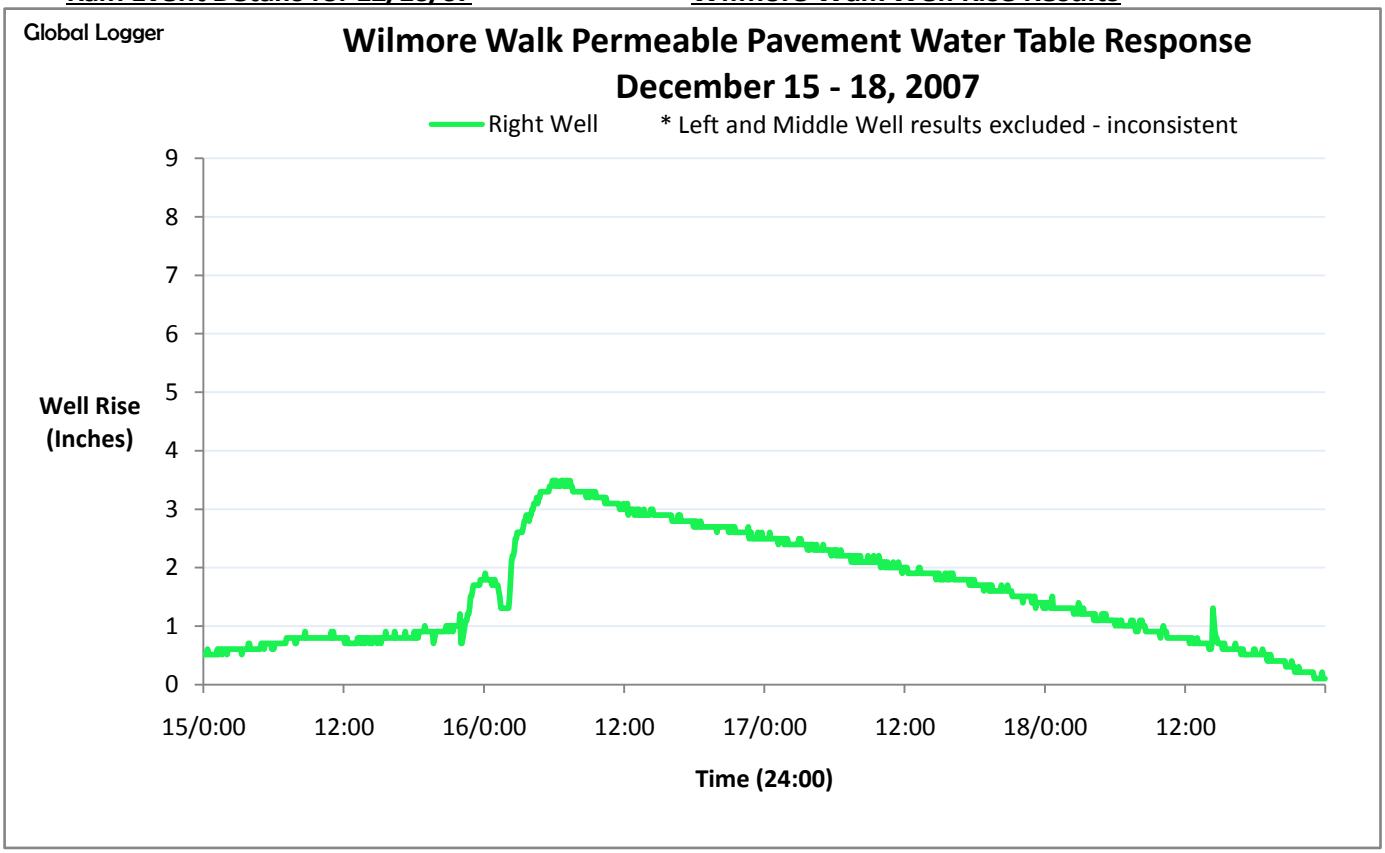
--- = No Data

Wilmore Walk October 2007 Water Quality Results

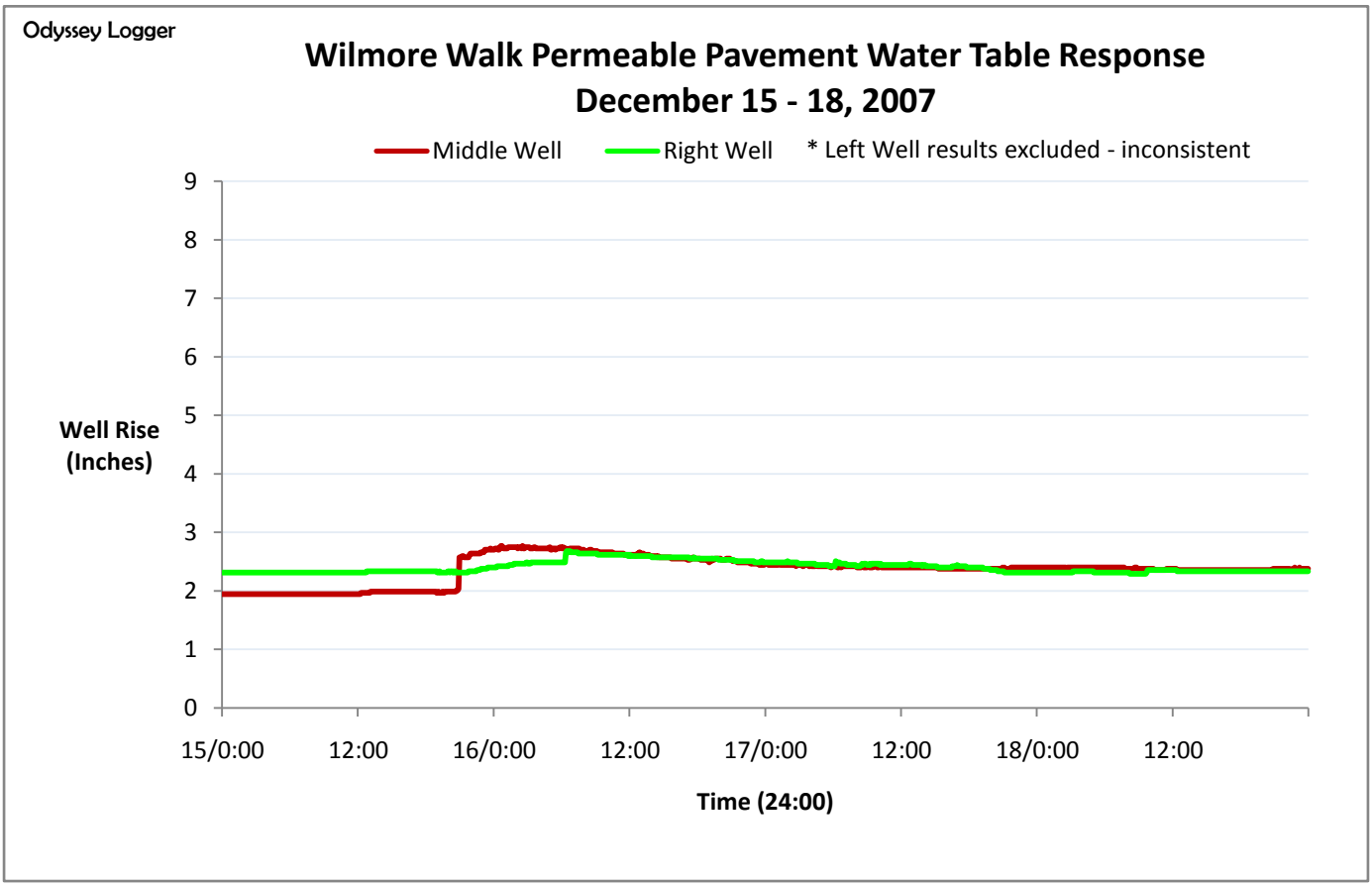
Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
10/21	Bulk Precipitation	15.6	5.62	1.55	0.53	0.15	0.08	0.00	1.62
10/24	Bulk Precipitation	11.3	4.98	16.47	1.08	1.36	0.15	0.21	

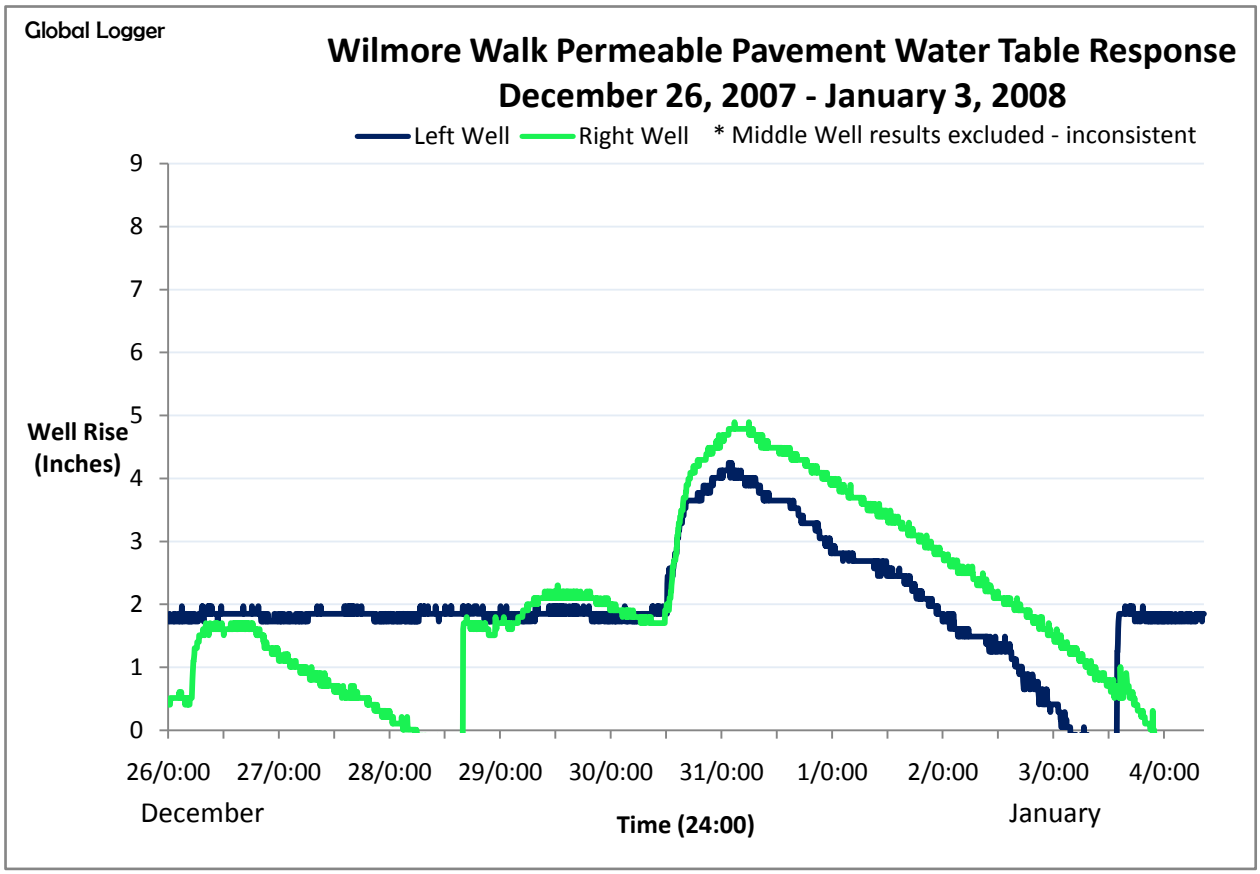
Rain Event Details for 12/16/07 **Wilmore Walk Well Rise Results**

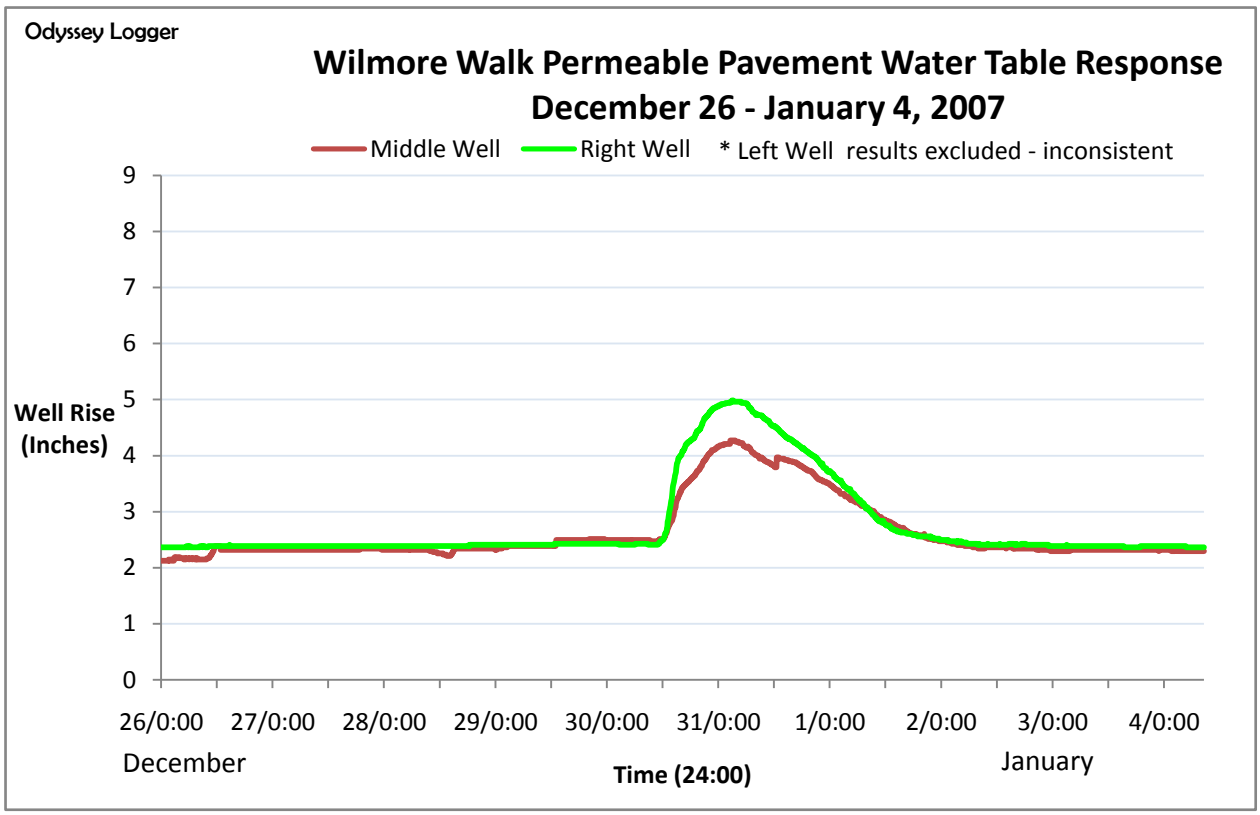
Global Logger



Odyssey Logger




Global Logger
Wilmore Walk Permeable Pavement Water Table Response
December 26, 2007 - January 3, 2008
Left Well
Right Well
* Middle Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
26/0:00
27/0:00
28/0:00
29/0:00
30/0:00
31/0:00
1/0:00
2/0:00
3/0:00
4/0:00
December
January
Time (24:00)


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
December 26 - January 4, 2007
Middle Well
Right Well
* Left Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
26/0:00
27/0:00
28/0:00
29/0:00
30/0:00
31/0:00
1/0:00
2/0:00
3/0:00
4/0:00
December
January
Time (24:00)

Rain Event Details for 12/26-30/07

	12/26/07
Precipitation Total (Inches)	0.48
Duration (Hours)	9.00
Peak 5 min Intensity (Inches/Hour)	0.28
Average Intensity (Inches/Hour)	0.05
	12/28/07
Precipitation Total (Inches)	0.60
Duration (Hours)	10.38
Peak 5 min Intensity (Inches/Hour)	0.94
Average Intensity (Inches/Hour)	0.06
	12/30/07
Precipitation Total (Inches)	0.93
Duration (Hours)	13.18
Peak 5 min Intensity (Inches/Hour)	0.57
Average Intensity (Inches/Hour)	0.07

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	---	1.19	1.19
Porosity	---	---	0.40	0.40
Infiltration Uncorrected (Inches/Hour)	---	---	0.06	0.06
Infiltration Corrected (Inches/Hour)	---	---	0.02	0.02

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.52	---	3.58	3.19
Porosity	0.37	---	0.31	0.29
Infiltration Uncorrected (Inches/Hour)	0.05	---	0.06	0.05
Infiltration Corrected (Inches/Hour)	0.02	---	0.02	0.01

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.52	---	3.19	2.86
Porosity	0.37	---	0.29	0.33
Infiltration Uncorrected (Inches/Hour)	0.05	---	0.05	0.05
Infiltration Corrected (Inches/Hour)	0.02	---	0.01	0.02

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	2.75	2.68	2.63
Porosity	---	0.41	0.42	0.37
Infiltration Uncorrected (Inches/Hour)	---	0.08	0.07	0.06
Infiltration Corrected (Inches/Hour)	---	0.03	0.03	0.02

--- = No Data

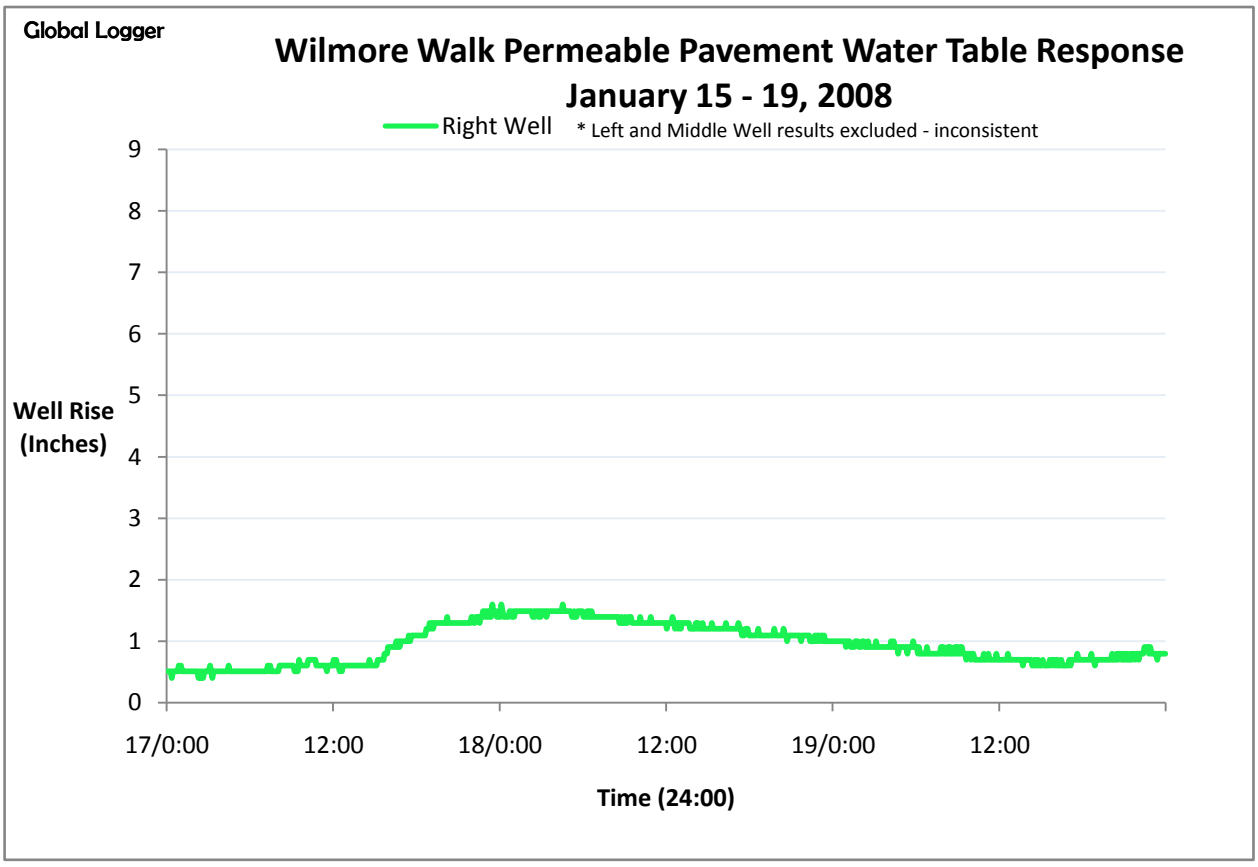
Wilmore Walk December 31, 2007 Water Quality Results

Sample	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	7.4	5.18	0.47	0.32	0.11	0.15	<DL	0.12
Left Well	141.0	6.81	0.53	0.57	0.33	0.00	0.03	0.45
Middle Well	108.8	6.44	0.44	0.27	0.17	0.00	0.01	0.18
Right Well	78.3	6.92	0.98		0.18	0.00	0.20	1.02

Wilmore Walk December 2008 Water Quality Results

Date	Sample	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
12/26	Bulk Precipitation	4.9	4.56	---	0.24	---	0.06	---	0.12

--- = No Data


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
January 15 - 19, 2008
Right Well
* Left and Middle Well results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
17/0:00
12:00
18/0:00
12:00
19/0:00
12:00
Time (24:00)

Rain Event Details for 1/17/08

Precipitation Total (Inches)	0.90
Duration (Hours)	13.72
Peak 5 min Intensity (Inches/Hour)	0.01
Average Intensity (Inches/Hour)	0.07

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	---	0.89	0.89
Porosity	---	---	NC	NC
Infiltration Uncorrected (Inches/Hour)	---	---	0.03	0.03
Infiltration Corrected (Inches/Hour)	---	---	0.03	0.03

--- = No Data NC = Not Calculated

Wilmore Walk January 17, 2008 Water Quality Results

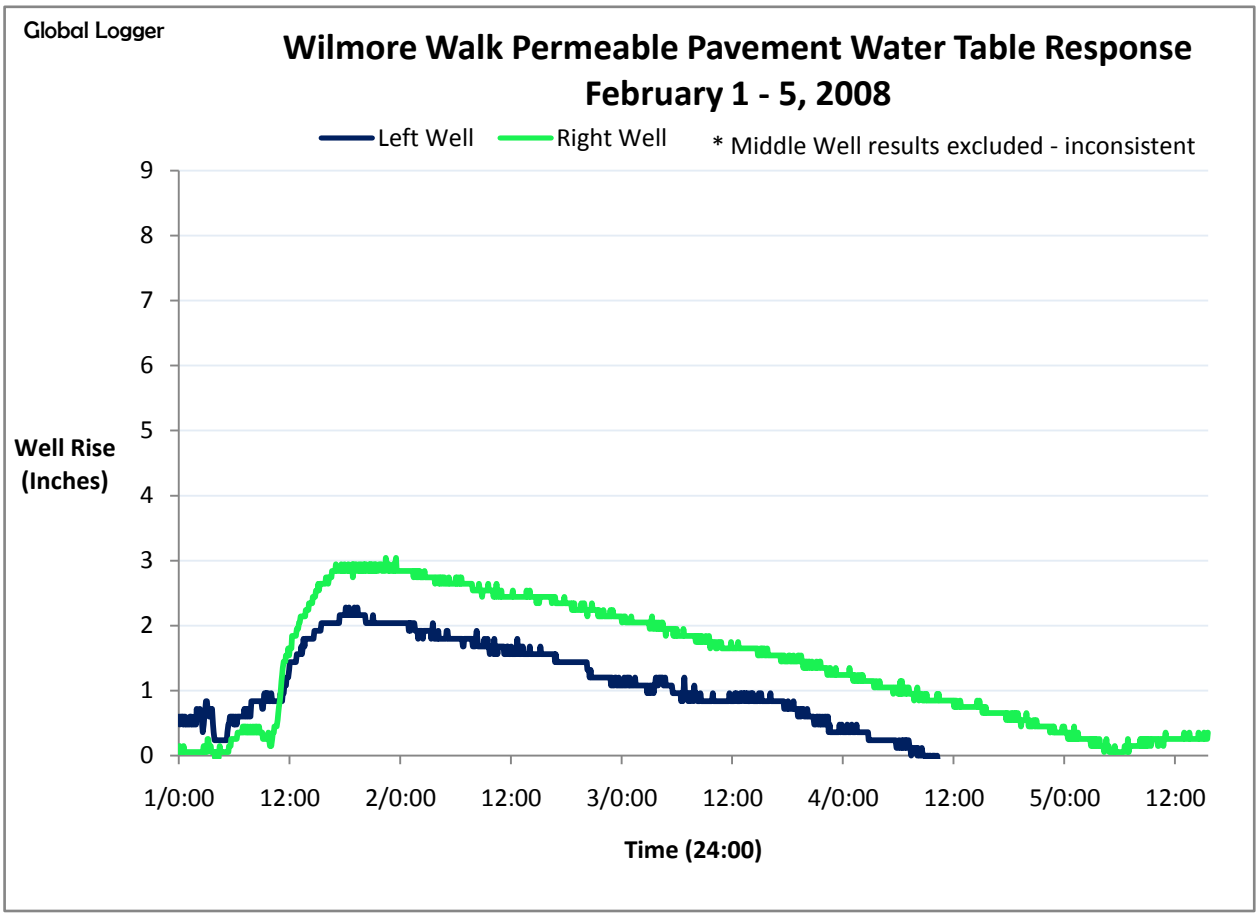
Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	32.1	4.62	8.76	0.97	0.38	0.50	0.04	0.19
Middle Well	128.2	6.48	0.50	0.43	0.22	---	<DL	---
Right Well	51.7	6.33	---	---	---	---	---	---

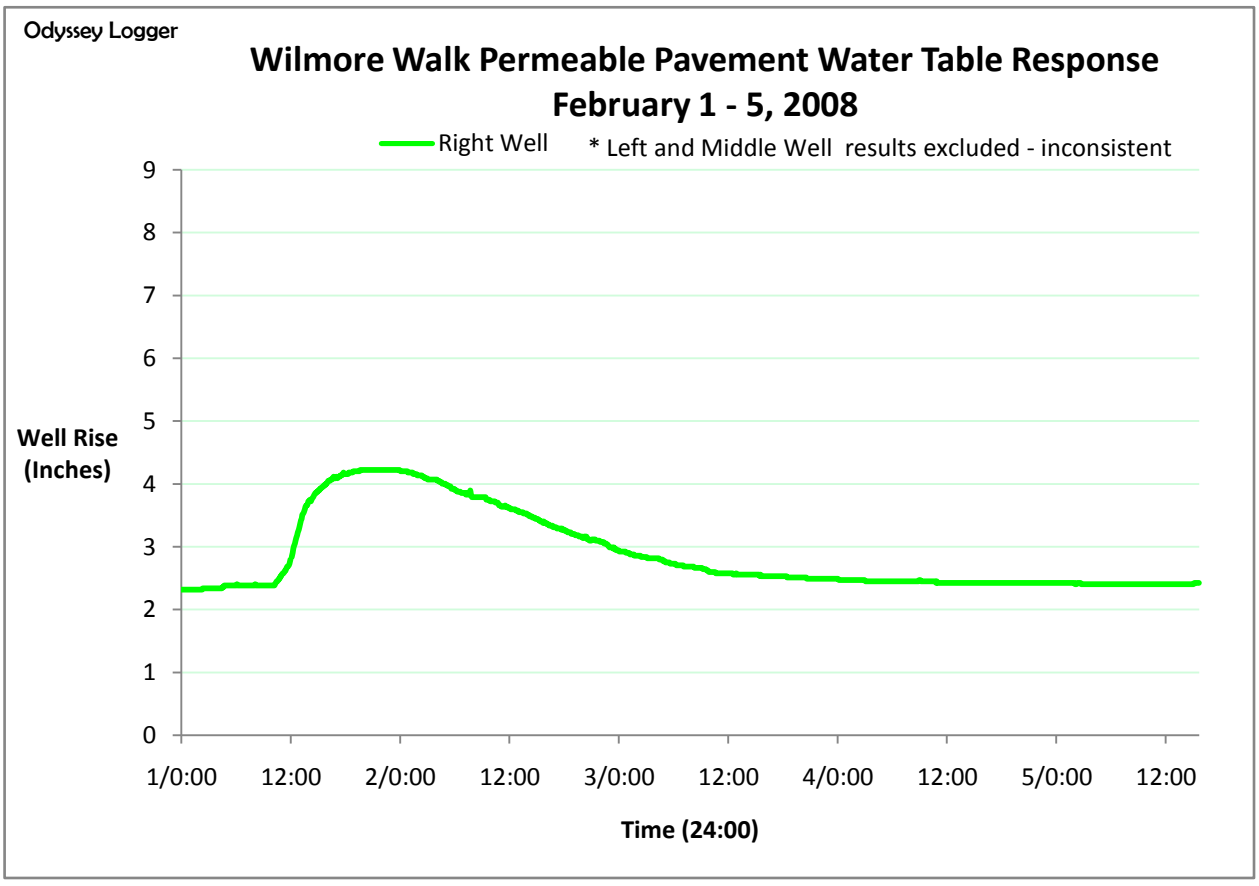
--- = No Data

Wilmore Walk January 2008 Water Quality Results

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
1/12	Bulk Precipitation			0.48	0.92	0.24	0.48	0.01	0.17
1/30	Bulk Precipitation	24.3	5.73	0.77	0.82	0.3	0.4	0	0.19

--- = No Data


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
February 1 - 5, 2008
Left Well
Right Well
* Middle Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
1/0:00
12:00
2/0:00
12:00
3/0:00
12:00
4/0:00
12:00
5/0:00
12:00
Time (24:00)


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
February 1 - 5, 2008
Right Well
* Left and Middle Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
1/0:00
12:00
2/0:00
12:00
3/0:00
12:00
4/0:00
12:00
5/0:00
12:00
Time (24:00)

Rain Event Details for 2/1/08

Precipitation Total (Inches)	1.15
Duration (Hours)	12.07
Peak 5 min Intensity (Inches/Hour)	0.10
Average Intensity (Inches/Hour)	0.02

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.04	---	2.99	2.52
Porosity	0.56	---	0.38	0.47
Infiltration Uncorrected (Inches/Hour)	0.04	---	0.04	0.04
Infiltration Corrected (Inches/Hour)	0.02	---	0.01	0.02

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	---	2.85	2.63
Porosity	---	---	0.40	0.45
Infiltration Uncorrected (Inches/Hour)	---	---	0.03	0.04
Infiltration Corrected (Inches/Hour)	---	---	0.03	0.02

--- = No Data NC = Not Calculated

Wilmore Walk February 1, 2008 Water Quality Results

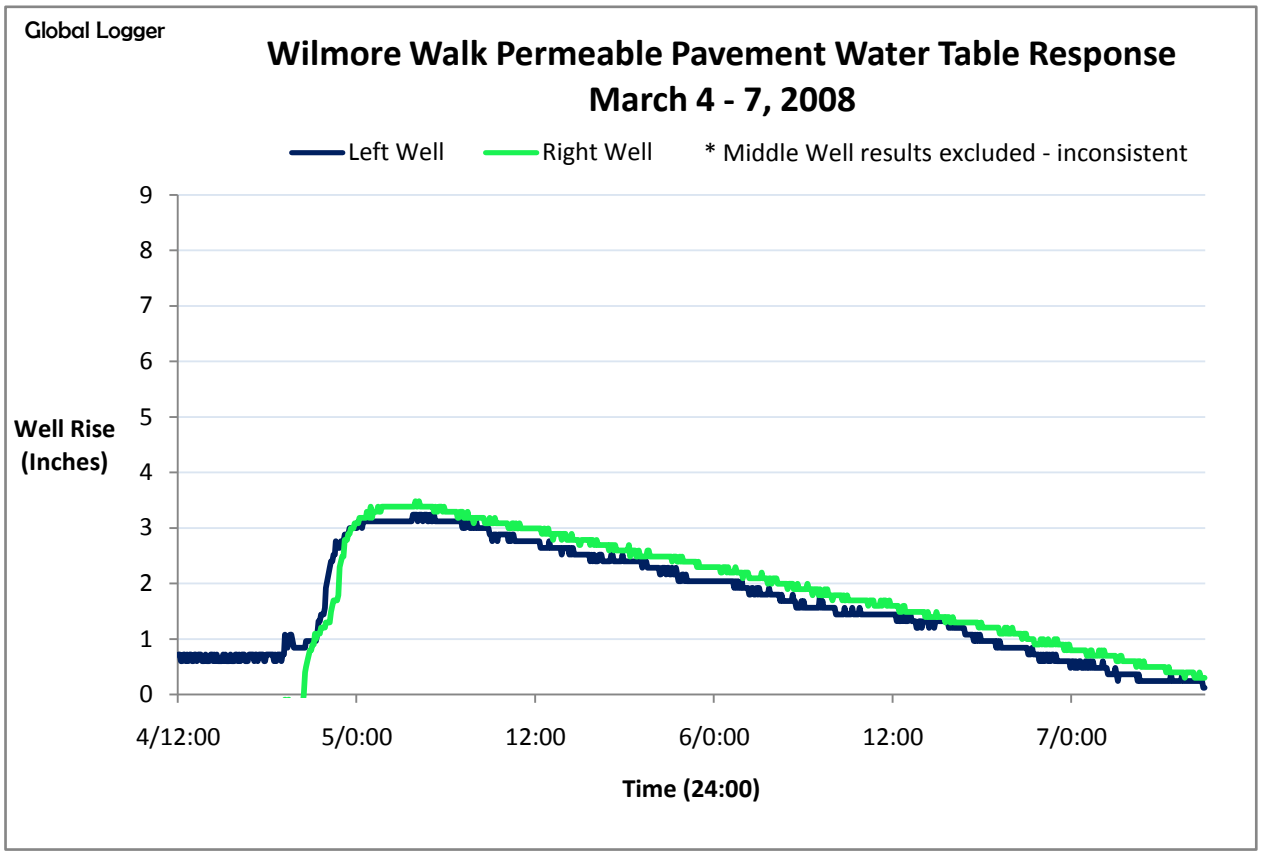
Sample	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	12.9	5.63	---	0.51	---	0.30	---	0.13
Left Well	194.5	6.43	16.66	1.51	1.31	0.11	0.21	0.80
Middle Well	147.4	6.23	3.43	0.52	0.33	<DL	<DL	0.14
Right Well	69.8	6.22	6.66	1.37	0.36	0.03	0.40	2.07

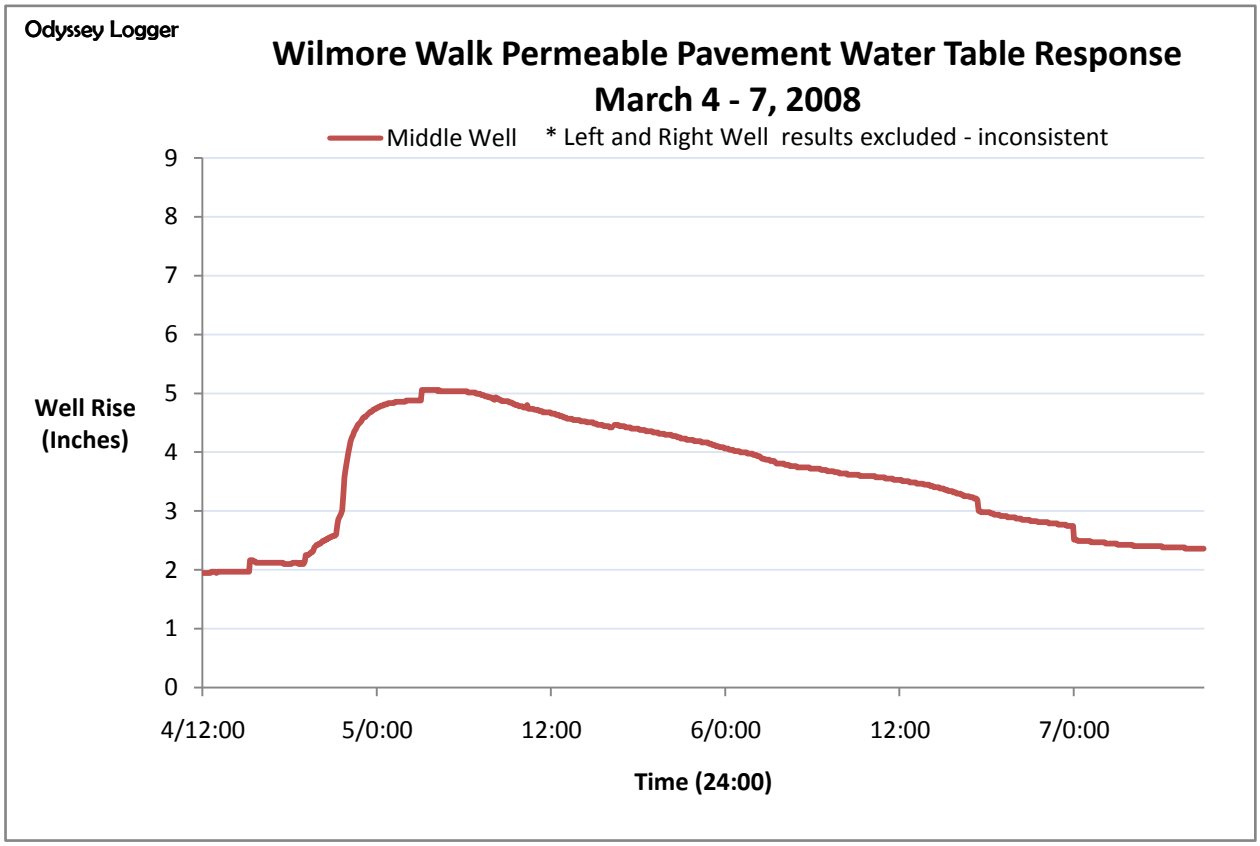
--- = No Data

Wilmore Walk February 2008 Water Quality Results

Date	Sample	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
2/7	Bulk Precipitation	31.9	5.40	---	0.94	---	0.37	---	0.25
2/14	Bulk Precipitation	12.8	6.25	0.39	0.59	0.24	0.31	<DL	0.16
2/19	Bulk Precipitation	56.5	5.75	1.74	4.74	0.54	2.19	0.87	3.64
2/24	Bulk Precipitation	40.3	5.62	0.94	1.30	0.27	0.15	0.01	0.34
2/27	Bulk Precipitation	16.0	5.46	0.29	0.75	0.30	0.38	<DL	0.21

--- = No Data


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
March 4 - 7, 2008
Left Well
Right Well
* Middle Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
4/12:00
5/0:00
12:00
6/0:00
12:00
7/0:00
Time (24:00)


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
March 4 - 7, 2008
Middle Well
* Left and Right Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
4/12:00
5/0:00
12:00
6/0:00
12:00
7/0:00
Time (24:00)

Rain Event Details for 3/4/08

Precipitation Total (Inches)	1.36
Duration (Hours)	7.45
Peak 5 min Intensity (Inches/Hour)	0.18
Average Intensity (Inches/Hour)	0.02

Wilmore Walk Well Rise Results

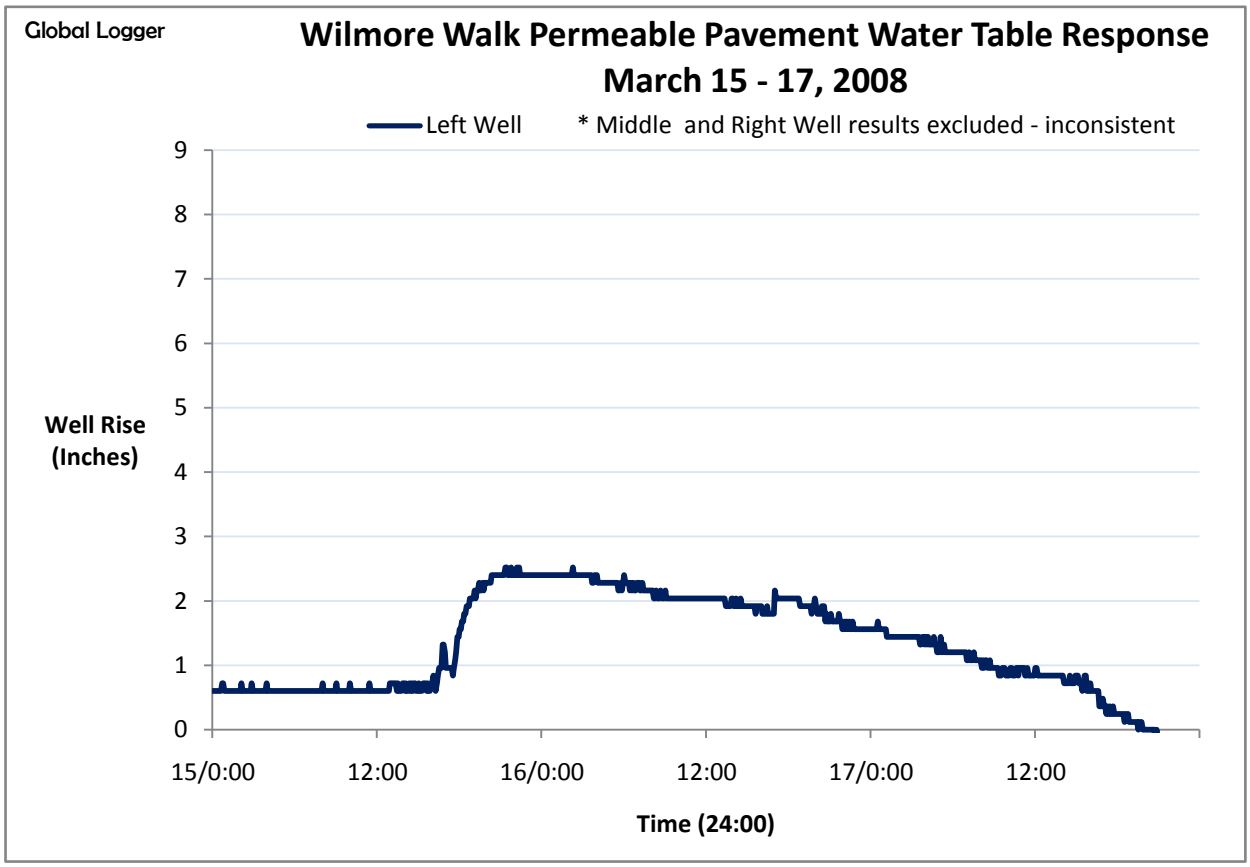
Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.52	---	3.38	2.95
Porosity	0.54	---	0.40	0.47
Infiltration Uncorrected (Inches/Hour)	0.05	---	0.07	0.06
Infiltration Corrected (Inches/Hour)	0.03	---	0.03	0.03

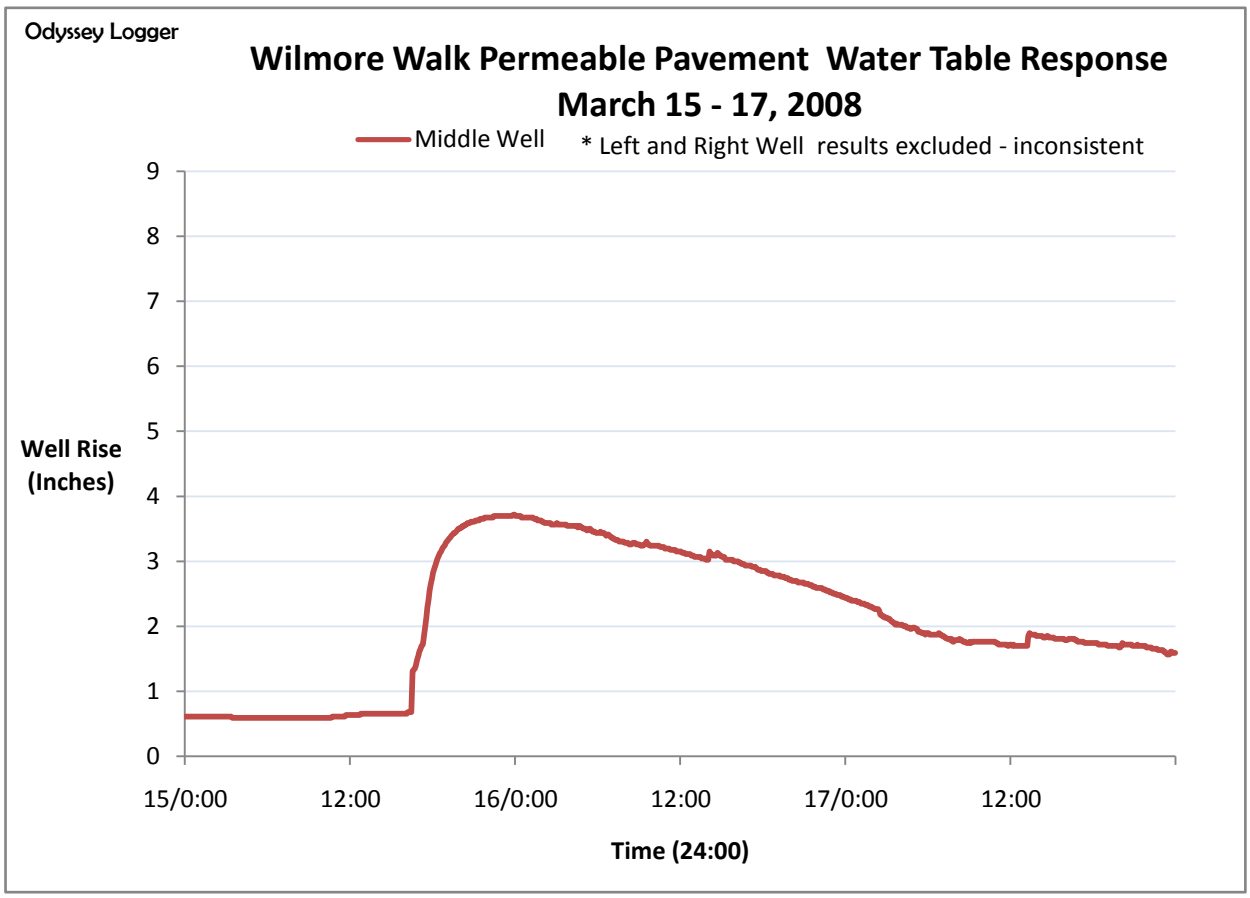
Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	3.68	---	3.19
Porosity	---	0.44	---	0.46
Infiltration Uncorrected (Inches/Hour)	---	0.08	---	0.07
Infiltration Corrected (Inches/Hour)	---	0.04	---	0.03

--- = No Data

Wilmore Walk March 4, 2008 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	11.7	5.62	0.63	1.42	0.08	0.34	0.23	1.14
Left Well	129.0	6.69	0.84	1.23	0.42	<DL	0.07	0.56
Middle Well	162.5	6.76	0.61	1.15	0.25	<DL	<DL	0.18
Right Well	83.4	6.43	0.56	2.07	0.23	0.58	0.10	0.63


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
March 15 - 17, 2008
Left Well
* Middle and Right Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
15/0:00
12:00
16/0:00
12:00
17/0:00
12:00
Time (24:00)


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
March 15 - 17, 2008
Middle Well
* Left and Right Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
15/0:00
12:00
16/0:00
12:00
17/0:00
12:00
Time (24:00)

Rain Event Details for 3/16/08

Precipitation Total (Inches)	1.24
Duration (Hours)	13.67
Peak 5 min Intensity (Inches/Hour)	0.03
Average Intensity (Inches/Hour)	0.09

Wilmore Walk Well Rise Results

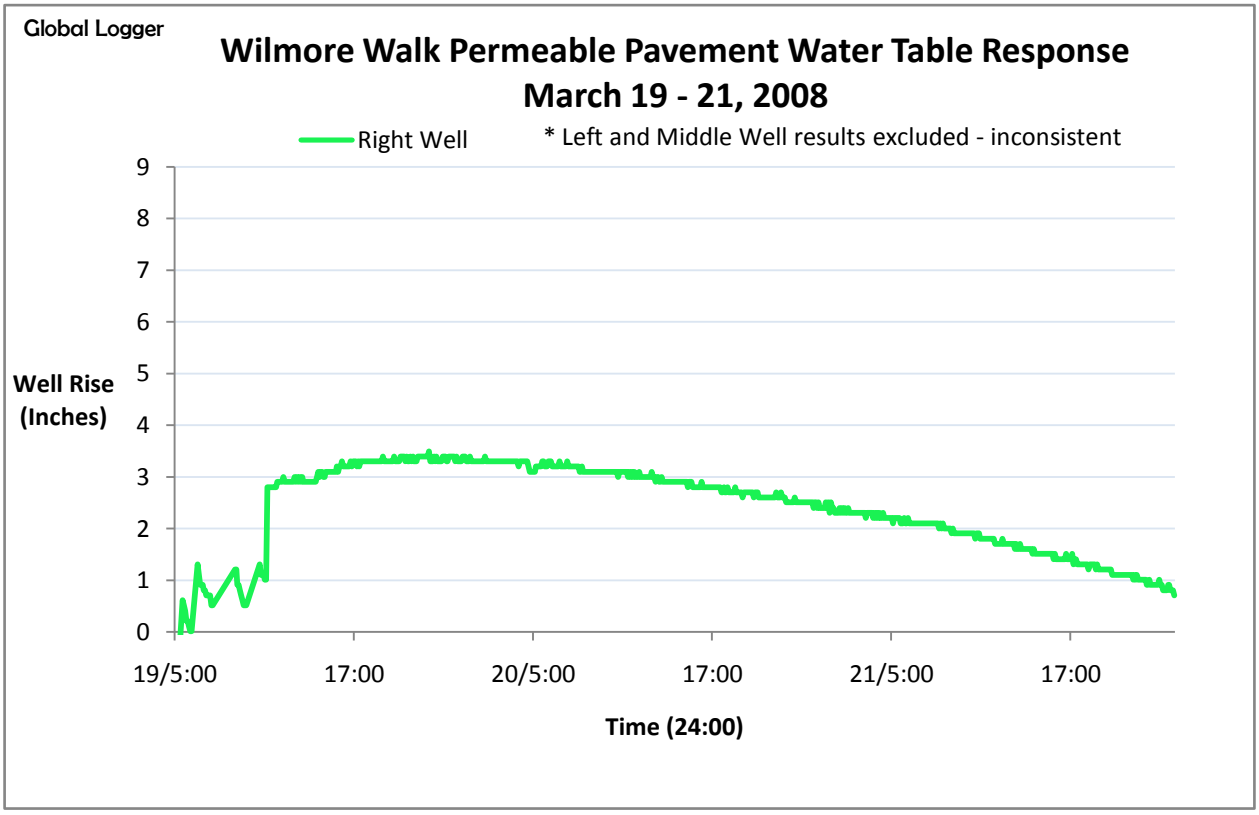
Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.40	---	---	2.40
Porosity	0.52	---	---	0.52
Infiltration Uncorrected (Inches/Hour)	0.06	---	---	0.06
Infiltration Corrected (Inches/Hour)	0.03	---	---	0.03

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	3.09	---	2.75
Porosity	---	0.40	---	0.46
Infiltration Uncorrected (Inches/Hour)	---	0.06	---	0.06
Infiltration Corrected (Inches/Hour)	---	0.02	---	0.03

--- = No Data

Wilmore Walk March 16, 2008 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	19.5	6.85	0.11	0.72	0.17	0.53	0.02	0.21
Left Well	185.7	6.94	0.96	1.04	0.63	<DL	0.02	0.35
Middle Well	122.7	6.81	0.42	0.49	0.29	<DL	<DL	0.14
Right Well	98.7	6.76	0.54	1.40	0.81	<DL	0.09	0.55


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
March 19 - 21, 2008
Right Well
* Left and Middle Well results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
19/5:00
17:00
20/5:00
17:00
21/5:00
17:00
Time (24:00)

Rain Event Details for 3/19/08

Precipitation Total (Inches)	0.66
Duration (Hours)	2.18
Peak 5 min Intensity (Inches/Hour)	0.03
Average Intensity (Inches/Hour)	0.30

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	---	2.39	2.39
Porosity	---	---	0.28	0.28
Infiltration Uncorrected (Inches/Hour)	---	---	0.05	0.05
Infiltration Corrected (Inches/Hour)	---	---	0.01	0.01

--- = No Data

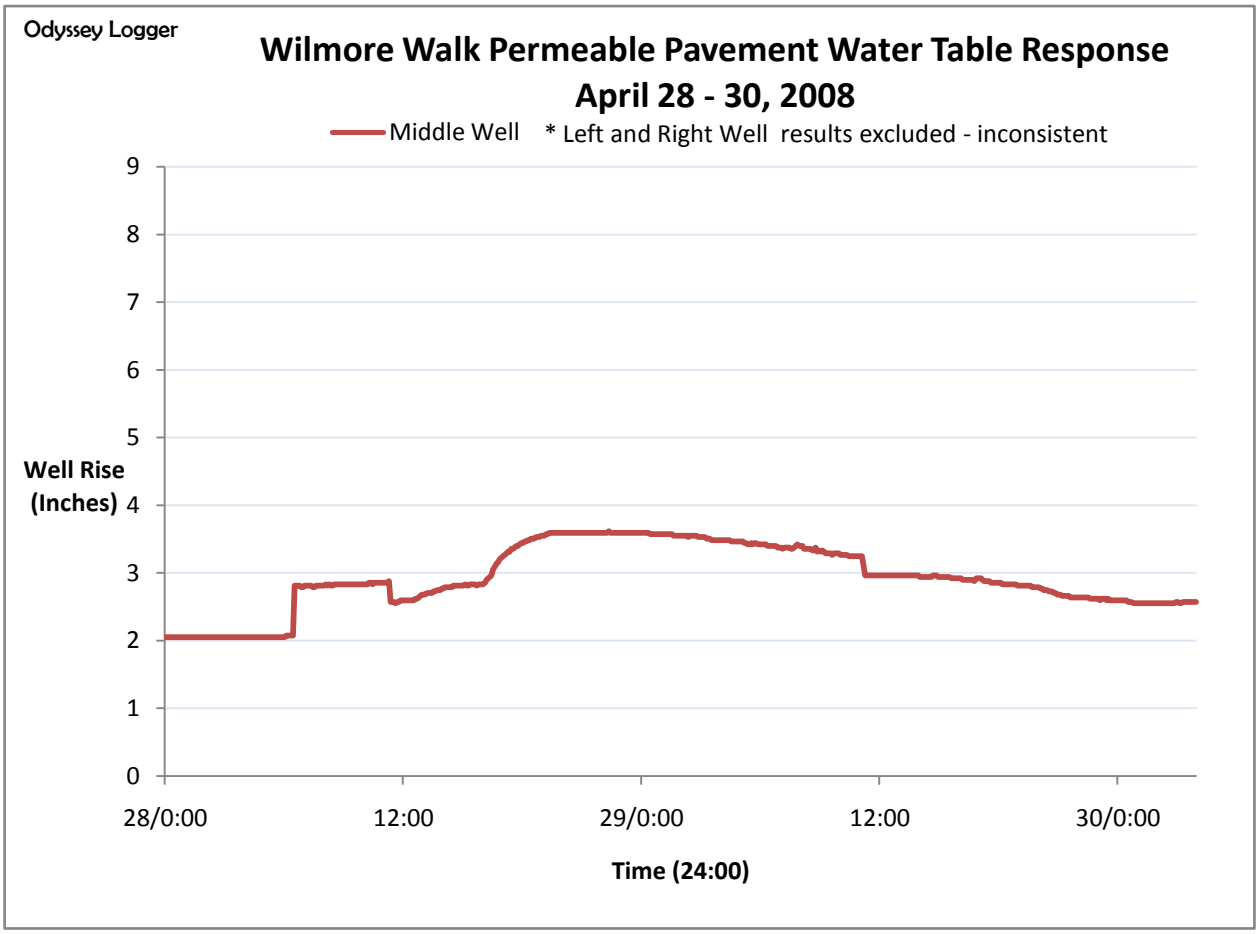
Wilmore Walk March 19, 2008 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	27.5	7.09	1.00	0.62	0.14	0.32	<DL	0.33
Left Well	---	---	---	---	---	---	---	---
Middle Well	172.0	7.02	0.50	0.66	0.37	<DL	<DL	0.12
Right Well	134.50	6.8	1.07	1.81	1.13	<DL	0.07	0.58

--- = No Data

Wilmore Walk March 2008 Water Quality Results Summary

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
3/9	Bulk Precipitation	13.8	5.66	0.26	0.81	0.28	0.43	<DL	0.18


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
April 28 - 30, 2008
Middle Well
* Left and Right Well results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
28/0:00
12:00
29/0:00
12:00
30/0:00
Time (24:00)

Rain Event Details for 4/28/08

Precipitation Total (Inches)	0.85
Duration (Hours)	13.58
Peak 5 min Intensity (Inches/Hour)	0.03
Average Intensity (Inches/Hour)	0.06

Wilmore Walk Well Rise Results

Odyssey Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	2.24	---	2.24
Porosity	---	0.38	---	0.38
Infiltration Uncorrected (Inches/Hour)	---	0.08	---	0.08
Infiltration Corrected (Inches/Hour)	---	0.03	---	0.03

--- = No Data

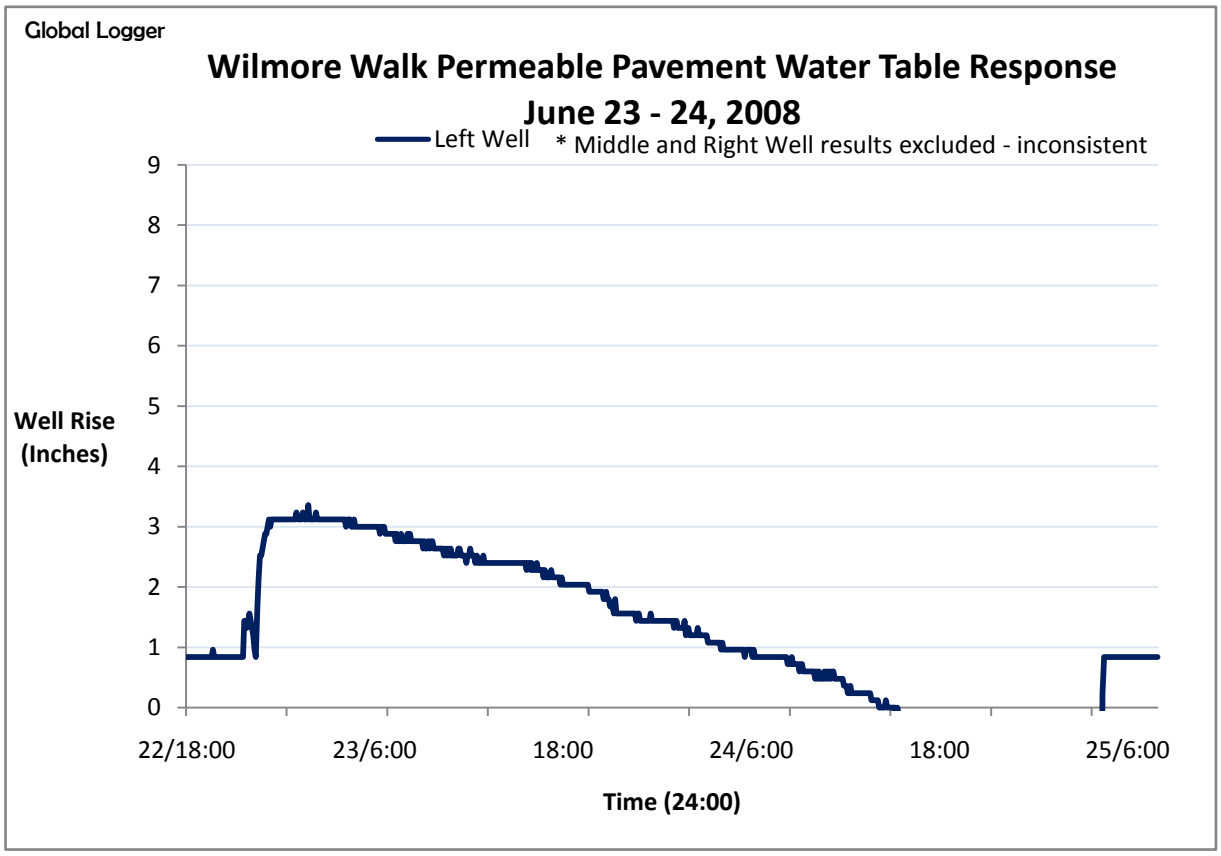
Wilmore Walk April 28, 2008 Water Quality Results

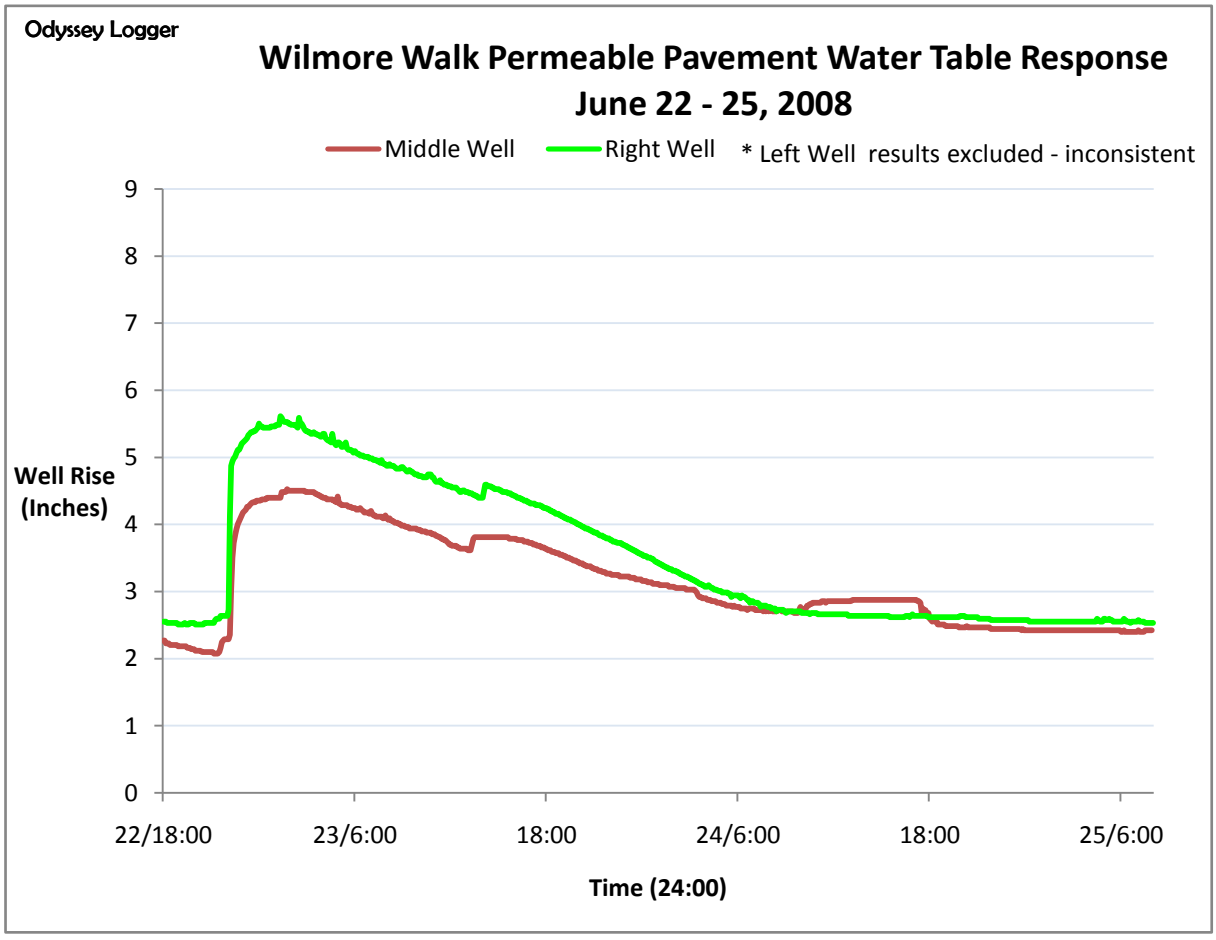
Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	0.9	6.26	0.30	0.35	0.14	<DL	0.06	0.20
Left Well	---	---	---	---	---	---	---	---
Middle Well	200	6.69	1.18	0.67	0.28	<DL	0.05	0.45
Right Well	92.9	6.15	0.96	0.82	0.49	<DL	0.03	0.18

--- = No Data

Wilmore Walk April 2008 Water Quality Summary

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
4/2	Bulk Precipitation	25.3	6.26	0.99	1.46	0.36	0.68	<DL	0.23
4/4	Bulk Precipitation	19.8	6.15	0.27	1.75	0.37	0.61	<DL	0.78
4/6	Middle Well	ND	ND	0.84	0.86	0.57	<DL	<DL	0.11
4/6	Bulk Precipitation	ND	ND	0.39	0.57	0.16	0.22	<DL	0.16


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
June 23 - 24, 2008
Left Well
* Middle and Right Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
22/18:00
23/6:00
18:00
24/6:00
18:00
25/6:00
Time (24:00)


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
June 22 - 25, 2008
Middle Well
Right Well
* Left Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
22/18:00
23/6:00
18:00
24/6:00
18:00
25/6:00
Time (24:00)

Rain Event Details for 6/22/08

Precipitation Total (Inches)	1.19
Duration (Hours)	3.90
Peak 5 min Intensity (Inches/Hour)	0.05
Average Intensity (Inches/Hour)	0.30

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.52	---	---	2.52
Porosity	0.47	---	---	0.47
Infiltration Uncorrected (Inches/Hour)	0.09	---	---	0.09
Infiltration Corrected (Inches/Hour)	0.04	---	---	0.04

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	2.38	3.06	2.65
Porosity	---	0.50	0.39	0.45
Infiltration Uncorrected (Inches/Hour)	---	0.07	0.09	0.08
Infiltration Corrected (Inches/Hour)	---	0.04	0.04	0.04

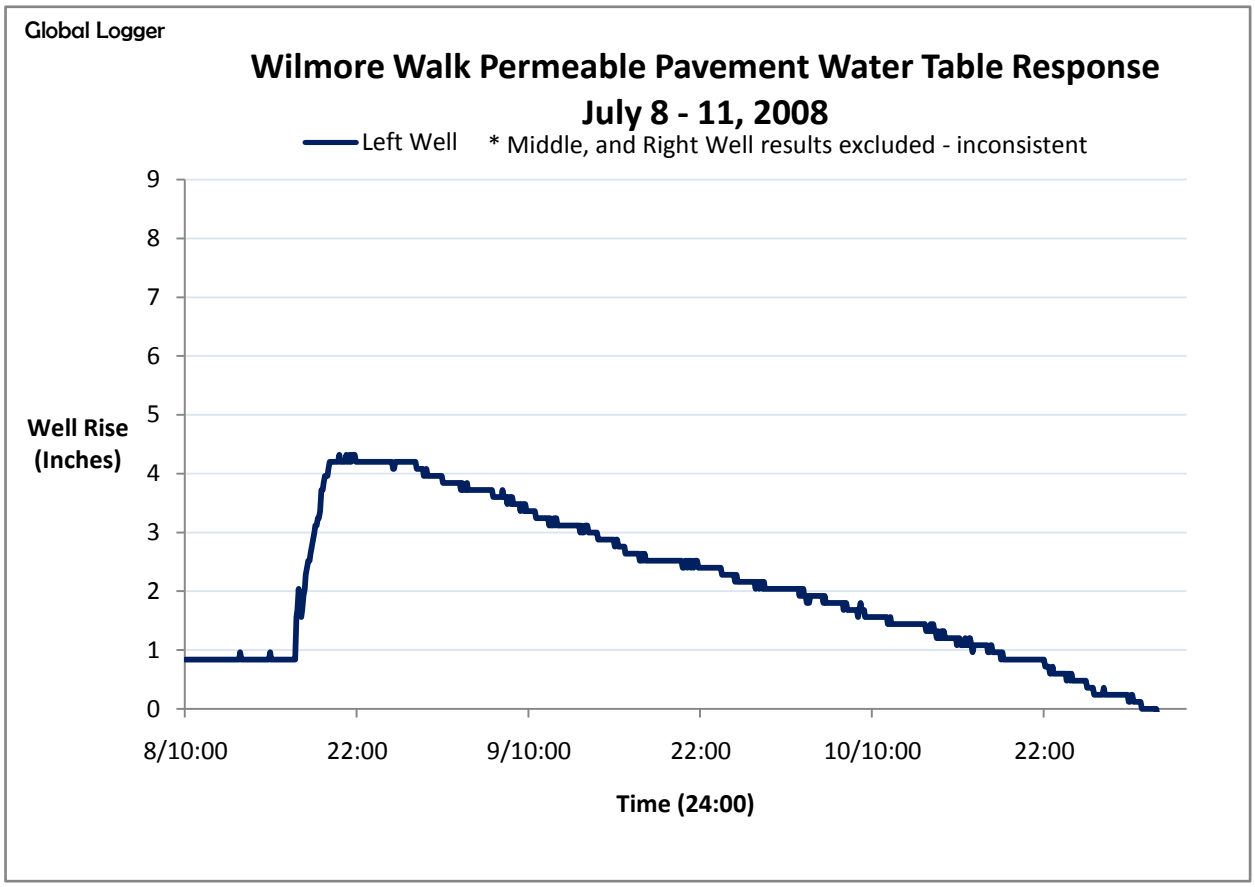
--- = No Data

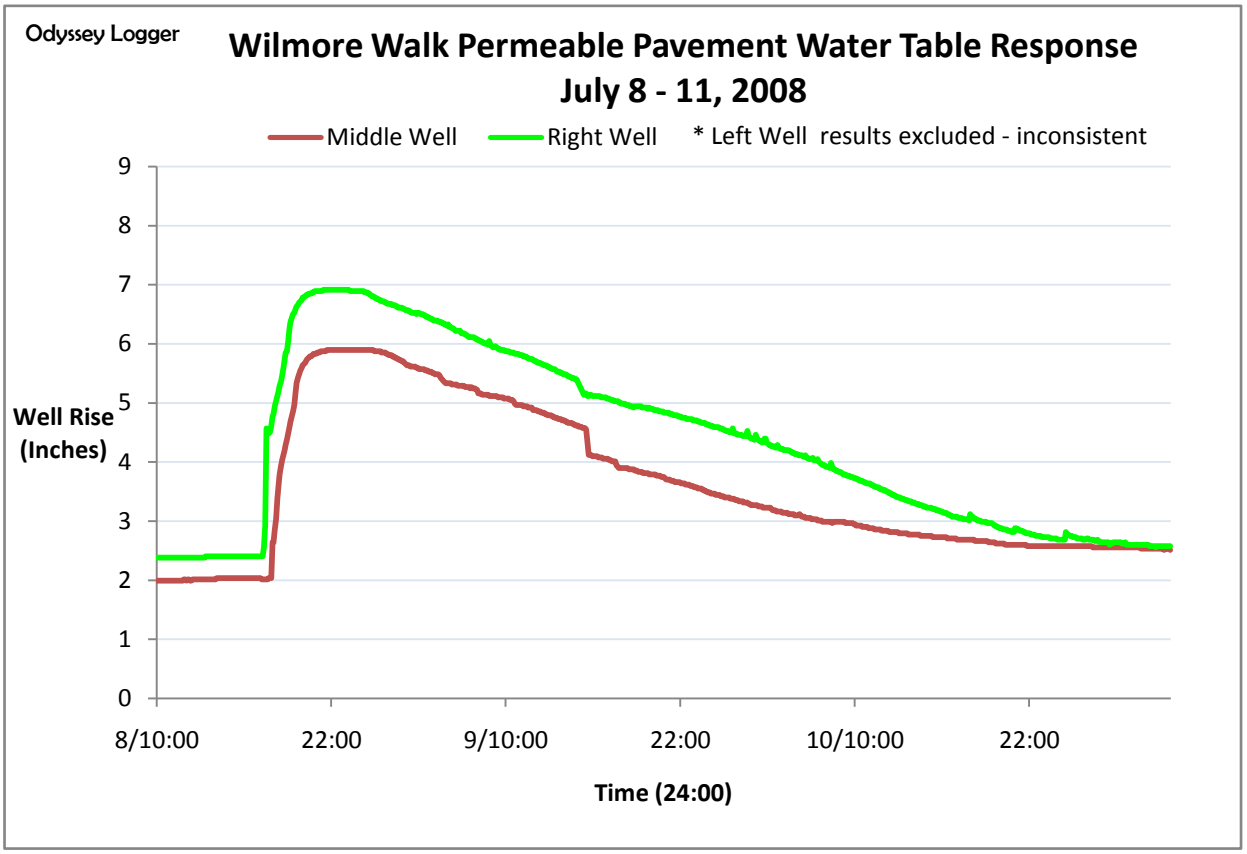
Wilmore Walk June 22, 2008 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	17.4	4.1	0.20	0.93	0.38	0.56	0.01	0.10
Left Well	191	6.25	2.03	2.71	2.46	0.00	0.09	0.28
Middle Well	206	6.5	0.53	0.85	0.68	0.00	0.00	0.06
Right Well	122	7.03	2.82	1.69	1.44	0.00	0.14	0.49

Wilmore Walk June 2008 Water Quality Summary

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
6/12	Bulk Precipitation	43.4	6.4	0.56	3.00	1.21	1.26	0.12	1.25


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
July 8 - 11, 2008
Left Well
* Middle, and Right Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
8/10:00
22:00
9/10:00
22:00
10/10:00
22:00
Time (24:00)


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
July 8 - 11, 2008
Middle Well
Right Well
* Left Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
8/10:00
22:00
9/10:00
22:00
10/10:00
22:00
Time (24:00)

Rain Event Details for 7/8/08

Precipitation Total (Inches)	1.53
Duration (Hours)	2.32
Peak 5 min Intensity (Inches/Hour)	0.07
Average Intensity (Inches/Hour)	0.66

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	3.48	---	---	3.48
Porosity	0.44	---	---	0.44
Infiltration Uncorrected (Inches/Hour)	0.08	---	---	0.08
Infiltration Corrected (Inches/Hour)	0.03	---	---	0.03

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	3.91	4.54	3.98
Porosity	---	0.39	0.35	0.39
Infiltration Uncorrected (Inches/Hour)	---	0.07	0.08	0.08
Infiltration Corrected (Inches/Hour)	---	0.03	0.03	0.03

--- = No Data

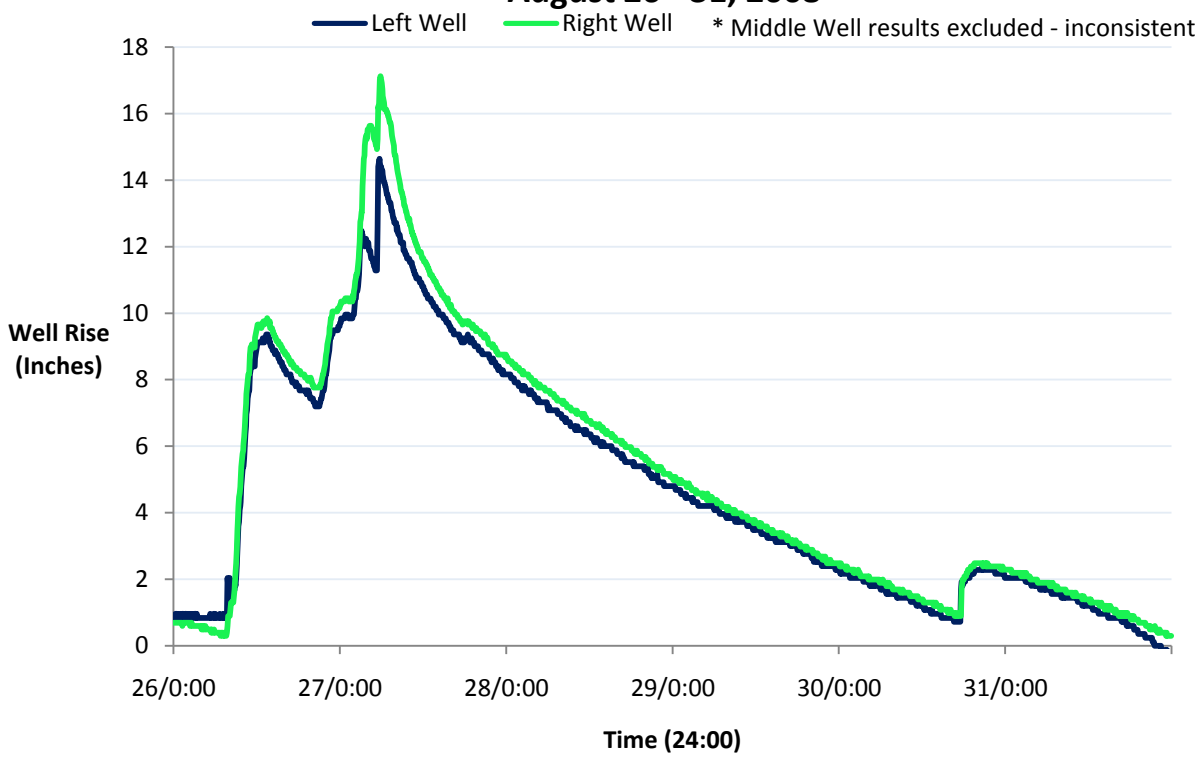
Wilmore Walk July 8, 2008 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	19.3	5.93	0.16	1.87	0.24	1.06	0.14	0.63
Left Well	139.1	6.32	1.08	1.50	1.26	0.08	0.06	0.33
Middle Well	175.2	6.90	0.43	0.63	0.47	0.00	0.00	0.14
Right Well	97.0	6.98	1.44	1.22	0.86	0.00	0.16	0.72

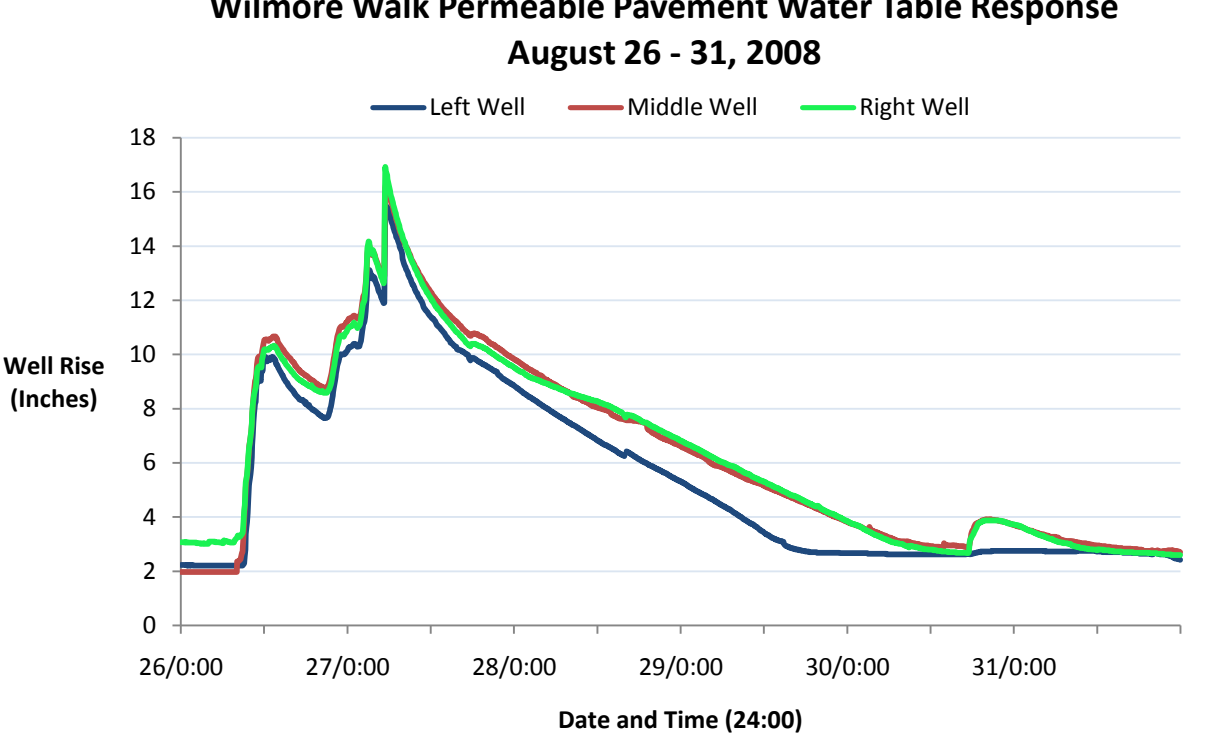
Wilmore Walk July 2008 Water Quality Summary

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
7/11	Bulk Precipitation	32.5	5.63	1.46	1.72	0.66	0.00	0.04	0.27
7/14	Bulk Precipitation	13.7	3.97	0.11	0.67	0.19	0.53	0.00	0.16
7/23	Bulk Precipitation	17.4	4.60	0.19	1.23	0.43	0.36	0.03	0.38
7/30	Bulk Precipitation	19.3	5.74	0.32	1.02	0.38	0.10	0.00	0.18

Global Logger



Odyssey Logger



Rain Event Details for 8/26/08

Precipitation Total (Inches)	5.69
Duration (Hours)	22.60
Peak 5 min Intensity (Inches/Hour)	0.03
Average Intensity (Inches/Hour)	0.16

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	13.80	---	16.43	15.12
Porosity	0.41	---	0.35	0.38
Infiltration Uncorrected (Inches/Hour)	0.17	---	0.20	0.19
Infiltration Corrected (Inches/Hour)	0.07	---	0.17	0.12

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	13.21	14.34	13.84	14.32
Porosity	0.43	0.40	0.41	0.40
Infiltration Uncorrected (Inches/Hour)	0.18	0.19	0.18	0.18
Infiltration Corrected (Inches/Hour)	0.08	0.08	0.08	0.10

Rain Event Details for 8/31/08

Precipitation Total (Inches)	0.57
Duration (Hours)	6.72
Peak 5 min Intensity (Inches/Hour)	0.06
Average Intensity (Inches/Hour)	0.08

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	0.96	---	1.09	1.03
Porosity (Inches/Hour)	0.43	---	0.41	0.42
Infiltration Uncorrected (Inches/Hour)	0.09	---	0.08	0.09
Infiltration Corrected (Inches/Hour)	0.04	---	0.03	0.04

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	0.39	2.96	3.57	1.79
Porosity	0.38	0.44	0.36	0.40
Infiltration Uncorrected (Inches/Hour)	0.10	0.10	0.11	0.10
Infiltration Corrected (Inches/Hour)	0.04	0.04	0.04	0.04

--- = No Data

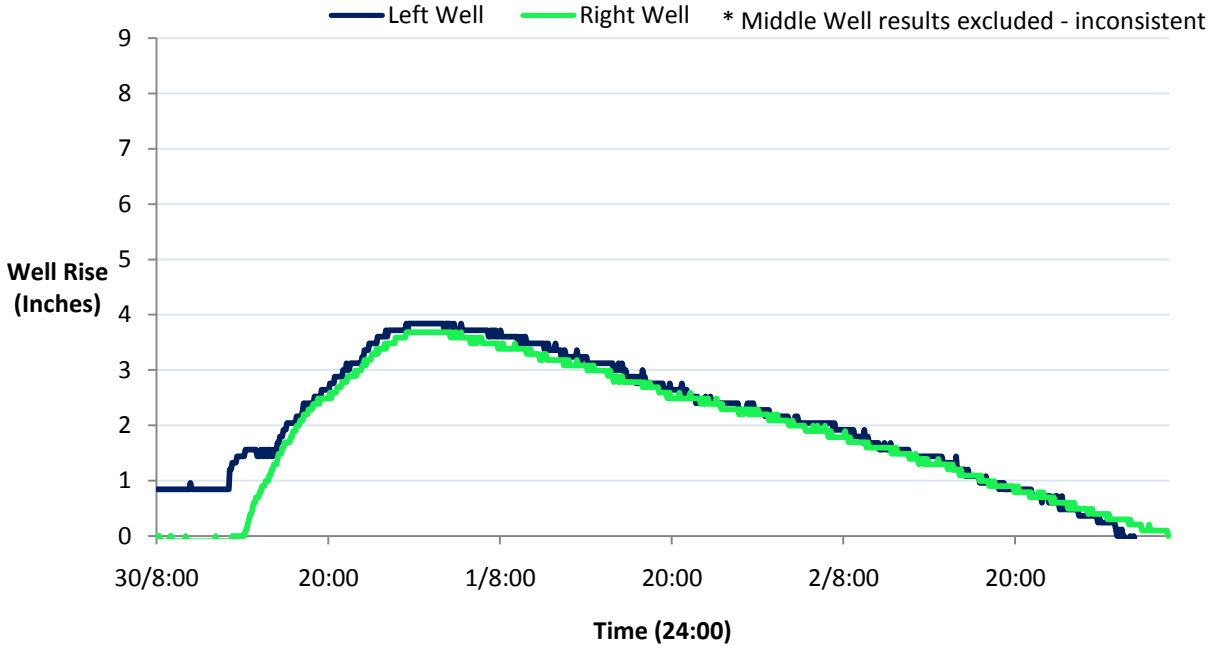
Wilmore Walk August 28, 2008 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	66.5	4.79	0.13	0.43	0.08	0.04	0.01	0.12
Left Well	93.8	6.03	0.56	0.52	0.29	0.02	0.04	0.2
Middle Well	96.3	6.41	0.74	0.54	0.38	<DL	0.01	0.06
Right Well	52.1	7.21	0.71	0.49	0.29	<DL	0.11	0.45

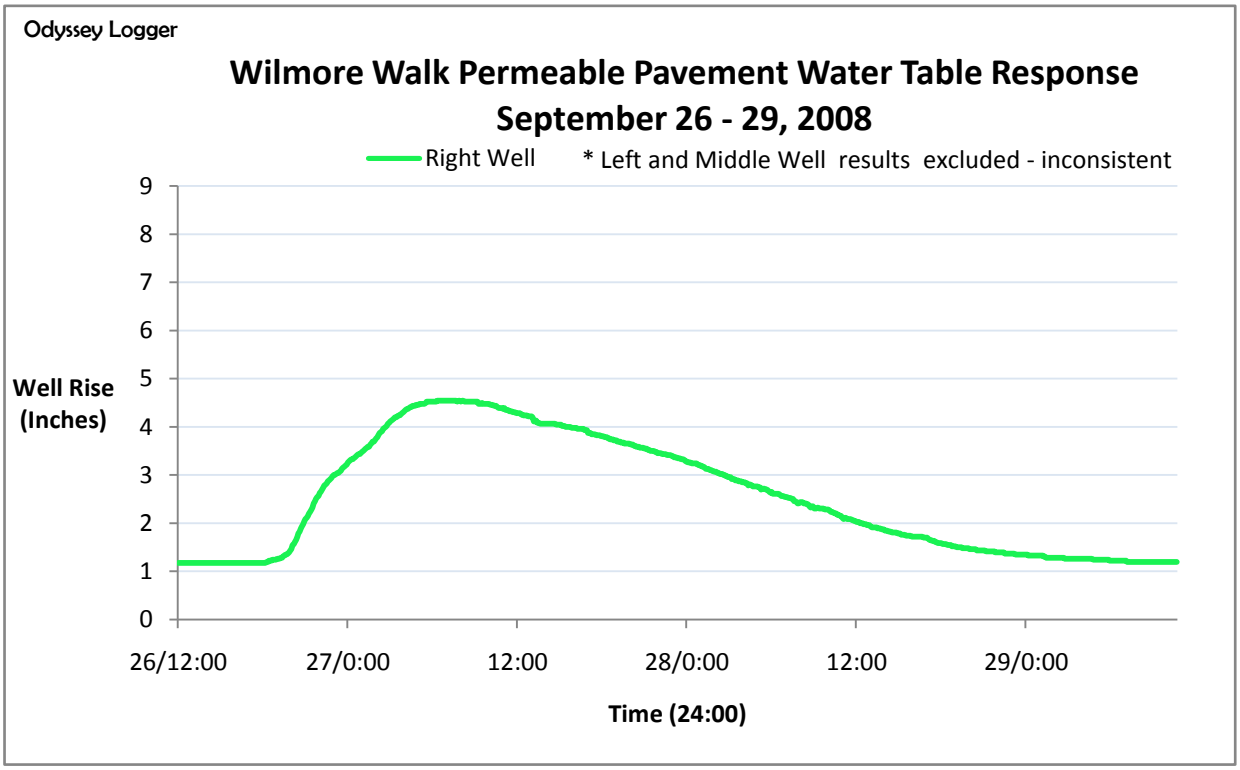
Wilmore Walk August 2008 Water Quality Summary

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
8/1	Bulk Precipitation	27.7	6.00	0.42	1.20	0.52	0.19	<DL	0.27
8/13	Bulk Precipitation	83.1	5.73	2.27	10.12	0.51	4.32	1.34	ND
8/16	Bulk Precipitation	1.5	4.59	1.15	3.13	0.68	0.88	0.11	0.74
8/17	Bulk Precipitation	13.6	4.11	0.09	0.85	0.35	0.33	<DL	0.02
8/26	Bulk Precipitation	11.3	4.79	0.20	1.00	0.09	<DL	0.07	0.44

Global Logger



Odyssey Logger



Rain Event Details for 9/27/08

Precipitation Total (Inches)	1.54
Duration (Hours)	4.67
Peak 5 min Intensity (Inches/Hour)	0.01
Average Intensity (Inches/Hour)	0.07

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	3.00	---	3.68	3.34
Porosity	0.51	---	0.42	0.47
Infiltration Uncorrected (Inches/Hour)	0.09	---	0.08	0.09
Infiltration Corrected (Inches/Hour)	0.05	---	0.03	0.04

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	---	3.34	3.34
Porosity	---	---	0.46	0.46
Infiltration Uncorrected (Inches/Hour)	---	---	0.07	0.08
Infiltration Corrected (Inches/Hour)	---	---	0.03	0.04

--- = No Data

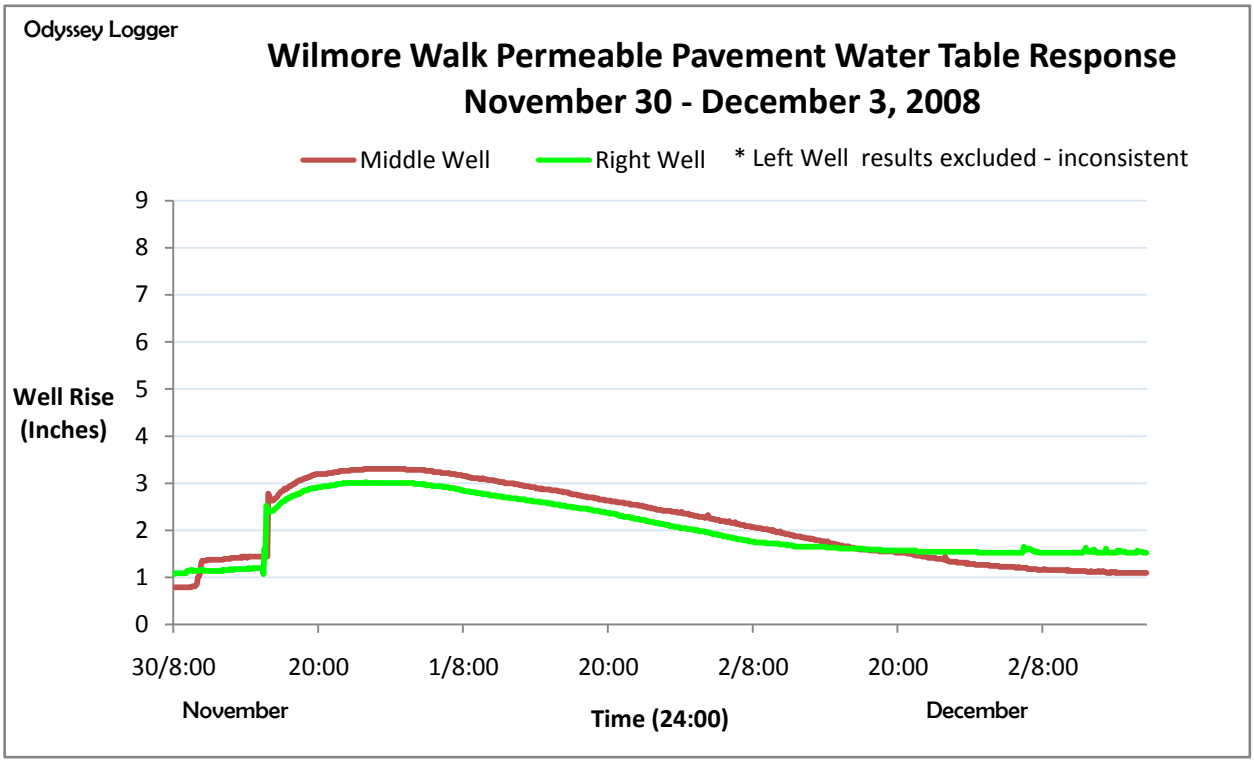
Wilmore Walk September 27, 2008 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	4.60	4.80	0.10	0.26	0.12	0.05	0.00	0.10
Left Well	1.20	6.32	0.64	1.16	0.98	0.00	0.06	0.33
Middle Well	0.40	6.58	0.48	0.55	0.39	0.00	<DL	0.13
Right Well	84.40	6.72	1.62	0.69	0.22	0.00	0.16	0.72

Wilmore Walk September 2008 Water Quality Results

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
9/2	Bulk Precipitation	18.50	5.49	0.15	1.86	0.41	1.50	0.08	0.44
9/11	Bulk Precipitation	9.10	5.68	0.22	0.52	0.19	0.27	0.04	0.21
9/14	Bulk Precipitation	38.80	5.71	---	---	---	---	---	1.25
9/19	Bulk Precipitation	13.50	4.61	0.29	0.94	0.38	0.67	0.00	0.29

--- = No Data


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
November 30 - December 3, 2008
Middle Well
Right Well
* Left Well results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
30/8:00
20:00
1/8:00
20:00
2/8:00
20:00
2/8:00
November
Time (24:00)
December

Rain Event Details for 11/30/08

Precipitation Total (Inches)	0.98
Duration (Hours)	17.08
Peak 5 min Intensity (Inches/Hour)	0.01
Average Intensity (Inches/Hour)	0.06

Wilmore Walk Well Rise Results

	Odyssey Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	2.52	3.02	2.77	
Porosity	---	0.39	0.32	0.36	
Infiltration Uncorrected (Inches/Hour)	---	0.05	0.06	0.06	
Infiltration Corrected (Inches/Hour)	---	0.02	0.02	0.02	

--- = No Data

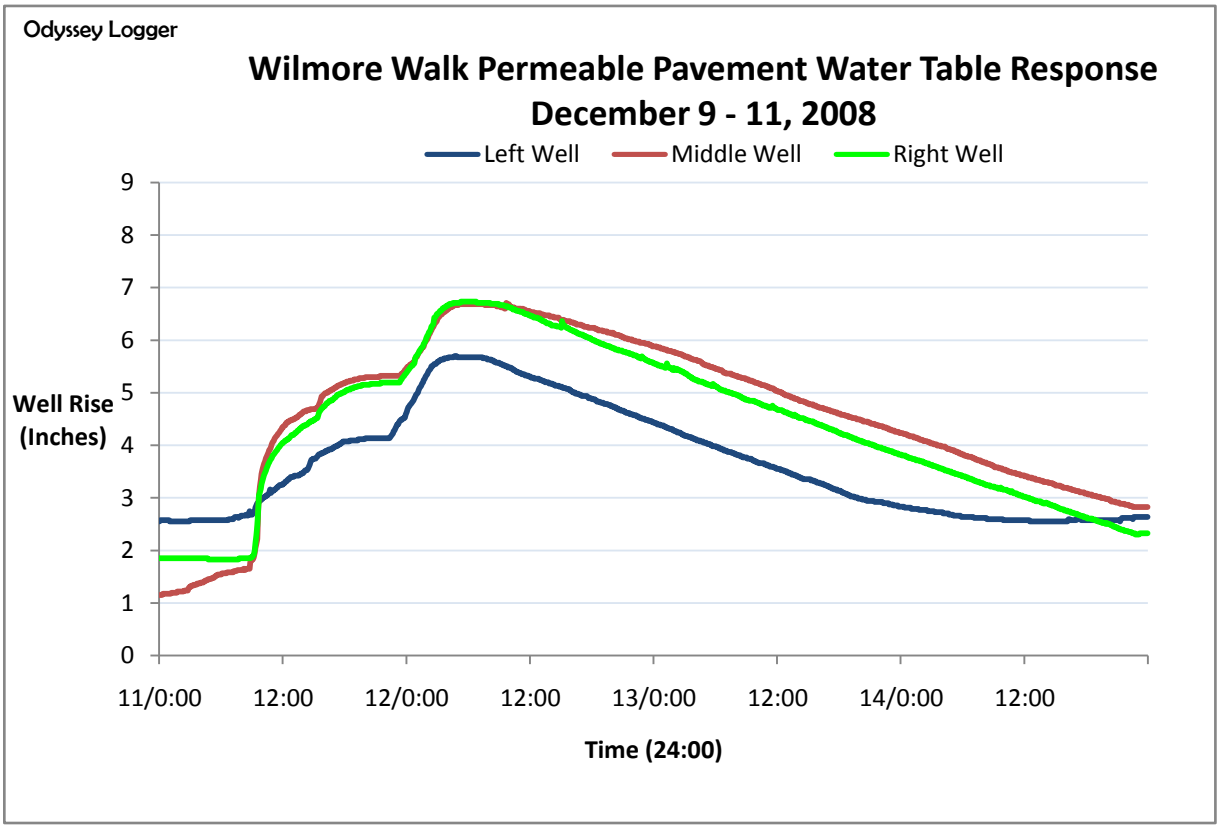
Wilmore Walk November 30, 2008 Water Quality Results

Sample	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	6.20	4.25	0.11	0.33	0.12	0.12	0.00	-0.02
Reservoir (Wells)	---	---	---	---	---	---	---	---

--- = No Data

Wilmore Walk November 2008 Water Quality Results

Date	Sample	Conductivity (µs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
11/15	Bulk Precipitation	8.40	4.46	0.53	0.41	0.15	0.20	0.00	0.11
11/25	Bulk Precipitation	26.70	4.52	0.60	0.94	0.42	0.49	0.00	0.19


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
December 9 - 11, 2008
Left Well
Middle Well
Right Well
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
11/0:00
12:00
12/0:00
12:00
13/0:00
12:00
14/0:00
12:00
Time (24:00)

Rain Event Details for 12/11-12/08

Precipitation Total (Inches)	1.37
Duration (Hours)	5.67
Peak 5 min Intensity (Inches/Hour)	0.01
Average Intensity (Inches/Hour)	0.04

Wilmore Walk Well Rise Results

Odyssey Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	3.15	5.53	4.48	4.39
Porosity	0.43	0.25	0.28	0.32
Infiltration Uncorrected (Inches/Hour)	0.06	0.09	0.08	0.08
Infiltration Corrected (Inches/Hour)	0.02	0.02	0.02	0.02

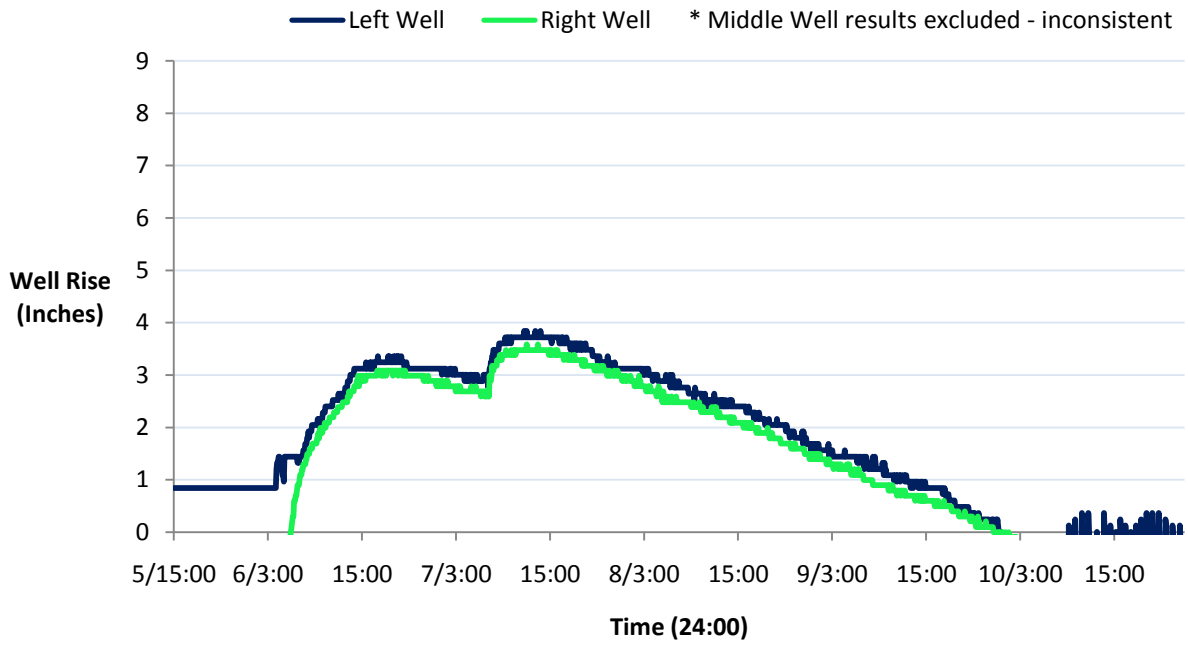
Wilmore Walk December 12, 2008 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	6.5	4.38	0.52	0.25	0.09	0.08	0.00	0.00
Left Well	115.6	6.20	0.76	0.54	0.40	0.00	0.04	0.22
Middle Well	196.4	6.51	0.75	0.25	0.17	0.00	0.00	0.05
Right Well	83.4	6.57	2.49	0.48	0.15	0.00	0.19	0.43

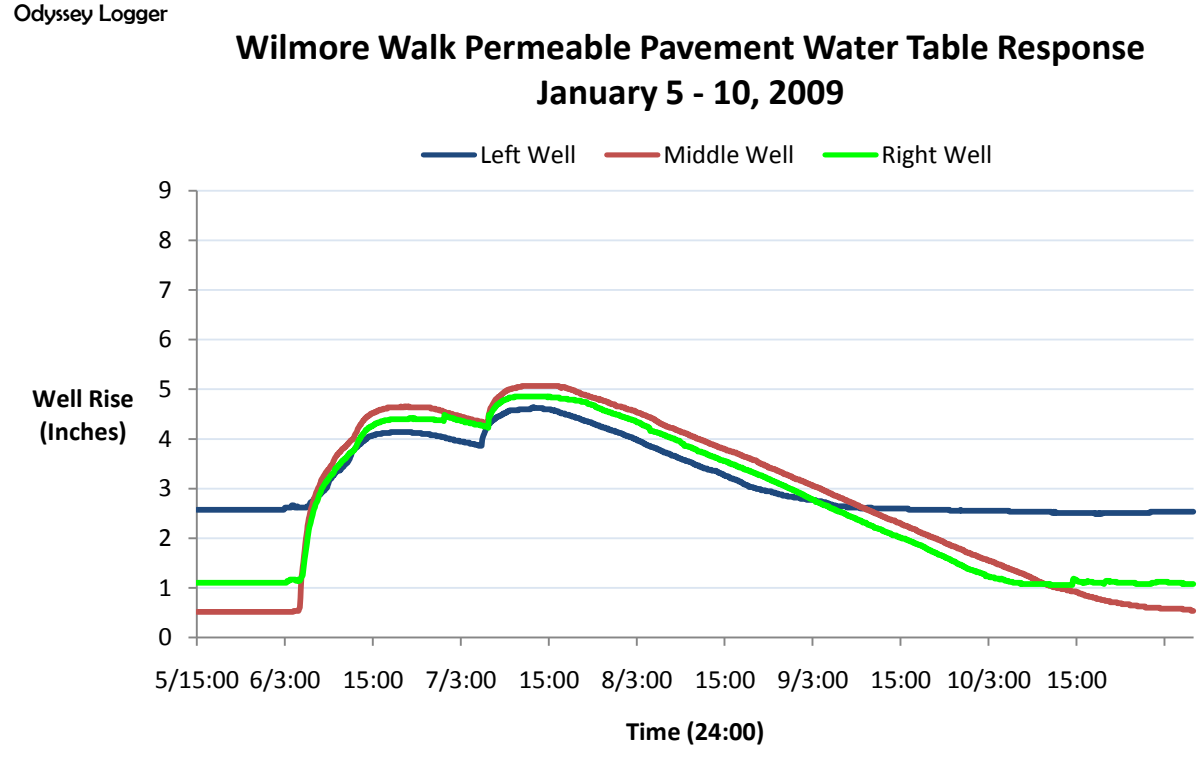
Wilmore Walk December 2008 Water Quality Results

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
12/19	Bulk Precipitation	62.0	3.94	0.85	1.87	0.93	0.97	0.05	0.35
12/25	Bulk Precipitation	14.7	4.95	1.33	0.81	0.34	0.50	0.00	0.04
12/27	Bulk Precipitation	1.5	5.48	0.99	1.42	0.43	1.34	0.00	0.09
12/30	Bulk Precipitation	2.5	5.96	3.34	1.55	0.47	1.63	0.02	0.26

Global Logger



Odyssey Logger



Rain Event Details for 1/6/09

Precipitation Total (Inches)	1.33
Duration (Hours)	2.37
Peak 5 min Intensity (Inches/Hour)	0.03
Average Intensity (Inches/Hour)	0.12

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.52	---	3.08	2.80
Porosity	0.53	---	0.42	0.48
Infiltration Uncorrected (Inches/Hour)	0.31	---	0.30	0.31
Infiltration Corrected (Inches/Hour)	0.16	---	0.13	0.15

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	4.14	4.12	3.32	3.44
Porosity	0.32	0.32	0.40	0.40
Infiltration Uncorrected (Inches/Hour)	0.43	0.38	0.33	0.35
Infiltration Corrected (Inches/Hour)	0.14	0.12	0.13	0.14

Rain Event Details for 1/7/09

Precipitation Total (Inches)	0.29
Duration (Hours)	5.78
Peak 5 min Intensity (Inches/Hour)	0.01
Average Intensity (Inches/Hour)	0.01

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.52	---	3.68	3.10
Porosity	0.53	---	0.42	0.48
Infiltration Uncorrected (Inches/Hour)	0.07	---	0.07	0.07
Infiltration Corrected (Inches/Hour)	0.02	---	0.02	0.02

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	0.78	0.76	0.56	1.66
Porosity	0.37	0.38	0.52	0.44
Infiltration Uncorrected (Inches/Hour)	0.05	0.05	0.04	0.06
Infiltration Corrected (Inches/Hour)	0.02	0.02	0.02	0.02

--- = No Data

Overall Storm Event Results for January 6 and 7, 2009

Rain Event Details for 1/6-7/09

Precipitation Total (Inches)	1.62
Duration (Hours)	8.15
Peak 5 min Intensity (Inches/Hour)	0.03
Average Intensity (Inches/Hour)	0.12

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	3.84	---	3.59	3.72
Porosity	0.42	---	0.45	0.44
Infiltration Uncorrected (Inches/Hour)	0.07	---	0.06	0.07
Infiltration Corrected (Inches/Hour)	0.03	---	0.03	0.03

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	4.64	4.56	3.75	4.08
Porosity	0.35	0.36	0.43	0.40
Infiltration Uncorrected (Inches/Hour)	0.08	0.06	0.05	0.06
Infiltration Corrected (Inches/Hour)	0.03	0.02	0.02	0.03

--- = No Data

Wilmore Walk January 7, 2009 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	11.9	6.29	0.29	0.31	0.09	0.27	0.00	0.02
Left Well	105.6	6.10	3.13	1.53	1.00	0.00	0.17	0.61
Middle Well	123.1	6.38	0.98	0.32	0.22	0.00	0.00	0.04
Right Well	12.3	6.10	3.71	1.17	0.10	0.00	0.23	0.91

Wilmore Walk January 2009 Water Quality Results

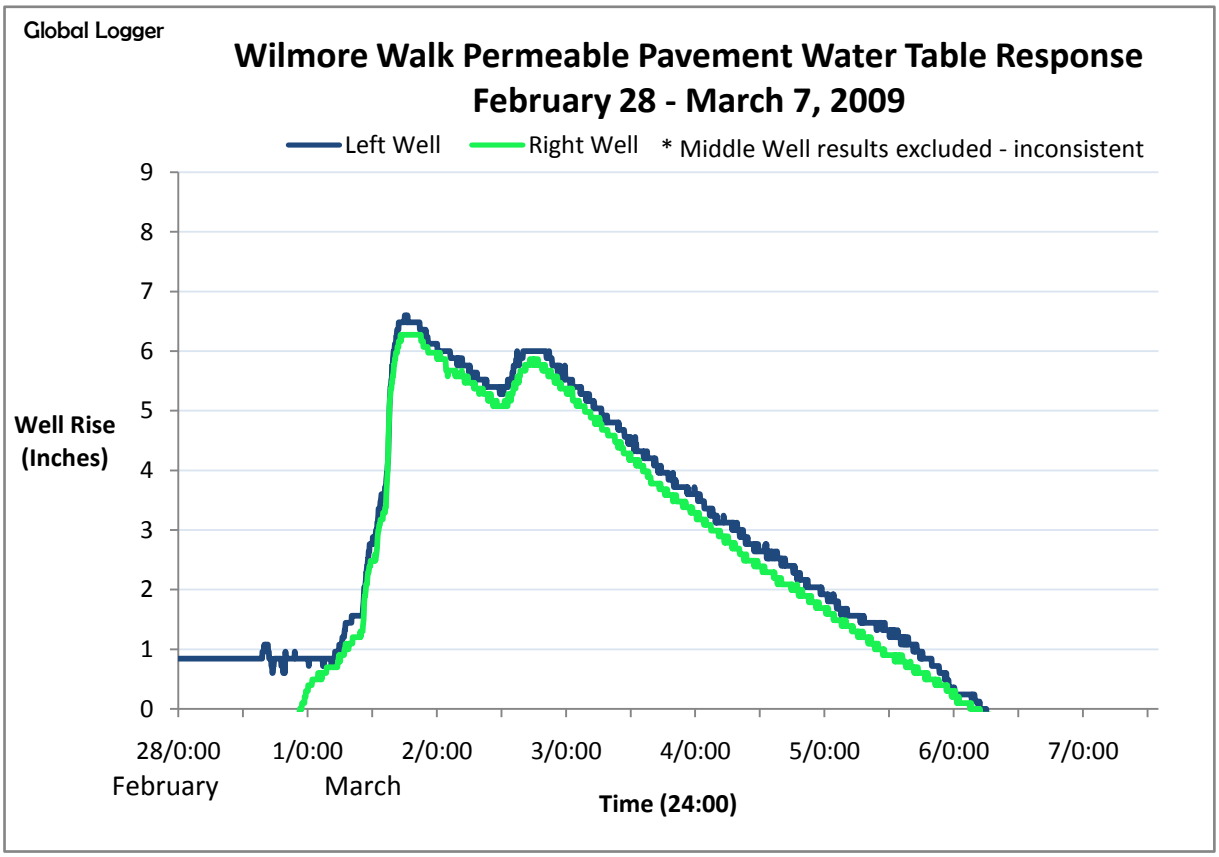
Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
1/11	Bulk Precipitation	27.3	6.15	0.75	1.05	0.37	0.86	0.00	0.12
1/30	Bulk Precipitation	34.2	5.46	3.32	2.54	1.02	2.48	0.01	0.24

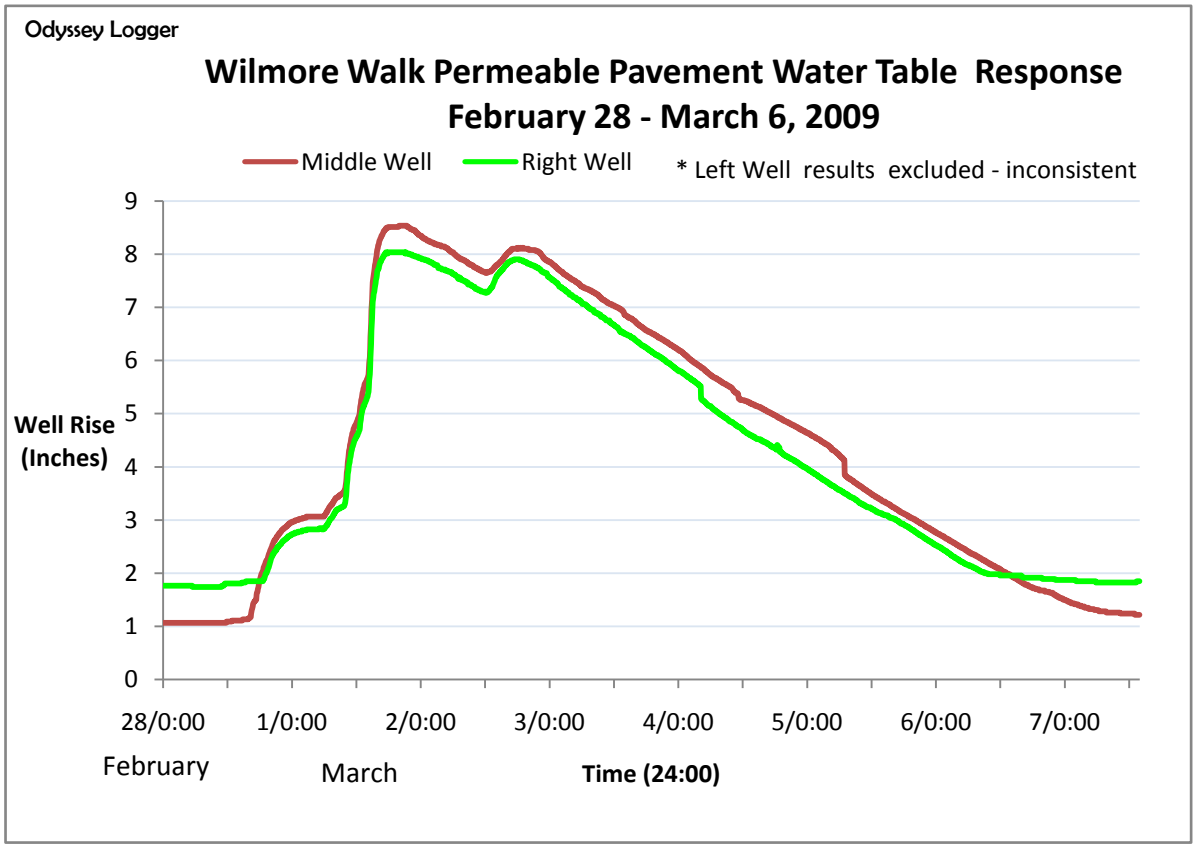
--- = No Data

February had no significant Well Response Results

Wilmore Walk February 2009 Water Quality Results

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
2/4	Bulk Precipitation	87.2	5.83	2.14	1.20	0.00	0.17	0.00	1.14
2/13	Bulk Precipitation	18.1	5.74	1.62	0.99	0.34	0.77	0.00	0.27
2/17	Bulk Precipitation	27.5	5.73	0.29	1.44	0.54	1.08	0.01	0.19


Global Logger
Wilmore Walk Permeable Pavement Water Table Response
February 28 - March 7, 2009
Left Well
Right Well
* Middle Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
28/0:00
1/0:00
2/0:00
3/0:00
4/0:00
5/0:00
6/0:00
7/0:00
February
March
Time (24:00)


Odyssey Logger
Wilmore Walk Permeable Pavement Water Table Response
February 28 - March 6, 2009
Middle Well
Right Well
* Left Well results excluded - inconsistent
Well Rise (Inches)
0
1
2
3
4
5
6
7
8
9
28/0:00
1/0:00
2/0:00
3/0:00
4/0:00
5/0:00
6/0:00
7/0:00
February
March
Time (24:00)

Rain Event Details for 3/1/09

Precipitation Total (Inches)	1.39
Duration (Hours)	2.50
Peak 5 min Intensity (Inches/Hour)	0.01
Average Intensity (Inches/Hour)	0.09

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	5.76	---	6.28	6.02
Porosity	0.24	---	0.22	0.23
Infiltration Uncorrected (Inches/Hour)	NC	---	NC	NC
Infiltration Corrected (Inches/Hour)	0.07	---	0.10	0.09

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	7.47	6.28	6.45
Porosity	---	0.19	0.22	0.22
Infiltration Uncorrected (Inches/Hour)	---	NC	NC	NC
Infiltration Corrected (Inches/Hour)	---	0.09	0.09	0.09

Rain Event Details for 3/2/09

Precipitation Total (Inches)	0.56
Duration (Hours)	6.50
Peak 5 min Intensity (Inches/Hour)	0.01
Average Intensity (Inches/Hour)	0.22

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	0.60	---	0.79	0.70
Porosity	NC	---	NC	NC
Infiltration Uncorrected (Inches/Hour)	0.01	---	0.01	0.01
Infiltration Corrected (Inches/Hour)	0.01	---	0.01	0.01

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	1.85	0.62	0.97
Porosity	---	0.30	NC	0.30
Infiltration Uncorrected (Inches/Hour)	---	0.25	0.07	0.09
Infiltration Corrected (Inches/Hour)	---	0.08	0.06	0.04

--- = No Data

Overall Storm Event Results for February 28 - March 2, 2009

Rain Event Details for 2/28-3/2/09

Precipitation Total (Inches)	2.81
Duration (Hours)	48.90
Peak 5 min Intensity (Inches/Hour)	0.01
Average Intensity (Inches/Hour)	0.06

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	6.00	---	5.87	5.94
Porosity	0.33	---	0.33	0.33
Infiltration Uncorrected (Inches/Hour)	0.08	---	0.08	0.08
Infiltration Corrected (Inches/Hour)	0.03	---	0.03	0.03

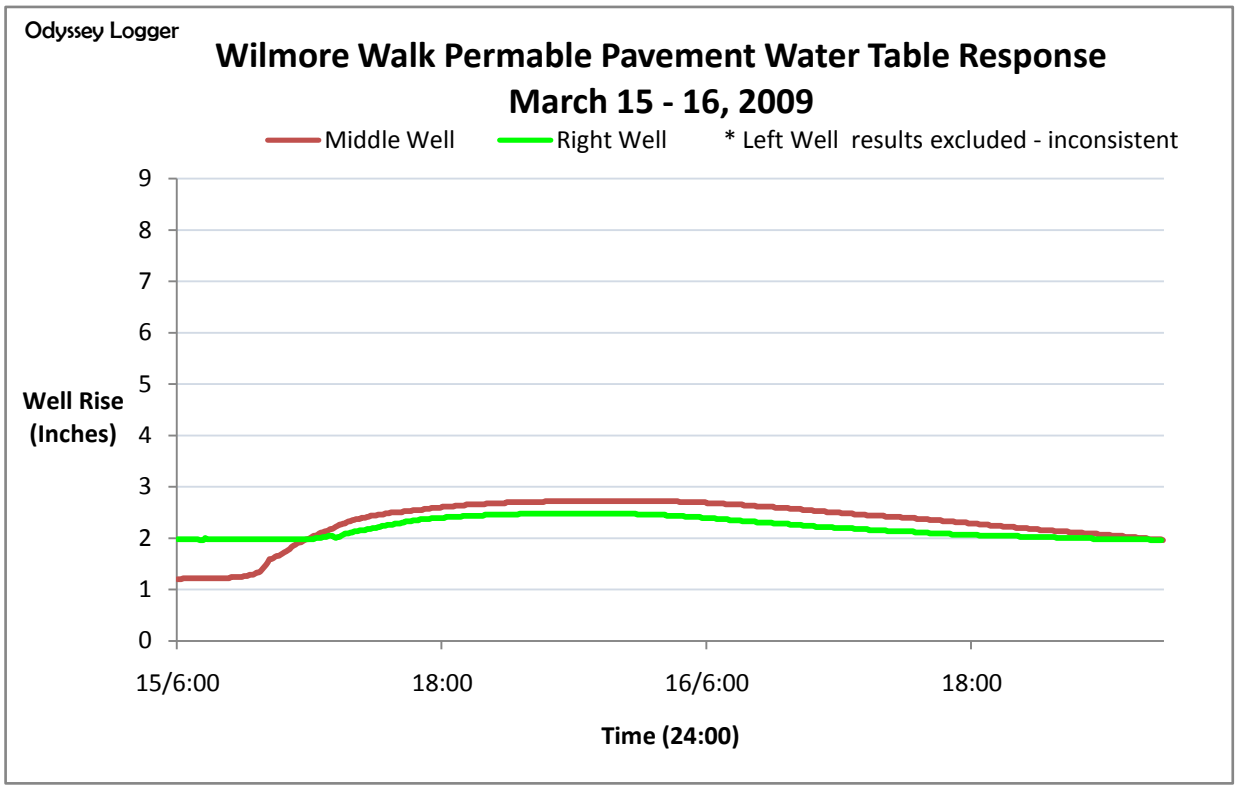
Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	---	6.84	6.05	6.19
Porosity	---	0.29	0.32	0.32
Infiltration Uncorrected (Inches/Hour)	---	0.06	0.06	0.07
Infiltration Corrected (Inches/Hour)	---	0.02	0.02	0.03

--- = No Data

Wilmore Walk March 2, 2009 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	5.5	6.13	0.45	0.29	0.23	0.23	0.01	0.04
Left Well	90.2	6.30	0.20	0.20	0.13	0.00	0.01	0.19
Middle Well	---	---	---	---	---	---	---	---
Right Well	34.8	6.26	0.08	0.25	0.00	0.00	0.01	0.36

--- = No Data


Odyssey Logger
Wilmore Walk Permable Pavement Water Table Response
March 15 - 16, 2009
Middle Well
Right Well
* Left Well results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
15/6:00
18:00
16/6:00
18:00
Time (24:00)

Rain Event Details for 3/15/09

Precipitation Total (Inches)	0.53
Duration (Hours)	17.38
Peak 5 min Intensity (Inches/Hour)	0.00
Average Intensity (Inches/Hour)	0.03

Wilmore Walk Well Rise Results

Odyssey Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	1.52	2.46	1.99
Porosity	---	0.35	0.22	0.29
Infiltration Uncorrected (Inches/Hour)	---	0.07	0.10	0.09
Infiltration Corrected (Inches/Hour)	---	0.02	0.02	0.02

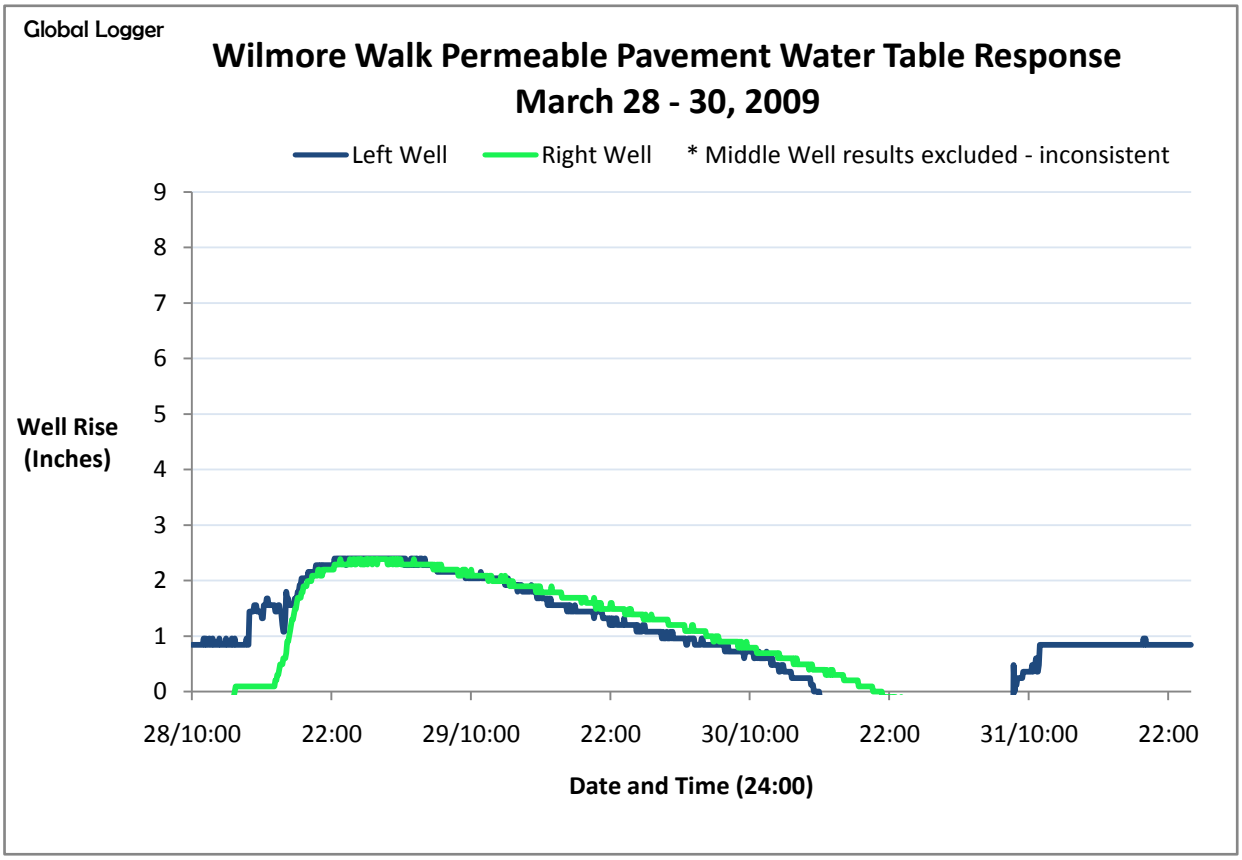
--- = No Data

Wilmore Walk March 15, 2009 Water Quality Results

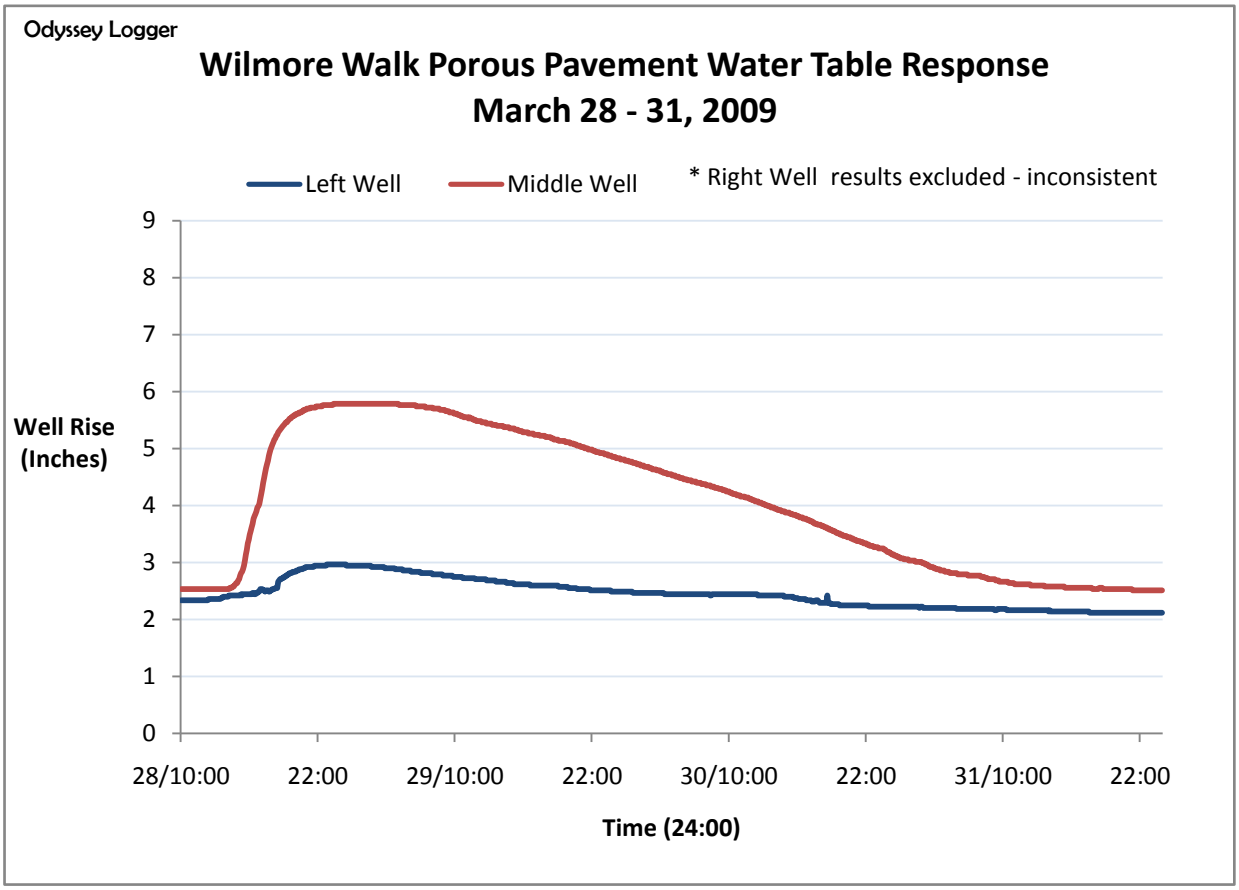
Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	22.2	5.13	2.14	0.85	0.44	0.2	1.43	1.1
Reservoir (Wells)	---	---	---	---	---	---	---	---

--- = No Data

Global Logger



Odyssey Logger



Rain Event Details for 3/27/09

Precipitation Total (Inches)	0.94
Duration (Hours)	8.04
Peak 5 min Intensity (Inches/Hour)	0.01
Average Intensity (Inches/Hour)	0.12

Wilmore Walk Well Rise Results

Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	2.40	---	2.38	2.39
Porosity	0.39	---	0.39	0.39
Infiltration Uncorrected (Inches/Hour)	0.07	---	0.06	0.07
Infiltration Corrected (Inches/Hour)	0.03	---	0.02	0.03

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	2.97	3.25	---	2.75
Porosity	0.32	0.29	---	0.35
Infiltration Uncorrected (Inches/Hour)	0.06	0.06	---	0.06
Infiltration Corrected (Inches/Hour)	0.02	0.02	---	0.02

--- = No Data

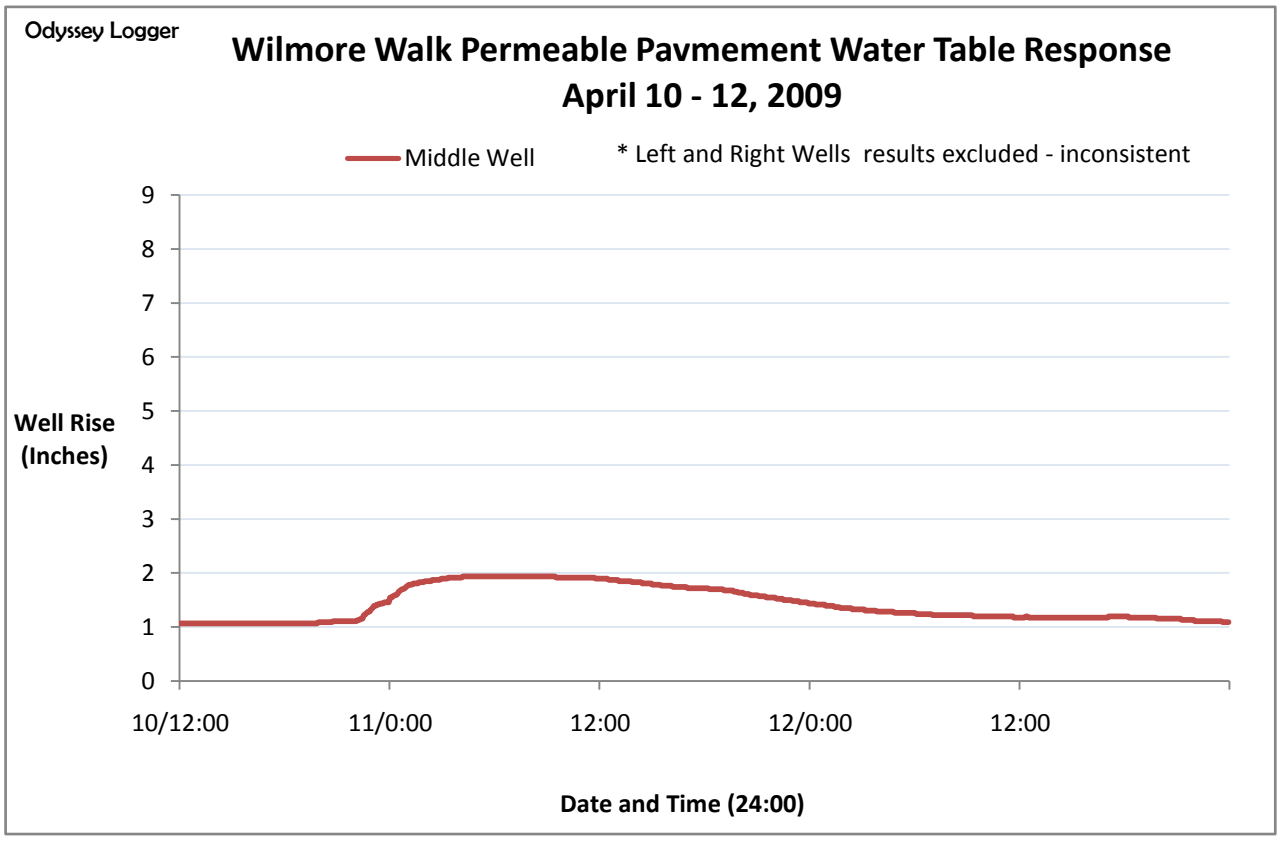
Wilmore Walk March 28, 2009 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	22.2	5.13	2.14	0.85	0.44	0.20	1.43	1.10
Reservoir (Wells)	---	---	---	---	---	---	---	---

--- = No Data

Wilmore Walk March 2009 Water Quality Results

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
3/26	Bulk Precipitation	21.80	4.74	0.31	1.93	0.89	1.26	0.03	0.24
3/30	Bulk Precipitation	13.50	5.41	0.90	0.91	0.31	0.58	0.07	0.37


Odyssey Logger
Wilmore Walk Permeable Pavmement Water Table Response
April 10 - 12, 2009
Middle Well
* Left and Right Wells results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
10/12:00
11/0:00
12:00
12/0:00
12:00
Date and Time (24:00)

Rain Event Details for 4/11/09

Precipitation Total (Inches)	0.80
Duration (Hours)	19.22
Peak 5 min Intensity (Inches/Hour)	0.03
Average Intensity (Inches/Hour)	0.04

Wilmore Walk Well Rise Results

Odyssey Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	1.84	---	1.84
Porosity	---	0.41	---	0.41
Infiltration Uncorrected (Inches/Hour)	---	0.05	---	0.05
Infiltration Corrected (Inches/Hour)	---	0.02	---	0.02

--- = No Data

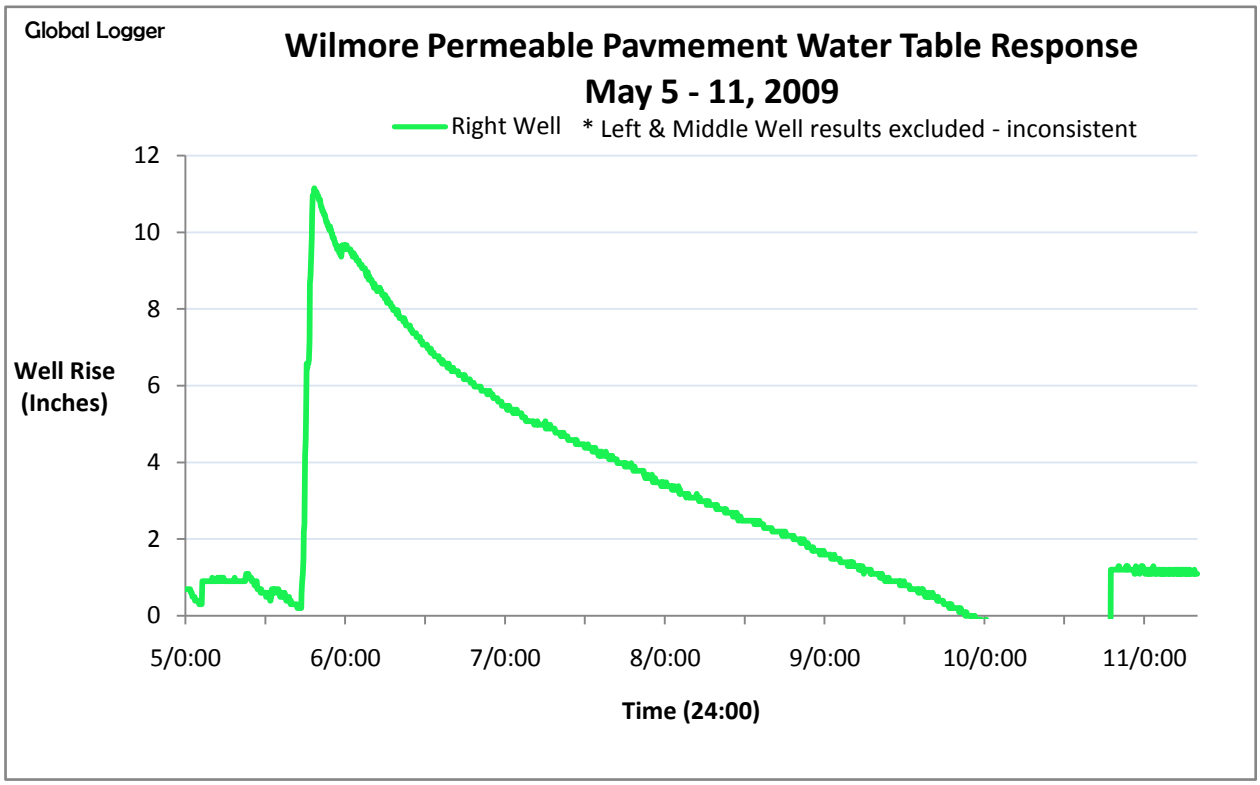
Wilmore Walk April 11, 2009 Water Quality Results

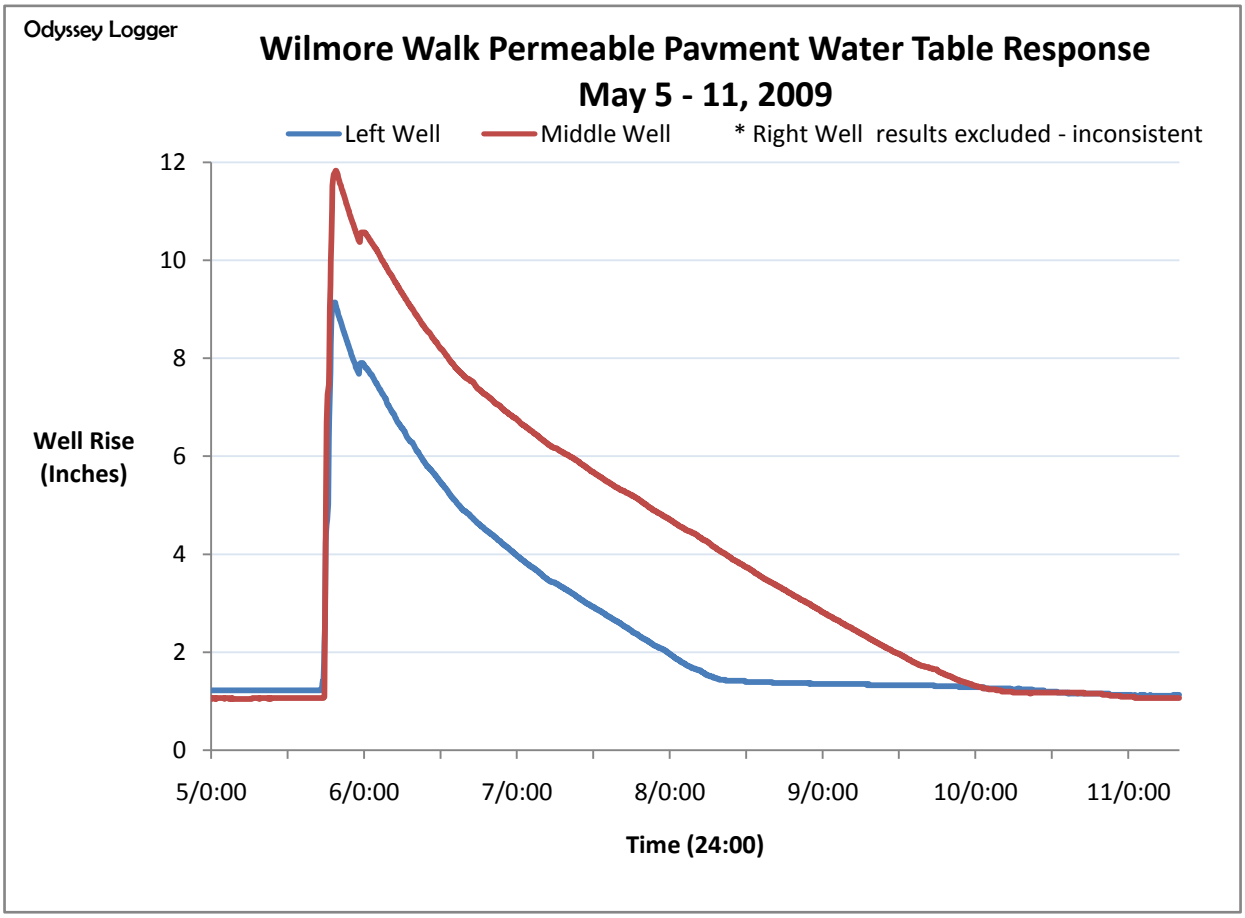
Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	26.7	4.88	0.68	1.88	0.3	1.71	0.15	0.71
Reservoir (Wells)	---	---	---	---	---	---	---	---

--- = No Data

Wilmore Walk April 2009 Water Quality Results

Date	Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
4/5	Bulk Precipitation	1.1	4.78	0.64	3.95	0.37	4.15	0.41	3.04
4/23	Bulk Precipitation	56.9	4.93	3.16	6.39	0.60	0.14	0.31	3.76


Global Logger
Wilmore Permeable Pavmement Water Table Response
May 5 - 11, 2009
Right Well
* Left & Middle Well results excluded - inconsistent
Well Rise (Inches)
12
10
8
6
4
2
0
5/0:00
6/0:00
7/0:00
8/0:00
9/0:00
10/0:00
11/0:00
Time (24:00)


Odyssey Logger
Wilmore Walk Permeable Pavment Water Table Response
May 5 - 11, 2009
Left Well
Middle Well
* Right Well results excluded - inconsistent
Well Rise (Inches)
12
10
8
6
4
2
0
5/0:00
6/0:00
7/0:00
8/0:00
9/0:00
10/0:00
11/0:00
Time (24:00)

Rain Event Details for 5/5/09

Precipitation Total (Inches)	2.61
Duration (Hours)	18.67
Peak 5 min Intensity (Inches/Hour)	0.06
Average Intensity (Inches/Hour)	0.14

Wilmore Walk Well Rise Results

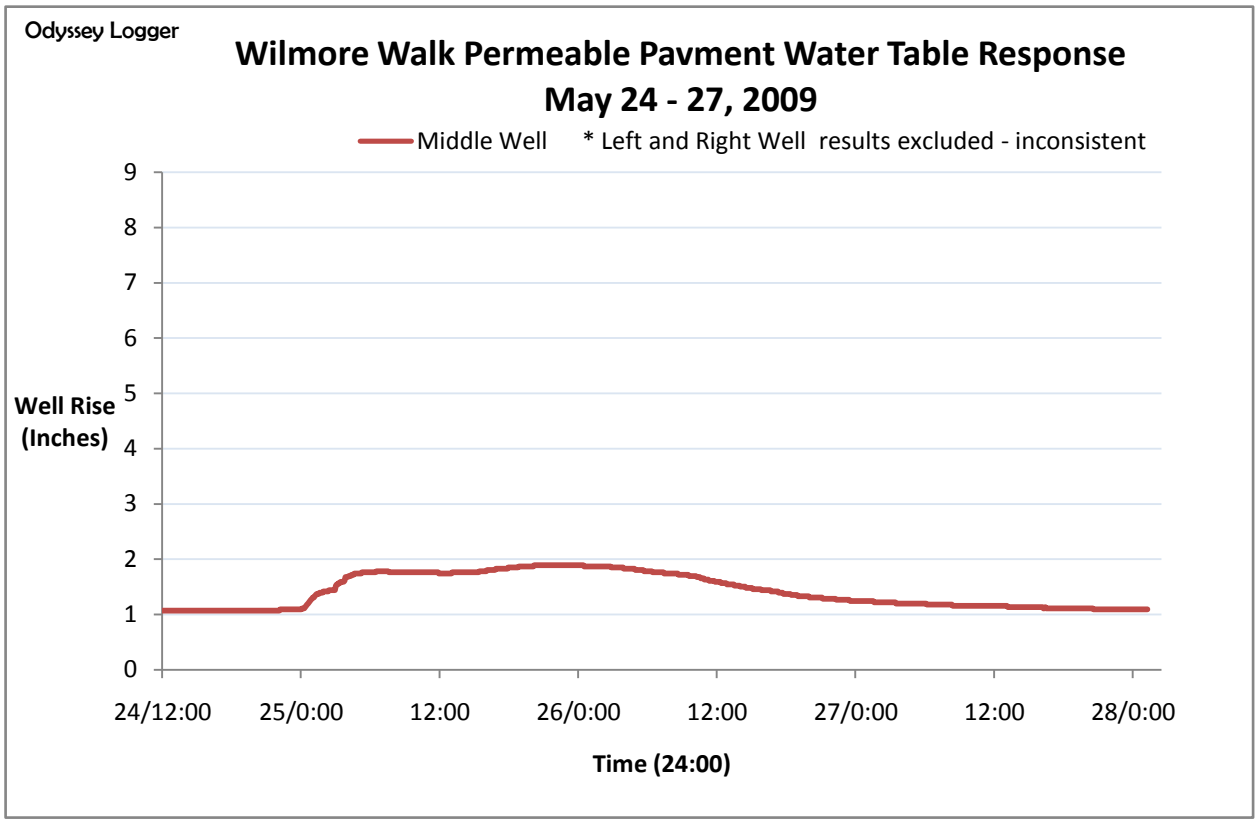
Global Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	---	10.05	10.05
Porosity	---	---	0.26	0.26
Infiltration Uncorrected (Inches/Hour)	---	---	0.10	0.10
Infiltration Corrected (Inches/Hour)	---	---	0.03	0.03

Odyssey Logger	Left Well	Middle Well	Right Well	Total Average
Total Rise (Inches)	7.92	10.76	---	9.58
Porosity	0.33	0.24	---	0.28
Infiltration Uncorrected (Inches/Hour)	0.14	0.11	---	0.12
Infiltration Corrected (Inches/Hour)	0.05	0.03	---	0.04

--- = No Data

Wilmore Walk May 5, 2009 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	7.3	4.44	0.01	0.14	1.02	0.19	0.00	0.23
Left Well	3.2	5.71	0.03	0.24	15.63	1.58	4.87	0.09
Middle Well	144	5.98	0.00	0.28	15.34	1.71	5.46	0.15
Right Well	59.5	5.72	0.06	0.15	6.40	1.04	2.12	0.23


Odyssey Logger
Wilmore Walk Permeable Pavment Water Table Response
May 24 - 27, 2009
Middle Well
* Left and Right Well results excluded - inconsistent
Well Rise (Inches)
9
8
7
6
5
4
3
2
1
0
24/12:00
25/0:00
12:00
26/0:00
12:00
27/0:00
12:00
28/0:00
Time (24:00)

Rain Event Details for 5/24/09

Precipitation Total (Inches)	0.70
Duration (Hours)	12.43
Peak 5 min Intensity (Inches/Hour)	0.02
Average Intensity (Inches/Hour)	0.06

Wilmore Walk Well Rise Results

Odyssey Logger	Left Well	Middle Well	Right Well	Average
Total Rise (Inches)	---	0.82	---	0.82
Porosity	---	0.29	---	0.29
Infiltration Uncorrected (Inches/Hour)	---	0.02	---	0.02
Infiltration Corrected (Inches/Hour)	---	0.01	---	0.01

--- = No Data

Wilmore Walk May 24, 2009 Water Quality Results

Sample	Conductivity (μs/cm)	pH	Cl^- (mg/L)	TN	NO_3-N (mg/L)	NH_4^+-N (mg/L)	PO_4-P (mg/L)	TP (PO_4^{-3}) (mg/L)
Bulk Precipitation	---	---	---	---	---	---	---	---
Reservoir (Wells)	---	---	---	---	---	---	---	---

--- = No Data