EVALUATION OF INFILTRATION SWALE MEDIA USING SMALL- AND INTERMEDIATE-SCALE TESTING TECHNIQUES

by

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ABSTRACT

When impervious surfaces such as paved roadways are constructed, the volume of water infiltrating into native soil decreases, leading to an increase in surface water runoff. This phenomenon results in higher peak flows, elevated erosion rates, and the transport of total suspended solids and pollutants. Hydrocarbons and other pollutants from paved surfaces find their way into receiving water bodies, posing environmental challenges. Regulations mandate water runoff control to minimize erosion and prevent sediment deposition. Low impact development (LID) practices aim to maintain the pre-development hydrological cycle through processes including evapotranspiration, infiltration, water reuse, and filtration. The Alabama Department of Transportation (ALDOT) relies on implementing infiltration swales, a type of LID practice, alongside roadways to manage water runoff quantity. These practices function by promoting surface water runoff to enter through an engineered media within roadside channels. By having a high permeability rate, the media serves to promote groundwater infiltration. Currently, ALDOT infiltration swale media is made up of a matrix consisting of topsoil, sand, and No. 57 stone wrapped with geotextile. Infiltration swales have been used throughout the state by ALDOT, however, their performance has not been evaluated and thus research is needed to understand how this standard media performs and to optimize its performance.

The purpose of this research was to design a methodology for evaluating and optimizing the performance of infiltration swale media. Testing methodologies and apparatuses were developed to assess their capacity to infiltrate water on a small and intermediate scale. Three types of apparatuses were built for this research: a permeameters structure, consisting of 18 permeameters with a diameter of 6 in. (15.2 cm) and a length of 3.0 ft (0.9 m), a clear infiltrometers structure, consisting of six infiltrometers with a diameter of 6 in. (15.2 cm) and a length of 3.0 ft (0.9 m),

and an infiltration swale chamber, monitored by a moisture content system, with internal dimensions measuring 8.0 ft (2.4 m) in length, 2.5 ft (0.8 m) in width, and 4.0 ft (1.2 m) in height. Constant head permeability tests conducted on the permeameters revealed that the current ALDOT infiltration swale media design yields a very low permeability ranging from 0.0017 in./min (0.0043 cm/min) to 0.019 in./min (0.0495 cm/min). This is attributed to the low permeability of the topsoil, which yielded 0.002 in./min (0.004 cm/min).

As a result, designs containing topsoil as the top layer could not achieve the minimum infiltration rate of 1.0 ft/day (0.38 m/day) required by the Alabama LID Manual. To improve the infiltration rate through the topsoil layer, alternatives with amended materials were investigated. Several mixtures of amended topsoil, consisting of topsoil and pine bark fines at different proportions, underwent falling head infiltration rate tests. The amended topsoil mixture containing 80% topsoil and 20% pine bark was selected as the top layer for future alternative designs because it yielded an average infiltration rate under falling head conditions of 5.6 ft/day (1.6 m/day), 8.8 times higher than topsoil alone, which yielded 0.63 ft/day (0.19 m/day).

Throughout the process, the testing methodology to evaluate the performance of infiltration swale media design in the infiltrometers was refined to establish a consistent testing regimen comprising three constant head infiltration tests lasting six hours each, followed by three falling head infiltration tests. Constant head infiltration tests simulated the prolonged use of infiltration swale media, providing insights into their long-term performance. Falling head infiltration tests allowed for understanding the time required by the designs to infiltrate the ponding water, enabling comparisons of their performances with the minimum required infiltration rate of 1 ft/day (0.38 m/day). Initially, five infiltration swale media designs were proposed and subjected to this testing regimen. In an iterative cycle of evaluation and improvement, the results of previous tests were analyzed to identify causes of low performance and potential enhancement options. During this testing and optimization process, it was evident that designs including a geotextile layer wrapped up around the No. 57 stone exhibited a continuous decrease in their infiltration rate due to the gradual clogging of geotextile pores by sand particles. This cycle of evaluation and improvement was iteratively repeated until finally achieving the F3 design, composed of 6 in. (15.2 cm) height of amended topsoil (80% topsoil and 20% pine bark fines by weight), 10 in. (25.4 cm) height of field sand, 6 in. (15.2 cm) height of pea gravel, and 9 in. (22.9 cm) height of #57 stone. The F3 design exhibited a performance of 13.73 ft/day (4.18 m/day) in constant head infiltration tests, 15.1 times higher than the 0.91 ft/day (0.28 m/day) obtained by the ALDOT standard matrix, and 11.66 ft/day (3.55 m/day) in falling head infiltration tests, 37.61 times higher than the 0.31 ft/day (0.09 m/day) obtained by the ALDOT standard matrix.

Finally, the ALDOT and the F3 design were tested in the infiltration swale chamber under constant and falling head conditions. The F3 design yielded 87.06 ft/day (26.54 m/day) in constant head conditions, 13.37 times higher than the 6.51 ft/day (1.98 m/day) yielded by the ALDOT design, and 75.79 ft/day (23.20 m/day) in falling head conditions, 15.28 times higher than the 4.96 ft/day (1.51 m/day) yielded by the ALDOT standard matrix. The tests conducted in the infiltration swale chamber were monitored by a moisture content system, showing that the F3 design has a drying rate 111 times higher than the ALDOT design. The results of this research showed that with the F3 design, infiltration swales will achieve higher infiltration rates in the short and long term, as well as superior drying rates, leading to a larger available storage volume after each rainfall event. The F3 design and the ALDOT design will be evaluated on a field-scale by the Auburn Stormwater team, and the results will be compared with those obtained in this research.

ACKNOWLEDGEMENTS

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I dedicate this work to my parents for all the effort they have put in, to my wife for her unconditional love and help, and to Majito for her joy and for being our motivation to keep moving forward.

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CHAPTER ONE:
INTRODUCTION

1.1 BACKGROUND

The growth of road infrastructure in the United States is a governmental priority and a key point for national advancement. Just in October 2023, an investment of 132 billion dollars (U.S. Census Bureau 2023) was directed towards the construction and maintenance of roads and streets, constituting 29.5% of the public investment in that period. During the execution of a construction project, it is possible to generate more than 40.46 tons/acre/year (100 tons/ha/year) of eroded soil, (Novotny 1995) a figure 1,000 to 2,000 times larger than the erosion present in forests (USEPA 2018). Additionally, research conducted over several years has determined that the placement of impermeable surfaces like pavements has adverse effects on the health of urban streams (Bell et al. 2020), resulting in increased water runoff volume that generates higher peak flows, and more contaminants entering the receiving water bodies (Paule-Mercado et al. 2017).

1.2 STORMWATER IMPACTS

Stormwater runoff is the portion of rainwater that flows over the land during and after rainfall. The runoff at a given point is determined by subtracting various losses, including infiltration, transpiration, evaporation, surface depression storage, and other losses, from the total amount of rainfall upstream of that point (Alabama SWCC 2018). The average precipitation in the U.S. during 2020 was 30.38 in. (77.17 cm) (NOAA 2020), and the annual precipitation in Alabama historically is 55.25 in. (140.34 cm) as shown in Figure 1-1 (NOAA 2023), which means that Alabama has 81.9% more precipitation than the national average.

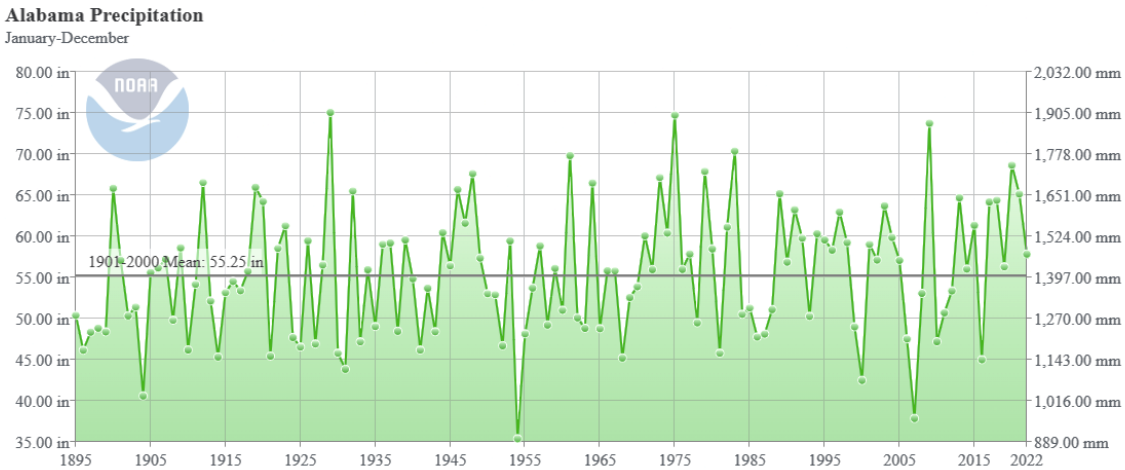


Figure 1-1. Annual Precipitation in Alabama from 1895 to 2022 (NOAA 2023).

The placement of impervious surfaces, such as pavements, contributes to an increase in water runoff, resulting in various issues such as flooding, erosion, reduced groundwater recharge, and harm to aquatic ecosystems (Davis et al. 2010). Water bodies can receive different kinds of pollutants in varying quantities depending on land use. Global water pollution represents a significant concern, affecting both aquatic ecosystems and the well-being of human populations (Schwarzenbach et al. 2010). The levels of pollutants in stormwater runoff from urban areas frequently surpass those found in treated wastewater (Gregory et al. 2015). Pollutants associated with land development that impact water quality include suspended solids, heavy metals, and polycyclic aromatic hydrocarbons (Aryal et al. 2010).

1.3 LOW IMPACT DEVELOPMENT

LID refers to practices that use or replicate natural processes to facilitate the infiltration, evapotranspiration, or utilization of stormwater, with the objective of safeguarding water quality and the habitats of aquatic ecosystems (USEPA 2009). Different from traditional methods, which use man-made structures such as detention ponds and pipes to control runoff, LID practices like rain gardens and permeable pavements aim to cooperate with nature by enabling water to infiltrate into the ground. LID is more eco-friendly, cheaper to maintain in the long term, and often enhances the beauty of communities, unlike traditional methods, which can be more centralized and less environmentally friendly (Cahill 2012).

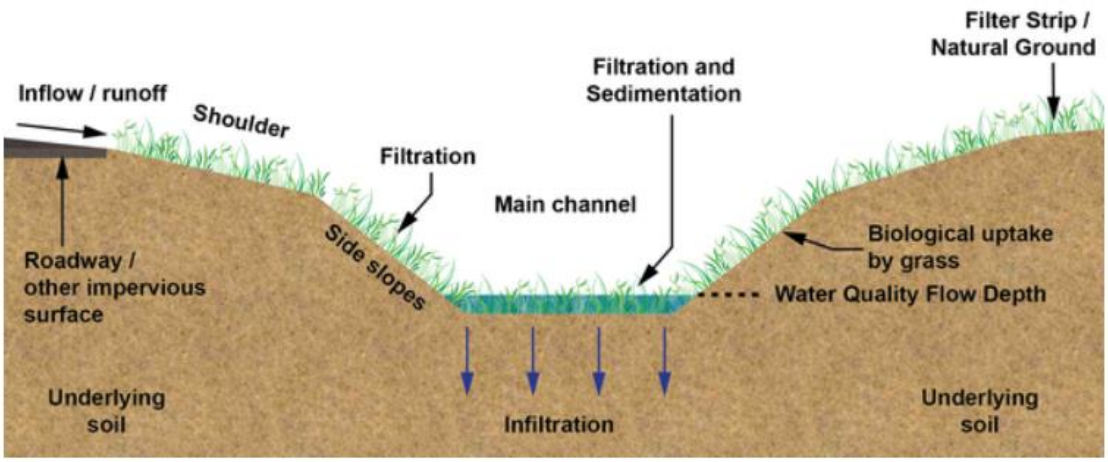
In the late 20th century, LID emerged as a different approach to design in the northeastern United States and the Pacific Northwest. Initially adopted to address stormwater management issues, particularly in safeguarding against flood damage, LID's popularity grew as people became more aware of its wider environmental advantages. Over time, its application has expanded to other regions, including Canada and Australia, where it is known as Water Sensitive Urban Design (WSUD) (Zimmer et al. 2007).

LID practices play a crucial role within Green Infrastructure (GI). GI, which refers to naturally engineered-designed ecosystems like green roofs, swales, and rain gardens (which are also LID practices), integrates LID techniques to allow the overall system to become more efficient at reducing the volume and velocity of stormwater, promoting infiltration, evapotranspiration, and harvesting runoff (USEPA 2015). The most frequently employed LID practices include swales, rain barrels, bioretention gardens, green roofs, and porous pavement (Ahiablame and Shakya 2016). The use of LID control practices is driven by the National Pollutant Discharge Elimination System (NPDES) permit program, which regulates water pollution by controlling point sources that discharge pollutants into waters of the United States (ADEM 2007).

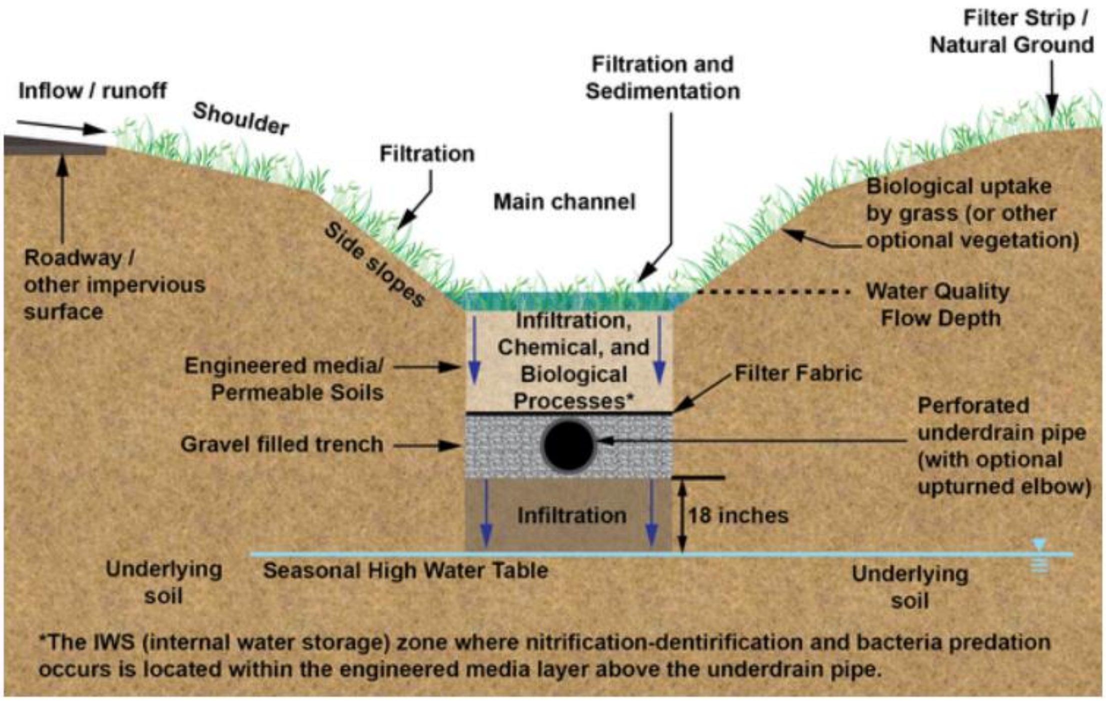
1.4 INFILTRATION SWALES

In current literature, either online or printed, a swale is referred to as a grass swale almost all the time. A grass swale is a natural or constructed channel designed to specific dimensions and established with appropriate vegetation (Alabama SWCC 2018). One of the major purposes constructing/establishing grass swales is to reduce channel erosion, especially for some sites where concentrated runoff will cause erosion damage. A grass swale can capture some sediments to improve stormwater quality and allows some runoff to infiltrate into the native soils to reduce the runoff volume, but grass swales normally do not have engineered soil media under the vegetated channel bed/bottom (Figure 1-2 [a]).

ALDOT infiltration swales, also called bioswales with engineered media beneath the channel bottom, are different from normal grass swales. These swales typically contain ditch checks or earthen check dams to slow down and pond stormwater runoff. They function by conveyance of stormwater runoff to enter the engineered soil media matrix and promote infiltration into the native soils and local groundwater table (Figure 1-2 [b]). Infiltration swales mimic the natural hydrological cycle by facilitating processes such as infiltration, evapotranspiration, and runoff. This characteristic qualifies them as a LID practice (Dietz 2007).



(a) Typical cross section of a grass swale



(b) Typical cross section of a bioswale or infiltration swale

Figure 1-2. Grass Swale and Infiltration Swale Typical Sections.(Ekka and Hunt 2020)

Grass swales mitigate water runoff volume, minimizing erosion and sediment transport, and preventing sediments and pollutants from reaching streams, rivers, lakes, and other water bodies. The effectiveness of swales in reducing runoff volumes, particularly during minor precipitation events, has been studied (Davis et al. 2012; Rushton 2001; Sañudo-Fontaneda et al. 2020; Shafique et al. 2018; Yu et al. 2001). Research has shown they can reduce water runoff rates between 15% to 82% (Knight et al. 2013; Lucke et al. 2014; Rujner et al. 2018; Rushton 2001; Winston et al. 2019). Grass swales have also demonstrated considerable efficacy in decreasing total suspended solids (TSS), with varied performance observed in the removal of metals and nutrients. Data suggests that they are more proficient in eliminating particulate-bound pollutants than dissolved pollutants (Boger et al. 2018).

1.5 RESEARCH OBJECTIVES

The main objective of this research was to assess the effectiveness of infiltration-swale media and optimize their performance. The efficiency of infiltration-swale media was evaluated through constant and falling head infiltration rate tests, with the optimal configuration identified as the one yielding the best infiltration rates in both tests. The study had three specific objectives:

1. Evaluate the performance of the existing ALDOT infiltration swale media design.
2. Assess the effectiveness of alternative infiltration swale media designs.
3. Determine the overall most efficient infiltration swale media design.

To accomplish these objectives, the project was divided into the following tasks:

1. Conduct a comprehensive literature review on infiltration swale standards and prior research.
2. Develop a small and intermediate-scale testing regime.
3. Construct three experimental devices: the permeameter structure and the clear infiltrometers for small-scale testing, and an infiltration swale chamber for intermediate-scale testing.
4. Perform small-scale experiments on ALDOT's standard infiltration swale media design and alternative designs, implementing iterative adjustments to optimize effectiveness until obtaining the design with optimal performance.
5. Conduct experiments in intermediate-scale tests for both ALDOT's standard design and the design with the best performance.
6. Evaluate the experimental data obtained from small-scale tests and compare them with the results obtained from intermediate-scale testing.

1.6 ORGANIZATION OF THE THESIS

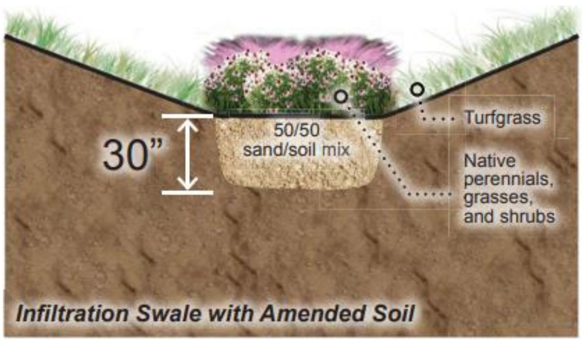
This thesis is structured into five distinct chapters to meet the specified research objectives of the project. Following this introductory section, Chapter Two: Literature Review examines the regulatory framework and the current design of infiltration swale media implemented by ALDOT. It also incorporates a review of prior studies and experiments investigating the efficacy of infiltration swale media. Chapter Three: Means and Methods details the design, testing apparatuses, and sampling procedures employed to prepare and execute tests on small and intermediate-scale infiltration swale media. In Chapter Four: Results and Analysis, the data, analyses, and overall findings of the conducted tests are discussed. Finally, Chapter Five: Conclusions and Recommendations outlines the performance of the tested infiltration swale media configurations and suggests areas for further research to improve guidance for their implementation.

CHAPTER TWO:
LITERATURE REVIEW

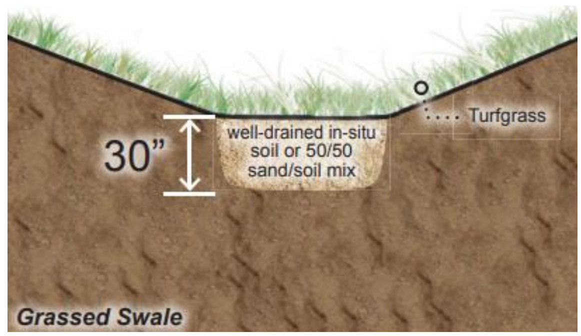
2.1 ALABAMA LID HANDBOOK

Alabama is a state that has abundant water resources, and their quality is crucial for plant and animal biodiversity, ecotourism, irrigation systems, transportation networks, and drinking water supplies (ADEM 2007). A partnership project between ADEM, the Alabama Cooperative Extension System (ACES), and Auburn University allowed the development of the Alabama LID Handbook. This Handbook provides the latest research findings and design suggestions to help interested groups establish objectives for their development and redevelopment initiatives.

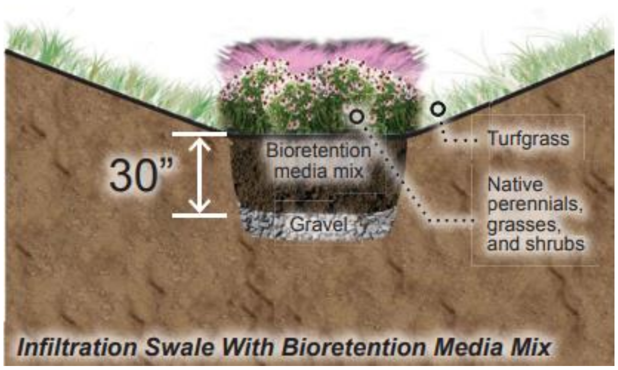
The Alabama LID Handbook (Alabama SWCC 2018) includes guidelines, principles, and practices related to LID, emphasizing sustainable and environmentally friendly approaches to land development. The handbook divides LID practices into eight categories: (1) bioretention cells, (2) constructed stormwater wetlands, (3) permeable pavement, (4) grassed swales, infiltration swales, and wet swales (Figure 2-1 [d]), (5) level spreaders and grassed filter strips, (6) rainwater harvesting, (7) green roofs, and (8) riparian buffers. It also includes another three retrofits or alternatives: rain gardens, curb cuts, and disconnected downspouts. Figure 2-1 from the handbook shows an example of grassed swale that fills 30 in. (76.2 cm) of well-drained in-situ soil or 50/50 sand soil mix under the channel bottom, and this is not a typical grass swale defined in other literature. The infiltration swales defined by the handbook are filled with either 30 inches (76.2 cm) of 50/50 sand/soil mix (without a gravel layer) or a bioretention media mix with a gravel layer. Additionally, they are planted with native perennials, grasses, and shrubs. Both infiltration swales and grassed swales in Figure 2-1 function as bioretention cells except they are placed in a channel setting. The wet swale above native clayey soil (Figure 2-1) is more like a small wetland or wet grass channel and function quite different from the grassed swales and the infiltration swales, which should not be grouped in the same category of the LID practices.



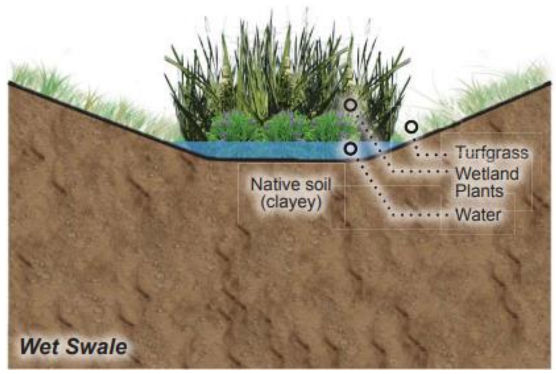
(a) Infiltration Swales (IS) with amended soil



(b) Grassed Swales (GS)



(c) IS with bioretention media mix



(d) Wet Swales (WS)

Figure 2-1. Grass Swales, Infiltration Swales, and Wet Swales (Alabama SWCC 2018)**.**

For each practice listed above, the Alabama LID Handbook provides a comprehensive layout, presenting the reader with the following eleven sections to consider when looking and designing stormwater management practices:

1. Synonyms: in this section the reader can find how the practices is referred by other states.
2. Practice: this section provides a short description and summary about the practice.
3. Site Selection: in this section the reader can check if the practice fits with the specific characteristics of the project.

4. General Significance Table: this table offers a convenient overview of construction expenses, maintenance needs, community approval, habitat considerations, and sunlight prerequisites for the implementation.
5. Site Selection: this section enables the reader to determine the feasibility of the practice by considering specific site conditions such as hydrologic soil group, infiltration rate, drainage area, etc.
6. Construction: this section places emphasis on construction activities, ordering, plant installation and establishment, etc.
7. Design: this section offers guidance for designing the practice, along with an example outlining the steps
8. Vegetation: this section offers guidance on vegetation design and provides an example outlining the designing process.
9. Maintenance: this section provides guidance for keeping the practice functional.
10. Pollutant Removal: This section presents the reduction in pollutant load resulting from the implementation of each practice.
11. References: this records any source(s) employed to acquire knowledge or information concerning the practice.

2.2 SOIL PERMEABILITY

Permeability refers to the capacity of a porous material to permit liquids or gases to pass through it (Ma 2019). The permeability of soil, also known as hydraulic conductivity, is assessed through various methods, which include constant and falling head laboratory tests conducted on either intact or reconstituted specimens (Elhakim 2016). The constant head permeability test is based on Darcy's Law, which states that the flow through the permeameter is linearly proportional to the cross-sectional area and the hydraulic gradient (Sanchéz 2008). According to Darcy's Law, permeability is calculated as shown in Equation 1.1:

$$k = QL/(Ath) \qquad (1.1)$$

Where:

k = coefficient of permeability at the test temperature,

Q = quantity or volume of water discharged,

L = distance between manometers,

A = cross-sectional area of specimen,

t = total time of discharge,

h = difference in the water head on manometers.

To determine the permeability of a sample, a standard permeameter is required. The permeameter is composed of the sample cylinder (Figure 2-2), a water supply system, and two pressure piezometers that allow the measurement of the difference in water head between two points in the sample.

Figure 2-2 Standard Permeameters with Sample Cylinder.

2.3 INFILTRATION SWALE DESIGN

To design infiltration swales, understanding the runoff volume is crucial. Estimating this volume from rainfall is a complex task with various methods available. One commonly used method is the Rational Method, where the runoff volume is directly proportional to the design storm rainfall depth, as indicated in Equation 2.1 (ADEM 2007).

$$V = 3630 * R_D * R_V * A \quad (2.1)$$

Where:

$V = Volume\ of\ runoff\ (ft^3)$

$R_D = Design\ storm\ rainfall\ depth\ (in.)$

$A = Drainage\ or\ Catchment\ Area\ (ac)$

$R_V = Volumetric\ Runoff\ coefficient\ (unitless)$

The ALDOT Hydraulic Manual in Chapter 5.4, "Road and Median Channel Guidelines and Criteria," specifies that roadside and median channels should be designed based on the 50-year storm for interstate systems and arterials, and on the 10-year storm for other facilities (ALDOT n.d.). Additionally, the ALDOT Hydraulic Manual specifies that the channel geometry must be designed following the guidelines included in the Federal Highway Administration's Hydraulic Engineering Circular No. 15 (Chen and Cotton 1988). According to Circular No. 15, key considerations for designing roadside channels involve assuming hydraulic conditions to be uniform and steady. When considering these flow conditions, the depth of normal flow must be calculated using Manning's equation combined with the continuity equation, as shown in Equation 2.2:

$$Q = \frac{\alpha}{n} A R^{2/3} {S_f}^{1/2} \quad (2.2)$$

Where:

Q = discharge, m^3/s (ft^3/s)

n = Manning's roughness coefficient, dimensionless

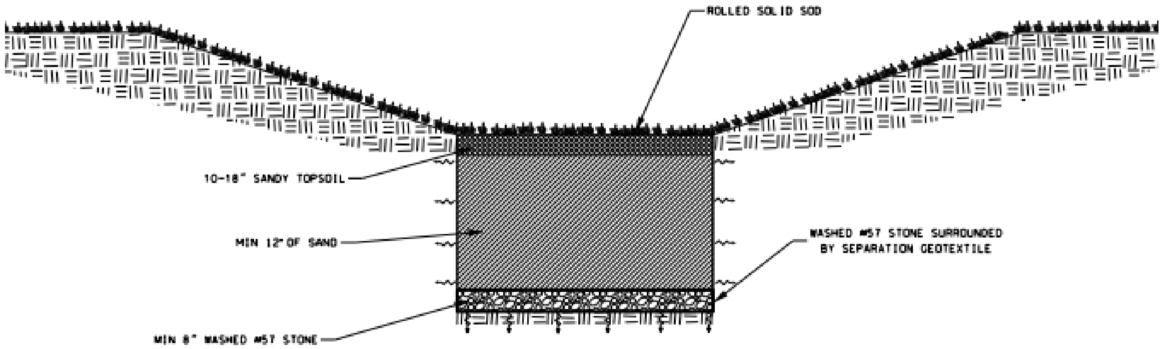
A = flow cross-sectional area, m^2 (ft^2)

R = hydraulic radius, m (ft)

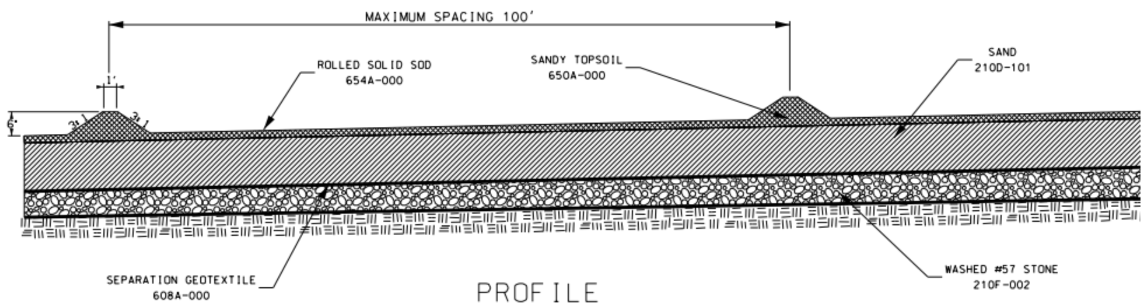
S_f = friction gradient, m/m (ft/ft)

α = unit conversion constant, 1.0 (SI), 1.49 (CU)

The current infiltration swale design by ALDOT (Figure 2-3) comprises a channel lined with vegetation and ditch checks. These ditch checks, spaced at a maximum distance of 100 ft (30.5 m), are intended to improve the overall effectiveness of the swale by reducing flow velocity, ponding/capturing runoff, increasing detention time, and consequently promoting the infiltration and causing more sedimentation and pollutant removal. The maximum longitudinal slope allowed along the channel is 5%. The design includes approximately 5 ft (1.5 m) of engineered soil media matrix, consisting of sandy topsoil ranging from 10 to 18 in. (25.4 to 45.7 cm) in depth, sand with a minimum depth of 12 in. (30.5 cm), and #57 stone with a minimum depth of 8 in. enclosed in filter fabric. Infiltration swales may incorporate an underdrain to enhance flow-through and filtration capability, particularly in cases where the infiltration rate of the native soil is low.



(a) ALDOT infiltration swale cross section



(b) ALDOT infiltration swale profile view

Figure 2-3. ALDOT Infiltration Swale Details (ALDOT, n.d.)**.**

Different DOT manuals were studied, revealing varying definitions, descriptions, and designs for swales. For instance, Georgia DOT (GDOT) (GDOT 2020) delineates two types of enhanced swales: dry and wet swales. These are vegetated open channels designed to capture and diminish water runoff while enhancing water runoff quality. The GDOT enhanced dry swale media (Figure 2-4) consists of three layers: 30 in. (76.2 cm) of permeable soil, 2 to 3 in. (5.1 to 7.6 cm) of pea gravel layer, and 12 in. (30.5 cm) of aggregate layer. This swale can reduce TSS by 80%, and total phosphorus and nitrogen by 50%. Moreover, it can reduce water runoff by 50% to 100%, depending on the presence of an underdrain. The minimum allowed infiltration rate is 2 ft/day (0.61 m/day), and the maximum longitudinal slope is 4%. The minimum distance between ditch checks is 50 ft (14.24 m).

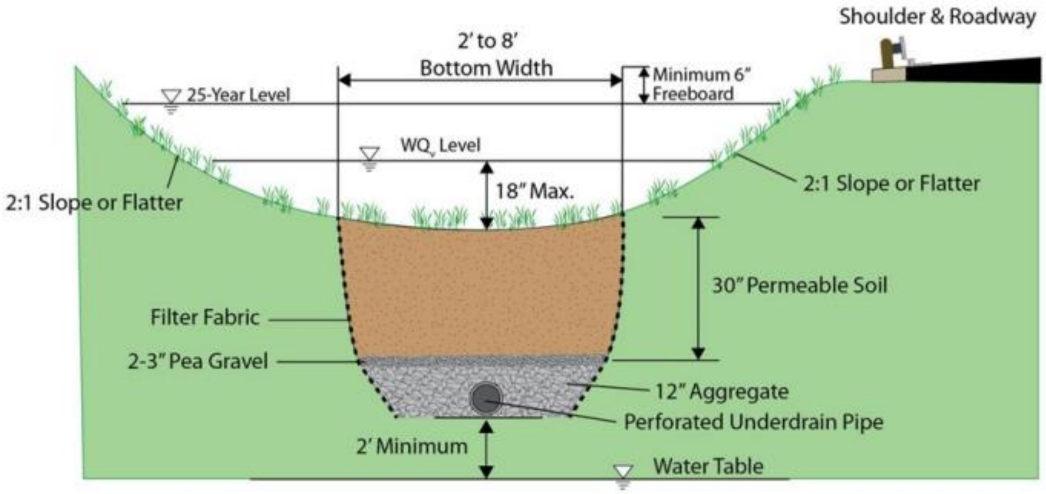


Figure 2-4. GDOT's Dry Infiltration Swale Layout (GDOT, 2020).

The Alabama Department of Environmental Management, as outlined in its LID Handbook (ADEM 2007), incorporates the infiltration swale design depicted in Figure 2-1. The infiltration swale has the option to utilize either a 30 in. (76.2 cm) mix of 50/50 sand/soil or a bioretention media mix. When utilizing bioretention media, the design must incorporate a layer of gravel beneath the media. The minimum allowed infiltration rate is 1 ft/day (0.30 m/day), and the maximum longitudinal slope is 5%. The maximum distance between ditch checks is 100 ft (30.5 m).

The North Carolina Department of Environmental and Natural Resources (NCDENR) BMP Manual (NCDENR 2009) incorporates grassed swales (Figure 2-5) designed to convey and infiltrate water runoff from roadways. These are vegetated open channels with a maximum standing water time of 48-hours and a maximum longitudinal slope of 4%. The recommended side slope is 3:1, but if pollutant removal is the objective, it must be 5:1.

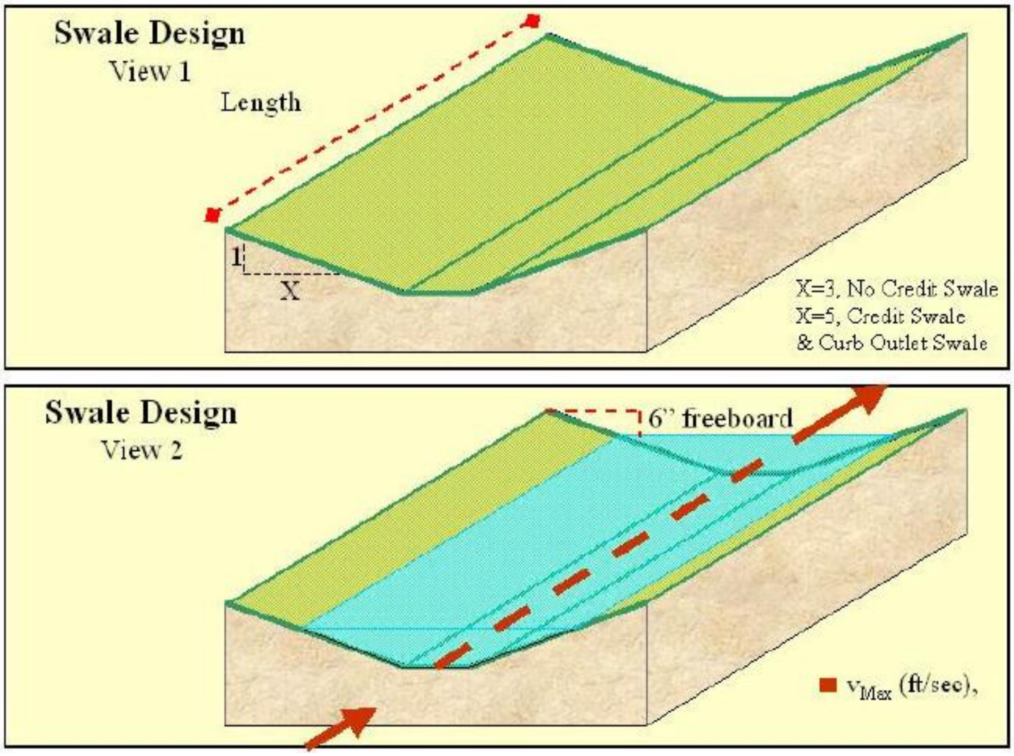


Figure 2-5. North Carolina Grassed Swale Design (NCDENR, 2009)**.**

NCDENR's grassed swale does not have engineered media beneath the channel bottom and are normal grass swales with ditch checks to pond runoff; therefore, they are different from ADEM's infiltration swales and grassed swales in Alabama LID handbook (Figure 2-1), ALDOT infiltration swales (Figure 2-3), and GDOT's dry infiltration swales (Figure 2-4). ALDOT infiltration swales have a topsoil layer and filter fabric wrapping on #57 stone, different from GDOT's and ADEM's infiltration swales, and have normal grass to grow (instead of native perennials, grasses, and shrubs) and be mowed by ALDOT maintenance crews.

2.4 TESTING OF GRASS SWALES

Several research studies on grass swales have been consulted to understand the current state of the subject, one of which was "Hydraulic performance of grass swales for managing highway runoff" by Davis et al. (2012), published in the International Water Association journal. This study evaluated the effectiveness of two grass swale design alternatives: pretreatment grass filter strips and vegetated check dams. These swales on loam or sandy loam soil were assessed during 52 storm events over 4.5 years. The study showed that the effectiveness of grass swales in reducing water runoff volume appears to be linked to the magnitudes of rainfall events. Smaller events with rainfall less than 1.2 in. (3 cm) typically result in no discharge, unlike larger storms that might transform a swale into a conveyance device with a more constrained ability to reduce pollutants. Additionally, this study demonstrated that the inclusion of check dams increases swale effectiveness, in contrast to filter strips that produce varied outcomes.

Another study, conducted by the University of Minnesota titled "Determining Infiltration Loss of a Grassed Swale" (Ahmed et al. 2014), presented at the World Environmental and Water Resources Congress 2014, evaluated the effectiveness of a grassed swale near Hwy 51 in Madison, WI, in mitigating stormwater. This involved conducting infiltration measurements at 108 locations within the swale using the Modified Philip Dunne (MPD) infiltrometer. Subsequently, a model based on the Green-Ampt equation was developed to estimate the infiltration of both direct rainfall and roadway stormwater runoff into the swale's soil during observed rainfall events. The model took into consideration factors such as the soil's antecedent moisture condition and Green-Ampt parameters. Furthermore, the study compared the model's estimated outflow rate with the actual outflow rate measured in the field, utilizing saturated hydraulic conductivity data. Additionally, an approach was developed to calculate the infiltration loss into the swale and the volume of runoff that does not infiltrate. The study's results indicated that the proposed infiltration model, utilizing the Green-Ampt equation and the MPD infiltrometer, could effectively assess the stormwater mitigation performance of a given swale.

Another study carried out by the University of Minnesota related to infiltration swales was "Field infiltration measurements in grassed roadside drainage ditches: Spatial and temporal variability" (Ahmed et al. 2015). This study focuses on grassed swales as stormwater due to their ability to reduce runoff volume. The research collected 722 infiltration measurements from six swales using MPD infiltrometer. The field-saturated hydraulic conductivity (Kfs) values obtained were unexpectedly high for various soil texture classes, possibly attributed to plant roots creating macropores facilitating infiltration. Statistical analysis explored the influence of initial soil moisture content, season, soil texture class, and downstream distance on the geometric mean Kfs value. While no significant impact was observed for initial soil moisture, season, and soil texture class, downstream distance could have a positive or negative effect on Kfs value due to high spatial variation within the same swale. An uncertainty analysis suggested that approximately twenty infiltration measurements are the minimum required for a representative geometric mean Kfs value of a swale less than 1,146 ft (350 m) long, within an acceptable level of uncertainty.

A study conducted by the Technical University of Munich titled "Evaluation of site-specific factors influencing heavy metal contents in the topsoil of vegetated infiltration swales" (Horstmeyer et al. 2016) focused on assessing factors influencing heavy metal concentrations in topsoil layers of vegetated infiltration swales used for treating stormwater runoff from traffic areas. A total of 262 topsoil samples were collected from 35 sites with varying characteristics such as age, traffic volume, road design, driving style, and site-specific conditions. The median concentrations of cadmium, chromium, copper, lead, and zinc in the topsoil were 0.36, 37.0, 28.0, 27.0, and 120 ppm dry matter, respectively. The analysis aimed to assess site-specific information, including land use, traffic characteristics, and operational features. While heavy metal levels generally increased with higher traffic volumes, factors such as road design, congestion, and specific traffic elements also played significant roles. Areas like stop-and-go zones, roundabouts, crossings, and locations with traffic lights, signs, and guardrails exhibited elevated heavy metal concentrations. These findings offer valuable insights for identifying heavily polluted traffic areas and improving standards for runoff treatment. The "vegetated infiltration swales" in this paper title refers to the grass swales, different from ALDOT infiltration swales.

The Urban Pollution Research Centre of Middlesex University conducted research focused on the effectiveness of swale to improve water quality. It was titled "Assessing the impact of swales on receiving water quality" (Revitt et al. 2017). This study used a semi-quantitative approach to assess how a swale reduces pollutants in both surface water and groundwater. The pollutants considered in this study were TSS, nitrate, chloride, heavy metals (Cd, Cu, Pb, Zn) and polyaromatic hydrocarbons (PAHs). The study concluded that swales have limitations in protecting surface water from less soluble pollutants. The quality of surface waters discharged from swales is influenced by pollutant removal efficiency, with all investigated pollutants (except nitrate) capable of having a detrimental effect on receiving water. However, thanks to their conveyance capacities, they can serve as an initial component of treatment trains involving additional pollutant removal facilities. While there are concerns about swales posing a risk to underlying groundwater due to infiltration processes, the study concludes that, with proper maintenance, the risk is negligible for various pollutants. The filtering of particles in swales can lead to clogging and affect water quality, emphasizing the need for regular cleaning and careful design. The research recognizes the varied designs and conditions of swales and proposes that the scientific comprehension of processes related to removing pollutants could be applied to other Sustainable Drainage Systems (SuDS) employing infiltration as a method for pollutant removal.

Another study focused on field evaluation of swales done by the Department of Civil, Environmental and Natural Resources Engineering of the Lulea University of Technology titled "Advancing green infrastructure design: Field evaluation of grassed urban drainage swales" (Rujner et al. 2016) investigated a 98.4 ft (30 m) section of an urban grassed swale in sandy soils, located in the City of Lulea, Sweden. The assessed swale possesses an average width of 10.17 ft (3.1 m) positioned between a bicycle path and a gravel surface parking area. Both neighboring areas contribute runoff to the swale. A mobile water supply system compound by several IBC tanks was used to simulate runoff flows coming into the swale considering a drainage area of 6,023 ft^2 (560 m^2) and four monitored systems were installed as shown Figure 2-6 .

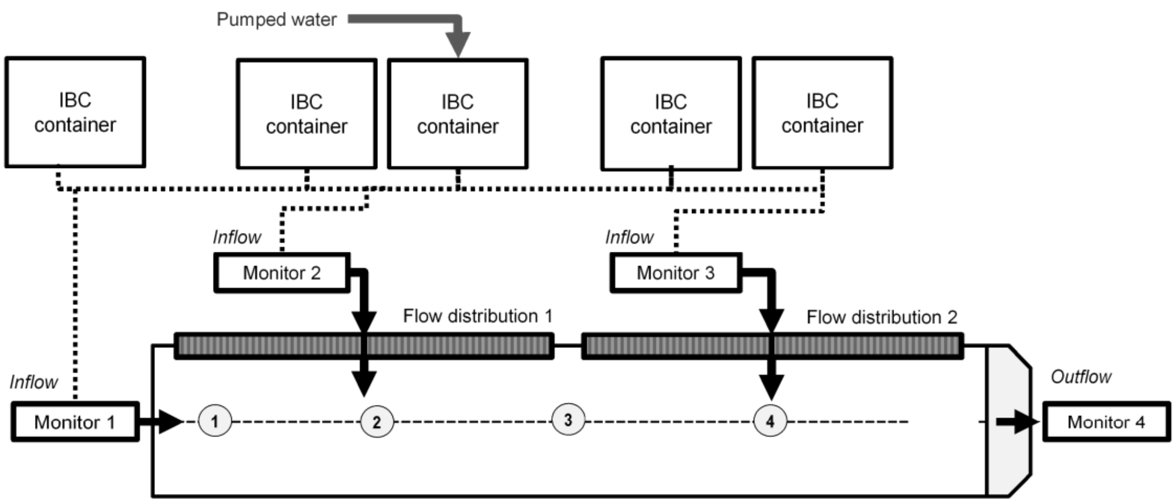


Figure 2-6. Layout of the Swale, Water Supply System, and Soil Moisture Probes (Numbered Circles), (Rujner et al. 2016)**.**

The preliminary results of this research suggest that the extent of swale inflow reduction relies on the intensity of runoff, the initial soil moisture conditions. Wetter soil conditions before the event reduced the infiltrated water and increased the conveyance of irrigation water, while drier conditions significantly reduced the flow in the swale.

Research published in the Environmental Science and Pollution Research Journal, titled "Analysis of swale factors implicated in pollutant removal efficiency using a swale database" by Fardel et al. 2019, gathered data on the performance of 59 swales in removing pollutants through a literature review. The examination of the data gathered in this investigation revealed that the median efficiency ratios (ERs) of the swales for reducing TSS were 56%, and reduced trace metals (copper, zinc, cadmium, and lead), by at least 62%. This suggests that these pollutants are efficiently captured through sedimentation in the swale bed or filtered within the soil of the swale. As other investigations, this research identified that the concentration of the inflow was a significant factor correlated with the removal efficiency for most pollutants. Additionally, for certain pollutants, there is an observed trend of achieving higher removal efficiency when the geometric design of the swale increases the hydraulic residence time.

A study titled "Long-term Hydraulic Performance of Stormwater Infiltration Systems" (Al-Rubaei et al. 2015) focused on research conducted in Vaxjo, southern Sweden. The study evaluated the water infiltration capacities of two grass swales and nine permeable pavements, utilizing double-ring clear infiltrometers. The two grass swales in question were 14 years and 9 years old, with respective widths of 3.28 ft (1.0 m) and 6.56 ft (2.0 m). Notably, these practices did not undergo regular maintenance to ensure proper infiltration. The study's findings indicated that the performance of the practices depended on the system's age and the type of joint filling. Specifically, regarding the swales, both exhibited a mean infiltration capacity of 0.004 in./min (0.10 mm/min), a rate significantly below the initial design values required for the site.

The Department of Civil Engineering at the University of Minnesota conducted a research project titled "Determining Infiltration Loss of a Grassed Swale" (Ahmed et al. 2014). The study aimed to predict the volume of water infiltrated and flowing through the swale channel during a rainfall event. In pursuit of this objective, infiltration measurements were taken at 108 locations within a swale located in Madison, WI. The researchers developed a model based on the Green-Ampt equation to forecast the volume of infiltrated water and outflow through the swale channel. The model incorporated field infiltration measurements mentioned earlier and considered the moisture content before the rainfall event. It estimated the infiltration of rain falling directly on the swale and stormwater entering the swale. The model underwent testing during a rain event on July 18, 2012, and the values closely aligned with the runoff ratio calculated based on field measurements.

A 2018 study titled “High-resolution modelling of the grass swale response to runoff inflows with Mike SHE” (Rujner et al. 2018) exposed a study intended to predict the response of a specific swale to a 12 irrigation events through a computational model using Mike SHE. The 94.4 ft (30.0 m) long swale channel studied in this research had a trapezoidal cross-section shape and was built in loamy fine sand. Irrigation tests were conducted under two conditions of the initial soil moisture: either dry or wet antecedent moisture conditions. Mike SHE simulations confirmed that a grass swale, when facing substantial water inflows, mainly serves as a conveyance channel with minimal reduction in flow volumes and peaks. The model exhibited strong agreement getting a Nash-Sutcliffe model efficiency (NSE) higher than 0.8 between observed and simulated hydrographs. the results indicate promising possibilities for utilizing distributed hydrological models like Mike SHE in detailed simulations of grass swales and other small-scale Low Impact Developments focused on specific processes. The model output exhibited limited sensitivity to variations in spatial soil water content, leading to increased disparities in simulated runoff peak flows and volumes, particularly under dry Antecedent Moisture Conditions (AMC). This implies that simulating scenarios involving soils with higher hydraulic conductivities or extremely low initial soil moistures poses greater challenges.

A research work titled "Field Test of Grassed-Swale Performance in Removing Ground Pollution," by Yu et al. (2001), evaluated the pollutant mass removal of two swales—one located in Virginia and another in Taiwan. The Virginia swale, a highway median swale, measured 903.9 ft (274.5 m) in length with two check dams at 191.4 yards (175.0 m) and 259.7 yards (237.5 m) from the swale inlet, and an average longitudinal slope of 1%. Water runoff for this swale was calculated using the rational formula, and the flow in the swale channel was estimated using Manning's equation. On the other hand, the Taiwan swale, measuring 32.8 yd (30.0 m) with an average longitudinal slope of 3% (Figure 2-7), was located in an agricultural test farm and tested using synthetic runoff with prescribed pollutant concentrations. The flow was introduced into the swales from two 5-ton storage tanks. In the Taiwan swale, a wooden check dam was used at the outlet in all tests, and some tests were conducted using a wooden midpoint check dam, while others omitted the midpoint check dam.

Figure 2-7. 32.8 yd (30 m) Swale with One Check Dam at Taiwan Test Farm (Yu et al. 2001)**.**

The test swales demonstrated varying average pollutant removal efficiencies, ranging from 14% to 99%, for pollutants such as TSS, chemical oxygen demand (COD), total nitrogen (TN), and total phosphorus (TP). The tests indicate that the inclusion of check dams typically enhances the overall performance of swales by increasing flow retardation and detention time, consequently improving sedimentation and pollutant removal. Additionally, the length of the swale was found to enhance pollutant removal capacity, as pollutant concentration decreases along the length of the swale. The study recommends that swales should be a minimum of 82.0 yd (75.0) meters in length with a maximum longitudinal slope of 3%.

2.4.1 Constant Head Permeability Test of Granular Soils

The constant head permeability test of granular soils ASTM D2334-68 (ASTM 2000) is a method to determine the coefficient of permeability in granular soils in a standard permeameter using a constant water head column. This test is better suited to determine the hydraulic conductivity of gravels, sands, and silts with a minimal content of clays. According to Verruijt (2001), the typical permeability of granular materials like gravel, sand or silt is shown in Table 2-1. This procedure consists of preparing the soil sample, placing it in a standard permeameter device, and measuring various factors such as water discharge, distance between manometers, cross-sectional area of the specimen, total discharge time, and the difference in head on manometers. Finally, the permeability is calculated applying the Darcy's law.

Table 2-1. Permeability of soils (Verruijt 2001).

Type of soil	*k, in./s (m/s)*
Gravel	$4x10^{-4} – 4x10^{-2}$ ($10^{-3} – 10^{-1}$)
Sand	$4x10^{-7} – 4x10^{-4}$ ($10^{-6} – 10^{-3}$)
Silt	$4x10^{-9} – 4x10^{-7}$ ($10^{-8} – 10^{-6}$)
Clay	$4x10^{-11} – 4x10^{-9}$ ($10^{-10} – 10^{-8}$)

2.4.2 Infiltration Rate of Soils in the Field Using Double-Ring Infiltrometer

The double-ring infiltrometer method to measure of the rate of infiltration of liquids into soils is depicted in the ASTM D3385-18 (ASTM 2018). Basically, the double-ring infiltrometer (See Figure 2-8) method involves placing two open cylinders, one within the other, into the ground. The rings are partially filled with water or another liquid and maintained at a constant level. The volume of liquid added to the inner ring to keep the level constant serves as a measure of liquid infiltration into the soil. The volume infiltrated over specified intervals is converted to incremental infiltration velocity by dividing it by the inner ring's area, typically expressed in centimeters per hour or inches per hour. This data is then plotted against elapsed time. The maximum steady-state or average incremental infiltration velocity, depending on the test's purpose, is considered equivalent to the infiltration rate.

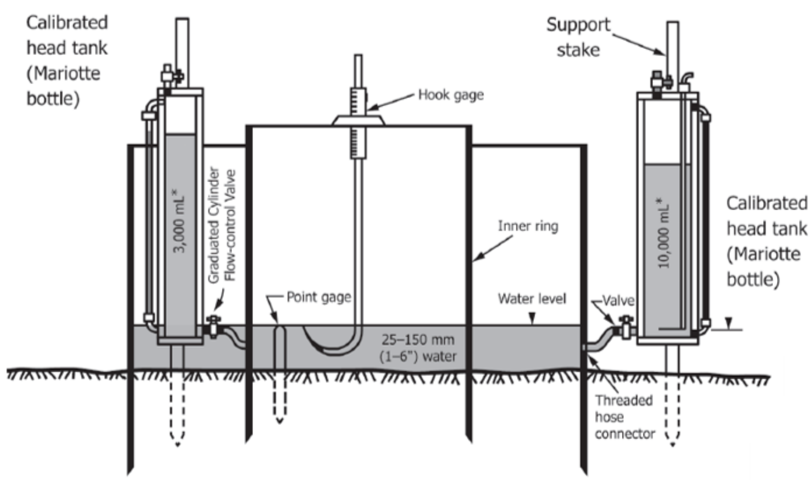


Figure 2-8. Ring Installation and Mariotte Bottle Details (ASTM 2018).

2.5 SUMMARY

Based on the literature review conducted, several research studies focused on the effectiveness in mitigating stormwater runoff and reducing pollutant loads of grass swales and related best management practices. The studies primarily focused on field evaluations of grass swales, with test sections ranging in length from tens to hundreds of feet. All these grass swales studied can infiltrate stormwater runoff into native soil but are different from ALDOT's, ADEM's, and GDOT's infiltration swales (Figure 2-1 to Figure 2-3). Small-scale tests similar to those conducted in this research were not identified. The range of performance observed in these studies varied depending on factors such as the design of the swales, the intensity of rainfall events, and the presence of additional treatment features like check dams. Overall, the research indicated that infiltration swales can effectively reduce water runoff volume, particularly during smaller rainfall events, but their performance may be limited during larger storms. Factors such as slope, length, and the presence of check dams significantly influenced the performance of infiltration swales. Studies indicated that swale length played a crucial role in enhancing pollutant removal capacity, with longer swales exhibiting better performance due to increased flow retardation and detention time along the swale length. Additionally, the slope of the swale influenced its hydraulic efficiency, with steeper slopes potentially leading to higher flow velocities and reduced pollutant removal efficiency. Moreover, the inclusion of check dams was found to enhance overall swale performance by increasing flow retardation and sedimentation, thereby improving pollutant removal efficiency. The typical pollutants measured included total suspended solids (TSS), heavy metals (such as copper, zinc, cadmium, and lead), nutrients (such as nitrate, total nitrogen, and total phosphorus), and organic contaminants (such as polyaromatic hydrocarbons). These pollutants were chosen for their relevance to stormwater runoff and their potential environmental impacts on receiving water bodies.

CHAPTER THREE:
MEANS AND METHODS

3.1 INTRODUCTION

This chapter provides a comprehensive description of the construction of the apparatus, testing protocols, and methodological framework employed in the investigation of the infiltration-swale media. The research methodology was designed to facilitate precise small- and intermediate-scale experimental assessment conducted under strictly controlled conditions.

The primary objective of this study is to conduct a rigorous evaluation of the permeability and infiltration rates of diverse infiltration media configurations. This involves a comprehensive examination of the materials properties, including gradation size distribution, density, porosity, and layer thickness, and their response to consolidation and compaction. In the small-scale phase of the project, permeability tests were conducted using the permeameter structure, and infiltration rate tests were performed using clear infiltrometers. In the medium-scale phase, infiltration tests were carried out in the infiltration swale chamber. The apparatuses and tests mentioned earlier will be explained in the following subsections.

3.2 APPARATUS DESIGN AND CONSTRUCTION

The initial two apparatuses crafted within the scope of this project, namely the permeameters and clear infiltrometers, were meticulously designed to facilitate the execution of permeability constant head tests and falling and constant infiltration rate test on a small-scale basis. Subsequently, a third apparatus, known as the infiltration swale chamber, was methodically engineered to conduct falling and constant infiltration rate tests at an intermediate scale. In the subsequent sections, we will delve into the intricacies of their construction methodologies.

3.2.1 Permeameters Structure

The permeameter structure is comprised of 18 individual units, firmly supported by a wooden framework constructed using 2 by 4 in. (5 by 10 cm) lumber. The wooden framework exhibits dimensions of 10 ft in length, 4 ft in height, and 1.2 ft in width (3 m in length, 1.2 m in height, and 0.4 m in width). On the frontal plane of the structure, nine permeameters were installed, while the remaining nine are placed on the rear face. Each permeameter's core is fashioned from a 6 in. (15.24 cm) diameter schedule 40 PVC pipe with a length of 3.0 ft (0.91 m). Permeameters were attached to the wooden structure using two 6 in. stainless steel clamps, as depicted in Figure 3-1.

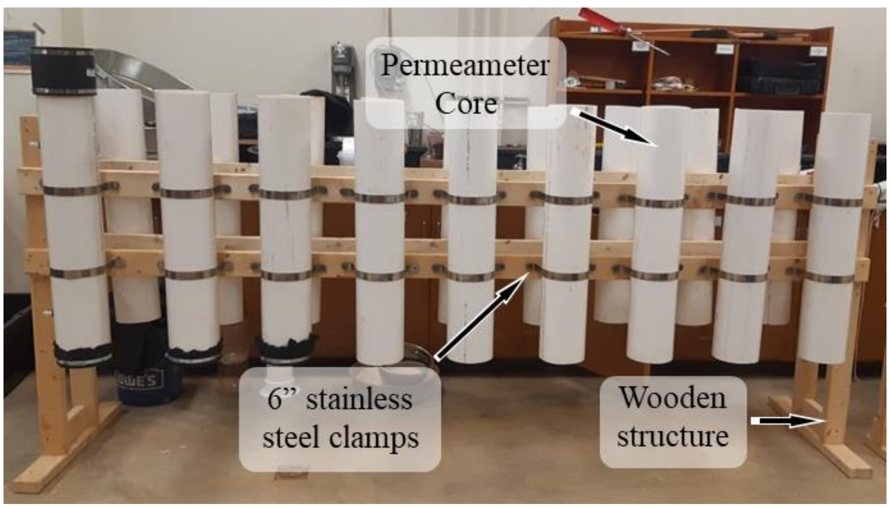
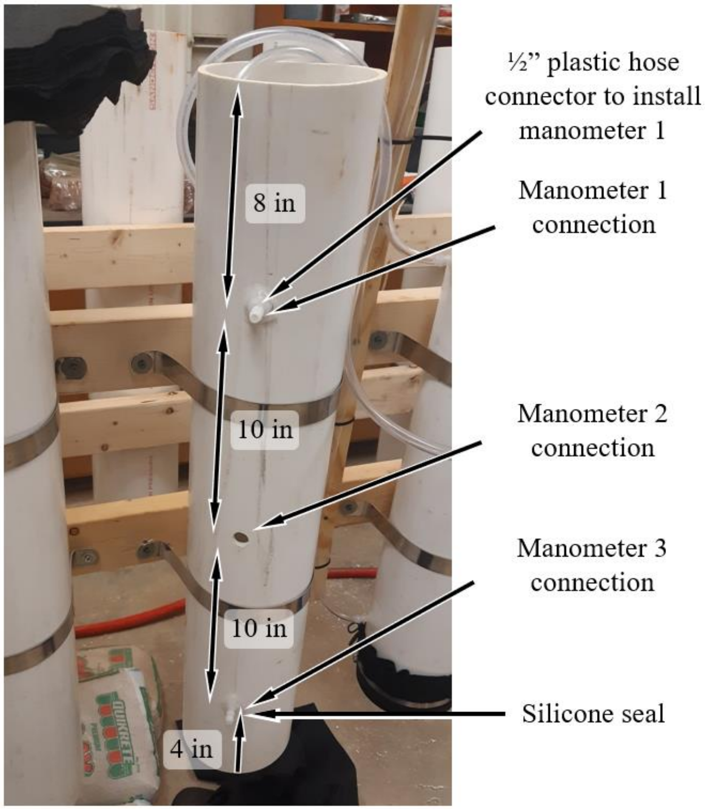
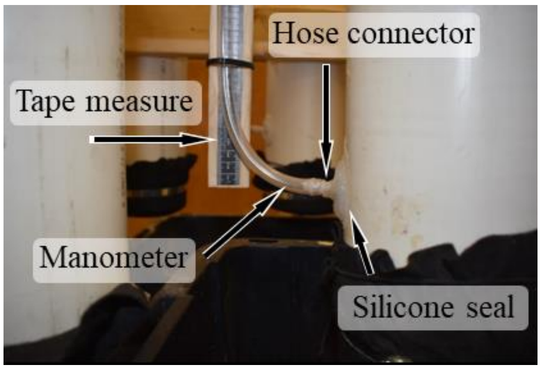


Figure 3-1. Wooden Structure with Permeameter Cores Installed.

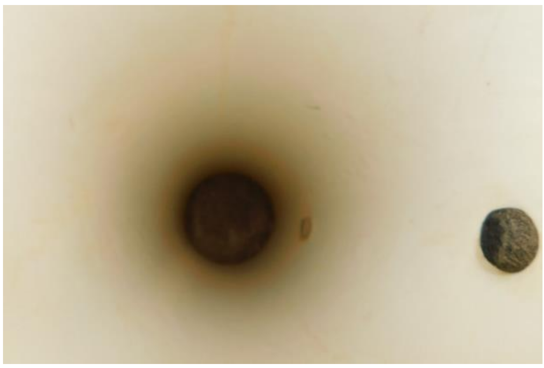
Three manometers (Figure 3-2[a]) were employed in each permeameter to allow for measurements at different points in the sample. These measurements were used to calculate the hydraulic gradient. Manometers were constructed using 0.5 in. (1.27 cm) diameter clear hose sections connected to the permeameter core through 0.5 in. (1.27 cm) plastic hose connectors. A piece of 1 in. by 2 in. (2.5 by 5 cm) lumber was affixed adjacent to each permeameter to facilitate water head measurement. A measuring tape was adhered to it as depicted in Figure 3-2(b). Silicon was applied to the juncture between hose connectors and the permeameter core to ensure a watertight seal. Additionally, to prevent the intrusion of sample materials into the manometers, a section of geotextile was affixed to the end of the connector that remained within the tube, as shown in Figure 3-2(c).



(a) Manometers position and connectors installation



(b) Joint between manometer and permeameter core



(c) Geotextile stuck to the plastic connector

Figure 3-2. Manometer Connection.

To contain the water head column over the sample during the test, a 6 in. (15.2 cm) diameter PVC pipe extension was affixed to the top of the permeameter core using a 6 in. (15.2 cm) rubber coupling. Additionally, to confine the materials within the column while permitting water flow, a geotextile piece was secured to the bottom of the core with a clamp, as illustrated in Figure 3-3.

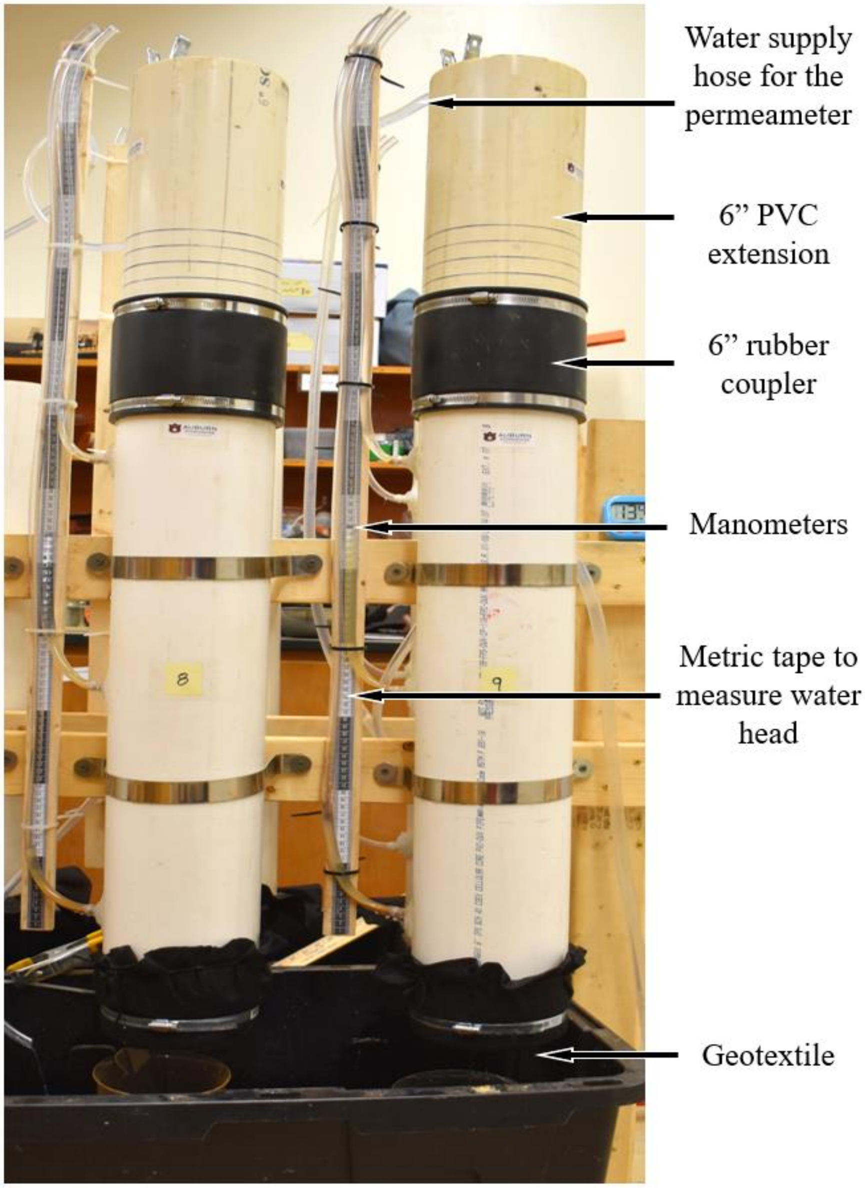
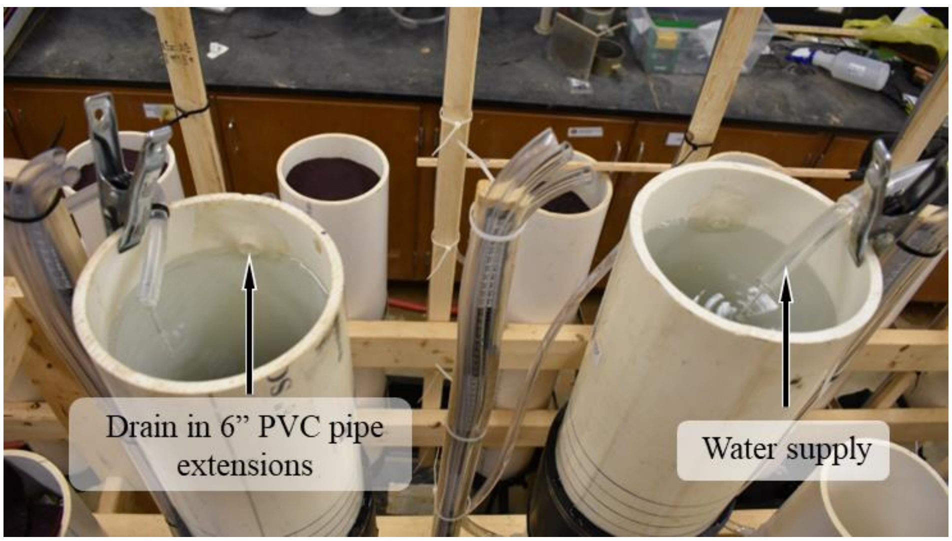


Figure 3-3. Columns 8 and 9 - Front View.

Water was supplied to each permeameter from the top of the 6 in. (15.24 cm) PVC extension through a hose connected to a laboratory sink faucet. To maintain a constant water head during the test, a 0.5 in. (1.27 cm) diameter drain was installed, connected to a 0.5 in. (1.27 cm) clear hose with a 0.5 in. (1.27 cm) plastic connector, in the same way as it was done to connect the manometers to the permeameter core (Figure 3-4[a]). Water flowing to this drain, as well as the water flowing out through the samples was collected in black plastic totes, as illustrated in Figure 3-4(b).



(a) Water supply and drain to keep the water head constant

(b) Plastic tote to collect water during the test

Figure 3-4. Water Supply and Drain Systems for Permeameters.

3.2.2 Clear Infiltrometers

The structure of the clear infiltrometers consists of six units, each securely mounted on a wooden framework crafted from 2 in. by 4 in. (5 by 10 cm) lumber. The dimensions of this wooden support structure measure 4.6 ft in length, 4.0 ft in height, and 1.2 ft in width, (1.40 m in length, 1.22 m in height, and 0.37 m in width). Among these infiltrometers, three were positioned on the frontal face of the structure, while the remaining three were situated on its rear face.

The core of each infiltrometer was fashioned from a 6 in. (12.7 cm) diameter clear plastic tubing, with a thickness of 5/6 in. (2.12 cm), and extending to a length of 3 ft (0.91 m). To ensure robust attachment to the wooden structure, each infiltrometer was affixed using two 6 in. (12.7 cm) stainless steel clamps. Given that these plastic tubes were relatively less resistant and more flexible compared to PVC pipes, it became necessary to reinforce them at four key points with 6 in. (12.7 cm) diameter PVC rings.

These reinforcing PVC rings were strategically placed as follows: one ring at the top of the column to facilitate the connection of the 6 in. (12.7 cm) rubber coupler, another at the base of the column to accommodate either the geotextile or the galvanized steel hardware cloth, and one at each clamp anchor point (Figure 3-5).

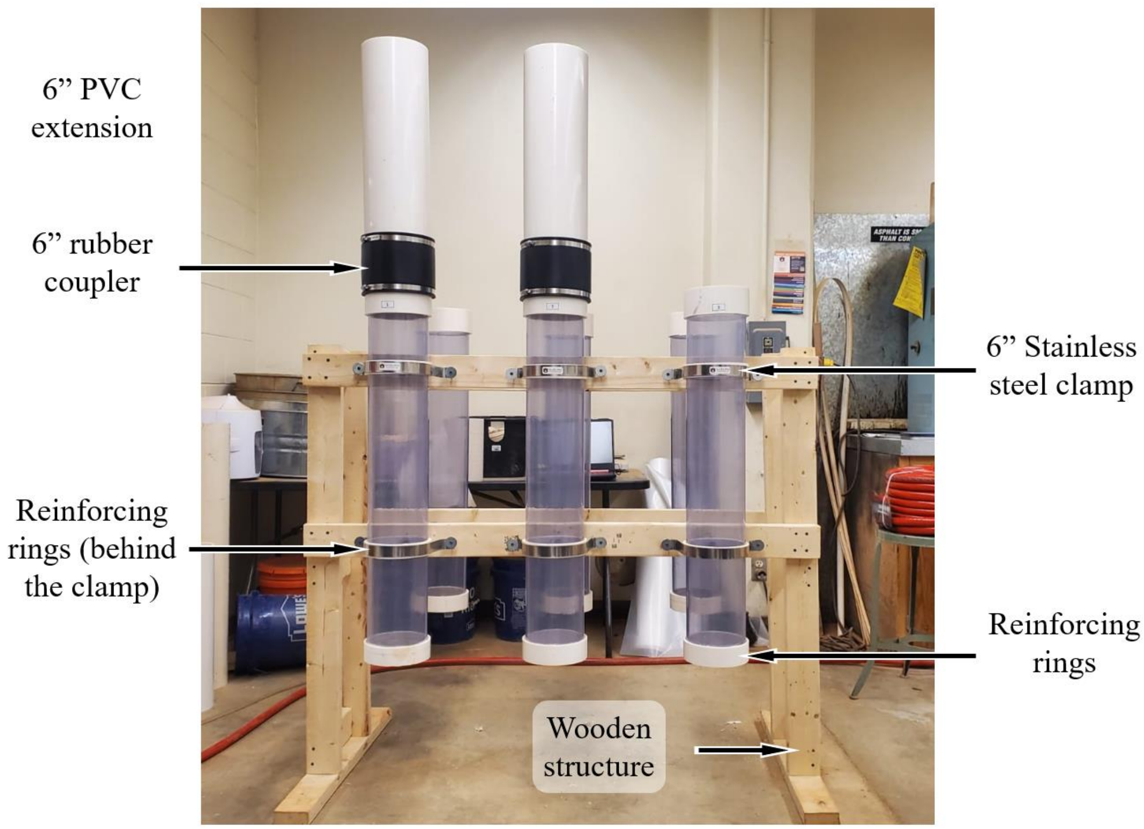


Figure 3-5. Clear Infiltrometers Installed.

The infiltrometers were designed to accommodate materials filled up to their maximum height of 3.0 ft (0.91 m). To effectively contain the water head column above the samples, a 6 in. (1.27 cm) PVC pipe extension was thoughtfully attached to the top of the infiltrometer core using a 6 in. (1.27 cm) rubber coupler. To keep the materials inside the column and allow water to flow, it was attached at the bottom of the clear column with a clamp, geotextile sheeting, or stainless-steel wire mesh, depending on the matrix design under evaluation. This ensured the confinement of materials within the column while allowing water to flow freely.

To simultaneously supplying water to all six clear columns, an irrigation system was constructed. This system consisted of six 0.75 in. (1.91cm) ball valves interconnected with PVC pipe and associated components, as illustrated in Figure 3-6.

(a) General view of irrigation system

(b) Irrigation system valve

Figure 3-6. Irrigation System for Clear Infiltrometers.

To maintain the water column constant during the constant head infiltration rate tests, a 0.5 in. (1.27 cm) diameter drain connected to a 0.5 in. (1.27 cm) clear hose through 0.5 in. (1.27 cm) PVC adapters were installed in the 6 in. (15.24 cm) PVC extension, as illustrated in Figure 3-7.

(a) Drainage system

(b) Drain hole

Figure 3-7. Drainage in Extensions to Keep the Water Head.

The water flowing through the extension's drains and the water discharged from the bottom of the samples were collected in the wooden drainage system depicted in Figure 3-8. This drainage system was constructed using 0.5 in. (1.27 cm) plywood and 2 in. by 4 in. (5 by 10 cm) lumber and was sealed with two layers of plastic sheeting to ensure impermeability.

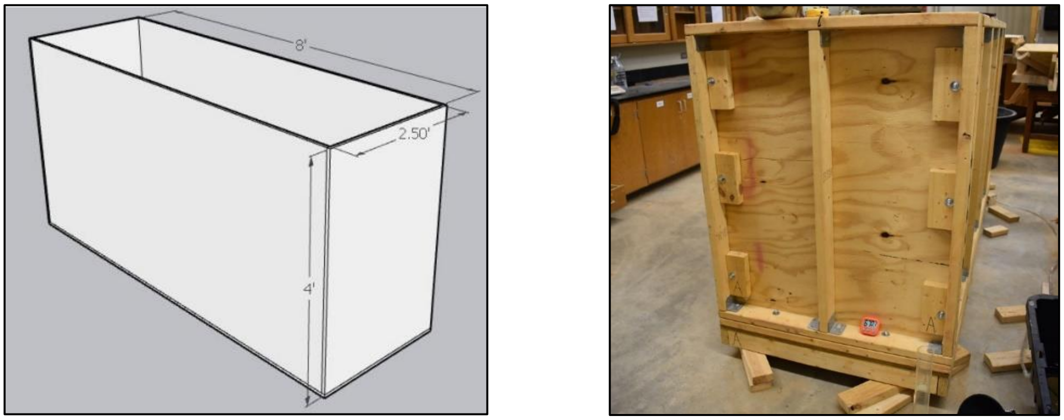
(a) Drainage system chamber

(b) Lined drainage system chamber

Figure 3-8. Infiltrometers Drainage System.

3.2.3 Infiltration Swale Chamber

To conduct intermediate-scale tests on infiltration swale media, a wooden chamber was constructed with internal dimensions measuring 8.0 ft in length, 2.5 ft in width, and 4.0 ft in height (2.44 m in length, 0.76 m in width, and 1,22 m in height). Each face of the chamber was constructed using 0.75 in. (1.91 cm) pressure-treated plywood reinforced with 2 in by 4 in (5 by 10 cm) lumber, as depicted in Figure 3-9.



(a) Internal dimensions infiltration swale chamber

(b) Infiltration swale chamber assembled

Figure 3-9. Infiltration Swale Chamber.

This apparatus was designed for conducting constant and falling infiltration rate tests. To adapt it for this purpose, a false perforated floor was constructed to allow the water discharged by the sample to flow freely across the bottom internal surface of the chamber, as depicted in Figure 3-10.

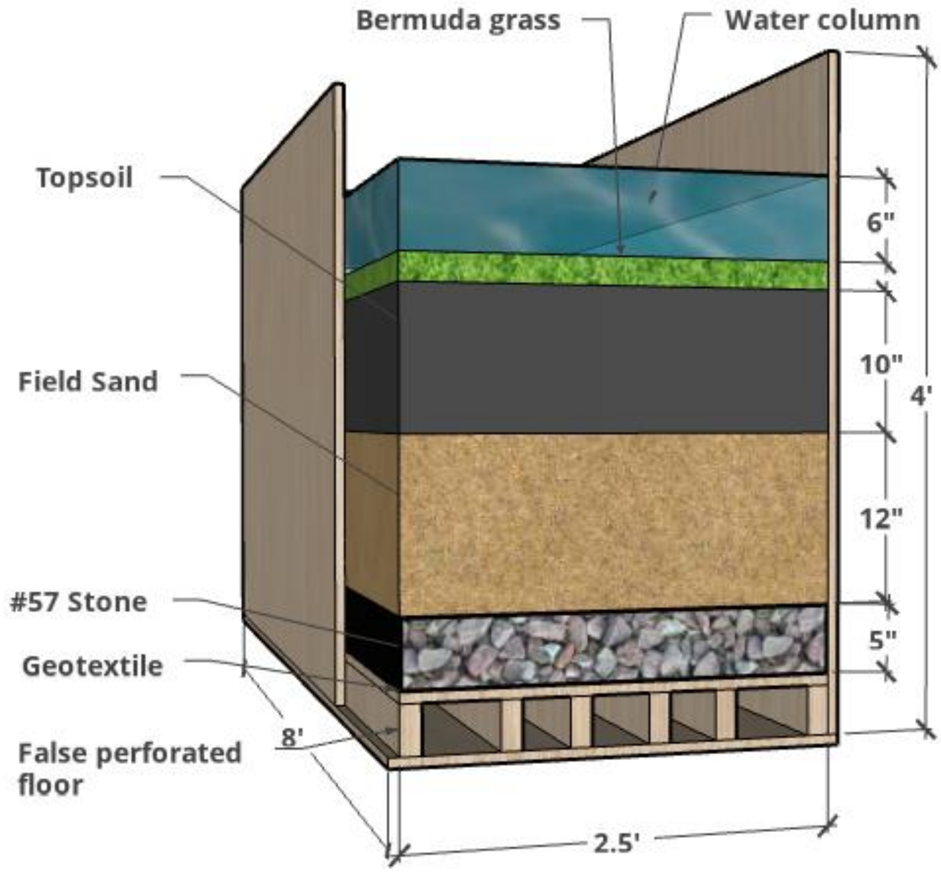
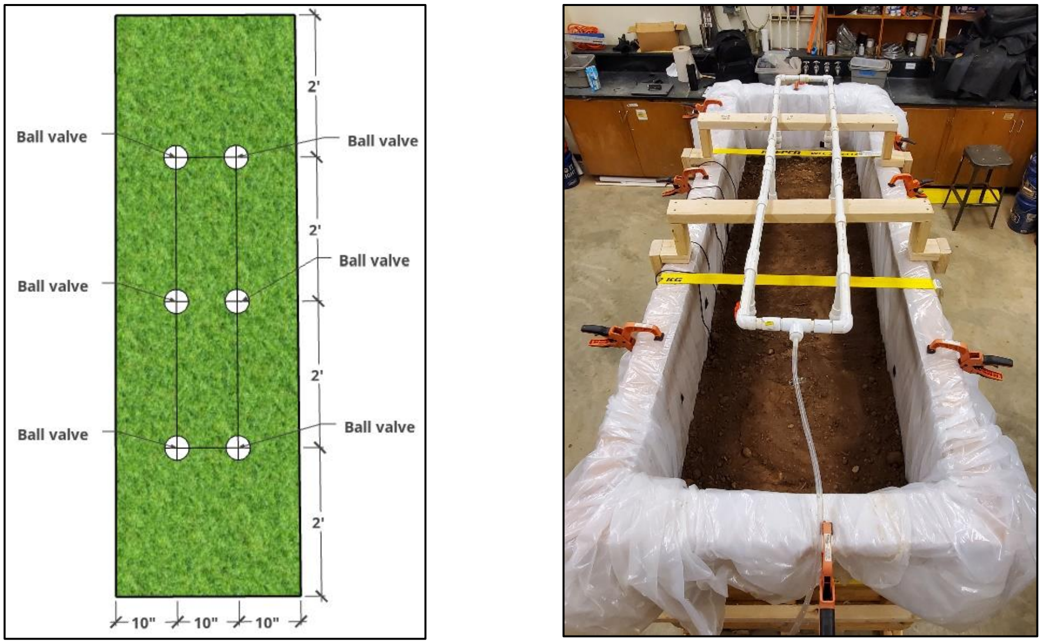


Figure 3-10. False Perforated Floor Location.

The false floor consisted of 0.75 in. (1.91 cm) pressure-treated plywood supported by six 2 by 4 in. (5 by 10 cm) lumber beams spaced at 5.0 in. (12.7 cm) intervals. The holes in the false perforated floor had a diameter of 0.38 in. (0.95 cm), with a total of 480 holes uniformly drilled 2.0 in. (5 cm) apart from center to center, as shown in Figure 3-11.

Figure 3-11. False Floor Bottom View.

The apparatus's irrigation system consisted of six 0.75 in. (1.91 cm) ball valves interconnected with PVC pipes and accessories. The valves were evenly distributed in two rows of three around the swale plant area, with a longitudinal spacing of 2.0 ft (0.61 m) and a transverse spacing of 10.0 in. (25.4 cm) from center to center, as depicted in Figure 3-12.



(a) Irrigation system ball valve distribution

(b) Infiltration system installed

Figure 3-12. Irrigation System.

To prevent water leaks during testing, the internal surface of the infiltration swale chamber was lined with two layers of 0.16 in. (4.0 mm) clear plastic sheeting, as illustrated in Figure 3-13.

Figure 3-13. Plastic Sheeting and False Perforated Floor Installed.

The infiltration swale chamber was positioned with a longitudinal slope of 1.5%, as depicted in Figure 3-14, and its lowest point housed the drainage system, as shown in Figure 3-15.

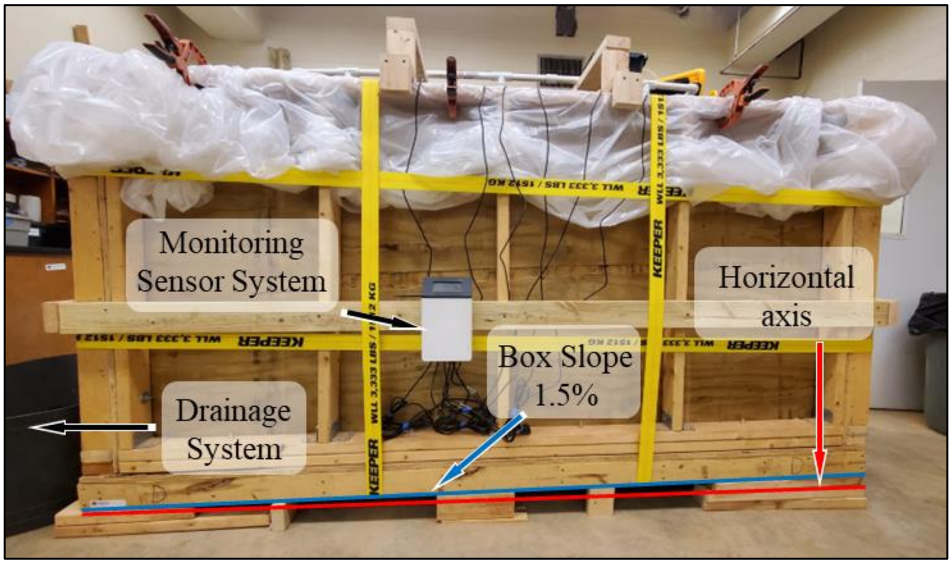


Figure 3-14. Infiltration Swale Chamber Slope.

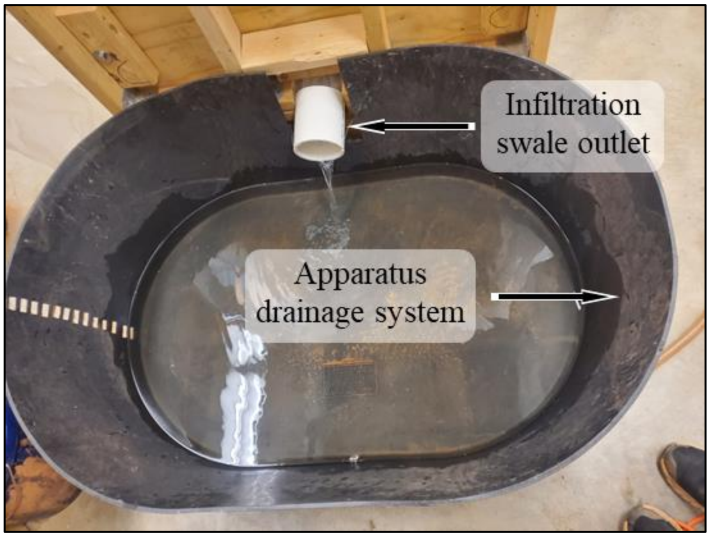


Figure 3-15. Infiltration Swale Drainage System.

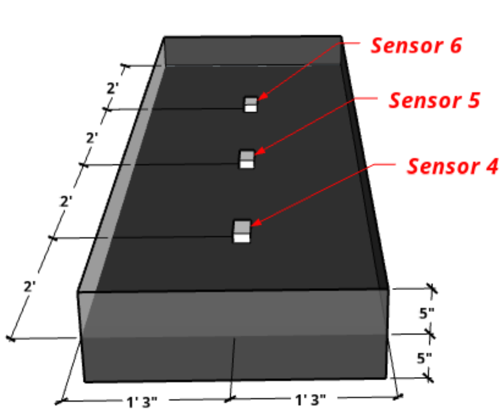
In the tests conducted within this apparatus, a ZL6 advanced cloud data logger equipped with six Teros10 soil water content sensors, manufactured by METER Group Inc., was utilized to monitor the water moisture content of both the top layer and the field sand layer of the samples (See Figure 3-16).

(a) Water content sensor installed in field sand

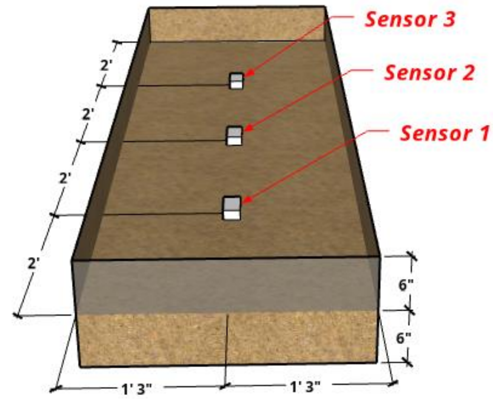
(b) Water volume content sensors installed in topsoil

Figure 3-16. Water Volume Content Sensors Installed.

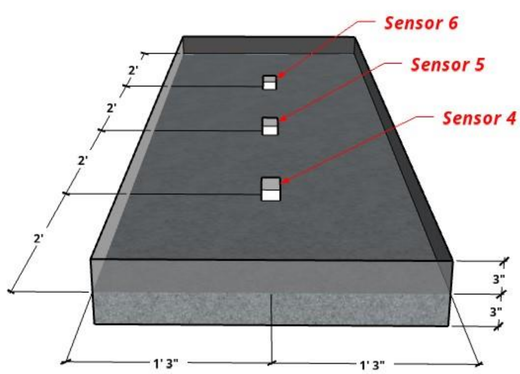
The distribution of the Teros10 sensors was as follows: three sensors were positioned in the top layer, halfway up the layer's height, along the central longitudinal axis, spaced 2.0 ft. (0.61 m) apart from center to center. The remaining three sensors were installed in the field sand layer in the same manner, as depicted in Figure 3-17.



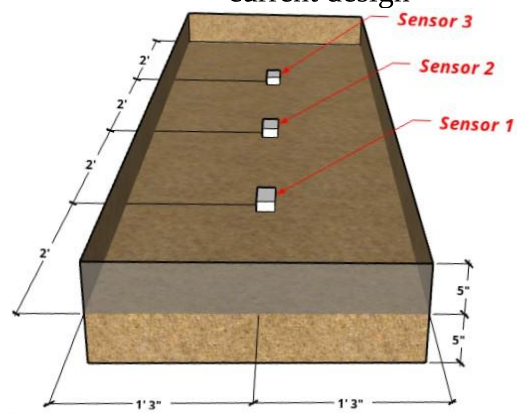
(a) Water volume content sensors distribution in topsoil – ALDOT current design



(b) Water volume content sensors distribution in field sand – ALDOT current design



(c) Water volume content sensors distribution in amended topsoil – F3 design

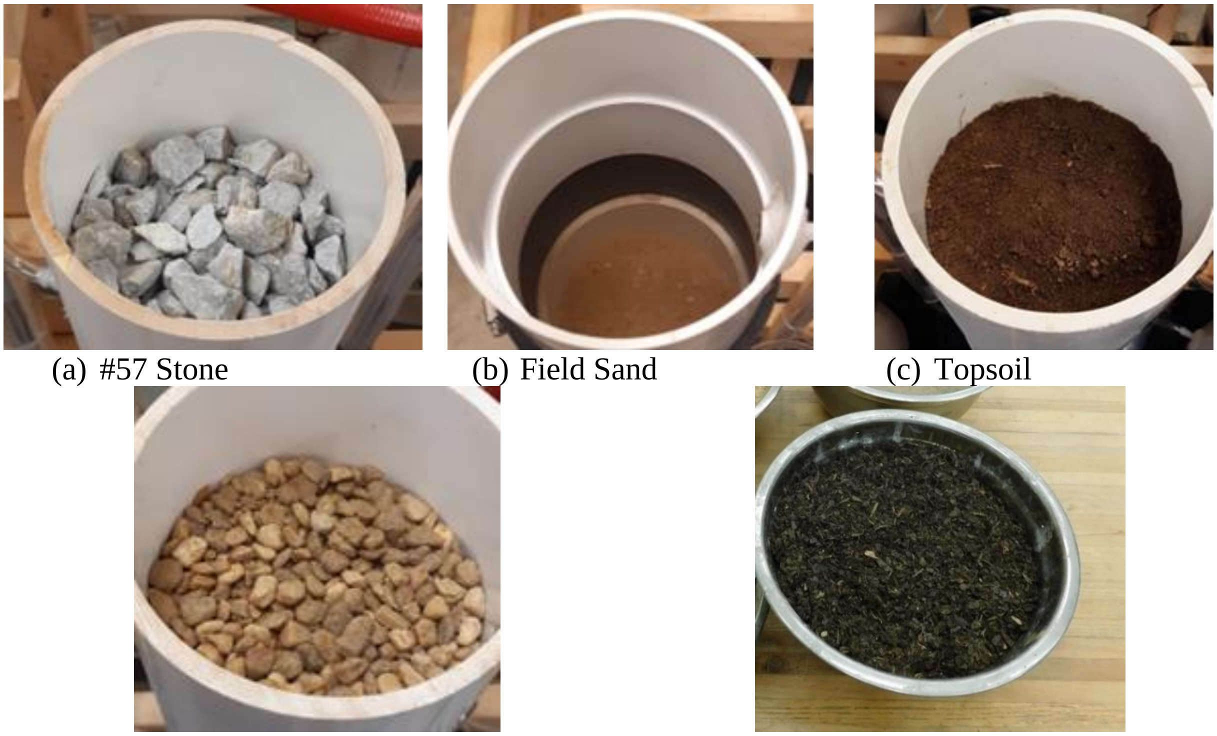


(d) Water volume content sensors distribution in field sand – F3 design

Figure 3-17. Water Volume Content Sensors Distribution in ALDOT and F3 Designs.

3.3 MATERIAL PROPERTIES

The current ALDOT infiltration swale media design consists of a bottom layer of #57 stone enveloped in non-woven geotextile, an intermediate layer of field sand, and a top layer of topsoil. For this research, these materials were used, and alternative designs were also explored, incorporating pea gravel and pine bark fines as additional components (See Figure 3-18).



(a) #57 Stone (b) Field Sand (c) Topsoil

(d) Pea Gravel (e) Pine bar fines

Figure 3-18. Materials Used in Infiltration Swale Media in this Research.

To understand the material characteristics associated with infiltration rates and permeability, the research team conducted gradation size distribution, bulk density, and porosity tests on all the previously mentioned materials. Additionally, standard permeability tests were performed on the field sand and topsoil to determine their permeabilities, and proctor tests were conducted to establish their optimum densities.

3.3.1 Compaction Process of Materials

Materials were compacted in two different ways to obtain the target densities for the tests. The first one was the mechanical compaction using a wooden manual rammer built specifically to fix in the internal area of the permeameters and infiltrometers. The second method consisted of compacting the material with a water column to promote consolidation.

Mechanical compaction: This compaction method involved compacting materials by applying mechanical energy using a manual wooden rammer. The rammer, specifically built for this research, featured a disc-shaped head and a handle (See Figure 3-19). It was used to achieve the target density required for the material layers. To ensure the most uniform density possible, the sample was divided into several sublayers. Each sublayer was compacted with the wooden rammer until the target density was reached, and this process was repeated for each subsequent upper sublayer.

Figure 3-19. Manual Wooden Rammer Designed to Compact Materials.

Compaction by consolidation with water: This method involved placing the material into the permeameter, infiltrometer, or infiltration chamber, and then adding a 1.0 ft (0.30 m) water column over the material to consolidate it. The target density was achieved when the entire 1.0 ft (0.30 m) water column was infiltrated by the material. To protect the material's surface from the direct impact of water, a circular sponge was placed before adding the water column in the permeameters and clear infiltrometers (See Figure 3-20). In the infiltration swale chamber, the consolidation process was the same, but to protect the materials during the filling process, a geotextile layer was used.

(a) Sand consolidation on clear infiltrometers

(b) Sand consolidation on infiltration swale chamber

Figure 3-20. Consolidation of Materials – Surface Protection.

3.4 TESTING PROCEDURES

To assess the water infiltration capacity of materials and matrices composed of multiple layers used in engineered infiltration swales, three distinct tests were conducted: (1) permeability constant-head tests, (2) constant-head infiltration rate tests, and (3) falling-head infiltration rate tests.

3.4.1 Modified Permeability Constant Head Test

The permeability constant head tests were conducted using the permeameters apparatus described in Chapter 3.2.1. A modified ASTM D2434 – 19 constant head method for permeability was devised to assess the permeability of materials commonly found in infiltration swale media in the U.S., including #57 stone, pea gravel, field sand, and topsoil. Additionally, this test was applied to matrices meeting the current ALDOT and GDOT requirements for infiltration swale media. Figure 3-21 show a layout of the modified permeability constant head test.

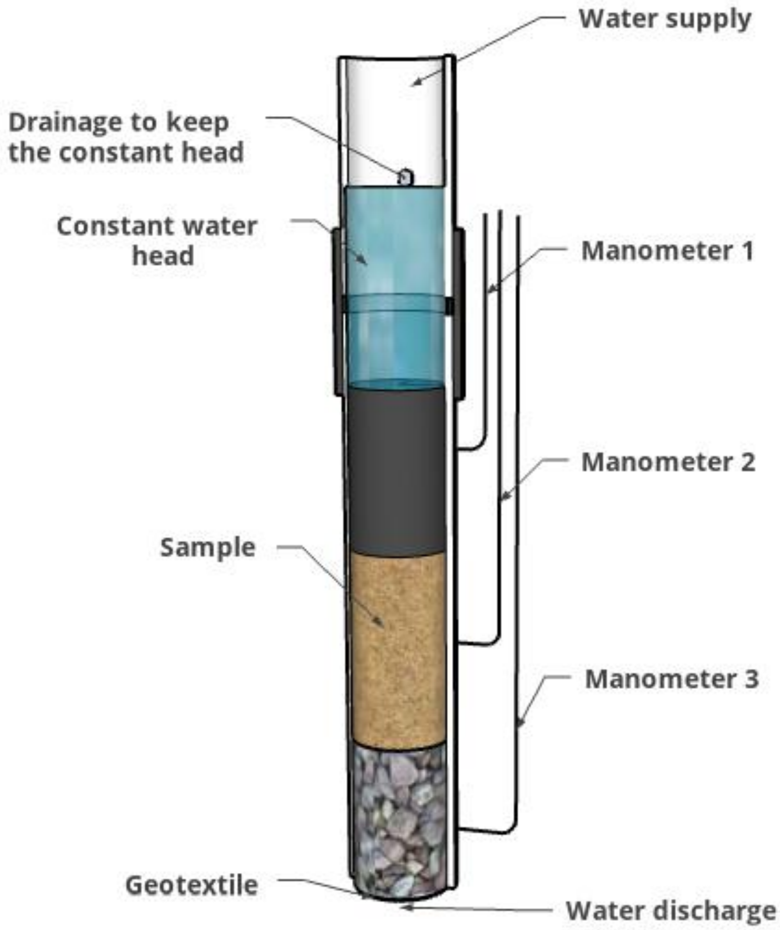


Figure 3-21. Layout Constant Head Permeability Test.

The constant head method used in this research differs from the standard method in two main aspects. First, in the permeability tests designed for this research, the two porous disks typically used in the standard method are omitted. Instead, the top porous disk is excluded, and the bottom porous disk is replaced with a geotextile layer serving the same purpose: containing the materials within the permeameter while permitting water flow. Second, this permeability test does not employ the spring mechanism used in the standard method to apply a 5.0 to 10.0 lb (2.27 to 4.54 kg) force to the sample. The absence of the spring is a modification that emulates field conditions and allows for the study of material consolidation effects likely to occur in real-world scenarios.

The detailed process for the constant head test designed in this research is as follows:

1. Install the geotextile at the bottom of the permeameter core.
2. Place the material layers inside the permeameter core.
3. Compact or consolidate the materials to achieve the target density for the test during placement.
4. Install the 6 in. (15.24 cm) rubber coupler and the 6 in. (15.24 cm) PVC extension at the top of the permeameter core.
5. Place a circular sponge over the top surface of the sample to protect it from the water impact.
6. Slowly introduce water to the sample.
7. Remove the circular sponge when the water column above the sample reaches a height of 6 in. (15.24 cm).
8. Once a steady flow of water discharges from the sample, indicating complete saturation, measure the discharged volume, water column levels in the manometers, and water temperature.
9. The permeability, k, at the temperature of the test is calculated.
10. The permeability, k, is corrected to that one at 20 ˚C (68° F).

The permeability, k, was calculated by applying Darcy’s Law, as shown in Equation 3.1:

$$k = QL/(Ath) \quad (3.1)$$

Where:

k = coefficient of permeability at the test temperature,

Q = quantity (volume) of water discharged,

L = distance between manometers,

A = cross-sectional area of specimen,

t = total time of discharge,

h = difference in the water head on manometers.

Finally, the permeability, k, was corrected to that for 20 ˚C (68° F), as shown in Equation 3.2:

$$k\ (20^{\circ}C) = k * u/u(20\ ^{\circ}C) \quad (3.2)$$

$k\ (20^{\circ}C) = k * u/u(20\ ^{\circ}C)$

Where:

$k\ (20^{\circ}C)$ = coefficient of permeability at $20^{\circ}C$,

k = coefficient of permeability at the test temperature,

μ = water viscosity at the test temperature,

$\mu(20\ ^{\circ}C)$= water viscosity at 20˚C.

3.4.2 Falling Infiltration Rate Test

The falling head infiltration rate tests were initially conducted in the permeameters apparatus. In the subsequent stage, they were performed in the clear infiltrometers to gain better insights into the interaction between materials and water, as well as the consolidation process.

This test involved placing a 2.0 ft (0.61 m) water column over a fully saturated sample and measuring the time it took for the sample to infiltrate the 2.0 ft (0.61m) water column (See Figure 3-22). Partial measurements were taken during the test to create an infiltrated water vs. time curve for the sample.

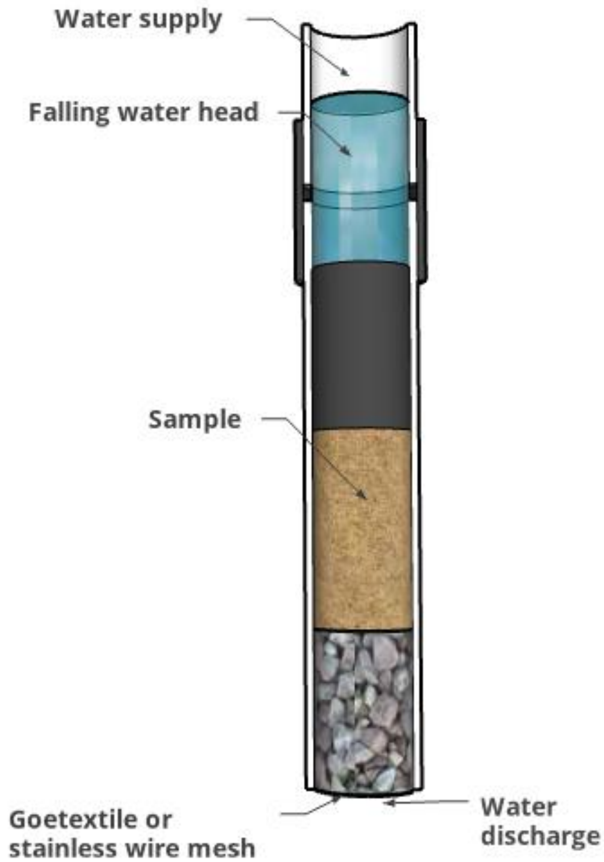


Figure 3-22. Layout Falling Head Infiltration Rate Test.

The detailed process for the falling head infiltration rate test design in this research was the following:

1. Install the geotextile layer or stainless wire mesh at the bottom of the infiltrometer core.
2. Place the material layers inside the infiltrometer core.
3. Compact or consolidate the materials to achieve the target density for the test during placement.
4. Install the 6 in. rubber coupler and the 6 in. (15.24 cm) PVC extension at the top of the infiltrometer core.

5. Place a circular sponge over the top surface of the sample to protect it from the impact of water.
6. Slowly introduce water to the sample.
7. Remove the circular sponge when the water column above the sample reaches a height of 6 in (15.24 cm).
8. Apply a 2.0 ft (0.61 m) high water column over the sample to saturate it. Saturation is achieved when the water discharged by the sample reaches a steady flow.
9. Replace the water infiltrated by the sample during saturation, and the test commences.
10. Take periodic measurements of infiltrated water height and time until the 2.0 ft (0.61 m) water column has infiltrated.

3.4.3 Constant Infiltration Rate Test

The constant head infiltration rate tests were conducted using the clear infiltrometers apparatus described in Chapter 3.2.2. This test involved maintaining a constant water head of 2.0 ft (0.61m) over the sample until saturation was achieved (See Figure 3-23). After saturation, the constant water head was maintained over the sample for an additional 6 hours. Infiltration rates were calculated every hour by measuring the quantity of water discharged during specific time intervals.

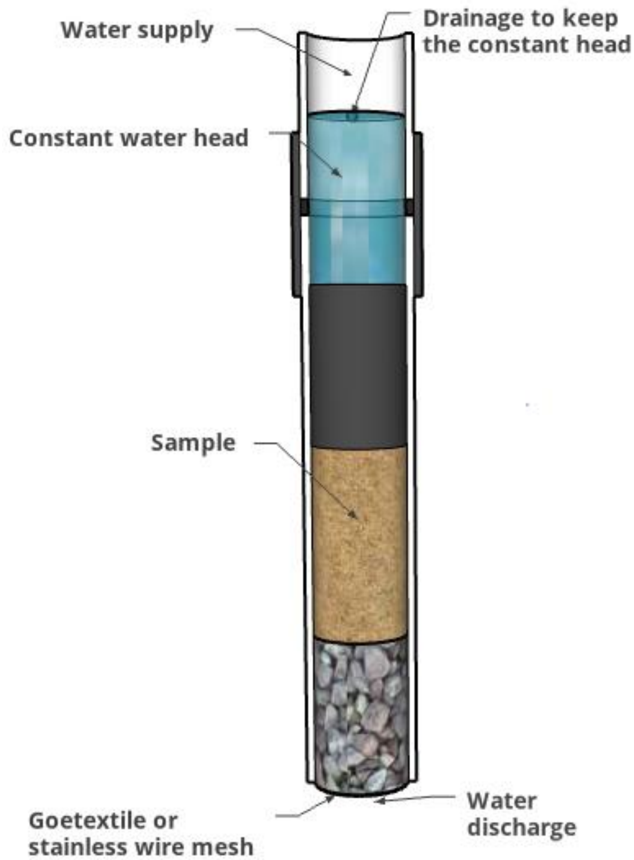


Figure 3-23. Layout Constant Head Infiltration Rate Test.

The detailed process for the constant head infiltration rate test designed in this research was the following:

1. Install the geotextile layer or stainless wire mesh at the bottom of the infiltrometer core.
2. Place the material layers inside the infiltrometer core.
3. Compact or consolidate the materials during placement to achieve the target density for the test.
4. Install the 6 in. rubber coupler and the 6 in. (15.24 cm) PVC extension at the top of the infiltrometer core.

5. Place a circular sponge over the top surface of the sample to shield it from the impact of water.
6. Initiate the slow introduction of water to the sample.
7. Remove the circular sponge when the water column above the sample reaches a height of 6 in. (15.24 cm).
8. Apply a constant water column of 2.0 ft (0.61 m) in height over the sample to saturate it. Saturation is attained when the water discharged by the sample reaches a steady flow.
9. Once the sample is saturated, measure the volume of water discharged by the sample during a specific time period to calculate the infiltration rate.
10. Repeat Step 9 every hour throughout the 6-hour test duration.

3.4.4 Constant Head Infiltration Rate Test – Intermediate Scale

The constant head infiltration rate test conducted on the infiltration swale chamber is similar to the constant head infiltration rate test designed for the clear infiltrometers. The test involved subjecting the sample to a constant water head of 6 in. (15.24 cm) for a duration of 8 hours. The test begins as soon as water is introduced over the sample. Then, every hour following the initiation of water introduction, and over the course of 8 hours, measurements are taken of the discharged volume over specific time intervals to calculate the infiltration rate. Figure 3-24 depicts the constant head infiltration rate test in the infiltration chamber.

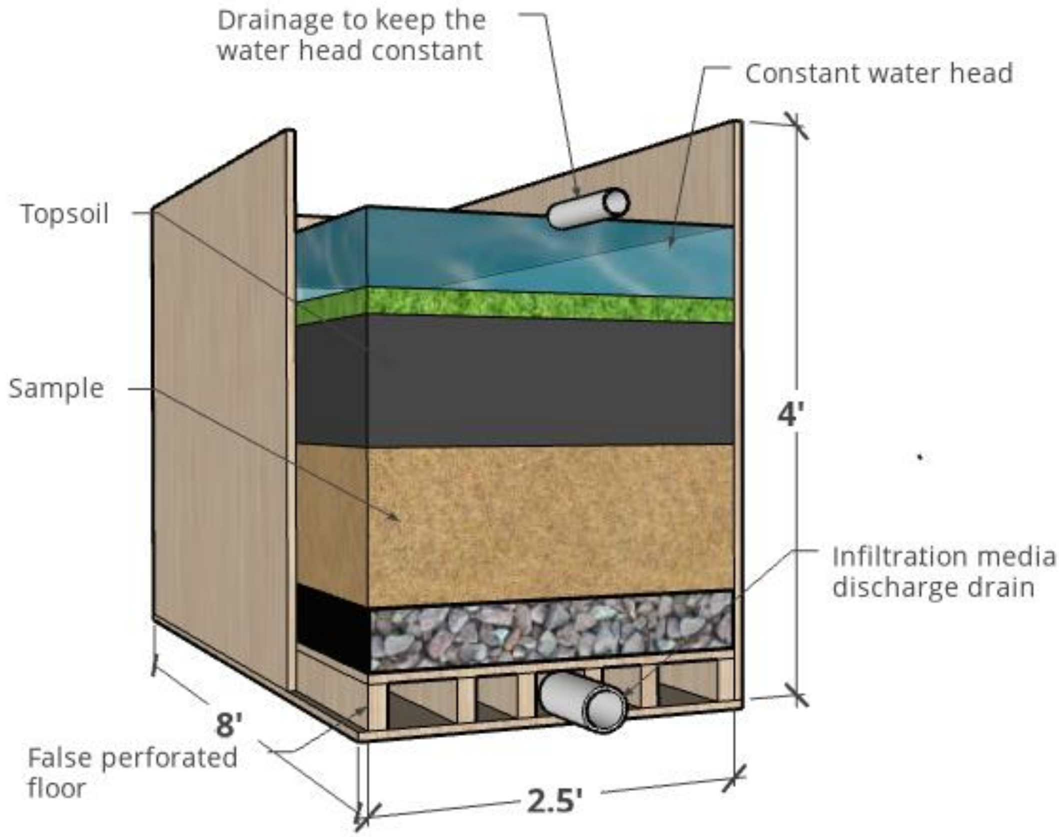


Figure 3-24. Layout Constant Head Infiltration Rate Test – Infiltration Chamber.

The detailed process for the constant head infiltration rate test conducted in the infiltration chamber designed for this research was as follows:

1. Install two layers of plastic sheeting inside the assembled wooden chamber.
2. Install the perforated false floor at the bottom of the chamber.
3. Place the material layers inside the chamber, on top of the false floor.
4. During the placement of the materials, consolidate the field sand and topsoil with water.
5. Slowly introduce water to the sample.
6. Maintain a constant water column of 6 in. (15.24 cm) high over the sample for 8 hours.
7. Measure the water discharged during a time interval every hour.
8. Repeat Step 7 every hour throughout the 8-hour test duration.

3.4.5 Falling Head Infiltration Rate Test – Intermediate Scale

The falling head infiltration rate test conducted on the infiltration swale chamber is similar to the falling head infiltration rate test designed for the clear infiltrometers. This test involved placing a 6 in. (15.2 cm) water column over the completely saturated sample and measuring the time it took for the sample to infiltrate the entire 6 in. (15.2 cm) water column. Partial measurements were taken during the test to create an infiltrated water vs. time curve for the sample (See Figure 3-25).

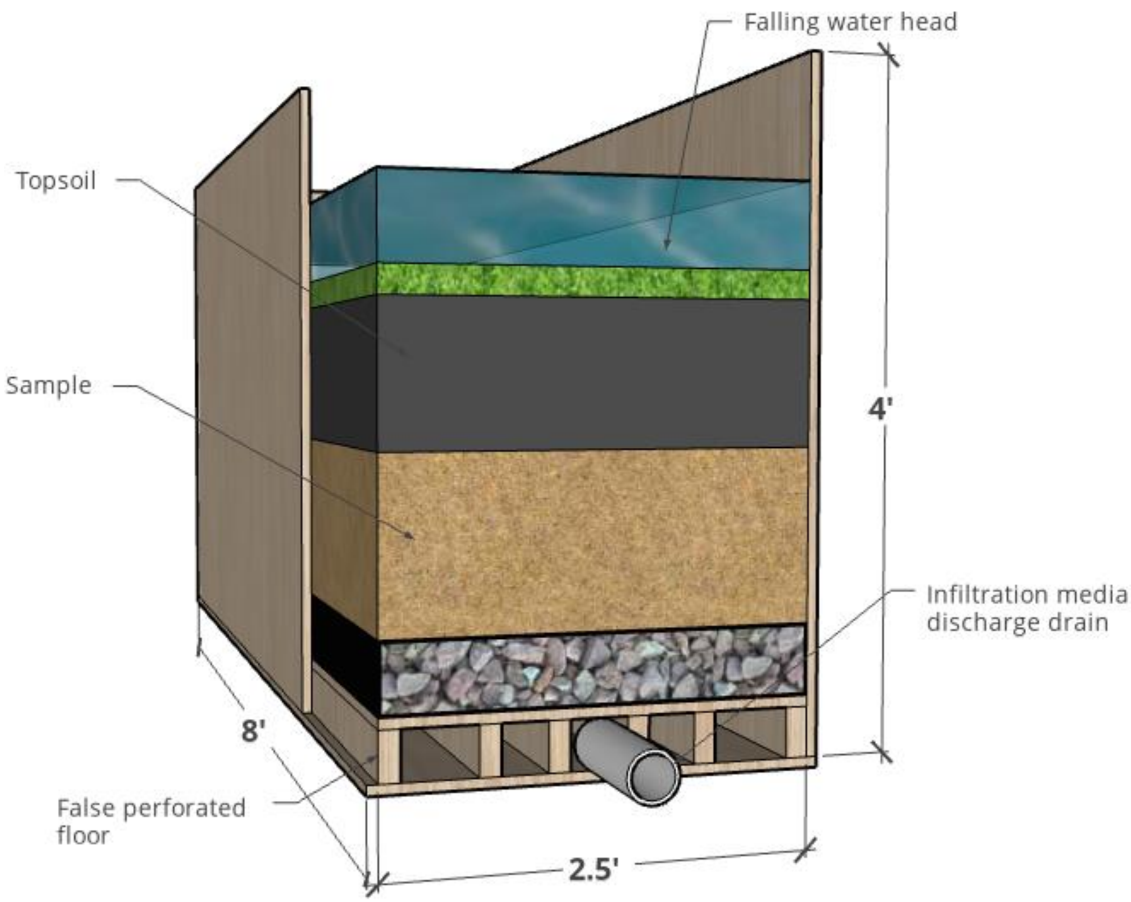


Figure 3-25. Layout Falling Head Infiltration Rate Test – Infiltration Chamber.

The detailed process for the falling head infiltration rate test designed in this research was as follows:

1. Install two layers of plastic sheeting inside the assembled wooden chamber.
2. Install the perforated false floor at the bottom of the chamber.
3. Place the material layers inside the chamber, on top of the false floor.
4. During the placement of the materials, consolidate the field sand and topsoil with water.
5. Slowly introduce water to the sample.
6. Maintain a constant head water column of 6 in. (15.24 cm) high over the sample to saturate it. Saturation is reached when the water discharged by the sample reaches a steady flow.
7. Stop the water supply and take periodic measurements of infiltrated water height and time until the 2.0 ft (0.61 m) water column has infiltrated.

CHAPTER FOUR:
RESULTS AND ANALYSIS

4.1 INTRODUCTION

The assessment of infiltration swale media performance in this research study was conducted through the systematic collection and analysis of data and observations. Multiple parameters were measured to evaluate the effectiveness of infiltration swale media, including permeability, infiltration rates under constant and falling water heads, settlement of materials, and moisture content.

In this research, the following tests were designed and conducted to evaluate the water infiltration capacities of materials and infiltration swale media. In the small-scale phase, modified constant head permeability tests were conducted on the permeameter structure. Falling and constant head infiltration rate tests were performed using the clear infiltrometers. In the intermediate-scale phase, falling and constant head infiltration rate tests were conducted on the infiltration swale box.

The small-scale phase of the project began with modified constant head permeability tests conducted in the permeameter apparatus. Samples of materials and infiltration swale media, representing the ALDOT and GDOT designs, underwent the modified constant head permeability test to determine their hydraulic conductivity. Additionally, field sand samples at various degrees of compaction underwent this test for extended periods, specifically 9 hours, to investigate how density and the consolidation process impact their permeability.

In the next stage, the team initiated the implementation of falling head infiltration rate tests on a small-scale using clear infiltrometers. Initially, due to the low permeability observed in topsoil, this test was conducted on both topsoil and amended topsoil samples to identify a top layer mixture with improved infiltration rate capacities. Following this, alternative engineered media matrices, some derived from the ALDOT design with specific modifications, underwent evaluation through this test to identify designs with superior performance.

Finally, infiltration media designs selected in the previous stages underwent testing under constant and falling head infiltration rates on a small-scale in the infiltrometers until achieving the F3 design, which demonstrated an appropriate performance in the short and long term. Design F3 was tested on an intermediate-scale alongside the ALDOT design in the infiltration swale chamber. Constant and falling head tests were conducted in the infiltration chamber. These two designs were simultaneously monitored by a moisture content monitoring system.

4.2 MATERIAL PROPERTIES

Standard Proctor tests, porosity assessments, bulk density measurements, and gradation size distribution analyses, all conducted in accordance with ASTM guidelines, were systematically performed on the materials employed in this research. These evaluations aimed to enhance our understanding of their inherent properties and characteristics. Specifically, in the context of the materials constituting the current ALDOT design, these tests played a pivotal role in ensuring compliance with the current ALDOT requirements for materials utilized in infiltration swales media.

4.2.1 Compaction

Field sand and topsoil were subjected to the D698-12 ASTM Test, commonly referred to as a Proctor Test, to determine their compaction curves and optimum dry densities. The optimum dry density determined for the field sand was 109.5 lb/ft³ (1.75 g/cm³). Figure 4-1 illustrates the compaction curve obtained for field sand.

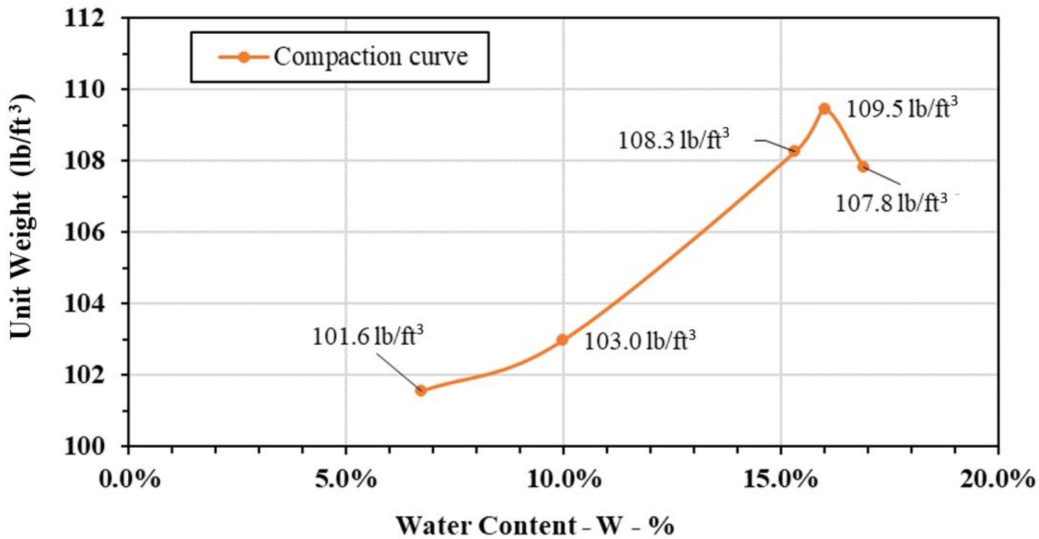


Figure 4-1. Field Sand Compaction Curve.

With respect to topsoil, the optimum dry density determined from the proctor test for it was 118.9 lb/ft³ (1.91 g/cm³). Figure 4-2 illustrates the compaction curve obtained for topsoil.

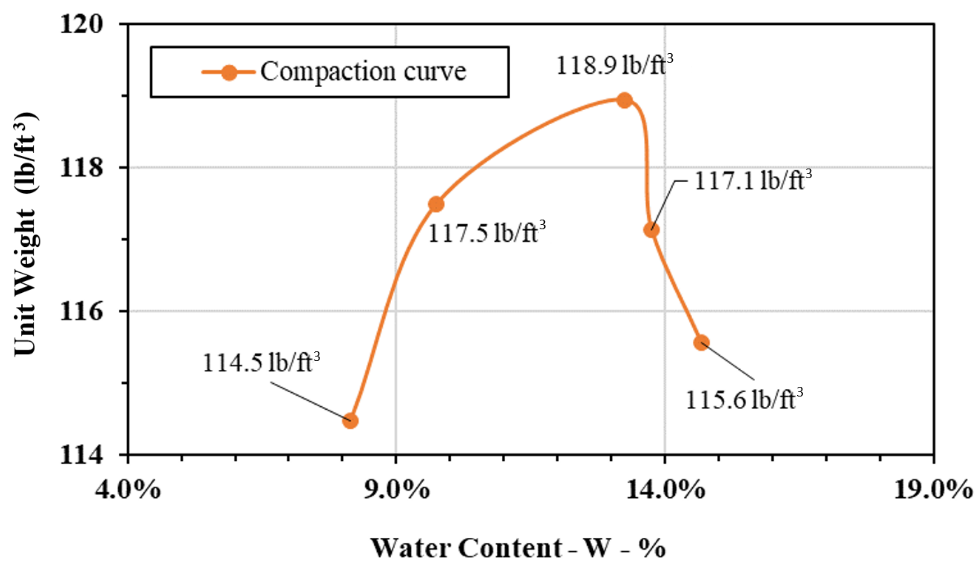


Figure 4-2. Topsoil - Compaction Curve.

4.2.2 Porosity and Bulk Density

Bulk density and porosity provide insights into the structure of a material, affecting its permeability. High bulk density and low porosity may suggest lower permeability, while high porosity and low bulk density can contribute to higher permeability. The materials used in this research were subjected to bulk density and porosity test and the results are shown in Table 4-1.

Table 4-1. Bulk Density and Porosity Tests Results.

Material	Bulk density	Porosity
Topsoil	22.12 g/in^3 (1.35 g/cm^3)	43%
#57 stone	23.60 g/in^3 (1.44 g/cm^3)	46%
Pea gravel	23.60 g/in^3 (1.44 g/cm^3)	41%
Field sand	27.53 g/in^3 (1.68 g/cm^3)	33%

According to the results of bulk density and porosity tests, topsoil is expected to exhibit higher permeability than field sand due to its greater porosity and lower bulk density. However, it is important to note that soil permeability is not solely determined by bulk density and the percentage of pores within the material; it is also influenced by the shape and inter-granular distribution of these pores (Elhakim, 2016), as well as the intermolecular interactions between particles that tend to adhere to each other (Kozlowski and Ludynia 2019).

4.2.3 Particle Size Distribution

The materials used in this research were subjected to particle size distribution tests. Regarding the topsoil, and the #57 stone, these tests were useful to verify that they meet with the current ALDOT requirements. Figure 4-3 shows the particle size distribution curves of the topsoil, field sand, pea gravel, and #57 stone.

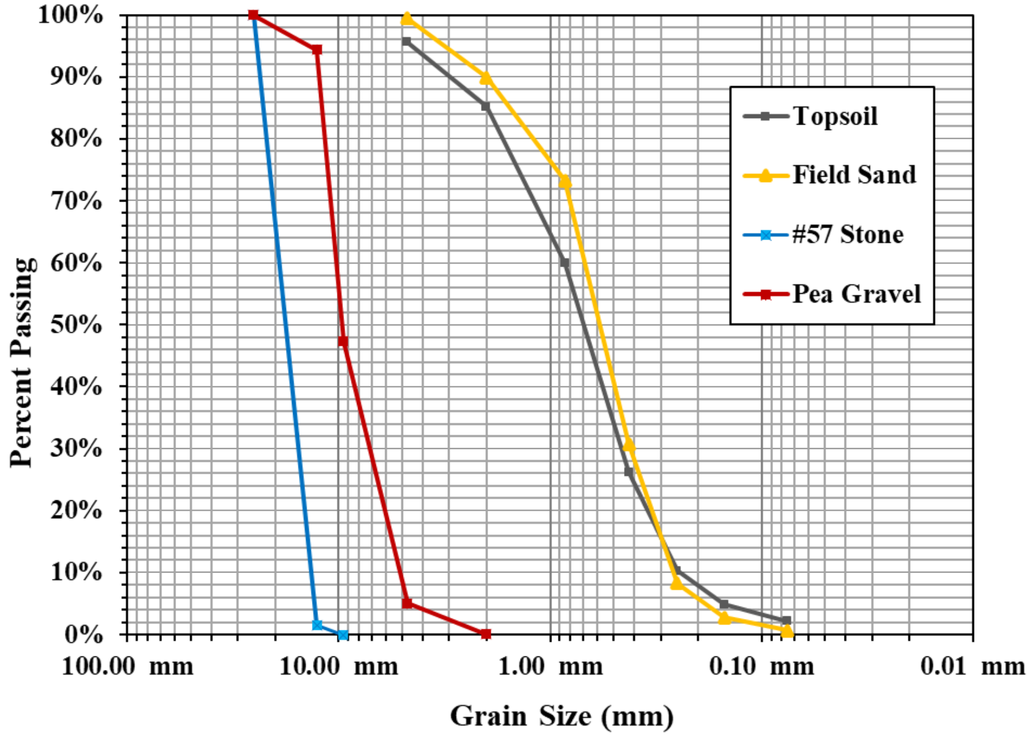


Figure 4-3 Particle Size Distribution Curves.

The particle size distribution curves indicate that topsoil has finer particles and a more well-graded size distribution than field sand. This difference is one of the reasons why the topsoil exhibits lower permeability than field sand, despite having higher porosity.

4.3 MODIFIED CONSTANT HEAD PERMEABILITY TESTS

The modified constant head permeability test, as explained in Chapter 3.4.1, was conducted on samples of topsoil, field sand, and #57 stone—the current materials used in ALDOT's infiltration swale media design. In addition to the ALDOT's materials, the permeability of pea gravel was assessed with the aim of incorporating this material into alternative designs.

Samples representing both ALDOT and Georgia DOT infiltration swale designs underwent this test to assess their hydraulic conductivity. Finally, field sand samples at different densities were tested over extended periods to evaluate the effects of density and consolidation on them.

4.3.1 Permeability tests on infiltration swale materials.

Loose samples of topsoil, field sand, #57 stone and pea gravel were tested on the permeameters apparatus to know their permeability at 20 °C. the results obtained are shown in Table 4-2.

Table 4-2. Modified Permeability Constant Head Results.

Materials	Height of the sample in. (cm)	Permeability, k, at 20 °C in./min (cm/min)
Topsoil	33 (83.82)	0.016 (0.004)
Field sand	33 (83.82)	1.56 (3.96)
#57 stone	33 (83.82)	2,403.03 (6,103.76)
Pea gravel	33 (83.82)	215.31 (546.98)

According to results from the constant permeability tests, the critical and limiting layer on the current ALDOT design was determined to be topsoil.

4.3.2 Permeability Tests on ALDOT and Georgia Designs.

Five samples, representative of the ALDOT infiltration swale design, and two samples, representative of the GDOT infiltration swale design, underwent the modified constant head permeability test. The configuration of all seven samples, along with the corresponding test results, is detailed in Table 4-3.

Table 4-3. Modified Permeability Tests Results – ALDOT and GDOT Designs.

Design	Materials			
	Topsoil layer height in. (cm)	Field sand layer height in. (cm)	#57 stone layer height in. (cm)	Permeability, k (20 °C) in./min (cm/min)
ALDOT 1	9.4 (24)	14.2 (36)	9.4 (24)	0.019 (0.050)
ALDOT 2	11.8 (30)	12.6 (32)	8.7 (22)	0.015 (0.039)
ALDOT 3	8.3 (21)	16.5 (42)	7.9 (20)	0.013 (0.033)
ALDOT 4	8.3 (21)	16.5 (42)	8.3 (21)	0.004 (0.011)
ALDOT 5	10.6 (27)	15.0 (38)	7.5 (19)	0.002 (0.004)
Design	**Materials**			
	Topsoil layer height in. (cm)	Pea gravel layer height in. (cm)	#57 stone layer height in. (cm)	Permeability, k (20 °C) in./min (cm/min)
GDOT 1	22.4 (57)	1.6 (4)	9.1 (23)	0.001 (0.002)
GDOT 2	22.0 (56)	2.4 (6)	8.7 (22)	0.002 (0.004)

The results of the modified permeability tests on the ALDOT and Georgia DOT designs confirmed again that the low permeability of topsoil must be improved.

4.3.3 Permeability Test on Field Sand at Different Densities.

The modified constant head permeability test was conducted on 11 field sand samples, each 3.0 ft (0.91 m) in height (See Figure 4-4), at various degrees of compaction over a 9-hour period. The degree of compaction represents the percentage of the sample's density compared to the optimum dry density obtained from the Proctor test for field sand, which was 109.5 lb/ft^3 (1.75 g/cm^3).

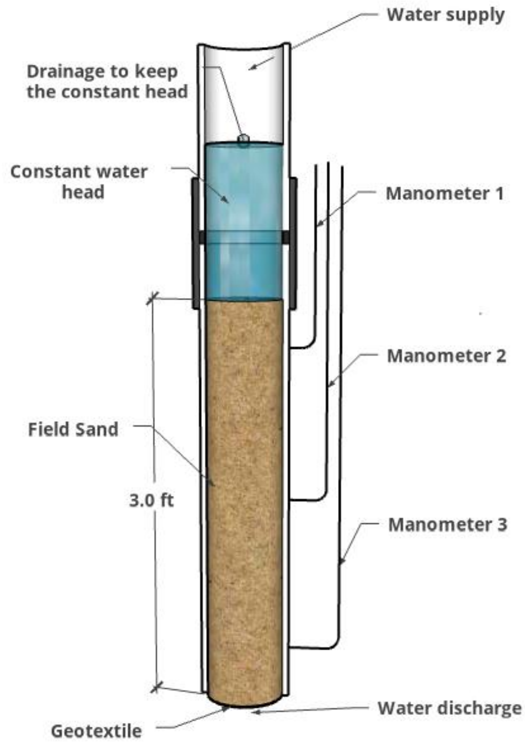


Figure 4-4. Layout Constant Head Permeability Test on Sand.

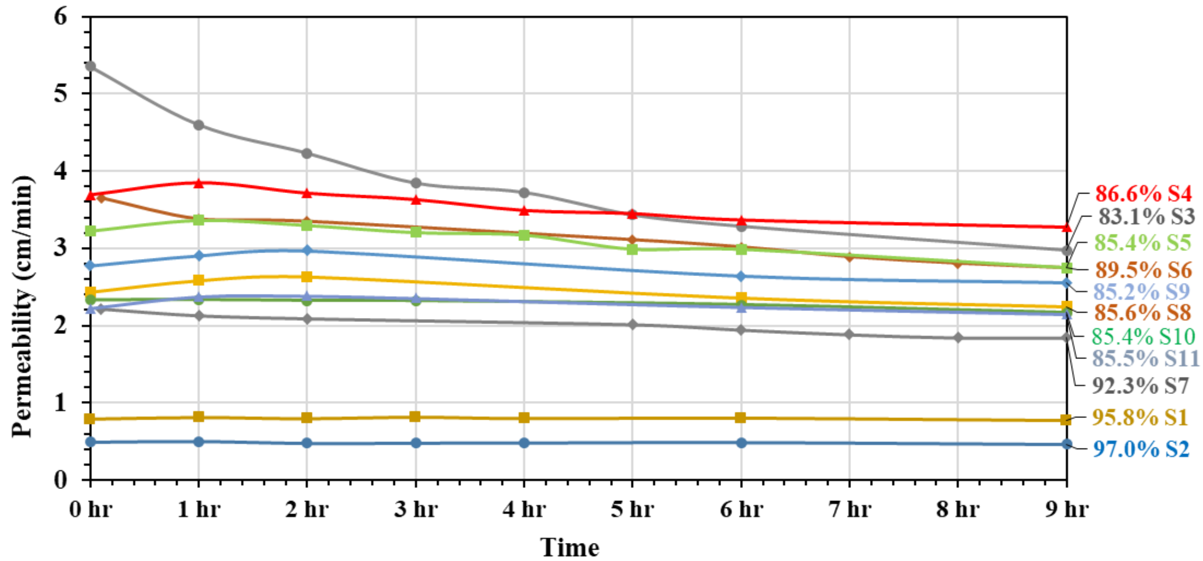
Hourly measurements were taken for water discharge, temperature, and water head in manometers 1 and 3 to calculate the permeability, *k*. A permeability vs. time curve was generated for each field sand sample using the permeabilities calculated at each hour during the test. Table 4-4 shows the results obtained in the modified constant head permeability tests of field sand samples.

Table 4-4. Field Sand Configuration and Permeability Results

Field Sand Sample	Final Density lb/ft^3 (g/cm3)	Degree of compaction (%)	Initial Permeability, k 20°C in./min (cm/min)	Final Permeability, k 20°C in./min (cm/min)	Permeability Reduction (%)	Compaction method
S1	104.9 (1.68)	95.8	0.31 (0.79)	0.30 (0.77)	2.5	Mechanical compaction
S2	106.1 (1.70)	97.0	0.19 (0.48)	0.17 (0.44)	8.3	Mechanical compaction
S3	91.1 (1.46)	83.1	2.11 (5.35)	1.17 (2.98)	44.3	Loose sample
S4	94.9 (1.52)	86.6	1.49 (3.68)	1.26 (3.19)	13.3	Mechanical compaction
S5	93.6 (1.50)	85.4	1.26 (3.20)	1.06 (2.69)	15.9	Mechanical compaction
S6	98.0 (1.57)	89.5	1.44 (3.65)	1.08 (2.74)	24.9	Loose sample
S7	101.1 (1.62)	92.3	0.87 (2.22)	0.72 (1.84)	17.1	Mechanical compaction
S8	93.6 (1.50)	85.6	0.96 (2.43)	0.89 (2.25)	7.4	Consolidated with water
S9	93.0 (1.49)	85.2	1.09 (2.77)	1.00 (2.54)	8.3	Consolidated with water
S10	93.6 (1.50)	85.4	0.91 (2.30)	0.83 (2.11)	8.3	Consolidated with water
S11	93.6 (1.50)	85.5	0.87 (2.22)	0.84 (2.14)	3.6	Consolidated with water

Note: Initial permeability: permeability of the sample at the start of the test.
Final permeability = permeability at 9 hours after the start of the test.
Permeability reduction = reduction in permeability during the 9-hour test.

The graph of the permeability vs. time curves of the 11 field sand samples obtained from the modified permeability tests are shown in Figure 4-5.



Note: Each curve is labeled with the degree of compaction of the sample followed by the sample's name. The degree of compaction represents the percentage of the sample's density compared to the optimum dry density.

Figure 4-5. Permeability vs. Time Curves – Field Sand Samples.

The prolonged modified constant head permeability test on field sand samples at different degrees of compaction revealed that the final density of this material, when placed without any compaction and subjected to a flowing water column, is 85.5% of its optimum density. In the field, this material undergoes the same consolidation phenomenon due to water flow. Consequently, if the sand is loosely installed without compaction, consolidation over time will lead this material to achieve a density of 85.5%. Therefore, in subsequent tests, this material was consolidated with water after being placed in the infiltrometers to attain the 85.5% degree of compaction, corresponding to 93.62 lb/ft^3 (1.50 g/cm^3).

4.3.4 72 hours - Permeability Test on Field Sand.

Two field sand samples, initially at densities of 88.1% and 91.8% of the optimum density, underwent a 72-hour modified constant head permeability test to evaluate the effects of consolidation on this material. The properties and permeability results are presented in Table 4-5.

Table 4-5. Field Sand Samples Properties Subjected to the 72-hour Modified Permeability Test.

Material	Initial Bulk density lb/ft^3 (g/cm^3)	Optimum density lb/ft^3 (g/cm^3)	Initial degree of compaction	Final Bulk density lb/ft^3 (g/cm^3)	Final degree of compaction	Initial Permeability in./min (cm/min)	Final Permeability in./min (cm/min)
Field Sand	96.8 (1.55)	109.2 (1.75)	88.1%	98.0 (1.57)	89.5%	1.39 (3.53)	0.85 (2.15)
Field Sand	100.5 (1.61)	109.2 (1.75)	91.8%	101.1 (1.62)	92.3%	0.85 (2.17)	0.50 (1.28)

Figure 4-6 illustrates the permeability vs. time curves for the two field sand samples during the 72-hour modified constant head test.

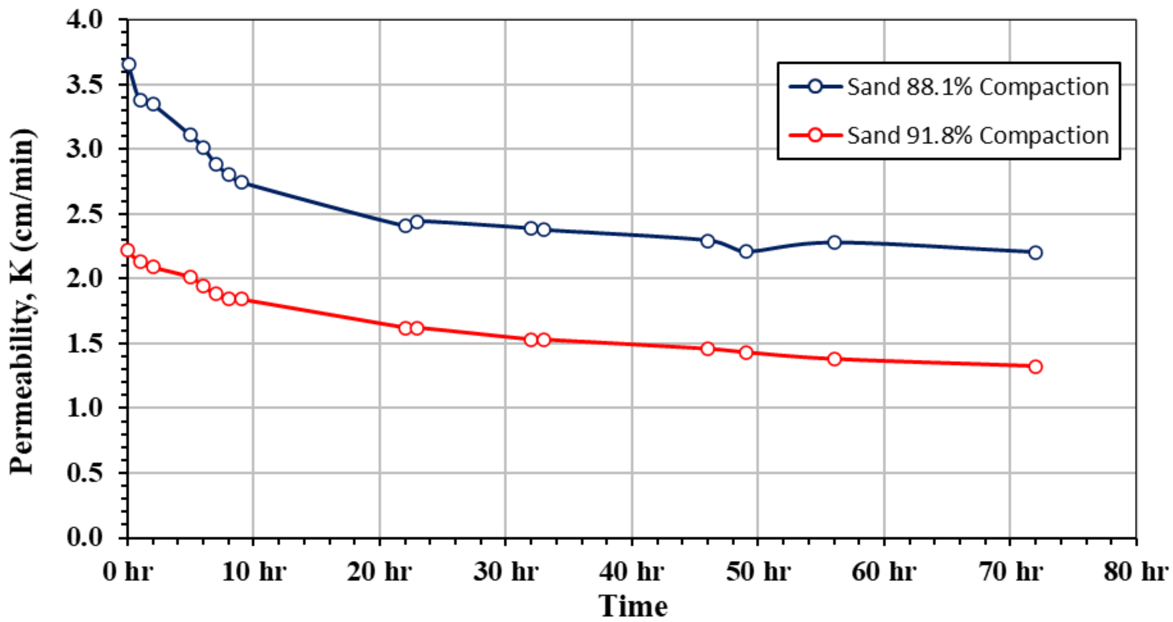


Figure 4-6. Permeability vs. Time Curves – 72-hour Test - Field Sand Samples.

The sample with 88.1% of the optimum density exhibited an initial permeability of 3.53 cm/min, and after 72 hours, its permeability decreased to 2.15 cm/min, representing a reduction of 39%. In terms of density, it changed from 88.1% to 89.5% of its optimum density. For the sample with 91.8% of the optimum density, the initial permeability was 2.17 cm/min, and after 72 hours, the permeability reduced to 1.28 cm/min, indicating a reduction of 41%. The density of this sample changed from 91.8% to 92.3%.

These tests show that after subjecting the materials to a water column for an extended period, the consolidation effects generated when a water column flows through the materials significantly reduce their infiltration capacities. In these two samples, it can be seen that, on average, the reduction was 40%, which is important when constructing infiltration swale media, as these field practices will invariably be subjected to this phenomenon.

4.4 FALLING HEAD INFILTRATION RATE TEST IN PERMEAMETERS

Topsoil samples, amended topsoil samples compound by a mixture of topsoil and pine bark fines, and six different infiltration swale media designs, including the current ALDOT design, were subjected to the falling head infiltration rate test explained in Chapter 3.4.2.

4.4.1 Topsoil – Falling Head Infiltration Rate Tests.

Three similar loose topsoil samples, each 6 in. (15.24 cm) high, underwent three falling head infiltration rate tests using a water column of 2.0 ft (0.61 m). The results are presented in Table 4-6.

Table 4-6. Topsoil - Falling Head Infiltration Rate Tests Results.

Topsoil sample	Falling head test Test 1	Test 2	Test 3	Average	Overall Average
Sample 1	0.76 ft/day (0.23 m/day)	0.35 ft/day (0.11 m/day)	0.27 ft/day (0.08 m/day)	0.46 ft/day (0.14 m/day)	0.63 ft/day (0.19 m/day)
Sample 2	0.86 ft/day (0.26 m/day)	0.41 ft/day (0.12 m/day)	0.28 ft/day (0.09 m/day)	0.52 ft/day (0.16 m/day)	
Sample 3	1.39 ft/day (0.42 m/day)	0.94 ft/day (0.29 m/day)	0.39 ft/day (0.11 m/day)	0.91 ft/day (0.28 m/day)	

According to the results, the topsoil exhibited an infiltration rate lower than the minimum requirement specified in the LID Manual of Alabama, which is 1.0 ft/day (0.30 m/day). Additionally, it was observed that the more the sample was tested—meaning, the more it was subjected to the effects of water flowing through it—the lower its infiltration rate became because of consolidation. Hence, the proposal was to blend this material with pine bark fines to enhance its infiltration rate.

4.4.2 Topsoil Mixed with Pine Bark Fines – Falling Head Infiltration Rate Tests.

Due to the low permeability of topsoil, it was amended by adding pine bark fines (Figure 4-7. Pine Bark Fines. Twelve samples, each 6 in. (15.24 cm) in height, were prepared for falling head infiltration rate tests. Ten of these samples were composed of a mixture of topsoil and pine fine barks at different weight proportions, one consisted of only topsoil, and another comprised solely of pine bark fines. Table 4-7 provides details on these samples and the infiltration rates obtained in the falling head tests.

Figure 4-7. Pine Bark Fines.

Table 4-7. Falling-Head Infiltration Rate Results.

Top layer samples composition		**Infiltration rate ft/day (m/day)**			
Topsoil % by weight	**Pine bark fines % by weight**	**Test 1**	**Test 2**	**Test 3**	**Average**
100	0	1.00 (0.30)	0.57 (0.17)	0.31(0.09)	0.63 (019)
95	5	0.87 (0.27)	0.55 (0.17)	0.87 (0.27)	0.76 (0.23)
93	7	0.96 (0.29)	1.67 (0.51)	0.03 (0.01)	0.89 (0.27)
90	10	0.92 (0.28)	0.87 (0.27)	1.63 (0.50)	1.14 (0.35)
85	15	1.50 (0.45)	2.32 (0.71)	3.29 (1.00)	2.37 (0.72)
80	20	5.70 (1.73)	3.40 (1.04)	7.70 (2.35)	5.60 (1.71)
75	25	14.26 (4.35)	17.04 (5.19)	21.33 (6.50)	17.54 (5.35)
70	30	12.92 (3.94)	30.64 (9.34)	35.12 (10.70)	26.23 (7.99)
60	40	45.00 (13.72)	15.65 (4.77)	16.28 (4.96)	25.61 (7.81)
50	50	221.54 (67.2)	411.43 (125.40)	320.00 (97.54)	317.66 (96.82)
25	75	261.82 (79.80)	320.00 (97.54)	411.43 (125.40)	331.08 (100.91)
0	100	2,160.00 (658.37)	1440.00 (438.91)	1920.00 (585.22)	1840.00 (560.83)

In Figure 4-8, the infiltration rate curve is plotted against the percentage content of pine bark fines in the mixture.

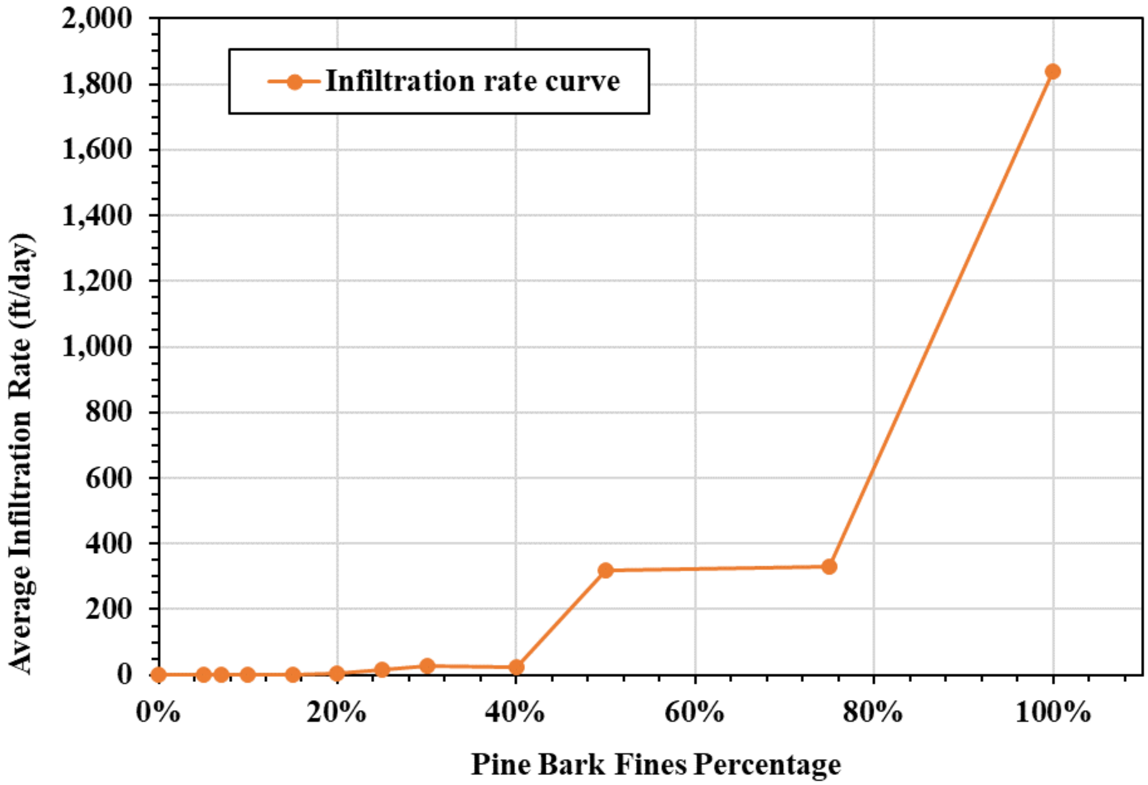


Figure 4-8. Average Infiltration Rate Vs. Pine Bark Fines Percentages

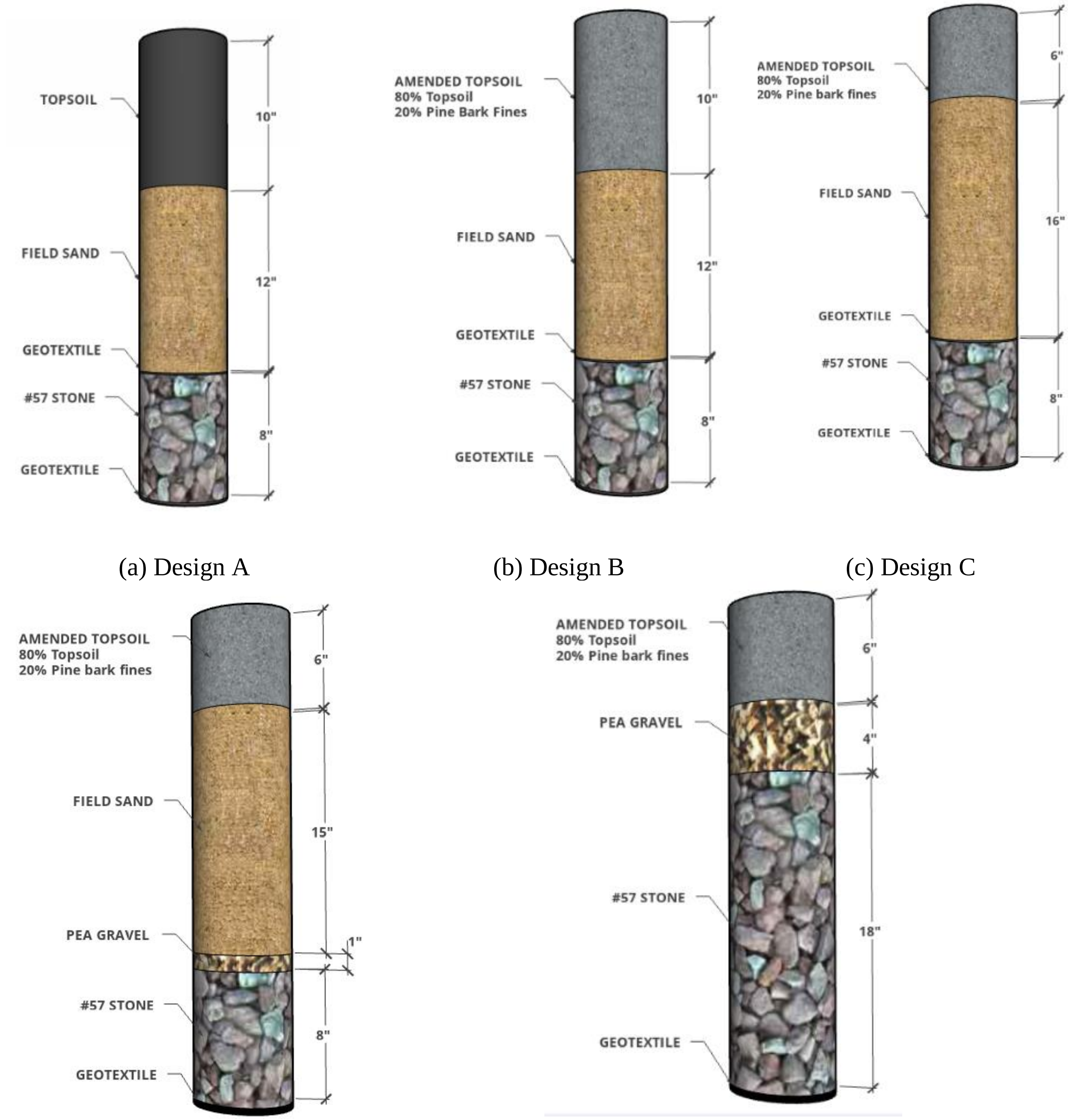
The results indicated that the higher the percentage of pine bark fines in the amended topsoil, the greater the infiltration rate of the mixture. Specifically, the amended topsoil design, composed of 80% topsoil and 20% pine bark fines by weight, demonstrated an average infiltration rate of 5.60 ft/day (1.71 m/day)—8.89 times higher than the infiltration rate obtained with topsoil alone, which was 0.63 ft/day (0.19 m/day). Consequently, this amended topsoil design was selected and integrated into some of the future alternative designs evaluated in this research due to its significant improvement in infiltration capacities compared to using a top layer composed entirely of 100% topsoil. From here out, every time amended topsoil is mentioned, it refers to the mixture composed of 20% pine bark fines and 80% topsoil by weight.

4.4.3 A, B, C, D, and E Designs – Falling Head Infiltration Rate Tests.

Three samples of each engineered media design were subjected to three falling head infiltration rate tests. Design A, the first representative prototype of the current ALDOT engineered media, consisted of a 10.0 in. (25.4 cm) topsoil layer, a 12.0 in. (30.5 cm) field sand layer, and an 8.0 in. (20.3 cm) geotextile-wrapped #57 stone layer. Design B was similar to Sample A, with the only difference being the use of amended topsoil instead of 100% topsoil. Design C was comprised of a 6.0 in. (15.2 cm) amended topsoil layer, a 16.0 in. (40.6 cm) field sand layer, and an 8.0 in. (20.2 cm) geotextile-wrapped #57 stone layer. Design D included a 6.0 in. (15.2 cm) amended topsoil layer, a 15 in. (38.1 cm) field sand layer, a 1.0 in. (2.5 cm) pea gravel layer, and an 8.0 in. (20.3 cm) #57 stone layer not wrapped in geotextile. Design E consisted of a 6.0 in. (15.2 cm) layer of amended topsoil, a 4.0 in. (10.2 cm) layer of pea gravel, and an 18.0 in. (45.7 cm) layer of #57 stone not wrapped in geotextile (See Figure 4-9). Table 4-8 summarizes the configuration of these samples.

Table 4-8. Designs A, B, C, D, and E Configuration.

Design	Topsoil	Amended topsoil	Field sand	Pea gravel	#57 stone	Geotextile wrapping the #57 stone layer
A	10 in. (25.4 cm)	-	12 in. (30.5 cm)	-	8 in. (20.3 cm)	Yes
B	-	10 in. (25.4 cm)	12 in. (30.5 cm)	-	8 in. (20.3 cm)	Yes
C	-	6 in. (15.2 cm)	16 in. (40.6 cm)	-	8 in. (20.3 cm)	Yes
D	-	6 in. (15.2 cm)	15 in. (38.1 cm)	1 in. (2.5 cm)	8 in. (20.3 cm)	No
E	-	6 in. (15.2 cm)	-	4 in. (10.2 cm)	18 in. (45.7 cm)	No
Layer theorical density lb/ft^3 (g/cm^3)	88.8 (1.42)	61.2 (0.98)	93.6 (1.50)	101.1 (1.62)	98.6 (1.58)	



(a) Design A (b) Design B (c) Design C

(d) Design D (e) Design E

Figure 4-9. Designs A, B, C, D, and E Layout.

Table 4-9 summarizes the results of the three falling head infiltration rate tests conducted on each of the three samples representing Designs A, B, C, D, and E.

Table 4-9. Falling Head Infiltration Rate Results for Designs A, B, C, D, and E.

Design	Average of the Three samples First test	Average of the Three samples Second Test	Average of the Three samples Third Test	Average of three test of the design Average
A	0.33 ft/day (0.10 m/day)	0.30 ft/day (0.09 m/day)	0.29 ft/day (0.09 m/day)	0.31 ft/day (0.09 m/day)
B	0.99 ft/day (0.30 m/day)	2.24 ft/day (0.68 m/day)	3.51 ft/day (1.07 m/day)	2.25 ft/day (0.69 m/day)
C	1.13 ft/day (0.34 m/day)	1.33 ft/day (0.41 m/day)	1.50 ft/day (0.46 m/day)	1.32 ft/day (0.40 m/day)
D	0.98 ft/day (0.30 m/day)	0.93 ft/day (0.28 m/day)	0.86 ft/day (0.26 m/day)	0.92 ft/day (0.28 m/day)
E	1.27 ft/day (0.39 m/day)	1.85 ft/day (0.56 m/day)	1.68 ft/day (0.51 m/day)	1.60 ft/day (0.49 m/day)

The results of these tests were valuable in detecting that the average infiltration rate of Design B was 7.26 times higher than the infiltration rate of Design A, representing the current ALDOT design. This indicates that changing the topsoil to amended topsoil increased the infiltration capacity of the ALDOT design by 7.25 times, from 0.31 ft/day (0.09 m/day) to 2.25 ft/day (0.69 m/day), when subjected to three falling head infiltration rate tests.

4.4.4 Constant and Falling Head Infiltration Rate test in Clear Columns

From this point forward, all tested designs underwent three falling head infiltration rate tests and three constant head infiltration rate tests. Initially, for designs A-1G and F, falling head infiltration rate tests were conducted first, followed by constant head infiltration rate tests. However, the order of the tests was later reversed. All samples were initially subjected to constant head tests to simulate extended use, followed by three falling head infiltration rate tests to assess their long-term performance under falling head conditions.

4.4.5 A-1G and F Designs: Three Falling and Three Constant Infiltration Rate Tests.

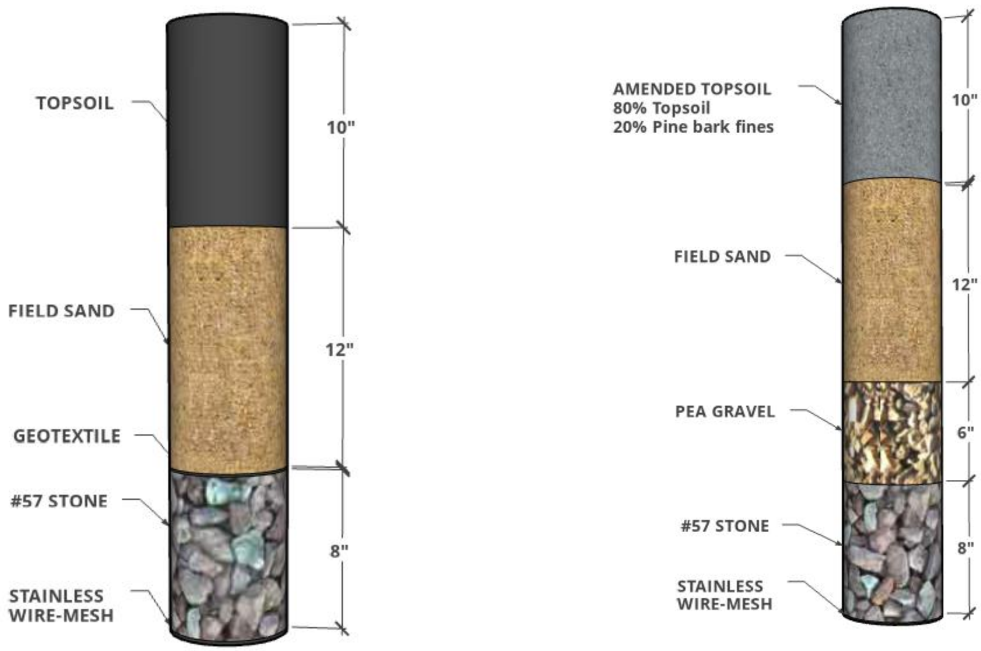
Three samples each of Designs A-1G and F were subjected to three falling head infiltration rate tests followed by three constant head infiltration rate tests. Design A-1G, representing the

ALDOT design with a subtle modification (See Figure 4-10(a)), had a geotextile layer installed over the #57 stone to separate it from the field sand. At the bottom, stainless wire-mesh with apertures of 0.25 by 0.25 in. (0.64 by 0.64 cm) was used instead of a geotextile layer. Omitting the geotextile layer at the bottom aimed to determine if it was causing a reduction in the infiltration rate.

In relation to Design F, tested in this phase (Figure 4-10[b]), it shared similarities with Design B but featured a 6.0 in. (15.2 cm) pea gravel layer between the field sand and #57 stone, replacing the geotextile layer used in Design B. Additionally, stainless wire-mesh was employed at the bottom. The configuration of Design F comprised 10 in. (25.4 cm) of amended topsoil, 12 in. (30.5 cm) of field sand, 6.0 in. (15.2 cm) of pea gravel, and 8.0 in. (20.3 cm) of #57 stone. Table 4-10 displays the materials comprising each design with their respective heights and densities, while Figure 4-10 illustrates their layout.

Table 4-10. Designs A-1G and F Configuration.

Design	Topsoil	Amended topsoil	Field sand	Pea gravel	#57 stone	Geotextile
A-1G	10 in. (25.4 cm)		12 in. (30.5 cm)		8 in. (20.3 cm)	Only one layer separating field sand from #57 stone
F		10 in. (25.4 cm)	12 in. (30.5 cm)		8 in. (20.3 cm)	No
Layer theorical density lb/ft^3 (g/cm^3)	88.8 (1.42)	61.2 (0.98)	93.6 (1.50)	101.1 (1.62)	98.6 (1.58)	



(a) Design A-1G design without the geotextile layer at the bottom

(b) Design F

Figure 4-10. Designs A-1G and F Layout.

The results of the falling and constant head infiltration rate tests for Designs A-1G and F are presented in Table 4-11.

Table 4-11. Falling and Constant Head Infiltration Rate Test Results Designs for A-1G and F.

Design	Falling head infiltration rate test Average	Constant head infiltration rate test Average
A-1G	0.62 ft/day (0.19 m/day)	0.46 ft/day (0.14 m/day)
F	5.99 ft/day (1.83 m/day)	7.66 ft/day (2.33 m/day)

The results indicate that the removal of the geotextile layer at the bottom of the ALDOT design, as done in the A-1G design, doubles the infiltration rate under falling water head conditions, increasing from 0.31 ft/day to 0.62 ft/day. In the case of Design F, which closely resembled Design B except for replacing the geotextile wrapping around the #57 stone with a 6 in. (15.2 cm) pea gravel layer, the results demonstrate that this replacement leads to 2.66 times increase in the infiltration rate under falling water head conditions of the engineered media, rising from 2.25 ft/day (0.69 m/day) to 5.99 ft/day (1.83 m/day). The constant head test showed that the design F yielded an infiltration rate of 7.66 ft/day (2.33 m/day), 16.6 times higher than design A-1G.

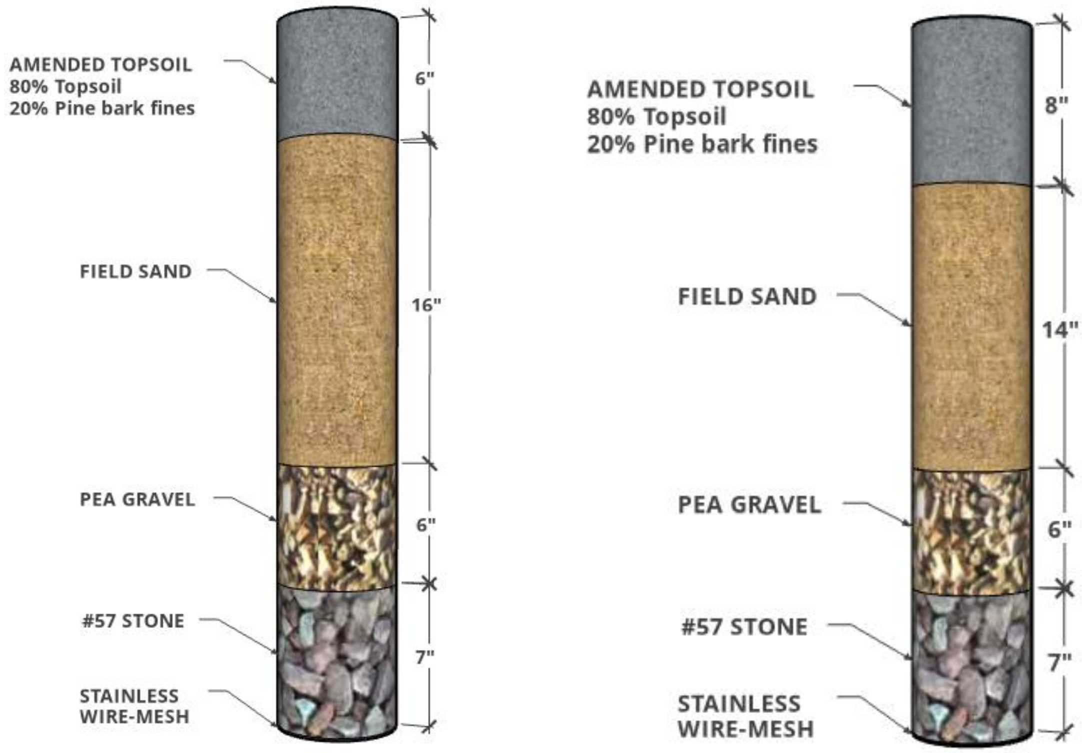
4.4.6 F1 and F2 Designs: Constant and Falling Head Infiltration Rate Tests.

Three samples each of Designs F1 and F2 underwent three constant head infiltration rate tests followed by three falling head infiltration rate tests. Both Designs F1 and F2 consisted of the same material layers as Design F. However, these two designs were intended to investigate how a reduction in the height of the amended topsoil layer, coupled with an equivalent increment in the field sand layer, would impact the infiltration rate of the engineered media.

The configuration of Design F1 included 6.0 in. (15.2 cm) of amended topsoil, 16.0 in. (40.6cm) of field sand, 6.0 in. (15.2 cm) of pea gravel, and 7.0 in. (17.8 cm) of #57 stone (See Figure 4-11[a]). Similarly, Design F2 comprised 8.0 in. (20.3 cm) of amended topsoil, 14.0 in. (35.6 cm) of field sand, 6.0 in. (15.2 cm) of pea gravel, and 7.0 in. (17.8 cm) of #57 stone (See Figure 4-11[b]). Table 4-12 provides a detailed breakdown of the materials comprising each design along with their respective heights and densities.

Table 4-12 Designs A-1G and F Configuration.

Design	Amended topsoil	Field sand	Pea gravel	#57 stone
F1	6 in. (15.2 cm)	16 in. (40.6 cm)	6 in. (15.2 cm)	7 in. (17.8 cm)
F2	8 in. (20.3 cm)	14 in. (35.6 cm)	6 in. (15.2 cm)	7 in. (17.8 cm)
Layer theorical density lb/ft3 (g/cm3)	61.2 (0.98)	93.6 (1.50)	101.1 (1.62)	98.6 (1.58)



(a) Design F1 (b) Design F2

Figure 4-11. Design F1 and F2 Layout.

The results of the constant and falling head infiltration rates tests of Designs F1 and F2 are shown in Table 4-13.

Table 4-13. Constant and Falling Head Infiltration Rate Test Results for Designs F1 and F2.

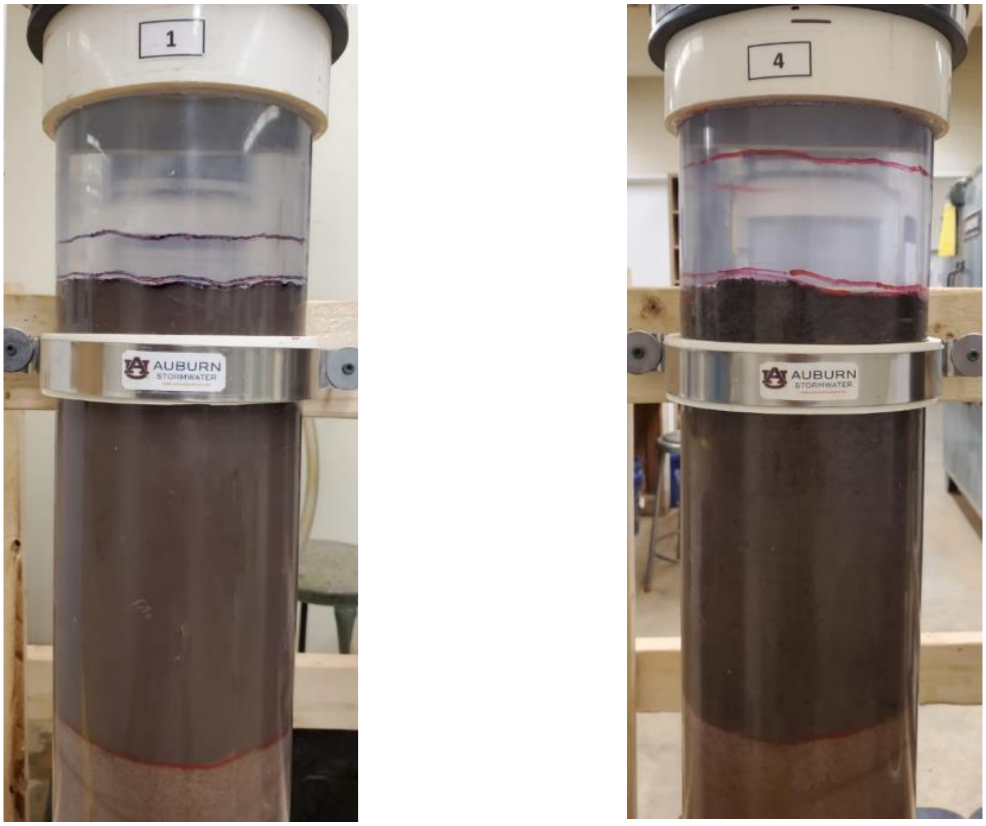
Design	Constant head infiltration rate test Average	Falling head infiltration rate test Average
F1	4.75 ft/day (1.45 m/day)	1.11 ft/day (0.34 m/day)
F2	6.73 ft/day (2.05 m/day)	1.58 ft/day (0.48 m/day)

The results indicated that Design F2 achieved an infiltration rate of 6.73 ft/day under constant head conditions and 1.58 ft/day under falling head conditions, which was 42% higher than the infiltration rate of Design F1 in both constant and falling head infiltration rate tests.

However, when comparing the performance of Design F2 to that of Design F, it was observed that Design F yielded higher infiltration rates in both constant, 7.66 ft/day (2.33 m/day), and falling, 5.99 ft/day (1.83 m/day), head infiltration rate tests.

4.4.7 Settlement Tracking and Adjustment of Densities

The transparency of the infiltrometers allowed for a more precise monitoring of the settlement in each of the material layers composing the specimens (See Figure 4-12). This tracking was carried out during the constant head and falling head infiltration tests conducted on Designs A-1G, F, F1, and F2, mentioned in the preceding two subsections. Given that these specimens were not only subjected to three falling head infiltration tests, as previously done, but also to three constant head infiltration tests lasting 9 hours each, the consolidation effects resulted in increased settlement in the upper layer of the specimens, composed of topsoil or amended topsoil. Therefore, in future tests, the density of both topsoil and amended topsoil was updated to achieve a final height (after the three constant head tests and the three falling head tests) in these layers equal to the theoretical one.



(a) Settlement on topsoil layer after all tests

(b) Settlement on amended topsoil layer after all tests

Figure 4-12. Settlement Tracking of Samples After Being Subjected to Three Constant and Three Falling Head Infiltration Rate Tests.

After monitoring the settlement of the layers, the densities of the topsoil and amended topsoil were updated, as shown in Table 4-14.

Table 4-14. Densities of Topsoil and Amended Topsoil.

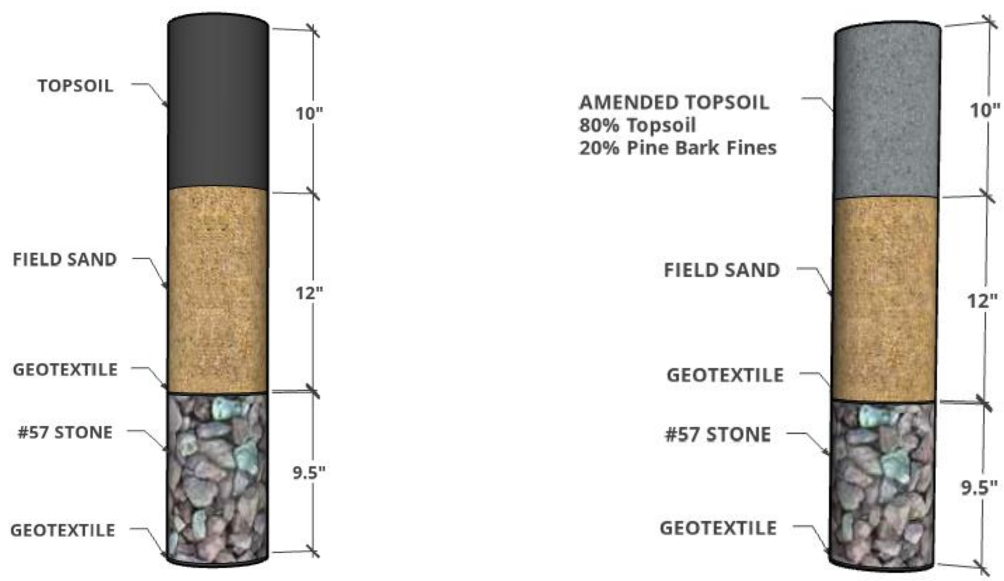
Material	Density before the settlement tracking lb/ft^3 (g/cm^3)	Updated Density: after the settlement tracking lb/ft^3 (g/cm^3)
Topsoil	88.6 (1.42)	96.8 (1.55)
Amended topsoil	61.2 (0.98)	68.7 (1.10)

4.4.8 A* and B* Designs: Constant and Falling Head Infiltration Rate Tests.

It was decided to retest Designs A and B, considering that the final density of the upper layer would be the updated density mentioned in the previous subsection. The designs with the updated density of the upper layer were named A* and B*. Table 4-15 provides a detailed breakdown of the materials comprising these designs along with their respective heights and densities. Figure 4-13 illustrates the layout of Designs A* and B*.

Table 4-15 Designs A* and B* Configuration.

Design	Topsoil	Amended topsoil	Field sand	#57 stone	Geotextile wrapping the #57 stone layer
A*	10 in. (25.4 cm)	-	12 in. (30.5 cm)	9.5 in. (24.1 cm)	Yes
B*	-	10 in. 25.4 cm)	12 in. (30.5 cm)	9.5 in. (24.1 cm)	Yes
Layer theorical density lb/ft^3 (g/cm^3)	96.8 (1.55)	68.7 (1.10)	93.6 (1.50)	98.6 (1.58)	-



(a) A* design, ALDOT Design considering final consolidation of topsoil

(b) Design B*, design B considering final consolidation

Figure 4-13. Designs A* and B* Layout.

The results of the constant and falling head infiltration rates tests of Designs A* and B* are shown in Table 4-16.

Table 4-16. Constant and Falling Head Infiltration Rate Test Results for Designs A* and B*.

Design	Constant head infiltration rate test Average	Falling head infiltration rate test Average
A*	1.73 ft/day (0.53 m/day)	0.49 ft/day (0.15 m/day)
B*	5.38 ft/day (1.64 m/day)	1.10 ft/day (0.33 m/day)

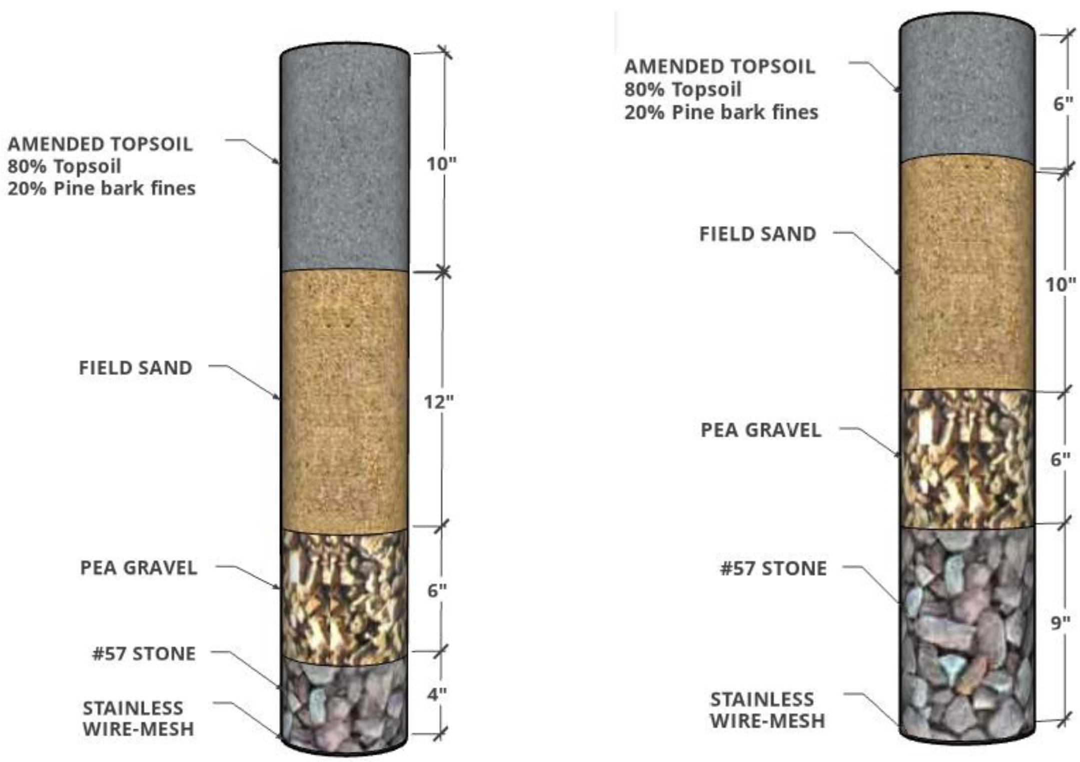
The results of the constant head infiltration rate test showed that Design B* yielded 5.38 ft/day (1.64 m/day), which is 3.10 times higher than the infiltration rate of Design A*. In the falling head infiltration rate test, Design B* yielded 1.10 ft/day (0.30 m/day), representing a 2.24 times higher infiltration rate than Design A*.

4.4.9 F* and F3 designs: Constant and Falling Head Infiltration Rate Tests.

Three samples of Design F* and three samples of Design F3 were subjected to three constant head infiltration rate tests, followed by three falling head infiltration rate tests. Design F* is equivalent to the previously tested Design F, but with the updated density of the amended topsoil. Table 4-17 provides a detailed breakdown of the materials comprising these designs along with their respective heights and densities. Figure 4-14 illustrates the layout of Designs F* and F3.

Table 4-17 Designs F* and F3 Configuration.

Design	Amended topsoil	Field sand	Pea gravel	#57 stone
F*	10 in. (25.4 cm)	12 in. (30.5)	6 in. (15.2 cm)	4 in. (10.2 cm)
F3	6 in. (15.2 cm)	10 in. (25.4 cm)	6 in. (15.2 cm)	9 in. (22.9 cm)
Layer theorical density lb/ft^3 (g/cm^3)	68.7 (1.10)	93.6 (1.50)	101.1 (1.62)	98.6 (1.58)



(a) F* design, sample F considering consolidation of amended topsoil

(b) Design F3

Figure 4-14. Designs F* and F3 Layout.

The results of the constant and falling head infiltration rates tests for Designs F* and F3 are shown in Table 4-18.

Table 4-18. Constant and Falling Head Infiltration Rate Test Results Designs F* and F3.

Design	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average – ft/day
F*	5.31 ft/day (1.62 m/day)	1.26 ft/day (0.38 m/day)
F3	5.75 ft/day (1.75 m/day)	2.24 ft/day (0.68 m/day)

The results of the constant head infiltration rate tests showed that Design F3 yielded 5.75 ft/day (1.75 m/day), 1.08 times more infiltration rate than Design F*. In the falling head infiltration rate tests, Design F3 yielded 2.24 ft/day (0.68 m/day), 1.78 times more infiltration rate than design F*.

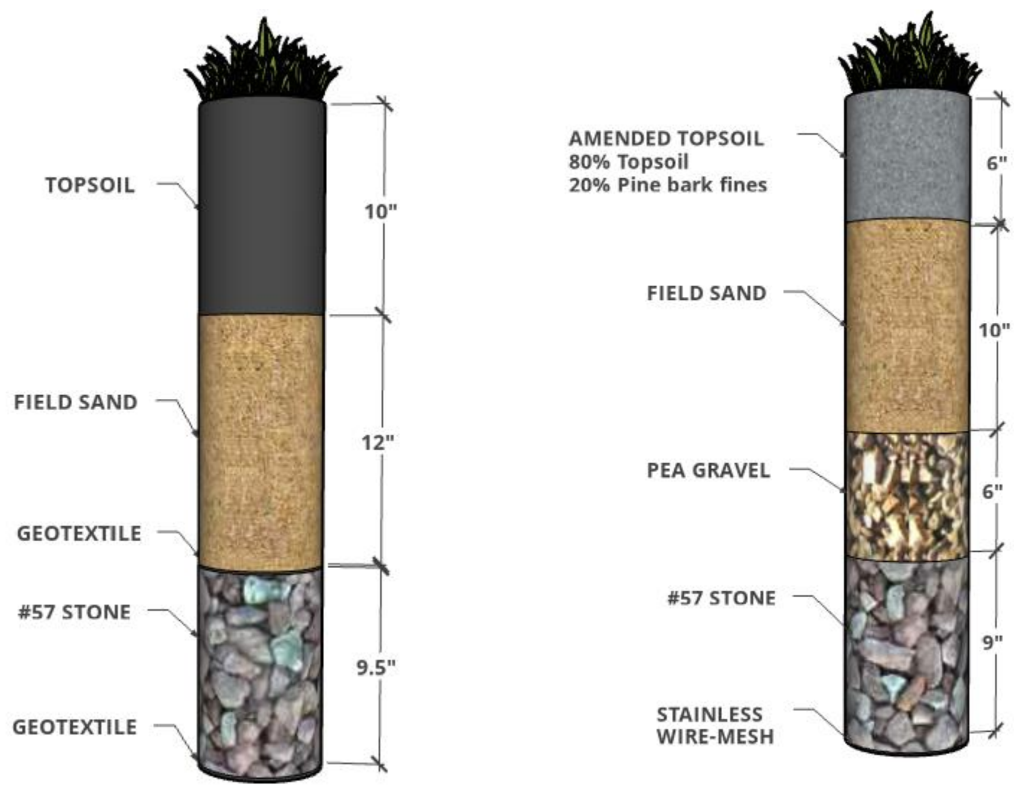
The F3 design exhibited the best performance in the infiltration tests under constant and falling head conditions. For this reason, in the upcoming tests using the clear infiltrometers, Design F3 and A*, representing the ALDOT Design considering final consolidation, were tested with Bermuda grass sod placed over them for comparison.

4.4.10 ALDOT + Grass and F3 + Grass Designs: Constant and Falling Head Infiltration Rate Tests.

Three samples of ALDOT + Grass Design, and three samples of F3 + Grass Design were subjected to three constant head infiltration rate tests, and then to three falling head infiltration rate tests. Table 4-19 provides a detailed breakdown of the materials comprising these designs along with their respective heights and densities. Figure 4-15 illustrates the layout of Designs F* and F3.

Table 4-19. Designs ALDOT + Grass and F3 + Grass Configuration.

Design	Bermuda grass	Topsoil	Amended topsoil	Field sand	Pea gravel	#57 stone	Geotextile wrapping the #57 stone layer
ALDOT + Grass	Yes	10 in. (25.4 cm)		12 in. (30.48 cm)		9.5 in. (24.1 cm)	Yes
F3 + Grass	Yes		6 in. (15.2 cm)	10 in. (25.4 cm)	6 in. (15.2 cm)	9 in. (22.9 cm)	No
Layer theorical density lb/ft^3 (g/cm^3)		96.7 (1.55)	68.7 (1.10)	93.6 (1.50)	101.1 (1.62)	98.6 (1.58)	



(a) ALDOT + Grass Design (b) F3 + Grass Design

Figure 4-15. Designs ALDOT + Grass and F3 + Grass Layout.

The results of the constant and falling head infiltration rates tests of the ALDOT + Grass and F3 + Grass Designs are shown in Table 4-20.

Table 4-20. Constant and Falling Head Infiltration Rate Test Results for ALDOT + Grass and F3 + Grass Designs.

Design	Constant head infiltration rate test - Average	Falling head infiltration rate test – Average
ALDOT + Grass	0.91 ft/day (0.28 m/day)	0.31 ft/day (0.09 m/day)
F3 + Grass	13.73 ft/day (4.18 m/day)	11.66 ft/day (3.55 m/day)
Ratio:	15.1	37.6

The results of the constant head infiltration rate test showed that Design F3 + Grass yielded 13.73 ft/day (4.18 m/day), 15.09 times more infiltration rate than ALDOT + Grass Design. In the falling head infiltration rate test the Design F3 + Grass yielded 11.66 ft/day (3.55 m/day), 37.61 times more infiltration rate than ALDOT + Grass Design.

Comparing the performance of the F3 + Grass design with its counterpart, F3, which does not include grass, it was observed that the performance of the F3 + Grass design was 2.39 times higher in constant head infiltration tests and 5.21 times higher in falling head tests (See Table 4-21).

Table 4-21. Comparison of Results Between Designs F3 + Grass and F3

Design	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
F3 + Grass	13.73 ft/day (4.18 m/day)	11.66 ft/day (3.55 m/day)
F3	5.75 ft/day (1.75 m/day)	2.24 ft/day (0.68 m/day)
Ratio:	2.4	5.2

The reason for the higher infiltration rate of Design F3 + Grass is that in F3 Design without Grass, the pine bark fines particles located in the superficial layer of the amended topsoil separate from it and start to float (See Figure 4-16) in the water during the tests. This happens because they are less dense than water and lack a confining layer like Bermuda Grass. The separation of these pine bark fines creates zones with higher topsoil density within the amended topsoil layer, causing a reduction in the infiltration rate of the specimen. In the case of the F3 + Grass design, the layer of Bermuda grass installed over the specimen prevents the separation of the pine bark fines from the amended topsoil, keeping the mixture unchanged, which does not affect its infiltration rate.

Figure 4-16. Pine Bark Fines Floating During Tests on F3 Designs.

4.5 INFILTRATION SWALE CHAMBER EXPERIMENTS

In the intermediate-scale phase of the project the Design F3, obtained in the previous phase, and ALDOT Design were subjected to constant and falling head infiltration rate tests in the infiltration swale chamber.

4.5.1 ALDOT Design: Constant and Falling Head Infiltration Rate Tests.

The ALDOT design was placed into the infiltration swale chamber as shown Figure 4-17. It was subjected to nine constant head infiltration rate tests, and one falling head infiltration rate test. The original experimental test design for the constant head infiltration rate test contemplated a test duration of 6 hours. However, after the first test, the AU stormwater team decided to extend the test duration to 8 hours to collect more data, allowing for a better comprehension of the sample's performance.

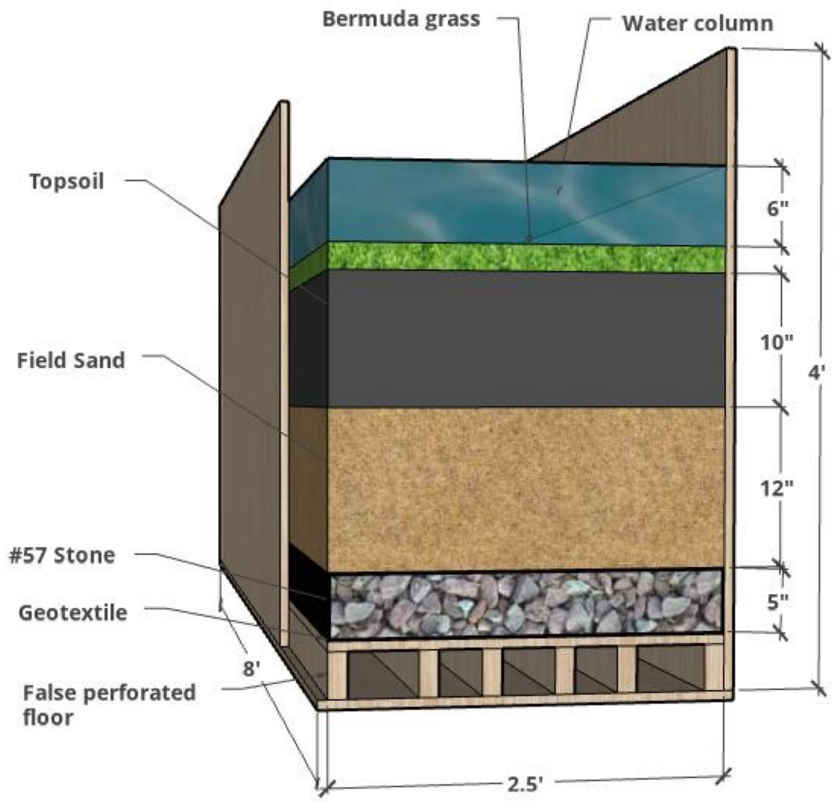


Figure 4-17. ALDOT Design Layout – Infiltration Swale Chamber

The results of the nine constant head infiltration rate tests conducted on the ALDOT Design are shown in Table 4-22.

Table 4-22. Results of Constant Head tests of ALDOT Design in Infiltration Swale Chamber.

Infiltration rate - ft/day (m/day)									
Test	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	Average
1	9.15 (2.79)	9.76 (2.97)	9.76 (2.97)	10.07 (3.07)	10.07 (3.07)	10.30 (3.14)	N/A (N/A)	N/A (N/A)	9.85 (3.00)
2	4.58 (1.40)	6.41 (1.95)	6.29 (1.92)	8.54 (2.60)	8.09 (2.47)	8.34 (2.54)	8.37 (2.55)	8.39 (2.56)	7.38 (2.25)
3	4.22 (1.29)	5.90 (1.80)	6.23 (1.90)	6.23 (1.90)	6.59 (2.01)	6.64 (2.02)	6.76 (2.06)	7.63 (2.33)	6.27 (1.91)
4	4.58 (1.40)	5.19 (1.58)	5.85 (1.78)	6.41 (1.95)	6.36 (1.94)	5.49 (1.67)	5.77 (1.76)	5.82 (1.77)	5.68 (1.73)
5	3.97 (1.21)	5.72 (1.74)	6.05 (1.84)	6.08 (1.85)	6.25 (1.91)	6.76 (2.06)	6.76 (2.06)	6.92 (2.11)	5.81 (1.77)
6	4.58 (1.40)	5.85 (1.78)	6.01 (1.83)	6.15 (1.87)	6.66 (2.03)	6.56 (2.00)	6.66 (2.03)	6.64 (2.02)	6.14 (1.87)
7	4.63 (1.41)	5.64 (1.72)	5.92 (1.80)	6.08 (1.85)	6.23 (1.90)	6.28 (1.91)	6.43 (1.96)	6.28 (1.91)	5.94 (1.81)
8	6.20 (1.89)	5.64 (1.72)	5.92 (1.80)	6.08 (1.85)	6.08 (1.85)	6.13 (1.87)	6.25 (1.91)	6.28 (1.91)	6.07 (1.85)
9	3.64 (1.11)	5.19 (1.58)	5.57 (1.70)	5.72 (1.74)	5.57 (1.70)	5.72 (1.74)	6.33 (1.93)	6.20 (1.89)	5.49 (1.67)
							Overall Average		6.51 (1.98)

The infiltration rate in the falling head infiltration rate test yielded by ALDOT Design in the infiltration swale chamber was 4.96 ft/day (1.51 m/day).

4.5.2 F3 Design: Constant and Falling Head Infiltration Rate Tests.

The F3 design (See Figure 4-18) underwent six constant head infiltration rate tests and one falling head infiltration rate test. The decision to conduct three fewer constant head infiltration rate tests compared to those performed on the ALDOT Design was due to the absence of a reduction in the infiltration rate after each test. This was in contrast to the ALDOT Design, where the infiltration rate decreased from the first to the fourth test.

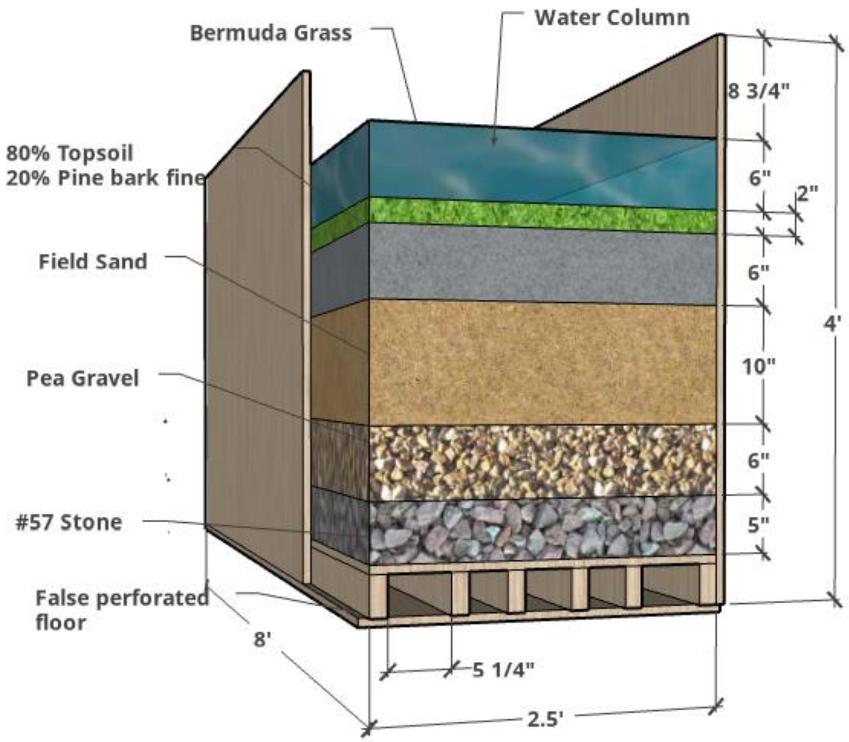


Figure 4-18. F3 Design Layout - Infiltration Swale Chamber.

The results of the six constant head infiltration rate tests conducted on the F3 Design are shown in Table 4-23.

Table 4-23. Results of Constant Head Tests of F3 Design in Infiltration Swale Chamber.

Infiltration rate – ft/day (m/day)									
Test	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	Average
1	99.14 (30.22)	93.28 (28.43)	88.02 (26.83)	82.01 (25.00)	77.36 (23.58)	75.97 (23.16)	74.12 (22.59)	69.83 (21.28)	82.47 (25.14)
2	104.85 (31.96)	93.99 (28.65)	86.76 (26.44)	81.78 (24.93)	75.48 (23.01)	74.01 (22.56)	73.08 (22.27)	57.00 (17.37)	80.87 (24.65)
3	86.41 (26.34)	91.88 (28.01)	93.00 (28.35)	81.95 (24.98)	78.73 (24.00)	74.74 (22.78)	73.72 (22.47)	73.35 (22.36)	81.72 (24.91)
4	103.58 (31.57)	104.50 (31.85)	97.61 (29.75)	91.68 (27.94)	83.98 (25.60)	80.31 (24.48)	79.22 (24.15)	77.23 (23.54)	89.76 (27.36)
5	111.69 (34.04)	108.08 (32.94)	99.27 (30.26)	102.15 (31.14)	98.97 (30.17)	95.53 (29.12)	88.31 (26.92)	83.11 (25.33)	98.39 (29.99)
6	104.73 (31.92)	96.52 (29.42)	92.01 (28.04)	86.72 (26.43)	85.02 (25.91)	84.32 (25.70)	82.98 (25.29)	80.83 (24.64)	89.14 (27.17)
							Overall Average		87.06 (25.54)

The infiltration rate in the falling head infiltration rate test yielded by F3 Design in the infiltration swale chamber was 75.79 ft/day (23.10 m/day).

4.5.3 Comparison of Results

Table 4-24 presents the outcomes of constant and falling head infiltration tests conducted on the ALDOT Design and the F3 Design in the infiltration swale chamber, along with the ratio between both.

Table 4-24. Comparison of Results of ALDOT and F3 Design in the Infiltration Swale Chamber

Design	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
ALDOT (Chamber)	6.51 ft/day (1.98 m/day)	4.96 ft/day (1.51 m/day)
F3 (Chamber)	87.06 ft/day (26.54 m/day)	75.79 ft/day (23.10 m/day)
Ratio: $\frac{F3\ Rate\ (Chamber)}{ALDOT\ Rate\ (Chamber)}$	13.37	15.28

Table 4-25 displays the ratio between the performance obtained by the F3 Design and the ALDOT Design in the infiltrometers and in the infiltration swale chamber during the constant and falling head infiltration tests.

Table 4-25. Comparison of Ratios Between the Results of F3 and ALDOT Designs Obtained in the Infiltrometers and in the Infiltration Swale Chamber.

	Ratio	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
Infiltrometers	$\frac{F3 + Grass\ Rate}{ALDOT + grass\ Rate}$	15.09	37.61
Infiltration swale chamber	$\frac{F3\ Rate}{ALDOT\ Rate}$	13.37	15.28

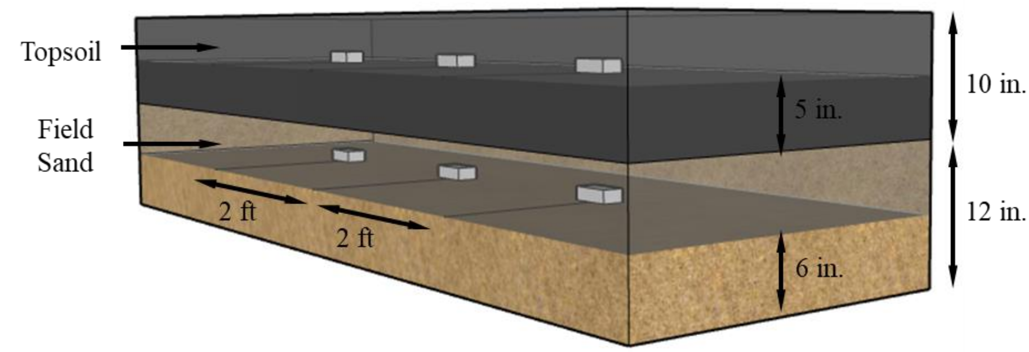
Table 4-26 displays the ratio between the performance obtained by F3 Design (tested in the infiltration chamber) and F3 + Grass Design (tested in the infiltrometers) and the ratio between the performance obtained by ALDOT Design (tested in the infiltration chamber) and ALDOT + Grass Design (tested in the infiltrometers).

Table 4-26. Comparison of Ratios Between Similar Designs Tested in the Infiltration Chamber and in the Infiltrometers.

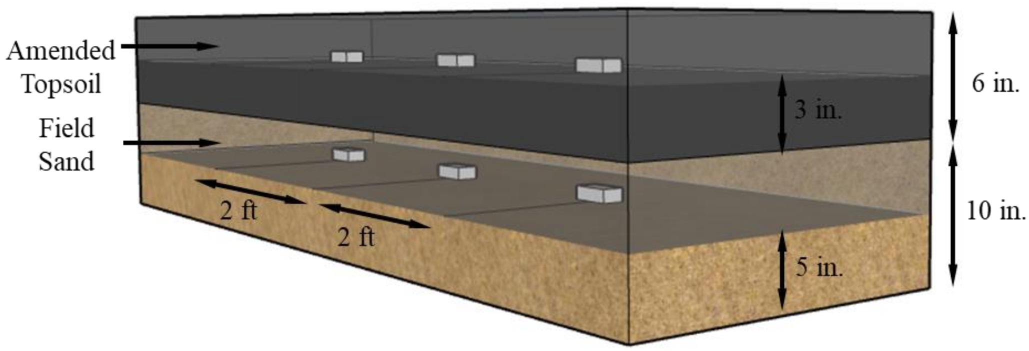
Ratio	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
$\frac{F3\ Rate\ (Infiltration\ chamber)}{F3 + Grass\ Rate\ (Infiltrometers)}$	$\frac{87.06\ ft/day}{13.73\ ft/day} = 6.3$	$\frac{75.79\ ft/day}{11.66\ ft/day} = 6.5$
$\frac{ALDOT\ Rate\ (Infiltration\ chamber)}{ALDOT + Grass\ Rate\ (Infiltrometers)}$	$\frac{6.51\ ft/day}{0.91\ ft/day} = 7.2$	$\frac{4.96\ ft/day}{0.31\ ft/day} = 16.0$

4.5.4 Moisture Content Analysis Considering Each Sensor Separately

A water volume content monitoring system was used to monitor the tests conducted in the infiltration swale chamber. Six sensors were installed in both the ALDOT Design and F3 Design. Three sensors were positioned in the top layer of the sample, halfway up the layer's height, along the central longitudinal axis, spaced 2.0 ft (0.61 m). apart from center to center. The other three sensors were installed in the field sand layer in the same manner. The distribution and position of the sensors on the ALDOT and F3 Designs are depicted in Figure 4-19 .



(a) Water content sensor distribution ALDOT Design.



(b) Water content sensor distribution F3 Design.

Figure 4-19. Distribution of Sensors in ALDOT and F3 Designs.

Figure 4-20 illustrates the water volume content vs. time curves during the second constant head test conducted on the ALDOT design. The test began at hour 1 when water was introduced through the irrigation system. Subsequently, at hour 9, eight hours after the test initiation, the water supply was stopped, concluding the test. Importantly, it should be noted that five days prior to this test, the ALDOT design underwent its first constant head test.

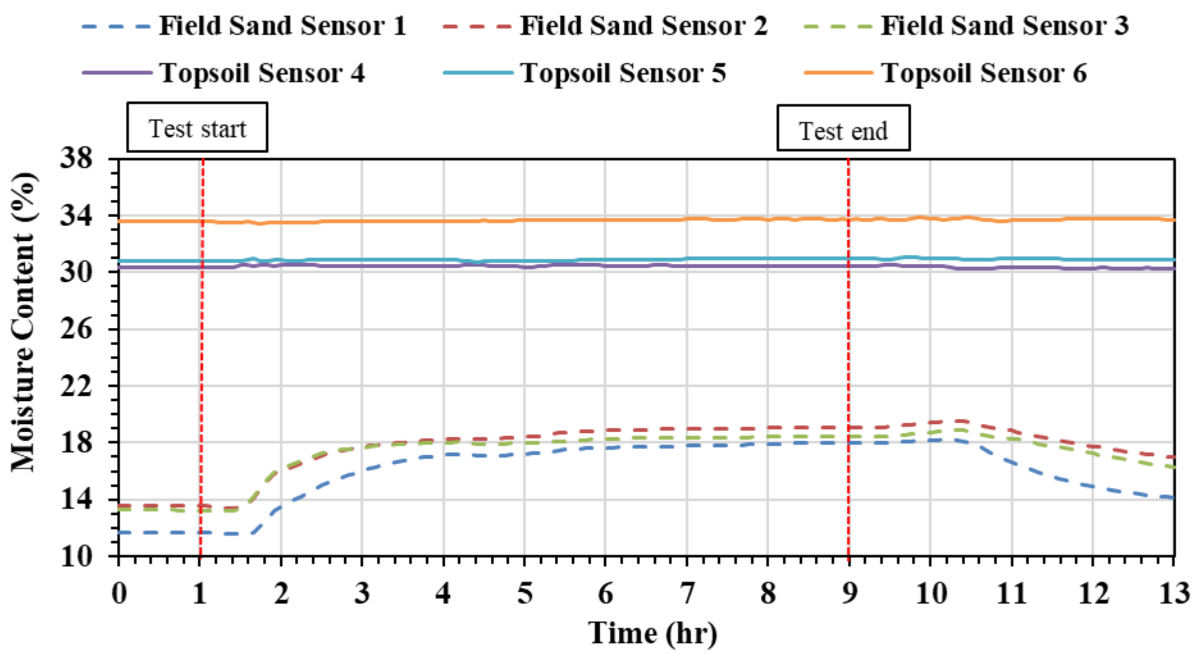


Figure 4-20. Moisture Content – ALDOT Design – Constant Head Test 2.

In this graph, it can be observed that the moisture content in the topsoil remains almost constant. This indicates that the topsoil has remained saturated since the last test, which occurred 5 days earlier. The information gathered from the sensors in the field sand layer revealed a response 25 minutes after the test's commencement. Furthermore, the moisture content in the sand layer started to decrease 90 minutes after the test concluded.

Following the approach taken with the ALDOT design, the constant head infiltration rate test for the F3 design extended for 8 hours. Figure 4-21 depicts the curves of water volume content vs. time during constant head test 2 conducted on the F3 design. The test commenced in hour 1 with the initiation of water supply through the irrigation system. The test concluded at hour 9, 8 hours after the start, when the water supply was stopped. It is worth noting that, one day before this test, the F3 design underwent its initial constant head test.

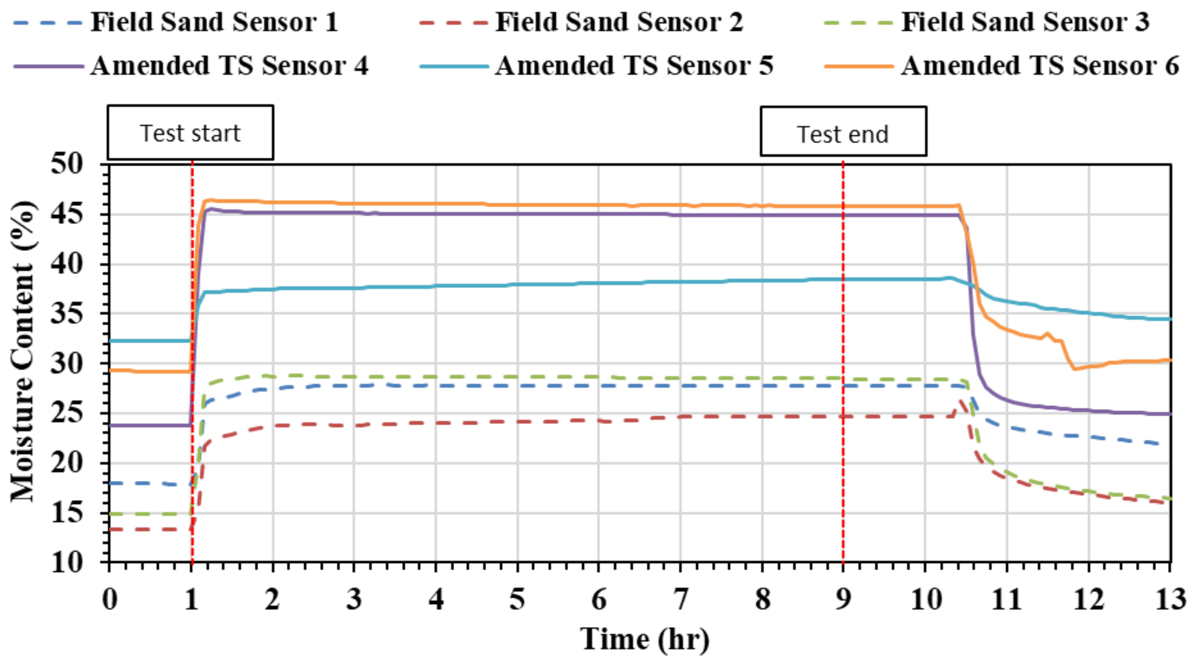


Figure 4-21. Moisture Content – F3 design – Constant Head Test 2.

The results indicated that the sensors in the amended topsoil and the field sand of the F3 Design exhibited faster reactions than the sensors in the topsoil and the field sand of the ALDOT Design. Furthermore, the moisture content achieved by the amended topsoil and the field sand of the F3 design was higher than the moisture content attained by the topsoil and the field sand of the ALDOT design. Regarding the drying process in the F3 Design, it was observed that this process commenced approximately 90 minutes after closing the irrigation system, and the moisture content in the amended and field sand layer decreased more rapidly than the moisture content in the topsoil and the field sand layer of the ALDOT Design.

4.5.5 Moisture Content Analysis Considering the Average of Each Layer.

In the ALDOT Design, the readings recorded by the three water volumetric content sensors installed in the topsoil were averaged, and the same was done with the readings from the three sensors installed in the field sand. With these averages, a curve of water volume content vs. time was created for each layer during the nine constant head infiltration tests (See Figure 4-22).

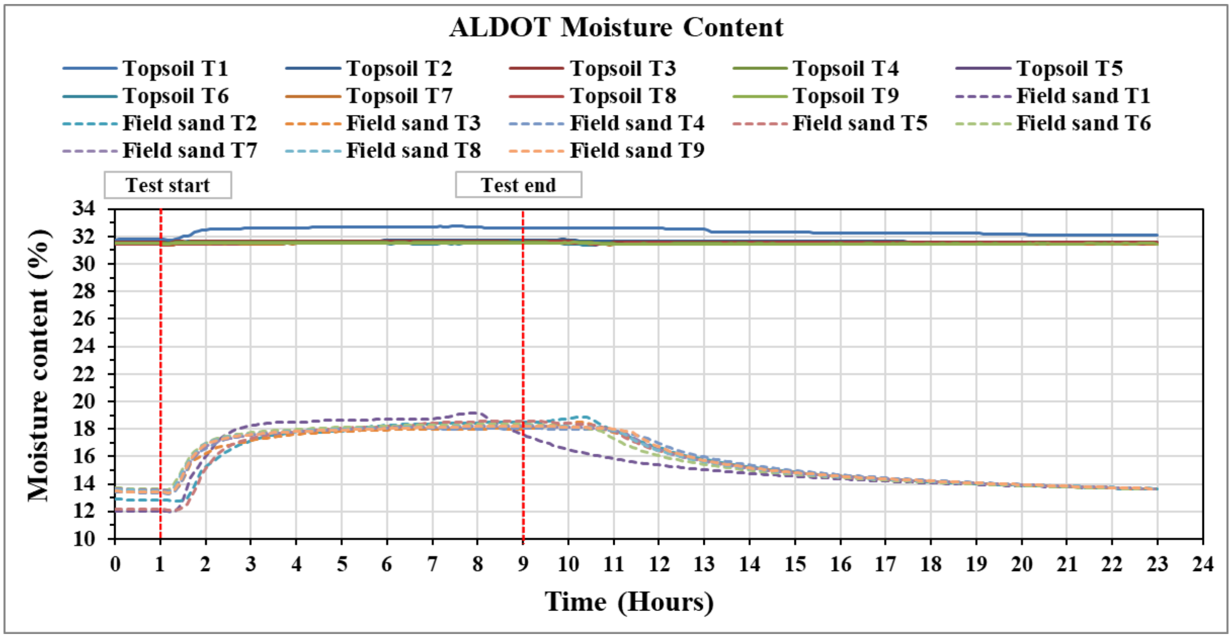


Figure 4-22. Layer Average Moisture Content vs Time - Per test – ALDOT Design.

For the F3 design, the same exercise was conducted as in the ALDOT design, with the readings recorded by the three water volumetric content sensors installed in the amended topsoil averaged, and the same done with the readings from the three sensors installed in the field sand. With these averages, a curve of water volume content vs. time was created for each layer during the six constant head infiltration tests (See Figure 4-23).

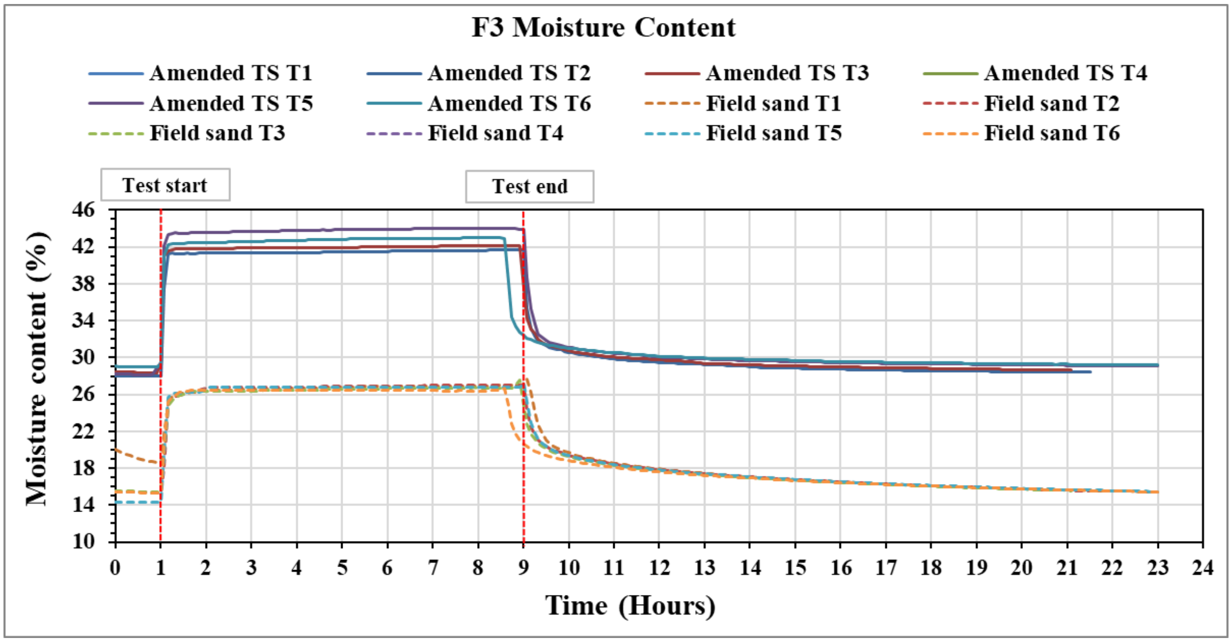


Figure 4-23. Layer Average Moisture Content vs Time - Per Test – F3 Design.

The curves from tests 2 to 8 representing the moisture content in the topsoil of the ALDOT Design were averaged to obtain the Average curve for all tests. The same was done with the curves from tests 2 to 8 representing the moisture content in the field sand of the ALDOT Design. As can be observed, the curve of the first test conducted on the ALDOT Design was not included in the average curve for all tests because it was not an 8-hour test but rather a 6-hour test. In the case of the F3 Design, the average curve for the amended topsoil and the field sand was also calculated, including all six tests conducted on this specimen. (See Figure 4-24)

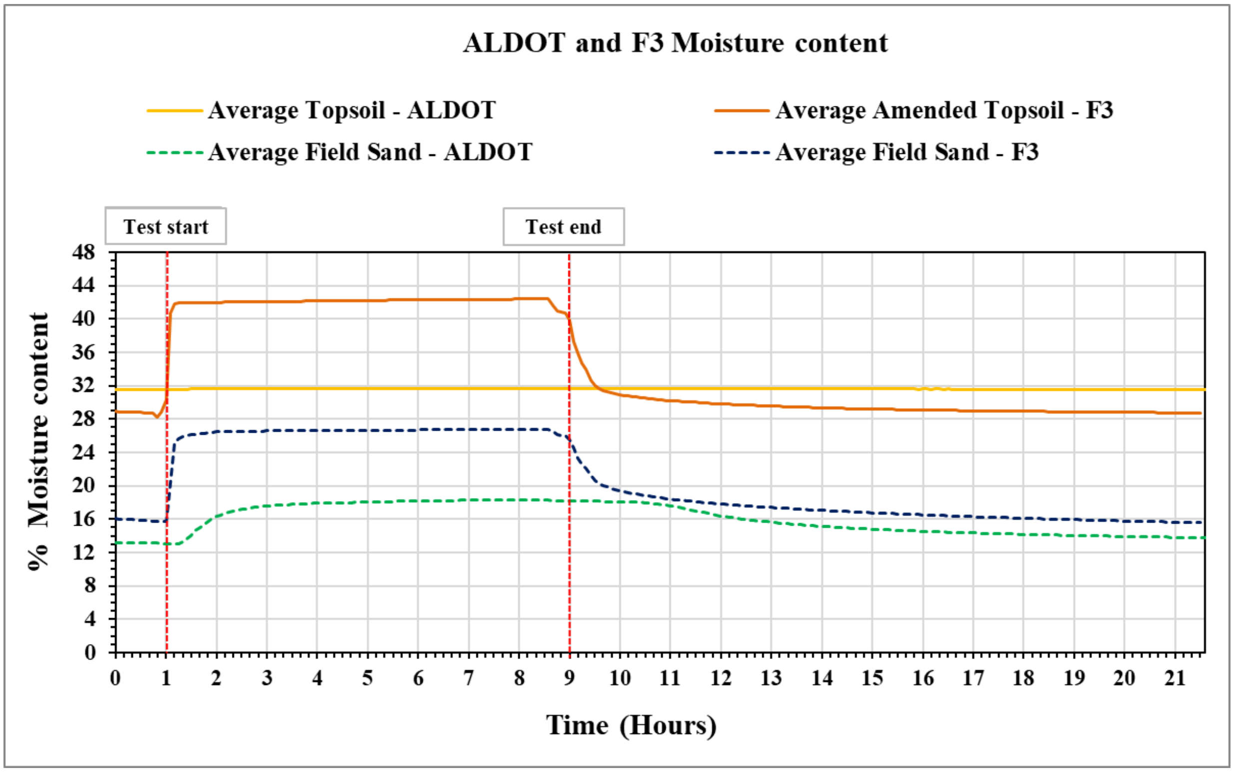


Figure 4-24. Moisture Content vs Time - Average Curve for All Tests.

The data from these curves were analyzed to determine the maximum and minimum moisture content reached by each layer, and also to calculate the time it takes for water to reach from the surface to the sensors installed in the field sand layer of both specimens. Similarly, the drying rate of the layers after the constant head infiltration test was completed was calculated. Table 4-27 summarizes all this information.

Table 4-27. Analysis of Moisture Content Sensors Data.

Design	Layer	Maximum moisture content (%)	Moisture content at 9-hours (%)	Moisture content at 21-hours (%)	Drying ratio (%/hour)	Sensors' response time
ALDOT	Topsoil	31.7	31.7	31.6	0.0083	20 to 25 min
	Field sand	18.3	18.2	13.7	0.37	20 to 25 min
F3	Amended topsoil	42.4	39.8	28.7	0.92	0 to 5 min
	Field sand	26.8	25.6	15.6	0.83	0 to 5 min

From the curves shown in Figure 4-24 and the data in Table 4-27, the following conclusions can be drawn:

1. The amended topsoil of the F3 Design reaches a maximum moisture content of 42.4%, equivalent to 1.33 times the maximum moisture content reached by the topsoil of the ALDOT Design, which was 31.7%.
2. The Field Sand of the F3 Design reaches a maximum moisture content of 26.8%, equivalent to 1.46 times the maximum moisture content reached by the field sand of the ALDOT Design, which was 18.3%.
3. The time it takes for water to travel from the surface of the F3 Design to the moisture sensors located in the field sand is between 0 and 5 minutes, and the time it takes for water to travel from the surface of the ALDOT Design to the moisture sensors located in the field sand is 20 to 25 minutes. This indicates that the water flow, and consequently the infiltration rate of the F3 Design, is higher than the infiltration rate of the ALDOT Design.
4. The drying rate of the amended topsoil and field sand of the F3 Design is higher than the drying rate of the topsoil and field sand layers of the ALDOT Design. The drying rate of the amended topsoil in the F3 Design is 0.92% per hour, which is 111 times greater than

the drying rate of the topsoil in the ALDOT Design, which is 0.0083% per hour. The drying rate of the field sand in the F3 Design is 0.83% per hour, 2.24 times greater than the drying rate of the field sand in the ALDOT Design, which is 0.37% per hour.

4.6 OVERALL ANALYSIS

The permeability tests allowed detecting that the critical layer of the ALDOT Engineered Media Design was the topsoil with a permeability of 0.002 in./min (0.004 cm/min). Additionally, they also revealed that loose sand, when subjected to a 9-hour constant head permeability test, consolidated to a density of 85.5% of its optimum density and a permeability of 0.83 in./day (2.11 cm/min). With these findings, the next step was to improve the permeability of the topsoil by mixing it with pine bark fines. After conducting falling head infiltration tests on 12 samples, the amended topsoil composed of 80% topsoil and 20% pine bark fines by weight was selected, which achieved an infiltration rate of 5.60 ft/day (1.70 m/day), 8.9 times higher than that of pure topsoil, which was 0.63 ft/day (0.19 m/day).

From here, the infiltration tests began. Initially, Designs A, B, C, D, and E were subjected to 3 falling head infiltration tests, with an initial water column of 2.0 ft. Design B showed the best performance with an average infiltration rate of 2.25 ft/day (0.14 m/day). Table 4-28 summarizes the characteristics of these designs and their results.

Table 4-28. Designs A, B, C, D and E: Characteristics and Results.

Design	Top Layer	h in. (cm)	Second Layer	h in. (cm)	Third Layer	h in. (cm)	Fourth Layer	h in. (cm)	3 Falling - Avg rate ft/day (m/day)
A	Topsoil	10 (25.4)	Field Sand	12 (30.5)	#57 Stone + Geotex.	8 (20.3)	-	-	0.31 (0.09)
B	Amended Topsoil	10 (25.4)	Field Sand	12 (30.5)	#57 Stone + Geotex.	8 (20.3)	-	-	2.25 (0.69)
C	Amended Topsoil	6 (15.2)	Field Sand	16 (40.6)	#57 Stone + Geotex.	8 (20.3)	-	-	1.32 (0.40)
D	Amended Topsoil	6 (15.2)	Field Sand	15 (38.1)	Pea Gravel	1 (2.54)	#57 Stone	8 (20.3)	0.92 (0.28)
E	Amended Topsoil	6 (15.2)	Pea Gravel	4 (10.2)	#57 Stone + Geotex.	18 (45.7)	-	-	1.6 (0.49)

Note: h = Height of the layer

After this, Designs A-1G and Design F underwent 3 falling head infiltration rate tests, with an initial water column of 2.0 ft (0.6 m), and 3 constant head infiltration rate tests lasting 6 hours each, with a constant head of 2.0 ft (0.6 m). Table 4-29 summarize the characteristics of these designs and their results.

Table 4-29. Designs A-1G and F: Characteristics and Results

Design	Top Layer	h in. (cm)	Second Layer	h in. (cm)	Third Layer	h in. (cm)	Fourth Layer	h in. (cm)	3 Falling – Avg. rate ft/day (m/day)	3 Constant – Avg. rate ft/day (m/day)
A-1G	Topsoil	10 (25.4)	Field Sand	12 (30.5)	#57 Stone	8 (20.3)	-	-	0.62 (0.19)	0.46 (0.14)
F	Amended Topsoil	10 (25.4)	Field Sand	12 (30.5)	Pea Gravel	6 (15.2)	#57 Stone	8 (20.3)	5.99 (1.83)	7.66 (2.33)

Note: A-1G represents the ALDOT design with a single layer of geotextile separating the field sand from the #57 stone.
h = Height of the layer.

This test was important because the specimen A-1G, which was similar to specimen A except that it had a single layer of geotextile (separating the #57 stone from the field sand) instead of two like A, averaged 0.62 ft/day (0.19 cm/day) in falling head infiltration rate tests, twice as much as Design A, which obtained 0.31 ft/day (0.09 cm/day). This finding led the team to explore other alternatives to replace the use of geotextile.

At this point in the research, the testing process was reversed. Therefore, the three constant head infiltration tests, which simulate the prolonged use of infiltration media, were conducted first. Subsequently, the three falling head infiltration tests were performed to determine how long water remains pooled in the infiltration swale after it stops receiving water runoff. The specimens tested in this phase were A*, B*, F*, F1, F2, F3, ALDOT + Grass, and F3 + Grass.

The specimens marked with an asterisk, A*, B*, and F*, are the same specimens A, B, and F, respectively, with a correction in the weight of their top layers. In the previous tests, the final densities of each layer of the specimens were checked more accurately thanks to the transparency of the infiltrometers. It was revealed that the final density reached by the Topsoil was 96.8 lb/ft^3 (1.55 g/cm^3), not 88.6 lb/ft^3 (1.42 g/cm^3) as estimated before. Additionally, the final density reached by the Amended topsoil was 68.7 lb/ft^3 (1.10 g/cm^3), not 61.2 lb/ft^3 (0.98 g/cm^3) as previously estimated.

In the final stage of the small-scale phase of the project, the F3 design was reached, which ultimately achieved the best infiltration rate results. To arrive at this design, it started with Design B*, which is similar to A* (representing the current ALDOT design), with the only difference being that the topsoil was replaced by amended topsoil. Making this change resulted in significant improvements in infiltration rates. In the falling head test, specimen B* achieved 1.1 ft/day (0.33 cm/day), 2.2 times more than specimen A*, which obtained 0.49 ft/day (0.15 cm/day).

To further enhance the performance of the engineered media, F-type designs were proposed. Similar to Design B*, these designs included amended topsoil instead of topsoil. Additionally, they introduced a layer of pea gravel as a transition and separation medium between the field sand and #57 stone, eliminating the need for geotextile, which causes a reduction in the long-term infiltration rate of engineered media.

Finally, the F3 design was achieved, which showed the second-highest infiltration rate in constant head tests and the highest in falling head tests. Subsequently, the ALDOT + Grass Design and the F3 + Grass Design were tested to compare the performance of the current ALDOT engineered media design with the F3 design proposed by the AU Stormwater team as a result of this research, including in both the upper layer of Bermuda grass sod. Table 4-30 summarizes the characteristics of the designs tested in this phase of the project and their results.

Table 4-30. Designs A*, B*, F*, F1, F2, F3, ALDOT + Grass, and F3 + Grass: Characteristics and Results

Design	Top Layer	h in. (cm)	Second Layer	h in. (cm)	Third Layer	h in. (cm)	Fourth Layer	h in. (cm)	3 Constant- Avg. rate ft/day (m/day)	3 Falling – Avg. rate ft/day (m/day)
A*	Topsoil	10 (25.4)	Field Sand	12 (30.5)	#57 Stone + Geotex.	9.5 (24.1)	-	-	1.73 (0.53)	0.49 (0.15)
B*	Amended Topsoil	10 (25.4)	Field Sand	12 (30.5)	#57 Stone + Geotex.	9.5 (24.1)	-	-	5.38 (1.64)	1.10 (0.33)
F*	Amended Topsoil	10 (25.4)	Field Sand	12 (30.5)	Pea Gravel	6 (15.2)	#57 Stone	4 (10.2)	5.31 (1.62)	1.26 (0.38)
F1	Amended Topsoil	6 (15.2)	Field Sand	16 (40.6)	Pea Gravel	6 (15.2)	#57 Stone	7 (17.8)	4.75 (1.45)	1.11 (0.34)
F2	Amended Topsoil	8 (20.3)	Field Sand	14 (35.6)	Pea Gravel	6 (15.2)	#57 Stone	7 (17.8)	6.73 (2.05)	1.58 (0.48)
F3	Amended Topsoil	6 (15.2)	Field Sand	10 (25.4)	Pea Gravel	6 (15.2)	#57 Stone	9 (22.9)	5.75 (1.75)	2.24 (0.68)
ALDOT +Grass	Topsoil	10 (25.4)	Field Sand	12 (30.5)	#57 Stone + Geotex.	9.5 (24.1)	-	-	0.91 (0.28)	0.31 (0.09)
F3 +Grass	Amended Topsoil	6 (15.2)	Field Sand	10 (25.4)	Pea Gravel	6 (15.2)	#57 Stone	9 (22.9)	13.73 (4.18)	11.66 (3.54)

Note: h = Height of the layer

Finally, in the intermediate-scale phase, the ALDOT Design and the F3 Design were tested in the infiltration swale chamber. The results obtained by both designs in the tests conducted in the infiltration swale chamber are shown in Table 4-31.

Table 4-31. ALDOT and F3 Designs Results in Infiltration Swale Chamber.

Design	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
ALDOT (Chamber)	6.51 ft/day (1.98 m/day)	4.96 ft/day (1.51 m/day)
F3 (Chamber)	87.06 ft/day (26.54 m/day)	75.79 ft/day (23.10 m/day)
Ratio: $\frac{F3\ Rate\ (Chamber)}{ALDOT\ Rate\ (Chamber)}$	13.37	15.28

Table 4-32 shows the results obtained in the transparent infiltrometers for ALDOT and the F3 Designs.

Table 4-32. Constant and Falling Head Infiltration Rate Test Results for ALDOT + Grass and F3 + Grass Designs.

Design	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
ALDOT + Grass	0.91 ft/day (0.28 m/day)	0.31 ft/day (0.09m/day)
F3 + Grass	13.73 ft/day (4.18 m/day)	11.66 ft/day (3.55 m/day)
Ratio: $\frac{F3 + Grass\ Rate}{ALDOT + Grass\ Rate}$	15.09	37.61

Table 4-33 shows the comparison of the results obtained in the infiltration chamber and the infiltrometers between similar designs.

Table 4-33. Comparison of Ratios Between Similar Designs Tested in the Infiltration Chamber and in the Infiltrometers.

Ratio	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
$\frac{F3\ Rate\ (Infiltration\ chamber)}{F3 + Grass\ Rate\ (Infiltrometers)}$	$\frac{87.06\ ft/day}{13.73\ ft/day} = 6.3$	$\frac{75.79\ ft/day}{11.66\ ft/day} = 6.5$
$\frac{ALDOT\ Rate\ (Infiltration\ chamber)}{ALDOT + Grass\ Rate\ (Infiltrometers)}$	$\frac{6.51\ ft/day}{0.91\ ft/day} = 7.2$	$\frac{4.96\ ft/day}{0.31\ ft/day} = 16.0$

There is certainly a difference in infiltration rate when comparing the 6 in. (15.2 cm) column experiments to the chamber experiments. A hypothesis is that in the infiltration chamber, water flows faster through the contact surface between the plastic lining and the materials than through the pores of the materials themselves.

The calculations shown in Table 4-34 that the infiltration chamber has 13.4 times more perimeter and 7.1 times more contour area than the infiltrometer columns. Despite both plastic layers covering the interior of the chamber being installed as carefully as possible to prevent wrinkles, it is possible that irregularities along the installation cause opportunities for water to short-circuit and flow more rapidly than through the inherent porosities of the materials composing the infiltration media. In the case of the 6 in. (15.2 cm) infiltrometer columns, the infiltration media materials are in contact with the homogeneous internal surface of the tubing, which prevents water from flowing more rapidly through the contact surface between the materials and the tubing. This fact could be visually confirmed during the saturation of the samples, thanks to the transparency of the used infiltrometers.

Table 4-34. Geometric Calculations of the Infiltrometers and the Chamber

	Infiltrometers	
Di	Internal diameter	0.50 ft (0.15 m)
Hi	Height of the samples	2.63 ft (0.80 m)
Ai	Surface area	0.20 ft^2 (0.02 m^2)
Pi	Surface perimeter	1.57 ft (0.47 m)
Cai	Contact area: Pi*Hi	4.12 ft^2 (0.38 m^2)
	Infiltration Swale Chamber	
W	Width	2.50 ft (0.76 m)
L	Length	8.00 ft (2.23 m)
Hi	Height of the samples	2.25 ft (0.68 m)
Aisc	Surface area	20.00 ft^2 (6.10 m^2)
Pisc	Surface perimeter	21.00 ft (6.40 m)
Caisc	Contact area	47.25 ft^2 (4.38 m^2)
	Comparison	
Areas Ratio	$\frac{Aisc}{Ai}$	$\frac{20.00\ ft^2}{0.20\ ft^2} = 101.86$
Perimeters Ratio	$\frac{Pisc}{Pi}$	$\frac{21.00\ ft}{1.57\ ft} = 13.37$
Contact area Ratio	$\frac{Caisc}{Cai}$	$\frac{47.25\ ft^2}{4.12\ ft^2} = 11.46$

Additionally, the moisture content sensors analysis allowed to confirm that the F3 Design has a better infiltration rate than the current ALDOT Design.

4.7 DISCUSSION

This research assessed the infiltration rate of various designs for infiltration swale media under both constant and falling head conditions. The methodology employed allowed for the identification of the causes behind the low infiltration rate of the current design, including the low permeability of the topsoil and the reduction in infiltration rate caused by the presence of geotextile, whose pores begin to be blocked by the smaller particles of the specimen, permanently reducing the permeability of the system.

With the identified weaknesses, different solutions were considered until the F3 Design was obtained. The F3 Design ensures an infiltration rate 15 times higher than that of the current design, without significant and permanent reduction issues in the infiltration rate like the previous design. Additionally, it has the ability to dry much faster than the previous design, allowing for a greater available storage volume in the face of another rainfall event.

CHAPTER FIVE:
CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This thesis focuses on a project aimed at providing ALDOT with a design for infiltration swale media that demonstrates improved capabilities for infiltrating water in both the short and, notably, long term. The data collected in this research contribute to a more comprehensive understanding of the performance of each layer of material comprising the infiltration swale media. This knowledge is instrumental in enhancing guidance for an effective implementation. Improving the long-term performance of infiltration swale media yields economic benefits in terms of maintenance savings and environmental advantages, as they will enjoy an extended life cycle.

The expansion of road infrastructure, synonymous with development, heightens the risk of water resource contamination, necessitating the implementation of improved Best Management Practices (BMPs) for effective control and management of stormwater runoff. Increasingly stringent government regulations mandate investments in optimizing the performance of these practices to comply with standards and preserve water quality.

5.2 RESEARCH APPROACH

The objective of this thesis was to design a methodology to evaluate the performance of infiltration swale media designs in order to understand the factors affecting their performance and thus improve their efficiency. The efficiency of infiltration swale media was measured through constant and falling head infiltration tests. During the process, the methodology was optimized, resulting in a final testing regimen consisting of three 6-hour constant head infiltration tests, followed by three falling head infiltration tests. The constant head infiltration tests simulated the prolonged use of infiltration swale media, allowing an assessment of their long-term performance after undergoing the material consolidation process. On the other hand, the falling head infiltration tests provided insights into the time required by the designs to infiltrate ponding water, enabling a comparison of their performances with the minimum required infiltration rate of 1.0 ft/day.

This research successfully achieved the three objectives. First, the current design of ALDOT's infiltration swale media was evaluated to determine its performance. Second, infiltration tests were conducted on various alternative designs to assess their performance. Subsequently, after analyzing the results, adjustments were made to some specimens to optimize their effectiveness. Throughout this process, some specimens were discarded due to poor performance, while others underwent modifications to continue refining their performance. This cycle of evaluation and improvement was iteratively repeated until finally achieving design F3, which exhibited optimal performance, standing out as the most efficient among all evaluated.

To accomplish these objectives, the following tasks were undertaken. Firstly, a literature review was conducted to gather information on infiltration swale standards, previous research, and factors to consider in their design. The second task involved developing a protocol for small and intermediate-scale testing. The third task involved constructing three devices: firstly, the permeameter structure; secondly, the clears infiltrometers; and lastly, the infiltration swale chamber. The fourth task consisted of executing small-scale tests on ALDOT's standard design and other alternative designs to evaluate their performance, implementing iterative adjustments to optimize effectiveness until obtaining the design with optimal performance. The fifth task involved intermediate-scale tests conducted in the infiltration chamber under the monitoring of a moisture sensor system for both ALDOT's current design and the selected F3 design. The sixth task was to evaluate the experimental data obtained from small-scale tests and compare them with the results obtained from intermediate-scale tests for the respective correlation.

5.3 KEY FINDINGS

To optimize the efficiency of infiltration swale media, it is essential to understand how key aspects such as hydraulic conductivity, thickness, and compaction of each material layer influence their infiltration rate. Additionally, understanding how material consolidation reduces performance over time is crucial. These considerations are vital to maximize their efficiency in infiltrating water and prevent excess water runoff generated by impermeable road surfaces from causing higher peak flows, sediment transport, and the transport of contaminants that may deposit in the surrounding environment and receiving water bodies.

The previous study has demonstrated that the presence of the geotextile layer wrapped around the #57 stone as in ALDOT's current design reduces the infiltration rate of the matrix. This reduction occurs because the geotextile pores gradually become clogged by the finer particles of the sand. Infiltration tests demonstrated that replacing the geotextile layer surrounding the #57 stone with a layer of pea gravel as a separation and transition medium between the field sand and the #57 stone improves the infiltration rate of the matrices and prevents the permanent decrease caused by the implementation of geotextile.

Permeability and infiltration rate tests conducted on samples composed solely of topsoil showed that this material has very low permeability, preventing infiltration swale media containing it as the top layer from meeting the minimum required infiltration rate of 1 ft/day. Infiltration tests have revealed that amended topsoil, composed of 80% topsoil and 20% pine bark fines by weight, has a higher infiltration rate than topsoil. Furthermore, when replacing topsoil with amended topsoil in infiltration swale media, the tests also demonstrated a significant increase in the infiltration rate of the entire matrix.

5.4 COMPARISON TO CURRENT ALDOT INFILTRATION SWALE MEDIA

The results of the infiltration rate tests conducted on the clear infiltrometers to ALDOT design and F3 design, represented by the samples ALDOT + Grass and F3 + Grass respectively, are shown in Table 5-1.

Table 5-1. Infiltration Rate Test Results for ALDOT + Grass and F3 + Grass designs - Clear Infiltrometers

Design	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
ALDOT + Grass	0.91 ft/day (0.28 m/day)	0.31 ft/day (0.09 m/day)
F3 + Grass	13.73 ft/day (4.18 m/day)	11.66 ft/day (3.55 m/day)
Ratio: $\frac{F3 + Grass\ Rate}{ALDOT + Grass\ Rate}$	15.09	37.61

The results of the constant head infiltration rate test showed that Design F3 + Grass yielded 13.73 ft/day, 15.09 times more infiltration rate than ALDOT + Grass Design. In the falling head infiltration rate test the Design F3 + Grass yielded 11.66 ft/day, 37.61 times more infiltration rate than ALDOT + Grass Design.

In the intermediate-scale phase, the ALDOT Design and the F3 Design were tested in the infiltration swale chamber. The results obtained by both designs in the tests conducted in the infiltration swale chamber are shown in Table 5-2.

Table 5-2. Comparison of Result of ALDOT and F3 Design in the Infiltration Swale Chamber

Design	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
ALDOT (Chamber)	6.51 ft/day (1.98 m/day)	4.96 ft/day (1.51 m/day)
F3 (Chamber)	87.06 ft/day (26.54 m/day)	75.79 ft/day (23.01 m/day)
Ratio: $\frac{F3\ Rate\ (Chamber)}{ALDOT\ Rate\ (Chamber)}$	13.37	15.28

Table 5-3 shows the comparison of the results obtained in the infiltration chamber and the infiltrometers between similar designs.

Table 5-3. Comparison of Ratios Between Similar Designs Tested in the Infiltration Chamber and in the Infiltrometers.

Ratio	Constant head infiltration rate test – Average	Falling head infiltration rate test – Average
$\frac{F3\ Rate\ (Infiltration\ chamber)}{F3 + Grass\ Rate\ (Infiltrometers)}$	$\frac{87.06\ ft/day}{13.73\ ft/day} = 6.3$	$\frac{75.79\ ft/day}{11.66\ ft/day} = 6.5$
$\frac{ALDOT\ Rate\ (Infiltration\ chamber)}{ALDOT + Grass\ Rate\ (Infiltrometers)}$	$\frac{6.51\ ft/day}{0.91\ ft/day} = 7.2$	$\frac{4.96\ ft/day}{0.31\ ft/day} = 16.0$

There is certainly a difference in infiltration rate when comparing the 6 in. (15.2 cm) column experiments to the chamber experiments. A hypothesis is that in the infiltration chamber, water flows faster through the contact surface between the plastic lining and the materials than through the pores of the materials themselves.

The calculations shown in Table 5-4 that the infiltration chamber has 13.4 times more perimeter and 7.1 times more contour area than the infiltrometer columns. Despite both plastic layers covering the interior of the chamber being installed as carefully as possible to prevent wrinkles, it is possible that irregularities along the installation cause opportunities for water to short-circuit and flow more rapidly than through the inherent porosities of the materials composing the infiltration media. In the case of the 6 in. (15.2 cm) infiltrometer columns, the infiltration media materials are in contact with the homogeneous internal surface of the tubing, which prevents water from flowing more rapidly through the contact surface between the materials and the tubing. This fact could be visually confirmed during the saturation of the samples, thanks to the transparency of the used infiltrometers.

Table 5-4. Geometric Calculations of the Infiltrometers and the Chamber

Infiltrometers		
Di	Internal diameter	0.50 ft (0.15 m)
Hi	Height of the samples	2.63 ft (0.80 m)
Ai	Surface area	0.20 ft^2 (0.02 m^2)
Pi	Surface perimeter	1.57 ft (0.47 m)
Cai	Contact area: Pi*Hi	4.12 ft^2 (0.38 m^2)
Infiltration Swale Chamber		
W	Width	2.50 ft (0.76 m)
L	Length	8.00 ft (2.23 m)
Hi	Height of the samples	2.25 ft (0.68 m)
Aisc	Surface area	20.00 ft^2 (6.10 m^2)
Pisc	Surface perimeter	21.00 ft (6.40 m)
Caisc	Contact area	47.25 ft^2 (4.38 m^2)
Comparison		
Areas Ratio	$\frac{Aisc}{Ai}$	$\frac{20.00\ ft^2}{0.20\ ft^2} = 101.86$
Perimeters Ratio	$\frac{Pisc}{Pi}$	$\frac{21.00\ ft}{1.57\ ft} = 13.37$
Contour area Ratio	$\frac{Caisc}{Cai}$	$\frac{47.25\ ft^2}{4.12\ ft^2} = 11.46$

Additionally, the moisture content sensors analysis allowed to confirm that the F3 Design has a better infiltration rate than the current ALDOT Design. Table 5-5 shows a summary of the results obtained from the moisture content data analysis.

Table 5-5. Analysis of Moisture Content Sensors Data.

Design	Layer	Maximum moisture content (%)	Moisture content at 9-hours (%)	Moisture content at 21-hours (%)	Drying ratio (%/hour)	Sensors' response time
ALDOT	Topsoil	31.7	31.7	31.6	0.0083	20 to 25 min
	Field sand	18.3	18.2	13.7	0.37	20 to 25 min
F3	Amended topsoil	42.4	39.8	28.7	0.92	0 to 5 min
	Field sand	26.8	25.6	15.6	0.83	0 to 5 min

The data results obtained from the moisture content curves analysis allowed to conclude the following:

1. The amended topsoil of the F3 Design reaches a maximum moisture content of 42.4%, equivalent to 1.33 times the maximum moisture content reached by the topsoil of the ALDOT Design, which was 31.7%.
2. The Field Sand of the F3 Design reaches a maximum moisture content of 26.8%, equivalent to 1.46 times the maximum moisture content reached by the field sand of the ALDOT Design, which was 18.3%. The reason for this is that in the ALDOT design, topsoil retains so much water that a flow capable of saturating this material does not reach field Sand.
3. The time it takes for water to travel from the surface of the F3 Design to the moisture sensors located in the field sand is between 0 and 5 minutes, and the time it takes for water to travel from the surface of the ALDOT Design to the moisture sensors located in the field sand is 20 to 25 minutes. This indicates that the water flow, and consequently the infiltration rate of the F3 Design, is higher than the infiltration rate of the ALDOT Design.
4. The drying rate of the amended topsoil and field sand of the F3 Design is higher than the drying rate of the topsoil and field sand layers of the ALDOT Design. The drying rate of

the amended topsoil in the F3 Design is 0.92% per hour, which is 111 times greater than the drying rate of the topsoil in the ALDOT Design, which is 0.0083% per hour. The drying rate of the field sand in the F3 Design is 0.83% per hour, 2.24 times greater than the drying rate of the field sand in the ALDOT Design, which is 0.37% per hour.

5.5 RECOMMENDATIONS FOR FUTURE TESTING

The mid-scale infiltration tests conducted in the infiltration chamber showed much higher results compared to the results obtained in the infiltration tests carried out in the clear infiltrometers. This is because the infiltration chamber was lined with two layers of plastic for waterproofing. However, the wrinkles formed in this material create voids through which water infiltrates faster than through the pores of the materials. For future studies, it is recommended to use a chamber constructed monolithically with materials such as carbon fiber that allows the contact between the matrix materials and the chamber surface to be equal to that observed between the matrix materials and the infiltrometers.

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APPENDICES

Appendix A: Permeability Tests Data

Appendix B: Infiltration Tests Data - Infiltrometers

Appendix C: Infiltration Tests Data – Infiltration chamber

APPENDIX A

Permeability Tests Data

Column 1
Field Sand
Date: 18/12/2022

K (20°C)	3.96 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.0 cm
P1 - P3	56.6 cm

Water Head over the sample:	**26.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*79.7 cm*
Area:	182 cm2	*P2*	*45.0 cm*
Volumen:	15,323 cm3	*P3*	*9.8 cm*
Weight:		*h (P1-P2)*	34.7 cm
Water Temp	*18 °C*	*h (P2-P3)*	35.2 cm
v - Kinem. viscosity (10^6	*1.055*	*h (P1-P3)*	69.9 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	0.91 l/min	*t1*	*132.29 s*
Q2	0.90 l/min	*t2*	*132.82 s*
***Q** avg*	0.91 l/min	***t** avg*	132.56 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.00 cm	56.60 cm
A	182 cm2	182 cm2	182 cm2
t	132.56 s	132.56 s	132.56 s
h (1-2)	34.70 cm	35.20 cm	69.90 cm
***K** (18°C)*	4.09 cm/min	3.95 cm/min	4.02 cm/min
***K** (20°C)*	4.29 cm/min	4.14 cm/min	4.22 cm/min

K Summary	
***K (20°C)** P1-P3*	4.22 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	4.22 cm/min

Field Sand Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.0 cm
P1 - P3	56.6 cm

Water Head over the sample:	**25.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*78.0 cm*
Area:	182 cm2	*P2*	*43.8 cm*
Volumen:	15,323 cm3	*P3*	*9.4 cm*
Weight:		*h (P1-P2)*	34.2 cm
Water Temp	*19 °C*	*h (P2-P3)*	34.4 cm
v - Kinem. viscosity (10^6	*1.030*	*h (P1-P3)*	68.6 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	0.89 l/min	*t1*	*135.55 s*
Q2	0.88 l/min	*t2*	*136.02 s*
Q *avg*	0.88 l/min	***t*** *avg*	135.79 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.00 cm	56.60 cm
A	182 cm2	182 cm2	182 cm2
t	135.79 s	135.79 s	135.79 s
h (1-2)	34.20 cm	34.40 cm	68.60 cm
K *(19°C)*	4.05 cm/min	3.94 cm/min	4.00 cm/min
K *(20°C)*	4.15 cm/min	4.04 cm/min	4.10 cm/min

K Summary	
K (20°C) *P1-P3*	4.10 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	4.10 cm/min

Field Sand Test 3

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.0 cm
P1 - P3	56.6 cm

Water Head over the sample:	**24.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*76.6 cm*
Area:	182 cm2	*P2*	*41.3 cm*
Volumen:	15,323 cm3	*P3*	*8.4 cm*
Weight:		*h (P1-P2)*	35.3 cm
Water Temp	19 °C	*h (P2-P3)*	32.9 cm
v - Kinem. viscosity (10^6	*1.030*	*h (P1-P3)*	68.2 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	0.84 l/min	*t1*	*143.01 s*
Q2	0.84 l/min	*t2*	*143.02 s*
***Q** avg*	0.84 l/min	***t** avg*	143.02 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.00 cm	56.60 cm
A	182 cm2	182 cm2	182 cm2
t	143.02 s	143.02 s	143.02 s
h (1-2)	35.30 cm	32.90 cm	68.20 cm
***K** (19°C)*	3.73 cm/min	3.91 cm/min	3.82 cm/min
***K** (20°C)*	3.82 cm/min	4.01 cm/min	3.91 cm/min

K Summary	
K (20°C) *P1-P3*	3.91 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	3.91 cm/min

Field Sand Test 4

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.0 cm
P1 - P3	56.6 cm

Water Head over the sample:	**23.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*75.6 cm*
Area:	182 cm2	*P2*	*41.4 cm*
Volumen:	15,323 cm3	*P3*	*8.3 cm*
Weight:		*h (P1-P2)*	34.2 cm
Water Temp	19 °C	*h (P2-P3)*	33.1 cm
v - Kinem. viscosity (10^6	*1.030*	*h (P1-P3)*	67.3 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	0.84 l/min	*t1*	*142.60 s*
Q2	0.85 l/min	*t2*	*141.70 s*
***Q** avg*	0.84 l/min	***t** avg*	142.15 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.00 cm	56.60 cm
A	182 cm2	182 cm2	182 cm2
t	142.15 s	142.15 s	142.15 s
h (1-2)	34.20 cm	33.10 cm	67.30 cm
***K** (19°C)*	3.87 cm/min	3.91 cm/min	3.89 cm/min
***K** (20°C)*	3.97 cm/min	4.01 cm/min	3.99 cm/min

K Summary	
***K (20°C)** P1-P3*	3.99 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	3.99 cm/min

Field Sand Test 5

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.0 cm
P1 - P3	56.6 cm

Water Head over the sample:	**22.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*74.0 cm*
Area:	182 cm2	*P2*	*38.1 cm*
Volumen:	15,323 cm3	*P3*	*7.0 cm*
Weight:		*h (P1-P2)*	35.9 cm
Water Temp	19 °C	*h (P2-P3)*	31.1 cm
v - Kinem. viscosity (10^6	*1.030*	*h (P1-P3)*	67.0 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	0.79 l/min	*t1*	*151.45 s*
Q2	0.79 l/min	*t2*	*152.16 s*
Q *avg*	0.79 l/min	***t*** *avg*	151.81 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.00 cm	56.60 cm
A	182 cm2	182 cm2	182 cm2
t	151.81 s	151.81 s	151.81 s
h (1-2)	35.90 cm	31.10 cm	67.00 cm
K *(19°C)*	3.45 cm/min	3.90 cm/min	3.66 cm/min
K *(20°C)*	3.54 cm/min	4.00 cm/min	3.75 cm/min

K Summary	
K (20°C) *P1-P3*	3.75 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	3.76 cm/min

Field Sand Test 6

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.0 cm
P1 - P3	56.6 cm

Water Head over the sample:	**23.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*75.0 cm*
Area:	182 cm2	*P2*	*38.1 cm*
Volumen:	15,323 cm3	*P3*	*8.1 cm*
Weight:		*h (P1-P2)*	36.9 cm
Water Temp	19 °C	*h (P2-P3)*	30.0 cm
v - Kinem. viscosity (10^6	*1.055*	*h (P1-P3)*	66.9 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	0.78 l/min	*t1*	*153.23 s*
Q2	0.78 l/min	*t2*	*153.91 s*
Q *avg*	0.78 l/min	***t*** *avg*	153.57 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.00 cm	56.60 cm
A	182 cm2	182 cm2	182 cm2
t	153.57 s	153.57 s	153.57 s
h (1-2)	36.90 cm	30.00 cm	66.90 cm
K *(18°C)*	3.32 cm/min	4.00 cm/min	3.62 cm/min
K *(20°C)*	3.49 cm/min	4.20 cm/min	3.80 cm/min

K Summary	
K (20°C) *P1-P3*	3.80 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	3.83 cm/min

Column 2
Pea Gravel

Date: 18/12/2022

K (20°C)	546.89 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.4 cm
P1 - P3	57.0 cm

Water Head over the sample:	**26.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*100.0 cm*
Area:	182 cm2	*P2*	*99.1 cm*
Volumen:	15,323 cm3	*P3*	*98.3 cm*
Weight:		*h (P1-P2)*	0.9 cm
Water Temp	*17 °C*	*h (P2-P3)*	0.8 cm
v - Kinem. viscosity (10^6	*1.082*	*h (P1-P3)*	1.7 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	3.12 l/min	*t1*	*38.44 s*
Q2	3.15 l/min	*t2*	*38.11 s*
Q *avg*	3.14 l/min	***t*** *avg*	38.28 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.40 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	38.28 s	38.28 s	38.28 s
h (1-2)	0.90 cm	0.80 cm	1.70 cm
K *(17°C)*	546.17 cm/min	610.15 cm/min	576.28 cm/min
K *(20°C)*	588.02 cm/min	656.89 cm/min	620.43 cm/min

K Summary	
K (20°C) *P1-P3*	620.43 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	621.78 cm/min

Pea Gravel Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.4 cm
P1 - P3	57.0 cm

Water Head over the sample:	**25.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*99.1 cm*
Area:	182 cm2	*P2*	*98.2 cm*
Volumen:	15,323 cm3	*P3*	*97.2 cm*
Weight:		*h (P1-P2)*	0.9 cm
Water Temp	*17 °C*	*h (P2-P3)*	1.0 cm
v - Kinem. viscosity (10^6	*1.082*	*h (P1-P3)*	1.9 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	2.77 l/min	*t1*	*43.34 s*
Q2	2.80 l/min	*t2*	*42.81 s*
***Q** avg*	2.79 l/min	***t** avg*	43.08 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.40 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	43.08 s	43.08 s	43.08 s
h (1-2)	0.90 cm	1.00 cm	1.90 cm
***K** (17°C)*	485.31 cm/min	433.73 cm/min	458.16 cm/min
***K** (20°C)*	522.49 cm/min	466.96 cm/min	493.26 cm/min

K Summary	
K (20°C) *P1-P3*	493.26 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	494.24 cm/min

Pea Gravel Test 3

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.4 cm
P1 - P3	57.0 cm

Water Head over the sample:	**24.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*98.3 cm*
Area:	182 cm2	*P2*	*97.4 cm*
Volumen:	15,323 cm3	*P3*	*96.9 cm*
Weight:		*h (P1-P2)*	0.9 cm
Water Temp	*17 °C*	*h (P2-P3)*	0.5 cm
v - Kinem. viscosity (10^6	*1.082*	*h (P1-P3)*	1.4 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	2.28 l/min	*t1*	*52.67 s*
Q2	2.33 l/min	*t2*	*51.41 s*
***Q** avg*	2.31 l/min	***t** avg*	52.04 s

K - Permeability coefficients

Between	P1 - P2	P2 - P3	P1 - P3
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.40 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	52.04 s	52.04 s	52.04 s
h (1-2)	0.90 cm	0.50 cm	1.40 cm
***K** (17°C)*	401.71 cm/min	718.01 cm/min	514.67 cm/min
***K** (20°C)*	432.48 cm/min	773.03 cm/min	554.11 cm/min

K Summary

***K (20°C)** P1-P3*	554.11 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	586.54 cm/min

Pea Gravel Test 4

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.4 cm
P1 - P3	57.0 cm

Water Head over the sample:	**23.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*97.3 cm*
Area:	182 cm2	*P2*	*96.2 cm*
Volumen:	15,323 cm3	*P3*	*95.4 cm*
Weight:		*h (P1-P2)*	1.1 cm
Water Temp	*17 ℃*	*h (P2-P3)*	0.8 cm
v - Kinem. viscosity (10^6	*1.082*	*h (P1-P3)*	1.9 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	3.03 l/min	*t1*	*39.66 s*
Q2	3.03 l/min	*t2*	*39.64 s*
***Q** avg*	3.03 l/min	***t** avg*	39.65 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.40 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	39.65 s	39.65 s	39.65 s
h (1-2)	1.10 cm	0.80 cm	1.90 cm
***K** (17°C)*	431.37 cm/min	588.99 cm/min	497.74 cm/min
***K** (20°C)*	464.42 cm/min	634.11 cm/min	535.87 cm/min

K Summary	
***K (20°C)** P1-P3*	535.87 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	544.80 cm/min

Pea Gravel Test 5

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.6 cm
P2 - P3	28.4 cm
P1 - P3	57.0 cm

Water Head over the sample:	**22.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*96.3 cm*
Area:	182 cm2	*P2*	*95.4 cm*
Volumen:	15,323 cm3	*P3*	*94.5 cm*
Weight:		*h (P1-P2)*	0.9 cm
Water Temp	*17 °C*	*h (P2-P3)*	0.9 cm
v - Kinem. viscosity (10^6	*1.082*	*h (P1-P3)*	1.8 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	2.84 l/min	*t1*	*42.26 s*
Q2	2.84 l/min	*t2*	*42.25 s*
***Q** avg*	2.84 l/min	***t** avg*	42.26 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.60 cm	28.40 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	42.26 s	42.26 s	42.26 s
h (1-2)	0.90 cm	0.90 cm	1.80 cm
***K** (17°C)*	494.73 cm/min	491.27 cm/min	493.00 cm/min
***K** (20°C)*	532.63 cm/min	528.91 cm/min	530.77 cm/min

K Summary	
***K (20°C)** P1-P3*	530.77 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	530.77 cm/min

Column 4
#57 Stone

Date: 19/12/2022

K *(20°C)*	6103.77 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.5 cm
P2 - P3	28.5 cm
P1 - P3	57.0 cm

Water Head over the sample:	**26.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*98.4 cm*
Area:	182 cm2	*P2*	*98.2 cm*
Volumen:	15,323 cm3	*P3*	*98.1 cm*
Weight:		*h (P1-P2)*	0.2 cm
Water Temp	*18 °C*	*h (P2-P3)*	0.1 cm
v - Kinem. viscosity (10^6	*1.055*	*h (P1-P3)*	0.3 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	5.71 l/min	*t1*	*21.00 s*
Q2	5.86 l/min	*t2*	*20.48 s*
Q *avg*	5.79 l/min	***t*** *avg*	20.74 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.50 cm	28.50 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	20.74 s	20.74 s	20.74 s
h (1-2)	0.20 cm	0.10 cm	0.30 cm
K *(18°C)*	4519.89 cm/min	9039.77 cm/min	6026.52 cm/min
K *(20°C)*	4744.76 cm/min	9489.51 cm/min	6326.34 cm/min

K Summary	
K (20°C) *P1-P3*	6326.34 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	6853.54 cm/min

#57 Stone   Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.5 cm
P2 - P3	28.5 cm
P1 - P3	57.0 cm

Water Head over the sample:	**25.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*97.2 cm*
Area:	182 cm2	*P2*	*97.0 cm*
Volumen:	15,323 cm3	*P3*	*96.9 cm*
Weight:		*h (P1-P2)*	0.2 cm
Water Temp	*18 °C*	*h (P2-P3)*	0.1 cm
v - Kinem. viscosity (10^6	*1.055*	*h (P1-P3)*	0.3 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	5.25 l/min	*t1*	*22.86 s*
Q2	5.34 l/min	*t2*	*22.47 s*
***Q** avg*	5.29 l/min	***t** avg*	22.67 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.50 cm	28.50 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	22.67 s	22.67 s	22.67 s
h (1-2)	0.20 cm	0.10 cm	0.30 cm
***K** (18°C)*	4136.00 cm/min	8272.00 cm/min	5514.67 cm/min
***K** (20°C)*	4341.77 cm/min	8683.54 cm/min	5789.03 cm/min

K Summary	
***K (20°C)** P1-P3*	5789.03 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	6271.45 cm/min

#57 Stone   Test 3

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.5 cm
P2 - P3	28.5 cm
P1 - P3	57.0 cm

Water Head over the sample:	**24.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*96.3 cm*
Area:	182 cm2	*P2*	*96.1 cm*
Volumen:	15,323 cm3	*P3*	*96.0 cm*
Weight:		*h (P1-P2)*	0.2 cm
Water Temp	*18 °C*	*h (P2-P3)*	0.1 cm
v - Kinem. viscosity (10^6	*1.055*	*h (P1-P3)*	0.3 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	6.21 l/min	*t1*	*19.31 s*
Q2	6.32 l/min	*t2*	*19.00 s*
Q *avg*	6.27 l/min	***t*** *avg*	19.16 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.50 cm	28.50 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	19.16 s	19.16 s	19.16 s
h (1-2)	0.20 cm	0.10 cm	0.30 cm
K *(17°C)*	4893.89 cm/min	9787.78 cm/min	6525.19 cm/min
K *(20°C)*	5137.37 cm/min	10274.73 cm/min	6849.82 cm/min

K Summary	
K (20°C) *P1-P3*	6849.82 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	7420.64 cm/min

#57 Stone Test 4

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.5 cm
P2 - P3	28.5 cm
P1 - P3	57.0 cm

Water Head over the sample:	**23.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*95.0 cm*
Area:	182 cm2	*P2*	*94.8 cm*
Volumen:	15,323 cm3	*P3*	*94.7 cm*
Weight:		*h (P1-P2)*	0.2 cm
Water Temp	*18 °C*	*h (P2-P3)*	0.1 cm
v - Kinem. viscosity (10^6	*1.055*	*h (P1-P3)*	0.3 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	5.10 l/min	*t1*	*23.52 s*
Q2	5.22 l/min	*t2*	*22.98 s*
Q *avg*	5.16 l/min	***t*** *avg*	23.25 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.50 cm	28.50 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	23.25 s	23.25 s	23.25 s
h (1-2)	0.20 cm	0.10 cm	0.30 cm
K *(17°C)*	4031.93 cm/min	8063.87 cm/min	5375.91 cm/min
K *(20°C)*	4232.53 cm/min	8465.05 cm/min	5643.37 cm/min

K Summary	
K (20°C) *P1-P3*	5643.37 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	6113.65 cm/min

#57 Stone Test 5

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.5 cm
P2 - P3	28.5 cm
P1 - P3	57.0 cm

Water Head over the sample:	**22.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*94.2 cm*
Area:	182 cm2	*P2*	*94.0 cm*
Volumen:	15,323 cm3	*P3*	*93.9 cm*
Weight:		*h (P1-P2)*	0.2 cm
Water Temp	*18 °C*	*h (P2-P3)*	0.1 cm
v - Kinem. viscosity (10^6	*1.055*	*h (P1-P3)*	0.3 cm

Outflow - Geotextile			
Volumen	*2,000.0 cm3*	***Time***	
Q1	5.38 l/min	*t1*	*22.30 s*
Q2	5.43 l/min	*t2*	*22.10 s*
Q *avg*	5.41 l/min	***t*** *avg*	22.20 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	2,000 cm3	2,000 cm3	2,000 cm3
L (Distance P1-P2)	28.50 cm	28.50 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	22.20 s	22.20 s	22.20 s
h (1-2)	0.20 cm	0.10 cm	0.30 cm
K *(17°C)*	4222.63 cm/min	8445.27 cm/min	5630.18 cm/min
K *(20°C)*	4432.71 cm/min	8865.43 cm/min	5910.29 cm/min

K Summary	
K (20°C) *P1-P3*	5910.29 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	6402.81 cm/min

Column 3
Top Soil

Date: 19/12/2022

K *(20°C)*	0.0037 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.5 cm
P2 - P3	28.5 cm
P1 - P3	57.0 cm

Water Head over the sample:	**51.50 cm**

Sample		**Piezometers Lecture**	
Height:	*73.5 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*97.2 cm*
Area:	182 cm2	*P2*	*40.8 cm*
Volumen:	13,407 cm3	*P3*	*3.5 cm*
Weight:		*h (P1-P2)*	56.4 cm
Water Temp	19 °C	*h (P2-P3)*	37.3 cm
v - Kinem. viscosity (10^6	*1.028*	*h (P1-P3)*	93.7 cm

Outflow - Geotextile			
Volumen	*120.0 cm3*	***Time***	
Q1	0.0012 l/min	*t1*	*6187.00 s*
Q *avg*	0.00 l/min	***t*** *avg*	6187.00 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	120 cm3	120 cm3	120 cm3
L (Distance P1-P2)	28.50 cm	28.50 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	6187.00 s	6187.00 s	6187.00 s
h (1-2)	56.40 cm	37.30 cm	93.70 cm
K *(19°C)*	0.0032 cm/min	0.0049 cm/min	0.0039 cm/min
K *(20°C)*	0.0033 cm/min	0.0050 cm/min	0.0040 cm/min

K Summary	
K (20°C) *P2-P3*	0.0040 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	0.0041 cm/min

Topsoil Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	28.5 cm
P2 - P3	28.5 cm
P1 - P3	57.0 cm

Water Head over the sample:	**47.50 cm**

Sample		Piezometers Lecture	
Height:	*73.5 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*97.4 cm*
Area:	182 cm2	*P2*	*45.5 cm*
Volumen:	13,407 cm3	*P3*	*3.5 cm*
Weight:		*h (P1-P2)*	51.9 cm
Water Temp	19 °C	*h (P2-P3)*	42.0 cm
v - Kinem. viscosity (10^6	*1.028*	*h (P1-P3)*	93.9 cm

Outflow - Geotextile			
Volumen	*60.0 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*3572.10 s*
***Q** avg*	0.00 l/min	***t** avg*	3572.10 s

K - Permeability coefficients

Between	P1 - P2	P2 - P3	P1 - P3
Q	60 cm3	60 cm3	60 cm3
L (Distance P1-P2)	28.50 cm	28.50 cm	57.00 cm
A	182 cm2	182 cm2	182 cm2
t	3572.10 s	3572.10 s	3572.10 s
h (1-2)	51.90 cm	42.00 cm	93.90 cm
***K** (19°C)*	0.0030 cm/min	0.0037 cm/min	0.0034 cm/min
***K** (20°C)*	0.0031 cm/min	0.0038 cm/min	0.0034 cm/min

K Summary	
***K (20°C)** P2-P3*	0.0034 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.0035 cm/min

Column 8
ALDOT 1

Date: 21/12/2022

K (20°C)	0.0495 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**26.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*70.0 cm*
Area:	182 cm2	*P2*	*34.5 cm*
Volumen:	15,323 cm3	*P3*	*4.0 cm*
Weight:		*h (P1-P2)*	35.5 cm
Water Temp	*21 °C*	*h (P2-P3)*	30.5 cm
v - Kinem. viscosity (10^6	*0.981*	*h (P1-P3)*	66.0 cm

Outflow - Geotextile			
Volumen	*200.0 cm3*	***Time***	
Q1	0.01 l/min	*t1*	*996.24 s*
Q2	0.01 l/min	*t2*	*979.60 s*
Q *avg*	0.01 l/min	***t*** *avg*	987.92 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	200 cm3	200 cm3	200 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	987.92 s	987.92 s	987.92 s
h (1-2)	35.50 cm	30.50 cm	66.00 cm
K *(21°C)*	0.056 cm/min	0.065 cm/min	0.061 cm/min
K *(20°C)*	0.055 cm/min	0.064 cm/min	0.059 cm/min

K Summary	
K (20°C) *P2-P3*	0.059 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	0.059 cm/min

ALDOT 1 Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	22.00 cm

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*71.5 cm*
Area:	182 cm2	*P2*	*34.5 cm*
Volumen:	15,323 cm3	*P3*	*4.0 cm*
Weight:		*h (P1-P2)*	37.0 cm
Water Temp	19 °C	*h (P2-P3)*	30.5 cm
v - Kinem. viscosity (10^6	*1.030*	*h (P1-P3)*	67.5 cm

Outflow - Geotextile			
Volumen	*200.0 cm3*	***Time***	
Q1	0.01 l/min	*t1*	*1500.00 s*
Q2	0.01 l/min	*t2*	*1500.00 s*
***Q** avg*	0.01 l/min	***t** avg*	1500.00 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	200 cm3	200 cm3	200 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	1500.00 s	1500.00 s	1500.00 s
h (1-2)	37.00 cm	30.50 cm	67.50 cm
***K** (19°C)*	0.036 cm/min	0.043 cm/min	0.039 cm/min
***K** (20°C)*	0.036 cm/min	0.044 cm/min	0.040 cm/min

K Summary	
***K (20°C)** P2-P3*	0.040 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.040 cm/min

ALDOT 1 Test 3

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**22.00 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*87.4 cm*
Area:	182 cm2	*P2*	*34.5 cm*
Volumen:	15,323 cm3	*P3*	*4.0 cm*
Weight:		*h (P1-P2)*	52.9 cm
Water Temp	20 °C	*h (P2-P3)*	30.5 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	83.4 cm

Outflow - Geotextile			
Volumen	*700.0 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*4911.94 s*
Q2	0.00 l/min	*t2*	*4911.94 s*
***Q** avg*	0.00 l/min	***t** avg*	4911.94 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	700 cm3	700 cm3	700 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	4911.94 s	4911.94 s	4911.94 s
h (1-2)	52.90 cm	30.50 cm	83.40 cm
***K** (20°C)*	0.027 cm/min	0.046 cm/min	0.034 cm/min
***K** (20°C)*	0.027 cm/min	0.046 cm/min	0.034 cm/min

K Summary	
***K (20°C)** P2-P3*	0.034 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.035 cm/min

Column 9
ALDOT 2

Date: 22/12/2022

K *(20°C)*	0.0389 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**40.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*70.8 cm*
Area:	182 cm2	*P2*	*34.2 cm*
Volumen:	15,323 cm3	*P3*	*4.2 cm*
Weight:		*h (P1-P2)*	36.6 cm
Water Temp	20 °C	*h (P2-P3)*	30.0 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	66.6 cm

Outflow - Geotextile			
Volumen	*84.0 cm3*	***Time***	
Q1	0.01 l/min	*t1*	*600.00 s*
Q2	0.01 l/min	*t2*	*607.23 s*
Q *avg*	0.01 l/min	***t*** *avg*	603.61 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	84 cm3	84 cm3	84 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	603.61 s	603.61 s	603.61 s
h (1-2)	36.60 cm	30.00 cm	66.60 cm
K *(20°C)*	0.038 cm/min	0.046 cm/min	0.041 cm/min
K *(20°C)*	0.038 cm/min	0.046 cm/min	0.041 cm/min

K Summary	
K (20°C) *P2-P3*	0.041 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	0.042 cm/min

ALDOT 2 Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**36.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*74.8 cm*
Area:	182 cm2	*P2*	*34.2 cm*
Volumen:	15,323 cm3	*P3*	*4.2 cm*
Weight:		*h (P1-P2)*	40.6 cm
Water Temp	20 °C	*h (P2-P3)*	30.0 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	70.6 cm

Outflow - Geotextile			
Volumen	*80.0 cm3*	***Time***	
Q1	0.01 l/min	*t1*	*600.00 s*
Q2	0.01 l/min	*t2*	*623.38 s*
***Q** avg*	0.01 l/min	***t** avg*	611.69 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	80 cm3	80 cm3	80 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	611.69 s	611.69 s	611.69 s
h (1-2)	40.60 cm	30.00 cm	70.60 cm
***K** (20°C)*	0.032 cm/min	0.043 cm/min	0.037 cm/min
***K** (20°C)*	0.032 cm/min	0.043 cm/min	0.037 cm/min

K Summary	
***K (20°C)** P2-P3*	0.037 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.037 cm/min

Column 10
ALDOT 3

Date: 23/12/2022

K (20°C)	0.0328 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**32.50 cm**

Sample		**Piezometers Lecture**	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*98.0 cm*
Area:	182 cm2	*P2*	*34.7 cm*
Volumen:	15,323 cm3	*P3*	*3.5 cm*
Weight:		*h (P1-P2)*	63.3 cm
Water Temp	*20 °C*	*h (P2-P3)*	31.2 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	94.5 cm

Outflow - Geotextile			
Volumen	*84.0 cm3*	***Time***	
Q1	0.01 l/min	*t1*	*600.00 s*
Q2	0.01 l/min	*t2*	*607.23 s*
***Q** avg*	0.01 l/min	***t** avg*	603.61 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	84 cm3	84 cm3	84 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	603.61 s	603.61 s	603.61 s
h (1-2)	63.30 cm	31.20 cm	94.50 cm
***K** (20°C)*	0.02 cm/min	0.04 cm/min	0.03 cm/min
***K** (20°C)*	0.02 cm/min	0.04 cm/min	0.03 cm/min

K Summary	
***K (20°C)** P1-P3*	0.029 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.032 cm/min

ALDOT 3 Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**28.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*74.8 cm*
Area:	182 cm2	*P2*	*34.2 cm*
Volumen:	15,323 cm3	*P3*	*4.2 cm*
Weight:		*h (P1-P2)*	40.6 cm
Water Temp	*20 °C*	*h (P2-P3)*	30.0 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	70.6 cm

Outflow - Geotextile			
Volumen	*80.0 cm3*	***Time***	
Q1	0.01 l/min	*t1*	*600.00 s*
Q2	0.01 l/min	*t2*	*623.38 s*
***Q** avg*	0.01 l/min	***t** avg*	611.69 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	80 cm3	80 cm3	80 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	611.69 s	611.69 s	611.69 s
h (1-2)	40.60 cm	30.00 cm	70.60 cm
***K** (20°C)*	0.03 cm/min	0.04 cm/min	0.04 cm/min
***K** (20°C)*	0.03 cm/min	0.04 cm/min	0.04 cm/min

K Summary	
***K (20°C)** P1-P3*	0.037 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.037 cm/min

Column 11
ALDOT 4

Date: 23/12/2022

K *(20°C)*	0.011 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**40.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*70.2 cm*
Area:	182 cm2	*P2*	*34.2 cm*
Volumen:	15,323 cm3	*P3*	*4.2 cm*
Weight:		*h (P1-P2)*	36.0 cm
Water Temp	20 °C	*h (P2-P3)*	30.0 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	66.0 cm

Outflow - Geotextile			
Volumen	*32.0 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*630.00 s*
Q2	0.00 l/min	*t2*	*630.00 s*
Q *avg*	0.00 l/min	***t*** *avg*	630.00 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	32 cm3	32 cm3	32 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	630.00 s	630.00 s	630.00 s
h (1-2)	36.00 cm	30.00 cm	66.00 cm
K *(20°C)*	0.01 cm/min	0.02 cm/min	0.02 cm/min
K *(20°C)*	0.01 cm/min	0.02 cm/min	0.02 cm/min

K Summary	
K (20°C) *P1-P3*	0.015 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	0.015 cm/min

ALDOT 4 Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**36.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*94.2 cm*
Area:	182 cm2	*P2*	*33.1 cm*
Volumen:	15,323 cm3	*P3*	*3.2 cm*
Weight:		*h (P1-P2)*	61.1 cm
Water Temp	*20 °C*	*h (P2-P3)*	29.9 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	91.0 cm

Outflow - Geotextile			
Volumen	*20.0 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*600.00 s*
Q2	0.00 l/min	*t2*	*600.00 s*
***Q** avg*	0.00 l/min	***t** avg*	600.00 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	20 cm3	20 cm3	20 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	600.00 s	600.00 s	600.00 s
h (1-2)	61.10 cm	29.90 cm	91.00 cm
***K** (20°C)*	0.005 cm/min	0.011 cm/min	0.007 cm/min
***K** (20°C)*	0.005 cm/min	0.011 cm/min	0.007 cm/min

K Summary	
***K (20°C)** P1-P3*	0.007 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.008 cm/min

Column 12
ALDOT 5

Date: 24/12/2022

K (20°C)	0.0043 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**35.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*95.2 cm*
Area:	182 cm2	*P2*	*33.2 cm*
Volumen:	15,323 cm3	*P3*	*3.2 cm*
Weight:		*h (P1-P2)*	62.0 cm
Water Temp	20 °C	*h (P2-P3)*	30.0 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	92.0 cm

Outflow - Geotextile			
Volumen	*12.0 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*600.00 s*
Q2	0.00 l/min	*t2*	*600.00 s*
Q *avg*	0.00 l/min	***t*** *avg*	600.00 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	12 cm3	12 cm3	12 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	600.00 s	600.00 s	600.00 s
h (1-2)	62.00 cm	30.00 cm	92.00 cm
K *(20°C)*	0.00 cm/min	0.007 cm/min	0.00 cm/min
K *(20°C)*	0.00 cm/min	0.007 cm/min	0.00 cm/min

K Summary	
K (20°C) *P2-P3*	0.004 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	0.005 cm/min

ALDOT 5 Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**31.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*92.2 cm*
Area:	182 cm2	*P2*	*33.2 cm*
Volumen:	15,323 cm3	*P3*	*3.2 cm*
Weight:		*h (P1-P2)*	59.0 cm
Water Temp	20 °C	*h (P2-P3)*	30.0 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	89.0 cm

Outflow - Geotextile			
Volumen	*11.5 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*600.00 s*
Q2	0.00 l/min	*t2*	*575.00 s*
Q *avg*	0.00 l/min	***t*** *avg*	587.50 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	11.5 cm3	11.5 cm3	11.5 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	587.50 s	587.50 s	587.50 s
h (1-2)	59.00 cm	30.00 cm	89.00 cm
K *(20°C)*	0.003 cm/min	0.006 cm/min	0.004 cm/min
K *(20°C)*	0.003 cm/min	0.006 cm/min	0.004 cm/min

K Summary	
K (20°C) *P2-P3*	0.004 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	0.005 cm/min

Column 17
GEORGIA 1

Date: 24/12/2022

***K** (20°C)*	0.0020 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**42.50 cm**

Sample		**Piezometers Lecture**	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*98.0 cm*
Area:	182 cm2	*P2*	*34.3 cm*
Volumen:	15,323 cm3	*P3*	*4.0 cm*
Weight:		*h (P1-P2)*	63.7 cm
Water Temp	*20 °C*	*h (P2-P3)*	30.3 cm
ν - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	94.0 cm

Outflow - Geotextile			
Volumen	*6.0 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*600.00 s*
Q2	0.00 l/min	*t2*	*600.00 s*
***Q** avg*	0.00 l/min	***t** avg*	600.00 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	6.0 cm3	6.0 cm3	6.0 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	600.00 s	600.00 s	600.00 s
h (1-2)	63.70 cm	30.30 cm	94.00 cm
***K** (20°C)*	0.0015 cm/min	0.0033 cm/min	0.0021 cm/min
***K** (20°C)*	0.0015 cm/min	0.0033 cm/min	0.0021 cm/min

K Summary	
***K (20°C)** P2-P3*	0.0021 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.0023 cm/min

GEORGIA 1 Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**38.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*95.2 cm*
Area:	182 cm2	*P2*	*34.3 cm*
Volumen:	15,323 cm3	*P3*	*4.0 cm*
Weight:		*h (P1-P2)*	60.9 cm
Water Temp	20 °C	*h (P2-P3)*	30.3 cm
v - Kinem. viscosity (10^6	*1.005*	*h (P1-P3)*	91.2 cm

Outflow - Geotextile			
Volumen	*5.5 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*600.00 s*
Q2	0.00 l/min	*t2*	*660.00 s*
Q *avg*	0.00 l/min	***t*** *avg*	630.00 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	5.5 cm3	5.5 cm3	5.5 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	630.00 s	630.00 s	630.00 s
h (1-2)	60.90 cm	30.30 cm	91.20 cm
K *(20°C)*	0.0014 cm/min	0.0028 cm/min	0.0019 cm/min
K *(20°C)*	0.0014 cm/min	0.0028 cm/min	0.0019 cm/min

K Summary	
K (20°C) *P2-P3*	0.0019 cm/min
K (20°C) *((P1-P2)+(P2-P3)+(P1-P3))/3*	0.0020 cm/min

Column 18
GEORGIA 2

Date: 26/12/2022

K (20°C)	0.0043 cm/min

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**41.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*95.5 cm*
Area:	182 cm2	*P2*	*34.4 cm*
Volumen:	15,323 cm3	*P3*	*4.1 cm*
Weight:		*h (P1-P2)*	61.1 cm
Water Temp	19 °C	*h (P2-P3)*	30.3 cm
v - Kinem. viscosity (10^6	*1.030*	*h (P1-P3)*	91.4 cm

Outflow - Geotextile			
Volumen	*14.0 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*600.00 s*
Q2	0.00 l/min	*t2*	*646.15 s*
***Q** avg*	0.00 l/min	***t** avg*	623.08 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	14.0 cm3	14.0 cm3	14.0 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	623.08 s	623.08 s	623.08 s
h (1-2)	61.10 cm	30.30 cm	91.40 cm
***K** (19°C)*	0.0036 cm/min	0.0073 cm/min	0.0049 cm/min
***K** (20°C)*	0.0037 cm/min	0.0075 cm/min	0.0050 cm/min

K Summary	
***K (20°C)** P2-P3*	0.0050 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.0054 cm/min

GEORGIA 2 Test 2

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Water Head over the sample:	**37.50 cm**

Sample		Piezometers Lecture	
Height:	*84.0 cm*	***Piezometers***	***Height***
Diameter:	15.24 cm	*P1*	*98.5 cm*
Area:	182 cm2	*P2*	*34.4 cm*
Volumen:	15,323 cm3	*P3*	*4.1 cm*
Weight:		*h (P1-P2)*	64.1 cm
Water Temp	19 °C	*h (P2-P3)*	30.3 cm
v - Kinem. viscosity (10^6	*1.030*	*h (P1-P3)*	94.4 cm

Outflow - Geotextile			
Volumen	*10.0 cm3*	***Time***	
Q1	0.00 l/min	*t1*	*600.00 s*
Q2	0.00 l/min	*t2*	*600.00 s*
***Q** avg*	0.00 l/min	***t** avg*	600.00 s

K - Permeability coefficients			
Between	**P1 - P2**	**P2 - P3**	**P1 - P3**
Q	10.0 cm3	10.0 cm3	10.0 cm3
L (Distance P1-P2)	30.00 cm	30.00 cm	60.00 cm
A	182 cm2	182 cm2	182 cm2
t	600.00 s	600.00 s	600.00 s
h (1-2)	64.10 cm	30.30 cm	94.40 cm
***K** (19°C)*	0.0026 cm/min	0.0054 cm/min	0.0035 cm/min
***K** (20°C)*	0.0026 cm/min	0.0056 cm/min	0.0036 cm/min

K Summary	
***K (20°C)** P2-P3*	0.0036 cm/min
***K (20°C)** ((P1-P2)+(P2-P3)+(P1-P3))/3*	0.0039 cm/min

PERMEABILITY TEST - AUBURN STORMWATER

AUBURN STORMWATER

Date: 5/01/2023 **Permeability test #:** **S1**

Column #: 5

Materials:

Material	Height	Compaction Grade	Moisture content
Orange sand	91.3 cm	95.8%	15.5%
Compacted with manual compactor and moisture content according to compaction curve. 24 layers.			

91.3 cm

ORANGE SAND

Dry density: 1.68 kg/m3

Compaction Grade: 95.8%

Piezometers data	
Piezometers	*Distance*
P1 - P2	29.0 cm
P2 - P3	28.5 cm
P1 - P3	57.5 cm

Start time	*12:00 p.m.*

Sample								
Hour:	*12:30 p. m.*	*1:30 p. m.*	*2:30 p. m.*	*3:30 p. m.*	*4:30 p. m.*	*6:30 p. m.*	*9:30 p. m.*	
Water Head	38.20 cm	38.20 cm	38.20 cm	38.20 cm	38.20 cm	38.20 cm	38.20 cm	
Height:	*91.3 cm*	*91.3 cm*	*91.3 cm*	*91.3 cm*	*91.3 cm*	*91.3 cm*	*91.3 cm*	
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	
Volumen:	16,654 cm3	16,654 cm3	16,654 cm3	16,654 cm3	16,654 cm3	16,654 cm3	16,654 cm3	
Dry Weight:	27,983.5 g	27,983.5 g	27,983.5 g	27,983.5 g	27,983.5 g	27,983.5 g	27,983.5 g	
Bulk Density	1,680 Kg/m3	1,680 Kg/m3	1,680 Kg/m3	1,680 Kg/m3	1,680 Kg/m3	1,680 Kg/m3	1,680 Kg/m3	
Water Temp	20 °C	19 °C	19 °C	19 °C	20 °C	19 °C	19 °C	
v - Kinem. viscosity (10^6	*1.005*	*1.030*	*1.030*	*1.030*	*1.005*	*1.030*	*1.030*	

Piezometers lectures								
Hour:	*12:30 p. m.*	*1:30 p. m.*	*2:30 p. m.*	*3:30 p. m.*	*4:30 p. m.*	*6:30 p. m.*	*9:30 p. m.*	
Piezometers	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	
P1	***90.2 cm***	***90.2 cm***	***89.5 cm***	***88.5 cm***	***87.8 cm***	***86.5 cm***	***85.4 cm***	
P2	***44.5 cm***	***44.8 cm***	***45.3 cm***	***44.2 cm***	***43.4 cm***	***42.0 cm***	***41.2 cm***	
P3	***0.4 cm***	***0.4 cm***	***0.4 cm***	***0.4 cm***	***0.4 cm***	***0.4 cm***	***0.4 cm***	
h (P1-P2)	45.7 cm	45.4 cm	44.2 cm	44.3 cm	44.4 cm	44.5 cm	44.2 cm	
h (P2-P3)	44.1 cm	44.4 cm	44.9 cm	43.8 cm	43.0 cm	41.6 cm	40.8 cm	
h (P1-P3)	89.8 cm	89.8 cm	89.1 cm	88.1 cm	87.4 cm	86.1 cm	85.0 cm	

Outflow - Geotextile								
Hour	***Time***	***Volumen***	***Time***	***Q***	***K (20°C) avg***	***K (20°C) P1-P3***	***K (20°C) P1-P2***	***K (20°C) P2-P3***
12:30 p. m.	0 hr	*940.0 cm3*	*251.0 s*	*3.7 cm3/s*	*0.79 cm/min*	*0.79 cm/min*	*0.78 cm/min*	*0.80 cm/min*
1:30 p. m.	1 hr	*450.0 cm3*	*120.0 s*	*3.8 cm3/s*	*0.81 cm/min*	*0.81 cm/min*	*0.81 cm/min*	*0.81 cm/min*
2:30 p. m.	2 hr	*438.0 cm3*	*120.0 s*	*3.7 cm3/s*	*0.79 cm/min*	*0.79 cm/min*	*0.81 cm/min*	*0.78 cm/min*
3:30 p. m.	3 hr	*665.0 cm3*	*180.0 s*	*3.7 cm3/s*	*0.81 cm/min*	*0.81 cm/min*	*0.82 cm/min*	*0.81 cm/min*
4:30 p. m.	4 hr	*662.0 cm3*	*180.0 s*	*3.7 cm3/s*	*0.80 cm/min*	*0.80 cm/min*	*0.79 cm/min*	*0.80 cm/min*
6:30 p. m.	6 hr	*640.0 cm3*	*180.0 s*	*3.6 cm3/s*	*0.80 cm/min*	*0.80 cm/min*	*0.78 cm/min*	*0.82 cm/min*
9:30 p. m.	9 hr	*608.0 cm3*	*180.0 s*	*3.4 cm3/s*	*0.77 cm/min*	*0.77 cm/min*	*0.75 cm/min*	*0.80 cm/min*

PERMEABILITY TEST - AUBURN STORMWATER

Date: 5/01/2023 **Permeability test #:** S2

Column #: 6

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	90.7 cm	97.0%	20.0%
Compacted with manual compactor and moisture content according to compaction curve. 24 layers.			

90.7 cm

ORANGE SAND

Dry density: 1.70 kg/m3

Compaction Grade: 97.0%

Piezometers data	
Piezometers	*Distance*
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Start time	***12:00 p.m.***

Sample								
Hour:	*12:30 p. m.*	*1:30 p. m.*	*2:30 p. m.*	*3:30 p. m.*	*4:30 p. m.*	*6:30 p. m.*	*9:30 p. m.*	
Water Head	38.20 cm	38.20 cm	38.20 cm	38.20 cm	38.20 cm	38.20 cm	38.20 cm	
Height:	*90.7 cm*	*90.7 cm*	*90.7 cm*	*90.7 cm*	*90.7 cm*	*90.7 cm*	*90.7 cm*	
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	
Volumen:	16,545 cm3	16,545 cm3	16,545 cm3	16,545 cm3	16,545 cm3	16,545 cm3	16,545 cm3	
Dry Weight:	28,140.0 g	28,140.0 g	28,140.0 g	28,140.0 g	28,140.0 g	28,140.0 g	28,140.0 g	
Bulk Density	1,701 Kg/m3	1,701 Kg/m3	1,701 Kg/m3	1,701 Kg/m3	1,701 Kg/m3	1,701 Kg/m3	1,701 Kg/m3	
Water Temp	20 °C	19 °C	20 °C	20 °C	20 °C	19 °C	19 °C	
v - Kinem. viscosity (10^6	*1.005*	*1.030*	*1.005*	*1.005*	*1.005*	*1.030*	*1.030*	

Piezometers lectures								
Hour:	*12:30 p. m.*	*1:30 p. m.*	*2:30 p. m.*	*3:30 p. m.*	*4:30 p. m.*	*6:30 p. m.*	*9:30 p. m.*	
Piezometers	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	
P1	*106.3 cm*	*105.2 cm*	*105.5 cm*	*105.5 cm*	*105.5 cm*	*105.5 cm*	*105.4 cm*	
P2	*66.9 cm*	*66.2 cm*	*67.4 cm*	*68.5 cm*	*68.8 cm*	*68.9 cm*	*69.2 cm*	
P3	*6.0 cm*	*5.2 cm*	*5.0 cm*	*5.0 cm*	*5.0 cm*	*4.5 cm*	*4.5 cm*	
h (P1-P2)	39.4 cm	39.0 cm	38.1 cm	37.0 cm	36.7 cm	36.6 cm	36.2 cm	
h (P2-P3)	60.9 cm	61.0 cm	62.4 cm	63.5 cm	63.8 cm	64.4 cm	64.7 cm	
h (P1-P3)	100.3 cm	100.0 cm	100.5 cm	100.5 cm	100.5 cm	101.0 cm	100.9 cm	

Outflow - Geotextile								
Hour	*Time*	*Volumen*	*Time*	*Q*	*K (20°C) avg*	*K (20°C) P1-P3*	*K (20°C) P1-P2*	*K (20°C) P2-P3*
12:30 p. m.	0 hr	*960.0 cm3*	*397.0 s*	*2.4 cm3/s*	*0.49 cm/min*	*0.48 cm/min*	*0.61 cm/min*	*0.39 cm/min*
1:30 p. m.	1 hr	*430.0 cm3*	*180.0 s*	*2.4 cm3/s*	*0.50 cm/min*	*0.48 cm/min*	*0.62 cm/min*	*0.40 cm/min*
2:30 p. m.	2 hr	*420.0 cm3*	*180.0 s*	*2.3 cm3/s*	*0.48 cm/min*	*0.46 cm/min*	*0.60 cm/min*	*0.37 cm/min*
3:30 p. m.	3 hr	*419.0 cm3*	*180.0 s*	*2.3 cm3/s*	*0.48 cm/min*	*0.46 cm/min*	*0.62 cm/min*	*0.36 cm/min*
4:30 p. m.	4 hr	*420.0 cm3*	*180.0 s*	*2.3 cm3/s*	*0.48 cm/min*	*0.46 cm/min*	*0.63 cm/min*	*0.36 cm/min*
6:30 p. m.	6 hr	*415.0 cm3*	*180.0 s*	*2.3 cm3/s*	*0.49 cm/min*	*0.46 cm/min*	*0.64 cm/min*	*0.36 cm/min*
9:30 p. m.	9 hr	*395.0 cm3*	*180.0 s*	*2.2 cm3/s*	*0.47 cm/min*	*0.44 cm/min*	*0.61 cm/min*	*0.34 cm/min*

PERMEABILITY TEST - AUBURN STORMWATER

Date: 7/01/2023 **Permeability test #:** S3

Column #: 7

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	91.7 cm	72.3%	3.3%
Loose sand with 3.3% of water. The sample reduced its height 12 cm.			

91.7 cm

ORANGE SAND

Initial Dry density:	1.27 kg/m3
Final Dry density:	1.46 kg/m3
Compaction Grade initial:	72.3%
Compaction Grade final	83.1%

Piezometers data	
Piezometers	*Distance*
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Start time	*12:40 p. m.*

Sample								
Hour:	*12:55 p. m.*	*1:55 p. m.*	*2:55 p. m.*	*3:55 p. m.*	*4:55 p. m.*	*5:55 p. m.*	*6:55 p. m.*	*9:55 p. m.*
Water Head	47.20 cm	47.20 cm	47.20 cm	47.20 cm	47.20 cm	47.20 cm	47.20 cm	47.20 cm
Height:	*91.7 cm*	*91.7 cm*	*91.7 cm*	*91.7 cm*	*91.7 cm*	*91.7 cm*	*91.7 cm*	*91.7 cm*
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2
Volumen:	16,727 cm3	16,727 cm3	16,727 cm3	16,727 cm3	16,727 cm3	16,727 cm3	16,727 cm3	16,727 cm3
Dry Weight:	21,190.0 g	21,190.0 g	21,190.0 g	21,190.0 g	21,190.0 g	21,190.0 g	21,190.0 g	21,190.0 g
Bulk Density	1,267 Kg/m3	1,267 Kg/m3	1,267 Kg/m3	1,267 Kg/m3	1,267 Kg/m3	1,267 Kg/m3	1,267 Kg/m3	1,267 Kg/m3
Water Temp	17 °C	17 °C	17 °C	17 °C	16 °C	17 °C	17 °C	17 °C
v - Kinem. viscosity (10^6	*1.082*	*1.082*	*1.082*	*1.082*	*1.110*	*1.082*	*1.082*	*1.082*

Piezometers lectures								
Hour:	*12:55 p. m.*	*1:55 p. m.*	*2:55 p. m.*	*3:55 p. m.*	*4:55 p. m.*	*5:55 p. m.*	*6:55 p. m.*	*9:55 p. m.*
Piezometers	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*
P1	***110.4 cm***	***104.0 cm***	***102.9 cm***	***103.4 cm***	***103.3 cm***	***104.2 cm***	***104.6 cm***	***105.3 cm***
P2	***65.8 cm***	***58.8 cm***	***56.9 cm***	***55.7 cm***	***54.7 cm***	***54.2 cm***	***54.0 cm***	***53.3 cm***
P3	***14.5 cm***	***12.0 cm***	***11.2 cm***	***10.8 cm***	***10.5 cm***	***10.1 cm***	***10.0 cm***	***9.5 cm***
h (P1-P2)	44.6 cm	45.2 cm	46.0 cm	47.7 cm	48.6 cm	50.0 cm	50.6 cm	52.0 cm
h (P2-P3)	51.3 cm	46.8 cm	45.7 cm	44.9 cm	44.2 cm	44.1 cm	44.0 cm	43.8 cm
h (P1-P3)	95.9 cm	92.0 cm	91.7 cm	92.6 cm	92.8 cm	94.1 cm	94.6 cm	95.8 cm

Outflow - Geotextile								
Hour	*Time*	*Volumen*	*Time*	*Q*	*K (20°C) avg*	*K (20°C) P1-P3*	*K (20°C) P1-P2*	*K (20°C) P2-P3*
12:55 p. m.	0 hr	*1,445.0 cm3*	*60.0 s*	*24.1 cm3/s*	*5.35 cm/min*	*5.34 cm/min*	*5.74 cm/min*	*4.99 cm/min*
1:55 p. m.	1 hr	*1,195.0 cm3*	*60.0 s*	*19.9 cm3/s*	*4.60 cm/min*	*4.60 cm/min*	*4.68 cm/min*	*4.52 cm/min*
2:55 p. m.	2 hr	*1,096.0 cm3*	*60.0 s*	*18.3 cm3/s*	*4.23 cm/min*	*4.23 cm/min*	*4.22 cm/min*	*4.25 cm/min*
3:55 p. m.	3 hr	*1,005.0 cm3*	*60.0 s*	*16.8 cm3/s*	*3.85 cm/min*	*3.84 cm/min*	*3.73 cm/min*	*3.96 cm/min*
4:55 p. m.	4 hr	*950.0 cm3*	*60.0 s*	*15.8 cm3/s*	*3.72 cm/min*	*3.72 cm/min*	*3.55 cm/min*	*3.90 cm/min*
5:55 p. m.	5 hr	*910.0 cm3*	*60.0 s*	*15.2 cm3/s*	*3.43 cm/min*	*3.42 cm/min*	*3.22 cm/min*	*3.65 cm/min*
6:55 p. m.	6 hr	*875.0 cm3*	*60.0 s*	*14.6 cm3/s*	*3.29 cm/min*	*3.28 cm/min*	*3.06 cm/min*	*3.52 cm/min*
9:55 p. m.	9 hr	*801.0 cm3*	*60.0 s*	*13.4 cm3/s*	*2.98 cm/min*	*2.96 cm/min*	*2.73 cm/min*	*3.24 cm/min*

PERMEABILITY TEST - AUBURN STORMWATER

Date: 1/11/2023 **Permeability test #:** **S4**

Column #: 5

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	87.9 cm	85.4%	3.3%
3 scoops per layer. 5 hits with the manual compactor per layer. Moisture content: 3.3%.			

86.7 cm

ORANGE SAND	
Initial Dry density:	1.50 kg/m3
Final Dry density:	1.52 kg/m3
Compaction Grade initial:	85.4%
Compaction Grade final	86.6%

Piezometers data	
Piezometers	*Distance*
P1 - P2	29.0 cm
P2 - P3	28.5 cm
P1 - P3	57.5 cm

Start time	*4:17 p. m.*

Sample								
Hour:	*4:30 p. m.*	*5:30 p. m.*	*6:30 p. m.*	*7:30 p. m.*	*8:30 p. m.*	*9:30 p. m.*	*10:30 p. m.*	*1:30 a. m.*
Water Head	36.00 cm	36.00 cm	36.00 cm	36.00 cm	36.00 cm	36.00 cm	36.00 cm	36.00 cm
Height:	*86.8 cm*	*86.7 cm*	*86.7 cm*	*86.7 cm*	*86.7 cm*	*86.7 cm*	*86.7 cm*	*86.7 cm*
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2
Volumen:	15,834 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3
Dry Weight:	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g
Bulk Density	1,516 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	1,518 Kg/m3
Water Temp	21 °C	17 °C	18 °C	18 °C	18 °C	18 °C	18 °C	18 °C
v - Kinem. viscosity (10^6	*0.981*	*1.082*	*1.055*	*1.055*	*1.055*	*1.055*	*1.055*	*1.055*

Piezometers lectures								
Hour:	*4:30 p. m.*	*5:30 p. m.*	*6:30 p. m.*	*7:30 p. m.*	*8:30 p. m.*	*9:30 p. m.*	*10:30 p. m.*	*1:30 a. m.*
Piezometers	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*
P1	***87.1 cm***	***80.5 cm***	***74.9 cm***	***72.5 cm***	***71.1 cm***	***70.9 cm***	***70.7 cm***	***70.3 cm***
P2	***42.5 cm***	***37.9 cm***	***34.2 cm***	***31.5 cm***	***30.3 cm***	***29.7 cm***	***29.5 cm***	***28.0 cm***
P3	***4.7 cm***	***2.9 cm***	***1.5 cm***	***1.0 cm***	***0.0 cm***	***0.0 cm***	***0.0 cm***	***0.0 cm***
h (P1-P2)	44.6 cm	42.6 cm	40.7 cm	41.0 cm	40.8 cm	41.2 cm	41.2 cm	42.3 cm
h (P2-P3)	37.8 cm	35.0 cm	32.7 cm	30.5 cm	30.3 cm	29.7 cm	29.5 cm	28.0 cm
h (P1-P3)	82.4 cm	77.6 cm	73.4 cm	71.5 cm	71.1 cm	70.9 cm	70.7 cm	70.3 cm

Outflow - Geotextile								
Hour	*Time*	*Volumen*	*Time*	*Q*	*K (20°C) avg*	*K (20°C) P1-P3*	*K (20°C) P1-P2*	*K (20°C) P2-P3*
4:30 p. m.	0 hr	*985.0 cm3*	*60.0 s*	*16.4 cm3/s*	*3.69 cm/min*	*3.68 cm/min*	*3.43 cm/min*	*3.97 cm/min*
5:30 p. m.	1 hr	*875.0 cm3*	*60.0 s*	*14.6 cm3/s*	*3.85 cm/min*	*3.83 cm/min*	*3.52 cm/min*	*4.21 cm/min*
6:30 p. m.	2 hr	*818.0 cm3*	*60.0 s*	*13.6 cm3/s*	*3.71 cm/min*	*3.69 cm/min*	*3.35 cm/min*	*4.10 cm/min*
7:30 p. m.	3 hr	*774.0 cm3*	*60.0 s*	*12.9 cm3/s*	*3.63 cm/min*	*3.58 cm/min*	*3.15 cm/min*	*4.16 cm/min*
8:30 p. m.	4 hr	*740.0 cm3*	*60.0 s*	*12.3 cm3/s*	*3.49 cm/min*	*3.44 cm/min*	*3.03 cm/min*	*4.01 cm/min*
9:30 p. m.	5 hr	*727.0 cm3*	*60.0 s*	*12.1 cm3/s*	*3.45 cm/min*	*3.39 cm/min*	*2.94 cm/min*	*4.01 cm/min*
10:30 p. m.	6 hr	*707.0 cm3*	*60.0 s*	*11.8 cm3/s*	*3.37 cm/min*	*3.31 cm/min*	*2.86 cm/min*	*3.93 cm/min*
1:30 a. m.	9 hr	*677.0 cm3*	*60.0 s*	*11.3 cm3/s*	*3.27 cm/min*	*3.19 cm/min*	*2.67 cm/min*	*3.97 cm/min*

PERMEABILITY TEST - AUBURN STORMWATER

Date: 1/11/2023 **Permeability test #:** S5

Column #: 6

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	89.7 cm	83.7%	3.3%
3 scoops per layer. 5 hits with manual compactor per layer. Moisture content: 3.3%.			

87.9 cm

ORANGE SAND	
Initial Dry density:	1.47 kg/m3
Final Dry density:	1.50 kg/m3
Compaction Grade initial:	83.7%
Compaction Grade final	85.4%

Piezometers data	
Piezometers	*Distance*
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Start time	*4:17 p. m.*

Sample								
Hour:	*4:30 p. m.*	*5:30 p. m.*	*6:30 p. m.*	*7:30 p. m.*	*8:30 p. m.*	*9:30 p. m.*	*10:30 p. m.*	*1:30 a. m.*
Water Head	36.70 cm	36.70 cm	36.70 cm	36.70 cm	36.70 cm	36.70 cm	36.70 cm	36.70 cm
Height:	*88.4 cm*	*88.3 cm*	*87.9 cm*	*87.9 cm*	*87.9 cm*	*87.9 cm*	*87.9 cm*	*87.9 cm*
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2
Volumen:	16,125 cm3	16,107 cm3	16,034 cm3	16,034 cm3	16,034 cm3	16,034 cm3	16,034 cm3	16,034 cm3
Dry Weight:	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g
Bulk Density	1,488 Kg/m3	1,490 Kg/m3	1,497 Kg/m3	1,497 Kg/m3	1,497 Kg/m3	1,497 Kg/m3	1,497 Kg/m3	1,497 Kg/m3
Water Temp	19 °C	16 °C	17 °C	17 °C	17 °C	18 °C	17 °C	17 °C
v - Kinem. viscosity (10^6	*1.030*	*1.110*	*1.082*	*1.082*	*1.082*	*1.055*	*1.082*	*1.082*

Piezometers lectures								
Hour:	*4:30 p. m.*	*5:30 p. m.*	*6:30 p. m.*	*7:30 p. m.*	*8:30 p. m.*	*9:30 p. m.*	*10:30 p. m.*	*1:30 a. m.*
Piezometers	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*
P1	*93.0 cm*	*89.7 cm*	*84.0 cm*	*80.4 cm*	*77.7 cm*	*76.5 cm*	*75.4 cm*	*77.1 cm*
P2	*43.8 cm*	*41.4 cm*	*37.5 cm*	*35.0 cm*	*34.0 cm*	*34.0 cm*	*34.0 cm*	*34.0 cm*
P3	*4.0 cm*	*4.0 cm*	*4.0 cm*	*4.0 cm*	*4.0 cm*	*4.0 cm*	*4.0 cm*	*4.0 cm*
h (P1-P2)	49.2 cm	48.3 cm	46.5 cm	45.4 cm	43.7 cm	42.5 cm	41.4 cm	43.1 cm
h (P2-P3)	39.8 cm	37.4 cm	33.5 cm	31.0 cm	30.0 cm	30.0 cm	30.0 cm	30.0 cm
h (P1-P3)	89.0 cm	85.7 cm	80.0 cm	76.4 cm	73.7 cm	72.5 cm	71.4 cm	73.1 cm

Outflow - Geotextile								
Hour	*Time*	*Volumen*	*Time*	*Q*	*K (20°C) avg*	*K (20°C) P1-P3*	*K (20°C) P1-P2*	*K (20°C) P2-P3*
4:30 p. m.	0 hr	*845.0 cm3*	*60.0 s*	*14.1 cm3/s*	*3.22 cm/min*	*3.20 cm/min*	*2.89 cm/min*	*3.58 cm/min*
5:30 p. m.	1 hr	*785.0 cm3*	*60.0 s*	*13.1 cm3/s*	*3.36 cm/min*	*3.33 cm/min*	*2.95 cm/min*	*3.81 cm/min*
6:30 p. m.	2 hr	*732.0 cm3*	*60.0 s*	*12.2 cm3/s*	*3.30 cm/min*	*3.24 cm/min*	*2.79 cm/min*	*3.87 cm/min*
7:30 p. m.	3 hr	*675.0 cm3*	*60.0 s*	*11.3 cm3/s*	*3.21 cm/min*	*3.13 cm/min*	*2.63 cm/min*	*3.86 cm/min*
8:30 p. m.	4 hr	*645.0 cm3*	*60.0 s*	*10.8 cm3/s*	*3.17 cm/min*	*3.10 cm/min*	*2.61 cm/min*	*3.81 cm/min*
9:30 p. m.	5 hr	*615.0 cm3*	*60.0 s*	*10.3 cm3/s*	*2.99 cm/min*	*2.93 cm/min*	*2.50 cm/min*	*3.54 cm/min*
10:30 p. m.	6 hr	*592.0 cm3*	*60.0 s*	*9.9 cm3/s*	*2.99 cm/min*	*2.94 cm/min*	*2.53 cm/min*	*3.49 cm/min*
1:30 a. m.	9 hr	*555.0 cm3*	*60.0 s*	*9.3 cm3/s*	*2.75 cm/min*	*2.69 cm/min*	*2.28 cm/min*	*3.28 cm/min*

PERMEABILITY TEST - AUBURN STORMWATER

Date: 1/18/2023 **Permeability test #:** S6

Column #: 5

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	89.0 cm	86.5%	15.0%
8 layers, each layer compacted with the manual compactor			

88.9 cm

ORANGE SAND	
Initial Dry density:	1.52 kg/m3
Final Dry density:	1.52 kg/m3
Compaction Grade initial:	86.5%
Compaction Grade final	86.6%

Piezometers data	
Piezometers	*Distance*
P1 - P2	29.0 cm
P2 - P3	28.5 cm
P1 - P3	57.5 cm

Start time	*10:50 a. m.*

Sample								
Hour:	*11:15 a. m.*	*12:15 p. m.*	*1:15 p. m.*	*2:15 p. m.*	*3:15 p. m.*	*4:15 p. m.*	*5:15 p. m.*	
Water Head	36.00 cm	36.00 cm	36.00 cm	36.00 cm	36.00 cm	36.00 cm	36.00 cm	
Height:	*89.0 cm*	*88.9 cm*	*88.9 cm*	*88.9 cm*	*88.9 cm*	*88.9 cm*	*88.9 cm*	
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	
Volumen:	16,235 cm3	16,217 cm3	16,217 cm3	16,217 cm3	16,217 cm3	16,217 cm3	16,217 cm3	
Dry Weight:	24,622.0 g	24,622.0 g	24,622.0 g	24,622.0 g	24,622.0 g	24,622.0 g	24,622.0 g	
Bulk Density	1,517 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	1,518 Kg/m3	
Water Temp	18 °C	19 °C	18 °C	19 °C	18 °C	19 °C	18 °C	
v - Kinem. viscosity (10^6	*1.055*	*1.030*	*1.055*	*1.030*	*1.055*	*1.030*	*1.055*	

Piezometers lectures								
Hour:	*11:15 a. m.*	*12:15 p. m.*	*1:15 p. m.*	*2:15 p. m.*	*3:15 p. m.*	*4:15 p. m.*	*5:15 p. m.*	
Piezometers	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*	
P1	***91.4 cm***	***92.5 cm***	***92.4 cm***	***92.8 cm***	***92.5 cm***	***92.4 cm***	***92.0 cm***	
P2	***58.0 cm***	***59.8 cm***	***60.0 cm***	***62.0 cm***	***62.5 cm***	***63.0 cm***	***63.0 cm***	
P3	***0.0 cm***	***0.0 cm***	***0.0 cm***	***0.0 cm***	***0.0 cm***	***0.0 cm***	***0.0 cm***	
h (P1-P2)	33.4 cm	32.7 cm	32.4 cm	30.8 cm	30.0 cm	29.4 cm	29.0 cm	
h (P2-P3)	58.0 cm	59.8 cm	60.0 cm	62.0 cm	62.5 cm	63.0 cm	63.0 cm	
h (P1-P3)	91.4 cm	92.5 cm	92.4 cm	92.8 cm	92.5 cm	92.4 cm	92.0 cm	

Outflow - Geotextile								
Hour	*Time*	*Volumen*	*Time*	*Q*	*K (20°C) avg*	*K (20°C) P1-P3*	*K (20°C) P1-P2*	*K (20°C) P2-P3*
11:15 a. m.	0 hr	*123.0 cm3*	*60.0 s*	*2.1 cm3/s*	*0.47 cm/min*	*0.45 cm/min*	*0.61 cm/min*	*0.35 cm/min*
12:15 p. m.	1 hr	*115.0 cm3*	*60.0 s*	*1.9 cm3/s*	*0.43 cm/min*	*0.40 cm/min*	*0.57 cm/min*	*0.31 cm/min*
1:15 p. m.	2 hr	*115.0 cm3*	*60.0 s*	*1.9 cm3/s*	*0.44 cm/min*	*0.41 cm/min*	*0.59 cm/min*	*0.31 cm/min*
2:15 p. m.	3 hr	*113.0 cm3*	*60.0 s*	*1.9 cm3/s*	*0.43 cm/min*	*0.39 cm/min*	*0.60 cm/min*	*0.29 cm/min*
3:15 p. m.	4 hr	*110.0 cm3*	*60.0 s*	*1.8 cm3/s*	*0.43 cm/min*	*0.39 cm/min*	*0.61 cm/min*	*0.29 cm/min*
4:15 p. m.	5 hr	*111.0 cm3*	*60.0 s*	*1.9 cm3/s*	*0.43 cm/min*	*0.39 cm/min*	*0.62 cm/min*	*0.28 cm/min*
5:15 p. m.	6 hr	*110.0 cm3*	*60.0 s*	*1.8 cm3/s*	*0.44 cm/min*	*0.40 cm/min*	*0.63 cm/min*	*0.29 cm/min*

PERMEABILITY TEST - AUBURN STORMWATER

Date: 1/18/2023 **Permeability test #:** **S7**

Column #: 6

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	91.2 cm	84.5%	15.0%
8 layers, each layer compacted with the manual compactor			

91.1 cm

ORANGE SAND

Initial Dry density:	1.48 kg/m3
Final Dry density:	1.48 kg/m3
Compaction Grade initial:	84.4%
Compaction Grade final	84.5%

Piezometers data	
Piezometers	*Distance*
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Start time	***10:50 a. m.***

Sample								
Hour:	***11:15 a. m.***	***12:15 p. m.***	***1:15 p. m.***	***2:15 p. m.***	***3:15 p. m.***	***4:15 p. m.***	***5:15 p. m.***	
Water Head	35.50 cm	35.50 cm	35.50 cm	35.50 cm	35.50 cm	35.50 cm	35.50 cm	
Height:	*91.2 cm*	*91.1 cm*	*91.1 cm*	*91.1 cm*	*91.1 cm*	*91.1 cm*	*91.1 cm*	
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	
Volumen:	16,636 cm3	16,618 cm3	16,618 cm3	16,618 cm3	16,618 cm3	16,618 cm3	16,618 cm3	
Dry Weight:	24,622.0 g	24,622.0 g	24,622.0 g	24,622.0 g	24,622.0 g	24,622.0 g	24,622.0 g	
Bulk Density	1,480 Kg/m3	1,482 Kg/m3	1,482 Kg/m3	1,482 Kg/m3	1,482 Kg/m3	1,482 Kg/m3	1,482 Kg/m3	
Water Temp	17 °C	18 °C	17 °C	18 °C	18 °C	19 °C	18 °C	
v - Kinem. viscosity (10^6	*1.082*	*1.055*	*1.082*	*1.055*	*1.055*	*1.030*	*1.055*	

Piezometers lectures								
Hour:	***11:15 a. m.***	***12:15 p. m.***	***1:15 p. m.***	***2:15 p. m.***	***3:15 p. m.***	***4:15 p. m.***	***5:15 p. m.***	
Piezometers	***Height***	***Height***	***Height***	***Height***	***Height***	***Height***	***Height***	
P1	***99.0 cm***	***101.0 cm***	***100.6 cm***	***100.7 cm***	***99.9 cm***	***99.8 cm***	***99.5 cm***	
P2	***52.0 cm***	***53.8 cm***	***53.5 cm***	***54.8 cm***	***54.3 cm***	***54.0 cm***	***53.0 cm***	
P3	***14.5 cm***	***16.9 cm***	***16.9 cm***	***16.0 cm***	***15.8 cm***	***15.9 cm***	***16.0 cm***	
h (P1-P2)	47.0 cm	47.2 cm	47.1 cm	45.9 cm	45.6 cm	45.8 cm	46.5 cm	
h (P2-P3)	37.5 cm	36.9 cm	36.6 cm	38.8 cm	38.5 cm	38.1 cm	37.0 cm	
h (P1-P3)	84.5 cm	84.1 cm	83.7 cm	84.7 cm	84.1 cm	83.9 cm	83.5 cm	

Outflow - Geotextile								
Hour	***Time***	***Volumen***	***Time***	***Q***	***K (20°C) avg***	***K (20°C) P1-P3***	***K (20°C) P1-P2***	***K (20°C) P2-P3***
11:15 a. m.	0 hr	*128.0 cm3*	*60.0 s*	*2.1 cm3/s*	*0.54 cm/min*	*0.54 cm/min*	*0.48 cm/min*	*0.60 cm/min*
12:15 p. m.	1 hr	*125.0 cm3*	*60.0 s*	*2.1 cm3/s*	*0.52 cm/min*	*0.51 cm/min*	*0.46 cm/min*	*0.58 cm/min*
1:15 p. m.	2 hr	*123.0 cm3*	*60.0 s*	*2.1 cm3/s*	*0.53 cm/min*	*0.52 cm/min*	*0.46 cm/min*	*0.60 cm/min*
2:15 p. m.	3 hr	*125.0 cm3*	*60.0 s*	*2.1 cm3/s*	*0.51 cm/min*	*0.51 cm/min*	*0.47 cm/min*	*0.56 cm/min*
3:15 p. m.	4 hr	*122.0 cm3*	*60.0 s*	*2.0 cm3/s*	*0.50 cm/min*	*0.50 cm/min*	*0.46 cm/min*	*0.55 cm/min*
4:15 p. m.	5 hr	*122.0 cm3*	*60.0 s*	*2.0 cm3/s*	*0.49 cm/min*	*0.49 cm/min*	*0.45 cm/min*	*0.54 cm/min*
5:15 p. m.	6 hr	*120.0 cm3*	*60.0 s*	*2.0 cm3/s*	*0.50 cm/min*	*0.50 cm/min*	*0.45 cm/min*	*0.56 cm/min*

PERMEABILITY TEST - AUBURN STORMWATER

Date: 21/01/2023 **Permeability test #:** S8

Column #: 8

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	84.0 cm	85.6%	3.0%
2 equal layers - Compacted/Consolidated by a water column			

84.0 cm

ORANGE SAND

Initial Dry density:	1.50 kg/m3
Final Dry density:	1.50 kg/m3
Compaction Grade initial:	85.6%
Compaction Grade final	85.6%

Piezometers data	
Piezometers	*Distance*
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Start time	***12:40 p. m.***

Sample								
Hour:	***1:00 p. m.***	***2:00 p. m.***	***3:00 p. m.***	***7:00 p. m.***	***10:00 p. m.***			
Water Head	35.00 cm	35.00 cm	35.00 cm	35.00 cm	35.00 cm			
Height:	*84.0 cm*	*84.0 cm*	*84.0 cm*	*84.0 cm*	*84.0 cm*			
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm			
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2			
Volumen:	15,323 cm3	15,323 cm3	15,323 cm3	15,323 cm3	15,323 cm3			
Dry Weight:	23,000.0 g	23,000.0 g	23,000.0 g	23,000.0 g	23,000.0 g			
Bulk Density	1,501 Kg/m3	1,501 Kg/m3	1,501 Kg/m3	1,501 Kg/m3	1,501 Kg/m3			
Water Temp	24 °C	19 °C	18 °C	18 °C	18 °C			
v - Kinem. viscosity (10^6	*0.913*	*1.030*	*1.055*	*1.055*	*1.055*			

Piezometers lectures								
Hour:	***1:00 p. m.***	***2:00 p. m.***	***3:00 p. m.***	***7:00 p. m.***	***10:00 p. m.***			
Piezometers	***Height***	***Height***	***Height***	***Height***	***Height***			
P1	***97.5 cm***	***95.0 cm***	***93.0 cm***	***91.6 cm***	***91.7 cm***			
P2	***56.2 cm***	***54.8 cm***	***52.8 cm***	***52.9 cm***	***52.3 cm***			
P3	***12.2 cm***	***11.8 cm***	***11.0 cm***	***11.1 cm***	***11.5 cm***			
h (P1-P2)	41.3 cm	40.2 cm	40.2 cm	38.7 cm	39.4 cm			
h (P2-P3)	44.0 cm	43.0 cm	41.8 cm	41.8 cm	40.8 cm			
h (P1-P3)	85.3 cm	83.2 cm	82.0 cm	80.5 cm	80.2 cm			

Outflow - Geotextile								
Hour	***Time***	***Volumen***	***Time***	***Q***	***K (20°C) avg***	***K (20°C) P1-P3***	***K (20°C) P1-P2***	***K (20°C) P2-P3***
1:00 p. m.	0 hr	*695.0 cm3*	*60.0 s*	*11.6 cm3/s*	*2.44 cm/min*	*2.43 cm/min*	*2.51 cm/min*	*2.36 cm/min*
2:00 p. m.	1 hr	*637.0 cm3*	*60.0 s*	*10.6 cm3/s*	*2.58 cm/min*	*2.58 cm/min*	*2.67 cm/min*	*2.50 cm/min*
3:00 p. m.	2 hr	*625.0 cm3*	*60.0 s*	*10.4 cm3/s*	*2.63 cm/min*	*2.63 cm/min*	*2.68 cm/min*	*2.58 cm/min*
7:00 p. m.	6 hr	*550.0 cm3*	*60.0 s*	*9.2 cm3/s*	*2.36 cm/min*	*2.36 cm/min*	*2.45 cm/min*	*2.27 cm/min*
10:00 p. m.	9 hr	*522.0 cm3*	*60.0 s*	*8.7 cm3/s*	*2.25 cm/min*	*2.25 cm/min*	*2.29 cm/min*	*2.21 cm/min*

PERMEABILITY TEST - AUBURN STORMWATER

Date: 21/01/2023 **Permeability test #:** S9

Column #: 9

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	84.4 cm	85.2%	3.0%
3 equal layers - Compacted/Consolidated by a water column			

84.4 cm

ORANGE SAND	
Initial Dry density:	1.49 kg/m3
Final Dry density:	1.49 kg/m3
Compaction Grade initial:	85.2%
Compaction Grade final	85.2%

Piezometers data	
Piezometers	*Distance*
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Start time	*12:40 p. m.*

Sample								
Hour:	*1:00 p. m.*	*2:00 p. m.*	*3:00 p. m.*	*7:00 p. m.*	*10:00 p. m.*			
Water Head	35.00 cm	35.00 cm	35.00 cm	35.00 cm	35.00 cm			
Height:	*84.4 cm*	*84.4 cm*	*84.4 cm*	*84.4 cm*	*84.4 cm*			
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm			
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2			
Volumen:	15,396 cm3	15,396 cm3	15,396 cm3	15,396 cm3	15,396 cm3			
Dry Weight:	23,000.0 g	23,000.0 g	23,000.0 g	23,000.0 g	23,000.0 g			
Bulk Density	1,494 Kg/m3	1,494 Kg/m3	1,494 Kg/m3	1,494 Kg/m3	1,494 Kg/m3			
Water Temp	22 °C	18 °C	17 °C	17 °C	17 °C			
v - Kinem. viscosity (10^6	*0.957*	*1.055*	*1.082*	*1.082*	*1.082*			

Piezometers lectures								
Hour:	*1:00 p. m.*	*2:00 p. m.*	*3:00 p. m.*	*7:00 p. m.*	*10:00 p. m.*			
Piezometers	*Height*	*Height*	*Height*	*Height*	*Height*			
P1	***97.1 cm***	***95.4 cm***	***93.6 cm***	***91.3 cm***	***91.0 cm***			
P2	***56.8 cm***	***56.5 cm***	***54.6 cm***	***53.7 cm***	***52.3 cm***			
P3	***17.9 cm***	***18.5 cm***	***17.5 cm***	***17.5 cm***	***18.3 cm***			
h (P1-P2)	40.3 cm	38.9 cm	39.0 cm	37.6 cm	38.7 cm			
h (P2-P3)	38.9 cm	38.0 cm	37.1 cm	36.2 cm	34.0 cm			
h (P1-P3)	79.2 cm	76.9 cm	76.1 cm	73.8 cm	72.7 cm			

Outflow - Geotextile								
Hour	*Time*	*Volumen*	*Time*	*Q*	*K (20°C) avg*	*K (20°C) P1-P3*	*K (20°C) P1-P2*	*K (20°C) P2-P3*
1:00 p. m.	0 hr	*701.0 cm3*	*60.0 s*	*11.7 cm3/s*	*2.77 cm/min*	*2.77 cm/min*	*2.72 cm/min*	*2.82 cm/min*
2:00 p. m.	1 hr	*647.0 cm3*	*60.0 s*	*10.8 cm3/s*	*2.91 cm/min*	*2.91 cm/min*	*2.87 cm/min*	*2.94 cm/min*
3:00 p. m.	2 hr	*638.0 cm3*	*60.0 s*	*10.6 cm3/s*	*2.97 cm/min*	*2.97 cm/min*	*2.90 cm/min*	*3.04 cm/min*
7:00 p. m.	6 hr	*550.0 cm3*	*60.0 s*	*9.2 cm3/s*	*2.64 cm/min*	*2.64 cm/min*	*2.59 cm/min*	*2.69 cm/min*
10:00 p. m.	9 hr	*522.0 cm3*	*60.0 s*	*8.7 cm3/s*	*2.55 cm/min*	*2.54 cm/min*	*2.39 cm/min*	*2.72 cm/min*

PERMEABILITY TEST - AUBURN STORMWATER

Date: 25/01/2023 **Permeability test #:** S10

Column #: 8

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	87.9 cm	85.4%	3.0%
1 layer - Compacted/Consolidated by a water column			

87.9 cm

ORANGE SAND	
Initial Dry density:	1.50 kg/m3
Final Dry density:	1.50 kg/m3
Compaction Grade initial:	85.4%
Compaction Grade final	85.4%

Piezometers data	
Piezometers	*Distance*
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Start time	*1:35 p. m.*

Sample								
Hour:	*1:45 p. m.*	*2:45 p. m.*	*3:45 p. m.*	*4:45 p. m.*	*7:45 p. m.*	*10:45 p. m.*		
Water Head	35.50 cm	35.50 cm	35.50 cm	35.50 cm	35.50 cm	35.50 cm		
Height:	87.9 cm	87.9 cm	87.9 cm	87.9 cm	87.9 cm	87.9 cm		
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm		
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2		
Volumen:	16,034 cm3	16,034 cm3	16,034 cm3	16,034 cm3	16,034 cm3	16,034 cm3		
Dry Weight:	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g		
Bulk Density	1,497 Kg/m3	1,497 Kg/m3	1,497 Kg/m3	1,497 Kg/m3	1,497 Kg/m3	1,497 Kg/m3		
Water Temp	18 °C	18 °C	19 °C	18 °C	18 °C	19 °C		
v - Kinem. viscosity (10^6	1.055	1.055	1.030	1.055	1.055	1.030		

Piezometers lectures								
Hour:	*1:45 p. m.*	*2:45 p. m.*	*3:45 p. m.*	*4:45 p. m.*	*7:45 p. m.*	*10:45 p. m.*		
Piezometers	*Height*	*Height*	*Height*	*Height*	*Height*	*Height*		
P1	97.9 cm	95.6 cm	94.0 cm	92.5 cm	90.6 cm	90.7 cm		
P2	60.8 cm	60.8 cm	59.7 cm	58.5 cm	58.0 cm	58.8 cm		
P3	11.5 cm	11.9 cm	12.0 cm	11.3 cm	11.3 cm	11.5 cm		
h (P1-P2)	37.1 cm	34.8 cm	34.3 cm	34.0 cm	32.6 cm	31.9 cm		
h (P2-P3)	49.3 cm	48.9 cm	47.7 cm	47.2 cm	46.7 cm	47.3 cm		
h (P1-P3)	86.4 cm	83.7 cm	82.0 cm	81.2 cm	79.3 cm	79.2 cm		

Outflow - Geotextile								
Hour	*Time*	*Volumen*	*Time*	*Q*	*K (20°C) avg*	*K (20°C) P1-P3*	*K (20°C) P1-P2*	*K (20°C) P2-P3*
1:45 p. m.	0 hr	575.0 cm3	60.0 s	9.6 cm3/s	2.33 cm/min	2.30 cm/min	2.68 cm/min	2.01 cm/min
2:45 p. m.	1 hr	555.0 cm3	60.0 s	9.3 cm3/s	2.33 cm/min	2.29 cm/min	2.75 cm/min	1.96 cm/min
3:45 p. m.	2 hr	555.0 cm3	60.0 s	9.3 cm3/s	2.32 cm/min	2.28 cm/min	2.73 cm/min	1.96 cm/min
4:45 p. m.	3 hr	536.0 cm3	60.0 s	8.9 cm3/s	2.32 cm/min	2.28 cm/min	2.72 cm/min	1.96 cm/min
7:45 p. m.	6 hr	510.0 cm3	60.0 s	8.5 cm3/s	2.27 cm/min	2.22 cm/min	2.70 cm/min	1.89 cm/min
10:45 p. m.	9 hr	496.0 cm3	60.0 s	8.3 cm3/s	2.17 cm/min	2.11 cm/min	2.62 cm/min	1.77 cm/min

PERMEABILITY TEST - AUBURN STORMWATER

Date: 25/01/2023 **Permeability test #:** **S11**

Column #: 9

Materials:

Material	Height	Compaction Grade	Moisture content
Orange Sand	87.8 cm	85.5%	3.0%
1 layer - Compacted/Consolidated by a water column			

87.8 cm

ORANGE SAND	
Initial Dry density:	1.50 kg/m3
Final Dry density:	1.50 kg/m3
Compaction Grade initial:	85.5%
Compaction Grade final	85.5%

Piezometers data	
Piezometers	*Distance*
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Start time	***12:40 p. m.***

Sample								
Hour:	***1:45 p. m.***	***2:45 p. m.***	***3:45 p. m.***	***4:45 p. m.***	***7:45 p. m.***	***10:45 p. m.***		
Water Head	35.50 cm	35.50 cm	35.50 cm	35.50 cm	35.50 cm	35.50 cm		
Height:	*87.8 cm*	*87.8 cm*	*87.8 cm*	*87.8 cm*	*87.8 cm*	*87.8 cm*		
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm		
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2		
Volumen:	16,016 cm3	16,016 cm3	16,016 cm3	16,016 cm3	16,016 cm3	16,016 cm3		
Dry Weight:	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g	24,000.0 g		
Bulk Density	1,499 Kg/m3	1,499 Kg/m3	1,499 Kg/m3	1,499 Kg/m3	1,499 Kg/m3	1,499 Kg/m3		
Water Temp	18 °C	18 °C	19 °C	18 °C	18 °C	19 °C		
v - Kinem. viscosity (10^6	*1.055*	*1.055*	*1.030*	*1.055*	*1.055*	*1.030*		

Piezometers lectures								
Hour:	***1:45 p. m.***	***2:45 p. m.***	***3:45 p. m.***	***4:45 p. m.***	***7:45 p. m.***	***10:45 p. m.***		
Piezometers	***Height***	***Height***	***Height***	***Height***	***Height***	***Height***		
P1	***97.1 cm***	***94.4 cm***	***92.4 cm***	***91.5 cm***	***90.6 cm***	***90.6 cm***		
P2	***54.2 cm***	***53.5 cm***	***51.8 cm***	***51.0 cm***	***50.3 cm***	***50.2 cm***		
P3	***8.4 cm***	***7.8 cm***	***7.5 cm***	***6.8 cm***	***6.5 cm***	***6.5 cm***		
h (P1-P2)	42.9 cm	40.9 cm	40.6 cm	40.5 cm	40.3 cm	40.4 cm		
h (P2-P3)	45.8 cm	45.7 cm	44.3 cm	44.2 cm	43.8 cm	43.7 cm		
h (P1-P3)	88.7 cm	86.6 cm	84.9 cm	84.7 cm	84.1 cm	84.1 cm		

Outflow - Geotextile								
Hour	***Time***	***Volumen***	***Time***	***Q***	***K (20°C) avg***	***K (20°C) P1-P3***	***K (20°C) P1-P2***	***K (20°C) P2-P3***
1:45 p. m.	0 hr	*571.0 cm3*	*60.0 s*	*9.5 cm3/s*	*2.22 cm/min*	*2.22 cm/min*	*2.30 cm/min*	*2.15 cm/min*
2:45 p. m.	1 hr	*595.0 cm3*	*60.0 s*	*9.9 cm3/s*	*2.38 cm/min*	*2.37 cm/min*	*2.51 cm/min*	*2.25 cm/min*
3:45 p. m.	2 hr	*600.0 cm3*	*60.0 s*	*10.0 cm3/s*	*2.39 cm/min*	*2.38 cm/min*	*2.49 cm/min*	*2.28 cm/min*
4:45 p. m.	3 hr	*577.0 cm3*	*60.0 s*	*9.6 cm3/s*	*2.36 cm/min*	*2.35 cm/min*	*2.46 cm/min*	*2.25 cm/min*
7:45 p. m.	6 hr	*545.0 cm3*	*60.0 s*	*9.1 cm3/s*	*2.24 cm/min*	*2.24 cm/min*	*2.33 cm/min*	*2.15 cm/min*
10:45 p. m.	9 hr	*535.0 cm3*	*60.0 s*	*8.9 cm3/s*	*2.15 cm/min*	*2.14 cm/min*	*2.23 cm/min*	*2.06 cm/min*

Column 5 10:05 a. m. Start

Loose Sand

K (20°C)	S12

Piezometers data	
Piezometers	*Distance*
P1 - P2	29.0 cm
P2 - P3	28.5 cm
P1 - P3	57.5 cm

Sample																	
Hour:	10:25 a. m.	10:30 a. m.	11:30 a. m.	12:30 p. m.	3:30 p. m.	4:30 p. m.	5:30 p. m.	6:30 p. m.	7:30 p. m.	8:30 a. m.	9:30 a. m.	6:30 p. m.	7:30 p. m.	8:30 a. m.	11:30 a. m.	6:30 p. m.	10:30 a. m.
Water Head	41.90 cm	42.20 cm	42.20 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm	42.40 cm
Height:	86.7 cm	86.4 cm	86.4 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm	86.2 cm
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2
Volumen:	15,815 cm3	15,761 cm3	15,761 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3	15,724 cm3
Dry Weight:	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g
Bulk Density	1,554 Kg/m3	1,559 Kg/m3	1,559 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3	1,563 Kg/m3
Water Temp	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C
v - Kinem. viscosity (10^6	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030
	88.6%																89.1%

Piezometers lectures																	
Hour:	10:25 a. m.	10:30 a. m.	11:30 a. m.	12:30 p. m.	3:30 p. m.	4:30 p. m.	5:30 p. m.	6:30 p. m.	7:30 p. m.	8:30 a. m.	9:30 a. m.	6:30 p. m.	7:30 p. m.	8:30 a. m.	11:30 a. m.	6:30 p. m.	10:30 a. m.
Piezometers	Height	Height	Height	Height	Height	Height	Height	Height	Height	Height	Height	Height	Height	Height	Height	Height	Height
P1	94.8 cm	94.0 cm	92.7 cm	91.0 cm	86.2 cm	85.8 cm	85.5 cm	85.9 cm	86.7 cm	86.6 cm	87.2 cm	86.2 cm	85.7 cm	84.1 cm	84.3 cm	83.0 cm	82.1 cm
P2	58.7 cm	58.7 cm	57.9 cm	57.0 cm	53.6 cm	52.7 cm	51.8 cm	52.0 cm	52.9 cm	51.7 cm	51.8 cm	53.0 cm	52.6 cm	49.7 cm	49.2 cm	49.9 cm	48.0 cm
P3	15.2 cm	15.2 cm	15.0 cm	14.8 cm	14.5 cm	14.6 cm	14.7 cm	15.0 cm	15.5 cm	14.7 cm	18.1 cm	18.2 cm	17.8 cm	16.6 cm	16.9 cm	16.5 cm	15.4 cm
h (P1-P2)	36.1 cm	35.3 cm	34.8 cm	34.0 cm	32.6 cm	33.1 cm	33.7 cm	33.9 cm	33.8 cm	34.9 cm	35.4 cm	33.2 cm	33.1 cm	34.4 cm	35.1 cm	33.1 cm	34.1 cm
h (P2-P3)	43.5 cm	43.5 cm	42.9 cm	42.2 cm	39.1 cm	38.1 cm	37.1 cm	37.0 cm	37.4 cm	37.0 cm	33.7 cm	34.8 cm	34.8 cm	33.1 cm	32.3 cm	33.4 cm	32.6 cm
h (P1-P3)	79.6 cm	78.8 cm	77.7 cm	76.2 cm	71.7 cm	71.2 cm	70.8 cm	70.9 cm	71.2 cm	71.9 cm	69.1 cm	68.0 cm	67.9 cm	67.5 cm	67.4 cm	66.5 cm	66.7 cm

		Outflow - Geotextile						
		Volumen	*Time*	*Q*	*K (20°c) avg*	*K P1-P3*	*K P1-P2*	*K P2-P3*
0 hr	**10:30 a. m.**	2,000.0 cm3	135.8 s	14.7 cm3/s	3.65 cm/min	3.53 cm/min	3.98 cm/min	3.17 cm/min
1 hr	**11:30 a. m.**	2,000.0 cm3	148.8 s	13.4 cm3/s	3.38 cm/min	3.27 cm/min	3.68 cm/min	2.94 cm/min
2 hr	**12:30 p. m.**	2,000.0 cm3	153.3 s	13.0 cm3/s	3.35 cm/min	3.24 cm/min	3.66 cm/min	2.90 cm/min
5 hr	**3:30 p. m.**	2,000.0 cm3	175.0 s	11.4 cm3/s	3.11 cm/min	3.01 cm/min	3.34 cm/min	2.74 cm/min
6 hr	**4:30 p. m.**	2,000.0 cm3	181.3 s	11.0 cm3/s	3.02 cm/min	2.93 cm/min	3.18 cm/min	2.71 cm/min
7 hr	**5:30 p. m.**	2,000.0 cm3	190.0 s	10.5 cm3/s	2.89 cm/min	2.81 cm/min	2.98 cm/min	2.66 cm/min
8 hr	**6:30 p. m.**	2,000.0 cm3	195.3 s	10.2 cm3/s	2.80 cm/min	2.73 cm/min	2.88 cm/min	2.59 cm/min
9 hr	**7:30 p. m.**	2,000.0 cm3	198.8 s	10.1 cm3/s	2.74 cm/min	2.67 cm/min	2.84 cm/min	2.52 cm/min
22 hr	**8:30 a. m.**	2,000.0 cm3	224.2 s	8.9 cm3/s	2.41 cm/min	2.35 cm/min	2.44 cm/min	2.26 cm/min
23 hr	**9:30 a. m.**	2,000.0 cm3	229.7 s	8.7 cm3/s	2.44 cm/min	2.38 cm/min	2.35 cm/min	2.42 cm/min
32 hr	**6:30 p. m.**	2,000.0 cm3	238.9 s	8.4 cm3/s	2.39 cm/min	2.33 cm/min	2.41 cm/min	2.26 cm/min
33 hr	**7:30 p. m.**	2,000.0 cm3	240.5 s	8.3 cm3/s	2.38 cm/min	2.32 cm/min	2.40 cm/min	2.24 cm/min
46 hr	**8:30 a. m.**	2,000.0 cm3	250.4 s	8.0 cm3/s	2.29 cm/min	2.24 cm/min	2.22 cm/min	2.26 cm/min
49 hr	**11:30 a. m.**	2,000.0 cm3	260.8 s	7.7 cm3/s	2.21 cm/min	2.15 cm/min	2.08 cm/min	2.23 cm/min
56 hr	**6:30 p. m.**	2,000.0 cm3	258.1 s	7.8 cm3/s	2.28 cm/min	2.20 cm/min	2.29 cm/min	2.18 cm/min
72 hr	**10:30 a. m.**	2,000.0 cm3	263.9 s	7.6 cm3/s	2.20 cm/min	2.15 cm/min	2.12 cm/min	2.18 cm/min

Column 6
Compacted sand

K (20°C)	**S13**

Piezometers data	
Piezometers	***Distance***
P1 - P2	30.0 cm
P2 - P3	30.0 cm
P1 - P3	60.0 cm

Sample

Hour:	10:25 a. m.	10:30 a. m.	11:30 a. m.	12:30 p. m.	3:30 p. m.	4:30 p. m.	5:30 p. m.	6:30 p. m.	7:30 p. m.	8:30 a. m.	9:30 a. m.	6:30 p. m.	7:30 p. m.	8:30 a. m.	11:30 a. m.	6:30 p. m.	10:30 a. m.
Water Head	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm	41.10 cm
Height:	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm	86.7 cm
Diameter:	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm	15.24 cm
Area:	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2	182 cm2
Volumen:	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3	15,815 cm3
Dry Weight:	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g	24,571.5 g
Bulk Density	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3	1,554 Kg/m3
Water Temp	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C	19 °C
v - Kinem. viscosity (10^6	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030
	88.6%																88.6%

Hour:	10:25 a. m.	10:30 a. m.	11:30 a. m.	12:30 p. m.	3:30 p. m.	4:30 p. m.	5:30 p. m.	6:30 p. m.	7:30 p. m.	8:30 a. m.	9:30 a. m.	6:30 p. m.	7:30 p. m.	8:30 a. m.	11:30 a. m.	6:30 p. m.	10:30 a. m.
Piezometers	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**	**Height**
P1	100.5 cm	99.5 cm	98.5 cm	97.5 cm	93.9 cm	94.2 cm	93.9 cm	93.4 cm	93.3 cm	92.0 cm	92.0 cm	91.2 cm	91.0 cm	90.7 cm	90.7 cm	90.6 cm	89.9 cm
P2	57.6 cm	56.6 cm	55.8 cm	54.9 cm	52.4 cm	51.7 cm	50.8 cm	50.2 cm	49.3 cm	46.3 cm	46.4 cm	45.0 cm	45.5 cm	44.4 cm	44.2 cm	45.0 cm	44.3 cm
P3	14.9 cm	14.6 cm	14.2 cm	13.6 cm	12.8 cm	12.6 cm	12.2 cm	12.0 cm	11.6 cm	11.6 cm	11.7 cm	11.2 cm	11.3 cm	10.9 cm	9.5 cm	9.5 cm	8.8 cm
h (P1-P2)	42.9 cm	42.9 cm	42.7 cm	42.6 cm	41.5 cm	42.5 cm	43.1 cm	43.2 cm	44.0 cm	45.7 cm	45.6 cm	46.2 cm	45.5 cm	46.3 cm	46.5 cm	45.6 cm	45.6 cm
h (P2-P3)	42.7 cm	42.0 cm	41.6 cm	41.3 cm	39.6 cm	39.1 cm	38.6 cm	38.2 cm	37.7 cm	34.7 cm	34.7 cm	33.8 cm	34.2 cm	33.5 cm	34.7 cm	35.5 cm	35.5 cm
h (P1-P3)	85.6 cm	84.9 cm	84.3 cm	83.9 cm	81.1 cm	81.6 cm	81.7 cm	81.4 cm	81.7 cm	80.4 cm	80.3 cm	80.0 cm	79.7 cm	79.8 cm	81.2 cm	81.1 cm	81.1 cm

		Outflow - Geotextile						
		Volumen	***Time***	***Q***	***K (20°c) avg***	***K P1-P3***	***K P1-P2***	***K P2-P3***
0 hr	***10:30 a. m.***	2,000.0 cm3	214.7 s	9.3 cm3/s	2.22 cm/min	2.17 cm/min	2.14 cm/min	2.19 cm/min
1 hr	***11:30 a. m.***	2,000.0 cm3	225.1 s	8.9 cm3/s	2.13 cm/min	2.08 cm/min	2.05 cm/min	2.11 cm/min
2 hr	***12:30 p. m.***	2,000.0 cm3	230.5 s	8.7 cm3/s	2.09 cm/min	2.04 cm/min	2.01 cm/min	2.07 cm/min
5 hr	***3:30 p. m.***	2,000.0 cm3	247.8 s	8.1 cm3/s	2.01 cm/min	1.96 cm/min	1.92 cm/min	2.01 cm/min
6 hr	***4:30 p. m.***	2,000.0 cm3	255.3 s	7.8 cm3/s	1.94 cm/min	1.89 cm/min	1.82 cm/min	1.98 cm/min
7 hr	***5:30 p. m.***	2,000.0 cm3	263.5 s	7.6 cm3/s	1.88 cm/min	1.83 cm/min	1.74 cm/min	1.94 cm/min
8 hr	***6:30 p. m.***	2,000.0 cm3	270.6 s	7.4 cm3/s	1.84 cm/min	1.79 cm/min	1.69 cm/min	1.91 cm/min
9 hr	***7:30 p. m.***	2,000.0 cm3	269.9 s	7.4 cm3/s	1.84 cm/min	1.79 cm/min	1.66 cm/min	1.94 cm/min
22 hr	***8:30 a. m.***	2,000.0 cm3	314.0 s	6.4 cm3/s	1.62 cm/min	1.56 cm/min	1.38 cm/min	1.81 cm/min
23 hr	***9:30 a. m.***	2,000.0 cm3	314.6 s	6.4 cm3/s	1.62 cm/min	1.56 cm/min	1.38 cm/min	1.81 cm/min
32 hr	***6:30 p. m.***	2,000.0 cm3	335.7 s	6.0 cm3/s	1.53 cm/min	1.47 cm/min	1.27 cm/min	1.74 cm/min
33 hr	***7:30 p. m.***	2,000.0 cm3	336.4 s	5.9 cm3/s	1.53 cm/min	1.47 cm/min	1.29 cm/min	1.72 cm/min
46 hr	***8:30 a. m.***	2,000.0 cm3	354.1 s	5.6 cm3/s	1.46 cm/min	1.40 cm/min	1.20 cm/min	1.66 cm/min
49 hr	***11:30 a. m.***	2,000.0 cm3	353.3 s	5.7 cm3/s	1.43 cm/min	1.38 cm/min	1.20 cm/min	1.61 cm/min
56 hr	***6:30 p. m.***	2,000.0 cm3	365.7 s	5.5 cm3/s	1.38 cm/min	1.33 cm/min	1.18 cm/min	1.52 cm/min
72 hr	***10:30 a. m.***	2,000.0 cm3	381.3 s	5.2 cm3/s	1.32 cm/min	1.28 cm/min	1.14 cm/min	1.46 cm/min

APPENDIX B

Infiltration Tests Data - Infiltrometers

WATER INFILTRATION TEST
AUBURN STORMWATER

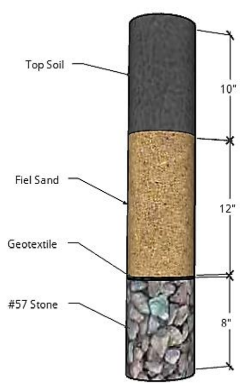
Date: 13/03/2023 Infiltration tes #: **A-F1**

Columns #: 1,2,3

Test done by:

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4633.3 cm3	1.42 g/cm3	6579.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth	63.0 cm	63.0 cm	63.6 cm
Settlement	2.0 cm	2.0 cm	2.6 cm

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.9 cm	70.6 cm	40.1 cm	14.7 cm	10:36:00	61.0 cm
2	2	91.0 cm	70.7 cm	40.2 cm	14.8 cm	10:39:00	61.0 cm
3	3	91.3 cm	71.0 cm	40.5 cm	15.1 cm	10:42:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	11:28:00	5.0 cm	13:20:00	10.1 cm	14:41:00	12.3 cm
2	2	11:29:00	4.2 cm	13:21:00	8.1 cm	14:42:00	11.1 cm
3	3	11:30:00	6.8 cm	13:22:00	13.5 cm	14:42:00	18.8 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	17:57:00	17.4 cm	7:47:00	35.7 cm	10:00:00	38.3 cm
2	2	17:57:00	16.0 cm	7:47:00	33.3 cm	10:00:00	35.7 cm
3	3	17:57:00	28.5 cm	7:47:00	55.3 cm	10:00:00	58.9 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	14:05:00	42.3 cm	20:28:00	49.8 cm	9:42:00	58.1 cm
2	2	14:05:00	43.4 cm	20:28:00	47.3 cm	9:42:00	55.4 cm
3	3	14:05:00	63.6 cm				

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	12:20:00	60.3 cm	13:20:00	61.0 cm	14:30:00	61.5 cm
2	2	12:20:00	57.3 cm	13:20:00	58.0 cm	14:30:00	59.0 cm
3	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	16:20:00	62.5 cm	17:18:00	63.0 cm		
2	2	16:20:00	59.8 cm	17:18:00	60.0 cm	23:15:00	Empty Before
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 13/03/2023 **Infiltration tes #:** **B-F1**

Columns #: 4,5,6

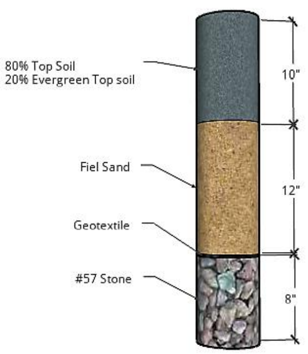
			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
4	1	91.4 cm	71.1 cm	40.6 cm	15.2 cm	10:45:00	61.0 cm
5	2	91.8 cm	71.5 cm	41.0 cm	15.6 cm	10:47:00	61.0 cm
6	3	91.6 cm	71.3 cm	40.8 cm	15.4 cm	10:50:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1	11:31:00	16.1 cm	13:23:00	32.1 cm	14:43:00	39.1 cm
5	2	11:31:00	15.5 cm	13:24:00	31.6 cm	14:44:00	37.9 cm
6	3	11:32:00	11.0 cm	13:25:00	20.2 cm	14:44:00	24.4 cm

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4633.3 cm3	0.98 g/cm3	3662.9 g
Ever Green	20%					899.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1	17:58:00	46.0 cm	7:49:00	66.5 cm		
5	2	17:58:00	46.8 cm	7:49:00	65.0 cm		
6	3	17:58:00	29.8 cm	7:49:00	43.0 cm	10:03:00	44.8 cm

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2						
6	3	14:11:00	47.8 cm	20:29:00	52.4 cm	9:43:00	58.2 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2						
6	3	12:19:00	69.5 cm	13:22:00	60.0 cm	14:30:00	60.5 cm

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2						
6	3	17:19:00	61.2 cm	23:15:00	63.4 cm	10:25:00	Before

	Column 4	Column 5	Column 6
Final sample depth	66.9 cm	66.5 cm	67.3 cm
Settlement	5.9 cm	5.5 cm	6.3 cm

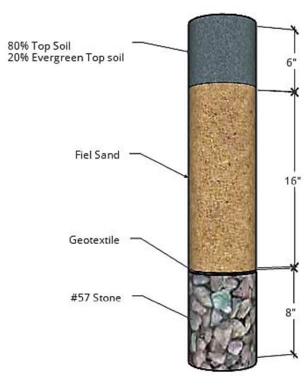
WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 13/03/2023 **Infiltration tes #:** **C-F1**

Columns #: 7,8,9

	COLUMNS 7,8,9					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	16.0 in	40.6 cm	7413.3 cm3	1.50 g/cm3	11120.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 7	Column 8	Column 9
Final sample depth	65.5 cm	66.0 cm	65.3 cm
Settlement	4.5 cm	5.0 cm	4.3 cm

			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
7	1	91.4 cm	71.1 cm	30.4 cm	15.2 cm	10:53:00	61.0 cm
8	2	91.0 cm	70.7 cm	30.0 cm	14.8 cm	10:55:00	61.0 cm
9	3	90.8 cm	70.5 cm	29.8 cm	14.6 cm	10:57:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	11:32:00	8.1 cm	13:26:00	16.5 cm	14:46:00	20.1 cm
8	2	11:33:00	8.1 cm	13:27:00	18.6 cm	14:46:00	23.5 cm
9	3	11:34:00	9.5 cm	13:28:00	20.8 cm	14:47:00	25.6 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	18:00:00	25.6 cm	7:50:00	38.7 cm	10:06:00	40.4 cm
8	2	18:00:00	29.9 cm	7:50:00	45.2 cm	10:06:00	47.0 cm
9	3	18:00:00	32.5 cm	7:50:00	48.2 cm	10:06:00	50.4 cm

		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	14:11:00	43.9 cm	20:30:00	48.0 cm	9:44:00	53.6 cm
8	2	14:11:00	49.7 cm	20:30:00	55.0 cm	9:44:00	60.9 cm
9	3	14:11:00	53.1 cm	20:30:00	58.5 cm	9:44:00	65.2 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	13:22:00	55.5 cm	15:26:00	56.0 cm	16:24:00	56.5 cm
8	2	13:22:00	62.5 cm	15:26:00	63.5 cm	16:27:00	64.5 cm
9	3	10:55:00	Before				

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	23:16:00	59.5 cm	10:26:00	62.9 cm	14:20:00	Before
8	2	17:20:00	Before				
9	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 13/03/2023 **Infiltration tes #:** **D-F1**

Columns #: 10,11,12

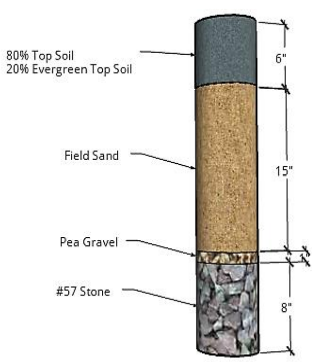
			Layer depth inside the colum			
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**4**
10	1	91.0 cm	91.0 cm	91.0 cm	91.0 cm	91.0 cm
11	2	91.3 cm	91.3 cm	91.3 cm	91.3 cm	91.3 cm
12	3	91.3 cm	91.3 cm	91.3 cm	91.3 cm	91.3 cm

	COLUMNS 10, 11, 12					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	15.0 in	38.1 cm	6950.0 cm3	1.50 g/cm3	10425.0 g
Pea gravel	100%	1.0 in	2.5 cm	463.3 cm3	1.62 g/cm3	750.6 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

		Initial data		Reading 1		Reading 2	
Column	**Sample**	**Initial Hour**	**Water over the sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	11:01:00	61.0 cm	11:34:00	6.4 cm	13:29:00	14.9 cm
11	2	11:04:00	61.0 cm	11:34:00	5.6 cm	13:30:00	15.2 cm
12	3	11:06:00	61.0 cm	11:35:00	7.1 cm	13:31:00	16.5 cm

		Reading 3		Reading 4		Reading 5	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	14:48:00	18.3 cm	18:02:00	24.4 cm	7:51:00	39.3 cm
11	2	14:48:00	19.4 cm	18:02:00	26.4 cm	7:51:00	43.5 cm
12	3	14:49:00	20.5 cm	18:02:00	26.4 cm	7:51:00	41.3 cm

SAMPLE OUTLINE



		Reading 6		Reading 7		Reading 8	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	10:12:00	41.5 cm	14:16:00	44.4 cm	20:31:00	49.4 cm
11	2	10:12:00	45.0 cm	14:16:00	48.4 cm	20:31:00	54.5 cm
12	3	10:12:00	43.6 cm	14:16:00	46.2 cm	20:31:00	51.5 cm

		Reading 9		Reading 10		Reading 11	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	9:45:00	56.0 cm	13:25:00	58.5 cm	15:28:00	59.0 cm
11	2	9:45:00	61.4 cm	13:25:00	63.0 cm	15:29:00	63.5 cm
12	3	9:45:00	57.3 cm	13:25:00	59.0 cm	15:29:00	59.5 cm

		Reading 12		Reading 13		Reading 14	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	16:28:00	60.0 cm	23:16:00	62.5 cm	10:27:00	Before
11	2	16:29:00	64.0 cm	17:21:00	65.0 cm	really few	
12	3	16:29:00	60.0 cm	23:16:00	62.5 cm	10:27:00	Before

	Column 10	**Column 11**	**Column 12**
Final sample depth	65.4 cm	65.5 cm	65.5 cm
Settlement	4.4 cm	4.5 cm	4.5 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 13/03/2023 **Infiltration tes #:** **E-F1**

Columns #: 13,14,15

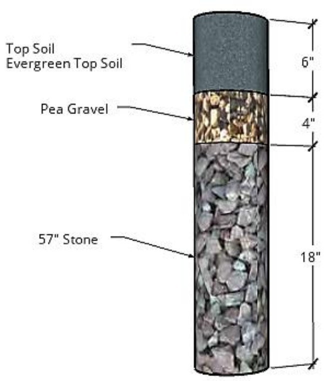
			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
13	1	91.0 cm	45.3 cm	35.1 cm	19.9 cm	11:08:00	61.0 cm
14	2	91.4 cm	45.7 cm	35.5 cm	20.3 cm	11:11:00	61.0 cm
15	3	91.7 cm	46.0 cm	35.8 cm	20.6 cm	11:13:00	61.0 cm

	COLUMNS 13,14,15					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Pea gravel	100%	4.0 in	10.2 cm	1853.3 cm3	1.62 g/cm3	3002.4 g
57 stone	100%	18.0 in	45.7 cm	8340.0 cm3	1.58 g/cm3	13177.2 g
		28.0 in	71.1 cm	12973.3 cm3		

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	11:36:00	5.8 cm	13:31:00	14.7 cm	14:51:00	19.1 cm
14	2	11:36:00	7.0 cm	13:33:00	19.7 cm	14:51:00	25.9 cm
15	3	11:37:00	6.5 cm	13:33:00	19.5 cm	14:52:00	24.9 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	18:04:00	25.4 cm	7:52:00	41.8 cm	10:15:00	43.2 cm
14	2	18:04:00	35.7 cm	7:52:00	56.2 cm	10:15:00	58.4 cm
15	3	18:04:00	34.5 cm	7:52:00	55.2 cm	10:15:00	57.5 cm

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	14:18:00	46.3 cm	16:08:00	48.0 cm	17:47:00	48.7 cm
14	2	14:18:00	62.5 cm	16:08:00	65.0 cm	17:47:00	Before
15	3	14:18:00	61.3 cm	16:08:00	63.4 cm	17:47:00	65.4 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	20:31:00	51.8 cm	9:46:00	58.4 cm	9:44:00	60.9 cm
14	2						
15	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	16:30:00	61.5 cm	23:17:00	64.0 cm	10:28:00	Before
14	2						
15	3						

	Column 13	Column 14	Column 15
Final sample depth	65.5 cm	64.5 cm	65.0 cm
Settlement	4.5 cm	3.5 cm	4.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 13/03/2023 **Infiltration tes #:** **T-F1**

Columns #: 16,17,18

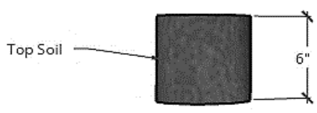
			Layer depth inside the colum	Initial data	
Column	**Sample**	**Colum height**	**1**	**Initial Hour**	**Water over the sample**
16	1	91.8 cm	76.6 cm	11:16:00	61.0 cm
17	2	91.4 cm	76.2 cm	11:18:00	61.0 cm
18	3	91.2 cm	76.0 cm	11:20:00	61.0 cm

	COLUMNS 16, 17,18					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	6.0 in	15.2 cm	2780.0 cm3	1.42 g/cm3	3947.6 g
				2780.0 cm3		

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	11:38:00	8.5 cm	13:34:00	13.4 cm	14:53:00	14.5 cm
17	2	11:38:00	3.0 cm	13:35:00	11.3 cm	14:54:00	11.3 cm
18	3	11:38:00	12.5 cm	13:35:00	21.4 cm	14:54:00	21.4 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	18:06:00	21.0 cm	7:54:00	37.0 cm	17:51:00	46.0 cm
17	2	18:06:00	16.8 cm	7:54:00	36.0 cm	17:51:00	45.9 cm
18	3	18:06:00	28.0 cm	7:54:00	48.0 cm	17:51:00	56.8 cm

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	20:32:00	48.8 cm	9:47:00	55.5 cm	13:30:00	58.0 cm
17	2	20:32:00	49.8 cm	9:47:00	57.0 cm	13:30:00	59.0 cm
18	3	20:32:00	60.2 cm	9:47:00	Before		

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	14:20:00	58.5 cm	16:31:00	58.5 cm	17:23:00	59.1 cm
17	2	14:20:00	56.0 cm	16:31:00	56.0 cm	17:23:00	60.7 cm
18	3						

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	23:17:00	61.5 cm	10:28:00	Before		
17	2	23:17:00	Before				
18	3						

	Column 16	Column 17	Column 18
Final sample depth	64.5 cm	62.9 cm	62.7 cm
Settlement	3.5 cm	1.9 cm	1.7 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

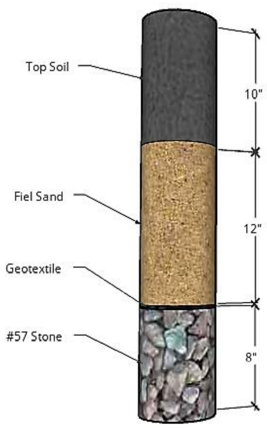
Date: 16/03/2023 **Infiltration tes #:** **A-F2**

Columns #: 1,2,3

Test done by: ________________

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4633.3 cm3	1.42 g/cm3	6579.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth	63.0 cm	63.0 cm	63.5 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.9 cm	70.6 cm	40.1 cm	14.7 cm	14:49:00	61.0 cm
2	2	91.0 cm	70.7 cm	40.2 cm	14.8 cm	14:51:00	61.0 cm
3	3	91.3 cm	71.0 cm	40.5 cm	15.1 cm	14:52:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	16:26:00	3.3 cm	23:54:00	15.0 cm	9:55:00	27.2 cm
2	2	16:26:00	0.8 cm	23:54:00	8.3 cm	9:55:00	15.5 cm
3	3	16:28:00	2.8 cm	23:54:00	10.0 cm	9:55:00	16.9 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	11:32:00	28.8 cm	23:34:00	39.4 cm	10:28:00	46.8 cm
2	2	11:32:00	16.5 cm	23:34:00	23.4 cm	10:28:00	29.8 cm
3	3	11:32:00	17.7 cm	23:34:00	24.8 cm	10:28:00	30.6 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	12:51:00	48.2 cm	18:21:00	51.2 cm	23:58:00	54.0 cm
2	2	12:51:00	29.9 cm	18:21:00	32.0 cm	23:58:00	34.3 cm
3	3	12:51:00	31.8 cm	18:21:00	34.4 cm	23:58:00	36.8 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	12:16:00	59.4 cm	22:27:00	before		
2	2	12:16:00	38.5 cm	22:27:00	41.9 cm	9:01:00	45.0 cm
3	3	12:16:00	42.0 cm	22:27:00	45.8 cm	9:01:00	49.3 cm

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2	20:56:00	48.0 cm	3:32:00	49.5 cm		
3	3	20:56:00	53.1 cm	3:32:00	55.0 cm		

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 16/03/2023 **Infiltration tes #:** **B-F2**

Columns #: 4,5,6

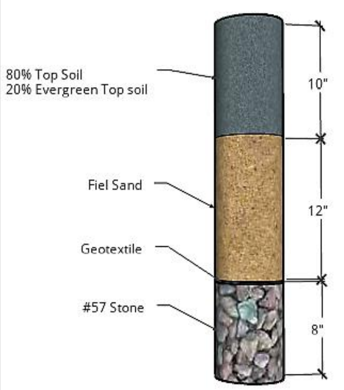
		Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
4	1	91.4 cm	71.1 cm	40.6 cm	15.2 cm	14:53:00	61.0 cm
5	2	91.8 cm	71.5 cm	41.0 cm	15.6 cm	14:54:00	61.0 cm
6	3	91.6 cm	71.3 cm	40.8 cm	15.4 cm	14:56:00	61.0 cm

		COLUMNS 4,5,6				
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4633.3 cm3	0.98 g/cm3	3662.9 g
Ever Green	20%					899.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1	16:29:00	7.3 cm	23:55:00	23.5 cm	9:56:00	39.8 cm
5	2	16:30:00	6.8 cm	23:55:00	22.9 cm	9:56:00	37.4 cm
6	3	16:31:00	2.0 cm	23:55:00	11.7 cm	9:56:00	22.0 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1	11:33:00	41.8 cm	23:35:00	54.8 cm	10:29:00	Before
5	2	11:33:00	39.3 cm	23:35:00	51.2 cm	10:29:00	59.6 cm
6	3	11:33:00	23.7 cm	23:35:00	33.5 cm	10:29:00	40.9 cm

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2	12:52:00	Before				
6	3	12:52:00	42.2 cm	18:22:00	45.1 cm	23:59:00	47.9 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2						
6	3	12:17:00	52.9 cm	22:27:00	56.5 cm	9:02:00	59.6 cm

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2						
6	3						

	Column 4	Column 5	Column 6
Final sample depth	66.9 cm	66.5 cm	67.3 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 16/03/2023 **Infiltration tes #:** **C-F2**

Columns #: 7,8,9

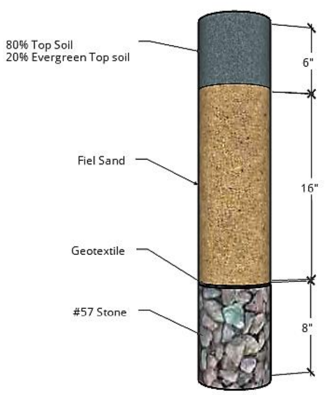
			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
7	1	91.4 cm	71.1 cm	30.4 cm	15.2 cm	14:57:00	61.0 cm
8	2	91.0 cm	70.7 cm	30.0 cm	14.8 cm	14:58:00	61.0 cm
9	3	90.8 cm	70.5 cm	29.8 cm	14.6 cm	14:59:00	61.0 cm

		COLUMNS 7,8,9				
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	16.0 in	40.6 cm	7413.3 cm3	1.50 g/cm3	11120.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	16:32:00	2.8 cm	23:56:00	14.8 cm	9:59:00	26.8 cm
8	2	16:32:00	9.0 cm	23:56:00	17.0 cm	9:59:00	29.5 cm
9	3	16:33:00	3.9 cm	23:56:00	15.7 cm	9:59:00	28.0 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	11:36:00	28.4 cm	23:36:00	39.7 cm	10:30:00	47.5 cm
8	2	11:36:00	31.4 cm	23:36:00	43.3 cm	10:30:00	52.4 cm
9	3	11:36:00	29.8 cm	23:36:00	41.9 cm	10:30:00	51.2 cm

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	12:53:00	49.1 cm	18:22:00	52.3 cm	23:59:00	55.3 cm
8	2	12:53:00	54.1 cm	18:22:00	57.8 cm	23:59:00	Before
9	3	12:53:00	53.0 cm	18:22:00	57.0 cm	23:59:00	Before

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	12:17:00	Before				
8	2						
9	3						

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1						
8	2						
9	3						

	Column 7	Column 8	Column 9
Final sample depth	65.5 cm	66.0 cm	65.3 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

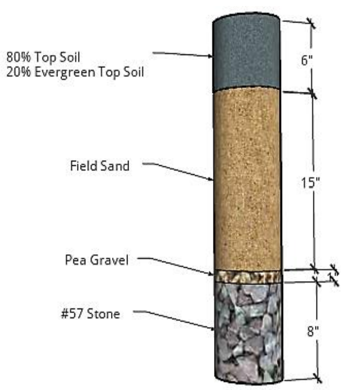
Date: 16/03/2023 **Infiltration tes #:** **D-F2**

Columns #: 10,11,12

			Layer depth inside the colum			
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**4**
10	1	91.0 cm	91.0 cm	91.0 cm	91.0 cm	91.0 cm
11	2	91.3 cm	91.3 cm	91.3 cm	91.3 cm	91.3 cm
12	3	91.3 cm	91.3 cm	91.3 cm	91.3 cm	91.3 cm

	COLUMNS 10, 11, 12					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	15.0 in	38.1 cm	6950.0 cm3	1.50 g/cm3	10425.0 g
Pea gravel	100%	1.0 in	2.5 cm	463.3 cm3	1.62 g/cm3	750.6 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 10	Column 11	Column 12
Final sample depth	65.4 cm	65.5 cm	65.5 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

		Initial data		Reading 1		Reading 2	
Column	**Sample**	**Initial Hour**	**Water over the sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	15:05:00	61.0 cm	16:34:00	3.5 cm	23:57:00	15.5 cm
11	2	15:06:00	61.0 cm	16:34:00	4.8 cm	23:57:00	19.5 cm
12	3	15:07:00	61.0 cm	16:35:00	3.0 cm	23:57:00	14.5 cm

		Reading 3		Reading 4		Reading 5	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	10:03:00	28.3 cm	11:37:00	29.9 cm	23:37:00	40.6 cm
11	2	10:03:00	33.3 cm	11:37:00	34.8 cm	23:37:00	46.6 cm
12	3	10:03:00	26.0 cm	11:37:00	27.8 cm	23:37:00	38.5 cm

		Reading 6		Reading 7		Reading 8	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	10:31:00	48.4 cm	12:54:00	49.7 cm	18:23:00	53.2 cm
11	2	10:31:00	58.4 cm	12:54:00	56.0 cm	18:23:00	59.5 cm
12	3	10:31:00	46.5 cm	12:54:00	47.4 cm	18:23:00	50.5 cm

		Reading 9		Reading 10		Reading 11	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	0:01:00	56.2 cm	12:18:00	before		
11	2	0:01:00	before				
12	3	0:01:00	53.4 cm	12:18:00	58.8 cm	22:27:00	before

		Reading 12		Reading 13		Reading 14	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1						
11	2						
12	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 16/03/2023 **Infiltration tes #:** **E-F2**

Columns #: 13,14,15

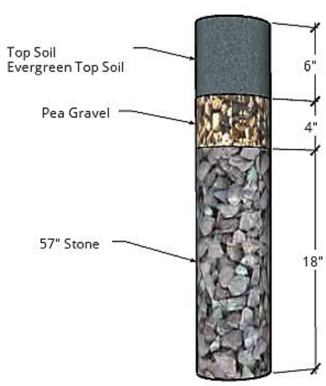
			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
13	1	91.0 cm	45.3 cm	35.1 cm	19.9 cm	15:08:00	61.0 cm
14	2	91.4 cm	45.7 cm	35.5 cm	20.3 cm	15:10:00	61.0 cm
15	3	91.7 cm	46.0 cm	35.8 cm	20.6 cm	15:11:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1	16:36:00	4.8 cm	23:58:00	19.6 cm	10:06:00	31.8 cm
14	2	16:36:00	6.0 cm	23:58:00	26.5 cm	10:06:00	42.0 cm
15	3	16:36:00	10.4 cm	23:58:00	36.0 cm	10:06:00	54.7 cm

	COLUMNS 13,14,15					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Pea gravel	100%	4.0 in	10.2 cm	1853.3 cm3	1.62 g/cm3	3002.4 g
57 stone	100%	18.0 in	45.7 cm	8340.0 cm3	1.58 g/cm3	13177.2 g
		28.0 in	71.1 cm	12973.3 cm3		

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1	11:48:00	33.5 cm	23:38:00	43.2 cm	10:32:00	50.0 cm
14	2	11:48:00	44.0 cm	23:38:00	54.6 cm	10:32:00	before
15	3	11:48:00	57.2 cm	23:38:00	before		

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1	12:55:00	51.5 cm	18:24:00	54.0 cm	0:01:00	57.0 cm
14	2						
15	3						

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1	12:19:00	before				
14	2						
15	3						

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1						
14	2						
15	3						

	Column 13	Column 14	Column 15
Final sample depth	65.5 cm	64.5 cm	65.0 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 16/03/2023 **Infiltration tes #:** **T-F2**

Columns #: 16,17,18

			Layer depth inside the colum	Initial data	
Column	**Sample**	**Colum height**	**1**	**Initial Hour**	**Water over the sample**
16	1	91.8 cm	76.6 cm	15:12:00	61.0 cm
17	2	91.4 cm	76.2 cm	15:13:00	61.0 cm
18	3	91.2 cm	76.0 cm	15:14:00	61.0 cm

	COLUMNS 16, 17,18					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	6.0 in	15.2 cm	2780.0 cm3	1.42 g/cm3	3947.6 g
				2780.0 cm3		

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	16:39:00	3.0 cm	23:58:00	8.3 cm	10:07:00	15.3 cm
17	2	16:39:00	2.0 cm	23:58:00	10.5 cm	10:07:00	19.5 cm
18	3	16:40:00	4.0 cm	23:58:00	20.0 cm	10:07:00	36.0 cm

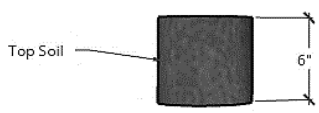
		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	11:49:00	16.4 cm	23:39:00	23.0 cm	10:33:00	28.0 cm
17	2	11:49:00	21.0 cm	23:39:00	28.8 cm	10:33:00	34.9 cm
18	3	11:49:00	38.0 cm	23:39:00	49.7 cm	10:33:00	57.3 cm

		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	12:55:00	28.8 cm	18:24:00	31.3 cm	0:02:00	33.4 cm
17	2	12:55:00	35.9 cm	18:24:00	38.4 cm	0:02:00	41.0 cm
18	3	12:55:00	58.5 cm	18:24:00	61.0 cm		

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	12:19:00	37.8 cm	22:27:00	40.7 cm	9:03:00	43.8 cm
17	2	12:19:00	45.6 cm	22:27:00	49.3 cm	9:03:00	52.1 cm
18	3						

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	21:05:00	46.8 cm	3:31:00	48.3 cm		
17	2	21:05:00	55.4 cm	3:31:00	56.6 cm		
18	3						

SAMPLE OUTLINE



	Column 16	Column 17	Column 18
Final sample depth	64.5 cm	62.9 cm	62.7 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 22/03/2023 **Infiltration tes #:** **A-F3**

Columns #: 1,2,3

Test done by: ______________

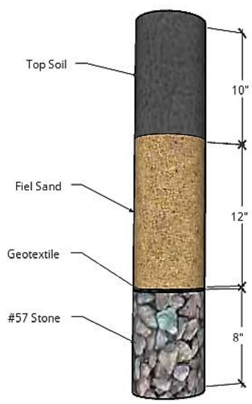
				Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
1	1	90.9 cm	70.6 cm	40.1 cm	14.7 cm	13:38:00	61.0 cm
2	2	91.0 cm	70.7 cm	40.2 cm	14.8 cm	13:42:00	61.0 cm
3	3	91.3 cm	71.0 cm	40.5 cm	15.1 cm	13:45:00	61.0 cm

		COLUMNS 1,2,3				
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4633.3 cm3	1.42 g/cm3	6579.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	21:35:00	16.0 cm	9:31:00	32.0 cm	11:00:00	34.2 cm
2	2	21:35:00	3.5 cm	9:31:00	8.4 cm	11:00:00	9.0 cm
3	3	21:35:00	11.4 cm	9:31:00	23.2 cm	11:00:00	25.0 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	12:01:00	34.7 cm	19:51:00	40.6 cm	22:01:00	42.1 cm
2	2	12:01:00	9.5 cm	19:51:00	12.0 cm	22:01:00	12.2 cm
3	3	12:01:00	25.6 cm	19:51:00	31.6 cm	22:01:00	33.0 cm

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	11:15:00	49.2 cm	14:00:00	50.6 cm	16:00:00	51.2 cm
2	2	11:15:00	17.0 cm	14:00:00	18.8 cm	16:00:00	18.8 cm
3	3	11:15:00	41.0 cm	14:00:00	42.9 cm	16:00:00	43.4 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	22:42:00	54.0 cm	12:27:00	59.5 cm	19:47:00	60.8 cm
2	2	22:42:00	20.4 cm	12:27:00	24.0 cm	19:47:00	25.6 cm
3	3	22:42:00	47.3 cm	12:27:00	53.3 cm	19:47:00	56.0 cm

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	12:50:00	60.8 cm				
2	2	12:50:00	25.6 cm	16:14:00	35.5 cm		
3	3	12:50:00	56.0 cm				

	Column 1	Column 2	Column 3
Final sample depth	63.0 cm	63.0 cm	63.5 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 22/03/2023 **Infiltration tes #:** **B-F3**

Columns #: 4,5,6

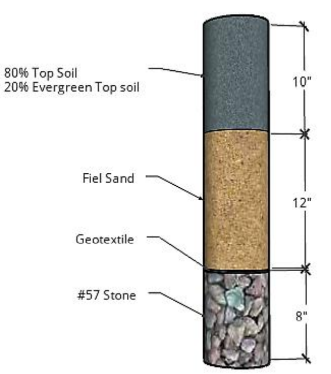
			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
4	1	91.4 cm	71.1 cm	40.6 cm	15.2 cm	13:47:00	61.0 cm
5	2	91.8 cm	71.5 cm	41.0 cm	15.6 cm	13:49:00	61.0 cm
6	3	91.6 cm	71.3 cm	40.8 cm	15.4 cm	13:51:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1	21:37:00	36.7 cm	9:34:00	61.0 cm		
5	2	21:37:00	24.6 cm	9:34:00	45.4 cm	11:03:00	48.3 cm
6	3	21:37:00	8.7 cm	9:34:00	19.1 cm	11:03:00	20.4 cm

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4633.3 cm3	0.98 g/cm3	3662.9 g
Ever Green	20%					899.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2	12:02:00	48.5 cm	19:53:00	58.2 cm	22:03:00	61.0 cm
6	3	12:02:00	21.5 cm	19:53:00	26.8 cm	22:03:00	28.4 cm

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2						
6	3	11:16:00	35.7 cm	14:00:00	37.1 cm	16:00:00	37.4 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2						
6	3	22:43:00	40.8 cm	22:43:00	46.0 cm	19:48:00	48.3 cm

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
4	1						
5	2						
6	3	12:51:00	53.5 cm	20:06:00	55.2 cm	16:15:00	59.6 cm

	Column 4	**Column 5**	**Column 6**
Final sample depth	66.9 cm	66.5 cm	67.3 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 22/03/2023 **Infiltration tes #:** **C-F3**

Columns #: 7,8,9

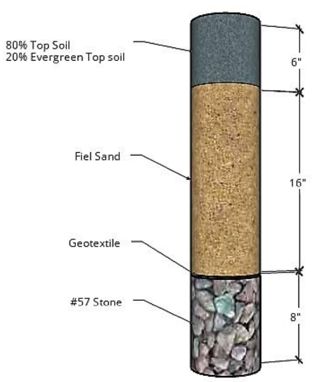
			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
7	1	91.4 cm	71.1 cm	30.4 cm	15.2 cm	13:52:00	61.0 cm
8	2	91.0 cm	70.7 cm	30.0 cm	14.8 cm	13:53:00	61.0 cm
9	3	90.8 cm	70.5 cm	29.8 cm	14.6 cm	13:55:00	61.0 cm

	COLUMNS 7,8,9					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	16.0 in	40.6 cm	7413.3 cm3	1.50 g/cm3	11120.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	21:39:00	10.5 cm	9:35:00	22.0 cm	11:05:00	23.6 cm
8	2	21:39:00	16.4 cm	9:35:00	30.1 cm	11:05:00	32.1 cm
9	3	21:39:00	16.4 cm	9:35:00	32.8 cm	11:05:00	34.9 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	12:04:00	24.7 cm	19:55:00	30.6 cm	22:05:00	32.5 cm
8	2	12:04:00	32.9 cm	19:55:00	40.5 cm	22:05:00	42.2 cm
9	3	12:04:00	35.7 cm	19:55:00	43.3 cm	22:05:00	45.0 cm

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	11:17:00	41.2 cm	14:00:00	43.2 cm	16:00:00	44.1 cm
8	2	11:17:00	52.4 cm	14:00:00	54.5 cm	16:00:00	55.8 cm
9	3	11:17:00	55.1 cm	14:00:00	58.1 cm	16:00:00	58.4 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1	22:43:00	47.7 cm	12:31:00	55.0 cm		
8	2	22:43:00	Before				
9	3	22:43:00	Before				

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
7	1						
8	2						
9	3						

	Column 7	Column 8	Column 9
Final sample depth	65.5 cm	66.0 cm	65.3 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

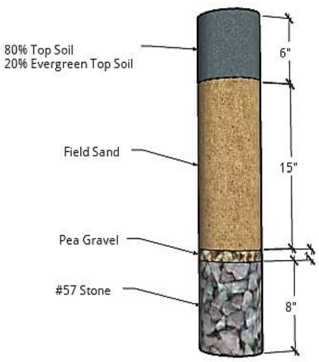
Date: 16/03/2023 **Infiltration tes #:** **D-F3**

Columns #: 10,11,12

			Layer depth inside the colum			
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**4**
10	1	91.0 cm	91.0 cm	91.0 cm	91.0 cm	91.0 cm
11	2	91.3 cm	91.3 cm	91.3 cm	91.3 cm	91.3 cm
12	3	91.3 cm	91.3 cm	91.3 cm	91.3 cm	91.3 cm

	COLUMNS 10, 11, 12					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	15.0 in	38.1 cm	6950.0 cm3	1.50 g/cm3	10425.0 g
Pea gravel	100%	1.0 in	2.5 cm	463.3 cm3	1.62 g/cm3	750.6 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 10	Column 11	Column 12
Final sample depth	65.4 cm	65.5 cm	65.5 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

		Initial data		Reading 1		Reading 2	
Column	**Sample**	**Initial Hour**	**Water over the sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	13:57:00	61.0 cm	21:41:00	10.9 cm	9:37:00	22.9 cm
11	2	13:58:00	61.0 cm	21:41:00	16.0 cm	9:37:00	30.1 cm
12	3	14:00:00	61.0 cm	21:41:00	9.9 cm	9:37:00	20.9 cm

		Reading 3		Reading 4		Reading 5	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	11:07:00	25.5 cm	12:06:00	25.7 cm	19:56:00	31.5 cm
11	2	11:07:00	32.4 cm	12:06:00	33.4 cm	19:56:00	40.2 cm
12	3	11:07:00	22.1 cm	12:06:00	23.2 cm	19:56:00	29.4 cm

		Reading 6		Reading 7		Reading 8	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	22:08:00	33.1 cm	11:19:00	42.0 cm	14:00:00	43.8 cm
11	2	22:08:00	42.0 cm	11:19:00	51.4 cm	14:00:00	53.4 cm
12	3	22:08:00	30.9 cm	11:19:00	39.7 cm	14:00:00	41.6 cm

		Reading 9		Reading 10		Reading 11	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	16:00:00	45.3 cm	22:44:00	49.4 cm	12:32:00	56.8 cm
11	2	16:00:00	54.3 cm	22:44:00	57.5 cm	12:32:00	Before
12	3	16:00:00	42.1 cm	22:44:00	46.2 cm	12:32:00	53.8 cm

		Reading 12		Reading 13		Reading 14	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	19:49:00	60.5 cm	12:52:00	Before		
11	2						
12	3	19:49:00	57.2 cm	12:52:00	Before		

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 22/03/2023 **Infiltration tes #:** **E-F3**

Columns #: 13,14,15

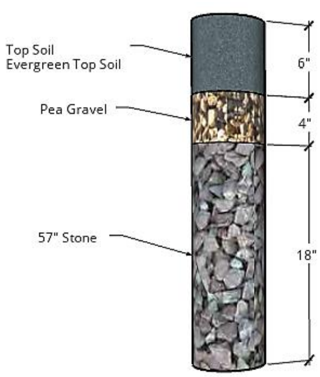
			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
13	1	91.0 cm	45.3 cm	35.1 cm	19.9 cm	14:01:00	61.0 cm
14	2	91.4 cm	45.7 cm	35.5 cm	20.3 cm	14:03:00	61.0 cm
15	3	91.7 cm	46.0 cm	35.8 cm	20.6 cm	14:05:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1	21:42:00	15.4 cm	9:38:00	29.0 cm	11:09:00	30.8 cm
14	2	21:42:00	23.4 cm	9:38:00	41.0 cm	11:09:00	42.9 cm
15	3	21:42:00	35.5 cm	9:38:00	54.7 cm	11:09:00	57.2 cm

		COLUMNS 13,14,15					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Pea gravel	100%	4.0 in	10.2 cm	1853.3 cm3	1.62 g/cm3	3002.4 g
57 stone	100%	18.0 in	45.7 cm	8340.0 cm3	1.58 g/cm3	13177.2 g
		28.0 in	71.1 cm	12973.3 cm3		

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1	12:08:00	32.1 cm	19:58:00	37.9 cm	22:11:00	39.3 cm
14	2	12:08:00	43.8 cm	19:58:00	50.9 cm	22:11:00	52.5 cm
15	3	12:08:00	57.9 cm	19:58:00	Before		

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1	11:21:00	47.7 cm	14:10:00	50.8 cm	16:10:00	51.4 cm
14	2	11:21:00	Before				
15	3						

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1	22:45:00	53.6 cm	12:34:00	59.0 cm	19:50:00	Before
14	2						
15	3						

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
13	1						
14	2						
15	3						

	Column 13	Column 14	Column 15
Final sample depth	65.5 cm	64.5 cm	65.0 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 22/03/2023 **Infiltration tes #:** **T-F3**

Columns #: 16,17,18

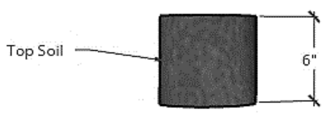
			Layer depth inside the colum	Initial data	
Column	**Sample**	**Colum height**	**1**	**Initial Hour**	**Water over the sample**
16	1	91.8 cm	76.6 cm	14:06:00	61.0 cm
17	2	91.4 cm	76.2 cm	14:08:00	61.0 cm
18	3	91.2 cm	76.0 cm	14:09:00	61.0 cm

		COLUMNS 16, 17,18				
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	6.0 in	15.2 cm	2780.0 cm3	1.42 g/cm3	3947.6 g
				2780.0 cm3		

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	21:44:00	5.0 cm	9:39:00	10.4 cm	11:10:00	12.2 cm
17	2	21:44:00	5.8 cm	9:39:00	12.8 cm	11:10:00	13.5 cm
18	3	21:44:00	9.9 cm	9:39:00	19.2 cm	11:10:00	19.8 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	12:10:00	12.4 cm	20:00:00	16.3 cm	22:13:00	17.0 cm
17	2	12:10:00	13.9 cm	20:00:00	17.9 cm	22:13:00	18.6 cm
18	3	12:10:00	20.6 cm	20:00:00	25.2 cm	22:13:00	26.7 cm

SAMPLE OUTLINE



		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	11:22:00	22.0 cm	14:15:00	23.0 cm	16:15:00	23.5 cm
17	2	11:22:00	24.0 cm	14:15:00	25.4 cm	16:15:00	25.4 cm
18	3	11:22:00	33.4 cm	14:15:00	34.7 cm	16:15:00	35.6 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	22:46:00	25.8 cm	12:35:00	29.8 cm	19:51:00	31.9 cm
17	2	22:46:00	27.8 cm	12:35:00	32.0 cm	19:51:00	33.9 cm
18	3	22:46:00	38.4 cm	12:35:00	44.3 cm	19:51:00	47.8 cm

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
16	1	12:53:00	36.0 cm	16:16:00	41.9 cm		
17	2	12:53:00	38.0 cm	16:16:00	43.5 cm		
18	3	12:53:00	54.0 cm	16:16:00	60.6 cm		

	Column 16	Column 17	Column 18
Final sample depth	64.5 cm	62.9 cm	62.7 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

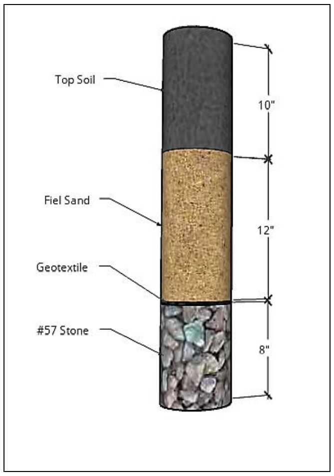
Date: 29/03/2023 **Infiltration tes #:** **A-F4**

Columns #: 1,2,3

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4633.3 cm3	1.42 g/cm3	6579.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		



	Column 1	Column 2	Column 3
Final sample depth	63.0 cm	63.0 cm	63.5 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
1	1	90.9 cm	70.6 cm	40.1 cm	14.7 cm	10:13:00	61.0 cm
2	2	91.0 cm	70.7 cm	40.2 cm	14.8 cm	10:16:00	61.0 cm
3	3	91.3 cm	71.0 cm	40.5 cm	15.1 cm	10:18:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	11:06:00	1.5 cm	16:02:00	8.0 cm	22:36:00	11.5 cm
2	2	11:06:00	0.2 cm	16:02:00	1.8 cm	22:36:00	3.5 cm
3	3	11:06:00	1.6 cm	16:02:00	7.3 cm	22:36:00	13.5 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	7:55:00	15.6 cm	14:16:00	18.3 cm	23:29:00	21.7 cm
2	2	7:55:00	6.3 cm	14:16:00	8.0 cm	23:29:00	10.4 cm
3	3	7:55:00	21.8 cm	14:16:00	27.0 cm	23:29:00	33.9 cm

		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	7:55:00	24.8 cm	11:31:00	25.9 cm	13:24:00	26.7 cm
2	2	7:55:00	12.2 cm	11:31:00	13.2 cm	13:24:00	13.6 cm
3	3	7:55:00	39.6 cm	11:31:00	41.8 cm	13:24:00	42.8 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	18:15:00	28.1 cm	7:58:00	43.5 cm	16:00:00	45.2 cm
2	2	18:15:00	14.9 cm	7:58:00	27.4 cm	16:00:00	29.0 cm
3	3	18:15:00	45.7 cm	22:58:00	48.1 cm	11:47:00	53.9 cm

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	22:41:00	46.5 cm				
2	2	22:41:00	30.2 cm				
3	3	13:07:00	54.6 cm	15:16:00	55.4 cm	0:19:00	59.3 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 29/03/2023 **Infiltration tes #:** **B-F4**

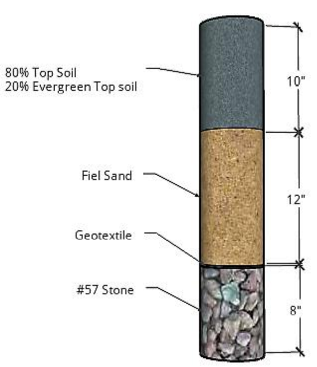
Columns #: 4,5,6

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4633.3 cm3	0.98 g/cm3	3662.9 g
Ever Green	20%					899.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth	66.9 cm	66.5 cm	67.3 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	91.4 cm	71.1 cm	40.6 cm	15.2 cm	10:20:00	61.0 cm
5	2	91.8 cm	71.5 cm	41.0 cm	15.6 cm	10:22:00	61.0 cm
6	3	91.6 cm	71.3 cm	40.8 cm	15.4 cm	10:23:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	11:07:00	2.0 cm	16:05:00	12.6 cm	22:37:00	24.5 cm
5	2	11:07:00	4.1 cm	16:05:00	21.1 cm	22:37:00	34.4 cm
6	3	11:07:00	0.3 cm	16:05:00	4.5 cm	22:37:00	8.9 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	7:56:00	39.8 cm	14:17:00	47.6 cm	17:04:00	50.8 cm
5	2	7:56:00	46.7 cm	14:17:00	53.5 cm	17:04:00	56.2 cm
6	3	7:56:00	14.5 cm	14:17:00	17.8 cm	17:04:00	19.4 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	23:30:00	56.8 cm	7:54:00	Before		
5	2	23:30:00	before				
6	3	23:30:00	22.5 cm	7:54:00	26.3 cm	11:36:00	28.4 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3	13:27:00	28.9 cm	11:48:00	27.4 cm	15:17:00	38.2 cm

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3	0:20:00	41.5 cm	16:14:00	41.5 cm	7:52:00	49.6 cm

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 29/03/2023 **Infiltration tes #:** **C-F4**

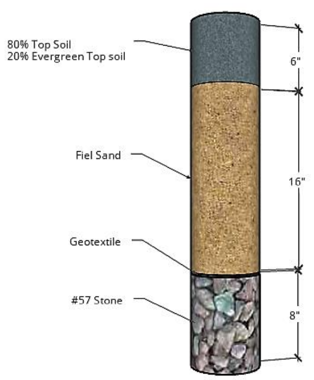
Columns #: 7,8,9

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 7,8,9					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	16.0 in	40.6 cm	7413.3 cm3	1.50 g/cm3	11120.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 7	Column 8	Column 9
Final sample depth	65.5 cm	66.0 cm	65.3 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
7	1	91.4 cm	71.1 cm	30.4 cm	15.2 cm	10:24:00	61.0 cm
8	2	91.0 cm	70.7 cm	30.0 cm	14.8 cm	10:26:00	61.0 cm
9	3	90.8 cm	70.5 cm	29.8 cm	14.6 cm	10:27:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	11:09:00	2.0 cm	16:08:00	12.8 cm	22:38:00	22.0 cm
8	2	11:09:00	3.7 cm	16:08:00	18.9 cm	22:38:00	29.9 cm
9	3	11:09:00	3.8 cm	16:08:00	19.6 cm	22:38:00	31.6 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	7:57:00	33.1 cm	14:18:00	39.3 cm	17:05:00	41.9 cm
8	2	7:57:00	42.2 cm	14:18:00	50.5 cm	17:05:00	53.9 cm
9	3	7:57:00	43.5 cm	14:18:00	50.0 cm	17:05:00	52.7 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	23:31:00	47.5 cm	7:51:00	54.2 cm	9:57:00	55.8 cm
8	2	23:31:00	61.0 cm	7:51:00	before		
9	3	23:31:00	58.3 cm	7:51:00	before		

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	11:37:00	57.0 cm	13:29:00	58.1 cm	18:16:00	61.0 cm
8	2						
9	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1						
8	2						
9	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 29/03/2023 **Infiltration tes #:** **D-F4**

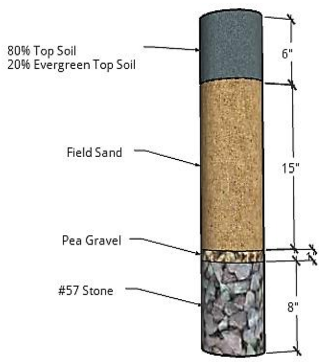
Columns #: 10,11,12

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 10, 11, 12					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	15.0 in	38.1 cm	6950.0 cm3	1.50 g/cm3	10425.0 g
Pea gravel	100%	1.0 in	2.5 cm	463.3 cm3	1.62 g/cm3	750.6 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 10	Column 11	Column 12
Final sample depth	65.4 cm	65.5 cm	65.5 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

			Layer depth inside the colum			
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**4**
10	1	91.0 cm	70.7 cm	68.1 cm	30.0 cm	14.8 cm
11	2	91.3 cm	71.0 cm	68.4 cm	30.3 cm	15.1 cm
12	3	91.3 cm	71.0 cm	68.4 cm	30.3 cm	15.1 cm

		Initial data		Reading 1		Reading 2	
Column	**Sample**	**Initial Hour**	**Water over the sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	10:24:00	61.0 cm	11:10:00	2.3 cm	16:12:00	12.1 cm
11	2	10:26:00	61.0 cm	11:10:00	3.1 cm	16:12:00	16.8 cm
12	3	10:27:00	61.0 cm	11:10:00	2.8 cm	16:12:00	12.4 cm

		Reading 3		Reading 4		Reading 5	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	22:39:00	22.7 cm	7:58:00	33.2 cm	14:19:00	39.8 cm
11	2	22:39:00	27.7 cm	7:58:00	40.4 cm	14:19:00	48.1 cm
12	3	22:39:00	21.7 cm	7:58:00	32.2 cm	14:19:00	38.4 cm

		Reading 6		Reading 7		Reading 8	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	17:06:00	42.3 cm	23:32:00	47.9 cm	7:57:00	54.0 cm
11	2	17:06:00	51.2 cm	23:32:00	57.7 cm	7:57:00	before
12	3	17:06:00	41.0 cm	23:32:00	46.6 cm	7:57:00	53.2 cm

		Reading 9		Reading 10		Reading 11	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	9:59:00	55.5 cm	11:39:00	56.3 cm	13:30:00	57.3 cm
11	2						
12	3	10:00:00	54.6 cm	11:39:00	55.9 cm	13:30:00	57.4 cm

		Reading 12		Reading 13		Reading 14	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
10	1	18:17:00	59.9 cm	22:58:00	before		
11	2						
12	3	18:17:00	61.0 cm				

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 29/03/2023 **Infiltration tes #:** **E-F4**

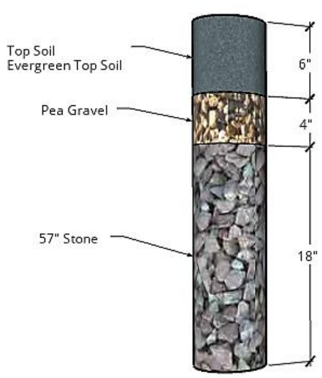
Columns #: 13,14,15

Test done by: ______________

Observation: Samples totally saturated before start the test.

	COLUMNS 13,14,15					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Pea gravel	100%	4.0 in	10.2 cm	1853.3 cm3	1.62 g/cm3	3002.4 g
57 stone	100%	18.0 in	45.7 cm	8340.0 cm3	1.58 g/cm3	13177.2 g
		28.0 in	71.1 cm	12973.3 cm3		

SAMPLE OUTLINE



					Column 13	Column 14	Column 15
Final sample depth	65.5 cm	64.5 cm	65.0 cm
Settlement	0.0 cm	0.0 cm	0.0 cm

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
13	1	91.0 cm	45.3 cm	35.1 cm	19.9 cm	10:32:00	61.0 cm
14	2	91.4 cm	45.7 cm	35.5 cm	20.3 cm	10:34:00	61.0 cm
15	3	91.7 cm	46.0 cm	35.8 cm	20.6 cm	10:35:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	11:12:00	1.5 cm	16:14:00	11.1 cm	22:40:00	21.0 cm
14	2	11:12:00	3.7 cm	16:14:00	24.6 cm	22:40:00	39.6 cm
15	3	11:12:00	4.4 cm	16:14:00	26.7 cm	22:40:00	41.4 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	7:59:00	31.8 cm	13:05:00	36.6 cm	14:20:00	37.8 cm
14	2	7:59:00	52.2 cm	13:05:00	56.5 cm	14:20:00	57.5 cm
15	3	7:59:00	53.8 cm	13:05:00	58.4 cm	14:20:00	59.6 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	17:07:00	40.2 cm	23:33:00	44.6 cm	7:59:00	49.3 cm
14	2	16:02:00	58.8 cm	17:07:00	59.9 cm	23:33:00	before
15	3	15:50:00	61.0 cm				

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	10:00:00	50.4 cm	18:18:00	53.9 cm	22:59:00	55.7 cm
14	2						
15	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	11:49:00	59.5 cm	13:06:00	59.9 cm	0:21:00	before
14	2						
15	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 04/03/23 - 04/04/23 **Infiltration tes #:** **A-F5**

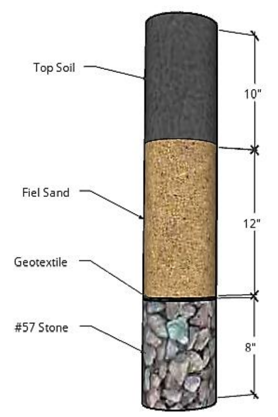
Columns #: 1,2,3

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4633.3 cm3	1.42 g/cm3	6579.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.9 cm	70.6 cm	40.1 cm	14.7 cm	14:29:00	61.0 cm
2	2	91.0 cm	70.7 cm	40.2 cm	14.8 cm	14:29:00	61.0 cm
3	3	91.3 cm	71.0 cm	40.5 cm	15.1 cm	9:14:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	21:22:00	2.4 cm	9:04:00	6.9 cm	11:22:00	7.9 cm
2	2	21:22:00	1.8 cm	9:04:00	4.4 cm	11:22:00	5.1 cm
3	3	10:46:00	1.8 cm	16:01:00	7.4 cm	22:42:00	12.9 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	9:07:00	15.0 cm	16:50:00	17.2 cm	9:09:00	21.9 cm
2	2	9:07:00	10.0 cm	16:50:00	11.6 cm	9:09:00	14.8 cm
3	3	8:22:00	20.1 cm	11:57:00	22.8 cm	15:05:00	24.5 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3	21:22:00	28.2 cm	9:04:00	35.3 cm	22:03:00	42.0 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3	9:07:00	46.6 cm	16:50:00	49.8 cm	9:09:00	55.8 cm

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 3/04/2023 **Infiltration tes #:** **B-F5**

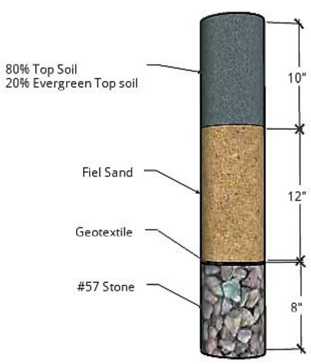
Columns #: 4,5,6

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4633.3 cm3	0.98 g/cm3	3662.9 g
Ever Green	20%					899.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	91.4 cm	71.1 cm	40.6 cm	15.2 cm	9:14:00	61.0 cm
5	2	91.8 cm	71.5 cm	41.0 cm	15.6 cm	9:14:00	61.0 cm
6	3	91.6 cm	71.3 cm	40.8 cm	15.4 cm	9:17:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	10:46:00	14.8 cm	16:02:00	39.5 cm	22:43:00	60.1 cm
5	2	10:46:00	11.0 cm	16:02:00	30.5 cm	22:43:00	48.1 cm
6	3	10:46:00	1.0 cm	16:02:00	5.0 cm	22:43:00	9.5 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	8:22:00	before				
5	2	8:22:00	before				
6	3	8:22:00	15.4 cm	11:58:00	17.5 cm	15:06:00	19.3 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3	21:23:00	22.4 cm	9:04:00	28.5 cm	9:07:00	37.8 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3	9:09:00	before				

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 3/04/2023 **Infiltration tes #:** **C-F5**

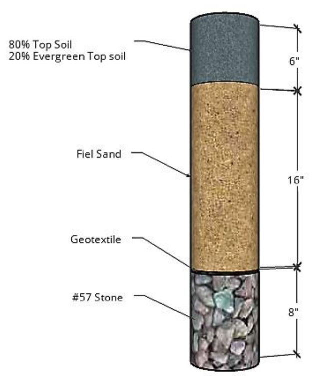
Columns #: 7,8,9

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 7,8,9					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	16.0 in	40.6 cm	7413.3 cm3	1.50 g/cm3	11120.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 7	Column 8	Column 9
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
7	1	91.4 cm	71.1 cm	30.4 cm	15.2 cm	9:17:00	61.0 cm
8	2	91.0 cm	70.7 cm	30.0 cm	14.8 cm	9:17:00	61.0 cm
9	3	90.8 cm	70.5 cm	29.8 cm	14.6 cm	9:17:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	10:48:00	4.2 cm	16:03:00	14.7 cm	22:44:00	25.1 cm
8	2	10:48:00	8.5 cm	16:03:00	24.8 cm	22:44:00	37.5 cm
9	3	10:48:00	9.8 cm	16:03:00	25.9 cm	22:44:00	40.9 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	8:23:00	36.8 cm	11:59:00	40.3 cm	14:14:00	42.6 cm
8	2	8:23:00	49.8 cm	11:59:00	53.6 cm	14:14:00	55.8 cm
9	3	8:23:00	54.5 cm	11:59:00	58.0 cm	14:14:00	60.4 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	15:08:00	43.4 cm	21:24:00	47.8 cm	9:05:00	56.9 cm
8	2	15:08:00	56.6 cm	21:24:00	before		
9	3	15:08:00	61.0 cm				

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	11:23:00	58.4 cm	13:15:00	59.5 cm	14:01:00	60.1 cm
8	2						
9	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	16:18:00	before				
8	2						
9	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 3/04/2023 **Infiltration tes #:** **D-F5**

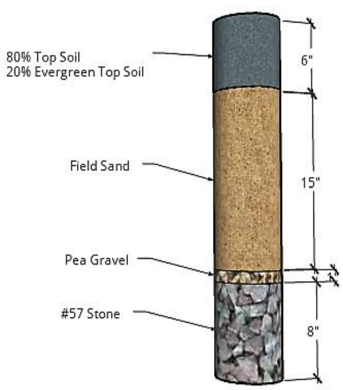
Columns #: 10,11,12

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 10, 11, 12					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	15.0 in	38.1 cm	6950.0 cm3	1.50 g/cm3	10425.0 g
Pea gravel	100%	1.0 in	2.5 cm	463.3 cm3	1.62 g/cm3	750.6 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 10	Column 11	Column 12
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
10	1	91.0 cm	70.7 cm	68.1 cm	30.0 cm	14.8 cm
11	2	91.3 cm	71.0 cm	68.4 cm	30.3 cm	15.1 cm
12	3	91.3 cm	71.0 cm	68.4 cm	30.3 cm	15.1 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
10	1	9:18:00	61.0 cm	10:51:00	3.0 cm	16:04:00	12.2 cm
11	2	9:20:00	61.0 cm	10:51:00	5.8 cm	16:04:00	17.9 cm
12	3	9:20:00	61.0 cm	10:51:00	4.5 cm	16:04:00	15.2 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
10	1	22:45:00	21.8 cm	8:24:00	32.5 cm	12:02:00	35.6 cm
11	2	22:45:00	29.0 cm	8:24:00	40.8 cm	12:02:00	44.7 cm
12	3	22:45:00	26.0 cm	8:24:00	37.4 cm	12:02:00	40.7 cm

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
10	1	15:10:00	38.3 cm	21:25:00	42.2 cm	9:05:00	50.7 cm
11	2	15:10:00	47.9 cm	21:25:00	52.7 cm	9:05:00	before
12	3	15:10:00	43.8 cm	21:25:00	48.7 cm	9:05:00	58.9 cm

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
10	1	11:24:00	52.0 cm	13:18:00	53.2 cm	16:18:00	54.8 cm
11	2						
12	3	11:24:00	61.0 cm				

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
10	1	22:03:00	57.5 cm	9:04:00	61.0 cm		
11	2						
12	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 3/04/2023 **Infiltration tes #:** **E-F5**

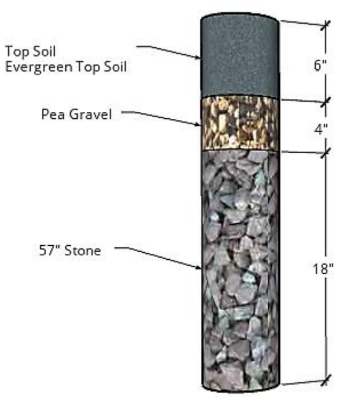
Columns #: 13,14,15

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 13,14,15					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Pea gravel	100%	4.0 in	10.2 cm	1853.3 cm3	1.62 g/cm3	3002.4 g
57 stone	100%	18.0 in	45.7 cm	8340.0 cm3	1.58 g/cm3	13177.2 g
		28.0 in	71.1 cm	12973.3 cm3		

SAMPLE OUTLINE



	Column 13	Column 14	Column 15
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
13	1	91.0 cm	45.3 cm	35.1 cm	19.9 cm	9:20:00	61.0 cm
14	2	91.4 cm	45.7 cm	35.5 cm	20.3 cm	9:20:00	61.0 cm
15	3	91.7 cm	46.0 cm	35.8 cm	20.6 cm	9:20:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	10:53:00	2.5 cm	16:05:00	10.0 cm	22:46:00	18.0 cm
14	2	10:53:00	7.5 cm	16:05:00	28.0 cm	22:46:00	43.4 cm
15	3	10:53:00	14.5 cm	16:05:00	41.5 cm	22:46:00	56.2 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	8:25:00	26.8 cm	12:05:00	29.8 cm	15:13:00	32.2 cm
14	2	8:25:00	55.4 cm	12:05:00	58.4 cm	15:13:00	before
15	3	8:25:00	before				

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	21:26:00	35.5 cm	9:05:00	42.3 cm	11:24:00	43.5 cm
14	2						
15	3						

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	22:04:00	48.0 cm	9:06:00	51.7 cm	16:50:00	54.0 cm
14	2						
15	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1						
14	2						
15	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 7/04/2023 **Infiltration tes #:** **A-F6**

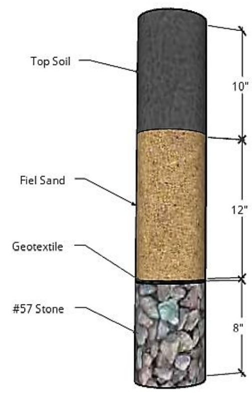
Columns #: 1,2,3

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4633.3 cm3	1.42 g/cm3	6579.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.9 cm	70.6 cm	40.1 cm	14.7 cm	10:16:00	61.0 cm
2	2	91.0 cm	70.7 cm	40.2 cm	14.8 cm	10:16:00	61.0 cm
3	3	91.3 cm	71.0 cm	40.5 cm	15.1 cm	10:17:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	15:27:00	1.8 cm	16:33:00	2.4 cm	20:22:00	3.4 cm
2	2	15:27:00	1.3 cm	16:33:00	1.8 cm	20:22:00	2.5 cm
3	3	15:27:00	5.5 cm	16:33:00	6.6 cm	20:22:00	10.4 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	9:51:00	7.8 cm	23:04:00	11.9 cm	11:08:00	15.7 cm
2	2	9:51:00	5.4 cm	23:04:00	8.1 cm	11:08:00	10.6 cm
3	3	9:51:00	20.9 cm	23:04:00	29.9 cm	11:08:00	37.0 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	21:30:00	18.5 cm	16:35:00	23.5 cm	9:32:00	27.5 cm
2	2	21:30:00	12.5 cm	16:35:00	16.0 cm	9:32:00	19.3 cm
3	3	21:30:00	42.5 cm	16:35:00	51.4 cm	9:32:00	58.0 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 7/04/2023 **Infiltration tes #:** **B-F6**

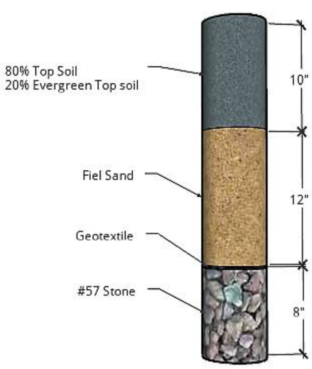
Columns #: 4,5,6

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4633.3 cm3	0.98 g/cm3	3662.9 g
Ever Green	20%					899.3 g
Field Sand	100%	12.0 in	30.5 cm	5560.0 cm3	1.50 g/cm3	8340.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	91.4 cm	71.1 cm	40.6 cm	15.2 cm	10:17:00	61.0 cm
5	2	91.8 cm	71.5 cm	41.0 cm	15.6 cm	10:18:00	61.0 cm
6	3	91.6 cm	71.3 cm	40.8 cm	15.4 cm	10:19:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	15:28:00	46.5 cm	16:35:00	51.7 cm	20:23:00	before
5	2	15:28:00	31.3 cm	16:35:00	35.6 cm	20:23:00	47.2 cm
6	3	15:28:00	4.3 cm	16:36:00	4.6 cm	20:23:00	7.5 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2	9:52:00	before				
6	3	9:52:00	15.4 cm	23:05:00	22.5 cm	11:09:00	28.5 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3	21:31:00	32.8 cm	16:36:00	39.5 cm	9:33:00	45.0 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 7/04/2023 **Infiltration tes #:** **C-F6**

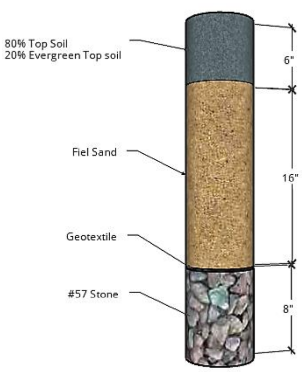
Columns #: 7,8,9

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 7,8,9					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	16.0 in	40.6 cm	7413.3 cm3	1.50 g/cm3	11120.0 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 7	Column 8	Column 9
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
7	1	91.4 cm	71.1 cm	30.4 cm	15.2 cm	10:19:00	61.0 cm
8	2	91.0 cm	70.7 cm	30.0 cm	14.8 cm	10:19:00	61.0 cm
9	3	90.8 cm	70.5 cm	29.8 cm	14.6 cm	10:19:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	15:29:00	12.0 cm	16:30:00	28.4 cm	20:24:00	19.9 cm
8	2	15:29:00	20.5 cm	16:31:00	23.1 cm	20:24:00	31.0 cm
9	3	15:29:00	25.7 cm	16:31:00	14.1 cm	20:24:00	38.0 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1	9:53:00	35.7 cm	23:05:00	48.0 cm	11:09:00	57.5 cm
8	2	9:53:00	48.9 cm	23:05:00	before		
9	3	9:53:00	58.1 cm	23:05:00	before		

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1						
8	2						
9	3						

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1						
8	2						
9	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
7	1						
8	2						
9	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 7/04/2023 **Infiltration tes #:** **D-F6**

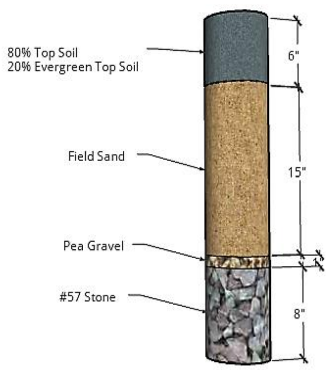
Columns #: 10,11,12

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 10, 11, 12					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Field Sand	100%	15.0 in	38.1 cm	6950.0 cm3	1.50 g/cm3	10425.0 g
Pea gravel	100%	1.0 in	2.5 cm	463.3 cm3	1.62 g/cm3	750.6 g
57 stone	100%	8.0 in	20.3 cm	3706.7 cm3	1.58 g/cm3	5856.5 g
		30.0 in	76.2 cm	13900.0 cm3		

SAMPLE OUTLINE



	Column 10	Column 11	Column 12
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
10	1	91.0 cm	70.7 cm	68.1 cm	30.0 cm	14.8 cm
11	2	91.3 cm	71.0 cm	68.4 cm	30.3 cm	15.1 cm
12	3	91.3 cm	71.0 cm	68.4 cm	30.3 cm	15.1 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
10	1	10:20:00	61.0 cm	15:31:00	9.4 cm	16:37:00	11.2 cm
11	2	10:21:00	61.0 cm	15:31:00	13.4 cm	16:37:00	15.3 cm
12	3	10:21:00	61.0 cm	15:31:00	11.6 cm	16:37:00	13.4 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
10	1	20:25:00	16.0 cm	9:54:00	30.4 cm	23:06:00	41.0 cm
11	2	20:25:00	21.9 cm	9:54:00	37.8 cm	23:06:00	49.5 cm
12	3	20:25:00	19.7 cm	9:54:00	36.0 cm	23:06:00	48.1 cm

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
10	1	11:10:00	49.5 cm	22:31:00	55.4 cm	16:37:00	before
11	2	11:10:00	57.5 cm				
12	3	11:10:00	58.0 cm				

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
10	1						
11	2						
12	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
10	1						
11	2						
12	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 7/04/2023 **Infiltration tes #:** **E-F6**

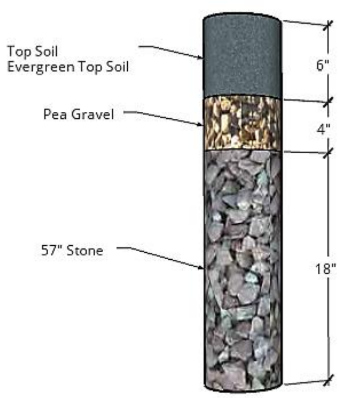
Columns #: 13,14,15

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 13,14,15					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2780.0 cm3	0.98 g/cm3	2197.7 g
Ever Green	20%					539.6 g
Pea gravel	100%	4.0 in	10.2 cm	1853.3 cm3	1.62 g/cm3	3002.4 g
57 stone	100%	18.0 in	45.7 cm	8340.0 cm3	1.58 g/cm3	13177.2 g
		28.0 in	71.1 cm	12973.3 cm3		

SAMPLE OUTLINE



	Column 13	Column 14	Column 15
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
13	1	91.0 cm	45.3 cm	35.1 cm	19.9 cm	10:21:00	61.0 cm
14	2	91.4 cm	45.7 cm	35.5 cm	20.3 cm	10:21:00	61.0 cm
15	3	91.7 cm	46.0 cm	35.8 cm	20.6 cm	10:22:00	61.0 cm

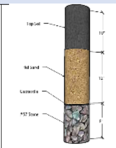
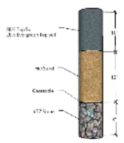
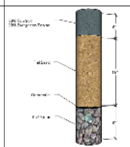
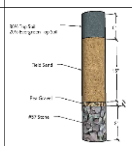
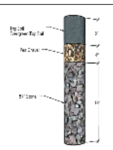
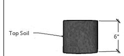
		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	15:32:00	7.4 cm	16:38:00	8.6 cm	20:27:00	13.0 cm
14	2	15:32:00	21.0 cm	16:38:00	24.4 cm	20:27:00	32.0 cm
15	3	15:32:00	29.0 cm	16:39:00	32.9 cm	20:27:00	42.2 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	9:55:00	24.8 cm	23:06:00	33.0 cm	22:32:00	43.2 cm
14	2	9:55:00	53.6 cm	23:06:00	61.0 cm		
15	3	9:55:00	before				

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1	16:37:00	49.5 cm	9:34:00	53.8 cm		
14	2						
15	3						

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1						
14	2						
15	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
13	1						
14	2						
15	3						

							SATURATED SAMPLES				
				FIRST TEST	SECOND TEST	THIRD TEST	FOUR TEST	FIFTH TEST	SIXTH TEST	GENERAL RESULTS	
SAMPLE OUTLINE		COLUMNS	ITEM	RESULTS	RESULTS	RESULTS	RESULTS	RESULTS	RESULTS	AVERAGE	REDUCTION: (First-Last one)/First *100
A		1,2,3	Average	**1.16 ft/day**	**0.48 ft/day**	**0.48 ft/day**	**0.33 ft/day**	**0.30 ft/day**	**0.29 ft/day**	**0.31 ft/day**	**13%**
			Sample 1	0.88 ft/day	0.67 ft/day	0.75 ft/day	0.28 ft/day	0.26 ft/day	0.23 ft/day	0.51 ft/day	
			Sample 2	0.84 ft/day	0.36 ft/day	0.23 ft/day	0.18 ft/day	0.17 ft/day	0.16 ft/day	0.32 ft/day	
			Sample 3	1.75 ft/day	0.40 ft/day	0.46 ft/day	0.54 ft/day	0.46 ft/day	0.48 ft/day	0.68 ft/day	
			SD	0.52 ft/day	0.17 ft/day	0.26 ft/day	0.19 ft/day	0.15 ft/day	0.17 ft/day	0.24 ft/day	
B		4,5,6	Average	**1.75 ft/day**	**0.97 ft/day**	**1.43 ft/day**	**0.99 ft/day**	**2.24 ft/day**	**3.51 ft/day**	**2.25 ft/day**	**-253%**
			Sample 1	2.27 ft/day	1.32 ft/day	2.43 ft/day	1.20 ft/day	3.51 ft/day	6.46 ft/day	2.86 ft/day	
			Sample 2	2.23 ft/day	1.08 ft/day	1.49 ft/day	1.44 ft/day	2.81 ft/day	3.69 ft/day	2.12 ft/day	
			Sample 3	0.74 ft/day	0.52 ft/day	0.38 ft/day	0.33 ft/day	0.41 ft/day	0.37 ft/day	0.46 ft/day	
			SD	0.87 ft/day	0.41 ft/day	1.02 ft/day	0.58 ft/day	1.62 ft/day	3.05 ft/day	1.26 ft/day	
C		7,8,9	Average	**0.85 ft/day**	**0.84 ft/day**	**0.80 ft/day**	**1.13 ft/day**	**1.33 ft/day**	**1.50 ft/day**	**1.32 ft/day**	**-33%**
			Sample 1	0.64 ft/day	0.76 ft/day	0.61 ft/day	0.86 ft/day	0.90 ft/day	0.93 ft/day	0.78 ft/day	
			Sample 2	0.88 ft/day	0.89 ft/day	0.88 ft/day	1.30 ft/day	1.49 ft/day	1.63 ft/day	1.18 ft/day	
			Sample 3	1.02 ft/day	0.87 ft/day	0.92 ft/day	1.24 ft/day	1.61 ft/day	1.94 ft/day	1.27 ft/day	
			SD	0.19 ft/day	0.07 ft/day	0.17 ft/day	0.24 ft/day	0.38 ft/day	0.52 ft/day	0.26 ft/day	
D		10,11,12	Average	**0.80 ft/day**	**0.79 ft/day**	**0.67 ft/day**	**0.98 ft/day**	**0.93 ft/day**	**0.86 ft/day**	**0.92 ft/day**	**12%**
			Sample 1	0.76 ft/day	0.78 ft/day	0.63 ft/day	0.84 ft/day	0.67 ft/day	0.72 ft/day	0.73 ft/day	
			Sample 2	0.88 ft/day	0.91 ft/day	0.80 ft/day	1.22 ft/day	1.15 ft/day	0.93 ft/day	0.98 ft/day	
			Sample 3	0.76 ft/day	0.67 ft/day	0.58 ft/day	0.86 ft/day	0.96 ft/day	0.94 ft/day	0.79 ft/day	
			SD	0.07 ft/day	0.12 ft/day	0.11 ft/day	0.22 ft/day	0.24 ft/day	0.12 ft/day	0.15 ft/day	
E		13,14,15	Average	**1.34 ft/day**	**1.43 ft/day**	**1.34 ft/day**	**1.27 ft/day**	**1.85 ft/day**	**1.68 ft/day**	**1.60 ft/day**	**-32%**
			Sample 1	0.78 ft/day	0.79 ft/day	0.66 ft/day	0.63 ft/day	0.53 ft/day	0.44 ft/day	0.64 ft/day	
			Sample 2	1.67 ft/day	1.32 ft/day	1.29 ft/day	1.54 ft/day	1.72 ft/day	1.31 ft/day	1.48 ft/day	
			Sample 3	1.58 ft/day	2.18 ft/day	2.07 ft/day	1.64 ft/day	3.29 ft/day	3.30 ft/day	2.34 ft/day	
			SD	0.49 ft/day	0.70 ft/day	0.71 ft/day	0.56 ft/day	1.38 ft/day	1.46 ft/day	0.88 ft/day	
T		16,17,18	Average	**1.00 ft/day**	**0.57 ft/day**	**0.31 ft/day**				**0.63 ft/day**	**69%**
			Sample 1	0.76 ft/day	0.35 ft/day	0.27 ft/day				0.46 ft/day	
			Sample 2	0.86 ft/day	0.41 ft/day	0.28 ft/day				0.52 ft/day	
			Sample 3	1.39 ft/day	0.94 ft/day	0.39 ft/day				0.91 ft/day	
			SD	0.34 ft/day	0.32 ft/day	0.07 ft/day				0.24 ft/day	

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS

Date: 1/05/2023 **Infiltration tes #:** **AC-F1**

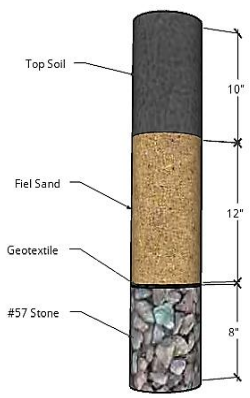
Columns #: 1,2,3

Test done by: ______________

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.42 g/cm3	6038.3 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	8.0 in	20.3 cm	3401.9 cm3	1.58 g/cm3	5375.0 g
		30.0 in	76.2 cm	12757.1 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.5 cm	70.2 cm	39.7 cm	14.3 cm	13:43:00	61.0 cm
2	2	90.5 cm	70.2 cm	39.7 cm	14.3 cm	13:43:00	61.0 cm
3	3	90.5 cm	70.2 cm	39.7 cm	14.3 cm	13:43:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	14:29:00	1.4 cm	16:07:00	4.1 cm	17:56:00	6.9 cm
2	2	14:29:00	2.1 cm	16:07:00	5.2 cm	17:56:00	8.9 cm
3	3	14:29:00	2.1 cm	16:07:00	5.6 cm	17:56:00	9.5 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	10:09:00	26.5 cm	12:25:00	28.9 cm	15:25:00	31.7 cm
2	2	10:09:00	33.0 cm	12:25:00	35.4 cm	15:25:00	38.5 cm
3	3	10:09:00	36.0 cm	12:25:00	38.7 cm	15:25:00	42.8 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	18:02:00	33.8 cm	19:01:00	34.8 cm	22:56:00	37.6 cm
2	2	18:02:00	41.2 cm	19:01:00	42.2 cm	22:56:00	46.2 cm
3	3	18:02:00	45.8 cm	19:01:00	47.0 cm	22:56:00	50.8 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	1:57:00	39.8 cm	7:58:00	44.5 cm	11:54:00	47.0 cm
2	2	1:57:00	48.7 cm	7:58:00	53.5 cm	11:54:00	56.5 cm
3	3	1:57:00	54.4 cm	7:58:00	before		

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	17:30:00	51.0 cm				
2	2	17:30:00	before				
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS

Date: 4/05/2023 **Infiltration tes #:** **AC-F2**

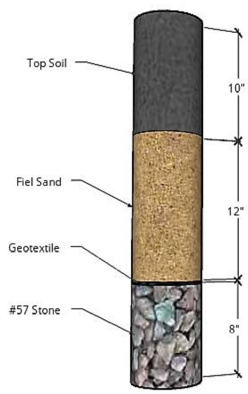
Columns #: 1,2,3

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.42 g/cm3	6038.3 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	8.0 in	20.3 cm	3401.9 cm3	1.58 g/cm3	5375.0 g
		30.0 in	76.2 cm	12757.1 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.5 cm	70.2 cm	39.7 cm	14.3 cm	12:42:00	61.0 cm
2	2	90.5 cm	70.2 cm	39.7 cm	14.3 cm	12:42:00	61.0 cm
3	3	90.5 cm	70.2 cm	39.7 cm	14.3 cm	12:42:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	14:24:00	2.2 cm	16:12:00	3.8 cm	19:02:00	7.0 cm
2	2	14:24:00	2.3 cm	16:12:00	4.4 cm	19:02:00	7.7 cm
3	3	14:24:00	2.2 cm	16:12:00	4.2 cm	19:02:00	6.4 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	11:39:00	20.3 cm	19:01:00	24.7 cm	11:22:00	34.1 cm
2	2	11:39:00	23.3 cm	19:01:00	29.0 cm	11:22:00	38.6 cm
3	3	11:39:00	19.5 cm	19:01:00	24.4 cm	11:22:00	34.6 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	23:25:00	39.5 cm	10:20:00	44.0 cm	21:48:00	48.7 cm
2	2	23:25:00	45.3 cm	10:20:00	51.0 cm	21:48:00	56.0 cm
3	3	23:25:00	40.8 cm	10:20:00	56.9 cm	21:48:00	52.9 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	11:43:00	53.6 cm				
2	2	11:43:00	before				
3	3	11:43:00	61.0 cm				

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS

Date: 8/05/2023 **Infiltration tes #:** **AC-F3**

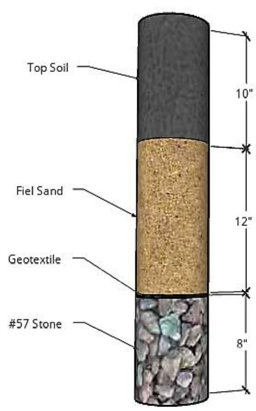
Columns #: 1,2,3

Test done by: ______________

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.42 g/cm3	6038.3 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	8.0 in	20.3 cm	3401.9 cm3	1.58 g/cm3	5375.0 g
		30.0 in	76.2 cm	12757.1 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
1	1	90.5 cm	70.2 cm	39.7 cm	14.3 cm	13:57:00	61.0 cm
2	2	90.5 cm	70.2 cm	39.7 cm	14.3 cm	13:57:00	61.0 cm
3	3	90.5 cm	70.2 cm	39.7 cm	14.3 cm	13:57:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	17:15:00	2.8 cm	20:04:00	4.6 cm	8:55:00	12.5 cm
2	2	17:15:00	2.7 cm	20:04:00	5.0 cm	8:55:00	13.0 cm
3	3	17:15:00	3.7 cm	20:04:00	6.0 cm	8:55:00	16.0 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	17:30:00	17.0 cm	20:45:00	18.3 cm	12:19:00	25.3 cm
2	2	17:30:00	17.9 cm	20:45:00	19.7 cm	12:19:00	27.9 cm
3	3	17:30:00	22.1 cm	20:45:00	24.1 cm	12:19:00	33.0 cm

		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	18:35:00	28.1 cm	10:33:00	33.8 cm	11:19:00	40.9 cm
2	2	18:35:00	31.1 cm	10:33:00	36.5 cm	11:19:00	45.2 cm
3	3	18:35:00	36.1 cm	10:33:00	42.7 cm	11:19:00	51.5 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	12:19:00	41.0 cm				
2	2	12:19:00	45.4 cm				
3	3	12:19:00	51.7 cm				

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 1/05/2023 **Infiltration tes #:** **F-F1**

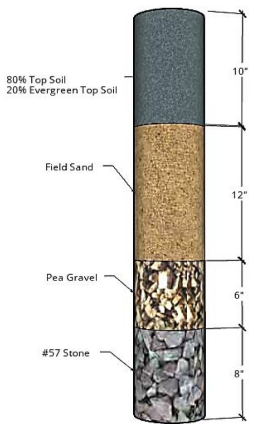
Columns #: 4,5,6

Test done by: ______________

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	0.98 g/cm3	3358.3 g
Ever Green	20%					824.5 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	8.0 in	20.3 cm	3401.9 cm3	1.58 g/cm3	5375.0 g
		36.0 in	91.4 cm	15308.5 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
4	1	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm
5	2	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm
6	3	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
4	1	11:45:00	61.0 cm	11:55:00	3.5 cm	13:29:00	30.9 cm
5	2	11:45:00	61.0 cm	11:55:00	3.5 cm	13:29:00	27.5 cm
6	3	11:45:00	61.0 cm	11:55:00	4.8 cm	13:29:00	38.0 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	14:30:00	41.3 cm	16:05:00	52.9 cm	16:35:00	55.4 cm
5	2	14:30:00	37.4 cm	16:05:00	48.5 cm	16:35:00	51.5 cm
6	3	14:30:00	51.0 cm	16:05:00	61.0 cm		

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	16:53:00	57.0 cm	17:12:00	58.7 cm	17:26:00	60.0 cm
5	2	16:53:00	53.0 cm	17:12:00	54.5 cm	17:26:00	55.5 cm
6	3						

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	17:37:00	61.0 cm				
5	2	17:26:00	56.5 cm	18:09:00	59.0 cm	18:24:00	61.0 cm
6	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 2/05/2023 **Infiltration tes #:** **F-F2**

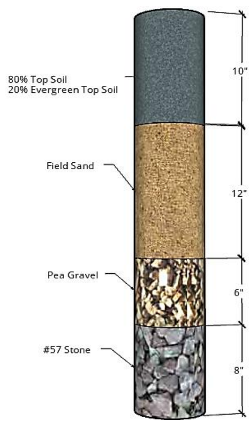
Columns #: 4,5,6

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	0.98 g/cm3	3358.3 g
Ever Green	20%					824.5 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	8.0 in	20.3 cm	3401.9 cm3	1.58 g/cm3	5375.0 g
		36.0 in	91.4 cm	15308.5 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
4	1	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm
5	2	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm
6	3	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
4	1	10:54:00	61.0 cm	11:04:00	1.1 cm	11:54:00	6.5 cm
5	2	10:54:00	61.0 cm	11:04:00	1.7 cm	11:54:00	9.4 cm
6	3	10:54:00	61.0 cm	11:04:00	2.4 cm	11:54:00	12.3 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	12:24:00	9.0 cm	13:54:00	17.0 cm	15:24:00	23.5 cm
5	2	12:24:00	13.5 cm	13:54:00	24.0 cm	15:24:00	32.9 cm
6	3	12:24:00	17.8 cm	13:54:00	30.6 cm	15:24:00	41.1 cm

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	16:34:00	28.0 cm	18:01:00	33.0 cm	19:00:00	36.0 cm
5	2	16:34:00	38.3 cm	18:01:00	44.9 cm	19:00:00	48.6 cm
6	3	16:34:00	48.0 cm	18:01:00	55.0 cm	19:00:00	59.5 cm

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	22:55:00	46.0 cm	1:58:00	51.6 cm	7:58:00	60.5 cm
5	2	22:55:00	61.0 cm				
6	3	19:13:00	61.0 cm				

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER

Date: 4/05/2023 **Infiltration tes #:** **F-F3**

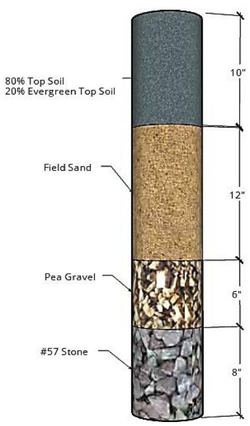
Columns #: 4,5,6

Test done by: ____________

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	0.98 g/cm3	3358.3 g
Ever Green	20%					824.5 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	8.0 in	20.3 cm	3401.9 cm3	1.58 g/cm3	5375.0 g
		36.0 in	91.4 cm	15308.5 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
4	1	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm
5	2	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm
6	3	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
4	1	10:54:00	61.0 cm	12:22:00	7.0 cm	12:51:00	9.8 cm
5	2	10:54:00	61.0 cm	12:22:00	16.0 cm	12:51:00	21.0 cm
6	3	10:54:00	61.0 cm	12:22:00	19.6 cm	12:51:00	25.5 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	14:23:00	16.9 cm	16:11:00	24.0 cm	17:04:00	27.0 cm
5	2	14:23:00	34.3 cm	16:11:00	45.5 cm	17:04:00	50.1 cm
6	3	14:23:00	41.4 cm	16:11:00	54.0 cm	17:04:00	59.0 cm

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	19:01:00	33.5 cm	7:40:00	59.5 cm		
5	2	19:01:00	58.3 cm				
6	3	17:20:00	61.0 cm				

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 12/05/2023 **Infiltration tes #:** **AC-C**

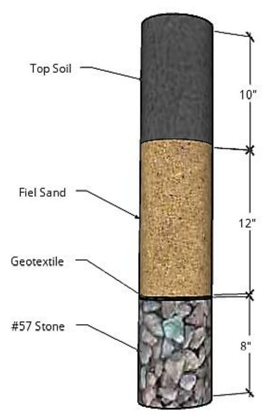
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.42 g/cm3	6038.3 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	8.0 in	20.3 cm	3401.9 cm3	1.58 g/cm3	5375.0 g
		30.0 in	76.2 cm	12757.1 cm3		2687.487097

SAMPLE OUTLINE



1.55

1.091549296

	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.5 cm	70.2 cm	39.7 cm	14.3 cm	13:50:00	61.0 cm
2	2	90.5 cm	70.2 cm	39.7 cm	14.3 cm	13:50:00	61.0 cm
3	3	90.5 cm	70.2 cm	39.7 cm	14.3 cm	13:50:00	61.0 cm

		Reading 1			Reading 2		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1	14:50:00	10.0 min	14.0 ml	17:50:00	10.0 min	14.0 ml
2	2	14:50:00	10.0 min	18.0 ml	17:50:00	10.0 min	15.0 ml
3	3	14:50:00	10.0 min	20.0 ml	17:50:00	10.0 min	18.0 ml

		Reading 3			Reading 4		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1	19:50:00	10.0 min	14.0 ml			
2	2	19:50:00	10.0 min	16.0 ml			
3	3	19:50:00	10.0 min	18.0 ml			

		Reading 5			Reading 6		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

		Reading 7			Reading 8		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

		Reading 9			Reading 10		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 10/05/2023 **Infiltration tes #:** **F-C**

Columns #: 4,5,6

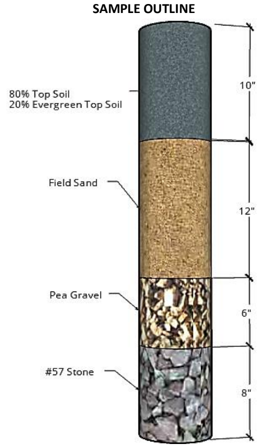
Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	0.98 g/cm3	3358.3 g
Ever Green	20%					824.5 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	8.0 in	20.3 cm	3401.9 cm3	1.58 g/cm3	5375.0 g
		36.0 in	91.4 cm	15308.5 cm3		1.1

1.118285915

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
4	1	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm
5	2	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm
6	3	90.5 cm	70.2 cm	54.9 cm	24.5 cm	-0.9 cm

		Initial data		Reading 1		
Column	Sample	Initial Hour	Water over the sample	Hour	Time (min)	Volumen (ml)
4	1	14:43:00	61.0 cm	15:43:00	4.0 min	70.0 ml
5	2	14:43:00	61.0 cm	15:43:00	4.0 min	123.0 ml
6	3	14:43:00	61.0 cm	15:43:00	4.0 min	133.0 ml

		Reading 2			Reading 3		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1	18:43:00	4.0 min	68.0 ml	20:43:00	4.0 min	70.0 ml
5	2	18:43:00	4.0 min	123.0 ml	20:43:00	4.0 min	126.0 ml
6	3	18:43:00	4.0 min	134.0 ml	20:43:00	4.0 min	130.0 ml

		Reading 4			Reading 5		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 6			Reading 7		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 8			Reading 9		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 28/05/2023 **Infiltration tes #:** **F1-C**

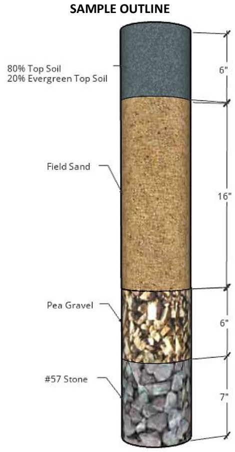
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.
Saturation start: 10:52 a.m.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	0.98 g/cm3	2015.0 g
Ever Green	20%					494.7 g
Field Sand	100%	16.0 in	40.6 cm	6803.8 cm3	1.50 g/cm3	10205.6 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	7.0 in	17.8 cm	2976.6 cm3	1.58 g/cm3	4703.1 g
		35.0 in	88.9 cm	14883.2 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	72.7 cm	57.5 cm	16.8 cm	1.6 cm
2	2	90.5 cm	72.7 cm	57.5 cm	16.8 cm	1.6 cm
3	3	90.5 cm	72.7 cm	57.5 cm	16.8 cm	1.6 cm

		Initial data		Reading 1		
Column	Sample	Initial Hour	Water over the sample	Hour	Time (min)	Volumen (ml)
1	1	11:22:00	61.0 cm	12:22:00	4.0 min	87.0 ml
2	2	11:22:00	61.0 cm	12:22:00	4.0 min	105.0 ml
3	3	11:22:00	61.0 cm	12:22:00	4.0 min	86.0 ml

		Reading 2			Reading 3		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1	15:22:00	4.0 min	55.0 ml	17:22:00	4.0 min	47.0 ml
2	2	15:22:00	4.0 min	65.0 ml	17:22:00	4.0 min	56.0 ml
3	3	15:22:00	4.0 min	56.0 ml	17:22:00	4.0 min	49.0 ml

		Reading 4			Reading 5		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

		Reading 6			Reading 7		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

		Reading 8			Reading 9		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 28/05/2023 **Infiltration tes #:** **F2-C**

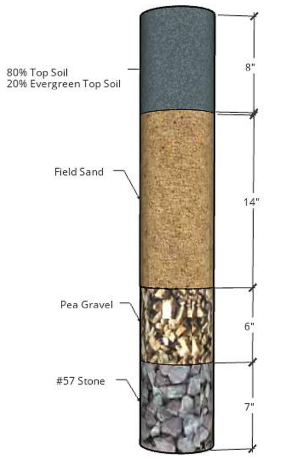
Columns #: 4,5,6

Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	8.0 in	20.3 cm	3401.9 cm3	0.98 g/cm3	2686.6 g
Ever Green	20%					659.6 g
Field Sand	100%	14.0 in	35.6 cm	5953.3 cm3	1.50 g/cm3	8929.9 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	7.0 in	17.8 cm	2976.6 cm3	1.58 g/cm3	4703.1 g
		35.0 in	88.9 cm	14883.2 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
4	1	90.5 cm	72.7 cm	57.5 cm	21.9 cm	1.6 cm
5	2	90.5 cm	72.7 cm	57.5 cm	21.9 cm	1.6 cm
6	3	90.5 cm	72.7 cm	57.5 cm	21.9 cm	1.6 cm

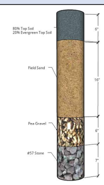
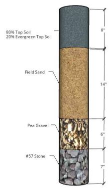
		Initial data		Reading 1		
Column	Sample	Initial Hour	Water over the sample	Hour	Time (min)	Volumen (ml)
4	1	11:42:00	61.0 cm	12:42:00	4.0 min	121.0 ml
5	2	11:42:00	61.0 cm	12:42:00	4.0 min	122.0 ml
6	3	11:42:00	61.0 cm	12:42:00	4.0 min	125.0 ml

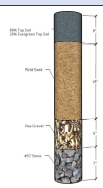
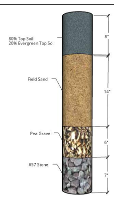
		Reading 2			Reading 3		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1	15:42:00	4.0 min	86.0 ml	17:42:00	4.0 min	79.0 ml
5	2	15:42:00	4.0 min	85.0 ml	17:42:00	4.0 min	74.0 ml
6	3	15:42:00	4.0 min	88.0 ml	17:42:00	4.0 min	79.0 ml

		Reading 4			Reading 5		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 6			Reading 7		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 8			Reading 9		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

FALLING HEAD TEST - WATER HEAD: 2 FT				FIRST TEST	SECOND TEST	THIRD TEST	GENERAL RESULTS
SAMPLE OUTLINE		COLUMNS	ITEM	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	AVERAGE
F1		1,2,3	Average	**1.29 ft/day**	**0.93 ft/day**	**1.11 ft/day**	**1.11 ft/day**
			Sample 1	1.29 ft/day	0.89 ft/day	1.15 ft/day	1.11 ft/day
			Sample 2	1.35 ft/day	0.89 ft/day	1.20 ft/day	1.15 ft/day
			Sample 3	1.22 ft/day	1.00 ft/day	0.97 ft/day	1.06 ft/day
			SD	0.06 ft/day	0.06 ft/day	0.12 ft/day	0.04 ft/day
F2		4,5,6	Average	**2.08 ft/day**	**1.46 ft/day**	**1.18 ft/day**	**1.58 ft/day**
			Sample 1	2.17 ft/day	1.52 ft/day	1.19 ft/day	1.62 ft/day
			Sample 2	1.94 ft/day	1.50 ft/day	1.18 ft/day	1.54 ft/day
			Sample 3	2.14 ft/day	1.38 ft/day	1.17 ft/day	1.56 ft/day
			SD	0.12 ft/day	0.08 ft/day	0.01 ft/day	0.04 ft/day

CONSTANT HEAD TEST - WATER HEAD: 2 FT				FIRST READING - 1 Hour	SECOND READING - 4 Hours	THIRD READING - 6 Hours	GENERAL RESULTS
SAMPLE OUTLINE		COLUMNS	ITEM	RESULTS	RESULTS	RESULTS	AVERAGE
F1		1,2,3 Time: 4 min	Average	**6.54 ft/day**	**4.14 ft/day**	**3.57 ft/day**	**4.75 ft/day**
			Sample 1	6.14 ft/day	3.88 ft/day	3.32 ft/day	4.44 ft/day
			Sample 2	7.41 ft/day	4.59 ft/day	3.95 ft/day	5.31 ft/day
			Sample 3	6.07 ft/day	3.95 ft/day	3.46 ft/day	4.49 ft/day
			SD	0.75 ft/day	0.39 ft/day	0.33 ft/day	0.49 ft/day
F2		4,5,6 Time: 4 min	Average	**8.65 ft/day**	**6.09 ft/day**	**5.46 ft/day**	**6.73 ft/day**
			Sample 1	8.54 ft/day	6.07 ft/day	5.57 ft/day	6.73 ft/day
			Sample 2	8.61 ft/day	6.00 ft/day	5.22 ft/day	6.61 ft/day
			Sample 3	8.82 ft/day	6.21 ft/day	5.57 ft/day	6.87 ft/day
			SD	0.15 ft/day	0.11 ft/day	0.20 ft/day	0.13 ft/day

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 13/06/2023 **Infiltration tes #:** Ac-C

Columns #: 1,2,3

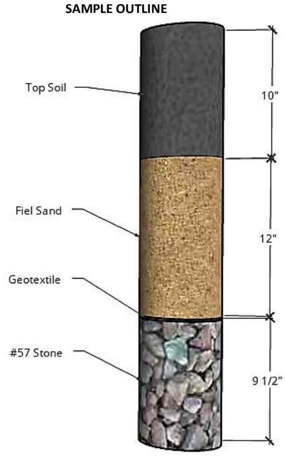
Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.

Saturation start: 06/12/2023, 8:00 pm

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.55 g/cm3	6608.2 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.5 cm	66.4 cm	35.9 cm	10.5 cm	7:30:00	61.0 cm
2	2	90.5 cm	66.4 cm	35.9 cm	10.5 cm	7:30:00	61.0 cm
3	3	90.5 cm	66.4 cm	35.9 cm	10.5 cm	7:30:00	61.0 cm

		Reading 1			Reading 2		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1	8:30:00	10.0 min	82.0 ml	11:30:00	10.0 min	80.0 ml
2	2	8:30:00	10.0 min	67.0 ml	11:30:00	10.0 min	57.0 ml
3	3	8:30:00	10.0 min	47.0 ml	11:30:00	10.0 min	41.0 ml

		Reading 3			Reading 4		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1	13:30:00	10.0 min	81.0 ml			
2	2	13:30:00	10.0 min	57.0 ml			
3	3	11:30:00	10.0 min	41.0 ml			

		Reading 5			Reading 6		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

		Reading 7			Reading 8		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

		Reading 9			Reading 10		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 06/17/2023 **Infiltration tes #:** Bc-C

Columns #: 4,5,6

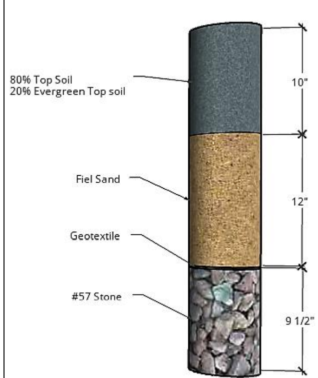
Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.

It was consolidated the amended topsoil layer using a water column.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	1.10 g/cm3	3750.1 g
Ever Green	20%					937.6 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum		
Column	Sample	Colum height	1	2	3
4	1	90.5 cm	66.4 cm	35.9 cm	10.5 cm
5	2	90.5 cm	66.4 cm	35.9 cm	10.5 cm
6	3	90.5 cm	66.4 cm	35.9 cm	10.5 cm

		Initial data		Reading 1		
Column	Sample	Initial Hour	Water over the sample	Hour	Time (min)	Volumen (ml)
4	1	8:00:00	61.0 cm	9:00:00	4.0 min	109.0 ml
5	2	8:00:00	61.0 cm	9:00:00	4.0 min	83.0 ml
6	3	8:00:00	61.0 cm	9:00:00	4.0 min	76.0 ml

4687.7

		Reading 2			Reading 3		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1	12:00:00	4.0 min	93.0 ml	14:00:00	4.0 min	84.0 ml
5	2	12:00:00	4.0 min	70.0 ml	14:00:00	4.0 min	65.0 ml
6	3	12:00:00	4.0 min	57.0 ml	14:00:00	4.0 min	49.0 ml

		Reading 4			Reading 5		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 6			Reading 7		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 8			Reading 9		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

+

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 13/06/2023 **Infiltration tes #:** **ACC-F1**

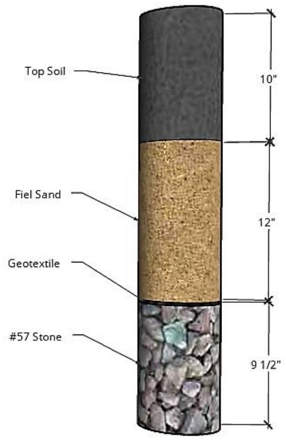
Columns 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.55 g/cm3	6608.2 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.5 cm	66.4 cm	35.9 cm	10.5 cm	14:21:00	61.0 cm
2	2	90.5 cm	66.4 cm	35.9 cm	10.5 cm	14:21:00	61.0 cm
3	3	90.5 cm	66.4 cm	35.9 cm	10.5 cm	14:21:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	19:24:00	12.1 cm	22:46:00	18.9 cm	8:33:00	35.6 cm
2	2	19:24:00	8.5 cm	22:46:00	13.2 cm	8:33:00	25.5 cm
3	3	19:24:00	5.0 cm	22:46:00	8.1 cm	8:33:00	17.7 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	11:47:00	40.2 cm	14:40:00	43.8 cm	20:18:00	51.2 cm
2	2	11:47:00	28.7 cm	14:40:00	31.4 cm	20:18:00	36.4 cm
3	3	11:47:00	20.7 cm	14:40:00	23.2 cm	20:18:00	27.8 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	22:39:00	52.7 cm	9:00:00	Before		
2	2	22:39:00	37.9 cm	9:00:00	44.2 cm	15:33:00	47.3 cm
3	3	22:39:00	29.4 cm	9:00:00	35.5 cm	15:33:00	38.8 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2	22:29:00	50.6 cm	10:26:00	55.7 cm		
3	3	22:29:00	41.7 cm	10:26:00	46.6 cm		

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 16/06/2023 **Infiltration tes #:** **ACC-F2**

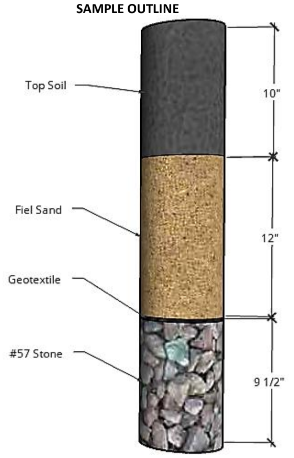
Columns : 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.55 g/cm3	6608.2 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
1	1	90.5 cm	66.4 cm	35.9 cm	10.5 cm	11:55:00	61.0 cm
2	2	90.5 cm	66.4 cm	35.9 cm	10.5 cm	11:55:00	61.0 cm
3	3	90.5 cm	66.4 cm	35.9 cm	10.5 cm	11:55:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	13:19:00	1.7 cm	16:06:00	4.7 cm	22:16:00	10.3 cm
2	2	13:19:00	1.3 cm	16:06:00	3.5 cm	22:16:00	7.8 cm
3	3	13:19:00	1.0 cm	16:06:00	2.9 cm	22:16:00	6.3 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	9:18:00	19.0 cm	15:33:00	23.0 cm	23:21:00	27.5 cm
2	2	9:18:00	14.4 cm	15:33:00	17.5 cm	23:21:00	21.2 cm
3	3	9:18:00	12.3 cm	15:33:00	15.0 cm	23:21:00	17.9 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	11:52:00	33.4 cm	19:26:00	36.4 cm	13:07:00	36.4 cm
2	2	11:52:00	26.3 cm	19:26:00	29.2 cm	13:07:00	29.2 cm
3	3	11:52:00	22.4 cm	19:26:00	25.0 cm	13:07:00	25.0 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	19:48:00	44.5 cm				
2	2	19:48:00	37.2 cm				
3	3	19:48:00	32.0 cm				

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 20/06/2023 **Infiltration tes #:** **ACC-F3**

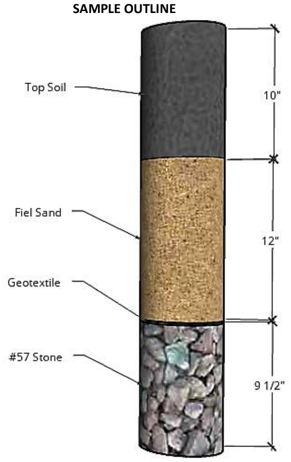
Columns #:

Test done by:

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.55 g/cm3	6608.2 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**Initial Hour**	**Water over the sample**
1	1	90.5 cm	66.4 cm	35.9 cm	10.5 cm	10:45:00	61.0 cm
2	2	90.5 cm	66.4 cm	35.9 cm	10.5 cm	10:45:00	61.0 cm
3	3	90.5 cm	66.4 cm	35.9 cm	10.5 cm	10:45:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	11:36:00	0.6 cm	14:58:00	2.6 cm	22:47:00	6.5 cm
2	2	11:36:00	0.5 cm	14:58:00	2.0 cm	22:47:00	5.3 cm
3	3	11:36:00	0.3 cm	14:58:00	1.5 cm	22:47:00	4.3 cm

		Reading 4		Reading 5		Reading 6	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	11:12:00	12.4 cm	15:30:00	14.4 cm	22:49:00	17.5 cm
2	2	11:12:00	10.0 cm	15:30:00	11.5 cm	22:49:00	14.0 cm
3	3	11:12:00	8.2 cm	15:30:00	9.3 cm	22:49:00	11.4 cm

		Reading 7		Reading 8		Reading 9	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	9:49:00	21.7 cm	15:39:00	24.2 cm	22:49:00	26.8 cm
2	2	9:49:00	17.8 cm	15:39:00	19.5 cm	22:49:00	21.8 cm
3	3	9:49:00	14.5 cm	15:39:00	16.0 cm	22:49:00	17.9 cm

		Reading 10		Reading 11		Reading 12	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1	10:02:00	30.6 cm				
2	2	10:02:00	24.8 cm				
3	3	10:02:00	20.5 cm				

		Reading 13		Reading 14		Reading 15	
Column	**Sample**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**	**Hour**	**Infiltrated water**
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 14/06/2023 **Infiltration tes #:** **A1-F1**

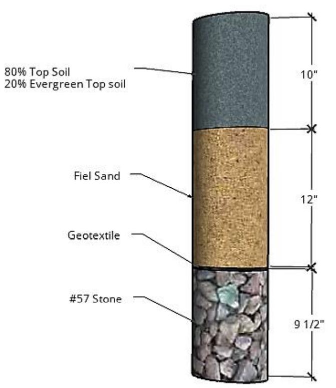
Columns #: 4,5,6

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.
It was consolidated the amended topsoil layer using a water column.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	1.10 g/cm3	3750.1 g
Ever Green	20%					937.6 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	91.4 cm	67.3 cm	36.8 cm	11.4 cm	14:38:00	61.0 cm
5	2	91.8 cm	67.7 cm	37.2 cm	11.8 cm	14:38:00	61.0 cm
6	3	91.6 cm	67.5 cm	37.0 cm	11.6 cm	14:38:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	14:48:00	1.0 cm	20:19:00	26.4 cm	22:40:00	33.0 cm
5	2	14:48:00	0.9 cm	20:19:00	23.2 cm	22:40:00	29.5 cm
6	3	14:48:00	0.7 cm	20:19:00	19.7 cm	22:40:00	26.0 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	9:01:00	54.7 cm	10:44:00	57.5 cm	12:22:00	Before
5	2	9:01:00	49.6 cm	10:44:00	52.4 cm	12:22:00	54.6 cm
6	3	9:01:00	46.8 cm	10:44:00	50.0 cm	12:22:00	52.6 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2	15:34:00	58.7 cm	22:30:00	Before		
6	3	15:34:00	57.5 cm	22:30:00	Before		

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: ____________ **Infiltration tes #:** **A1-F2**

Columns #: 4,5,6

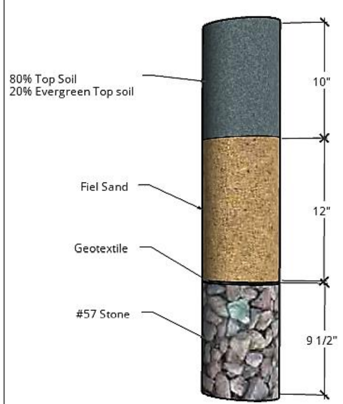
Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

It was consolidated the amended topsoil layer using a water column.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	1.10 g/cm3	3750.1 g
Ever Green	20%					937.6 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	91.4 cm	67.3 cm	36.8 cm	11.4 cm	11:54:00	61.0 cm
5	2	91.8 cm	67.7 cm	37.2 cm	11.8 cm	11:54:00	61.0 cm
6	3	91.6 cm	67.5 cm	37.0 cm	11.6 cm	11:54:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	13:20:00	3.4 cm	14:07:00	8.7 cm	18:48:00	13.2 cm
5	2	13:20:00	3.7 cm	14:07:00	9.5 cm	18:48:00	14.5 cm
6	3	13:20:00	3.9 cm	14:07:00	9.8 cm	18:48:00	14.7 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	22:17:00	18.3 cm	9:19:00	32.4 cm	15:34:00	38.3 cm
5	2	22:17:00	20.0 cm	9:19:00	34.3 cm	15:34:00	34.3 cm
6	3	22:17:00	20.2 cm	9:19:00	33.9 cm	15:34:00	33.9 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	23:22:00	43.8 cm	11:53:00	52.4 cm	15:47:00	54.7 cm
5	2	23:22:00	45.3 cm	11:53:00	53.0 cm	15:47:00	55.4 cm
6	3	23:22:00	44.5 cm	11:53:00	53.0 cm	15:47:00	55.5 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	19:27:00	56.7 cm	21:22:00	57.7 cm		
5	2	19:27:00	56.9 cm	21:22:00	57.9 cm		
6	3	19:27:00	57.8 cm	21:22:00	58.6 cm		

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 19/06/2023 **Infiltration tes #:** **A1-F3**

Columns #: 4,5,6

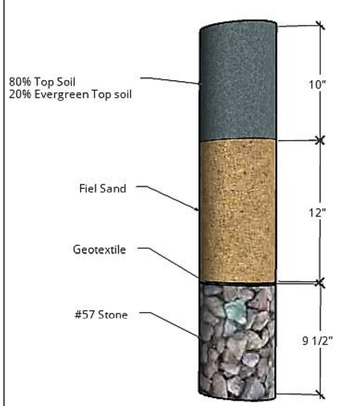
Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

It was consolidated the amended topsoil layer using a water column.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	1.10 g/cm3	3750.1 g
Ever Green	20%					937.6 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	91.4 cm	67.3 cm	36.8 cm	11.4 cm	21:03:00	61.0 cm
5	2	91.8 cm	67.7 cm	37.2 cm	11.8 cm	21:03:00	61.0 cm
6	3	91.6 cm	67.5 cm	37.0 cm	11.6 cm	21:03:00	61.0 cm

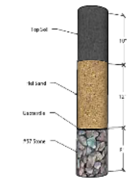
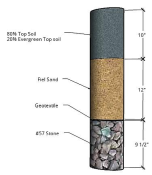
		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	23:11:00	4.3 cm	8:30:00	18.7 cm	10:30:00	21.2 cm
5	2	23:11:00	3.1 cm	8:30:00	14.1 cm	10:30:00	15.6 cm
6	3	23:11:00	4.2 cm	8:30:00	18.0 cm	10:30:00	20.2 cm

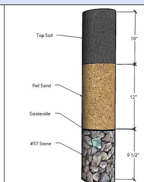
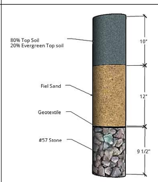
		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	14:59:00	25.7 cm	22:48:00	32.3 cm	11:13:00	39.0 cm
5	2	14:59:00	19.8 cm	22:48:00	26.4 cm	11:13:00	34.2 cm
6	3	14:59:00	25.0 cm	22:48:00	31.8 cm	11:13:00	39.9 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	13:30:00	39.8 cm	15:31:00	40.7 cm	22:33:00	43.0 cm
5	2	13:30:00	35.2 cm	15:31:00	36.5 cm	22:33:00	39.4 cm
6	3	13:30:00	40.8 cm	15:31:00	42.0 cm	22:33:00	45.5 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	9:50:00	47.0 cm	15:40:00	48.7 cm	22:50:00	50.6 cm
5	2	9:50:00	43.4 cm	15:40:00	45.5 cm	22:50:00	48.1 cm
6	3	9:50:00	52.5 cm	15:40:00	55.8 cm	22:50:00	Before

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	10:03:00	53.8 cm	14:17:00	54.9 cm	20:40:00	56.4 cm
5	2	10:03:00	52.5 cm	14:17:00	54.0 cm	14:17:00	56.5 cm
6	3						

CONSTANT HEAD TEST - WATER HEAD: 2 FT				FIRST READING - 1 Hour	SECOND READING - 4 Hours	THIRD READING - 6 Hours	GENERAL RESULTS
SAMPLE OUTLINE		COLUMNS	ITEM	RESULTS	RESULTS	RESULTS	AVERAGE
Ac ALDOT		1,2,3 Time: 10 min	Average	**1.84 ft/day**	**1.67 ft/day**	**1.68 ft/day**	**1.73 ft/day**
			Sample 1	2.31 ft/day	2.26 ft/day	2.29 ft/day	2.29 ft/day
			Sample 2	1.89 ft/day	1.61 ft/day	1.61 ft/day	1.70 ft/day
			Sample 3	1.33 ft/day	1.16 ft/day	1.16 ft/day	1.21 ft/day
			SD	0.50 ft/day	0.55 ft/day	0.57 ft/day	0.54 ft/day
Bc		4,5,6 Time: 4 min	Average	**6.30 ft/day**	**5.17 ft/day**	**4.66 ft/day**	**5.38 ft/day**
			Sample 1	7.69 ft/day	6.56 ft/day	5.93 ft/day	6.73 ft/day
			Sample 2	5.86 ft/day	4.94 ft/day	4.59 ft/day	5.13 ft/day
			Sample 3	5.36 ft/day	4.02 ft/day	3.46 ft/day	4.28 ft/day
			SD	1.23 ft/day	1.29 ft/day	1.24 ft/day	1.24 ft/day

FALLING HEAD TEST - WATER HEAD: 2 FT				FIRST TEST	SECOND TEST	THIRD TEST	GENERAL RESULTS
SAMPLE OUTLINE		COLUMNS	ITEM	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	AVERAGE
Ac ALDOT		1,2,3	Average	**0.82 ft/day**	**0.37 ft/day**	**0.28 ft/day**	**0.49 ft/day**
			Sample 1	1.28 ft/day	0.44 ft/day	0.34 ft/day	0.69 ft/day
			Sample 2	0.64 ft/day	0.37 ft/day	0.27 ft/day	0.43 ft/day
			Sample 3	0.54 ft/day	0.32 ft/day	0.23 ft/day	0.36 ft/day
			SD	0.40 ft/day	0.06 ft/day	0.06 ft/day	0.17 ft/day
Bc		4,5,6	Average	**1.97 ft/day**	**0.80 ft/day**	**0.54 ft/day**	**1.10 ft/day**
			Sample 1	2.25 ft/day	0.79 ft/day	0.46 ft/day	1.17 ft/day
			Sample 2	1.85 ft/day	0.79 ft/day	0.50 ft/day	1.05 ft/day
			Sample 3	1.82 ft/day	0.80 ft/day	0.66 ft/day	1.09 ft/day
			SD	0.24 ft/day	0.01 ft/day	0.10 ft/day	0.06 ft/day

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 29/06/2023 **Infiltration tes #:** **FC-C**

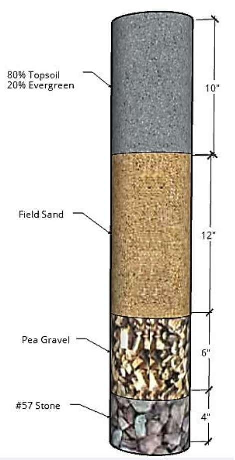
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.
Saturation start: 11:00 p.m.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	1.10 g/cm3	3750.1 g
Ever Green	20%					937.6 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	4.0 in	10.2 cm	1700.9 cm3	1.58 g/cm3	2687.5 g
		32.0 in	81.3 cm	13607.5 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm
2	2	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm
3	3	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm

		Initial data		Reading 1		
Column	Sample	Initial Hour	Water over the sample	Hour	Time (min)	Volumen (ml)
1	1	9:00:00	61.0 cm	10:00:00	5.0 min	113.0 ml
2	2	9:00:00	61.0 cm	10:00:00	5.0 min	114.0 ml
3	3	9:00:00	61.0 cm	10:00:00	5.0 min	86.0 ml

		Reading 2			Reading 3		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1	13:00:00	5.0 min	95.0 ml	15:00:00	5.0 min	95.0 ml
2	2	13:00:00	5.0 min	100.0 ml	15:00:00	5.0 min	94.0 ml
3	3	13:00:00	5.0 min	75.0 ml	15:00:00	5.0 min	74.0 ml

		Reading 4			Reading 5		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

		Reading 6			Reading 7		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

		Reading 8			Reading 9		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 29/06/2023 **Infiltration tes #:** **F3-C**

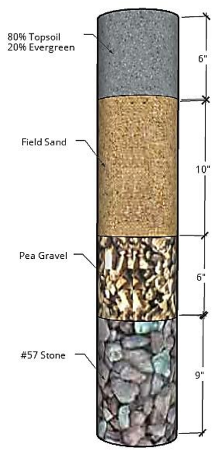
Columns #: 4,5,6

Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.
Saturation start: 11:00 p.m.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
4	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
5	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
6	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		
Column	Sample	Initial Hour	Water over the sample	Hour	Time (min)	Volumen (ml)
4	1	9:00:00	61.0 cm	10:00:00	4.0 min	106.0 ml
5	2	9:00:00	61.0 cm	10:00:00	4.0 min	80.0 ml
6	3	9:00:00	61.0 cm	10:00:00	4.0 min	91.0 ml

		Reading 2			Reading 3		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1	13:00:00	4.0 min	90.0 ml	15:00:00	4.0 min	87.0 ml
5	2	13:00:00	4.0 min	67.0 ml	15:00:00	4.0 min	64.0 ml
6	3	13:00:00	4.0 min	76.0 ml	15:00:00	4.0 min	72.0 ml

		Reading 4			Reading 5		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 6			Reading 7		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 8			Reading 9		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 30/06/2023 **Infiltration tes #:** **FC-F1**

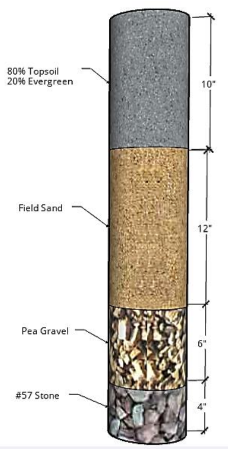
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	1.10 g/cm3	3750.1 g
Ever Green	20%					937.6 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	4.0 in	10.2 cm	1700.9 cm3	1.58 g/cm3	2687.5 g
		32.0 in	81.3 cm	13607.5 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm
2	2	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm
3	3	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
1	1	11:59:00	61.0 cm	12:19:00	1.7 cm	15:36:00	15.7 cm
2	2	11:59:00	61.0 cm	12:19:00	1.5 cm	15:36:00	15.7 cm
3	3	11:59:00	61.0 cm	12:19:00	1.5 cm	15:36:00	13.0 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	19:10:00	27.5 cm	23:15:00	37.6 cm	6:43:00	50.7 cm
2	2	19:10:00	27.8 cm	23:15:00	38.4 cm	6:43:00	52.5 cm
3	3	19:10:00	23.5 cm	23:15:00	33.2 cm	6:43:00	45.4 cm

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	10:41:00	57.0 cm				
2	2	10:41:00	58.5 cm				
3	3	10:41:00	51.2 cm	15:13:00	56.5 cm		

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 1/07/2023 **Infiltration tes #:** **FC-F2**

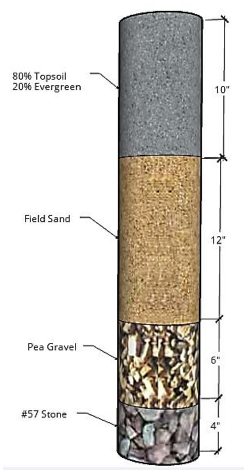
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	1.10 g/cm3	3750.1 g
Ever Green	20%					937.6 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	4.0 in	10.2 cm	1700.9 cm3	1.58 g/cm3	2687.5 g
		32.0 in	81.3 cm	13607.5 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm
2	2	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm
3	3	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
1	1	15:50:00	61.0 cm	17:37:00	5.5 cm	23:43:00	19.4 cm
2	2	15:50:00	61.0 cm	17:37:00	5.5 cm	23:43:00	19.3 cm
3	3	15:50:00	61.0 cm	17:37:00	5.0 cm	23:43:00	18.9 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	7:07:00	32.0 cm	10:28:00	36.9 cm	14:10:00	41.2 cm
2	2	7:07:00	32.0 cm	10:28:00	36.7 cm	14:10:00	40.7 cm
3	3	7:07:00	31.2 cm	10:28:00	35.6 cm	14:10:00	39.9 cm

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	21:47:00	48.5 cm	8:26:00	57.0 cm		
2	2	21:47:00	47.9 cm	8:26:00	56.4 cm		
3	3	21:47:00	46.0 cm	8:26:00	53.8 cm	14:02:00	57.0 cm

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 3/07/2023 **Infiltration tes #:** **FC-F3**

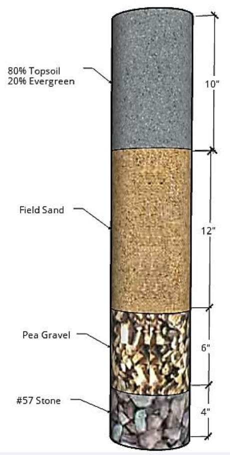
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	10.0 in	25.4 cm	4252.4 cm3	1.10 g/cm3	3750.1 g
Ever Green	20%					937.6 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	4.0 in	10.2 cm	1700.9 cm3	1.58 g/cm3	2687.5 g
		32.0 in	81.3 cm	13607.5 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm
2	2	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm
3	3	90.5 cm	80.3 cm	65.1 cm	34.6 cm	9.2 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
1	1	14:38:00	61.0 cm	15:20:00	1.0 cm	21:39:00	11.2 cm
2	2	14:38:00	61.0 cm	15:20:00	1.3 cm	21:39:00	12.2 cm
3	3	14:38:00	61.0 cm	15:20:00	1.0 cm	21:39:00	8.5 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	1:35:00	16.4 cm	6:18:00	21.6 cm	14:10:00	29.3 cm
2	2	1:35:00	18.4 cm	6:18:00	25.0 cm	14:10:00	34.2 cm
3	3	1:35:00	13.0 cm	6:18:00	17.7 cm	14:10:00	24.5 cm

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	12:55:00	44.8 cm	22:21:00	50.0 cm	15:51:00	57.5 cm
2	2	12:55:00	53.4 cm	22:21:00	61.0 cm		
3	3	12:55:00	39.0 cm	22:21:00	43.0 cm	15:51:00	49.5 cm

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3	22:41:00	51.9 cm				

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 30/06/2023 **Infiltration tes #:** **F3-F1**

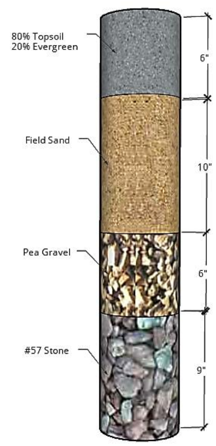
Columns #: 4,5,6

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

				COLUMNS 4,5,6		
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
4	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
5	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
6	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
4	1	11:59:00	61.0 cm	12:20:00	1.9 cm	15:37:00	17.0 cm
5	2	11:59:00	61.0 cm	12:20:00	1.9 cm	15:37:00	15.4 cm
6	3	11:59:00	61.0 cm	12:20:00	2.5 cm	15:37:00	18.9 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	19:11:00	29.5 cm	23:16:00	39.7 cm	6:44:00	55.6 cm
5	2	19:11:00	27.0 cm	23:16:00	37.8 cm	6:44:00	54.2 cm
6	3	19:11:00	31.0 cm	23:16:00	40.7 cm	6:44:00	57.5 cm

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	7:24:00	57.2 cm				
5	2	7:24:00	55.5 cm				
6	3	7:24:00	59.0 cm				

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 1/07/2023 **Infiltration tes #:** **F3-F2**

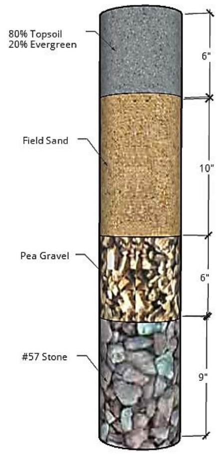
Columns #: 4,5,6

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
4	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
5	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
6	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
4	1	15:50:00	61.0 cm	17:38:00	9.0 cm	23:44:00	31.0 cm
5	2	15:50:00	61.0 cm	17:38:00	9.2 cm	23:44:00	31.6 cm
6	3	15:50:00	61.0 cm	17:38:00	10.7 cm	23:44:00	32.5 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	7:08:00	45.8 cm	10:29:00	52.0 cm	14:09:00	57.8 cm
5	2	7:08:00	44.4 cm	10:29:00	50.4 cm	14:09:00	56.1 cm
6	3	7:08:00	48.8 cm	10:29:00	55.5 cm	14:09:00	Before

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 3/07/2023 **Infiltration tes #:** **F3-F3**

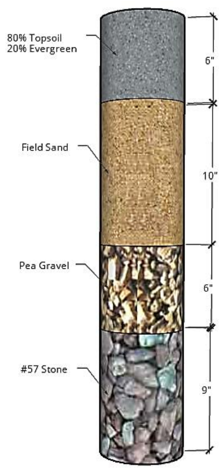
Columns #: 4,5,6

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
4	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
5	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
6	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

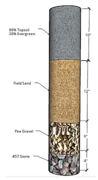
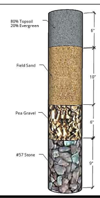
		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
4	1	14:38:00	61.0 cm	15:21:00	4.5 cm	21:40:00	27.5 cm
5	2	14:38:00	61.0 cm	15:21:00	4.6 cm	21:40:00	27.6 cm
6	3	14:38:00	61.0 cm	15:21:00	6.1 cm	21:40:00	36.2 cm

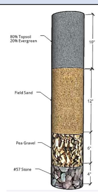
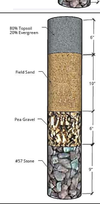
		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	1:36:00	36.5 cm	6:19:00	44.6 cm	14:11:00	58.0 cm
5	2	1:36:00	36.8 cm	6:19:00	45.3 cm	14:11:00	58.6 cm
6	3	1:36:00	47.6 cm	6:19:00	59.3 cm	14:11:00	Before

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

CONSTANT HEAD TEST - WATER HEAD: 2 FT				FIRST READING - 1 Hour	SECOND READING - 4 Hours	THIRD READING - 6 Hours	GENERAL RESULTS
SAMPLE OUTLINE		COLUMNS	ITEM	RESULTS	RESULTS	RESULTS	AVERAGE
Fc		1,2,3 Time: 5 min	Average	**5.89 ft/day**	**5.08 ft/day**	**4.95 ft/day**	**5.31 ft/day**
			Sample 1	6.38 ft/day	5.36 ft/day	5.36 ft/day	5.70 ft/day
			Sample 2	6.43 ft/day	5.64 ft/day	5.31 ft/day	5.79 ft/day
			Sample 3	4.85 ft/day	4.23 ft/day	4.18 ft/day	4.42 ft/day
			SD	0.90 ft/day	0.75 ft/day	0.67 ft/day	0.77 ft/day
F3		4,5,6 Time: 4 min	Average	**6.51 ft/day**	**5.48 ft/day**	**5.24 ft/day**	**5.75 ft/day**
			Sample 1	7.48 ft/day	6.35 ft/day	6.14 ft/day	6.66 ft/day
			Sample 2	5.64 ft/day	4.73 ft/day	4.52 ft/day	4.96 ft/day
			Sample 3	6.42 ft/day	5.36 ft/day	5.08 ft/day	5.62 ft/day
			SD	0.92 ft/day	0.82 ft/day	0.82 ft/day	0.85 ft/day

FALLING HEAD TEST - WATER HEAD: 2 FT				FIRST TEST	SECOND TEST	THIRD TEST	GENERAL RESULTS
SAMPLE OUTLINE		COLUMNS	ITEM	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	AVERAGE
Fc		1,2,3	Average	**1.88 ft/day**	**1.06 ft/day**	**0.84 ft/day**	**1.26 ft/day**
			Sample 1	1.98 ft/day	1.11 ft/day	0.92 ft/day	1.33 ft/day
			Sample 2	2.03 ft/day	1.09 ft/day	0.86 ft/day	1.33 ft/day
			Sample 3	1.63 ft/day	0.97 ft/day	0.73 ft/day	1.11 ft/day
			SD	0.21 ft/day	0.07 ft/day	0.10 ft/day	0.13 ft/day
F3		4,5,6	Average	**2.32 ft/day**	**2.12 ft/day**	**2.29 ft/day**	**2.24 ft/day**
			Sample 1	2.32 ft/day	2.04 ft/day	1.94 ft/day	2.10 ft/day
			Sample 2	2.25 ft/day	1.98 ft/day	1.96 ft/day	2.06 ft/day
			Sample 3	2.39 ft/day	2.34 ft/day	2.98 ft/day	2.57 ft/day
			SD	0.07 ft/day	0.20 ft/day	0.59 ft/day	0.28 ft/day

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 8/03/2023 **Infiltration tes #:** **F3G-C**

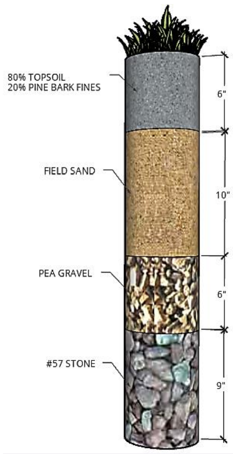
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.
Saturation start: 9:20 p.m.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	**Sample**	**Colum height**	**1**	**2**	**3**	**4**
1	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
2	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
3	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		
Column	**Sample**	**Initial Hour**	**Water over the sample**	**Hour**	**Time (min)**	**Volumen (ml)**
1	1	9:00:00	61.0 cm	10:00:00	4.0 min	230.0 ml
2	2	9:00:00	61.0 cm	10:00:00	4.0 min	124.0 ml
3	3	9:00:00	61.0 cm	10:00:00	4.0 min	302.0 ml

		Reading 2			Reading 3		
Column	**Sample**	**Hour**	**Time (min)**	**Volumen (ml)**	**Hour**	**Time (min)**	**Volumen (ml)**
1	1	13:00:00	4.0 min	188.0 ml	15:00:00	4.0 min	176.0 ml
2	2	13:00:00	4.0 min	109.0 ml	15:00:00	4.0 min	106.0 ml
3	3	13:00:00	4.0 min	256.0 ml	15:00:00	4.0 min	260.0 ml

		Reading 4			Reading 5		
Column	**Sample**	**Hour**	**Time (min)**	**Volumen (ml)**	**Hour**	**Time (min)**	**Volumen (ml)**
1	1						
2	2						
3	3						

		Reading 6			Reading 7		
Column	**Sample**	**Hour**	**Time (min)**	**Volumen (ml)**	**Hour**	**Time (min)**	**Volumen (ml)**
1	1						
2	2						
3	3						

		Reading 8			Reading 9		
Column	**Sample**	**Hour**	**Time (min)**	**Volumen (ml)**	**Hour**	**Time (min)**	**Volumen (ml)**
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - CONSTANT HEAD

Date: 3/08/2023 **Infiltration tes #:** AG-C

Columns #: 4,5,6

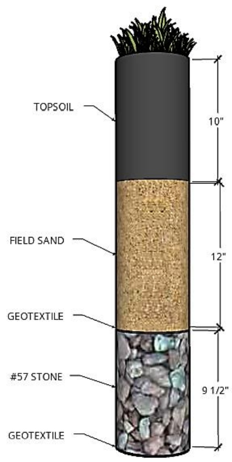
Test done by: Diego Ramirez

Observation: Samples totally saturated before starting the test.

Saturation start: 8/02/2023, 9:20 pm

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.55 g/cm3	6608.2 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	90.5 cm	66.4 cm	35.9 cm	10.5 cm	9:00:00	61.0 cm
5	2	90.5 cm	66.4 cm	35.9 cm	10.5 cm	9:00:00	61.0 cm
6	3	90.5 cm	66.4 cm	35.9 cm	10.5 cm	9:00:00	61.0 cm

		Reading 1			Reading 2		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1	10:00:00	10.0 min	37.0 ml	13:00:00	10.0 min	34.0 ml
5	2	10:00:00	10.0 min	30.0 ml	13:00:00	10.0 min	28.0 ml
6	3	10:00:00	10.0 min	34.0 ml	13:00:00	10.0 min	33.0 ml

		Reading 3			Reading 4		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1	15:00:00	10.0 min	33.0 ml			
5	2	15:00:00	10.0 min	28.0 ml			
6	3	15:00:00	10.0 min	34.0 ml			

		Reading 5			Reading 6		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 7			Reading 8		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

		Reading 9			Reading 10		
Column	Sample	Hour	Time (min)	Volumen (ml)	Hour	Time (min)	Volumen (ml)
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 8/03/2023 **Infiltration tes #:** **F3G-F1**

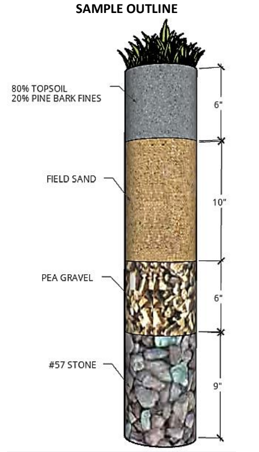
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
2	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
3	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
1	1	15:29:00	61.0 cm	16:41:00	14.6 cm	19:48:00	39.7 cm
2	2	15:29:00	61.0 cm	16:41:00	9.3 cm	19:48:00	28.2 cm
3	3	15:29:00	61.0 cm	16:41:00	18.6 cm	19:48:00	46.0 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	21:22:00	46.7 cm	22:42:00	52.9 cm		
2	2	21:22:00	35.2 cm	22:42:00	39.2 cm	5:08:00	61.0 cm
3	3	21:22:00	57.0 cm	22:42:00	Before		

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 8/07/2023 **Infiltration tes #:** **F3G-F2**

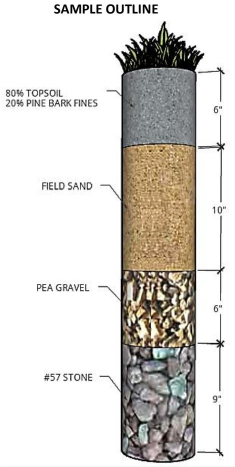
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
2	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
3	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
1	1	11:37:00	61.0 cm	12:07:00	20.5 cm	12:47:00	39.0 cm
2	2	11:37:00	61.0 cm	12:07:00	10.0 cm	12:47:00	20.5 cm
3	3	11:37:00	61.0 cm	12:07:00	17.1 cm	12:47:00	33.6 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	13:37:00	54.0 cm	13:50:00	57.0 cm	14:34:00	Before
2	2	13:37:00	31.0 cm	13:50:00	32.7 cm	14:34:00	39.5 cm
3	3	13:37:00	46.0 cm	13:50:00	48.5 cm	14:34:00	58.5 cm

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2	16:21:00	52.0 cm	16:57:00	56.0 cm		
3	3						

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 8/07/2023 **Infiltration tes #:** **F3G-F3**

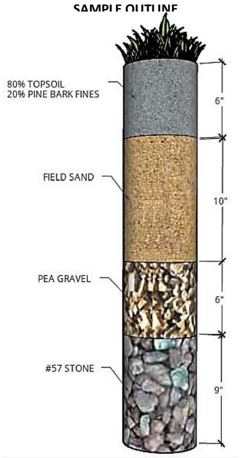
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
2	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
3	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
1	1	17:09:00	61.0 cm	19:12:00	29.4 cm	20:46:00	43.0 cm
2	2	17:09:00	61.0 cm	19:12:00	29.4 cm	20:46:00	43.6 cm
3	3	17:09:00	61.0 cm	19:12:00	31.0 cm	20:46:00	45.0 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	22:23:00	55.1 cm				
2	2	22:23:00	55.0 cm				
3	3	22:23:00	57.6 cm				

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 8/08/2023 **Infiltration tes #:** **F3G-F4**

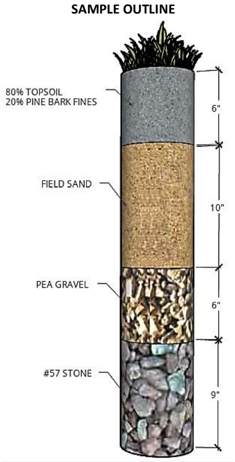
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
2	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
3	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
1	1	12:03:00	61.0 cm	12:33:00	12.5 cm	14:20:00	41.5 cm
2	2	12:03:00	61.0 cm	12:33:00	6.4 cm	14:20:00	23.5 cm
3	3	12:03:00	61.0 cm	12:33:00	12.5 cm	14:20:00	41.0 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	15:22:00	51.5 cm	15:48:00	56.0 cm	19:13:00	Before
2	2	15:22:00	31.5 cm	15:48:00	34.6 cm	19:13:00	54.2 cm
3	3	15:22:00	51.7 cm	15:48:00	56.4 cm	19:13:00	Before

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 8/09/2023 **Infiltration tes #:** **F3G-F5**

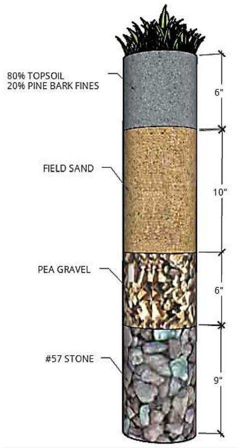
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
2	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
3	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
1	1	14:45:00	61.0 cm	15:02:00	9.5 cm	17:24:00	50.4 cm
2	2	14:45:00	61.0 cm	15:02:00	4.6 cm	17:24:00	32.3 cm
3	3	14:45:00	61.0 cm	15:02:00	9.5 cm	17:24:00	50.5 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	17:56:00	57.0 cm				
2	2	17:56:00	36.4 cm	20:43:00	55.3 cm		
3	3	17:56:00	57.1 cm				

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 08/13/2023 **Infiltration tes #:** **F3G-F6**

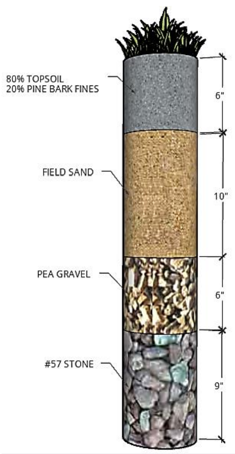
Columns #: 1,2,3

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 1,2,3					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	80%	6.0 in	15.2 cm	2551.4 cm3	1.10 g/cm3	2250.1 g
Ever Green	20%					562.6 g
Field Sand	100%	10.0 in	25.4 cm	4252.4 cm3	1.50 g/cm3	6378.5 g
Pea gravel	100%	6.0 in	15.2 cm	2551.4 cm3	1.62 g/cm3	4133.3 g
57 stone	100%	9.0 in	22.9 cm	3827.1 cm3	1.58 g/cm3	6046.8 g
		31.0 in	78.7 cm	13182.3 cm3		

SAMPLE OUTLINE



	Column 1	Column 2	Column 3
Final sample depth			
Settlement			

			Layer depth inside the colum			
Column	Sample	Colum height	1	2	3	4
1	1	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
2	2	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm
3	3	90.5 cm	67.6 cm	52.4 cm	27.0 cm	11.8 cm

		Initial data		Reading 1		Reading 2	
Column	Sample	Initial Hour	Water over the sample	Hour	Infiltrated water	Hour	Infiltrated water
1	1	15:41:00	61.0 cm	16:11:00	22.4 cm	16:52:00	43.0 cm
2	2	15:41:00	61.0 cm	16:11:00	13.0 cm	16:52:00	27.4 cm
3	3	15:41:00	61.0 cm	16:11:00	20.5 cm	16:52:00	40.0 cm

		Reading 3		Reading 4		Reading 5	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1	17:20:00	43.0 cm	17:33:00	57.5 cm		
2	2	17:20:00	27.4 cm	17:33:00	37.5 cm	19:20:00	56.4 cm
3	3	17:20:00	40.0 cm	17:33:00	52.5 cm		

		Reading 6		Reading 7		Reading 8	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 9		Reading 10		Reading 11	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

		Reading 12		Reading 13		Reading 14	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
1	1						
2	2						
3	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 8/03/2023 **Infiltration tes #:** AG-F1

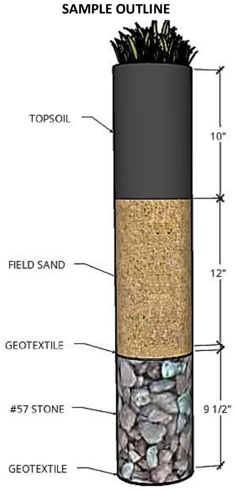
Columns 4.5.6

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.55 g/cm3	6608.2 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	90.5 cm	66.4 cm	35.9 cm	10.5 cm	15:29:00	61.0 cm
5	2	90.5 cm	66.4 cm	35.9 cm	10.5 cm	15:29:00	61.0 cm
6	3	90.5 cm	66.4 cm	35.9 cm	10.5 cm	15:29:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	16:46:00	2.2 cm	19:54:00	5.3 cm	22:43:00	6.6 cm
5	2	16:46:00	2.3 cm	19:54:00	4.7 cm	22:43:00	5.7 cm
6	3	16:46:00	2.0 cm	19:54:00	5.2 cm	22:43:00	7.0 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	5:40:00	12.8 cm	14:05:00	19.4 cm	21:27:00	24.7 cm
5	2	5:40:00	10.9 cm	14:05:00	16.2 cm	21:27:00	21.0 cm
6	3	5:40:00	13.4 cm	14:05:00	19.5 cm	21:27:00	24.5 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	10:58:00	32.9 cm	20:59:00	38.5 cm	14:13:00	43.0 cm
5	2	10:58:00	27.8 cm	20:59:00	32.0 cm	14:13:00	38.2 cm
6	3	10:58:00	32.0 cm	20:59:00	36.5 cm	14:13:00	41.8 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	23:41:00	46.0 cm	10:55:00	49.7 cm		
5	2	23:41:00	40.3 cm	10:55:00	42.8 cm		
6	3	23:41:00	44.4 cm	10:55:00	48.2 cm		

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: ____________ **Infiltration tes #:** AG-F2

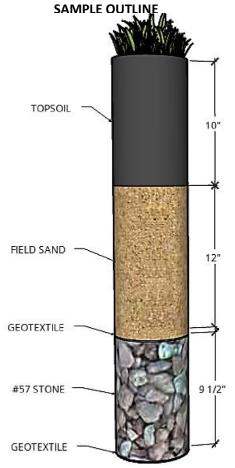
Columns 4.5.6

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.55 g/cm3	6608.2 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	90.5 cm	66.4 cm	35.9 cm	10.5 cm	11:37:00	61.0 cm
5	2	90.5 cm	66.4 cm	35.9 cm	10.5 cm	11:37:00	61.0 cm
6	3	90.5 cm	66.4 cm	35.9 cm	10.5 cm	11:37:00	61.0 cm

		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	12:07:00	0.2 cm	12:48:00	0.7 cm	14:44:00	2.0 cm
5	2	12:07:00	0.2 cm	12:48:00	0.5 cm	14:44:00	1.5 cm
6	3	12:07:00	0.2 cm	12:48:00	0.6 cm	14:44:00	1.8 cm

		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	19:13:00	4.5 cm	22:24:00	6.5 cm	11:13:00	13.0 cm
5	2	19:13:00	3.5 cm	22:24:00	5.0 cm	11:13:00	10.5 cm
6	3	19:13:00	4.1 cm	22:24:00	5.7 cm	11:13:00	12.0 cm

		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	19:13:00	17.0 cm	13:50:00	25.0 cm	17:25:00	26.4 cm
5	2	19:13:00	13.4 cm	13:50:00	20.0 cm	17:25:00	21.5 cm
6	3	19:13:00	15.5 cm	13:50:00	22.9 cm	17:25:00	24.1 cm

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	20:44:00	27.5 cm	14:08:00	34.2 cm	15:09:00	52.6 cm
5	2	20:44:00	22.2 cm	14:08:00	27.9 cm	15:09:00	44.7 cm
6	3	20:44:00	25.7 cm	14:08:00	31.0 cm	15:09:00	47.2 cm

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

WATER INFILTRATION TEST
AUBURN STORMWATER
CLEAR COLUMS - FALLING HEAD

Date: 13/08/2008 **Infiltration tes #:** AG-F3

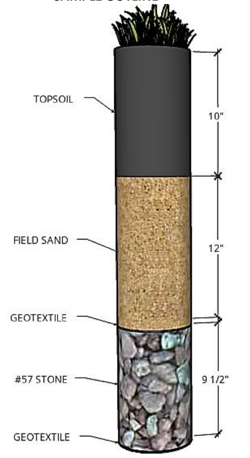
Columns : 4.5.6

Test done by: Diego Ramirez

Observation: Samples totally saturated before start the test.

	COLUMNS 4,5,6					
Materials	% by weight	Height	Height	Volumen	Density	Weight
Top soil	100%	10.0 in	25.4 cm	4252.4 cm3	1.55 g/cm3	6608.2 g
Field Sand	100%	12.0 in	30.5 cm	5102.8 cm3	1.50 g/cm3	7654.2 g
57 stone	100%	9.5 in	24.1 cm	4039.7 cm3	1.58 g/cm3	6382.8 g
		31.5 in	80.0 cm	13394.9 cm3		

SAMPLE OUTLINE



	Column 4	Column 5	Column 6
Final sample depth			
Settlement			

			Layer depth inside the colum			Initial data	
Column	Sample	Colum height	1	2	3	Initial Hour	Water over the sample
4	1	90.5 cm	66.4 cm	35.9 cm	10.5 cm	15:41:00	61.0 cm
5	2	90.5 cm	66.4 cm	35.9 cm	10.5 cm	15:41:00	61.0 cm
6	3	90.5 cm	66.4 cm	35.9 cm	10.5 cm	15:41:00	61.0 cm

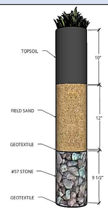
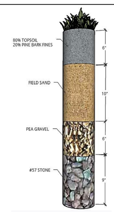
		Reading 1		Reading 2		Reading 3	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	17:34:00	0.5 cm	9:54:00	7.6 cm	15:46:00	10.4 cm
5	2	17:34:00	0.6 cm	9:54:00	6.6 cm	15:46:00	8.8 cm
6	3	17:34:00	0.5 cm	9:54:00	6.4 cm	15:46:00	8.5 cm

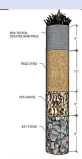
		Reading 4		Reading 5		Reading 6	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1	13:05:00	18.5 cm				
5	2	13:05:00	16.0 cm				
6	3	13:05:00	14.5 cm				

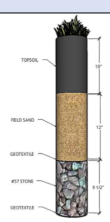
		Reading 7		Reading 8		Reading 9	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 10		Reading 11		Reading 12	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

		Reading 13		Reading 14		Reading 15	
Column	Sample	Hour	Infiltrated water	Hour	Infiltrated water	Hour	Infiltrated water
4	1						
5	2						
6	3						

CONSTANT HEAD TEST - WATER HEAD: 2 FT				FIRST READING - 1 Hour	SECOND READING - 4 Hours	THIRD READING - 6 Hours	GENERAL RESULTS
SAMPLE OUTLINE		COLUMNS	ITEM	RESULTS	RESULTS	RESULTS	AVERAGE
ALDOT + GRASS		4,5,6 Time of water discharged collection: 10 min	Average	**0.95 ft/day**	**0.89 ft/day**	**0.89 ft/day**	**0.91 ft/day**
			Sample 1	1.04 ft/day	0.96 ft/day	0.93 ft/day	0.98 ft/day
			Sample 2	0.85 ft/day	0.79 ft/day	0.79 ft/day	0.81 ft/day
			Sample 3	0.96 ft/day	0.93 ft/day	0.96 ft/day	0.95 ft/day
			SD	0.10 ft/day	0.09 ft/day	0.09 ft/day	0.09 ft/day
F3 + GRASS		1,2,3 Time of water discharged collection: 4 min	Average	**15.43 ft/day**	**13.00 ft/day**	**12.75 ft/day**	**13.73 ft/day**
			Sample 1	16.23 ft/day	13.26 ft/day	12.42 ft/day	13.97 ft/day
			Sample 2	8.75 ft/day	7.69 ft/day	7.48 ft/day	7.97 ft/day
			Sample 3	21.31 ft/day	18.06 ft/day	18.34 ft/day	19.24 ft/day
			SD	6.32 ft/day	5.19 ft/day	5.44 ft/day	5.64 ft/day

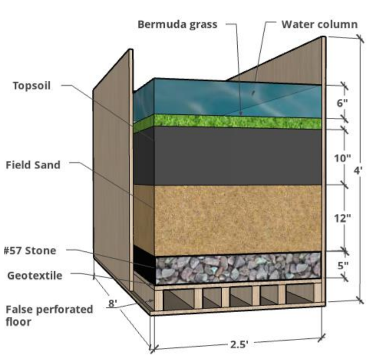
FALLING HEAD TEST - WATER HEAD: 2 FT				FIRST TEST	SECOND TEST	THIRD TEST	FOURTH TEST	FITH TEST	SIXTH TEST	GENERAL RESULTS
SAMPLE OUTLINE		COLUMNS	ITEM	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	AVERAGE
F3 + GRASS		1,2,3	Average	**5.64 ft/day**	**14.71 ft/day**	**8.41 ft/day**	**9.85 ft/day**	**11.84 ft/day**	**19.52 ft/day**	**11.66 ft/day**
			Sample 1	5.77 ft/day	20.25 ft/day	8.29 ft/day	11.76 ft/day	14.10 ft/day	24.25 ft/day	14.07 ft/day
			Sample 2	3.52 ft/day	8.27 ft/day	8.28 ft/day	5.95 ft/day	7.30 ft/day	12.17 ft/day	7.58 ft/day
			Sample 3	7.63 ft/day	15.61 ft/day	8.67 ft/day	11.84 ft/day	14.12 ft/day	22.15 ft/day	13.34 ft/day
			SD	2.06 ft/day	6.04 ft/day	0.22 ft/day	3.38 ft/day	3.93 ft/day	6.46 ft/day	3.68 ft/day

FALLING HEAD TEST - WATER HEAD: 2 FT				FIRST TEST	SECOND TEST	THIRD TEST	GENERAL RESULTS
SAMPLE OUTLINE		COLUMNS	ITEM	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	SATURATED SAMPLES RESULTS	AVERAGE
ALDOT + GRASS		4,5,6	Average	**0.40 ft/day**	**0.26 ft/day**	**0.28 ft/day**	**0.31 ft/day**
			Sample 1	0.43 ft/day	0.28 ft/day	0.32 ft/day	0.34 ft/day
			Sample 2	0.37 ft/day	0.24 ft/day	0.28 ft/day	0.29 ft/day
			Sample 3	0.42 ft/day	0.25 ft/day	0.25 ft/day	0.31 ft/day
			SD	0.03 ft/day	0.02 ft/day	0.04 ft/day	0.03 ft/day

APPENDIX C

Infiltration Tests Data – Infiltration chamber

CONSTANT HEAD TEST - WATER HEAD: 0.5 FT										
SAMPLE OUTLINE	Constant head test	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	AVERAGE
ALDOT	1	9.15 ft/day	9.76 ft/day	9.76 ft/day	10.07 ft/day	10.07 ft/day	10.30 ft/day	N/A	N/A	9.85 ft/day
	2	4.58 ft/day	6.41 ft/day	6.29 ft/day	8.54 ft/day	8.09 ft/day	8.34 ft/day	8.37 ft/day	8.39 ft/day	7.38 ft/day
	3	4.22 ft/day	5.90 ft/day	6.23 ft/day	6.23 ft/day	6.59 ft/day	6.64 ft/day	6.76 ft/day	7.63 ft/day	6.27 ft/day
	4	4.58 ft/day	5.19 ft/day	5.85 ft/day	6.41 ft/day	6.36 ft/day	5.49 ft/day	5.77 ft/day	5.82 ft/day	5.68 ft/day
	5	3.97 ft/day	5.72 ft/day	6.05 ft/day	6.08 ft/day	6.25 ft/day	6.76 ft/day	6.76 ft/day	6.92 ft/day	5.81 ft/day
	6	4.58 ft/day	5.85 ft/day	6.01 ft/day	6.15 ft/day	6.66 ft/day	6.56 ft/day	6.66 ft/day	6.64 ft/day	6.14 ft/day
	7	4.63 ft/day	5.64 ft/day	5.92 ft/day	6.08 ft/day	6.23 ft/day	6.28 ft/day	6.43 ft/day	6.28 ft/day	5.94 ft/day
	8	6.20 ft/day	5.64 ft/day	5.92 ft/day	6.08 ft/day	6.08 ft/day	6.13 ft/day	6.25 ft/day	6.28 ft/day	6.07 ft/day
	9	3.64 ft/day	5.19 ft/day	5.57 ft/day	5.72 ft/day	5.57 ft/day	5.72 ft/day	6.33 ft/day	6.20 ft/day	5.49 ft/day
								GENERAL AVERAGE		6.51 ft/day



CONSTANT HEAD TEST - WATER HEAD: 0.5 FT										
SAMPLE OUTLINE	Constant head test	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	AVERAGE
F3	1	99.14 ft/day	93.28 ft/day	88.02 ft/day	82.01 ft/day	77.36 ft/day	75.97 ft/day	74.12 ft/day	69.83 ft/day	82.47 ft/day
	2	104.85 ft/day	93.99 ft/day	86.76 ft/day	81.78 ft/day	75.48 ft/day	74.01 ft/day	73.08 ft/day	57.00 ft/day	80.87 ft/day
	3	86.41 ft/day	91.88 ft/day	93.00 ft/day	81.95 ft/day	78.73 ft/day	74.74 ft/day	73.72 ft/day	73.35 ft/day	81.72 ft/day
	4	103.58 ft/day	104.50 ft/day	97.61 ft/day	91.68 ft/day	83.98 ft/day	80.31 ft/day	79.22 ft/day	77.23 ft/day	89.76 ft/day
	5	111.69 ft/day	108.08 ft/day	99.27 ft/day	102.15 ft/day	98.97 ft/day	95.53 ft/day	88.31 ft/day	83.11 ft/day	98.39 ft/day
	6	104.73 ft/day	96.52 ft/day	92.01 ft/day	86.72 ft/day	85.02 ft/day	84.32 ft/day	82.98 ft/day	80.83 ft/day	89.14 ft/day
								GENERAL AVERAGE		87.06 ft/day