FINAL DRAINAGE LETTER

FOR

LOT 12, CLAREMONT BUSINESS PARK FILING NO. 2 EL PASO COUNTY, COLORADO

AUGUST 2017

Include the following as attachments.
1. WQCV calculation. **Unresolved.**
2. Percolation Test. **Unresolved.**

Prepared for:

Hammers Construction, Inc.
1411 Woolsey Heights
Colorado Springs, CO 80915

Prepared by:

M&S CIVIL CONSULTANTS, INC.

20 Boulder Crescent, Suite 110
Colorado Springs, CO 80903
(719) 955-5485

Project #44-026
PCD Project No. PPR-17-026

DRAINAGE LETTER
FOR
Lot 12, Claremont Business Park Filing No. 2

DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria acceptable to the City of Colorado Springs. I accept responsibility for any liability caused by any negligent acts, errors of omission on my part in preparing this report.

____
Virgil A. Sanchez, P.E. #37160
For and on Behalf of M&S Civil Consultants, Inc

DEVELOPER'S STATEMENT

I, the developer have read and will comply with all the requirements specified in this drainage report and plan.

BY:__________________________________

TITLE:__________________________
DATE:__________________________

ADDRESS: Hammers Construction, LLC
1411 Woolsey Heights
Colorado Springs, CO 80915

EL PASO COUNTY'S STATEMENT

Filed in accordance with the requirements of El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Manual, as amended.

BY:______________________________ DATE:___________________
Jennifer Irvine, P.E.
County Engineer / ECM Administrator

CONDITIONS:

CIVIL CONSULTANTS, INC.

20 Boulder Crescent, Suite 110
Colorado Springs, CO 80903
Mail to: P.O. Box 1360
Colorado Springs, CO 80901
719.955.5485

August 7, 2017

Attn: Jennifer Irvine, P.E.
El Paso County Engineer
2880 International Circle
Colorado Springs, Colorado 80910

RE: Final Drainage Letter for Lot 12, Claremont Business Park Filing No. 2, in El Paso County, Colorado.

Dear Jennifer,

The purpose of this letter is to show that there shall be no negative drainage effects associated with the proposed development of Lot 12 within the Claremont Business Park Filing No. 2, recorded January 4, 2007 under Reception No. 207712506 of the El Paso County Records. This final drainage letter is being submitted concurrently with the improvement construction plans proposing a 5000 SF building and the associated parking improvements.

Property Description:

The proposed project site is within the Northeast Quarter of Section 8, Township 14 South, Range 65 West of the 6th Principal Meridian. Lot 12 consist of 0.4 acres and is currently vacant. The proposed project consist of all infrastructure typically associated with a 5,000 SF building structure. The majority of the site will consist of asphalt, curb, lighting, a subsurface Storm Water Quality Facility and landscaping.

Existing Drainage Characteristics.

The site, which is located Northwest of Meadowbrook Parkway, within an establish commercial / light industrial neighborhood is bound to the Northeast by Cole View private roadway, and then to the Southeast and Southwest by commercial lots, and then to the Northwest by the vacant Lot 13. The site is currently vacant land with a relatively new roadway infrastructure and associated utilities with slopes ranging between 0-4 % from Northeast to Southwest. Flows from the site run along the north side of an existing retaining wall along the southern border of the property line and then eventually outfalls to an existing storm sewer collection system at the Southwest corner of Lot 13 and ultimately discharges to the East Fork Sand Creek.

Floodplain Statement

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) No. 08041C0756 F, dated March 17, 1997, none of the site lies in a designated flood plain. The nearest major drainage way is East Fork Sand Creek just Northwest of the commercial business park.

Proposed drainage characteristics:

The proposed project consist of all infrastructure typically associated with a 5,000 SF building structure. The majority of the site will consist of asphalt, curb, lighting, a subsurface Storm Water Quality Facility and landscaping. The subject site was previously analyzed within the Final Drainage Report for Claremont Business Park Filing No. 2 prepared by Matrix Design Group approved April 24, 2007. On-site WQCV is required but on-site stormwater detention is not required per the FDR for Claremont Business Park Fil. 2.

The developed flows from Lot 12 shall be directed to a subsurface Storm Water Quality Facility along the Northwest property line of Lot 12. (See Grading plan).

Flows released from the subsurface Storm Water Quality Facility and any additional overflow shall outfall to a 3' wide curb opening at the Southwest corner of the site. Then continue along the north side of the existing retaining wall on the southern border of the property line of Lot 13 (West) and then eventually outfall to an existing storm sewer collection system at the Southwest corner of Lot 13 and ultimately discharges to the East Fork Sand Creek.

Collected flows from Lot 11 (East) and any overflow shall pass along the southern property line of the Lot 12 via curb and outfall through the 3' wide curb opening at the southwest corner of Lot 12.

FOUR STEP PROCESS

Step1 Employ Runoff Reduction Practices – The project does not provide any runoff reduction practices.

Step 2 Stabilize Drainageways – The site is indirectly adjacent to the Sand Creek Channel. The Lot 12 site proposed a subsurface Storm Water Quality Facility before discharging East Fork Sand Creek. The proposed WQ system has been designed to drain a peak event within 12 hours, therefore is not anticipated to have negative effects on downstream drainageways.

Step 3 Provide Water Quality Capture Volume – A subsurface Storm Water Quality Facility is proposed to provide WQCV.

Step4 Consider Need for Industrial and Commercial BMP's – This submittal provides a final grading and erosion control plans with BMPs in place. The proposed project will use silt fence, a vehicle tracking control pad, concrete washout area, mulching and reseeding to mitigate the potential for erosion across the site.

Water Quality Provisions:

Lot 12's on-site WQCV shall be directed to a subsurface Storm Water Quality Facility as detailed on the grading plans. (See Grading plan included within this report). The proposed Water Quality Facility is an experimental system per ECM Section 1.7.2. A performance monitoring program will be established and the experimental system will be replaced at the owner's expense should the WQ Facility not function to the required level of performance. The percolation test findings per the Percolation Test by Geoquest, LLC dated October 13, 2016 (included within the report), conclude that the test holes drained at a rate of 17.3 minutes per inch. The proposed subsurface Water Quality Facility is expected to drain the WQCV of 339 CF within 3.63 hrs in which meets the UDFCD minimum requirement of 2 times the rate within a 12 hour period for full infiltration section; therefore no underdrain system is required. Flows released from the subsurface Storm Water Quality Facility and any additional overflow shall outfall to a 3' wide curb opening at the Southwest corner of the site. Then continue along the north side of the existing retaining wall on the southern border of the property line of Lot 13 and then eventually outfall to an existing storm sewer collection system at the Southwest corner of Lot 13 and ultimately discharges to the East Fork Sand Creek.

Private Water Quality Facility - Cost Estimate:

Private Subsurface Water Quality Facility: **$14,750.00**

Drainage fees:

No drainage fees are due as the site has been previous platted.

Conclusion:

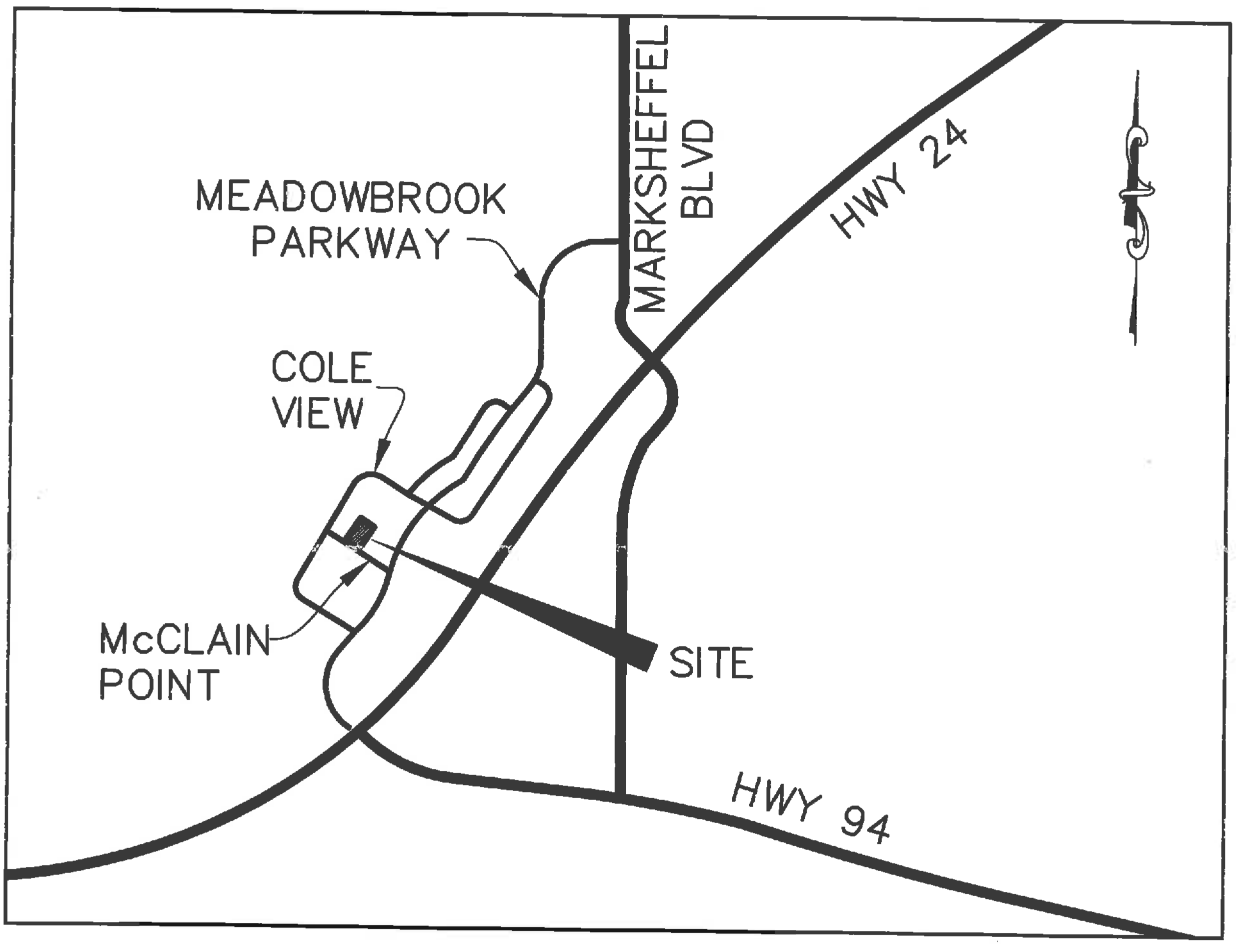
No negative drainage effects associated with the proposed development of Lot 12 within the Claremont Business Park Filing No. 2.

This proposal does not conflict or change the specifications as previously detailed within the "Final Drainage Report for Claremont Business Park Filing No. 2" prepared by Matrix Design Group approved April 24, 2007.

This letter has been prepared according to the County drainage criteria and is being submitted for approval. If you have any question about this submittal, please feel free to call me at 719-491-0818 or email me at Virgils@mscivil.com

Sincerely,

Virgil A. Sanchez



VICINITY MAP

N.T.S.

TECHNICAL NOTE

Storm Water Quality Units

TN 1.03
November 2007

Introduction

The ADS Storm Water Quality Unit (SWQU) is designed to remove pollutants from storm water during a storm event. ADS has modified its standard N-12® pipe to include weir plates at certain locations and heights to help facilitate sediment and oil removal from storm water. A bypass pipe is included in the storm water quality unit, so the system can focus on treating the "first flush". After the "first flush" has entered the system, the bypass pipe directs high volumes of storm water around the system.

Storm Water Treatment

The ADS SWQU is designed to treat the "first flush" of a storm event or lower volume storms. First flush refers to the initial runoff generated by a storm event. Relatively high concentrations of pollutants may be flushed into storm drains during a first flush. First flush pollutant concentrations are relatively high at the beginning of storms and drop off over time. Although it may vary based on site conditions, the first flush can contain over 80% of the pollutants that will be transported off a site.

It is a widely accepted practice to provide treatment for the first flush as opposed to treating the entire design storm event. Treating the first flush provides a high level of storm water quality at a much lower cost to the developer. The storm water runoff, which follows the first flush, is generally assumed to be relatively clean in comparison. Providing treatment for this "clean water" can often double, if not triple, the cost of treatment at a minimum. By treating the first flush one can provide a great benefit to the environment at a reasonable cost.

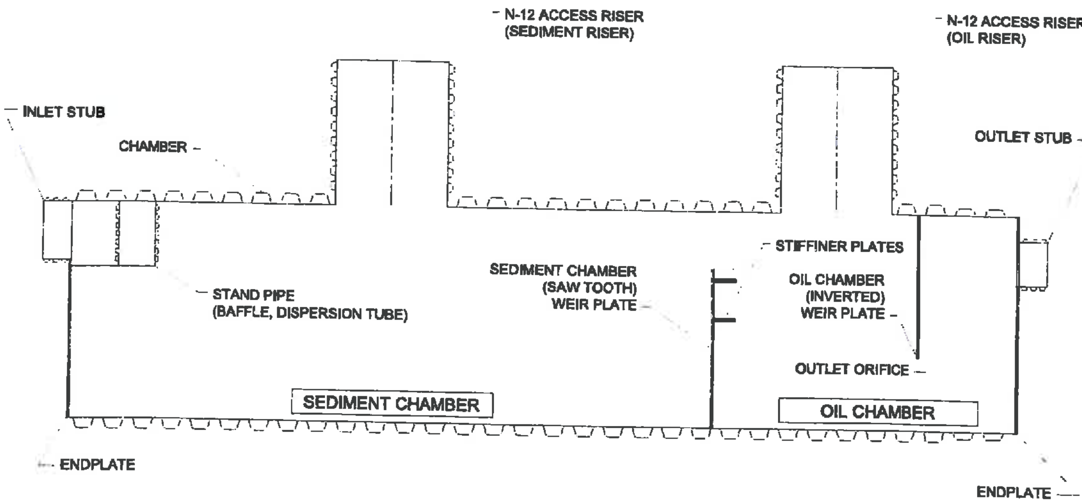
The treatment of the contaminated storm water is achieved through the use of weir plates installed at various locations within the unit. The storm water will enter the first chamber, or Sediment Chamber, which consists of an upright weir for trapping sediment. A second chamber, or Oil Chamber, uses an inverted weir to trap oils, grease, and debris. Figure 1 illustrates the typical layout of a SWQU. Field and lab testing of the unit indicate the following removal efficiencies:

- 80% Total Suspended Solids removal
- Greater than 43% Total Phosphorous removal
- 72% Heavy Metals removal
- Removal of floatable debris such as oils and greases

Testing reports and summaries are available by contacting your ADS Representative or Application Engineering. The flow through the unit is controlled at the outlet of the unit by using an orifice, thus categorizing the Storm Water Quality Unit as an outlet-controlled system. The design methodology behind outlet control is described in the entitled section Sizing a Storm Water Quality Unit.

When greater storm volumes are encountered, the addition of an external bypass allows the excess water to bypass the unit so as not to cause turbulent flow and possible resuspension of contaminants in the unit. This allows the lower volume storms and first flush events, where most contaminants are flushed off the pavement, to be trapped by the unit and remain there until the unit is cleaned.

Figure 1
Storm Water Quality Unit



Sizing a Storm Water Quality Unit

The ADS Storm Water Quality Unit is designed using the fundamental principles of Stoke's Law and a standard orifice equation. Stoke's Law is used to determine the settling velocity of a known particle size. The settling velocity can then be used to calculate the settling time, which is the time it takes a particle to fall a distance equal to the inlet pipe diameter plus 2 inches (50mm). The velocity through the chamber is found by dividing the treated flow rate by the cross sectional area of the storm water quality unit. The length of the sediment chamber can now be determined by taking the velocity through the chamber and multiplying by the settling time. After the length of the sediment chamber is established, the size of the orifice must be calculated. The orifice controls the amount of water entering the water quality unit. Once the treated flow rate is reached, excess water is diverted to the bypass. A standard orifice equation is used to find the diameter of the orifice. Example 1 provides an example calculation for sizing a Storm Water Quality Unit.

Example 1

Particle size: 140 sieve
Treated flow rate, Q_{treat} = 2.26 CFS
Assume 48 in. Water Quality Unit with 12 in. inlet pipe

<u>Stoke's Law to determine settling velocity:</u>

$$V_{settling} = 2gr^2 \frac{(\gamma_1 - \gamma_2)}{(9\mu)}$$

$V_{settling}$: Velocity of fall for a particle (ft/sec)
g : Acceleration of gravity = 32.2ft/ sec^2
r : Equivalent radius of particle
140 sieve: r = 0.000175 ft.
200 sieve: r = 0.000125 ft.

γ_1 : Density of particle (soil) = 3.69 slug/ ft^3

γ_2 : Density of medium (water) = 1.94 slug/ ft^3

μ : Viscosity of medium (water at 20° C) = 2.09 x 10^{-5} ibf-sec/ ft^2

$$V_{settling} = 2\left(32.2\frac{ft}{\sec^2}\right)(.000175ft)^2\left(\frac{\left(3.69\frac{slug}{ft^3} - 1.94\frac{slug}{ft^3}\right)}{\left(9\left(2.09x10^{-5}\frac{lbf-\sec}{ft^2}\right)\right)}\right) = 0.018 \text{ ft/sec.}$$

$V_{settling}$ = 0.018 ft/sec.

Settling Time:

$$T_{settling} = \frac{SD}{V_{settling}}$$

$T_{settling}$: Settling time for a particle of known size: (sec)

SD : Settling distance, inlet pipe diameter + 2 in. = (12.15 in. + 2 in.) = 1.18ft.

$V_{settling}$: Settling velocity = 0.018 ft/sec

$$T_{settling} = \frac{1.18ft.}{0.018\frac{ft}{\sec}} = 66\sec$$

$T_{settling}$ = 66 sec

Velocity through Sediment Chamber:

$$V_{SC} = \frac{Q_{treat}}{A_{WQU}}$$

V_{SC} : Velocity through the sediment chamber (ft/sec)

Q_{treat} : Flow at which one wants to treat for water quality = 2.26 CFS

A_{WQU} : Cross sectional area of the water quality unit = $\frac{\pi}{4}D^2 = \frac{\pi}{4}(4ft.)^2 = 12.57 ft^2$

$$V_{SC} = \frac{2.26\ CFS}{12.57\ ft^2} = 0.180\ \frac{ft}{\sec}$$

V_{SC} = 0.180 ft/sec

Length of Sediment Chamber:

$$L_{sediment} = (V_{SC})(T_{settling})$$

$L_{sediment}$: Length of the sediment chamber (ft.)

V_{SC} : Velocity through the sediment chamber = 0.180 ft/sec

$T_{settling}$: Settling time for a particle of known size = 65.56 sec

$$L_{sediment} = \left(0.180\frac{ft}{\text{sec}}\right)(66\,\text{sec}) = 12\,ft$$

$L_{sediment}$ = 12 ft.

Orifice Equation:

$$Q_{treat} = (C_d)(A_0)\sqrt{2gh_0}$$

Q_{treat} : Treated flow rate = 2.26 CFS

Cd : Coefficient = 0.56

A_0 : Area of the orifice = $\frac{\pi}{4}d_0^{\,2}$ (ft²)

g : Acceleration of gravity = 32.2 ft/sec^2

h_0 : Head pressure ft = SD = 1.18 ft.

Solving the equation for the diameter of the orifice:

$$d_0 = \left[\frac{4Q_{treat}}{0.56\pi(2gh_0)^{1/2}}\right]^{1/2} = \left[\frac{4(2.26CFS)}{0.56\pi\left(2\left(32.2\frac{ft}{\sec^2}\right)1.18ft\right)^{\frac{1}{2}}}\right]^{\frac{1}{2}} = 0.77\,ft.$$

d_0 = 0.77ft., Use 9.24" orifice

NOTE: Although the Water Quality Unit is installed level, there is a drop across the unit to provide for proper head pressure and system performance.

Conclusion

The ADS SWQU provides a cost efficient treatment option for a variety of applications while achieving removal efficiencies that meet or exceed most local minimum requirements for storm water treatment. The treatment of both settling and floating pollutants provides a good first level management technique that offers the user the opportunity to use the device in either a stand- alone configuration or as a step in a treatment train.

TECHNICAL NOTE

Testing of Storm Water Quality Units

TN 1.04
July 2007

Introduction

For the last 20 years storm water management has become an increasingly important issue in the United States. This has affected not only the larger metropolitan communities but has begun to become important in smaller rural communities around the country. The areas of interest for these projects are not only storm water quantity but also storm water quality. The ADS Storm Water Quality Unit (SWQU) provides the first step in the treatment train: removal of floating debris, suspended solids, and contaminants.

Development

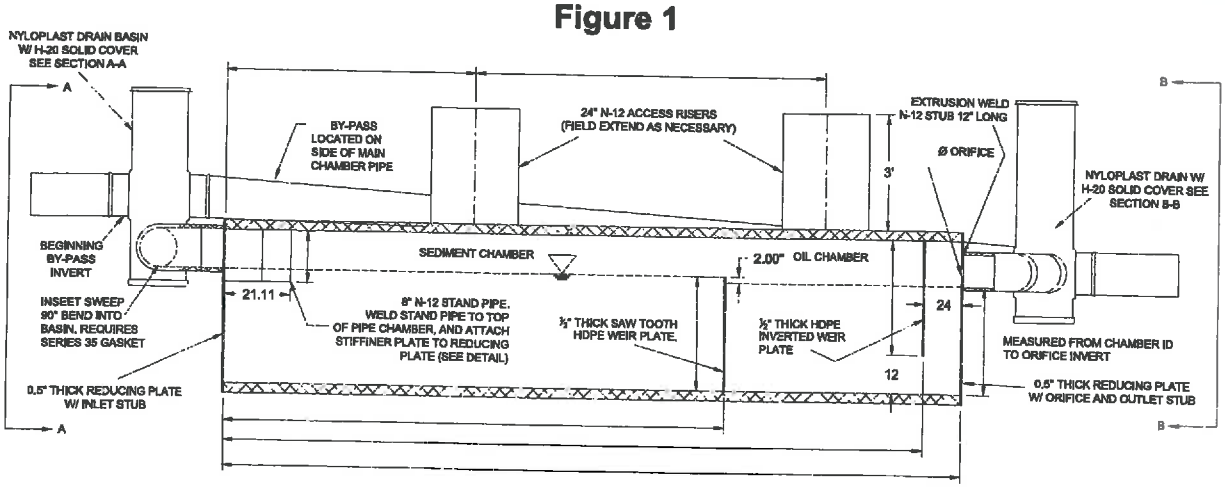
The ADS SWQU was developed to provide a simple, effective method for the control of storm water quality. The basic design of the unit is an oil grit separator. The unit consists of an upright weir for trapping sediment and an additional inverted weir for trapping the floatable particles such as oils, grease, and debris. This technology has been around for several years and is very effective until higher event storms. During intense storm events, oil grit separators are subject to resuspension of solids and washout of floating particles. Although the efficiency of the early units was fairly high, they had difficulty retaining the particles that were trapped during high volume storm events.

The ADS SWQU utilizes the same technology but improves upon it to provide a more efficient yet still simple method of controlling water quality. The addition of an external bypass allows higher storm volumes to be bypassed *around* the unit without passing through the unit and causing turbulent flow. This allows the lower volume storms — where most contaminants are flushed off of the pavement — to be trapped by the unit and remain there until the unit is cleaned out. In addition, the ADS SWQU is constructed of High Density Polyethylene (HDPE) which is inert and much more chemical resistant than the standard concrete Oil Grit Separators previously used for these applications.

Design

A full discussion of the SWQU design methodology is available in Technical Note 1.01: *Water Quality Units - EPA Phase II, Best Management Practices.* In summary, the SWQU utilizes Stoke's law in order to predict removal efficiencies based on particle size. The units are designed with a sediment chamber, a floatable chamber, and an outlet chamber to provide the stormwater treatment ability of the unit. All flows above the velocity required are routed through the bypass line to prevent the resuspension and removal of trapped materials from the unit. See Figure 1 for a layout of a typical SWQU.

Figure 1



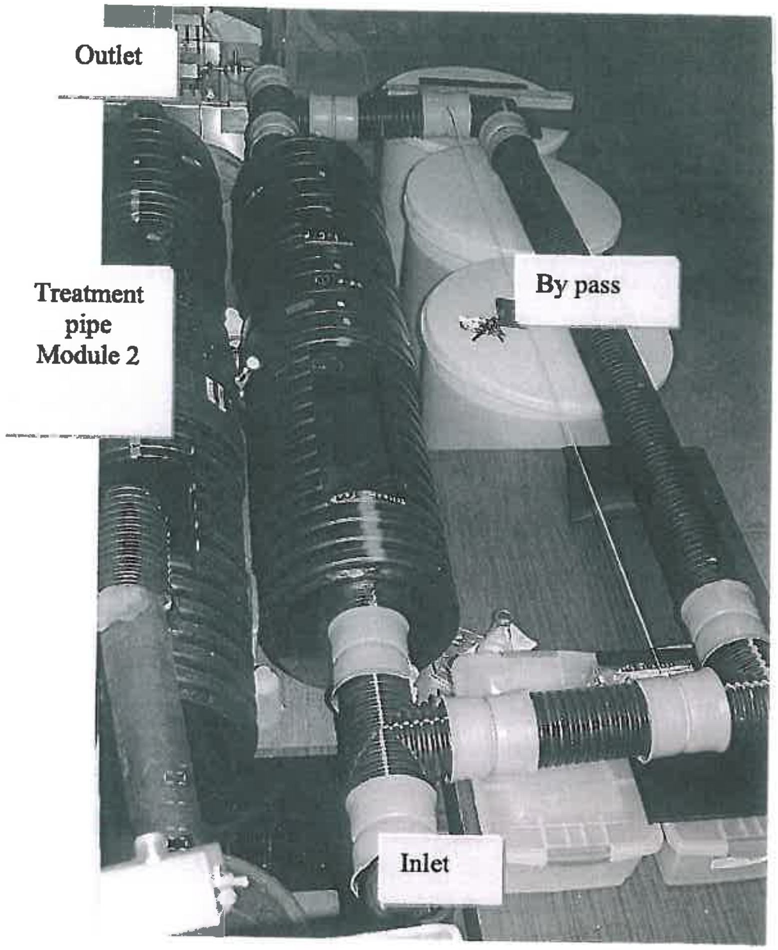
Laboratory Testing and Research

As with any device designed to treat water quality, testing should be performed to determine the removal rates and efficiencies of the device. The ADS SWQU has been subjected to of several different testing protocols to determine the removal rates for both total suspended solids (TSS) and oil and hydrocarbons. Testing has been conducted in both the laboratory and the field. The following summarizes the testing which has been initiated or completed on the ADS SWQU:

Ohio University Scale Model Lab Testing

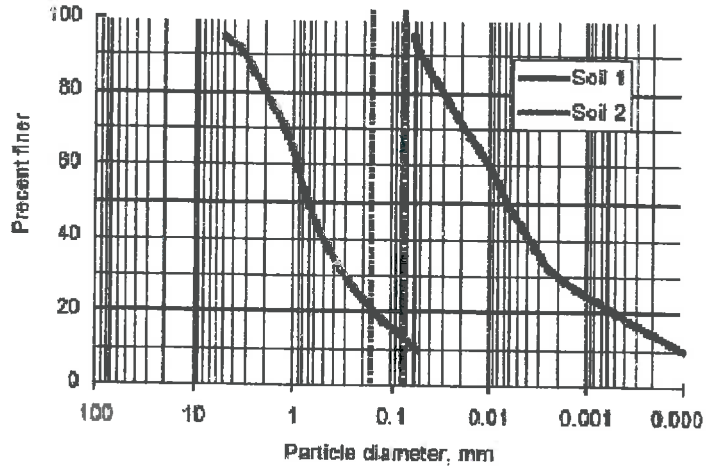
Testing consists of a scale model test loop including the Water Quality Unit and the bypass line. The model tested was a 12" diameter Water Quality Unit with appropriate scaled appurtenances. This testing was completed in September of 2003. The model was tested for both sediment and oil removal during the evaluation. A layout of the test loop is shown below in Figure 2.

Figure 2



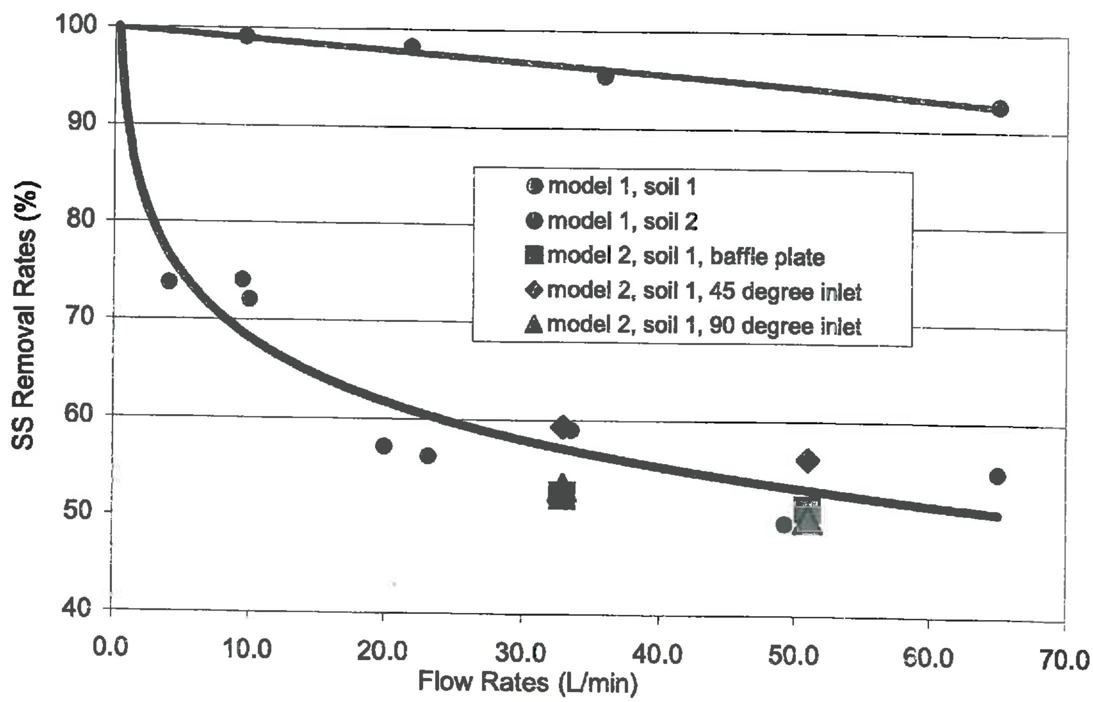
Two different soils were used for the evaluation in the Ohio University Lab study. The soils are shown as Type 1 and Type 2. The Type 1 soil contains particles which are generally smaller than the 200 sieve or 75 micron size. The Type 2 soil contains particles which are generally larger than the 200 sieve or 75 micron size. Sieve analyses for both soil types are shown below in Figure 3 and 4. The vertical lines represent the 140 sieve and 200 sieve particle sizes.

Figure 3



Soil Type 1 showed removal rates of 50 – 60% in the higher flow regimes. This would be expected for this soil type, given the smaller particle sizes and the flow rates used in the experiment. In tests with lower flow rates, the removal rates increased as the residence time increased. This again would be expected with any soil distribution which might be used in the system. Soil Type 1, for the most part, consisted of very fine particles such as silts and clays. The performance of the SWQU using these particle sizes was excellent considering they were outside the design of the unit. A graph of the removal rates for both soil types can be seen in Figure 4.

Figure 4



4640 TRUEMAN BLVD. HILLIARD, OH 43026 (800) 821-6710 www.ads-pipe.com

Soil Type 2 consisted of particles which generally were larger than the 200 sieve and larger than the soils in Type 1. These soils, because of their larger size, allowed for less residence time in the unit and still maintained high removal rates. The removal rates for these particle sizes were over 90% for the flow regimes tested. The soils which were present in this classification range were particles which are targeted for removal in the ADS Water Quality Unit.

Scaling of Lab Data

Laboratory testing is a convenient method for testing practical theories and design principles. It provides a method to use a controlled environment and change the appropriate variables to try and achieve the desired results. This is especially true when scale models can be used to reduce the cost and logistics of testing large devices. Once the testing is complete it must be scaled to the appropriate standard to produce results which can be predicted in the real world. In the case of the ADS SWQU it requires that the unit be scaled up in order for flow rates and SWQU sizes to be appropriate for application.

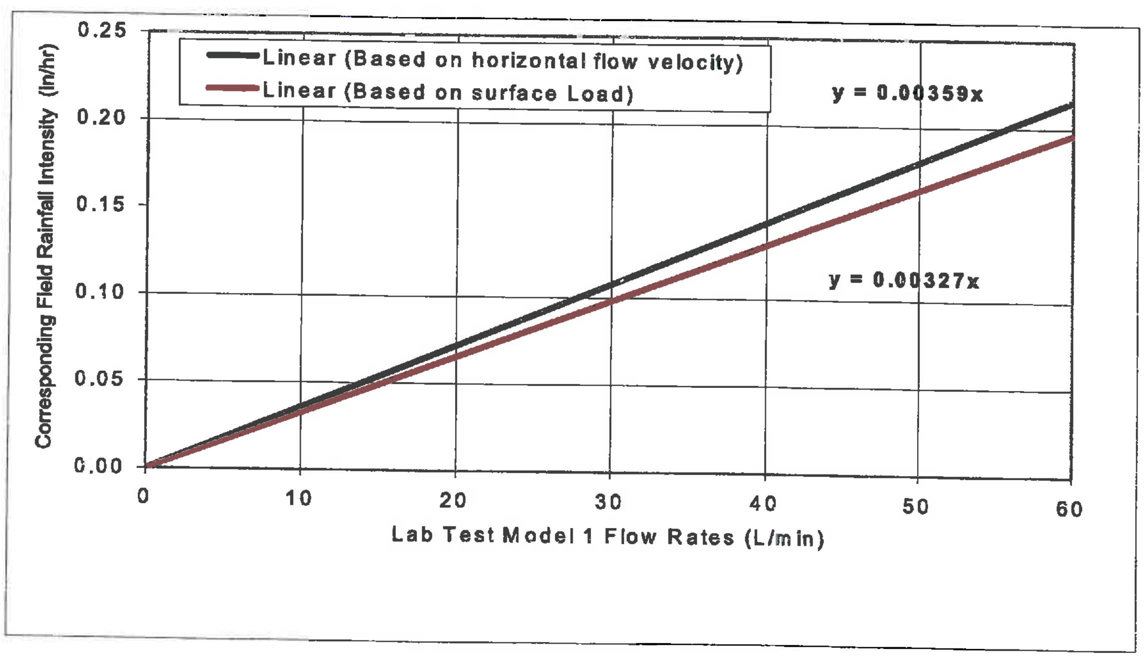
Two methods for scaling the laboratory data are discussed here. They are the "surface load method" and the "horizontal flow velocity" method.

The surface flow method is defined by the following equation:

Surface load = overflow rate = flow rate / surface area
(Tchobanoglous and Franklin, 1991)

The horizontal flow velocity simply takes the runoff rate and converts it to a flow based on pipe diameter to get a flow velocity. If both of these methods are used, a chart comparing field rainfall intensity to laboratory flow date can be developed, as shown below in Figure 5.

Figure 5



Alden Labs Maine DEP Laboratory Testing Protocol:

In addition to the scale model testing which was performed at Ohio University, full scale laboratory testing was performed at Alden Laboratories in Holden, Mass. Alden Labs tested the SWQU for conformance with the Maine Department of Environmental Protection Protocol for total suspended solids (TSS) removal. The Maine DEP protocol was put in place to provide a fair and unbiased mechanism for the evaluation of competitive manufactured water quality treatment devices. The protocol calls for the injection of a test media into the treatment flow at a predetermined concentration. The concentration is held at these levels and required residence time is computed. Samples are taken for background levels, influent levels, and effluent levels. The material collected in each sample is then filtered out and appropriately dried. Once the material is dried, it is weighed and the concentration of the total suspended solids is determined.

For the ADS SWQU, a 60-inch diameter, full scale unit was used. The unit was placed in a test loop at Alden Labs which consisted of the SWQU and the necessary support structure to run the tests. The testing was conducted on a standard 60" unit with a few small modifications to provide for accessibility and conformance to the requirements of the system loop. The modifications included an increase in the size of the risers to 36", the introduction of flanges on the inlet and outlet sides of the unit, and the insertion of small diameter pipe at the invert on the inlet and outlet side. The 36" risers were added primarily as inspection risers and for access into the system in case modifications or changes in the monitoring and testing procedure were required. In addition, the large risers provided easier access for the system to be cleaned out between tests. The flanges were provided on the inlet and outlet side of the unit to allow the SWQU to be inserted into the test loop, and to provide a watertight connection for the testing procedure. The small diameter pipe at the invert was put in place to allow the unit to be easily drained and cleaned out for subsequent tests at differing flow rates. In all other regards the unit tested was a standard ADS SWQU with appropriate weir spacing and weir heights. A drawing of the unit is shown in Figures 6A & B.

Figure 6A

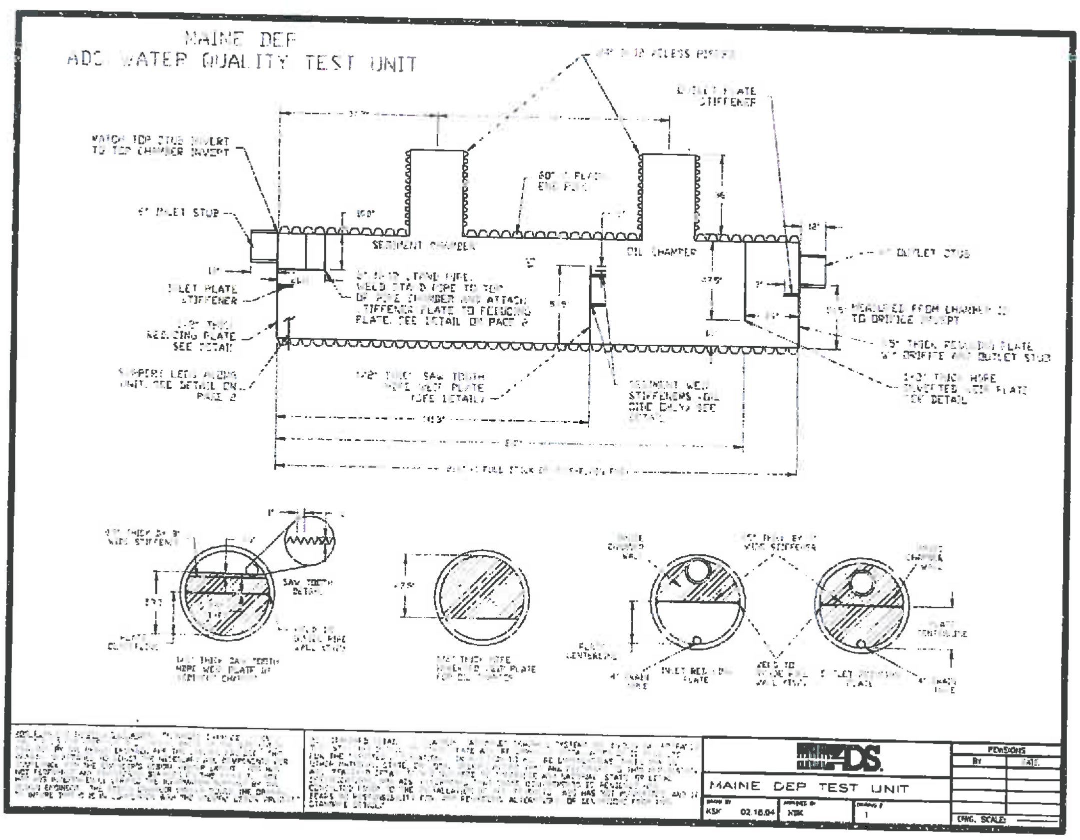
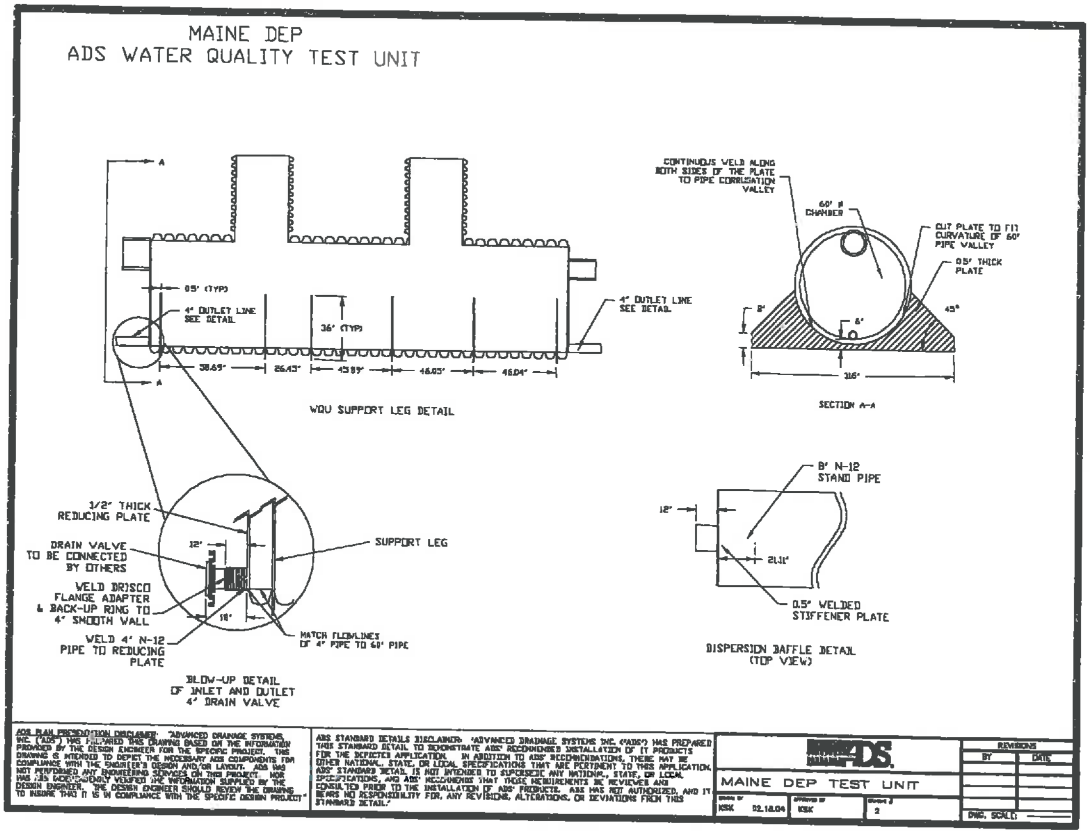


Figure 6B



The testing of the unit was run at various flow rates in order to determine the variance in the levels of efficiency for the SWQU based on flow rate and residence time. The concentration of sediment was approximately 250 mg/L. Each test run consisted of 5 inlet and outlet sample pairs to provide an adequate data set for the testing on the unit. The timing of the samples was such that the residence time in the unit was taken into account to provide samples which were coordinated with each other. A picture of the test unit in the testing loop is shown in Figure 7.

Figure 7

The test media used consisted of two different sands manufactured by U.S. Silica. The F-95 sand has a larger particle size and the OK-110 sand has a smaller particle size. The sieve analysis for each product is shown Table 1.

Table 1

U.S Silica Test Media

US Std. Sieve	% Retained F-95	OK-110
30		0
40	<1	0
50	1	0
70	9	0
100	60	1
120		15
140	42	48
170		24.2
200	15	9.7
270	3	1.9
Pan	<1	0.2

Multiple tests were conducted on the unit to provide a comprehensive analysis of the performance of the unit at various flow rates. The targeted flow rate based on Stoke's Law for the 60-inch Water Quality Unit is 1.47 cfs. Tests were conducted on the unit above and below the unit's anticipated flow rate to determine the performance limitations. For the 1.5 cfs. test, the average removal rate for the OK-110 sand was 88.3%. As a result of this testing, a scaling factor can be used to correlate the results with different size SWQU's and indicates that the design for the units is accurate. Scaling to other size units is accomplished by the following equation:

$$Q_{treatment} = (0.016949 cfs / ft^2)(area)$$

As a result, the treatment rates from testing at Alden Labs compare favorably to our recommendations for flow rates through the unit based on the theoretical design. Table 2 shows the tested flow rates compared to the recommended rate.

Table 2

Product No.	Minimum Treatment Chamber Area (sf)	Maximum treated flow (cfs) (tested)	Design Treated Flow (cfs) (recommended)
3620WQB	55.50	0.94	0.7
3640WQB	111.00	1.88	1.6
4220WQB	64.43	1.09	0.86
4240WQB	128.86	2.18	1.83
4820WQB	71.40	1.21	1.13
4840WQB	142.80	2.42	2.39
6020WQB	88.50	1.50	1.47
6040WQB	177.00	3.00	3.12

For design purposes the Design Treated Flow rate should be used. As a follow up to the total suspended solids testing, further study of the Water Quality Unit was conducted to determine the oil removal efficiency of the unit.

Alden Labs Oil Removal Testing

The same 60-inch diameter SWQU that was used in the total suspended solids removal testing at Alden Labs was also used for the oil removal study. The unit was again slightly modified to provide for an accurate determination of the oil removal efficiency of the unit. A skimmer wall, retraction assembly, and sidewall blockage areas were added to confine the oil collected so that it could be easily identified

Soybean based vegetable oil was used as the test medium. The density of the oil was approximately 0.92 g/ml. Oil was introduced into the system by use of a pump, which was calibrated prior to testing to determine the relationship between pump speed and the oil feed rate. Once again, the background levels were recorded to determine any influence from the water used in the system. The SWQU was tested with flow rates ranging from 0.5 cfs. to 2 cfs. The oil injection concentration ranged from 50 to 100mg/L. The tests were run for a period of 1 to 2 hours, depending on the influent flow, until approximately 10 liters of oil were injected into the unit. After the flow oil was discontinued, the unit was allowed to operate for a period of time to make sure that all of the oil had been injected into the unit and that the water volume carrying the oil had passed through. Flow rates and removal efficiencies are shown in Table 3.

Table 3

Oil Removal Efficiencies

Flow Rate (cfs)	Removal Efficiency (%)
0.5	95
1	87
1.5	80
2	57

Once again the flow rate targeted for design purposes is 1.5 cfs for the 60" unit. This would show an 80% removal rate. The scaling of this information remains the same as shown in the previous section.

Field Testing and Research

Due to the complexities of field research and the dependence on the weather for cooperation, field testing requires more time and resources. Also, because of the lack of control on all of the variables, the results can be somewhat inconsistent and often require more analysis when completed. However, the field data and testing when approached correctly, can provide valuable information for further enhancements and improvements. The SWQU is being tested in several field installations. Because of the time required to complete these studies none of the current field studies have been completed, but some of them are yielding preliminary information. The studies currently underway are as follows:

University of New Hampshire Center for Stormwater Technology
Nashville Study of Eight Water Quality Units
Mississippi Testing of Water Quality Units

The status of each study is summarized below.

University of New Hampshire Center for Stormwater Technology

This study consists of a Water Quality Unit and a perforated retention system in series on the site. The site is a study area for several different manufactured and natural stormwater treatment and control devices. The entire 8 acres that the property is located on is the drainage area from a parking lot for the University. The runoff collected from the site is urban and generates sediment, oil and grease. The storm water is metered to all the different devices on the site so that each treatment device receives 1 cfs. The stormwater is sampled on the influent and effluent sides to provide TSS and Floatable Removal Rate. Several other parameters are also tested at this site, including heavy metals, organics, and nutrients. The samplers used are automatic and the information is collected centrally for ease of access.

In addition, the site has been studied from a hydrologic standpoint to provide detailed data on rainfall and runoff rates. From this data, storms which provide adequate parameters are selected to provide the sample data set. A full set of data and the parameters for testing are available upon request. Preliminary results are not publicly available at this time.

Nashville Study of Eight Water Quality Units

This study consists of eight Water Quality Units located at various sites around the metro Nashville area. The testing was conducted by Qore Property Sciences and the final report was issued on June 23, 2005. The eight units were each tested for one storm event within each unit's treatment capacity. The samples were collected in accordance with the Technology Acceptance Reciprocity Partnership (TARP) Protocol for Stormwater BMP demonstrations. The testing was done in accordance with ASTM 3977-97, Standard Test Method for Determining Sediment Concentration in Water Samples, for the range of particles specified by Nashville using the No.10 to the No.140 sieve. Results from the testing are shown in the Table 4.

Table 4

Location	Unit Diameter	Sieve #	Weight Retained Influent (Grams)	Weight Retained Effluent (Grams)	Precent Removed
Occupational Health 4300 Sidco Drive	48"	140	8.28	0.14	98
Jim and Nick's BBQ 7004 Charlotte Pike	60"	140	2.99	0.05	98
Autowash 7006 Charlotte Pike	36"	140	1.5	0.3	80
Shurgard Storage 2360 Gallatin Road	48"	140	4.59	0.21	95
Southern Unit: Walgreen's HWY 100 at Old Harding Pike	48"	140	1.81	0.13	93
Taco Bell 2904 Gallatin Road	48"	140	1.21	0.08	93
High Tech Institiute 560 Royal Parkway	42"	140	0.88	0.08	91
DMW Expedite 1850 Elm Hill Pike	48"	140	1.22	0.21	83

In addition to the results summarized in Table 4, an analysis of particle sizes ranging from the No.10 to the No.200 sieve was also conducted. The samples taken were in accordance with TARP protocol and ASTM 3977-97 was used to determine the resulting efficiencies. A summary of the results is shown in Table 5.

Table 5

Location	Unit Diameter	Sieve #	Weight Retained Influent (Grams)	Weight Retained Effluent (Grams)	Precent Removed
Occupational Health 4300 Sidco Drive	48"	200	8.29	0.15	98
Jim and Nick's BBQ 7004 Charlotte Pike	60"	200	3.29	0.07	98
Autowash 7006 Charlotte Pike	36"	200	1.7	0.31	82
Shurgard Storage 2360 Gallatin Road	48"	200	4.6	0.21	95
Southern Unit: Walgreen's HWY 100 at Old Harding Pike	48"	200	1.99	0.15	93
Taco Bell 2904 Gallatin Road	48"	200	1.2	0.1	92
High Tech Instituite 560 Royal Parkway	42"	200	0.94	0.1	89
DMW Expedite 1850 Elm Hill Pike	48"	200	1.62	0.34	79

Mississippi Testing of Water Quality Units

The Mississippi testing consists of 5 individual Water Quality Units on a single site in Mississippi. The units are located on a Lowes commercial building site. The units have been installed, have been cleaned out from construction operations, and are ready to begin testing. No results are available at this time.

Conclusions

The ADS SWQU can provide significant treatment for stormwater quality on a variety of stormwater projects. The treatment of both settling and floating pollutants provides a good first level management technique. This provides the opportunity to use the device in both a stand-alone configuration or as the first step in a treatment train.

*For Inspection + Maintenance Only

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Detention • Retention • Water Quality

A division of ADS

Save Valuable Land and Protect Water Resources

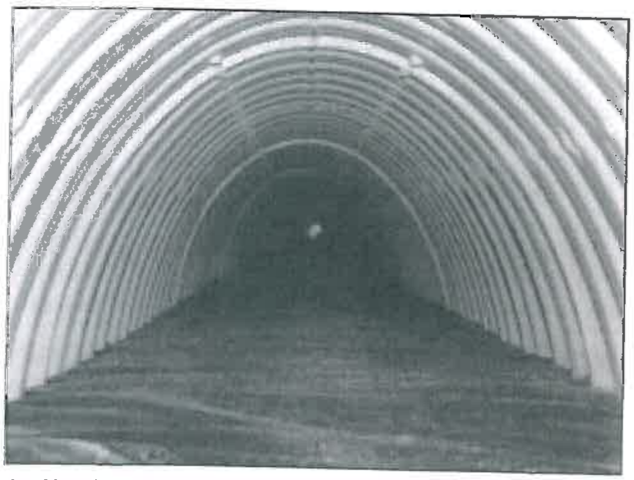
Isolator® Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator® Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.



Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

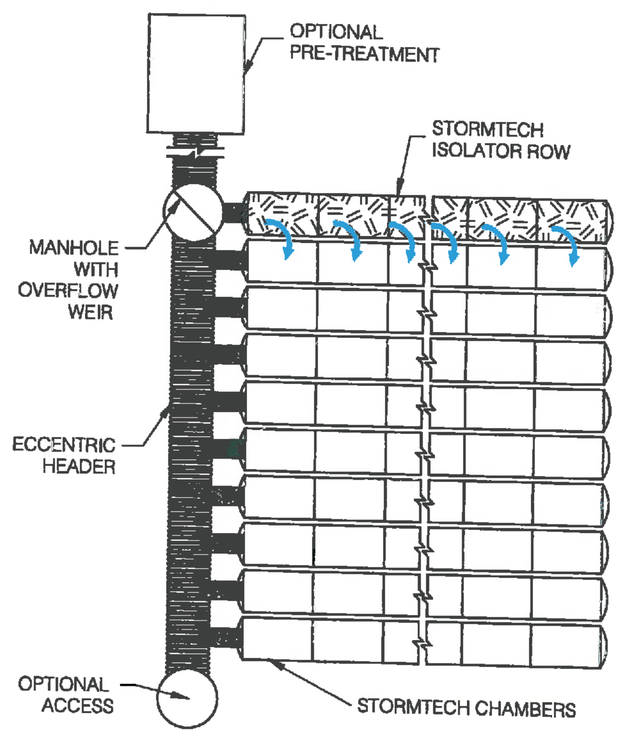
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

StormTech

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

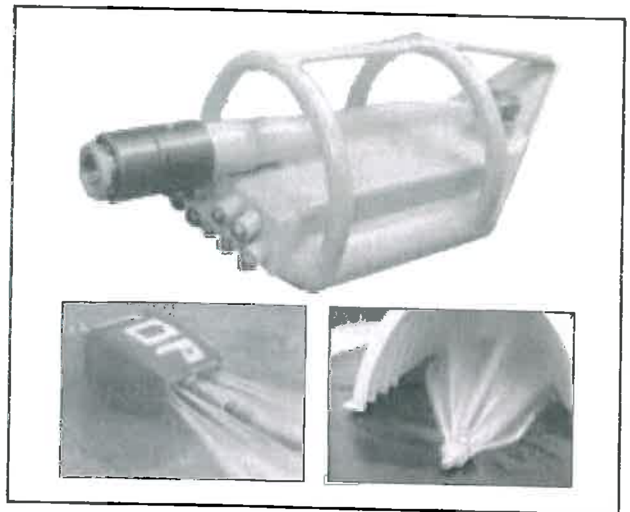
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

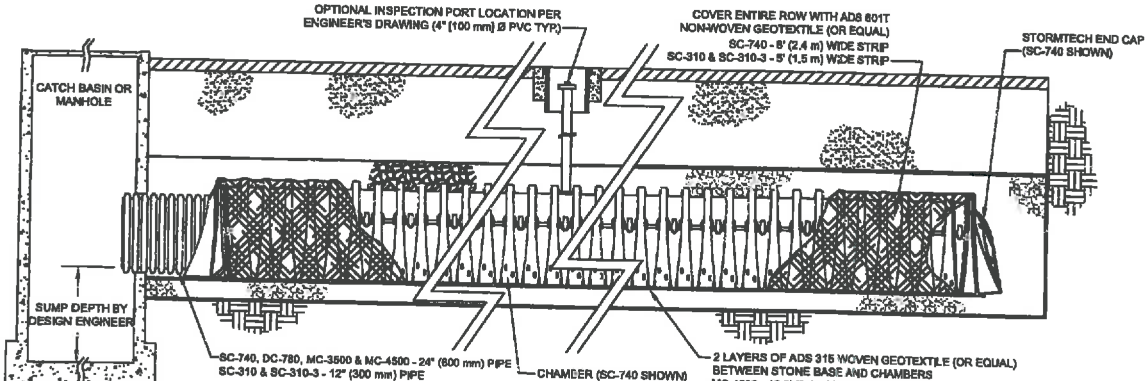
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

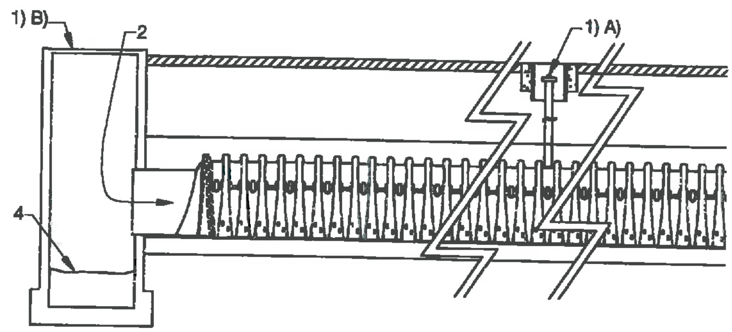


NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

3.0 Isolator Row Step By Step Maintenance Procedures

Step 1) Inspect Isolator Row for sediment
A) Inspection ports (if present)
  i. Remove lid from floor box frame
  ii. Remove cap from inspection riser
  iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
  iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.
B) All Isolator Rows
  i. Remove cover from manhole at upstream end of Isolator Row
  ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process
A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

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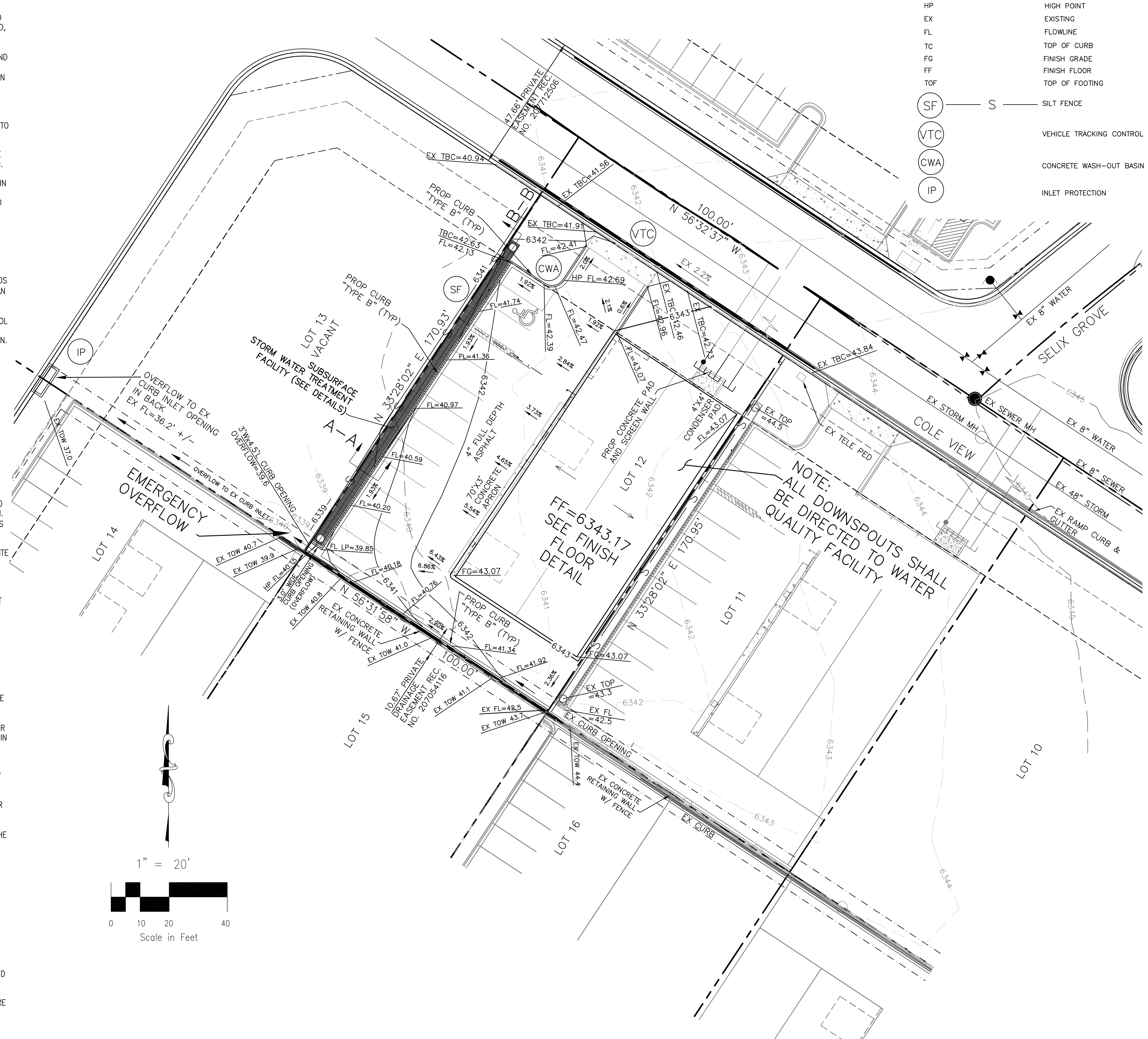
1000, LLC

EL PASO COUNTY, STATE OF COLORADO
GRADING & EROSION CONTROL PLAN
LOT 12 OF CLAREMONT BUSINESS PARK FIL. NO. 2

GRADING AND EROSION CONTROL NOTES:

1. CONSTRUCTION MAY NOT COMMENCE UNTIL A CONSTRUCTION PERMIT IS OBTAINED FROM DEVELOPMENT SERVICES AND A PRECONSTRUCTION CONFERENCE IS HELD WITH DEVELOPMENT SERVICES INSPECTIONS.
2. STORMWATER DISCHARGES FROM CONSTRUCTION SITES SHALL NOT CAUSE OR THREATEN TO CAUSE POLLUTION, CONTAMINATION, OR DEGRADATION OF STATE WATERS. ALL WORK AND EARTH DISTURBANCE SHALL BE DONE IN A MANNER THAT MINIMIZES POLLUTION OF ANY ON-SITE OR OFF SITE WATERS, INCLUDING WETLANDS.
3. NOTWITHSTANDING ANYTHING DEPICTED IN THESE PLANS IN WORDS OR GRAPHIC REPRESENTATION, ALL DESIGN AND CONSTRUCTION RELATED TO ROADS, STORM DRAINAGE AND EROSION CONTROL SHALL CONFORM TO THE STANDARDS AND REQUIREMENTS OF THE MOST RECENT VERSION OF THE RELEVANT ADOPTED EL PASO COUNTY STANDARDS, INCLUDING THE LAND DEVELOPMENT CODE, THE ENGINEERING CRITERIA MANUAL, THE DRAINAGE CRITERIA MANUAL, AND THE DRAINAGE CRITERIA MANUAL VOLUME 2. ANY DEVIATIONS TO REGULATIONS AND STANDARDS MUST BE REQUESTED, AND APPROVED, IN WRITING.
4. A SEPARATE STORMWATER MANAGEMENT PLAN (SMWP) FOR THIS PROJECT SHALL BE COMPLETED AND AN EROSION AND STORMWATER QUALITY CONTROL PERMIT (ESQCP) ISSUED PRIOR TO COMMENCING CONSTRUCTION. DURING CONSTRUCTION THE SWMP IS THE RESPONSIBILITY OF THE DESIGNATED STORMWATER MANAGER, SHALL BE LOCATED ON SITE AT ALL TIMES AND SHALL BE KEPT UP TO DATE WITH WORK PROGRESS AND CHANGES IN THE FIELD.
5. ONCE THE ESQCP HAS BEEN ISSUED, THE CONTRACTOR MAY INSTALL THE INITIAL STAGE EROSION AND SEDIMENT CONTROL BMPS AS INDICATED ON THE GEC. A PRECONSTRUCTION MEETING BETWEEN THE CONTRACTOR, ENGINEER, AND EL PASO COUNTY WILL BE HELD PRIOR TO ANY CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE APPLICANT TO COORDINATE THE MEETING TIME AND PLACE WITH COUNTY DSD INSPECTIONS STAFF.
6. SOIL EROSION CONTROL MEASURES FOR ALL SLOPES, CHANNELS, DITCHES, OR ANY DISTURBED LAND AREA SHALL BE COMPLETED WITHIN 21 CALENDAR DAYS AFTER FINAL GRADING, OR FINAL EARTH DISTURBANCE, HAS BEEN COMPLETED. DISTURBED AREAS AND STOCKPILES WHICH ARE NOT AT FINAL GRADE BUT WILL REMAIN DORMANT FOR LONGER THAN 30 DAYS SHALL ALSO BE MULCHED WITHIN 21 DAYS AFTER INTERIM GRADING. AN AREA THAT IS GOING TO REMAIN IN AN INTERIM STATE FOR MORE THAN 60 DAYS SHALL ALSO BE SEEDED. ALL TEMPORARY SOIL EROSION CONTROL MEASURES AND BMPS SHALL BE MAINTAINED UNTIL PERMANENT SOIL EROSION CONTROL MEASURES ARE IMPLEMENTED AND ESTABLISHED.
7. TEMPORARY SOIL EROSION CONTROL FACILITIES SHALL BE REMOVED AND EARTH DISTURBANCE AREAS GRADED AND STABILIZED WITH PERMANENT SOIL EROSION CONTROL MEASURES PURSUANT TO STANDARDS AND SPECIFICATION PRESCRIBED IN THE DCM VOLUME II AND THE ENGINEERING CRITERIA MANUAL (ECM) APPENDIX I.
8. ALL PERSONS ENGAGED IN EARTH DISTURBANCE SHALL IMPLEMENT AND MAINTAIN ACCEPTABLE SOIL EROSION AND SEDIMENT CONTROL MEASURES INCLUDING BMPS IN CONFORMANCE WITH THE EROSION CONTROL TECHNICAL STANDARDS OF THE DRAINAGE CRITERIA MANUAL (DCM) VOLUME II AND IN ACCORDANCE WITH THE STORMWATER MANAGEMENT PLAN (SWMP).
9. ALL TEMPORARY EROSION CONTROL FACILITIES INCLUDING BMPS AND ALL PERMANENT FACILITIES INTENDED TO CONTROL EROSION OF ANY EARTH DISTURBANCE OPERATIONS, SHALL BE INSTALLED AS DEFINED IN THE APPROVED PLANS, THE SWMP AND THE DCM VOLUME II AND MAINTAINED THROUGHOUT THE DURATION OF THE EARTH DISTURBANCE OPERATION.
10. ANY EARTH DISTURBANCE SHALL BE CONDUCTED IN SUCH A MANNER SO AS TO EFFECTIVELY REDUCE ACCELERATED SOIL EROSION AND RESULTING SEDIMENTATION. ALL DISTURBANCES SHALL BE DESIGNED, CONSTRUCTED, AND COMPLETED SO THAT THE EXPOSED AREA OF ANY DISTURBED LAND SHALL BE LIMITED TO THE SHORTEST PRACTICAL PERIOD OF TIME.
11. ANY TEMPORARY OR PERMANENT FACILITY DESIGNED AND CONSTRUCTED FOR THE CONVEYANCE OF STORMWATER AROUND, THROUGH, OR FROM THE EARTH DISTURBANCE AREA SHALL BE DESIGNED TO LIMIT THE DISCHARGE TO A NON-EROSIVE VELOCITY.
12. CONCRETE WASH WATER SHALL BE CONTAINED AND DISPOSED OF IN ACCORDANCE WITH THE SWMP. NO WASH WATER SHALL BE DISCHARGED TO OR ALLOWED TO RUNOFF TO STATE WATERS, INCLUDING ANY SURFACE OR SUBSURFACE STORM DRAINAGE SYSTEM OR FACILITIES.
13. EROSION CONTROL BLANKETING IS TO BE USED ON SLOPES STEEPER THAN 3:1.
14. BUILDING, CONSTRUCTION, EXCAVATION, OR OTHER WASTE MATERIALS SHALL NOT BE TEMPORARILY PLACED OR STORED IN THE STREET, ALLEY, OR OTHER PUBLIC WAY, UNLESS IN ACCORDANCE WITH AN APPROVED TRAFFIC CONTROL PLAN. BMP'S MAY BE REQUIRED BY EL PASO COUNTY ENGINEERING IF DEEMED NECESSARY, BASED ON SPECIFIC CONDITIONS AND CIRCUMSTANCES.
15. VEHICLE TRACKING OF SOILS AND CONSTRUCTION DEBRIS OFF-SITE SHALL BE MINIMIZED. MATERIALS TRACKED OFFSITE SHALL BE CLEANED UP AND PROPERLY DISPOSED OF IMMEDIATELY.
16. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL WASTES FROM THE CONSTRUCTION SITE FOR DISPOSAL IN ACCORDANCE WITH LOCAL AND STATE REGULATORY REQUIREMENTS. NO CONSTRUCTION DEBRIS, TREE SLASH, BUILDING MATERIAL WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURIED, DUMPED, OR DISCHARGED AT THE SITE.
17. THE OWNER, SITE DEVELOPER, CONTRACTOR, AND/OR THEIR AUTHORIZED AGENTS SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL CONSTRUCTION DEBRIS, DIRT, TRASH, ROCK, SEDIMENT, AND SAND THAT MAY ACCUMULATE IN THE STORM SEWER OR OTHER DRAINAGE CONVEYANCE SYSTEM AND STORMWATER APPURTENANCES AS A RESULT OF SITE DEVELOPMENT.
18. THE QUANTITY OF MATERIALS STORED ON THE PROJECT SITE SHALL BE LIMITED, AS MUCH AS PRACTICAL, TO THAT QUANTITY REQUIRED TO PERFORM THE WORK IN AN ORDERLY SEQUENCE. ALL MATERIALS STORED ON-SITE SHALL BE STORED IN A NEAT, ORDERLY MANNER, IN THEIR ORIGINAL CONTAINERS, WITH ORIGINAL MANUFACTURER'S LABELS.
19. NO CHEMICALS ARE TO BE USED BY THE CONTRACTOR, WHICH HAVE THE POTENTIAL TO BE RELEASED IN STORMWATER UNLESS PERMISSION FOR THE USE OF A SPECIFIC CHEMICAL IS GRANTED IN WRITING BY THE ECM ADMINISTRATOR. IN GRANTING THE USE OF SUCH CHEMICALS, SPECIAL CONDITIONS AND MONITORING MAY BE REQUIRED.
20. BULK STORAGE STRUCTURES FOR PETROLEUM PRODUCTS AND OTHER CHEMICALS SHALL HAVE ADEQUATE PROTECTION SO AS TO CONTAIN ALL SPILLS AND PREVENT ANY SPILLED MATERIAL FROM ENTERING STATE WATERS, INCLUDING ANY SURFACE OR SUBSURFACE STORM DRAINAGE SYSTEM OR FACILITIES.
21. NO PERSON SHALL CAUSE THE IMPEDIMENT OF STORMWATER FLOW IN THE FLOW LINE OF THE CURB AND GUTTER OR IN THE DITCHLINE.
22. INDIVIDUALS SHALL COMPLY WITH THE "COLORADO WATER QUALITY CONTROL ACT" (TITLE 25, ARTICLE 8, CRS), AND THE "CLEAN WATER ACT" (33 USC 1344), IN ADDITION TO THE REQUIREMENTS INCLUDED IN THE DCM VOLUME II AND THE ECM APPENDIX I. ALL APPROPRIATE PERMITS MUST BE OBTAINED BY THE CONTRACTOR PRIOR TO CONSTRUCTION (NPDES, FLOODPLAIN, 404, FUGITIVE DUST, ETC.). IN THE EVENT OF CONFLICTS BETWEEN THESE REQUIREMENTS AND LAWS, RULES, OR REGULATIONS OF OTHER FEDERAL, STATE, OR COUNTY AGENCIES, THE MORE RESTRICTIVE LAWS, RULES, OR REGULATIONS SHALL APPLY.
23. ALL CONSTRUCTION TRAFFIC MUST ENTER/EXIT THE SITE AT APPROVED CONSTRUCTION ACCESS POINTS.
24. PRIOR TO ACTUAL CONSTRUCTION THE PERMITEE SHALL VERIFY THE LOCATION OF EXISTING UTILITIES.
25. A WATER SOURCE SHALL BE AVAILABLE ON SITE DURING EARTHWORK OPERATIONS AND UTILIZED AS REQUIRED TO MINIMIZE DUST FROM EARTHWORK EQUIPMENT AND WIND.
26. THE SOILS REPORT FOR THIS SITE HAS BEEN PREPARED BY ENTECH ENGINEERING, INC. # 76021 JUNE 1, 2011. AND SHALL BE CONSIDERED A PART OF THESE PLANS.
27. AT LEAST TEN DAYS PRIOR TO THE ANTICIPATED START OF CONSTRUCTION, FOR PROJECTS THAT WILL DISTURB 1 ACRE OR MORE, THE OWNER OR OPERATOR OF CONSTRUCTION ACTIVITY SHALL SUBMIT A PERMIT APPLICATION FOR STORMWATER DISCHARGE TO THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, WATER QUALITY DIVISION. THE APPLICATION CONTAINS CERTIFICATION OF COMPLETION OF A STORMWATER MANAGEMENT PLAN (SWMP), OF WHICH THIS GRADING AND EROSION CONTROL PLAN MAY BE A PART. FOR INFORMATION OR APPLICATION MATERIALS CONTACT:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
WATER QUALITY CONTROL DIVISION
WQCD – PERMITS
4300 CHERRY CREEK DRIVE SOUTH
DENVER, CO 80246-1530
ATTN: PERMITS UNIT



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WATER EMERGENCIES 520-0300

LEGEND

	EX MAJ CONT
	EX MIN CONT
	PROP MAJ CONT
	PROP MIN CONT
LP	LOW POINT
HP	HIGH POINT
EX	EXISTING
FL	FLOWLINE
TC	TOP OF CURB
FG	FINISH GRADE
FF	FINISH FLOOR
TOF	TOP OF FOOTING
SF — S —	SILT FENCE
VTC	VEHICLE TRACKING CONTROL
CWA	CONCRETE WASH-OUT BASIN
IP	INLET PROTECTION

DESIGN ENGINEER'S STATEMENT

THIS GRADING AND EROSION CONTROL PLAN WAS PREPARED UNDER MY DIRECTION AND SUPERVISION AND IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. SAID PLAN HAS BEEN PREPARED ACCORDING TO THE CRITERIA ESTABLISHED BY THE COUNTY FOR GRADING AND EROSION CONTROL PLANS. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY NEGLIGENT ACTS, ERRORS OR OMISSIONS ON MY PART IN PREPARING THIS PLAN.

VIRGIL A. SANCHEZ, COLORADO P.E. #37160 DATE
FOR AND ON BEHALF OF M & S CIVIL CONSULTANTS, INC.

OWNER/DEVELOPER'S STATEMENT:

I, THE OWNER/DEVELOPER HAVE READ AND WILL COMPLY WITH ALL OF THE REQUIREMENTS SPECIFIED IN THESE DETAILED PLANS AND SPECIFICATIONS.

NAME: DATE

DBA: HAMMERS CONSTRUCTION

ADDRESS: 1411 WOOLSEY HEIGHTS COLORADO SPRINGS, 80915

EL PASO COUNTY:

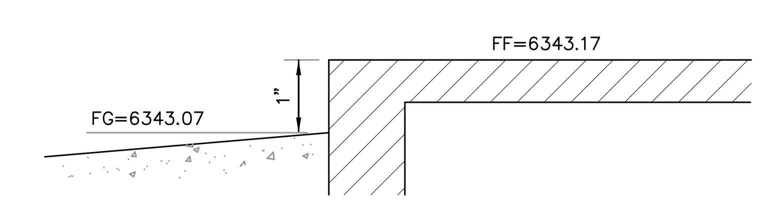
COUNTY PLAN REVIEW IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH COUNTY DESIGN CRITERIA. THE COUNTY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE COUNTY THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

FILED IN ACCORDANCE WITH THE REQUIREMENTS OF THE EL PASO COUNTY LAND DEVELOPMENT CODE, DRAINAGE CRITERIA, AND ENGINEERING CRITERIA MANUAL AS AMENDED.

IN ACCORDANCE WITH ECM SECTION 1.12, THESE CONSTRUCTION DOCUMENTS WILL BE VALID FOR CONSTRUCTION FOR A PERIOD OF 2 YEARS FROM THE DATE SIGNED BY THE EL PASO COUNTY ENGINEER. IF CONSTRUCTION HAS NOT STARTED WITHIN THOSE 2 YEARS, THE PLANS WILL NEED TO BE RESUBMITTED FOR APPROVAL, INCLUDING PAYMENT OF REVIEW FEES AT THE PLANNING AND COMMUNITY DEVELOPMENT DIRECTOR'S DISCRETION.

JENNIFER IRVINE, P.E. DATE
COUNTY ENGINER / ECM ADMINISTRATOR

WQCV SUMMARY
WQCV REQUIRED = 338 CF
WQCV PROVIDED = 124' x 2.77 SF/LF = 343.4 CF
SEDIMENT STORAGE REQUIREMENT
SEDIMENT STORAGE REQUIRED = 124'X3'X3" = 93 CF
SEDIMENT STORAGE PROVIDED = $\pi\ (1.5)^2 = 7065$ SF 93 CF / 7.065 SF = 13.16' 13.16' /4 TIMES = 3.30' (TO BE CLEANED 4 TIMES PER EVENT)



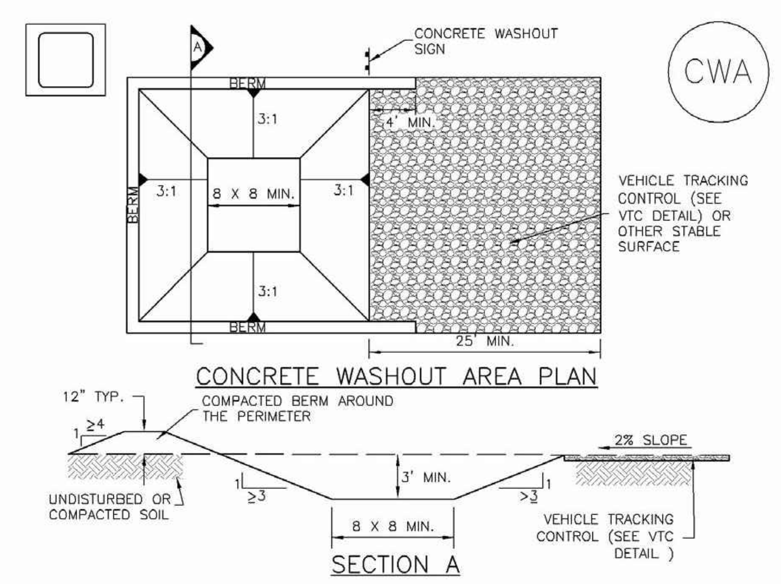
BUILDING FINISH FLOOR DETAIL

GRADING & EROSION CONTROL PLAN
1000, LLC
JOB NO. 44-026
DATE PREPARED: JUNE 9, 2017
DATE REVISED: AUGUST 7, 2017

EL PASO COUNTY FILE NO. PPR 17-026

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

Concrete Washout Area (CWA) MM-1



CWA–1. CONCRETE WASHOUT AREA

CWA INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   –CWA INSTALLATION LOCATION.

2. DO NOT LOCATE AN UNLINED CWA WITHIN 400' OF ANY NATURAL DRAINAGE PATHWAY OR WATERBODY. DO NOT LOCATE WITHIN 1,000' OF ANY WELLS OR DRINKING WATER SOURCES. IF SITE CONSTRAINTS MAKE THIS INFEASIBLE, OR IF HIGHLY PERMEABLE SOILS EXIST ON SITE, THE CWA MUST BE INSTALLED WITH AN IMPERMEABLE LINER (16 MIL MIN. THICKNESS) OR SURFACE STORAGE ALTERNATIVES USING PREFABRICATED CONCRETE WASHOUT DEVICES OR A LINED ABOVE GROUND STORAGE ARE SHOULD BE USED.

3. THE CWA SHALL BE INSTALLED PRIOR TO CONCRETE PLACEMENT ON SITE.

4. CWA SHALL INCLUDE A FLAT SUBSURFACE PIT THAT IS AT LEAST 8' BY 8' SLOPES LEADING OUT OF THE SUBSURFACE PIT SHALL BE 3:1 OR FLATTER. THE PIT SHALL BE AT LEAST 3' DEEP.

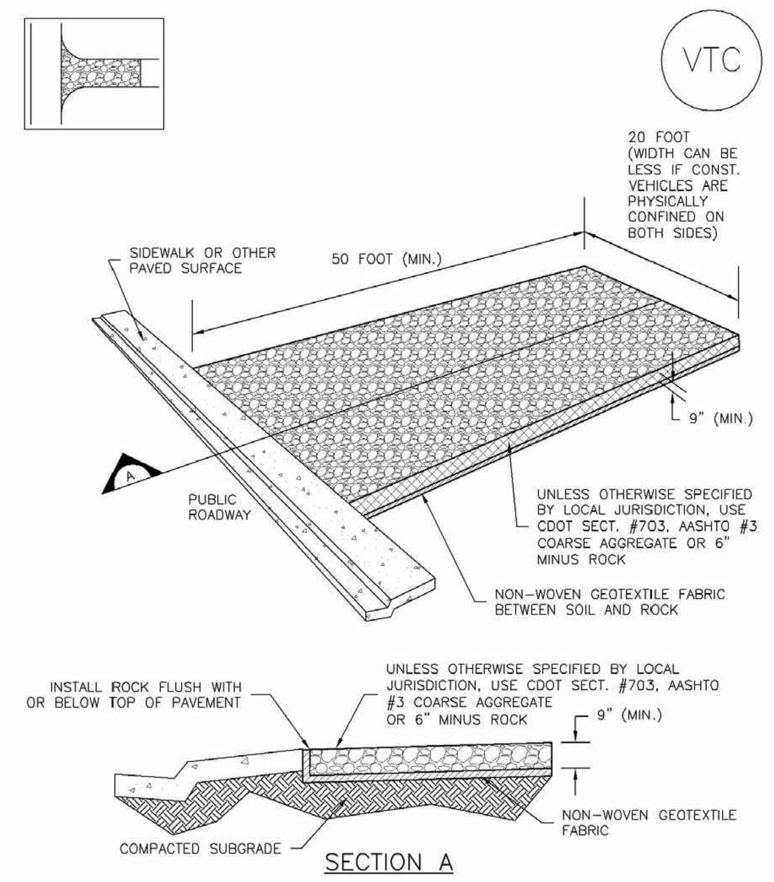
5. BERM SURROUNDING SIDES AND BACK OF THE CWA SHALL HAVE MINIMUM HEIGHT OF 1'.

6. VEHICLE TRACKING PAD SHALL BE SLOPED 2% TOWARDS THE CWA.

7. SIGNS SHALL BE PLACED AT THE CONSTRUCTION ENTRANCE, AT THE CWA, AND ELSEWHERE AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CWA TO OPERATORS OF CONCRETE TRUCKS AND PUMP RIGS.

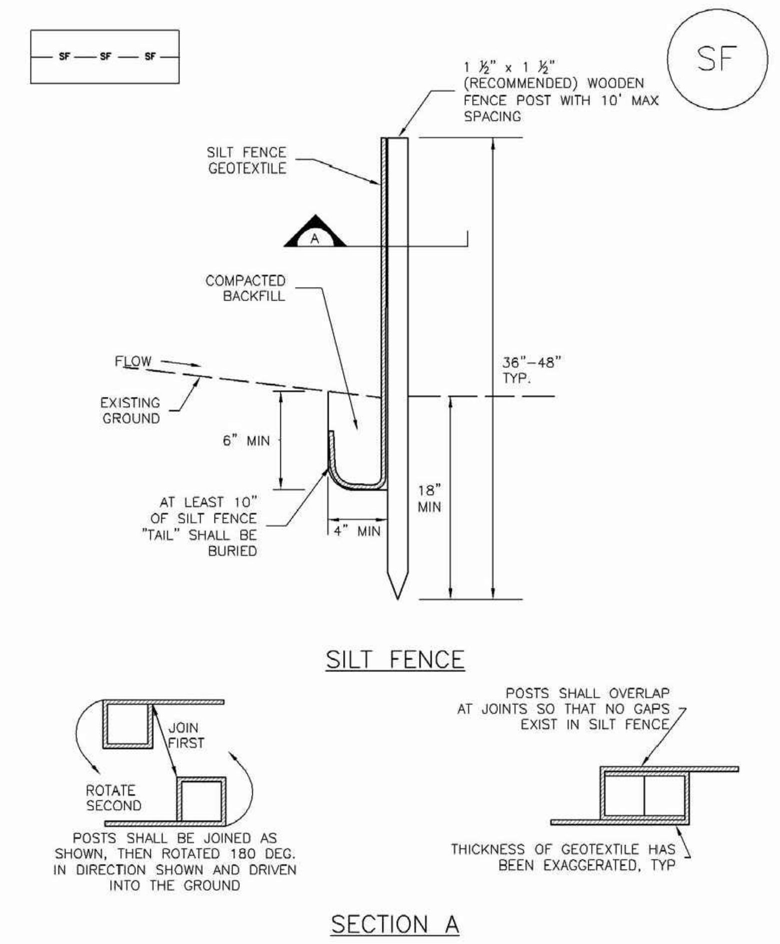
8. USE EXCAVATED MATERIAL FOR PERIMETER BERM CONSTRUCTION.

Vehicle Tracking Control (VTC) SM-4

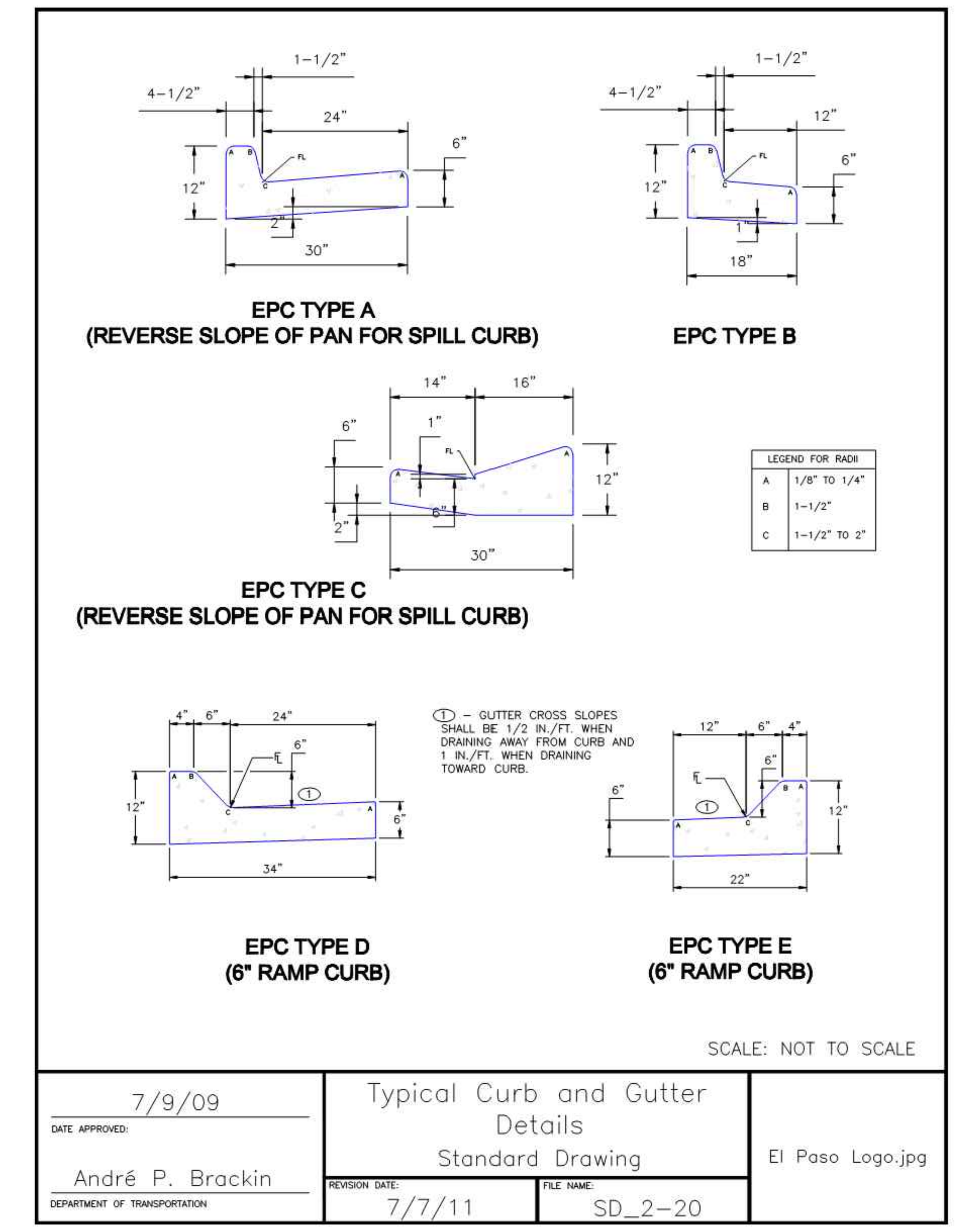


VTC–1. AGGREGATE VEHICLE TRACKING CONTROL

Silt Fence (SF) SC-1



SF–1. SILT FENCE



EC-2 Temporary and Permanent Seeding (TS/PS)

Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses

Common[a] Name	Botanical Name	Growth Season[b]	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Alakali Soil Seed Mix					
Alkali sacaton	*Sporobolus airoides*	Cool	Bunch	1,750,000	0.25
Basin wildrye	*Elymus cinereus*	Cool	Bunch	165,000	2.5
Sodar streambank wheatgrass	*Agropyron riparium 'Sodar'*	Cool	Sod	170,000	2.5
Jose tall wheatgrass	*Agropyron elongatum 'Jose'*	Cool	Bunch	79,000	7.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**17.75**
Fertile Loamy Soil Seed Mix					
Ephriam crested wheatgrass	*Agropyron cristatum 'Ephriam'*	Cool	Sod	175,000	2.0
Dural hard fescue	*Festuca ovina 'duriuscula'*	Cool	Bunch	565,000	1.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Sodar streambank wheatgrass	*Agropyron riparium 'Sodar'*	Cool	Sod	170,000	2.5
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	7.0
Total					**15.5**
High Water Table Soil Seed Mix					
Meadow foxtail	*Alopecurus pratensis*	Cool	Sod	900,000	0.5
Redtop	*Agrostis alba*	Warm	Open sod	5,000,000	0.25
Reed canarygrass	*Phalaris arundinacea*	Cool	Sod	68,000	0.5
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Pathfinder switchgrass	*Panicum virgatum 'Pathfinder'*	Warm	Sod	389,000	1.0
Alkar tall wheatgrass	*Agropyron elongatum 'Alkar'*	Cool	Bunch	79,000	5.5
Total					**10.75**
Transition Turf Seed Mix[c]					
Ruebens Canadian bluegrass	*Poa compressa 'Ruebens'*	Cool	Sod	2,500,000	0.5
Dural hard fescue	*Festuca ovina 'duriuscula'*	Cool	Bunch	565,000	1.0
Citation perennial ryegrass	*Lolium perenne 'Citation'*	Cool	Sod	247,000	3.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Total					**7.5**

Temporary and Permanent Seeding (TS/PS) EC-2

Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses (cont.)

Common Name	Botanical Name	Growth Season[b]	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Sandy Soil Seed Mix					
Blue grama	*Bouteloua gracilis*	Warm	Sod-forming bunchgrass	825,000	0.5
Camper little bluestem	*Schizachyrium scoparium 'Camper'*	Warm	Bunch	240,000	1.0
Prairie sandreed	*Calamovilfa longifolia*	Warm	Open sod	274,000	1.0
Sand dropseed	*Sporobolus cryptandrus*	Cool	Bunch	5,298,000	0.25
Vaughn sideoats grama	*Bouteloua curtipendula 'Vaughn'*	Warm	Sod	191,000	2.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**10.25**
Heavy Clay, Rocky Foothill Seed Mix					
Ephriam crested wheatgrass[d]	*Agropyron cristatum 'Ephriam'*	Cool	Sod	175,000	1.5
Oahe Intermediate wheatgrass	*Agropyron intermedium 'Oahe'*	Cool	Sod	115,000	5.5
Vaughn sideoats grama[e]	*Bouteloua curtipendula 'Vaughn'*	Warm	Sod	191,000	2.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**17.5**

[a] All of the above seeding mixes and rates are based on drill seeding followed by crimped straw mulch. These rates should be doubled if seed is broadcast and should be increased by 50 percent if the seeding is done using a Brillion Drill or is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. If hydraulic seeding is used, hydraulic mulching should be done as a separate operation.

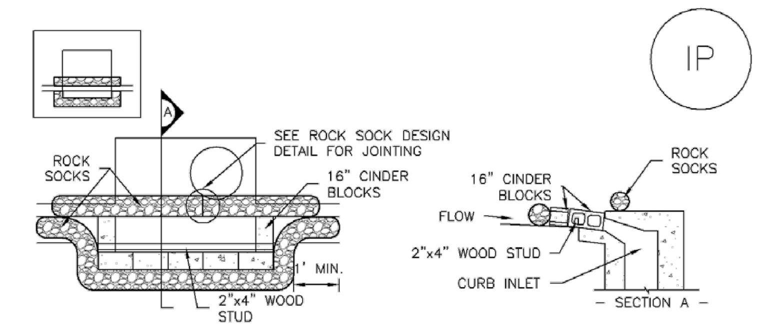
[b] See Table TS/PS-3 for seeding dates.

[c] If site is to be irrigated, the transition turf seed rates should be doubled.

[d] Crested wheatgrass should not be used on slopes steeper than 6H to 1V.

[e] Can substitute 0.5 lbs PLS of blue grama for the 2.0 lbs PLS of Vaughn sideoats grama.

SC-6 Inlet Protection (IP)



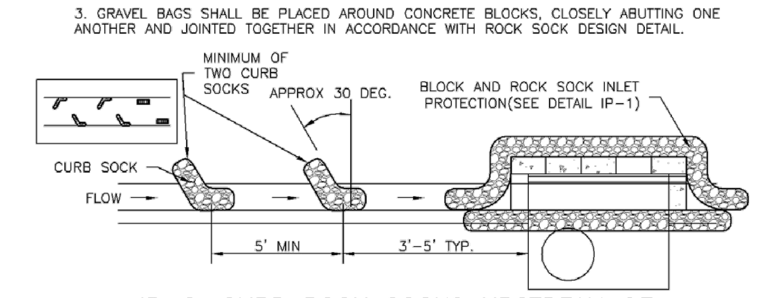
IP–1. BLOCK AND ROCK SOCK SUMP OR ON GRADE INLET PROTECTION

BLOCK AND CURB SOCK INLET PROTECTION INSTALLATION NOTES

1. SEE ROCK SOCK DESIGN DETAIL FOR INSTALLATION REQUIREMENTS.

2. CONCRETE "CINDER" BLOCKS SHALL BE LAID ON THEIR SIDES AROUND THE INLET IN A SINGLE ROW, ABUTTING ONE ANOTHER WITH THE OPEN END FACING AWAY FROM THE CURB.

3. GRAVEL BAGS SHALL BE PLACED AROUND CONCRETE BLOCKS, CLOSELY ABUTTING ONE ANOTHER AND JOINTED TOGETHER IN ACCORDANCE WITH ROCK SOCK DESIGN DETAIL.



IP–2. CURB ROCK SOCKS UPSTREAM OF INLET PROTECTION

CURB ROCK SOCK INLET PROTECTION INSTALLATION NOTES

1. SEE ROCK SOCK DESIGN DETAIL INSTALLATION REQUIREMENTS.

2. PLACEMENT OF THE SOCK SHALL BE APPROXIMATELY 30 DEGREES FROM PERPENDICULAR IN THE OPPOSITE DIRECTION OF FLOW.

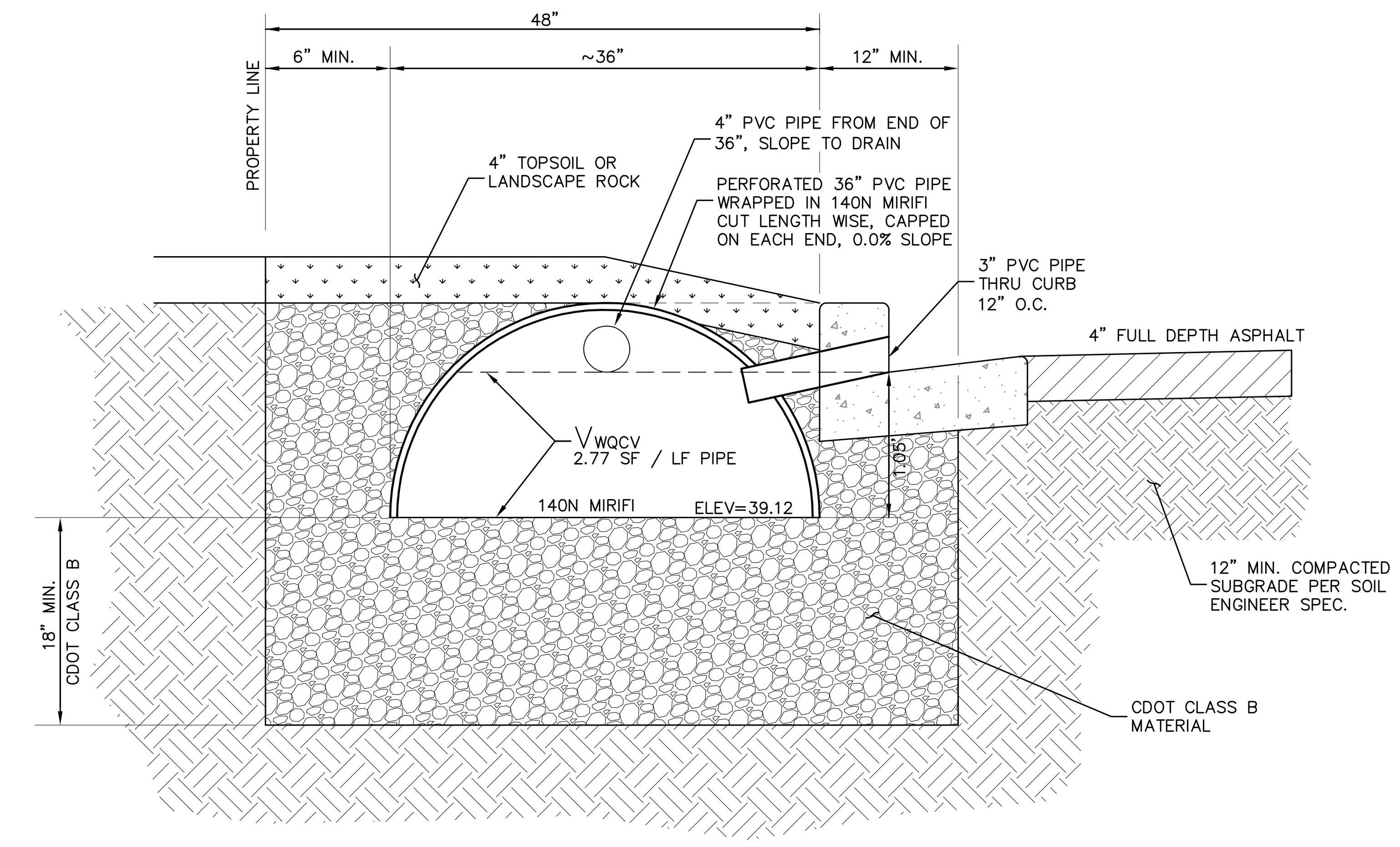
3. SOCKS ARE TO BE FLUSH WITH THE CURB AND SPACED A MINIMUM OF 5 FEET APART.

4. AT LEAST TWO CURB SOCKS IN SERIES ARE REQUIRED UPSTREAM OF ON–GRADE INLETS.

GRADING & EROSION CONTROL PLAN DETAILS
1000, LLC
JOB NO. 44–026
DATE PREPARED: JUNE 9, 2017
DATE REVISED: AUGUST 7, 2017

EL PASO COUNTY FILE NO. PPR 17–026

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

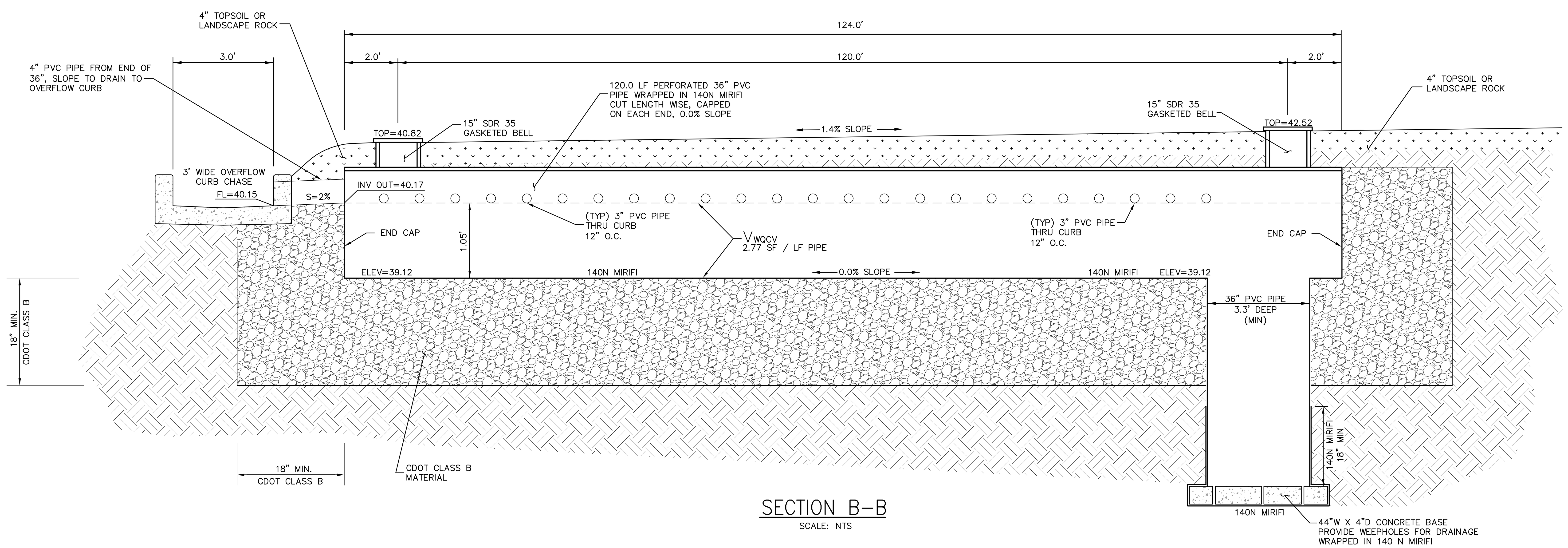


SECTION A–A
SCALE: NTS

WQCV SUMMARY
WQCV REQUIRED = 338 CF
WQCV PROVIDED = 124' x 2.77 SF/LF = 343.4 CF
SEDIMENT STORAGE REQUIREMENT
SEDIMENT STORAGE REQUIRED = 124'X3'X3" = 93 CF
SEDIMENT STORAGE PROVIDED = $\pi\ (1.5)^2$=7065 SF 93 CF / 7.065 SF = 13.16' 13.16' /4 TIMES = 3.30' (TO BE CLEANED 4 TIMES PER EVENT)

INFILTRATION PER TEST RESULTS BY GEOQUEST, LLC*
INFILTRATION RATE = 17.3 MINUTES PER INCH
SURFACE AREA: 124' X 3' = 372 SF
VOLUME : 343.4 CF
1.05' = 12.6" 17.3 MIN/IN X 12.6" = 218 MINS $218 \text{ MIN} \times \frac{1 \text{ HR}}{60 \text{ MIN}} = 3.63 \text{ HRS}$ ✓ GOOD; LESS THAN 12 HRS

WATER QUALITY STORAGE DETAILS



SECTION B–B
SCALE: NTS

GRADING & EROSION CONTROL PLAN DETAILS
1000, LLC
JOB NO. 44–026
DATE PREPARED: JUNE 9, 2017
DATE REVISED: AUGUST 7, 2017

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Markup Summary

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GRADING & EROSION CONTROL PLAN DETAILS 1000, LLC JOB NO. 44-026 DATE PREPARED: JUNE 9, 2017 DATE REVISED: AUGUST 7, 2017

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SHEET 4 OF 9

Subject:
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EL PASO COUNTY FILE NO. PPR 17-026

dsdlaforce (1)

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Include the following as attachments.
1. WQCV calculation. Unresolved.
2. Percolation Test. Unresolved.