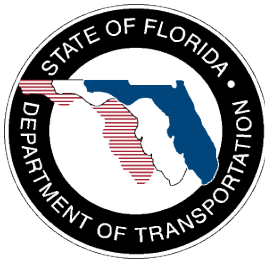


Final Report FDOT Project BD521-04

**STATE of FLORIDA MANUALS for EROSION
AND SEDIMENT CONTROL
and the
RAINFALL RUNOFF SIMULATOR at the
STORMWATER MANAGEMENT ACADEMY**

A Joint Research Program of



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The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation.

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Two manuals that are used to design, review, and construct erosion and sediment control facilities in the State of Florida, namely the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (306 pages) and the State of Florida Erosion and Sediment Control Field Manual (122 pages) were published and are available to the practicing professionals. These were published as a combined effort with the State Department of Environmental Protection. Notable contributors to the manuals were professionals from the State of Florida Water Management Districts, HydroDynamics Inc, the United States Geological Survey, the University of Central Florida (UCF), and various consultants. The Manuals are available on line at www.stormwater.ucf.edu. UCF conducted two training classes for FDOT personnel to both promote an understanding of the manuals and for future training upgrades. Researchers constructed an erosion control laboratory on the campus of UCF to review new products, develop and prove theories related to erosion control, and to test existing products. Built two eight feet by 30 feet test beds capable of variable slopes and water table depths. In addition, constructed is the world's only rainfall simulator capable of rainfall rates of up to twelve inches of rain per hour at appropriate drop sizes. The rainfall simulator and the test beds with an index testing area comprise the world's largest erosion control and stormwater management facility of its type. Video of the simulator when in operation is available online at www.stormwater.ucf.edu. One application of the rainfall simulator and the test bed supported by this funding was to demonstrate the effectiveness of a silt fence. This project has provided the simulator for over 160 rainfall and runoff tests in an 18 month period using various Erosion and Sediment Control (E&SC) materials and natural conditions as conducted by other funding support.			
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Executive Summary

A result of this research is the development of two manuals, one for design and review of erosion and sediment control practices and the other to guide the construction of erosion and sediment control practices in the field. Both manuals can be downloaded from www.stormwater.ucf.edu. The manuals were developed by unprecedented cooperation among state, federal, academic, local and consulting agencies. The collective wisdom and understanding of 23 professionals created the writing of the manuals.

A set of lesson plans for training in conjunction with the design and review manual is also available. Two pilot courses were completed to educate participants and refine the information in the manual.

The professionals involved in writing the manuals also recognized the need to test existing products and to develop newer ones. Thus a test bed with rainfall simulator was built. It is the world's only rainfall simulator capable of a rainfall rate of up to 12 inches per hour at appropriate drop sizes. The rainfall simulator and the test beds with an index testing area comprise the world's largest erosion and sediment control and stormwater management testing facility of its type. An example evaluation for silt fence is presented to illustrate the capability of the simulator and test bed.

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CHAPTER 1 – INTRODUCTION

Erosion and sediment control in the State of Florida is an important aspect of water pollution control relative to construction projects. With the adoption of the statewide stormwater rule in 1982, Florida was the first state in the country to require the treatment of construction runoff from all new projects. The stormwater rule is a technology-based rule relying upon a performance standard or an environmental goal with Best Management Practices (BMPs) design criteria that are presumed to meet the goal. The performance standards are set forth in the Water Resource Implementation Rule (Chapter 62-40, F.A.C.).

Erosion control is important to reduce sediment and pollution loads to receiving water bodies and to provide for the timely completion of construction projects within pollution control regulations. The water quality measure used to indicate a reduction in sediment and pollution is turbidity. Performance standards for erosion and sediment control are to retain sediment on-site so that no discharge shall violate the State of Florida's water quality standard for turbidity. Thus, goals of the Florida's stormwater regulatory program are to protect water quality and to minimize erosion and sedimentation by requiring the use of effective BMPs during and after construction.

Reviews and surveys of the erosion control industry show that several other state DOTs, such as those in Texas, Georgia, Colorado, Utah, South Carolina, Maine and California, have aggressive product evaluation and testing programs, and in many cases partnering with independent research centers at state universities (Brzozowski, 2004). Specifically, a recent

evaluation of the FDOT's current sediment and erosion control program recommended allowing the use of hydraulically applied methods and products for erosion control (Fifield, 2001).

To accomplish the goals for erosion and sediment control and the implementation of the recommendations for hydraulically applied methods, various products must be offered for use before, during and after construction. To provide data on the performance of these products requires experimentation in Florida soil and climate conditions. Thus, a laboratory is established on the campus of the University of Central Florida (UCF) to evaluate new ideas and products that have the potential to reduce sediment and pollution loadings within the state. In addition, guidance in the form of manuals for the proper installation and operation of erosion and sediment control products are developed.

1.1 OBJECTIVES

The objectives of this research are as follows:

1. Review and publish manuals for erosion and sediment control that are acceptable to a wide cross section of the practicing professionals.
2. Construct and demonstrate the use of a facility for the evaluation and development of erosion and sediment control products and procedures.

1.2 LIMITATIONS

The results are constrained by the soil conditions and climate in Florida.

1.3 APPROACH

This report consists of four chapters. The first chapter is an introduction to the topic and description of the research objectives and the limitation to the Florida climate and soil conditions. Chapter two presents the need for the manuals and an outline of the manuals. Chapter three presents the test bed and rainfall simulator with information on its applicability of the UCF rainfall simulator to reproduce Florida rainfall and the test bed to reproduce Florida soil and water table conditions. The final chapter is a summary and conclusions of the research.

CHAPTER 2 – EROSION AND SEDIMENT CONTROL MANUALS

2.1 DESIGNER AND REVIEWER MANUAL

The Designer and Reviewer Manual is a 300 page comprehensive manual to aid the professionals in the design, construction, maintenance, and review of erosion and sediment control methods. The manual has been in use since June of 2007 and is scheduled for updates as new products, changes in regulations, and information become available. Over four thousand visits have been made to the web site since June 2007 where the manual is located and over two thousand professionals have asked to be notified when updates are available.

SUMMARY STATENTS FOR THE EROSION AND SEDIMENT CONTROL DESIGNER AND REVIEWER MANUAL

There are five sections in which the basic design and reviewer materials are presented. Supporting data for the sections are presented in five appendices.

SECTION I: INTRODUCTION

The purpose of the manual with a history of soil and erosion control is presented. Basic definitions are offered to help the reader understand the differences in erosion and sediment control methods. Sediment loading is introduced and its impact to water bodies with relationship to impacts on surface water bodies. Special attention is given to nutrients as there are many water bodies in the state that have a total maximum daily load restriction for nutrients. Other water quality parameters are discussed including references to hydrocarbons and metals. The importance of vegetation is stressed because of its role in erosion and sediment control.

Regulations and statutory requirements that affect decisions on water quality are reviewed as they relate to construction activities. The Construction General Permit (CGP) is the center of an erosion and sediment control program along with the Stormwater Pollution Prevention Plan (SWPPP). Inspections along with notices of actions are related to the permit process along with retention of records. Thus, the regulatory aspects for erosion and sediment control are presented in a depth necessary for an understanding of rules and regulations governing the process.

SECTION II: DEVELOPING EFFECTIVE SWPPP AND E&SC DRAWINGS

The contents of a SWPPP and erosion and sediment control (E&SC) plans and drawings are presented. Designer and contractor certification requirements are reviewed. The development of a plan with record keeping and updates are reviewed. Emphasized are effective E&SC drawings. A SWPPP and an E&SC drawing must be based on factual data, thus reviewed are the needs for data collection and interpretation of the data. Even details such as the title sheet data and pre and post grading plans are reviewed. Some examples of typical detail and specifications sheets are noted.

SECTION III: EROSION CONTROL METHODS

The design of vegetation with methods of construction and maintenance is stressed. Vegetative filter strips, temporary sod, permanent sod, mulches, compost, seeding and other commercial covers are presented. The need for a pure seed without weeds is stressed. There is a special section on soil binders, and one for rolled erosion control products (RECPs). Details of soft versus hard armoring are discussed. There are additional sections on factors affecting the

selection of all vegetative methods, runoff control structures, diversion dikes, and channel check structures. Slope of the drainage basin and roadway are also considered in design and review. Example designs are used to reinforce the presentations.

SECTION IV: SEDIMENT CONTAINMENT SYSTEMS (SCSs)

The design and review of sedimentation containment systems (SCSs) or sometimes called *sed ponds* are presented. Both end of system and pre sedimentation ponds are discussed. There is a separate division for estimating the effectiveness of SCSs and another for the design of outlet structures. Surface skimmers to reduce sediment load in the discharge are also presented. Dewatering activities and use in conjunction with SCSs with their impact are presented. Rim ditching, sock pipe, horizontal wells, and well pointing are also options presented in this Section. An effective strategy may be the use of polymers or coagulants and is presented with the proper use. Examples of SCSs in terms of design and review are presented.

SECTION V: TEMPORARY CONSTRUCTION SITE BMPS

Using barriers to remove sediment from runoff water is the main objective in this Section. Limitations of each method are presented. The proper design and installation of silt-fences, fiber logs, berms, curb and drop inlets are discussed with example problems. Examples are presented with data in this section and other related examples for coastal and inland applications are found in the Appendices. The use of polymers is highlighted as a method for erosion and sediment control. However, other chemical methods of treatment are presented in an effort to illustrate the effectiveness of all methods.

2.2 FIELD MANUAL

The Field Manual was completed for use on a job site as a complete reference to relevant soil and erosion control methods. It was distributed in February of 2008 with four sections. It is 122 pages long, and a convenient size for use in the field. The content of the Field Manual stresses information useful for installation and construction activities. It has the same but condensed information as found in the Designer and Reviewer Manual.

CHAPTER 3 – RAINFALL RUNOFF SIMULATION

3.1 NEED BASED ON FLORIDA CLIMATE AND SOIL CONDITIONS

On average, Florida receives over 50-inches of rain each year, often in the form of torrential downpours that cause runoff carrying sediment, fertilizers, pesticides, oil, heavy metals, bacteria, and other contaminants which may enter surface waters. Rainfall rates have been reported for 8-15 minute time durations to exceed 10 inches per hour. Add to that the drop size of the rainfall and there are most likely erosion forces that are not found in many other parts of the world. There is also a recognized variability in geographic area and timing of rainfall that further complicates management of erosion and sediment control. In the northern and some coastal areas of the state, average yearly rainfall consistently exceeds 60 inches per year; in the central part of the state average yearly rainfall is around 50 inches per year, while in the Keys, the averages may not exceed 40 inches per year.

Adding to the difficulty in managing runoff are different soil conditions. The northern part of the state has a majority of clay, while most of the coastal and in-land areas are sandy. Outcroppings of limestone are also visible or near the surface. In addition, the professional must recognize water table conditions, which do vary around the state from very deep to near the surface.

To provide erosion and sediment control, the professionals must work within the spatial and time variables for soils and climate and then construct systems that will minimize adverse soil loss impacts. This means that the selection of erosion and sediment control methods is

complicated and can be a challenge to those not familiar with the state climate and soil conditions. Thus, a laboratory that can provide evaluation conditions using different rainfall rates and soils should be made available to the profession. The following issues related to erosion and sediment control are to be addressed at this facility:

1. What are the best new erosion control products and methods for Florida conditions?
2. What are the performance characteristics for Florida conditions?
3. What data are available for proper design and operation?
4. What are the benefits and potential constraints to use/implementation?

3.2 TEST BEDS

The purpose of the erosion and sediment control test beds is to conduct testing and evaluation of materials and methods that have the potential to

1. Improve the product lines used in erosion and sediment control Best Management Practices (BMPs).
2. Evaluate performance of existing products and methods and recommend methods and procedures for improvement if necessary.
3. Encourage the development of new products and approaches that are relevant to Florida conditions.

Two eight foot by thirty foot aluminum test beds with a one foot maximum depth of soil are constructed on the campus of UCF. Aluminum was used since it is lightweight and the beds were expected to come in contact with water. The test beds were designed by a registered

structural engineer. A tilting system with a pivot at one end and a hydraulic mechanism was found to be the best choice. Figure 1 shows the foundation for a test bed and Figure 2 shows the placement of the two test beds in place. A single hydraulic system is used to set a slope on the bed. The maximum obtainable slope is 1:2 (V:H). Figure 3 shows the hydraulic cylinder that is used to lift the test beds to the various slopes.



Figure 1 Foundation for One Test Bed



Figure 2 Installation of the Test Beds



Figure 3 Hydraulic System Used to lift a Test Bed to Obtain Different Slopes

The test beds are also unique in that they are constructed either to hold a water table or to make water table depth not relevant. In Figure 4 is shown the collection of tubing and a horizontal reservoir that is used to maintain the water table at predetermined depths within the test beds. This tubing is also used for water sampling that infiltrates into and percolates through the soil.



Figure 4 Tubes and Reservoir to Maintain a Water Table within the Test Bed

Two Gantry cranes with a hoist on each are used to lift the rainfall simulator above the test beds. Each crane has a clear span opening of thirty feet and a capacity to lift two tons each. The rainfall simulator weight is about 1000 pounds. The cranes and hoist provide the flexibility to move the rainfall simulator over each of the beds and also tilt it such that the simulator remains parallel to the test beds in all configurations. Figure 5 shows the installation of the gantry crane system.



Figure 5 Installation of Gantry Crane System to Suspend Rainfall Simulator

Safety catches and other features are built into the design. When the bed is extended with a slope, it rests on structural support as well as the hydraulic system. Figure 6 shows the structural support system used to prop the test beds at various slopes. Although these systems were in place, some excessive stresses were noted at the joints and weld failure did take place. Additional welding of the structure had to be done where these weld failures occurred. In addition, the research team redesigned the support system to move more smoothly to prevent rotational stress buildup and excessive stress at some of the welds at the pivot points as shown in Figure 7.



Figure 6 Safety Support Structure for the Test Beds



Figure 7 Additional Welding at the Pivot Points

Figure 8 shows the final setup used for erosion control testing at the laboratory. It shows the rainfall simulator in place above one of the beds that is tilted and filled with soil. The runoff is collected in the tanks at the bottom of the hopper or chute system shown in Figure 8. The runoff volumes are evaluated to determine the amount of erosion for a given rain event.



Figure 8 Configuration of Erosion Control Test Bed and Rainfall Simulator

Within 18 months of operation, the test beds have been used to simulate the runoff using bare earth, natural vegetation, asphalt pavement, concrete pavement, roof shingles and tiles, and fertilizer application rates. Over one hundred and sixty separate tests in an eighteen month period have been completed at all slopes and a variety of rainfall conditions. Satisfactory results have been obtained and additional publications have been completed. The pictorial results for one of the tests is shown in Figure 9. Note the rather turbid runoff from a 10 inch/hr rainfall event on exposed soil.



Figure 9 Example Runoff from a Rainfall Event on a Bare Soil Surface

The test beds are one of a kind because of the flexibility for experimentation and their size. They provide the largest surface area with the flexibility for slope and material changes.

3.3 RAINFALL SIMULATOR AND CALIBRATION

A rainfall simulator is used with the test beds to simulate rainfall and subsequent runoff conditions. The rainfall simulator must be designed and operated over a range of rainfall intensities common for Florida, namely rainfall rates of up to or greater than 10 inches per hour for 8-15 minute durations. Also the drop size must be consistent with natural rainfall. The UCF rainfall simulator shown in Figure 10 is composed of a pressurized distribution system with specialized water spray nozzles. The nozzles are designed to produce a drop size that would be

similar to natural rainfall. A drop size distribution curve is measured for natural rain and compared to that from the rainfall simulator.



Figure 10 UCF Rainfall Simulator

The drop-size distribution of the UCF rainfall simulator was measured using a Joss-Waldvogel Disdrometer (JWD). This instrument owned by NASA is operating at a data collection site located at the UCF campus. With the permission of NASA, the JWD instrument was temporally relocated to the rainfall simulator site to take the measurements. For comparison purposes, the rainfall rate and accumulation from the simulator were also measured using a tipping bucket rain gauge and a rain accumulation gauge. The JWD has been commercially available for over 30 years and is considered by many as the “industry standard”. It is an impact type device and measures the drop size within 5% accuracy. The JWD has a sampling cross-

sectional area of 50 cm², and drops are sorted into 127 size intervals ranging from 0.3 to about 5.5 mm for 30-second averaging periods. The boundaries of the 127 channels are not uniform, and increase with drop size from 0.1 mm to about 0.5 mm. The calibration of each unit determines the exact channel boundaries. Figure 11 shows a typical setup for this unit.

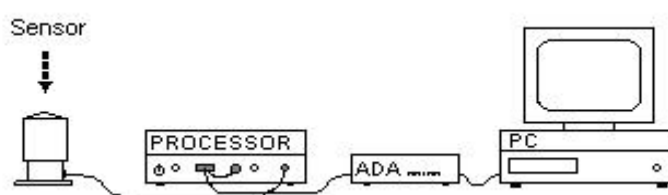


Figure 11 Typical Setup of the Joss-Waldvogel Disdrometer (from the JWD website)

The sensor consists of a Styrofoam cone attached to a pair of moving coils. When a raindrop hits the Styrofoam sensing cone mounted on the transducer of the JWD, the cone and two attached coils within the transducer are driven downward through a magnetic field. This induces a voltage in the sensing coil that is amplified and applied to the driving coil (returning the cone to its original position), thereby improving the response time of the instrument. The processor reads the produced voltage and through some internal processing converts it to an equivalent drop size. To calibrate and verify the UCF rainfall simulator as a reasonable device to simulate rainfall intensities and drop sizes, the JWD, two rain tipping buckets and accumulation gauges are installed underneath the spray jets of the rainfall simulator. The UCF rainfall simulator was then operated and data collected on rates and rain drop sizes. The rainfall rate was verified at up to 12 inches per hour.

Four data sets at different rainfall rates were measured. The duration of each experiment was 5 minutes and between runs the filter cartridge attached to the discharge side of the pump was cleaned. The four simulations are as follows:

- 2 runs at 10 inches/hour
- 1 run at 5 inches/hour
- 1 run at 0.25 inches/hour

Drop Size Histograms

The drop-size histogram of each rainfall simulation was measured. Shown in Figure 12 are the four histograms on the same scale. All histograms showed peak rates around 2mm. This is expected, due to the fact that the rain rate varied by varying the on/off cycle of the jets, that is, for high rain rates the jets spray almost continuously and for lower rates the jets are turned on and off. As expected, the low rain-rate produced far less rain drops because the jets were spraying only briefly within the cycle.

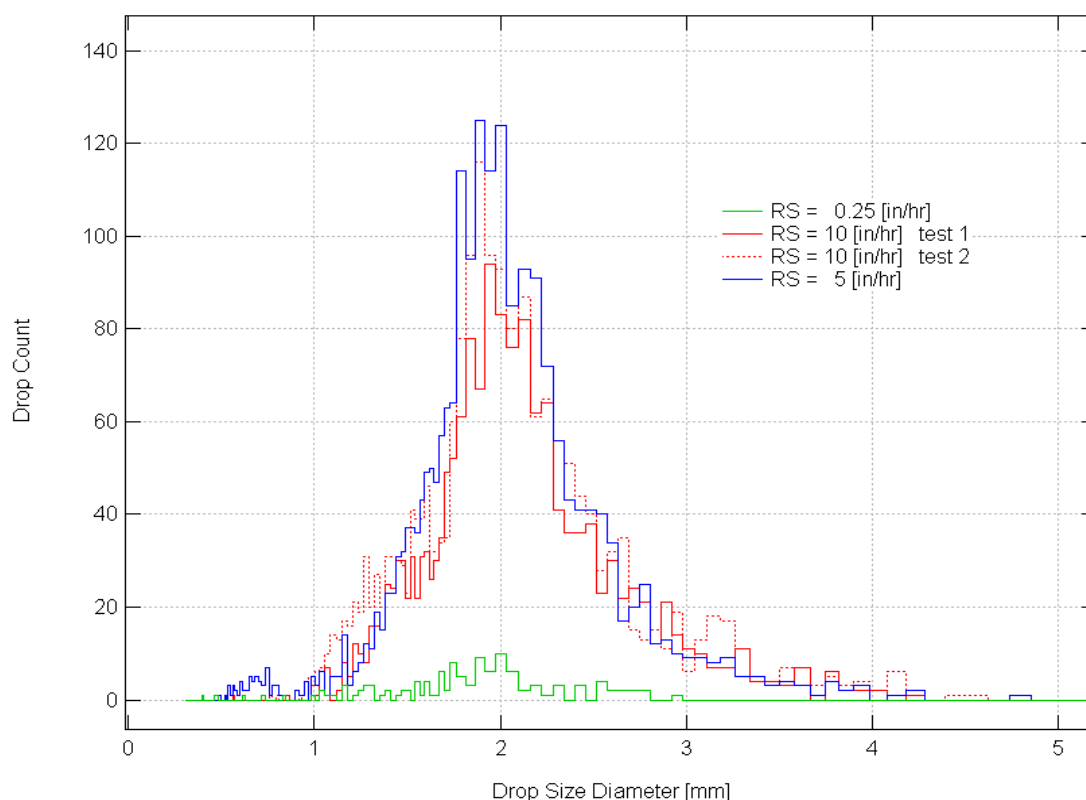


Figure 12 Drop-size Histograms of the Four UCF Rainfall Simulations

Comparison of the measured rainfall by tipping bucket to actual produced similar results and intensities of up to 10 inches per hour can be produced with the UCF rainfall simulator. The JWD could not however be used to verify this result but was used to measure the drop size distribution. Next, these distributions are compared to those from natural rainfall events.

For comparison purposes, three natural rain events were analyzed. Two of the rainfall events were a storm that passed through central Florida on March 20, 2008. This storm was observed by data collection sites at the UCF main campus and at the Florida Solar Energy Center (FSEC). Both sites are equipped with JWD and a cluster of rain gauges. The JWD at the UCF site is the same one that was used with the UCF rainfall simulator tests. Figure 13 and 14 are the

drop size histograms from the UCF site and from the FSEC site. It needs to be noted that the UCF storm lasted about 60 minutes and the FSEC storm lasted about 90 minutes.

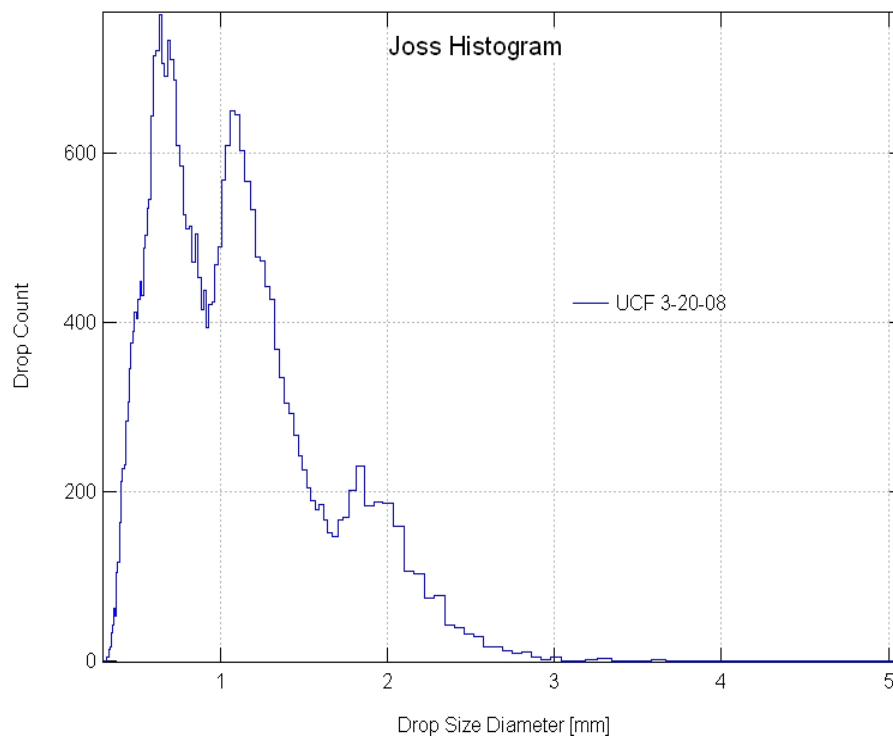


Figure 13 Drop Size Histogram for a Storm at UCF on March 20, 2008 with Rainfall Rate of Approximately 0.2 Inches/Hour.

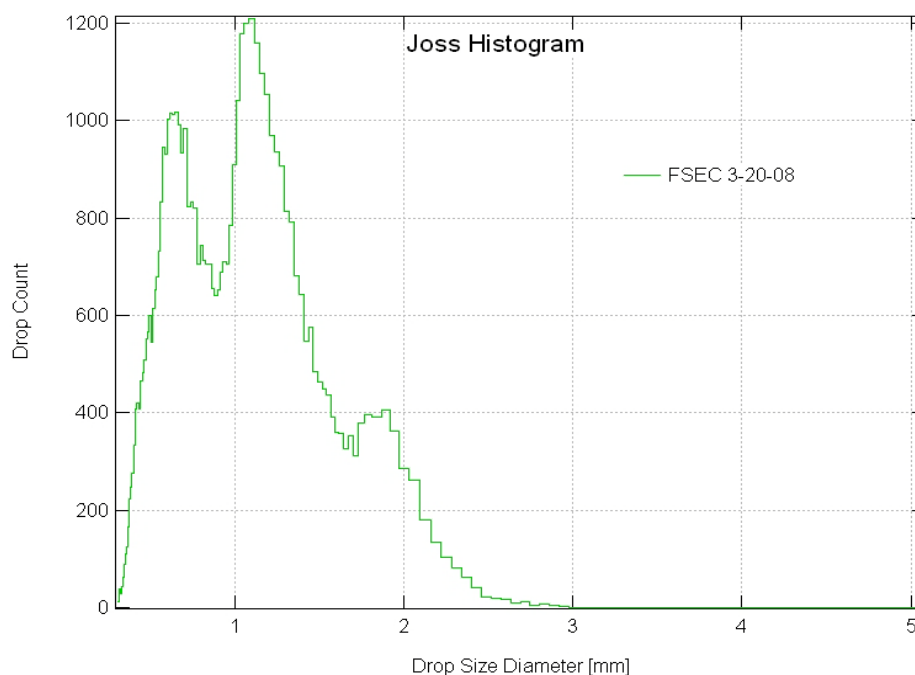


Figure 14 Drop Size Histogram for a Storm at FSEC on March 20, 2008 with Rainfall Rate of Approximately 0.25 Inches/Hour.

In the table below, a comparison of rain accumulation from the rain gauges with accumulation derived from the JWD computed by accumulating the drops is shown. This is considered to be an excellent agreement between JWD derived rainfall and the tipping bucket rainfall volumes which would add credibility to the measurement methods.

RAIN EVENT	Joss Derived Accumulation [in]	Tipping Bucket Accumulation [in]
UCF 3-20-08	0.18	0.20
FSEC 3-20-08	0.32	0.35

Searching JWD archived measured rainfall to identify drop sizes at UCF recorded from mid year of 2007 to mid year of 2008 produced a high intensity rainfall event on May 10, 2007

with an average intensity of about 1 inch/hr. Within this time, intensities were at least 10 inches per hour for a few minutes. Figure 15 shows the Joss Histogram for this rainfall event. The drop sizes are similar to those produced by the UCF rainfall simulator.

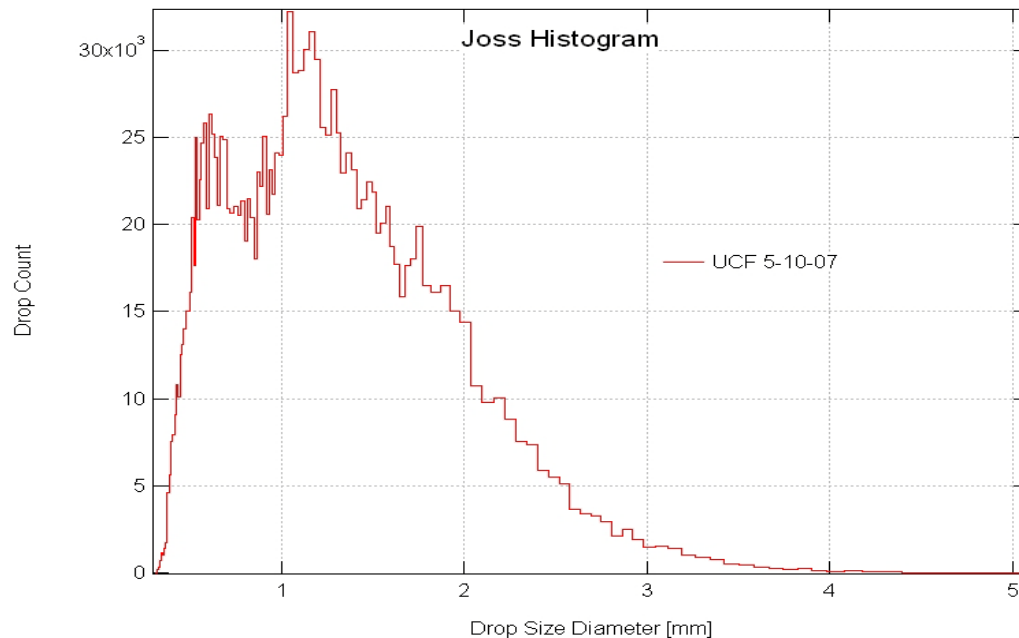


Figure 15 Drop Size Histogram for a storm at UCF on May 10, 2008 with Rainfall Rate of Approximately 1 Inch/Hour.

Operation Details

The rainfall simulator has water influent from a 1500 gallon opaque UV protected cistern for potable water storage. The potable water is delivered to the spray heads at up to 100 gallons per minute as measured by an in-line flow meter using a centrifugal pump and 5 micron disc filter. It is important to clean this filter to achieve the required flow rate and prevent any debris or particles from blocking the spray nozzle outlets. Any excess water is re-circulated by

catchment basins attached to the simulator and returned to the cistern to conserve as much potable water as possible during testing.

General Conclusions of Drop Size Testing Under Actual Operating Conditions

Significant information is derived from the drop size testing of the UCF rainfall simulator and from the actual operation of the test bed and simulator. One obvious observation is that the simulator and test bed is functional and is being used to simulate a variety of rainfall rates and at different slopes and soil conditions. The rainfall rates of the drop size JWD were compared to tipping bucket measures and accumulated values while the range of drop sizes of the UCF simulator were compared to the range of drop sizes from natural rainfall events. The rainfall intensities and accumulated values are comparable and can be measured by simple accumulation volumes. Rates of up to 12 inches per hour and even higher are measured. The drop size distribution produced by the UCF rainfall simulator is comparable to that of natural rainfall events. The UCF rainfall simulator produces slightly higher drop sizes but this is not considered to be problem. For erosion control studies, a larger drop size is considered to be conservative. Terminal velocity measures were not conclusive but the terminal velocities are considered to be significant from the UCF rainfall simulator. The terminal velocities from the UCF simulator are significant because of the height of operation (usually 7-20 feet above the bed) and the use of pressurized water from the spray nozzles.

3.4 EXAMPLE APPLICATION OF THE RAINFALL SIMULATOR/TEST BED

Evaluations of E&SC materials and runoff studies have been completed using the simulator and test bed system and as funded by other agencies. Thus, the system is available for use by other agencies. However, it was tested for reproducibility and accuracy under the terms of this contract. An example of the testing procedure is presented using a silt fence.

The system is tested using silt fence to demonstrate and calibrate the instrumentation using a sampling protocol. Silt fence is one of the more common products for sediment control in Florida, thus it would make sense to evaluate a product line that is in common use. The scope of the work was to determine the structural stability and filtration capacity under different slope and rainfall intensities. A testing protocol is also developed and implemented for various slopes and rainfall rates. Figure 16 shows a photo before one of the test runs and Figure 17 is the results of a 3 inch per hour rainfall on the functioning of the silt fence are shown. This particular silt fence being tested for the specified soil, slope and rainfall intensities functioned as a stable unit and continued to filter. Test results similar to this are made available to agencies. It should be noted that the rainfall simulator and test beds have the capacity to evaluate a variety of products under many operating conditions, in addition to evaluation of installation measures.



Figure 16 Silt Fence on the Test Bed before Evaluation with the Rainfall Simulator.



Figure 17 After a 3 Inches per Hour Rain Event, the Silt Fence Remains Stable.

An example of a test protocol is detailed to illustrate the completeness and flexibility of the rainfall simulator and test bed using the silt fence as the sediment control material.

1. Set the test bed at a minimum slope (as an example, use 1:10) and run the rainfall simulator at 1 inch/hour rainfall intensity.
2. Allow the rainfall simulator to continue for 30 minutes after runoff starts.
3. Record start and end time of runoff before (upstream) and after (downstream) the silt fence.
4. Measure the volume of runoff at 1 minute interval until runoff stops.

5. Measure the depth of runoff water held behind (upstream) the silt fence barrier at 5 minutes interval until runoff stops.
6. Collect runoff water samples before (upstream) and after (downstream) the silt fence barrier at 5 minutes interval until runoff stops.
7. Test all collected water samples for total suspended solids (TSS), particle sizes (Sieve) and turbidity (NTU).
8. Check structural stability of silt fence barrier and record time and type of any failure observed during test – picture evidence necessary.
9. Take pictures of the test bed showing erosion type after test.
10. If no structural failure was observed, repeat steps 1 to 9, and if no failure, repeat one more time.
11. Remove all sediment attached to silt fence if no structural failure, or reinstall silt fence if structural failure occurred during test.
12. Fill the test bed to desired depth and compact to achieve compaction level.
13. Repeat steps 1 to 12 with rainfall intensity at 3, 5, and 10 inches/hour.
14. Repeat steps 1 to 13 at test bed set at higher slopes (as example set at 1:3 and 1:2 slopes).

CHAPTER 4 – TRAINING COURSE

4.1 BACKGROUND

The interagency State of Florida Erosion and Sediment Control Manual was released in 2007 as described in chapter 2. This manual was aimed at assisting designers and reviewers in providing meaningful and practical erosion and sediment control (E&SC) drawings as part of the Stormwater Pollution Prevention Plan (SWPPP) for the contractor to implement. The manual has been developed to strive toward a consistent level of technical expertise and professional conduct for designers and reviewers developing and reviewing E&SC drawings and SWPPP. Ultimately, the guidance in this manual strives to ensure the desired benefits of stormwater management systems are being achieved.

A technology transfer project was added as a supplement to the original project to develop and offer two pilot sessions of a training course related to the manual. The first course took place at the Stormwater Management Academy (SMA) on the campus of the University of Central Florida (UCF) in Orlando on September 30-October 1, 2009. Based on the feedback from this first pilot offering, some modifications were made to the list of instructors, content of the course and delivery method. A summary of the survey results and changes that were made after the first pilot are discussed later in this chapter. A second pilot offering was then held in Lake City on January 27-28, 2010. The second offering of the course included clear lesson plans for each session and related the classroom teaching materials directly to the sections in the manual.

The training course brought together a number of qualified instructors with a diverse set of backgrounds. The instructors included representatives from the SMA, Environmental Sciences, Florida Department of Environmental Protection, and water management districts. Course materials were refined and lesson plans were developed.

The first course spanned three days but the second offering was shortened to two days of instruction. Both formats culminated in a comprehensive final examination. The duration of the final examination was two hours and consisted of several multiple-choice questions. The passing requirement was 70% correct answers.

A list of the instructors for the two pilot courses is provided in Table 1 below. SMA personnel serving as instructors include Drs. Wanielista and Chopra along with Mike Hardin who was brought on for the second course. FDOT personnel involved in the instruction include Larry Ritchie and Patrick Muench. John Slupecki of American Excelsior and Steve Iwinski of Applied Polymers assisted in coordinating and presenting the field demonstrations on erosion and sediment control.

Several UCF sub-consultants were also used for the pilot courses. Dr. Jerry Fifield from Hydrodynamics in Colorado was a major part of the first pilot program. Other teachers for the pilot offerings were Patricia Tierney of StormH2O, Heather Ritchie of FDEP, Andi Reyes of SFWMD, John Slupecki of American Excelsior, Steve Iwinski of Applied Polymers, and Eddie Snell of Reedy Creek as they bring extensive knowledge and experience of erosion and sediment control practice to the training course.

Table 1 List of Instructors

Instructors	Pilot Course Participation	Affiliation
Martin Wanielista	1 and 2	UCF Stormwater Academy
Jerry Fifield	1	Hydrodynamics, Inc.
Mike Hardin	2	UCF Stormwater Academy
Patricia Tierney	1 and 2	Storm H2O, LLC
Eddie Snell	1 and 2	Reedy Creek
Manoj Chopra	1 and 2	UCF Stormwater Academy
Steve Iwinski	1 (field demos in 2)	Applied Polymers
Heather Ritchie	1 and 2	FDEP
John Slupecki	Both Field Demos	American Excelsior
Andi Reyes	1 and 2	SFWMD
Larry Ritchie	1 and 2	FDOT
Pat Muench	2	FDOT

In order to ensure the consistency of the presentation materials, lesson plans for each session were developed and was followed by each instructor. Each instructor also provided the presentation slides but these were not provided to the participants beforehand. One proposed modification for future offerings is to provide a handout with presentation materials and working examples in a binder to the participants to allow them to take notes and work out problems along with the instructors.

4.2 AGENDA

An agenda of the course split into Day 1 and Day 2 with the corresponding instructors, is provided in Table 2 below. It includes reference to the corresponding sections from the manual, related issues such as regulatory and enforcement, along with field demonstrations.

Table 2 Final Agenda for the Training Course with Instructor Names Associated with the Pilot Course Offerings

Day 1

8:00-8:10 Introductions [L. Ritchie and M. Wanielista]

8:10-9:00 Policies, Definitions, and Terminology [H. Ritchie]

Manual Reference: Sections I and II

- Review of State Regulations
- Policies, statutory requirements, and responsibilities
- Basic Terminology
 - The alphabet of acronyms, ERP, WMD, DEP, NOI, SWPPP, TSS.

9:00-10:00 Hydrology and Hydraulics Review [M. Wanielista]

Manual Reference: Section III

- Rainfall and Design Curves
- Drainage basin assessment and runoff rates and volumes
 - Rational Equation for Flow Rates
 - Common Uses
 - Limitations
- Volume Estimates
 - Common Uses
 - Limitations

10:00-10:15 Break 1

10:15-11:00 Introductions to Erosion Control [P. Tierney]

Manual Reference: Section III

- The Erosion Process
 - Types
 - Factors influencing erosion
- Soils and properties
- Impacts
- Principles of erosion control
 - Plan to minimize exposed area
 - Perimeter control
 - Low velocities

11:00-12:00 Sediment Control Methods [E. Snell]

Manual Reference: Section V and Appendices II & III

- Temporary BMPs applications with installation, inspections & illustrations

12:00-1:00 Lunch

**1:00-2:00 Field Demonstrations – [M. Hardin and J. Slupecki]
Manual Reference: Section III**

- Common problems
- Products

**2:00-3:30 Erosion Control Methods [P. Tierney and E. Snell]
Manual Reference: Section III and Appendix I**

- Use of Vegetation
 - o Types and examples
 - o Application rates
 - o Inland and coastal
- Mulches and Compost
 - o Applications
 - o Methods

3:30-3:45 Break 2

**3:45-5:00 Sediment Control Methods Continued [E. Snell]
Manual Reference: Section V and Appendices II & III**

- Polymer Enhancement
- Examples of Polymers and other chemical additions

Day 2

**8:00-9:15 Introduction of day's Instructors and Erosion Control Methods Continued
[M. Hardin]**

- Rolled Erosion Control Products
 - o Selection guides
 - o Slopes and Channels
- Runoff Control Structures
 - o Slope drains
 - o Check Structures

**9:15-10:15 Sediment Control [M. Hardin]
Manual Reference: Section IV and Appendices II & III**

- Principles of sediment control
 - o Soil types
 - o Transport

- o Sedimentation rates
- Sediment Containment Systems (SCS)
 - o Types
 - o Effectiveness
 - o Outlet structures
 - o Inlet protection
 - o Surface skimmers
 - o Pre-sedimentation
- Example Problems

10:15-10:30 Break1

10:30-11:00 Sediment Control [A. Reyes]

Manual Reference: Section IV and Appendices II & III

- Dewatering
 - o Methods
 - o Treatment options
 - o Field applications
 - o Connection between design and application

11:00-11:30 Erosion and Sediment Control - Water Management District Perspective [A. Reyes]

11:30-12:00 Policies, Definitions, and Terminology [P. Muench and L.Farrell]

Manual Reference: Sections I and II

- Review of existing E&SC plan
- Group discussion

12:00-1:00Lunch

1:00-2:00 Field Demonstrations – [M. Chopra and J.Slupecki]

Manual Reference: Sections IV & V and Appendices II& III

2:00-3:00 Discussion and Relevancy to FDOT Practices [M. Chopra and L. Ritchie]

Manual Reference: All information

- Manual relevancy
- Pay Items
- Questions and Review

3:00-4:45 Comprehensive Exam [M. Wanielista and/or M. Chopra]

4:45-5:00 Review and further discussion [M. Wanielista and/or M. Chopra]

4.3 SUMMARY OF SURVEYS AND COURSE MODIFICATIONS

A survey was conducted by the UCF Division of Continuing Education of all participants in each of the two pilot courses. The results of the surveys from the first pilot offering were compiled and a post-course meeting was held of the organizing group (SMA and FDOT) to recommend changes to the course. This meeting was followed by a meeting of the instructors to discuss and implement the changes for the second pilot course. A summary of the survey comments from the first pilot course in Orlando are provided in the Table 3.

Table 3 Summaries of Survey Results from Pilot Course One in Orlando

What topics would you have liked to have spent more or less time on?

- a. Analyzing why BMPs failed and what alternatives should be implemented.
- b. Dewatering does not apply to my job duties.
- c. More review of hydraulic applications. Field demonstrations were very effective.
- d. Erosion control methods.
- e. Lot of repeated information with ECB and polymers. Also lot about how things work out west in the mountains, but were not applicable to Florida as there are no steep slopes.
- f. Cut down on theory and just give the equations to use with some examples so the audience can work exam problems. Computational work should be worked in the classroom prior to the exam. Pictures of FL application of E&SC products would be better than those from Colorado.

What improvement might you recommend to the exam format or content?

- a. Group questions with similar subject matter together.
- b. Have more problem solving during the training.
- c. Make sure all content is covered in the training.
- d. Fewer calculations and more about what to do where and when things fail. More geared towards engineers than inspectors.
- e. Some errors in the questions related to tables in the manual. Fix those.
- f. Provide a copy of all the presentation slides for note-taking. Provide a CD.
- g. Exam was brutal. Need to recognize non-engineers may be present.

What did instructors do well and what suggestions do you have to improve effectiveness?

- a. There is a lack of education in the proper use of E&SC measures and attitudes need to change. Good intentions exist on most sites.
- b. Pictures of failing BMPs and the steps taken to correct the problems should be included.
- c. Add subject tabs to the handbook (manual).
- d. Presentation of subject matter in the manual appears logical and concise. Lectures did not appear to follow the manual well.
- e. Difficult to see the presentations. Better projector or slide color.

What was most useful about the exercises?

- a. Complicated and detailed and did not add to the class. Roadway designers do not calculate pipe sizes, sediment ponds, flumes and drainage designers do not specify BMPs.
- b. The incline erosion demonstration.
- c. Understanding the differences between erosion and sediment control and their applications.
- d. Hopefully FDOT will implement the E&S controls.
- e. Seeing the way things work instead of just being told how they work.
- f. What exercises?

What changes would you recommend to improve the course and make it more effective?

- a. No changes. Great class. I learned much more than expected.
- b. More examples of commonly seen field issues.
- c. Should be a shorter course. Perhaps 1.5 days. Lab shear tests should be eliminated.
- d. Instead of ending with exam, use the afternoon to review the exam results and solve problems together. I am sure exam participants learned a lot by taking open-book exam. They would benefit even more by process of immediate feedback and correcting any errors.
- e. Do not invite water management district to participate.

- f. Have more problem-solving during the training.
- g. Shorten the course. Lot of repeat information. Also stay on schedule. Make sure information is relevant. A lot of information may not be useful here as there are no mountains.

Modifications Made after Pilot Course One in Orlando:

1. Established learning objectives for each instructor and developed lesson plans, reference to sections in manual, practical applications (examples of silt fence and stakes, silt saver, TRMs samples, etc)
2. Lecture Materials were related to the manual – showing bad example and then showing how it is repaired. BMP selection and combination of products.
3. Included more about what DOES work and less about what DOES NOT – have to show hay bales do not work.
4. More problem solving is included during the course and more time is spent on example calculations.
5. An existing FDOT Project is used as a template to explain different aspects of the E&SC plan for Florida-specific applications..
6. Compliance materials were shortened.
7. The second pilot was shortened to a Two-day course – 16 hours over two days.
8. The presentations were made more interactive – involving the participants in discussions, solving problems, demonstrations.
9. The speakers were timed to keep the course on schedule.

10. Change in instructors - To sustain the course for the future and make the content more relevant to Florida, Dr. Fifield was not involved in the second pilot offering.
11. Small field demos each day for a two day course. First day address silt fence, inlet protection. Second day – rolled erosion control products and polymers.
12. Fridays will not be included as a part of this course.

Suggested changes to manual that were recommended by some participants with extensive experience in erosion and sediment control practice:

1. Add some discussion to draw attention to other design issues that can result in erosion problems such as drainage considerations, location of inlets, shoulder drains and structural design issues. Also, add this into the training course content. Verbally elevate these issues during the course but not have piecemeal versions of the course. Have the participants prepare examples of their “real-world” examples of design issues of erosion and bring it to the class. Add to the discussions.
2. Add shear stress diagrams with more explanations. Can also be discussed during the class.

A summary of the survey comments from the second pilot course in Lake City are provided in the Table 4

Table 4 Summaries of Survey Results from Pilot Course Two in Lake City**What topics would you have liked to have spent more or less time on?**

- a. More time on preparing SWPPPs.
- b. Focus on linear projects with limited right of way and what needs to go into a set of plans for a roadway project.
- c. Specific responsibilities of the designer and contractor.
- d. More case studies and applications will be useful.
- e. Use actual projects from FDOT as examples.
- f. Overanalyzed for construction people but good for designers.
- g. Presentations add a lot to the manual. Add what is important to the regulatory agencies. When do you need double silt fence and floating turbidity barriers?
- h. Are there any rules of thumb in a general case such as needing 10 feet around project site for E&SC? Quantity calculations such as 1% of construction costs.

What improvement might you recommend to the exam format or content?

- a. Give an idea what the exam will cover from the beginning of the course.

What did instructors do well and what suggestions do you have to improve effectiveness?

- a. I have no advice for instructors.
- b. Well done.
- c. Provide slide printouts.
- d. Present in order of the manual. More a conference and not class.
- e. Let us do examples on our own.
- f. All instructors fix presentations so it can be seen well on projector.
- g. You have given us tools and reference sources to improve E&SC plans.
- h. Slow down when solving problems. Need to explain where to get the equations.
- i. Define the terms at the beginning. Reference local requirements for erosion control.
- j. Very good presentation. Little deceleration on the speed of presentation.
- k. Work through the problems using the slides.

What was most useful about the exercises?

- a. Contractors should do their own plans and remove liability from FDOT. Too many unknowns for FDOT designers.
- b. Designers may not be as familiar with specifications or resources like Drainage Handbook. Needs to have more on box culverts.

What changes would you recommend to improve the course and make it more effective?

- a. The only thing to improve this course is to organize the example problems more. It made me read the reference materials.
- b. More time on preparing SWPPPs.
- c. E&SC should be a lump sum pay item. E&SC should be taken out of low bid process if 100% compliance is desired.
- d. Show more actual design and plan sheets. Do not use “what we did here’ scenarios.
- e. Show comparisons to current FDOT standard specs and pay items.
- f. Separate the course content for Contractor from Designer.
- g. More information on pay items and breakdown of work unit responsibilities.
- h. The class was very informative and I would not change much.
- i. Some of the teaching was good information but most was not what we use in everyday operations. Overall good information.
- j. Thanks for great training. All materials were very interesting.
- k. Manual needs improvement. Need to place examples, formulae and charts in better sequence. No numbering or referencing of formulae.
- l. Follow the manual more closely.

Recommended modifications after Pilot Course Two in Lake City:

1. Move the FDOT presentation about E&SC practices and pay items to the end of the course.
2. Make changes to two exam questions that were too difficult and were not answered correctly by most of the participants.
3. Review solutions after the examination are completed. Immediate Feedback is provided.
– should take only about 15 min. to discuss after everyone has completed. Let the group know that this will happen.
4. Need to develop a participant handbook and provide copy of slide presentation for note taking. Provide CD of all presentations. – Email the presentations as PDF and/or send them a link where it is stored. May be downloaded. PDF version with three slides per page with room for notes. CDs are too expensive.

5. Present the material in the order of the manual as much as possible to cut down on page flipping.
6. Field demonstrations are excellent but need to be more organized so all vendors get a fair amount of time to show their BMPs and make their presentation. We will have escorts take groups to different vendor locations to allow for sufficient time and move things along.
7. All presentations will be reviewed before the course takes place.

4.4 EXAMINATION RESULTS

The results of the final comprehensive examination are as follows:

Pilot 1 in Orlando:

20 out of 21 participants obtained a passing score of 70% or higher correct answers

The average score was 80%.

Pilot 2 in Lake City:

26 out of 28 participants (30 attended but 28 took the final examination) obtained a passing score of 70% or higher correct answers

The average score was 76%.

4.5 LESSON PLANS

The lesson plans developed for the different sections of the training course are provided in the Appendix. They are the results of committee input and were developed by the teachers in the pilot courses.

CHAPTER 5 – CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY AND FINDINGS

A need in the state was identified for additional information to help design and review soil erosion and sedimentation plans. A committee composed of professionals from government, consulting, and academic areas met and developed manuals that can be used for design, review, and installation of soil erosion and sedimentation practices. The manuals are available to any person and at no cost through the UCF Stormwater Management Academy web site, namely www.stormwater.ucf.edu. Access to the site also allows the individual to sign up for notice of updates to the manuals.

There was also identified a need for additional products and methods for soil erosion and sediment control. A laboratory for testing and evaluation was designed, built, and has been operational for about two years. The parameters for design included slope conditions, rainfall rates, and soils common to the State of Florida. The laboratory is considered to be unique as compared to others in the world. It is the only rainfall simulator that can produce rainfall rates common to long return period storms in Florida and at any storm duration. In addition, drop size is similar to natural rainfall. Within 18 months, over 160 tests have been conducted. Silt fence testing is one example. Other testing involved rainfall excess estimates as a function of slope and rain intensity, erosion blanket performance, runoff from fertilizer applications, and runoff from natural conditions.

5.2 RECOMMENDATIONS

The results of this study recommend that the manuals receive wide distribution and use. They represent the talents of a diverse professional group and incorporate the latest technologies. They should also be updated on a periodic basis. To get acceptance and use, training courses are recommended. Three and two day pilot courses for FDOT training were completed and the content and delivery were modified based on participant comments. Changes were also made to the manual based on comments from the instructors and the students.

The UCF rainfall simulator and test bed can be used to evaluate the effectiveness of existing products and methods. Also, new product development or improvement of existing ones is expected with the use of the rainfall simulator and test beds. Access to the simulator is through the Stormwater Management Academy at the University of Central Florida. It is further recommended that vendors and researchers take advantage of this unique laboratory for evaluation and testing of new products and procedures that have potential to reduce erosion and prevent sedimentation.

LIST OF REFERENCES

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- FDEP. 1988. Florida Development Manual. Stormwater and Non Point Source Management Section, Tallahassee Florida.
- FDOT and FDEP. 2007. Florida Erosion and Sediment Control Designer and Reviewer Manual. http://stormwater.ucf.edu/FLerosionSedimentManual_6_07.pdf.
- Fifield, Jerald S. 2001. Florida Department of Transportation Review. Hydrodynamics Incorporated, May.

APPENDIX LESSON PLANS

The lesson plans in this appendix are arranged in the order of presentation. The last two entries in each lesson plan which are Take Home Tasks and Reference are the same for all lesson plans. For Take Home Tasks, all participants are expected to 1) review what was presented in class, 2) mark for easy reference information of interest in the manual, and 3) develop questions about manual and class room materials. The lesson plans were developed by the professor doing the presentations and are consistent with the manual. The plans reflect the strength of the professor and the content of the manual.

LESSON PLANS	E&SC MANUAL	Course Ref:	STATE OF FLORIDA EROSION & SEDIMENT CONTROL/ADVANCED
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Reference:
STATE OF FLORIDA EROSION & SEDIMENT CONTROL (E&SC) DESIGNER AND REVIEWER MANUAL, last published in 2010 WITH UPDATES, and available from www.stormwater.ucf.edu as a download.

DAY 1: 8:00 am - 8:10 am

Topic:	PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC		
Lesson Title:	INTRODUCTIONS		
Level:	Advanced	Lesson Duration:	10 minutes

Lesson Objectives:
Introduce Training Facilities and Amenities Conduct and Work Expectations Introduction of speakers

Summary of Tasks / Actions:

INSTRUCTORS:	1. Prepare and coordinate training facility
	2. Introductory materials on speakers
	3. Review handout materials
STUDENT:	1. Understand course objectives
	2. Know training facility amenities
	3. Understand what is required to complete the course

Materials / Equipment:

Presentation is by PowerPoint, and student will use a copy of the manual and bring to the training class note taking aids as well as a computation device (calculator or computer).

DAY 1: 8:10 am -9:00 am

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		POLICIES, DEFINITIONS, AND TERMINOLOGY	
Level:	Advanced	Lesson Duration:	50 minutes

Lesson Objectives:

Review of Existing E&SC plan
Understand basic definitions and terminology
Identify sources and impact of erosion and sediment loading

Summary of Tasks / Actions:

INSTRUCTORS: 1. Prepare lecture materials in power point
2. Deliver and discuss lecture materials and questions

STUDENT: 1. The ability to know definitions, policies and terminology
2. Understand and recognize plans
3. Understand State Regulations.
4. Review Manual and assimilate lecture materials

Materials / Equipment:

Presentation is by PowerPoint, note taking is encouraged plus reference to the Manual to note information in Sections I and II.

DAY 1: 9:00 am -10:00 am

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		Hydrology and Hydraulics Review	
Level:	Advanced	Lesson Duration:	60 minutes

Lesson Objectives:			
Review of Existing E&SC plan			
Understand basic hydrology and hydraulics			

Summary of Tasks / Actions:			
INSTRUCTORS: 1. Prepare lecture materials in power point			
2. Deliver and discuss lecture materials and questions			
STUDENT:	1. The ability to understand the formation of rainfall		
	2. To perform calculations of runoff volume		
	3. To perform calculations for runoff rate		
	4. To perform calculations for pipe sizes		

Materials / Equipment:			
Presentation is by PowerPoint, student must perform calculations using a computer or calculator and refer to the manual (Sections I, II, and part of III)			

DAY 1: 10:15 am -11:00 am

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		INTRODUCTION TO EROSION CONTROL	
Level:	Advanced	Lesson Duration:	45 minutes

Lesson Objectives:			
Define erosion and understand basic principles of erosion control.			
Introduce the various types of erosion processes.			
Identify factors which influence the erosion process.			
Identify soil properties as related to erosion.			
Review impacts of erosion.			

Summary of Tasks / Actions:			
INSTRUCTORS: 1. Prepare lecture materials in power point			
2. Deliver and discuss lecture materials and questions			
STUDENT:	1. The ability to know how erosion occurs and what processes influence erosion		
	2. What soil properties are important		
	3. Review manual and assimilate lecture materials into plan design and review.		

Materials / Equipment:			
Presentation is by PowerPoint, student will use the manual and perform minimal calculations using a calculator or computer or their choice. Section III of the manual.			

DAY 1: 11:00 am -12:00 noon

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		INTRODUCTION TO SEDIMENT CONTROL	
Level:	Advanced	Lesson Duration:	60 minutes

Lesson Objectives:

Define sediment control and understand basic principles.
 Introduce the various types of sediment control processes.
 Identify factors which influence the sediment control process.
 Review impacts of sediment on the natural environments.

Summary of Tasks / Actions:

INSTRUCTORS: 1. Prepare lecture materials in power point
 2. Deliver and discuss lecture materials and questions
 STUDENT: 1. The ability to know how controls work
 2. Why soil properties are important
 3. Review manual and assimilate lecture materials into plan design and review.

Materials / Equipment:

Presentation is by PowerPoint, student will use the manual and perform calculations using a calculator or computer or their choice. Section V and Appendices II and III of the manual.

DAY 1: 1:00 pm - 2:00 pm

Topic:		INSTALLATION AND CONSTRUCTION RELATED TO E&SC	
Lesson Title:		FIELD DEMONSTRATIONS	
Level:	Advanced	Lesson Duration:	60 minutes

Lesson Objectives:

Demonstrate erosion and sediment control techniques and BMPs in a field setting.
 Coordinate demonstrations involving various vendors of sediment control BMPs

Summary of Tasks / Actions:

INSTRUCTORS: 1. Coordinate the presentations by the vendors in the field
 2. Discuss various methods and answer questions
 STUDENT: 1. The ability to recognize and utilize different BMPs as methods for control.
 2. Enter into discussion.
 3. Review manual sections that information to these field demonstrations.

Materials / Equipment:

Field demonstrations are made by vendors and professors. Student is encouraged to engage in discussion. All Sections of the manual are appropriate.

DAY 1: 2:00 pm – 3:00 pm

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		EROSION CONTROL METHODS	
Level:	Advanced	Lesson Duration:	60 minutes

Lesson Objectives:

Methods available and incorporating vegetation for erosion control when designing a project.
 Identifying differences between inland and coastal projects.
 Factors involved in design

Summary of Tasks / Actions:

INSTRUCTORS: 1. Prepare lecture materials in PowerPoint
 2. Deliver and discuss lecture materials and questions
 STUDENT: 1. The ability to recognize and utilize vegetation when designing a project.
 2. Understand the differences between inland and coastal projects.
 3. Assimilate lecture materials into the design process.

Materials / Equipment:

Presentation by PowerPoint and some Calculations. Use Section III and Appendix I of the manual.

DAY 1: 3:45 pm -5:00 pm

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		SEDIMENT CONTROL METHODS	
Level:	Advanced	Lesson Duration:	75 minutes

Lesson Objectives:

Methods available and incorporating chemicals to improve treatment
 Identifying differences between inland and coastal projects.
 Factors involved in design

Summary of Tasks / Actions:

INSTRUCTORS: 1. Prepare lecture materials in PowerPoint
 2. Deliver and discuss lecture materials and questions
 STUDENT: 1. The ability to recognize and utilize various chemicals.
 2. Example use of polymers.
 3. Assimilate lecture materials into the design process.

Materials / Equipment:

Presentation by PowerPoint and some Calculations. Use Section V and Appendices II and III of the manual.

DAY 2: 8:00 am -9:15 am

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		EROSION CONTROL METHODS CONTINUED	
Level:	Advanced	Lesson Duration:	75 minutes

Lesson Objectives:

Rolled Erosion Control Products (RECP) and selection guides.
Runoff Control Structures.
Factors involved in design.

Summary of Tasks / Actions:

INSTRUCTORS: 1. Prepare lecture materials in PowerPoint
2. Deliver and discuss lecture materials and questions
STUDENT: 1. The ability to recognize and design for sediment control using RECP.
2. Solve problems using computational aids.
3. Assimilate lecture materials into the design process.

Materials / Equipment:

Presentation by PowerPoint and some Calculations. Calculations using computers and calculators. Use Section IV and Appendix I of the manual.

DAY 2: 9:15 am -10:15 am

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		SEDIMENT CONTROL METHODS CONTINUED	
Level:	Advanced	Lesson Duration:	60 minutes

Lesson Objectives:

Understand Sediment Containment Systems (SCS) and principles of sediment control.
Complete design problems and understand how designs change.
Understand effectiveness of designs and operation.

Summary of Tasks / Actions:

INSTRUCTORS: 1. Prepare lecture materials in PowerPoint
2. Deliver and discuss lecture materials and questions
STUDENT: 1. The ability to recognize and design for sediment control using SCS.
2. Solve problems using computational aids.
3. Assimilate lecture materials into the design process.

Materials / Equipment:

Presentation by PowerPoint and some Calculations. Calculations using computers and calculators. Use Section IV and Appendix II and III of the manual.

DAY 2: 10:30 am -11:00 am

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		SEDIMENT CONTROL AND DEWATERING	
Level:	Advanced	Lesson Duration:	30 minutes

Lesson Objectives:

Know the methods available and treatment options.
 Identifying field problems and solutions.
 Understand factors involved in design

Summary of Tasks / Actions:

INSTRUCTORS: 1. Prepare lecture materials in PowerPoint
 2. Deliver and discuss lecture materials and questions
 STUDENT: 1. The ability to recognize and utilize dewatering methods.
 2. Understand field operations.
 3. Assimilate the connection between the design process and application.

Materials / Equipment:

Presentation by PowerPoint and some Calculations. Use Section IV and Appendices II and III of the manual.

DAY 2: 11:00 am -11:30 am

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		WATER MANAGEMENT PERSPECTIVE	
Level:	Advanced	Lesson Duration:	30 minutes

Lesson Objectives:

Know the locations and functions of the Districts.
 Understand the operations and interactions of inspectors.

Summary of Tasks / Actions:

INSTRUCTORS: 1. Prepare lecture materials in PowerPoint
 2. Deliver and discuss lecture materials and questions
 STUDENT: 1. The ability to recognize and utilize WMD personnel.
 2. Understand the inspection process.
 3. Assimilate the connection between the design inspection and operation.

Materials / Equipment:

Presentation by PowerPoint and some Calculations. Most of the manual is beneficial as we near the end of the course.

DAY 2: 11:30 am -12:00 noon

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		AN EXAMPLE E&SC PLAN	
Level:	Advanced	Lesson Duration:	30 minutes

Lesson Objectives:

Know how to incorporate E&SC items into a plan.
 Identifying field problems and solutions.
 Understand factors involved in design, installation and construction.

Summary of Tasks / Actions:

INSTRUCTORS: 1. Prepare lecture materials in PowerPoint
 2. Review and existing plan.
 STUDENT: 1. The ability to recognize and utilize E&SC methods.
 2. Understand options for plans and operations.
 3. Assimilate the connection between the design process and application.

Materials / Equipment:

Presentation by PowerPoint and some Calculations. Most Sections and Appendices will be helpful in the manual.

DAY 2: 1:00 pm - 2:00 pm

Topic:		INSTALLATION AND CONSTRUCTION RELATED TO E&SC	
Lesson Title:		FILED DEMONSTRATIONS CONTINUED	
Level:	Advanced	Lesson Duration:	60 minutes

Lesson Objectives:

Demonstrate erosion and sediment control techniques and BMPs in a field setting.
 Coordinate demonstrations involving various vendors of sediment control BMPs

Summary of Tasks / Actions:

INSTRUCTORS: 1. Coordinate the presentations by the vendors in the field
 2. Discuss various methods and answer questions
 STUDENT: 1. The ability to recognize and utilize different BMPs as methods for control.
 2. Enter into discussion.
 3. Review manual sections that information to these field demonstrations.

Materials / Equipment:

Field demonstrations are made by vendors and professors. Student is encouraged to engage in discussion. All Sections of the manual are appropriate.

DAY 2: 2:00 pm -3:00 pm

Topic:		PLANNING , OPERATIONS, AND DESIGN RELATED TO E&SC	
Lesson Title:		FDOT PRACTICE AND IMPLEMENTATION	
Level:	Advanced	Lesson Duration:	60 minutes

Lesson Objectives:
Know the relevancy of the manual to daily practice.
Identifying field problems and solutions.
Understand pay items and other factors affecting daily work.

Summary of Tasks / Actions:
INSTRUCTORS: 1. Prepare lecture materials in PowerPoint
2. Deliver and discuss lecture materials and questions
STUDENT: 1. The ability to recognize and utilize the manual.
2. Understand the direction and implementation of the manual within FDOT.
3. Participate in discussion to further an understanding of E&SC.

Materials / Equipment:
Presentation by PowerPoint and some Calculations. All Section and Appendices of the manual.

