

What Are the Most Important Issues of Storm Water Pollution Prevention Planning for Construction Graduates to Know?

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Having an approved storm water pollution prevention plan (SWPPP) on a construction jobsite is a necessity in today's construction industry. A contractor must have a SWPPP or risk possible catastrophic environmental contaminations, and more importantly in today's business world, very costly monetary fines and possibly even prison time for all parties involved in the violations. The purpose of this paper is to determine what graduating students of Auburn University's Building Science program need to know about SWPPP. The current curriculum in the program has no lecture module or information regarding SWPPP being taught to students. The result of this study will provide the baseline data for determining what information is most important for incoming employees to the construction industry, based on interviews and surveys of industry professionals as well as feedback from other academics.

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Introduction

In recent years, public demand for environmental consciousness has continued to thrive as can be witnessed in the emergence of Leadership in Energy and Environmental Design (LEED) – America's most widely recognized performance benchmark for environmentally friendly construction projects. Likewise, as the environmental concerns have become more significant, the laws and regulations have become more stringent, increasing demands on contractors with respect to sitework – specifically erosion and sediment control. In fact, one of the prerequisites for achieving any points in the Sustainable Sites portion of the LEED rating system is maintaining a good best management practices erosion and sediment control program for projects pursuing certification. In an effort to integrate sustainable practices into the Soils class at Auburn University, as well as to respond to the Industry Advisory Council's request to integrate erosion and sediment control topics into the existing curriculum, the authors have solicited responses from the industry professionals who regularly deal with this matter in an effort to determine exactly what construction students need to know upon graduating from the Building Science program at Auburn University. The authors have also contacted other construction education programs in an effort to determine related approaches.

Literature Review

Public outcry of concerns about the unregulated procedures within industries causing pollution and damage to the world's environment and the United States water supply caused the U.S. Congress to create and enact the National Environmental Protection Act of 1969. The act has many purposes; one being to declare a national policy which will encourage productive and

enjoyable harmony between man and the environment. Other purposes of the National Environmental Protection Act of 1969 were to promote efforts which will prevent or eliminate damage done to the environment and all of its inhabitants and to enrich the understanding of the ecological systems and natural resources important to the world. To monitor these efforts, the U.S. congress established the Environmental Protection Agency (EPA). The National Environmental Protection Act of 1969 established the Council on Environmental Quality as well. The National Environmental Protection Act of 1969 also brought about the creation of the Clean Water Act of 1972 which still governs pollution laws today. (EPA, 2006)

The first target of the Clean Water Act of 1972 was large industries and wastewater treatment plants that were dumping pollutants and raw sewage directly into waterways of the United States. According to EPA statistics, industries and wastewater treatment plants were responsible for just 40% of the pollution entering U.S. waterways. The majority of the rest of pollution comes from the various activities of the construction industry. As a result, in 1987 the EPA narrowed its focus even more and started monitoring large construction activities that disturbed more than five acres of land. (National Storm Water Summit, 2006) The revision of focus was called Phase I of the National Pollution Discharge Elimination System (NPDES) under the Clean Water Act. In 1990, the EPA began requiring any construction activity that disturbed more than five acres of land to acquire an NPDES permit.

The EPA narrowed its focus even further in 2003 by establishing Phase II of the NPDES. Construction activities, including many other land-disturbing activities that affect one acre or more of land are now required to obtain an NPDES permit as well, with an approved SWPPP. (NPDES, 1999) NPDES Phase II regulations regarding storm water management on construction jobsites are still under the umbrella of the Clean Water Act. On March 10, 2003, new regulations came into effect that extended coverage to construction sites that disturb one acre or more of land, including smaller sites that are part of a larger common plan of development or sale. Only sites disturbing five acres or more were regulated previously. (EPA, 2006)

One of the main harmful consequences to the environment caused by construction is due to contractors who have improperly implemented their SWPPPs and allowed uncontrolled runoff of silt and sediment from their jobsites. The runoff that comes from construction jobsites can carry harmful contaminants into the water supply, polluting the public drinking supply, or risking the existence of certain endangered species of animals in fragile ecosystems. Runoff also causes problems by transporting loose alluvial top soils down flood plains and into city drainage systems creating increased costs of monitoring and maintenance for local municipalities. (Schroeder, 2004)

In addition to the environmental consequences, the legal ramifications that can be placed on the contractor responsible for improper storm water management can be quite severe. The Clean Water Act makes it illegal for any person or business to discharge any pollutant liquid, solid or otherwise unless a permit for such a discharge is issued under the Clean Water Act. If a person or business is found guilty of violating any of the terms set forth by the Clean Water Act, they can face both civil and criminal penalties. The civil penalties from the Clean Water Act can be up to \$25,000 per day until the violation is alleviated. The criminal penalties can also be up to

\$25,000 per day; but may also assess an additional penalty of up to one year in prison. (Kelleher, 2005)

The first step that a contractor must take in order to prevent any possible violations is to apply for a general construction permit with the EPA. However, the EPA's general permit does not apply in all states. Some states have their own versions of general construction permits, but these state versions must meet or exceed the limits set forth by the original EPA's general construction permit. (Kelleher, 2005) The process of getting approved for the EPA's general construction permit is for the entity in control of the jobsite to establish a SWPPP that is specific to each jobsite and to file a "Notice of Intent" with the EPA. In order for the jobsite specific erosion and sediment control plan to meet the EPA or individual state standards, it must include storm water control measures, a plan for maintaining the control measures and identification of all the contractors and subcontractors that will be responsible for implementing the SWPPP. (Environmental Protection Agency, 1998)

There are several methods and procedures for abiding with the rules and regulations set forth by the EPA. These methods and procedures are known in the industry as best management practices, or simply "BMPs". "The key to proper jobsite management and the reduction of potential liability is the continual implementation of best management practices." (Kelleher, 2005)

In addition to understanding the background of this issue, and how to obtain a general permit, the National Stormwater Summit identifies the following objectives as being necessary for construction professionals:

"Learn to discuss the different permits, identify regulations for various storm water discharges, review enforcement issues and problems, identify what contractors and municipalities can do to reduce their impact on the environment, review the permit acquisition process, discuss the implementation of Phase II stormwater regulations, identify possible remedies and defenses, identify issues pertaining to stormwater management, discuss the legal and regulatory framework of stormwater management, discuss compliance with stormwater requirements, discuss stormwater pollution prevention programming and best management practice guidance, identify permit exemptions and exclusions, review good and bad examples of compliance, discuss recent trends in the enforcement of storm water regulations, explain mistakes that are commonly made with stormwater compliance, describe means to comply with regulations and avoid legal problems, identify the best available technology, and implement a variety of traditional and technologically advanced methods of best management practices." (National Storm Water Summit, 2006)

The information provided by the results of this study will allow the authors to simplify the objectives stated above and to develop teaching modules appropriate for use in the construction program at Auburn University.

Method

In order to best ascertain what knowledge is most important to construction graduates in the broad area of storm water pollution prevention planning, several research tools and methods were incorporated into this study. A mixed methodology research plan was used for this particular study to gain both primary and secondary data. The primary data came from a series of interviews and surveys with several professionals from varying backgrounds that deal with storm water pollution prevention planning on a day-to-day basis. A list of the interview questions was compiled prior to conducting the interviews in an attempt to reduce any bias in the data being gathered. A list of the interview questions can be found in Appendix A and the survey can be found in Appendix B. The list of interviewees, shown in Table 1 above, is comprised of a variety of industry professionals from the geographical region surrounding the authors' university. The interviews were limited to this geographical region due to the fact that, historically, nearly all of the graduates in this program tend to accept employment from construction firms within this geographical region of the country.

ID	Credentials	Employer	Position
1	CPSSC, CPESC, CHMM, ADEM Instructor	Engineering Consultant	Senior Scientist
2	N/A	Construction Company	Project Manager
3	N/A	Construction Company	Project Manager
4	P.E., Wal-Mart SWPPP Trained	Developer/Construction	Executive V.P.
5	Wal-Mart SWPPP Trained	Developer/Construction	V.P. Construction
6	Wal-Mart SWPPP Trained	Developer/Construction	Project Manager
7	CPESC	Erosion Control Specialty Sub.	Project Manager
8	ADEM QCI, City Water Resource Mgt. Dept.	City Official	Stormwater Coordinator
9	ADEM QCI, City Water Resource Mgt. Dept.	City Official	Watershed Coordinator
10	P.E., Municipal Consultant	Engineering Consultant/Training	Vice President
11	N/A	Construction Company	Technical Sales
12	National Stormwater Summit Expert Panelist	U.S. EPA Region 4	Gulf Enforcement Section
13	National Stormwater Summit Expert Panelist	U.S. EPA Region 4	Geologist & Enforcement Officer
14	State SWPPP Instructor	State Soil & Water Conservation Commission	Urban Program Technical Specialist
15	CPESC	Erosion Control Product Supplier	Regional Sales Manager
16	CPESC	Owner/Large Developer	Director of Stormwater Management

17	N/A	Developer/Construction Company	Developer
18	CPESC	Owner/Large Developer	Director of Stormwater Management
19	N/A	Construction Company	Superintendent
20	N/A	Developer/Construction Company	President/Developer
21	MS, CPESC	Erosion Control Product Supplier	Director – Business Development
22	Civil Engineer	University	Dept. of Civil Engineering

Table 1: Interview Matrix.

Although the interviewees’ names have been replaced with identification numbers, Table 1 shows that multiple responses have been obtained from state and local environmental compliance agencies, the EPA, general contractors, developers, sitework contractors, university professors, and environmental trainers who deliver qualified credentialed inspector (QCI) program training on a regular basis. Each individual that was interviewed was also asked to complete a survey, ranking the importance of each topic; but not every one that completed a survey was interviewed.

One notable interview was with the Executive Vice President of a general contractor that has built more stores for a particular retailer than any other construction company in the world. That retailer is considered by several industry experts to have the strictest best management practices due to being under a microscopic eye by the Environmental Protection Agency because it has the stigma of being given the largest ever one-time fine (\$3.1 million) for stormwater management violations.

For secondary data, several research measures such as an extensive literature review and internet searches were conducted to learn the basic fundamental knowledge of storm water pollution prevention planning.

The literature review for this study included an extensive search of current storm water pollution prevention programs available in books, textbooks, industry journals, and industry magazines. Much of the fundamental knowledge to base a teaching module from will be based on the information found in these sources. The internet was also utilized in the search for further knowledge and global examples for the benefit of the construction students at Auburn University.

Two other reliable sources of information for this study include continuing education training sessions that the authors attended. One of the training sessions was the “National Storm Water Summit” and the other was the Qualified Credentialed Inspector (QCI) Program.

The National Storm Water Summit is a nationwide tour of storm water compliance experts. It was created in response to a quickly growing need for quality storm water compliance training and direct field knowledge from industry experts. A wide variety of experts and professionals from across the industry including construction site supervisors, project managers, civil engineers, public works and utilities directors, environmental professionals, best management

practice installers, surveyors and geotechnical professionals, general contractors, subcontractors, landscape designers and architects, property owners and managers, land developers, Environmental Protection Agency representatives, State regulators and officials, industry attorneys, presidents and vice presidents of construction companies, business owners and managers, as well as university academic representatives, attended the National Storm Water Summit. (National Storm Water Summit, 2006) More valuable insight into the creativity of the teaching module came from the National Storm Water Summit and the several unstructured interviews conducted while attending the Summit.

According to the National Storm Water Summit webpage, “The Environmental Protection Agency estimates that just 35% of today’s construction industry is in compliance with the 1972 Clean Water Act and its NPDES permit requirements. Expensive fines, penalties, work stoppage and even jail time are at stake for individuals involved in the construction industry. Unfortunately, the educational efforts to date seem to have created more questions than answers. The construction industry complains of getting different answers from regulators, engineering firms, lawyers and their own trade associations.” (National Storm Water Summit, 2006)

The Qualified Credentialed Inspector Program is an 8-hour training program that is sponsored by the Alabama Department of Environmental Management (ADEM) and taught by Thompson Engineering. At the end of the training program, attendees are given a test to become an ADEM Qualified Credentialed Inspector (QCI). If the individual receiving the training passes the examination, the certification is valid for one year. After the year has passed, in order for the certification to be renewed, the individual must take a 4-hour refresher course and pass another examination. The certification belongs to the employer of the individual who has been trained and passes the exam, which prevents an individual from taking the credentials with them should they leave the company that had a financial investment in the training.

Attempts were made to contact the American Council for Construction Education’s top fifteen schools, as identified by Piper (Piper, 2000) in order to analyze comparable programs and ensure that the lecture module would meet or exceed that of the competition. The schools examined included Purdue University, Colorado University, the University of Florida, Southern Polytechnic State University, and the University of Texas. Prior to sending the surveys, attempts had been made to contact personnel within the universities in hopes of creating a higher response rate. The survey simply consisted of a list of the interview questions, and those surveyed were asked to rate the importance of each question on a scale from 1 – 8 (1 being the greatest importance) without answering them. Responses varied, and the remainder of the schools that had been contacted did not provide any correspondence.

The statistics gathered from the survey will be used to produce quantifiable data from unbiased sources in order to determine the rank of importance of the interview questions. The survey statistics, along with all the other important knowledge that is being gathered through literature review, world-wide-web research, attending the National Storm Water Summit, The Alabama Department of Environmental Management’s *Qualified Credentialed Inspector Program*, and the interviews will provide a basis for the relative importance of each of the objectives from a qualitative perspective, as well.

Results of the Analysis

The information gained from the personal interviews stated that students in the Department of Building Science at Auburn University need to have an overall understanding of the importance of storm water management for the environment, and that students should be aware of the possible consequences of improperly implementing a storm water pollution prevention plan from a monetary and environmental perspective. The interviews also stated that improper maintenance is the main cause of failure in erosion and sediment control plans. The personal interviews provided most of the innovative knowledge used in creating the lecture module and have been transferred to audio files and archived in Auburn University's Building Science computer system.

Thirty surveys were completed by construction industry professionals. Four of the surveys were filled out incorrectly, making only 26 of the surveys valid for use. The results of the survey are shown in Appendix C. The surveys that were filled out incorrectly and thus invalid have been highlighted and marked with an "X" above the survey number. Notice how these invalid responses have multiple items listed as a "1" – "most important". Ironically, each of these cite *Federal, State and Local Regulations* as being a "1"; and all but one also agree that *Needs for a SWPPP; Possible Civil, Criminal and Monetary Penalties; and Ability to Evaluate SWPPPs for Jobsites As to Their Effectiveness & Compliance* are equally as important.

Table 2, shown below, provides statistics of the survey results. In Table 2, the "skewed" values have taken the statistical mean, mode, and median of all values, whereas the "actual" values shown have been adjusted by omitting the data contained in the responses which were answered incorrectly. For example:

$$\text{Skewed Mean} = \Sigma (\text{All values in "Needs for SWPPP"}) / \text{TOTAL number of responses}$$

$$\text{Actual Mean} = \Sigma (\text{All values in "Needs for SWPPP" – the specific values given by individuals who responded incorrectly}) / (\text{TOTAL number of responses – Number of responses that were incorrect})$$

It should be noted that in the definitions above, the term "incorrect" and "incorrectly" indicate a data source that used any number more than once. The respondents were instructed to rank order the importance of each item, using each number only once.

The topic that ranked highest in importance in the survey (denoted by the lowest value in the actual mean column) was showing the *Need for a SWPPP* followed closely behind by the importance of understanding *Federal, State, & Local Regulations Governing SWPPP*.

Topic	Skewed Mean	Skewed Mode	Skewed Median	Actual Mean	Actual Mode	Actual Median
Needs for a SWPPP	2.40	1.00	2.00	2.50	2.00	2.00
Federal, State & Local Regulations Governing	2.80	1.00	2.00	3.08	1.00	3.00

SWPPP						
Procedures Used to Monitor SWPPPs	4.83	6.00	5.00	5.31	6.00	5.50
Organizations, or Entities, Responsible for Monitoring SWPPPs	4.40	6.00	4.50	4.81	6.00	6.00
Possible Civil, Criminal & Monetary Penalties	4.40	8.00	4.00	4.65	2.00	4.00
Techniques to Encourage Compliance & Teamwork	4.37	4.00	4.00	4.77	4.00	4.50
Ability to Evaluate SWPPPs for Jobsites as to Their Effectiveness & Compliance	4.47	1.00	5.00	4.88	8.00	5.00
Products & Maintenance of SWPPPs on Jobsites	5.20	8.00	5.50	5.77	8.00	6.00

Table 2: Survey Results.

The information gained from correspondence with other universities showed that Purdue University requires their construction management undergraduates to take several courses in Civil Engineering that include an extensive look at erosion and sediment control. Colorado University's curriculum also has a heavy emphasis on SWPPP with degrees offered in Civil Engineering, Environmental Engineering, and Architectural Engineering. The University of Florida offers a bachelor's of science degree in building construction, but places no specific importance on erosion and sediment control within its core undergraduate curriculum. Southern Polytechnic State University also offers a bachelors degree in Construction Management and discusses several issues involving erosion and sediment control with a class specifically dedicated to site planning. The University of Texas offers undergraduate degrees in Architectural Engineering and Civil Engineering with both degrees requiring studies in site management which include erosion and sediment control.

Conclusion

Though stormwater pollution prevention planning is a relatively new concept in the construction industry, it can have significant financial effects on a construction site's overall success. Having obtained a plethora of knowledge from the QCI training, several academics suggested having the QCI trainers present ADEM's QCI certification program in fulfillment of this requirement. However, this was quite costly and the certification that could be earned was not transferable to the future employer. Consequently, a decision was made to prepare and deliver the best possible teaching module, based on the suggestions from the feedback of the interviews and surveys, as originally planned. The compilation of all the information in this study converged around a few main issues that were considered as focal points in the creation of the lecture module for storm water pollution prevention planning in Auburn University's Building Science program.

The use of a mixed method research methodology to gather information for this lecture module resulted in valid and beneficial information for the lecture module that will better prepare the students of the Building Science program at Auburn University. The data gained provided the necessary knowledge to create a competitive and encompassing lecture module on SWPPP. The lecture module will be incorporated into the undergraduate soils class and will be used at the instructor's discretion for a minimum of two 50 minute lectures specifically dedicated to SWPPP. The effectiveness of these modules is currently being tested and results are expected to be published in a future paper.

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Appendix A

Storm Water Pollution Prevention Planning Interview Questions:

1. Why is storm water pollution prevention planning important?
2. What is the most overlooked aspect of storm water pollution prevention planning?
3. What regulations for storm water pollution prevention planning are too stringent?
4. Are the rules and regulations for storm water pollution prevention planning adequately monitored on all jobsites?
5. Who is responsible for monitoring storm water pollution prevention plans?
6. What is the biggest, as well as the most common fine issued?
7. What are the ranges of monetary and criminal punishment?
8. What could be done to encourage more compliance for storm water pollution prevention planning rules and regulations?
9. What should Building Science graduates know about storm water pollution prevention planning before entering the industry?
10. Who makes a storm water pollution prevention plan for a jobsite?
11. How often must storm water pollution prevention plans, or Best Management Practices (BMPs) be repaired & what are the causes?

Appendix B

Survey

The information given for this survey instrument is confidential. The information gathered will be used to develop material for a class to teach undergraduate students in Auburn University's Building Science Program. Please rank the importance of each topic below using a scale of 1 – 8. Please use each number (1 – 8) only once to rank the topics. The number 1 represents the most important topic; and 8 represents the least important topic.

- _____ Needs for a storm water pollution prevention plan
- _____ Federal, State and Local Regulations governing SWPPP
- _____ Procedures used to monitor storm water pollution prevention plans
- _____ Organizations, or entities, responsible for monitoring storm water pollution prevention plans.
- _____ Possible civil, criminal and monetary penalties
- _____ Techniques to encourage compliance and teamwork
Ex.: conferences, workshops, industry incentives, informational packets
- _____ Ability to evaluate SWPPPs for jobsites as to their effectiveness and compliance
- _____ Products and maintenance of storm water pollution prevention on jobsites

Thank you for your time and consideration. Please write any additional questions or comments in the space below:

Topic
Needs for a SWPPP
Federal, State, & Local Regulations Governing SWPPPs
Procedures Used to Monitor SWPPPs
Organizations or Entities Responsible for Monitoring SWPPPs
Possible Civil, Criminal, and Monetary Penalties
Techniques to Encourage Compliance & Teamwork
Ability to Evaluate SWPPPs for Jobsites as to Their Effectiveness & Compliance
Products & Maintenance of SWPPPs on Jobsites