Seventh International Conference on Construction in the 21st Century (CITC-VII)
"Challenges in Innovation, Integration and Collaboration in Construction & Engineering"
December 19-21, 2013, Bangkok, Thailand

Case Study: Cost Analysis For The Implementation Of The Clean Water Act And Storm Water Pollution Prevention Plan

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Abstract

This paper presents a cost analysis and a description of a qualified storm water pollution prevention practitioner (QSP) for the implementation of the Clean Water Act, more specifically for a Storm Water Pollution Prevention Plan (SWPPP). Keeping harmful pollutants out of storm water has become an important aspect for construction in the United States of America. Through laws and regulations, constructors are required to take precautionary measures to ensure pollutants stay on jobsites as opposed to running into the storm water system. This paper will break down the costs associated with storm water pollution prevention on a twenty-five acre, $70,000,000 high school project that had a construction schedule of two years. The primary roles of the QSP for this project is also discussed. Cost analysis was taken from historical data and was applied in a quantity takeoff. The SWPPP cost for this project was 0.25% of the total project cost. This equated to 1/12th of the constructors profit. Additionally, the cost savings of having an internal QSP verses hiring a third party consultant are provided and discussed.

Key Words
Storm Water Pollution Prevention Plan (SWPPP), Clean Water Act (CWA), Qualified SWPPP Practitioner (QSP).

1. Introduction

Land clearing and grading disturb the soil. When rain and snowmelt flow over the disturbed land, they pick up sediment and other pollutants, such as fertilizer, concrete, and oil. These pollutants flow into U.S. waters where aquatic plants and fish live and where we get our water for drinking and recreation.

Development and construction disturb the land, increasing the amount and speed of runoff, the possibility of erosion, and the amount of sediment and other pollutants in U.S. waters. In the natural environment, the soil absorbs and filters runoff from rain and snowmelt flowing along the natural contours of the land. Vegetation, such as grass, brush, and trees, filters runoff, removing pollutants and purifying it. As runoff flows down a hillside, the vegetation growing on the hillside slows the water flow, keeping it from eroding the soil and from transporting it to rivers, lakes, streams, and other bodies of water. On a site that's undergoing development and construction, the soil is disturbed, meaning that the land has been graded and cleared of vegetation, and the protective topsoil has been removed. When it rains, the runoff flows more quickly along the new contours of land, and the soil absorbs relatively little of the runoff. As runoff flows over disturbed land, it takes soil with it, eroding the hillside. Wind also can erode the soil, especially in climates with sandy soil.

As the runoff flows into storm drains, rivers, lakes, streams, and other bodies of water, it transports the eroded soil to these bodies of water as sediment. As sediment builds up, it makes the water cloudy and reduces water depth, creating a hazardous environment for plants and fish. The sediment blocks the sunlight, reducing the amount of dissolved oxygen in the water, which the aquatic environment depends on to thrive. Nutrients in the soil, such as nitrogen, can cause excessive plant growth that severely damages and changes a body of water and its ecosystem. Runoff also picks up trace metals like zinc and lead that impair water quality, harm aquatic life, and potentially contaminate groundwater.

Due to growing public concern over water pollution, the EPA created the first version of the Clean Water Act in 1972. The CWA regulates the discharge of pollutants to U.S. waters in an effort by the Environmental Protection Agency (EPA) to regulate the discharge of these pollutants to storm drains, waterways, and bodies of water. The Environmental Protection Agency (EPA) provides Best Management Practices (BMPs), called runoff, erosion, and sediment controls, regarding how to control runoff and erosion to prevent sediment from entering U.S. waters. The CWA requires builders to apply for coverage under a Construction General Permit (CGP) and to submit and comply with a Stormwater Pollution Prevention Plan (SWPPP) to prevent stormwater pollution.

The SWPPP is a plan that describes the measures a builder will take on the jobsite to control stormwater pollution. The main reason for preparing a SWPPP is to ensure that the right steps have been taken in preventing stormwater from picking up sediment and other pollutants and harming the environment. Closely following the SWPPP is critical to ensuring compliance with the Construction General Permit (CGP) and avoiding costly fines. A SWPPP is designed and submitted prior to development, and it's implemented from the start of construction activity until final stabilization is complete. The SWPPP has to be in place before development begins because construction operations pose environmental risks as soon as activity starts. When the SWPPP is properly implemented, it helps ensure compliance with the CGP.

The CGP contains specific requirements for the SWPPP. The SWPPP has to identify all potential sources of pollution that could affect the quality of stormwater discharges. In addition, it has to describe the controls and measures, known as Best Management Practices (BMPs), that will be used to reduce pollution in stormwater discharges from the site. The SWPPP also has to include a written portion and drawings, as well as local permits and BMP specifications. SWPPP requirements can vary from state to state, so builders have to check with state and local water authorities to find out their specific requirements about what documents the SWPPP should include.

The federal EPA administers the nationwide stormwater permit program; however, the Clean Water Act (CWA) contains a provision that allows states to seek authority to administer the permit program themselves. Once the EPA approves a state's stormwater plan, the state is responsible for issuing permits and citations, inspecting jobsites, and carrying out its permit program. There are very few states that don't have their own permit program. For those states without one, builders have to comply with the federal EPA's general stormwater permit program instead of the state's. The different environmental issues faced by each authorized state cause them to have varying permit programs and requirements. For this reason, builders have to check with local and state water authorities for their particular stormwater regulations and requirements (Kelting, 2011).

To notify authorities that they intend to obtain coverage under the Construction General Permit, builders have to submit a Notice of Intent (NOI) before starting development. An NOI can be submitted for an entire project; or, if a project is divided into several phases, an NOI can be submitted for each phase. The CGP also requires builders to submit and implement a SWPPP that specifies Best Management Practices (BMPs). The BMPs keep construction pollutants, including sediment, out of U.S. waters.

The Clean Water Act (CWA) requires builders to post, file, and keep a number of records during development and construction. Before site development begins, the builder posts the Notice of Intent near the site entrance and keeps a copy of the SWPPP in an easily accessible location onsite. Once construction begins, the builder keeps accurate and up-to-date records detailing inspection and maintenance work, as well as the latest version of the SWPPP. All of these documents, in return, help the builder prepare for visits from compliance inspectors seeking to make sure the site complies with EPA regulations. Many large constructors have designated a member of their staff to become a Qualified SWPPP Practitioner (QSP) rather than hiring a consultant for this role. The QSP certification allows this designated person to become the lead team member ensuring that the construction site adheres to SWPPP policies and regulations. The designated QSP team member must take an in- person three day class and pass an online test in order to be qualified for the responsibility of holding the QSP title. It costs $500 and three days worth of time in order to receive the certificate (Johnson, 2004). However, there is a lot more money and time that goes into having this role as QSP.

The EPA requires the builder to submit at Notice of Termination (NOT) once construction has ceased and the area is stabilized on a phase or lot. The NOT turns over responsibility for stormwater discharges to the new owners and verifies that coverage under the CGP is no longer needed.

Storm water pollution prevention has a 40 year running history which covers many different aspects of controlling pollutants. Protection of our receiving water and wildlife is a large issue to a Storm Water Pollution Prevention Plan (SWPPP). Beginning in 1972 with the passing of the Clean Water Act, America has been in pursuit of keeping waste contained on jobsites and preventing them from entering our precious water supply (Franzetti, 2006). Beginning in 1999, Phase II Storm Water Program was implemented into all municipalities, industries and construction sites. This Phase II Rule requires controls on storm water discharges for all of the listed sectors of industries. Any construction site that disturbs between one and five acres of land must now control storm water and prevent its runoff into storm drains (Franzetti, 2006). Phase II Rule has developed six minimum control measures; each of these six minimum measures play a large role in the ability to limit the amount of pollutants leaving a facility and being dumped into the environment. The six minimum control measures are:

1) Public education and outreach
2) Public participation/involvement
3) Illicit discharge detection and elimination
4) Construction site runoff
5) Post-construction run-off
6) Pollution prevention/good housekeeping

This case study was designed to research and analyse the cost of SWPPP during the design and construction of a large high school project located in Long Beach, California. Totaling an estimated $70 million in construction costs, the project was being built on a large plot of land, nearly 25 acres. There are seven buildings at the center of the campus. On the peremiter there are basketball courts, a baseball/softball diamond and a socer field. With this much land, there are regulations that must be met by the constructor in terms of permitting and SWPPP. The authors' analyzed the financial aspect of SWPPP to determine an accurate financial cost placed on the constructor for the project. Additionally, the authors' used an exploratory qualitative research strategy for examining the roles of the Qualified SWPPP Practitioner (QSP).

1.1 Accomplishments

In order to determine the effectiveness of the Clean Water Act, its accomplishments should be closely analyzed. According to the US Environmental Protection Agency (EPA), between the years 1970-1990, the Clean Water Act prevented (Schmitz):

- 205,000 premature deaths
- 672,000 cases of chronic bronchitis
- 21,000 cases of heart disease
- 843,000 asthma attacks
- 189,000 cardiovascular hospitalizations
- 10.4 million lost I.Q. points in children from lead reductions
- 18 million child respiratory illnesses

Americans use 100 gallons of water in their homes each day, making clean water critical to their daily lives (Schmitz). In a study of lakes from 1970 to 2007, water quality improved. Half of these lakes saw less nutrient concentrations and a quarter saw improved tropic status. Public drinking water is much cleaner now than in the 1970s. In 1993, ninety-two percent of Americans received water that met health standards in comparison to the seventy-nine percent who received this clean water in the 1970s (Schmitz).

1.2 Costs and Penalties

According to the EPA, it costs approximately $202.5 billion to implement the Clean Water Act from 1972-2004. Cost estimates are updated every four years by the agency as part of the Clean Watersheds Needs Survey Report to Congress (CWNS) (Lyon and Stein, 2008). SWPPP has become an important aspect of construction and should be taken very seriously by constructors. The EPA requires routine inspections of BMPs. Throughout the life of the construction project, the constructor has to inspect, maintain, and repair the controls and measures implemented on the site. BMPs won't work if they aren't installed and maintained properly. Routine maintenance reduces the need for repairs and minimizes the chance of jobsite runoff harming the environment by finding and correcting problems before the next rain. In order to create a fair and even playing field for all constructors, the EPA has sets of calculations and formulas to determine penalties for each violator of the Clean Water Act. The CWA Section 404 Settlement Penalty Policy ensures that violators do not obtain an unfair economic advantage over competitors who have complied with the Clean Water Act. This policy is intended to provide guidance to EPA staff calculating an appropriate penalty amount in settlement of civil judicial and administrative actions associated with Section 404 (Lowrance, 2001). The Clean Water Act has provided EPA with the ability to fine those who have not adhered to the law.

2. Methodology

This case study is designed to research and analyse the costs of SWPPP and to better understand the roles of a QSP. The authors worked with a large constructor and used their database containing the costs of SWPPP material and labor costs. These costs have been collected over many years and appear to be very accurate to the actual costs per linear foot, man hours etc. Once these unit costs were found, the authors then applied a quantity-take off to determine the actual costs of materials, man hours etc. It is important to note the two different sections within the take-off below. Section one includes QSP training, while section two does not. These different sections show the benefits and downfalls of having a QSP trained employee onsite vs. hiring a third party firm. Additionally, a semi-structured interview with a set of guiding questions was completed to identify the roles of a QSP.

3. Research Questions

Since 1972 and the introduction of the Clean Water Act, general constructors have been refining their estimates to cover the costs of the Clean Water Act. When developing SWPPP estimates constructors evaluate many factors. Constructors attempt to accurately estimate the SWPPP cost by answering questions about the type of project, the size of site, length of project, and the geographical location of the site. The answers to these questions may be useful for constructors who may be involved in biding future projects and looking to cut costs. To answer these questions, this study described the estimated SWPPP costs of a $70 million high school project that took place on a 25-acre site.

This study attempted to answer the following questions:

- Approximately, how much will SWPPP materials and labor cost?
- What was the primary role of a QSP, as characterized by the QSP?
- What was the cost difference of having an internal QSP verses hiring a third party consultant?

4. Results

The designated QSP for this project was an internal employee with the title of a field engineer. He had many responisibilities in addition to his role as QSP. He described his primary responsibility as taking dust readings. Three times a week he was responsible for taking dust readings. Taking a specialized dust reader with him, he was required to walk around the 25 acre jobsite and take readings of dust with an odometer which was purchased by the constructor at the beginning of the project. He would generally spend approximately 1-1.5 hours per week taking dust readings. This is a large portion of the 50+ hours he works per week, and has very little to do with actual construction. In addition to his time spent taking dust readings, he managed a labor forman who spent approximately one hour per day laying water on the dirt throughout the job. The purpose of the water control is to keep the dirt wet so it stays on the jobsite and does not leave the site. Although there was great effort to keep dust onsite, it is nearly impossible to keep it all on the job. Tables 1 and 2 will go into a detailed take-off to determine costs associated with the implementation of SWPPP.

Table 1: Quantity Take-Off Material and Labor Costs of SWPPP

	Item	Quantity	Unit	Unit Cost	Total
1	Fiber Rolls	2500	lf	$0.76	$1,900.00
2	Silt Fence	2500	lf	$0.14	$350.00
3	Dust Control	520	hours	$30.00	$15,600.00
4	Water	13.369	Gallons/mo (converted)	$0.88	$29,364.71
5	QSP Training	1	Week	$500.00	$500.00
6	Weekly QSP Tasks	104	Weeks	$35.00	$3,640.00
7	Third Party Inspection	104	Weeks	$135.00	$14,040.00
8	Dust Odometer	1	Odometer	$2,500.00	$2,500.00
9	Street Cleaning (Estimated)	1	dollars	$111,057.14	$111,057.14

	Maintenance/Installation				
10	Laborer 1	80	hours	$36.00	$2,880.00
11	Laborer 2	80	hours	$36.00	$2,880.00
12	Laborer 3	80	hours	$46.00	$3,680.00
13	**Total W/ QSP Training**				**$174,351.85**
14	**Total W/O QSP Training**				**$184,251.85**

Table 2: Quantity Take-Off for Dust Control

Item	Unit Cost						Quantity		Total
Dust Control Take-Off	$30.00	per hour	x	1	hour/day	x	520	days=	$15,600.00

Above is a quantity take-off including materials, labor and weekly time dedicated to the implementation of SWPPP. As shown above, there is about a $10,000 difference between line item 13 and 14. Hiring a third party inspector to come in weekly to do tests for the contractor in comparison to having a team member trained, has generated this difference. The 80 hours dedicated to each laborer includes maintenance throughout the duration of the project. It is important to not only look at costs associated with placing materials, such as silt fence and fiber rolls. The weather, workers maintenance and time play a large role in the life length of these materials. While talking with Poland, he mentioned that it is very important to keep these materials in good condition and replace them when need be.

The authors will now explain how costs of water per month were determined and why it is a ‘converted’ number (line item 4). The water company charges commercial buildings (including construction) at a different rate than regular residential homes. Because these large commercial buildings use much more water than residential buildings, the water company charges at a rate of 748 residential gallons = 1 commercial gallon (‘converted’). This is done in order to use simpler numbers for billing. Above, the 13.369 gallons is equivalent to 10,000 gallons. The authors have determined that approximately 500 gallons of water were used each day by the water truck. This water truck was filled once a day and would be emptied by the end of the day. Having powdery and light soil on the site, it was vital to keep dust down and retain it on site. By driving the water truck around the site and placing water on the soil, the constructor is adhering to regulations relating to dust by keeping it out of sewers and keeping it on the jobsite.

Due to the type of work that is conducted in construction, it is nearly impossible to keep all dirt and materials contained on a jobsite. In order to avoid issues with the city, state or local residents in the neighborhood, many constructors decide to invest in a street sweeping service. Using previous month’s costs for street cleaning, the authors were then able to take an average and apply that average throughout the rest of the project months. As shown below, the average was $4,828.57 per month. By applying this average, the authors were able to give the contractor a legitimate estimate for the remaining costs of street cleaning. Below is an estimate for the total costs of street cleaning. Figure 1 shows the average monthly costs and the estimated costs for the entire project. Nov-11 through Apr-12 is not linear to the rest of the chart because those were actual costs used to determine the average used for the rest of the job.

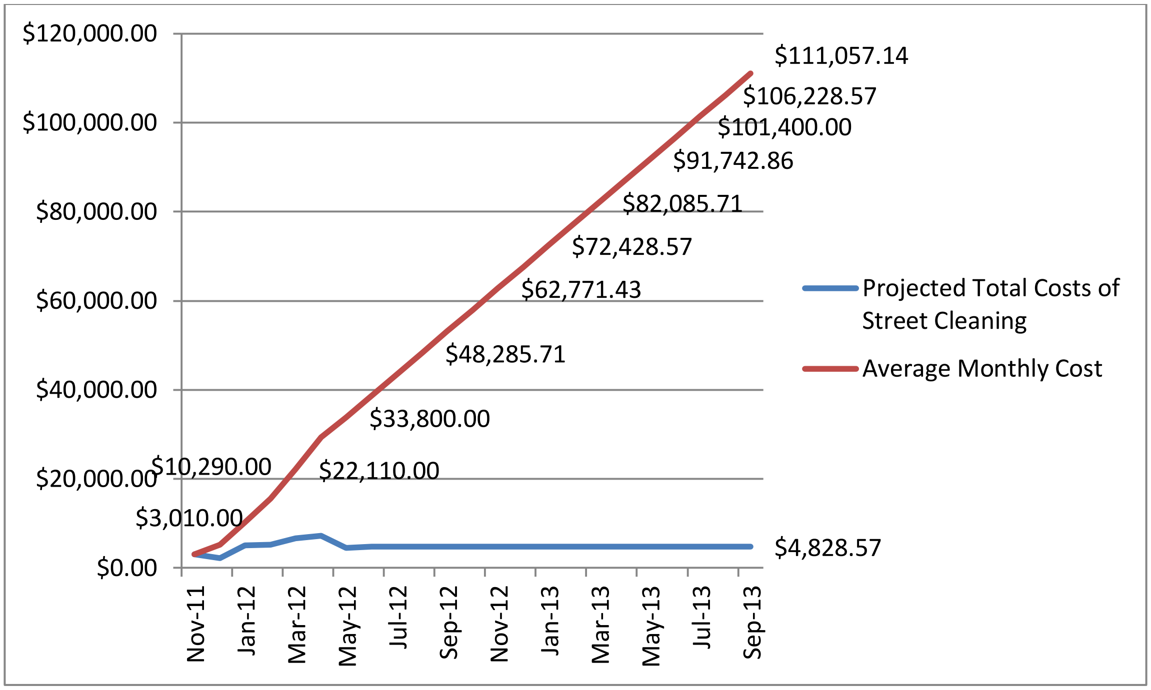

Figure 1: Estimated Cost of Street Cleaning

Table 3 provides a summary of total construction costs and the estimated cost for implementation of SWPPP. The total estimated cost of SWPPP as shown below is less than half a percentage of the entire project value. As a constructor, this percentage can be a very valuable number to incorporate into an initial big. Many constructors are working to earn a profit between 2%-5%.

Table 3: Percentage Costs of SWPPP/Total Construction Costs

Total Costs w/ QSP Training		$174,351.85
Total Cost of Construction		$70,000,000.00
% cost of SWPPP/Total Construction Costs		0.25%

DISCUSSION

The results of this research were based off of one case study for a $70,000,000 high school construction project that lasted two years. Without the incorporation of this quarter of a percentage, a constructor could potentially loose profits. Assuming a constructor forgets to entirely negate this .25% and plans to earn 3% profit, the contractor will automatically be going from a profit of $2,100,000 to $1,925,000. By forgetting to add the cost of SWPPP to their initial build, a constructor will be losing a total of $175,000 before construction even begins.

There are many elements that need to be considered when determining the actual costs to implement a Storm Water Pollution Prevention Plan into a budget for construction. The authors found a percentage and a total cost to implement SWPPP for this one specific project. While this number is accurate, it does not necessarily mean it can be used for any case or any job.

CONCLUSION

The authors have conducted a case study in order to present a cost analysis for the implementation of a Storm Water Pollution Plan. Constructors can save money by assigning QSP duties to internal employees instead of hiring a consultant. The QSP interviewed for this case study described his primary responsibility as taking dust readings. Three times a week he was responsible for taking dust readings.

Through many reforms, laws and changes to the legal system, constructors have been given increased responsibilities to help protect the environment. Every construction job is unique and different and because of this every constructor must evaluate the size of their job, the total cost of construction, the length of the schedule, and time management. In this case study, a 25-acre site was analyzed. Research found .25% of total construction cost was associated to SWPPP. The authors found that each acre of land cost approximately $7,000 to install and maintain SWPPP throughout the course of a two-year project.

The authors plan to conduct similar studies with the goal of developing simple percentages to constructors that can be used in the preparation of base bids. Having a recognized base percentage to use for bids could be a powerful tool which constructors could use to either save money with accurate estimates associated with SWPPP and the Clean Water Act.

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