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# Construction Site Sedimentary Pollution in a Watershed

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# CONSTRUCTION SITE SEDIMENTARY POLLUTION IN A WATERSHED

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The College of Science

The Graduate program in Environmental Science

# Construction Site Sedimentary Pollution in a Watershed

A Thesis in

Environmental Science

By

Imo Okwu

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I have submitted this thesis in partial fulfillment of the requirements for the degree of Master of Science.

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# ACRONYMS

| | |
|---|---|
| ASTM | American Society for Testing and Materials |
| ASTM: D5396(98) | American Society for Testing and Materials; Designated number 5396 (revised in 1998) |
| BMP | Best Management Practice |
| bpf | Blow per foot |
| CWA | Clean Water Acts |
| EPA | Environmental Protection Agency |
| EPD | Environmental Protection Division |
| FCWA | Federal Clean Water Act |
| GDOT | Georgia Department of Transportation |
| GDNR | Georgia Department of Natural Resources |
| GWQCA | Georgia Water quality Control Acts |
| NPDES | National pollutant Discharge Elimination System |
| NOI | Notice of Intent |
| SWMM | Storm Water Management Model |
| TSEC | Total Solvent Extractable Content |
| USCS | Unified Soil Classification System |
| $W_t$ | Total Weight |
| $W_r$ | Weight Retained |

## ABSTRACT

In the study of sediment pollution on and near a construction site, it is necessary to remember that sediment movement and deposition are part of the natural environment before the intervention of construction. As with many hydrologic problems, most sedimentation problems have visual impacts for relatively short periods, because they are rainstorm-related. Perhaps the most serious sedimentation problem is general deterioration of the total environment, a condition usually not recognized by the public.

This research presents an analytical evaluation of five construction sites. The analytical framework categorized the life cycle of construction sites into three stages in order to facilitate a sampling method; these are phase one- the beginning; phase two- the middle and phase three- the end. Each stage generates pollution due to the construction materials used. Soil samples were collected from the construction sites at different stages of construction procedures at strategic locations on the site within two days after a rainfall event. The soil samples were then analyzed to determine how much of the construction materials, (i.e., pollutants), mica, bitumen and paint each contained.

The primary objective of the research is assessing how much of these construction materials, pollutants, remain on the sites after construction activities one year later.

The results from the construction sites indicate integration of runoff processes and sedimentary pollution, which enhance the determination that; sediments from construction sites were sources of pollution to watersheds. In addition, the (pollutants) mica, bitumen and paint were present in soil samples from the construction sites during and after construction one year later. The distribution and migration pattern of pollutants diminish from the sources toward the stream outfall.

# INTRODUCTION

Greatly accelerated soil erosion and stream sedimentation are persistent problems in and around construction cites. Individual construction sites can contribute massive loads of sediment to small areas in short time. The effect of sedimentation on streams, lakes, and wetlands are well-documented (Graf 1975, Booth 1990). These impacts are expensive in terms of both dollar and aesthetic costs (Pimentel and others, 1995). Sediment is widely considered a principal pollutant in our water systems, a point explicitly recognized in the Clean Water Acts (CWA) enacted in 1972 and the Food Security Act of 1985. Soil erosion and sediment deposition in urban areas are as much an environmental blight as air, water, and noise pollution. In addition, sedimentation has many direct and indirect effects on watersheds that may be remote from the urban environment.

One obstacle to scientific and engineering remediation of sediment-related environmental problems is conflict between political and industrial restrictions. In addition, some difficulty may involve the fact that scientists and engineers cannot always communicate with each other. Fortunately, both scientists and engineers did meet half way in agreement with the 1987 reauthorization of the CWA, under which all states were required to conduct assessment of non-point sources. In 1988, a mitigation plan was developed, which promoted the identification of non-point pollution sources at the watershed level, and the implementation of the Best Management Practices (BMP). BMP are structural, vegetative, or managerial practices used to treat, prevent, or reduce watershed pollution. In 1992, a revised version of the 1987 BMP list was prepared with yearly updates.

In the study of sediment pollution on and near a construction site, it is necessary to remember that sediment movement and deposition was a part of the natural environment before the intervention of construction. Like flooding, sedimentation problems become important only when humans are affected. Sometimes the problems that result from natural conditions are small and unnoticed; but, when natural circumstances are altered to create a different kind of environment, then the previously small and unnoticed problems become greatly magnified. Severe sediment problems occur when covering vegetation is removed on construction sites. The flow regime in channels is altered by realignment or by the increased or decreased flow due to sedimentation. As heavy loads of sediment move into channels on construction sites, the fine particles move through rapidly and the coarser particles tend to fill the channel system.

The harmful effects of sediments on watersheds may affect public health in many ways: for example, efforts to control mosquito breeding have often been ineffective because sediments have filled drainage channels. Harmful bacteria, toxic chemicals and radionuclides tend to be adsorbed onto sediment particles. The adsorbed substances may not be harmful in their original residence but become hazardous when transported into water supplies or deposited and perhaps concentrated at a new location. The problem of sheet, rill and gully erosion, associated with sedimentation, may cause undesirable changes in graded areas of construction sites. Dispersion of soil particles by raindrop impact seals the land surface and thereby reduces infiltration, increases stream runoff, and decreases ground water recharge.

Perhaps the most serious sedimentation problem is general deterioration of the total environment – a condition usually not recognized by the public. As with many hydrologic problems, most sedimentation problems have visual impacts for relatively short periods, because they are rainstorm-related. Because these problems are usually rooted within the urban or urbanizing areas, they are limited to relatively small areas of the country. However, because of intense capital investment and human use of urban areas, the recognition of sediment problems and solution to sediment problems become socially and economically very important.

The analysis of the sedimentary pollution to watersheds includes:

A) the recognition of construction sites as point sources to watershed pollution,
B) considering construction activities as an integral part of urbanization,
C) treating construction firms as their industrial counterparts by authorizing the discharge of construction waste into the nation's waters, under the National Pollutant Discharge Elimination System (NPDES).

Complying with the NPDES requires that storm water discharges associated with construction activities be permitted into the nation's water under certain rules and regulations. The average sediment yield from construction sites and the condition of the stream channels tend to change with advancing forms of land use activities. Soil loss rates have generally declined in most construction areas because of Best Management Practices (BMP). Since Wolman and Schick (1967) reported loss rates over 100,000 tons/mi$^2$/year, many modern construction sites suffer substantial loss rates despite regulations.

In the State of Georgia, for example, the provisions of the Georgia Water Quality Control Act (Georgia Laws 1964, p.416, as amended) (GWQCA) and the Federal Clean Water Act, (FCWA) as amended (33 U.S.C. 1251 et seq) rules and regulations require construction firms to obtain a permit before discharging storm water associated with construction activities into the State waters. The Environmental Protection Division (EPD) under Georgia Department of Natural Resources (GDNR) administers this law. The EPD issues a permit to a construction firm upon receiving correct submittal of a Notice Of Intent (NOI) from the firm. The permit authorizes the firm to discharge storm water associated with a construction activity to the waters of the State of Georgia in accordance with the limitations, monitoring requirements and other conditions set fourth in the law.

Unfortunately, the NPDES provides for the permitting and monitoring of the discharges, but does not consider what happens to the discharged substances at a specified time after construction activities.

## RESEARCH OBJECTIVES

This research presents an analytical evaluation of five construction sites. The analytical framework (beginning, middle and ending phases) divides the life cycle of construction sites into three stages in order to facilitate sampling. Each stage generates pollution due to construction materials used. Soil samples were collected from the construction sites at different stages of construction procedures, and at strategic locations on each site within two days after a rainfall event. The soil samples are analyzed to determine how much of the construction materials, i.e. (pollutants), they contain. The primary objective of the research is to access how much of these construction materials still remain on the sites after construction activities one year later.

### Area of Study:

The area of study (fig.1) is located in the State of Georgia within metro Atlanta counties. The construction sites were selected according to the following criteria: type of construction – (commercial), proximity to a stream or creek, and size of construction site -- (at least one to five acres or more).These sites were chosen to represent different stages of construction completion in those counties experiencing rapid growth on the urban-rural fringes of the State. The areas have an abundance of small-scale water features that were probably attractive to developers, but highly vulnerable to sedimentation from even small construction sites. Preliminary studies of the site areas were conducted through library research to determine the soil, topographic, and hydrologic data of the areas. The locations of the sites were affirmed with GIS/GPS (Geographic Information System/Global Position System).

| # | LOCATION DESCRIPTION | LATITUDE | LONGTITUDE | X-COODINATE | Y-COODINATE |
|---|---|---|---|---|---|
| 1 | CAR WASH PROJECT | -84.6538 | 33.85915 | 2148704.53 | 1404159.82 |
| 2 | MID. SCH. PROJECT | -84.5620 | 33.70108 | 2783510.73 | 1346523.03 |
| 3 | IND. W/HOUSE PROJECT | -84.5871 | 33.74829 | 2168818.47 | 1363731.32 |
| 4 | BJ SHOP. CTR. PROJECT | -84,6185 | 33,85916 | 2098705.94 | 1404440.35 |
| 5 | OFF.BLDG.CPLX.PROJECT | -84.6241 | 33.79174 | 2157611.60 | 1379589.56 |

TABLE 1: EXPERIMENT SITE LOCATIONS

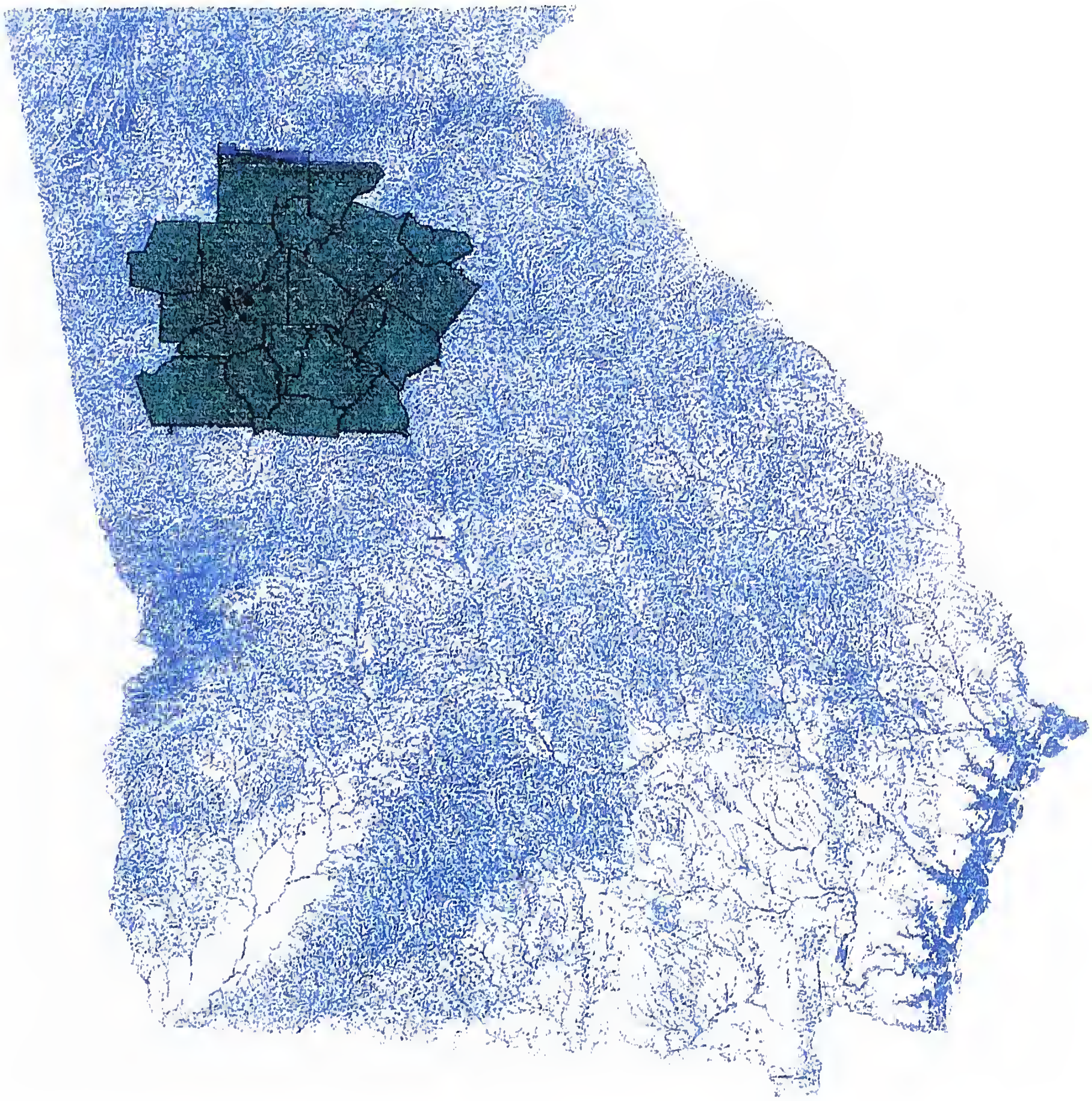


FIGURE1: Hydrography of Georgia depicting metro-Atlanta Counties
Where experiment sites are located. Source: USGS (DLG)

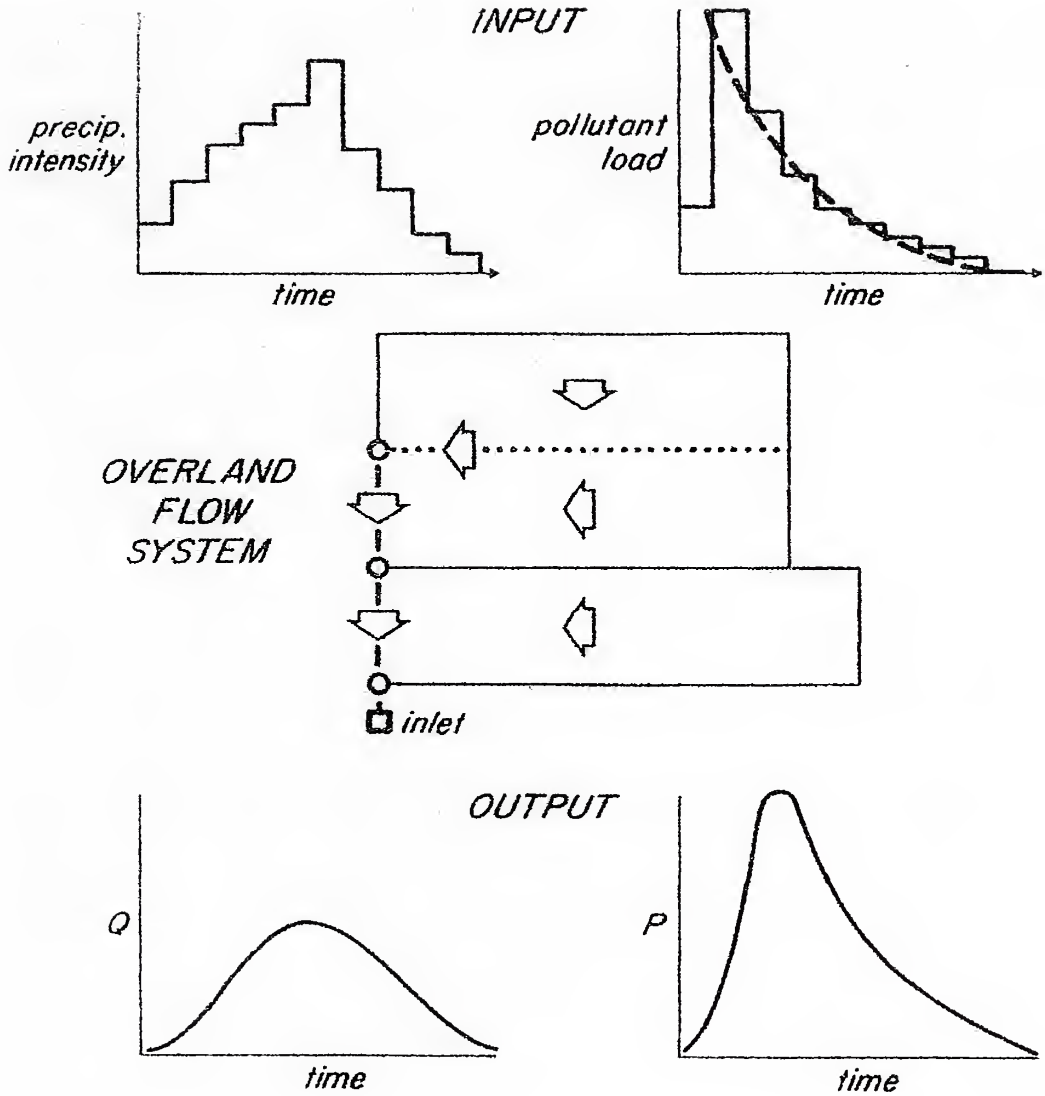
**Sedimentary Pollution and Runoff Processes**

The basic characteristic of a drainage system is that it is the pathway for guiding the flow of water over a land surface. The system during construction includes all appurtenances such as sediment traps, inlet basins, detention ponds, rip-raps and outfall devices that guide, control, or otherwise modify the quantity, rate of flow, or quality of runoff from the area. These constitute an array of subsystems, which interact to carry rainfall from its point of impact to the receiving waters. These subsystems can be categorized into three subsystems: the surface runoff subsystem, the transport subsystem and the receiving water.

The surface runoff system (fig.2) includes the drainage area relative to the inlet; each drainage area is characterized by its imperviousness, hydraulic roughness, slope and certain coefficients. These characteristics relate to the area's production of sediments that may be transported to a holding structure or storage by overland flow. The hydrologic input of the subsystem is expressed by a rainfall hyetograph, that is, (a rainfall intensity versus time graph). The hydrologic input also includes loss rate parameters and pollutant buildup/washoff coefficients that describe the rate at which pollutant will be delivered, depending on storm intensity and ground surface cover condition. The overland flow transforms the rainfall-excess hyetograph into two graphs; (the time distribution of flows called the hydrograph and the time-concentration of a pollutant called the pollutograph). Both graphs, expressed on Figure-2, make up the flow and quality of output of the surface runoff subsystem that automatically become the input or the beginning of the transport subsystem (fig.3).

The transport subsystem serves the actual duties of carrying storm water and their associated pollutant loads from construction sites and urban areas through a network of erosion control devices to a point of outfall. Additionally, flow and pollutant concentrations routed through the devices, mostly became modified output. The modification of the hydrograph and pollutograph expressed on figure 3, in turn became the inputs for the last subsystem, the receiving water (fig.4)

The receiving water may be a stream, creek or lake. The impact of discharge on receiving water is best assessed in terms of the concentration of particular quality of pollutants, their distribution in space, their persistence in time and their frequency of exceeding a certain critical level. Figure 4 expresses the receiving water subsystem for the hydrologic event. This present research study observed all the subsystems of the hydrologic model on the experimental sites; therefore, it may directly relate them to flow distribution and concentration of pollutants.




Hydrograph

Time- Distribution of flow

Pollutograph

Time-Pollutant Concentration

FIGURE 2: Surface runoff subsystem of stormwater/pollution showing the input, overland flow and output. Source: Highway Hydrology (No.13067)

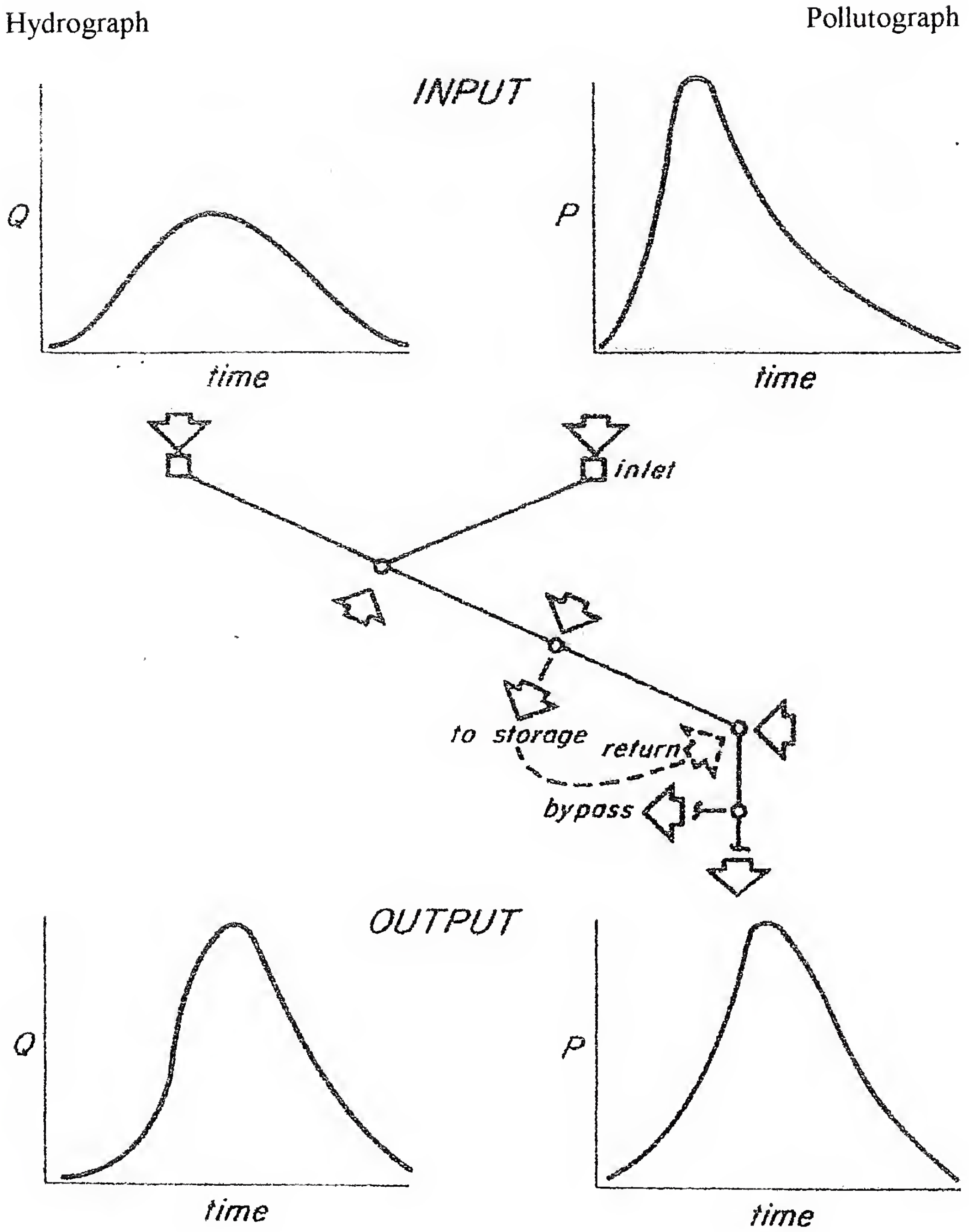



FIGURE 3: Transport subsystem of stormwater/pollution showing the input, storage, transport network and output. Source: Highway Hydrology (No.13067)

Hydrograph Pollutograph

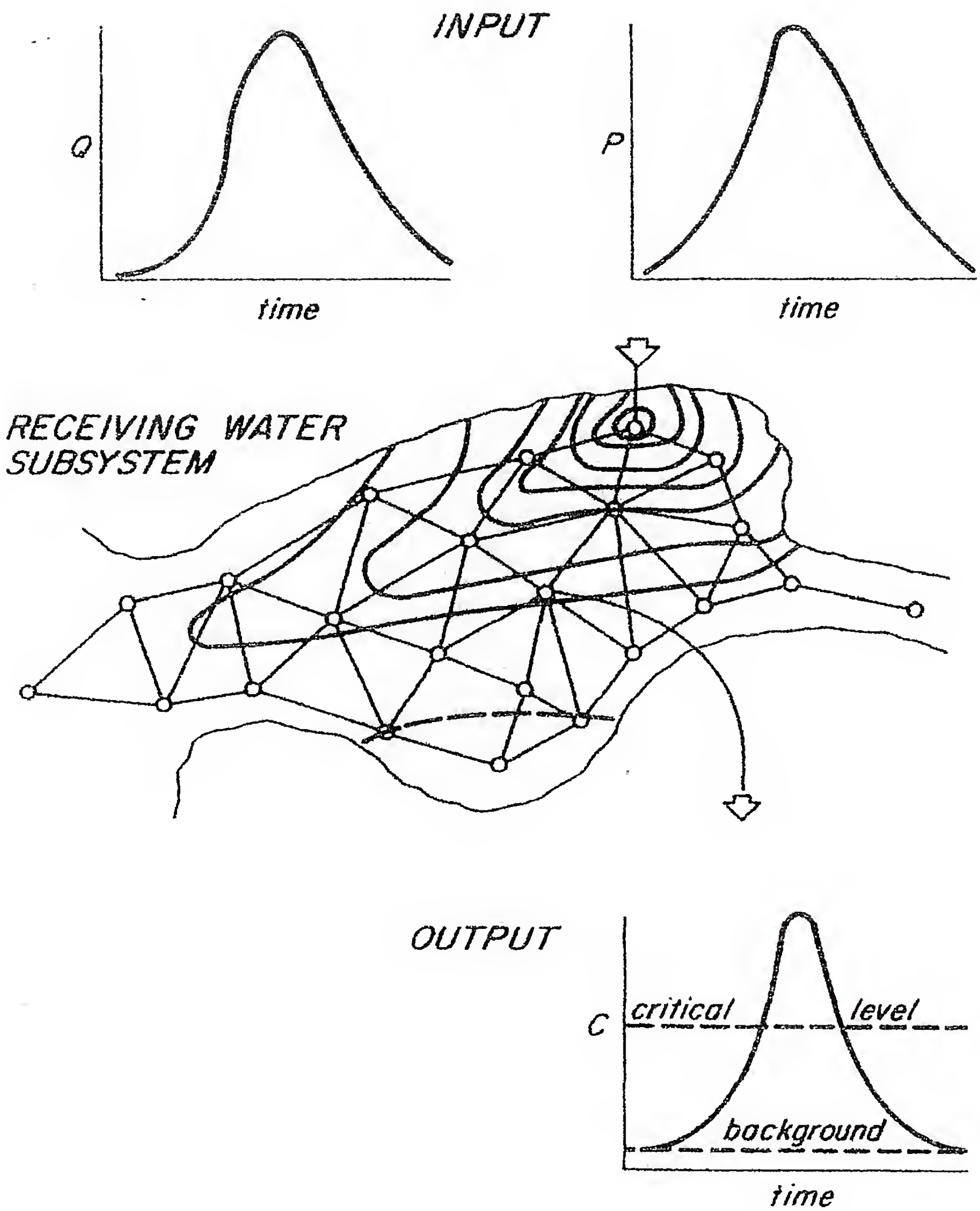



FIGURE 4.Receiving water subsystem of stormwater/pollution showing the outfall, critical level and background. Source: Highway Hydrology (No.13067)

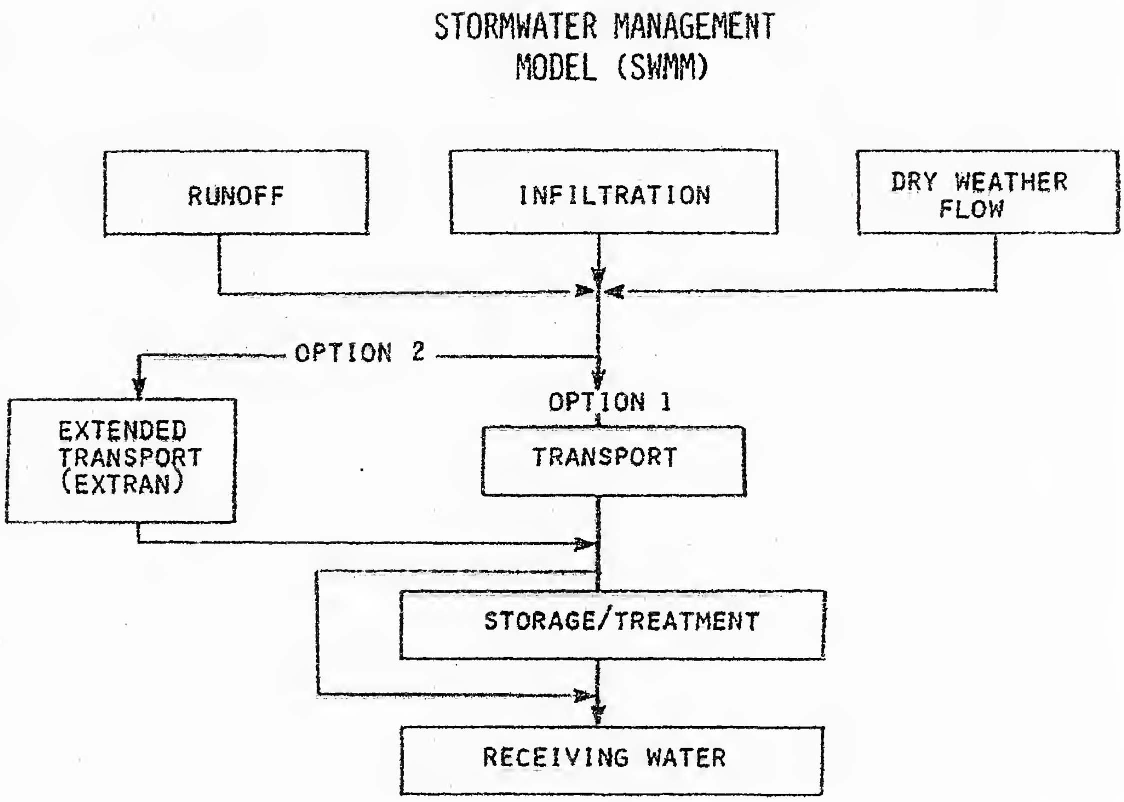



FIGURE 5: EPA Storm Water Management Model Subroutines. Source: Design of Stormwater Management Systems

Figure 5 shows a comprehensive Storm Water Management Model (SWMM) developed by the Environmental Protection Agency (EPA). SWMM is a large FORTRAN program which modeled complete urban rainfall/runoff cycle, including overland flow and in the sewage system; and could be modified for use in underdeveloped areas such as construction sites. The model utilized the Horton equation for infiltration and kinematics wave method for routing the flows. The empirical equations were used for runoff quality and the time step was variable

The estimated mass rate of removal of suspendable solids from the underdeveloped or undeveloped area is part of the modified output of the model. Urban non-point pollution is often referred to as storm water runoff, but in rural areas and construction sites it is still classified as non-point pollution. These obscure the understanding of point source sedimentary pollution of watersheds. The development of SWMM model provided a comprehensive approach that combines both urban and rural point-source pollutions to watershed management.

The hydrologic models presented on figures two, three and four simulated single storm event based on rainfall hyetograph inputs, transport system and receiving water characteristics. The complexity of the storm events give rise to situations only SWMM can help to solve.

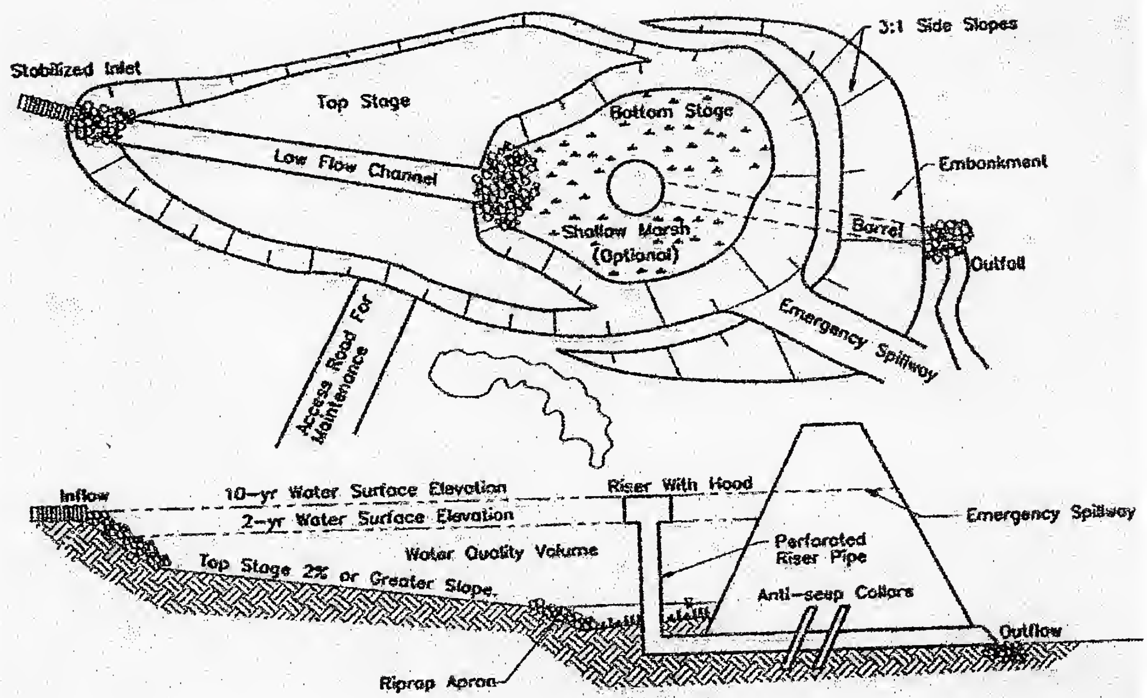



FIGURE 6: A typical plan view and cross section of detention pond with Rip-rap Source: Urban Drainage Design Manual (No.22)

All the experiment sites have detention ponds, but their location at various sites differ. Some sites have detention ponds located closer to the stream outfall, and some are closer to the construction site. The ones further away from the stream outfall usually have elongated rip-rap pads stretching towards the outfall. Detention ponds serve two major purposes: detention of runoff, and water quality control. Detention ponds are designed with certain devices, which enable them to detain water and runoff during rainstorms; and gradually release them to outfall. During storm-water detention period, there are opportunities for water quality improvements and improving runoff settlement at the bottom of the pond. Occasionally, clean-up and pond maintaince help to get rid of the runoff sediments at the bottom of the ponds. Most detention ponds have retrofits with rip-raps which filter off some of the sediments. Emergency spillways relieve excess overflow during heavy rainstorms. Typical detention ponds are built with embankments of at least 3:1 side slopes stabilized with permanent vegetation.

## METHODOLOGY

Compliance with the Clean Water Act (CWA) was evaluated in this study by assessing sediment motion from construction sites after sizable precipitation. The general guideline followed was the concept that soil sedimentation is an after-effect of rainfall. Construction activities set the tempo for sedimentary pollution; therefore, soil acts as a vehicle to convey pollutants from construction sites to water systems.

This study analyzed sediments to determine the specific pollutants conveyed. The analytical framework was created to detect construction materials being used on site, with construction materials limited to paints, bitumen and concrete materials. However, preliminary soil analyses of the construction sites were conducted to ensure that there was no prior presence of the construction materials. These preliminary analyses included visual investigation and pulverization of soil mortar. (Pulverization of soil is the ability of soil material to be reduced into powder).

### Procedures.

1.) Sediments and soil materials were collected at the construction sites from the following locations:

a) Before a retrofit

b) At the outfall of a detention pond

c) About six inches away from the rip-rap or splash pad,

d) Downstream, fifty feet from construction site

e) Upstream, fifty feet from construction site

2.) These samples were labeled, and cataloged for identification purposes in preservative bags. The samples were stored in ordinary room temperature before being taken to the laboratory. Collection of the samples was correlated with the three phases of construction:

a) Beginning Phase:

Beginning phase of construction included the stages of clearing and grubbing, grading and before the installation of curb and gutter.

b) Middle Phase:

Middle phase included the installation of curb and gutter, drainage structures, paving driveways and parking lots.

c) Ending Phase:

Ending phase included erection of building structures, both exterior and interior finishes.

Samples were collected after significant precipitation of one or more inches of rainfall for each phase. In the laboratory, the samples were analyzed to determine the presence of cement material -- (Mica), bituminous -- (Coal tar), finishing materials -- (Paints) in soil materials. These analyses were recorded and saved, and henceforth termed pollutants. One year later, investigative research was conducted on and around construction sites at the same locations. At this time, soil materials and sediment deposits were collected by drilling and probing the ground. These samples were stored and saved in containers and bags, and taken to the laboratory to analysis for the presence the pollutants: mica, bitumen, and paint.

The Georgia Department of Transportation (GDOT) method of material testing was used in this study. The GDT-51 was used to determine pulverization of soil mortar at the construction sites. The methods GDT-37 and GDT-76 were respectively used to determine presence of mica and bitumen in soil samples. Analyzing the presence of paint in soil was done using the American Society for Testing and Materials (ASTM) Standard: D5369 (98).

**The Test for Soil Mortar Pulverization**

The method of testing for pulverization of soil mortar was done according to the Georgia Department of Transportation method – (GDT-51). The method describes the procedures for determining the degree of pulverization in a soil mortar. Apparatus used are a balance, sieves, oven and sieve shaker. Sampling was done by taking a representative sample of the soil material from each sample location. A sample weight of at least 70-grams was taken in such a manner that it represented the best condition of the soil, and avoided additional pulverization. The sample was dried until all moisture was out at approximately 110°C temperature. While drying, the sample was gently stirred to maintain uniform drying and yet not vigorously enough to break down any clay balls in the sample.

Procedures: the dried sample weight of 50-grams was recorded as the total weight sample, (Wt). The dried sample was shaken over the required sieves until all the pulverized soil had passed the sieves. Care was taken not to shake too long so that the clay balls in the sample may not break up. The unpulverized soil was weighed, xclusive of any stone or gravel, starting with the largest sieve first and record the weight as the weight retained, (Wr). The soil retained on each following sieves were weighed with the previously weighed soil and recorded as the accumulated weight retained.

Calculations: The percentage of unpulverized soil was calculated as follows:

$$100-(Wr/Wt\times 100)$$

Where:

Wr = Weight retained on sieve

Wt = Weight of total sample representative

**Test for Presence of Concrete Material (Mica)**

Mica is thin crystalline material often added in making cement. Mica, specifically Muscovite or chemically referred to as hydrous potassium aluminum silicate, is colorless or white in color. The method of testing mica was done according to the Georgia Department of Transportation method: (GDT-76). The method describes how to determine mica content of a fine aggregate.

Apparatus used were four separatory funnels, glass funnels, balance, rack glass stirring rods, sieves and sieves shaker, oven, beakers, evaporation dishes, plastic wash bottles, filter papers and bromoform with specific gravity of 2.8.

The samples were taken from materials passing the #30 sieve and oven dried after grinding. Approximately 50-grams were weighed as representative samples.

Procedures: the sample was placed in the first separatory funnel, approximately 100ml or more of bromoform was added, and a thorough mix of sample and the solvent was one. The mixture was allowed to settle until the heavier material had settled and the lighter material had risen to the surface. The heavier material was then drawn off to another separatory funnel containing bromoform solution. Again, thorough mixing and settling were allowed until separation was achieved. The heavier material was drawn from separatory #2 into separatory funnel #3 which contained some bromoform, and after mixing and settling the heavier material was once drawn into #4 separatory funnel. The mixture was worked back into #1 separatory funnel and the process continued until no further settling of the heavier material occurred in separatory funnels: #1, #2, and #3. After the separation process, the heavy material portion from separatory funnel #4 was drained into a 250ml beaker. The heavy material was washed with some bromoform solution using previously weighed number 540 filter paper. Later, heavy material and filter paper were oven dried and the weight was determined after cooling. In addition, the light material from the four separatory funnels was drained into a beaker, filtered, washed, dried, cooled and weighed with the heavy material.

Calculation:

$W_3 - W_2/W_1\ (100)$ ------------- for heavy material (specific gravity > 2.8)

$W_5 - W_4/W_1\ (100)$ ------------ for light material (specific gravity < 2.8)

Where:

$W_1$ = Original weight of sample

$W_2$ = Weight of filter paper

$W_3$ = Weight of filter paper and heavy material

$W_4$ = Weight of filter paper

$W_5$ = Weight of filter paper and light material

The weight of the heavy material reflect the actual mica content

## Test for the Presence of Bitumen

The method of testing was done according to the Georgia Department of Transportation (GDT-37). The method determines by cold solvent extraction, the percentage of bitumen in a paving mixture in which all, the aggregates pass a 1.5-inch sieve. The recovered bitumens were not used or tested; rather the different in weight of the dried aggregates determines the weight of bitumen.

Note: 1) Solvent used for extraction was Trichloroethane because bitumen is soluble in the solvent.

2) Centrifuge calibration was performed before the testing was carried out. This was done according to the method of test for determining Rotarex Correction Factor, as in the Georgia Department of Transportation (GDT-25).

(GDT-25): is method of testing to determine the centrifuge correction factor in order to establish the quantity of fines (minus #200 sieve material) that was being lost in the process of extracting the bitumen from sample mixture.

Procedures: A representative of asphalt- mix design sample was obtained from Asphalt Plant as follows:

Bin #1 aggregate ----------------- 50%

Bin #2 aggregate ----------------- 20%

Bin #3 aggregate ----------------- 30%

Asphalt cement ------------------ 6.5%

At the Laboratory, materials were blended on the same proportion as the Asphalt Plant settings to obtain a composite sample approximating the capacity of the bowl being calibrated. Blending to determine the correction factor was as follows:

Bin #1 aggregate -------- 0.5×100 grams = 50 grams

Bin #2 aggregate -------- 0.2×100 grams = 20 grams

Bin #3 aggregate -------- 0.3×100 grams = 30 grams

Total aggregate --------------------------- = 100 grams

Weight of asphalt cement for Lab. Mix design = 100 grams×6.5/93.5 = 6.9 grams

Blending was done at oven temperature between 142° to 164°c. after which the mixture was transferred to the centrifuge bowl with introducing extracting solvent. The lid on the bowl was tightened and exact position it was placed was marked. The centrifuge was run to about 3600 rpm speed. When the mixture was thoroughly cleaned it was removed dried and weighed. This particular bowl was used for the rest of the bitumen testing.

Calculation:

$$\text{Bowl correction factor} = \%AC - W_1 - W_2/W_1 \times 100$$

Where:

%AC = Percentage asphalt cement, (6.9%)

$W_1$ = Weight of initial sample (including AC), 103.4 grams

$W_2$ = Weight of extracted mineral (aggregate), 100 grams

Average of two trials = 0.032, therefore, correction factor = 0.03

The method (GDT-37) of extraction proceeded after the centrifuge correction factor was determined. Sample: Aggregated soil samples collected at various locations of the construction site were dried and some 50-grams weighed samples representatives were taken. Procedures: The representative sample was placed in the already calibrated bowl according to the (GDT-25) and some quantity of trichloroethane solvent was added. Sufficient time was allowed for the solvent to disintegrate the sample; before running the centrifuge. The centrifuge was operated at a maximum speed of 3600 rpm, and was stopped after solvent ceased to flow to the drain. Sufficient solvent was used to wash the sample, and the sample was filtered, dried and weighed.

Calculation: The percentage bitumen in the sample was calculated as follows:

$$\text{Bitumen content, percent} = (W_1 - W_2/W_1 \times 100) - W_3$$

Where:

$W_1$ = Weight of sample

$W_2$ = Weight of extracted mineral, (aggregate)

$W_3$ = Correction factor as determined by method, (GDT-25) = 0.03

## **Test for the Presence of Paint**

This practice describes standard procedures for extracting non-volatile and semi-volatile organic compounds from solids such as soils, sediments, sludge and granular wastes using Soxhlet Extraction. The method is the ASTM – D5369 – (98). In addition to the practice are the ASTM methods: D4281 and D5368, which were applied for gravimetric determination of the Total Solvent Extractable Content (TSEC) of the soil samples.

Note: 1) It was discovered that most of the paints used in construction sites were oil based paints, that means oil is used as vehicle for the paints solute materials

2) Organic based chemical such as polymeric dispersants and chelants, antifoams, filming and neutralizing amines, oxygen scavenger and paint Pigments may be recovered as oil and grease when these test methods are applied.

3) Solvent used for extraction was Fluoroform/methanol (1:1)

4) Acid used to acidify the soil samples was diluted sulfuric acid.

Sample: The samples were soil collected at various locations on the construction site and suspected of containing paint materials. The soil samples were dried, sieved to pass #10-mesh and ground to powder.

Procedures: The ground soil sample was acidified with diluted sulfuric acid. The acid was later drained on filter paper and soil cake formed was dried and extracted in a Soxhlet Extraction apparatus with the Fluorocarbon solvent for four hours. The fluorocarbon solvent containing the extracted materials was evaporated and the residue was determined gravimetrically.

Calculation: Calculate the results of the determination, in milligrams per liter as follows:

$$\text{Extractable Residue, mg/l} = W_2\text{-}W_1/V \times 1000$$

Where:

$W_1$ = Tare weight of boiling flask, (mg)

$W_2$ = Weight of boiling flask after removal of extraction solvent, (mg)

V = Volume of sample, (L)

**Soil test boring procedures (ASTM, D-1586)**

The American Standard for Testing and Materials (ASTM) method D-1586 was used for soil test boring in this study. The soil test borings were achieved by twisting continuous auger flights or sampler into the ground. In the case of this study, selected locations such as detention ponds, rip-rap splash pads and stream outfalls, soil samples were obtained by driving a standard tube sampler into the ground. The sampler was initially seated about two inches to penetrate any lose cuttings created in the boring process. The sampler was then driven an additional six to seven inches by gentle thrust and push on the sampler. No hammer blows were applied on the sampler to achieve a satisfactory depth because over-burden soils were soft and posed no penetration resistance. The soil samples recovered were sealed in zip lock bags, labeled and taken to the laboratory for analysis. The analysis included traces of bitumen, mica and paint in the soil samples.

## RAINFALL DATA

Rainfall data (Table 2) were taken from three Daily Climate Data stations close to the construction experiment sites. The stations were constantly monitored for sizable precipitation. Collection of soil samples from the construction experiment sites were conducted a day or two after a significant precipitation event. Each sample collected relates to a particular phase of construction, which often yields anticipated pollutants according to the construction materials used.

| Date sample collected | Construction Exp.site | Rainfall Amt. (inches) | Rainfall Intensity(in/hr) | Construction Phase | Weather Data Source |
|---|---|---|---|---|---|
| Dec/20/2002 | 1 | 0.56 | 0.023 | I | Atlanta-WSO Station ID 090451 |
| Jan/29/2003 | 4 | 1.40 | 0.06 | I | Atlanta-bolt. Station ID 090444 |
| Feb/22/2003 | 3 | 0.66 | 0.025 | I | Atlanta-bolt. Station ID 090444 |
| Mar/30/2003 | 1 | 0.29 | 0.012 | II | Atlanta-WSO Station ID 090451 |
| Mar/30/2003 | 2 | 0.34 | 0.014 | I | Douglasville Station ID 092791 |
| Apr/24/2003 | 4 | 0.65 | 0.024 | II | Atlanta-bolt. Station ID 090444 |
| May/26/2003 | 3 | 0.22 | 0.009 | II | Atlanta-bolt. Station ID 090444 |
| Jun/14/2003 | 2 | 0.3 | 0.013 | II | Douglasville Station ID 092791 |
| Jun/15/2003 | 1 | 0.2 | 0.009 | III | Atlanta-WSO Station ID 090451 |
| Jul/01/2003 | 5 | 1.19 | 0.05 | I | Douglasville Station ID 092791 |
| Aug/30/2003 | 2 | 0.65 | 0.027 | III | Douglasville Station ID 092791 |
| Oct/08/2003 | 5 | 0.3 | 0.013 | II | Douglasville Station ID 092791 |
| Oct/09/2003 | 3 | 0.28 | 0.012 | III | Atlanta-bolt. Station ID 090444 |
| Nov/19/2003 | 4 | 1.46 | 0.07 | III | Atlanta-bolt. Station ID 090444 |
| Jan/26/2004 | 5 | 1.31 | 0.06 | III | Douglasville Station ID 092791 |

TABLE 2: RAINFALL DATA TABLE

**Estimating Sediment/Pollutant Load For The Construction Sites**

The estimate assumes an average pollutant (mica, bitumen and paint) concentration is multiplied by the average runoff to yield an average loading estimate.

The pollutant loading can be estimated from the following equation:

$$L = \frac{(P\,R_v\,P_j)\,(C)\,(A)}{98.6}$$

(Source: Urban Drainage Design Manual)

Where:

$L$ = Pollutant load, kg

$P$ = Rainfall depth over the desired time interval, mm

$R_v$ = Runoff coefficient (see Table 3)

$P_j$ = Correction factor for storms that produce no flow

$C$ = Flow-weighted mean concentration of the pollutant in urban runoff, Mg/L

$A$ = Area of the development site, ha

98.6 = Unit conversion factor

Explanation: The equation is applied later on the study to determine the amount of pollutants traced.

| Type of Drainage Area | Runoff Coefficient, C* |
|---|---|
| Business: | |
| Downtown areas | 0.70 - 0.95 |
| Neighborhood areas | 0.50 - 0.70 |
| Residential: | |
| Single-family areas | 0.30 - 0.50 |
| Multi-units, detached | 0.40 - 0.60 |
| Multi-units, attached | 0.60 - 0.75 |
| Suburban | 0.25 - 0.40 |
| Apartment dwelling areas | 0.50 - 0.70 |
| Industrial: | |
| Light areas | 0.50 - 0.80 |
| Heavy areas | 0.60 - 0.90 |
| Parks, cemeteries | 0.10 - 0.25 |
| Playgrounds | 0.20 - 0.40 |
| Railroad yard areas | 0.20 - 0.40 |
| Unimproved areas | 0.10 - 0.30 |
| Lawns: | |
| Sandy soil, flat, 2% | 0.05 - 0.10 |
| Sandy soil, average, 2 - 7% | 0.10 - 0.15 |
| Sandy soil, steep, 7% | 0.15 - 0.20 |
| Heavy soil, flat, 2% | 0.13 - 0.17 |
| Heavy soil, average 2 - 7% | 0.18 - 0.22 |
| Heavy soil, steep, 7% | 0.25 - 0.35 |
| Streets: | |
| Asphaltic | 0.70 - 0.95 |
| Concrete | 0.80 - 0.95 |
| Brick | 0.70 - 0.85 |
| Drives and walks | 0.75 - 0.85 |
| Roofs | 0.75 - 0.95 |

* Higher values are usually appropriate for steeply sloped areas and longer return periods because infiltration and other losses have a proportionally smaller effect on runoff in these cases.

TABLE: 3 THE RUNOFF COEFFICIENT FOR RATIONAL FORMULA Source: Urban Drainage Design Manual (No.22) THE PERCENT OF SITE IMPERVIOUSNESS WAS ACCESSED THROUGH SOIL TYPE, GROUND COVER AND TOPOGRAPHY.

The runoff coefficient used here was selected from the unimproved areas and the lawns in Table 3; these were suitable for the ground cover and topography of the experiment sites. The choice of the site drainage type was solely based on the anticipated percentage ranges of imperviousness for any site underdevelopment.

# RESULTS

## During Construction Results ( Experiment Site One)

The Construction Site result started on December 20, 2002 with the phase-I of construction activities. Rainfall gauge recorded 14.00mm with an intensity of 0.57mm per hour. The visual investigation of soils on the site revealed that the soils conformed to native soil soils of the area. (See Appendix Table B-1)

Soil samples were collected on March 30, 2003 during the installation of concrete curb and gutter, placement of graded aggregate base and concrete driveway. The recorded rainfall was 7.2mm with intensity of 0.3mm per hour. The collected soil samples were analyzed for traces of mica and there were average of 0.15 grams of mica traced on the Site. (See Appendix Table C-1)

June 15, 2003 marked the Phase-III of construction activities with the placement of asphalt pavement. Soil samples were collected after a recorded rainfall of 50mm with intensity of 0.2mm per hour. Testing for traces of bitumen were performed on the soil samples and an average of 0.53 gram of bitumen was discovered on the site. (See Appendix Table D-1). Tests for traces of paints were not conducted on this site because painting activities never happened on site; rather, all structural members were pre-fabricated and painted before shipping to the construction site ;( See Appendix Table F-1 for During Construction Summary Log).

**During Construction Results ( Experiment Site Two)**

Clearing, grubbing, grading and construction site layout marked the construction Phase-I of Experiment Site Two. On March 30, 2003, soil samples were collected after a rainfall event of 8.5mm with an intensity of 0.4mm per hour. Visual inspection of soil samples from the topsoil stockpile, proposed detention pond location, and stream outfall, showed that the soil was natural and free of any construction pollutants. The land-disturbed area of 1.82 ha. Was made vulnerable to soil erosion. (See Appendix Table B-2)

The Phase-II included such construction activities as the installation of drainage structures, concrete curb and gutter, structural steel and asphalt pavement. The soil samples collected on June 14, 2003 were analyzed for traces of mica and bitumen, the very pollutants contents of the construction materials. Remarkably, the amount of mica traced was 0.12 gram and that of bitumen was 0.04 gram. Soil samples were collected on the site after a recorded rainfall of 7.5mm and intensity of 0.31mm per hour. (See Appendixes Table C-2, D-2)

On August 30, 2003, soil samples were collected on the site after a recorded rainfall of 16.3mm and intensity of 0.67mm per hour. Painting exterior and interior structural members were construction activities at this phase; therefore, soil samples were analyzed for traces of paints. Averages of 1.6mg per liter were traced after analyzing 0.5 liter of the soil samples in solution. (See Appendix Table E-2). The during Construction Summary Log is Appendix Table F-2.

## During Construction Results (Experiment Site Three)

Soil samples were collected on the site after land clearing, grubbing and rainfall of 35mm with an intensity of 1.5mm per hour. The samples were collected from top soil stockpile, fifty feet up and down of the stream outfall. The visual inspection of these samples revealed natural soils with organic materials, but no construction materials. (See Appendix Table B-3) The entire land disturbed area was 3.14 ha.

0.10 gram and 0.12 gram of mica and bitumen respectively were traced after analyzing the soil samples collected from site on April 24, 2003.The recorded rainfall on the day soil samples were collected was 16.3mm with intensity of 0.56mm per hour. (See Appendixes Table C-3, D-3)

On November 19, 2003, soil samples were collected on the experiment site after a recorded rainfall of 36.5mm and intensity of 1.52mm per hour. This was the Phase-III of the Experiment Site, which comprised installation of exterior and interior structural members including acoustical items. Most importantly, painting had been finished at this site. The soil samples were analyzed for traces of paint and average of 3.6 mg per liter was traced. (See Appendix Table E-3). The During Construction Summary Log is Appendix Table F-3.

**During Construction Results (Experiment Site Four)**

Construction activity at this phase was clearing and grubbing the site. Locations of the detention pond and stream outfall were unknown at this time. However, on the February 22, 2003 soil samples were collected from topsoil stockpile after a rainfall depth of 16.5mm and intensity of 0.53mm per hour. The soil samples conformed to the native soil of the area. (See Appendix Table B-4)

By May 26, 2003 all the drainage structures, concrete curb and gutter, asphalt pavements and some wall panels had been installed. On the date stated some soil samples were collected after a recorded rainfall depth of 5.5mm with intensity of 0.23mm per hour. The collected samples were tested for traces of mica and bitumen. Surely, 0.11 gram of mica and 0.15 gram were traced respectively. (See Appendixes Table C-4, D- 4)

The construction Phase-III remarked the finishing phase of most activities. Visual observations indicated that there was careless handling of paints on the site; even the asphalt pavement markings were excessive. On October 9, 2003, soil samples were collected from the site after a recorded rainfall of 7.00mm and intensity of 0.3mm per hour. The analysis of soil samples indicated traces of 24mg per liter of paint (See Appendix Table E-4). The During Construction Summary Log is Appendix Table F-4

## During Construction Results (Experiment Site Five)

On July 1, 2003, soil samples were collected from the Experiment Site after a recorded rainfall of 29.8mm and intensity of 1.24mm per hour. The site was at the clearing and grubbing phase. The soils collected were mostly topsoils with organic materials and conformed to the native soils. (See Appendix Table B-5)

The installation of concrete curb and gutter, asphalt pavement and utility lines rough-in marked the Phase-II of the Experiment Site. On October 8, 2003, soil samples were collected after recorded rainfall of 8.25mm and intensity of 0.34mm per hour. The samples were analyzed for traces of mica; and bitumen. Results indicated that there were 0.07gram of mica and 0.02gram of bitumen. (See Appendixes Table C-5, D-5)

On the third Phase of construction, soil samples were collected on January 26, 2004 after a rainfall depth of 32.8mm and intensity of 1.36mm per hour. The activities on this phase involved painting of structural members including acoustical materials; therefore, soil samples were analyzed for traces of paint. An average of 1.2mg per liter was traced on the site (See Appendix Table E-5). The During Construction Summary Log is Appendix Table F-5.

**After Construction Results, One Year later (Experiment Site One)**

On July 3, 2004, soil-boring tests were performed on Experiment Site One and soil samples were collected at the detention pond, rip-rap splash pad and stream outfall areas. The soil samples were analyzed for traces of mica and bitumen. Tests for traces of paint were not conducted because none was used during construction.

See Appendix Table G-1 for Soil Boring Procedures on Experiment Site One

The results indicated traces of 5.0g of mica at the detention pond area, 2.0g at the rip-rap splash pad area and none at the stream outfall. Soil sample analysis for trace bitumen indicated no traces of bitumen found in any of the three sample locations.

**After Construction Results One Year later (Experiment Site Two)**

Soil samples collected from Experiment Site Two on September 16, 2004 were analyzed for traces of mica, bitumen and paint. The samples were collected through soil boring tests at the detention pond, rip-rap splash pad and stream outfall areas.

See Appendix Table G-2 for Soil Boring Procedures on Experiment Site Two. After the soil samples analysis, 13.0 g of mica were traced at the detention pond location, 9.0g were dictated at the rip-rap splash pad area, and 2.0g were traced at the stream outfall area.

Some bitumen was traced at the sample locations; notably, the detention pond with 0.23g of bitumen, the rip-rap splash pad recorded 0.1g of bitumen and the stream outfall had no traces of bitumen. When test for traces of paints were conducted on soil samples, only the soil samples collected at the detention pond area showed 2.0mg of paint present. The rip-rap splash pad and stream outfall areas indicated no traces of paint.

**After Construction Results, One Year later (Experiment Site Three)**

Soil Boring Tests were conducted on the Experiment Site Three to collect soil samples. The samples were collected at the detention pond, rip-rap splash pad, and stream outfall areas. The soil samples were collected on November 25 2004, analyzed for traces of mica, bitumen and paint. See Appendix Table G-3 for Soil Boring Procedures on Experiment Site Three.

The soil sample analysis indicated that 27.0 g of mica was traced at the detention pond, 19.0 g traced at the rip-rap splash pad area, and 8.0 g traced at the stream outfall area. Analyzing soil samples for traces of bitumen indicated 0.7g of bitumen at the detention pond area, 0.3g at the rip-rap splash pad area, and 0.1g at the stream outfall area. Paint traced at the detention pond area was 2.5mg, after samples analysis, while 3.8mg was traced at the rip-rap splash pad area. In addition, after samples analysis, 0.3 mg of paint was traced at the Stream outfall area.

## After Construction Results, One Year later (Experiment Site Four)

On November 26, 2004, Soil samples were collected from Experiment Site Four to analysis for traces of mica, bitumen and paint. The samples were collected at the detention pond, rip-rap splash pad, and the stream outfall areas. See Appendix Table G-4 for Soil Boring Procedures on Experiment Site Four. At the detention pond area, 23.0g of mica were traced, 17.0g at the rip-rap splash pad area, and 6.0g of Mica were traced at the stream outfall.

When the soil samples were analyzed for bitumen, 0.9g was traced at the detention pond area, while 0.5g was traced at the rip-rap splash pad area. The stream outfall area showed no traces of bitumen. Soil samples analyzed for traces of paint at sample locations indicated that 10.0mg were traced at the detention pond area, 3.0mg at the rip-rap splash pad area, and 0.1mg trace of paint at the stream outfall area.

## After Construction Results, One Year later (Experiment Site Five)

Soil samples collected from Experiment Site Five on March 3, 2005 were analyzed for traces of mica, bitumen, and paint. See Appendix Table G-5 for Soil Boring Procedures on Experiment Site Five. 11.0g of mica was traced at the detention pond area and 8.0g traced at the rip-rap splash pad area. At the stream outfall, only 2.0g of mica were traced.

Among the three sample locations: detention pond area, rip-rap splash pad area and stream outfall, only the detention pond area showed 1.5mg traces of paint. The rest of the sample locations showed no traces of paint. Soil sample analysis for traces of bitumen indicated 14.0g at the detention pond area and 18.0g at the rip-rap splash pad area. The stream outfall area showed 5.0g of bitumen.

## POLLUTANTS TRACED

A simple method was used to estimate the construction materials pollutant loads (bitumen, mica and paint). The simple method assumes an average pollutant concentration is multiplied by the average runoff to yield an average loading estimate. Therefore, the pollutant export or loading from the sites was estimated from the following equation:

$$L = \frac{(P\ R_v\ P_j)(C)(A)}{98.6} \quad \text{-------------------- Equation-1}$$

Where:

L = Pollutant load, kg

P = Rainfall depth over the desired time interval, mm

$R_v$ = Runoff coefficient

$P_j$ = Correction factor storms that produce no flow

C = Flow-weighted mean concentration of the Pollutant in Urban runoff, mg/L

A = Area of the development site, ha

98.6 = unit conversion factor

The rainfall depth, P, was based on the record data of daily precipitation obtained from the regional climate center. The time interval over which the pollutant load estimate was based on the construction duration, coupled with construction phases.

The value of, $P_j$, was used to compensate for those precipitations within the time interval that yielded no pollutant runoff. The $P_j$ of a site was determined by averaging those storm events that formed surface depressions, but produced no flow.

The runoff coefficient, $R_v$ was determined by the degree of construction site imperviousness. $R_v$, could be obtained from the following equation:

**$R_v$ = 0.05+0.009(I)** -------------------- Equation-2

Where:

$R_v$ = Runoff coefficient

I = Percent of site imperviousness (accessed through site soil type, ground cover and topography) see table-3

The flow-weighted mean concentration of the pollutants in urban runoff for mica, bitumen and paint could be obtained from the National Urban Runoff Pollutant (NURP) database. Rather for this study, the traced weight of pollutants: mica, bitumen and paint obtained from construction sites were used to estimate pollutant load.

The area, A, in equation-1 was total area of construction site, as were noted on "During Construction Summary Logs" on Appendices Tables:F-1, F-2, F-3, F-4 and F-5. Average estimate for pollutant load on the Experiment Sites are depicted below.

**Carwash Construction Site Pollution Load Calculation Site#1**

Estimating pollutant load at Experiment site-1(*Carwash construction site)*

$$R_v = 0.05+0.009(0.25) = 0.0148$$

Estimating mica :

$$L = \frac{(7.25)(0.0148)(0.42)(0.15)(0.709)}{98.6} = 4.86x10Kg$$

Estimating bitumen material:

$$L = \frac{(5.0)(0.0148)(0.46)(0.53)(0.709)}{98.6} = 0.0001kg$$

## Industrial Warehouse Construction Site Pollution Load Calculation Site#2

Estimating pollutant load at Experiment site-2 (*Industrial Warehouse construction site)*

Estimating mica:

$$\mathbf{R_v = 0.05+0.009(0.22) = 0.0130}$$

$$\mathbf{L = \frac{(7.5)(0.0130)(0.51)(0.12)(1.820)}{98.6} \quad = 0.0001kg}$$

Estimating bitumen material:

$$\mathbf{L = \frac{(7.5)(0.0130)(0.51)(0.04)(1.820)}{98.6} \quad =3.67x10Kg}$$

Estimating paint material:

$$\mathbf{L = \frac{(16.3)(0.0130)(0.51)(8)(1.820)}{98.6} \quad =0.016\ Kg}$$

**<u>Middle School Construction Site Pollution Load Calculation Site#3</u>**

Estimating pollutant load at Experiment site-3 (*Middle school construction site)*

Estimating mica:

$$R_v = 0.05+0.009(0.17) = 0.010$$

$$L = \frac{(16.3)(0.010)(0.47)(0.10)(3.14)}{98.6} = 0.0002\text{Kg}$$

Estimating bitumen material:

$$L = \frac{(16.3)(0.010)(0.47)(0.12)(3.14)}{98.6} = 0.0003\text{ Kg}$$

Estimating paint material:

$$L = \frac{(36.5)(0.010)(0.58)(12)(3.14)}{98.6} = 0.081\text{ Kg}$$

**BJ Shopping Center Construction Site Pollution Load Calculation Site#4**

Estimating pollutant load at Experiment site-4 (*BJ shopping center construction site)*

Estimating mica:

$$\mathbf{R_v = 0.05+0.009(0.20) = 0.0118}$$

$$\mathbf{L = \frac{(5.5)(0.0118)(0.54)(0.11)(2.72)}{98.6} = 0.0001Kg}$$

Estimating bitumen material:

$$\mathbf{L = \frac{(5.5)(0.0118)(0.54)(0.15)(2.72)}{98.6} = 0.0001Kg}$$

Estimating paint material:

$$\mathbf{L = \frac{(7.0)(0.0118)(0.\ 43)(24)(2.72)}{98.6} = 0.022Kg}$$

**Office Building Complex Construction Site Pollution Load Calculation Site#5**

Estimating pollutant load at Experiment site-5 (*Office building complex construction site)*

Estimating mica:

$$R_v = 0.05+0.009(0.20) = 0.0118$$

$$L = \frac{(8.25)(0.0118)(0.37)(0.07)(1.79)}{98.6} \quad =4.58\text{x}10\text{Kg}$$

Estimating bitumen material:

$$L = \frac{(8.25)(0.0118)(0.37)(0.02)(1.79)}{98.6} \quad =1.31\text{x}10\text{Kg}$$

Estimating paint material:

$$L = \frac{(2.0)(0.0118)(0.\ 47)(6)(1.79)}{98.6} \quad =0.0012\text{Kg}$$

**DURING AND AFTER CONSTRUCTION POLLUTANT TRACES COMPARED**

It was obvious that more pollutants :( mica, bitumen and paint) were traced on the Experiment Sites during construction than after construction. Generalizing the comparison on the amount of each pollutant traced from the experiment sites may pose errors; rather, comparing from the sample locations and fifty grams standard sample weight per location was more determinative:

Therefore, each sample location on the Experiment Sites was compared separately. In the comparisons, the standard initial sample weight of fifty grams was used both during and after construction. The retained amounts of the pollutant were analyzed from each sample. In some areas the pollutants: mica, bitumen and paint were prominent, whereas in some areas, there was little or none at all. These were such that more pollutants were traced in the detention pond area than any other sample locations. These evident are depicted on the figures shown below.

**CARWASH CONSTRUCTION SITE(EXP.SITE-1)**

| Sample location | Sample weight(g) | Mica trace during construction(g) | Mica trace after construction(g) |
|---|---|---|---|
| Detention pond | 50 | 22 | 5 |
| Rip-Rap pad | 50 | 20 | 2 |
| Stream outfall | 50 | 0.8 | 0 |

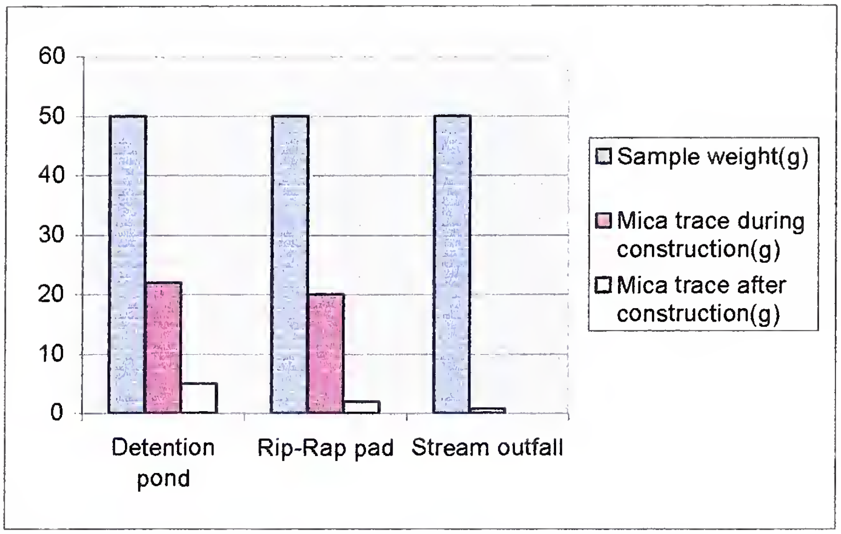



FIGURE:7 Graph showing Mica material traced on the Carwash construction site, During and After costruction compared

| Sample location | Sample weight(g) | Bitu. trace during construction(g) | Bitu. trace after construction(g) |
|---|---|---|---|
| Detention pond | 50 | 0.09 | 0 |
| Rip-Rap pad | 50 | 0.06 | 0 |
| Stream outfall | 50 | 0.02 | 0 |

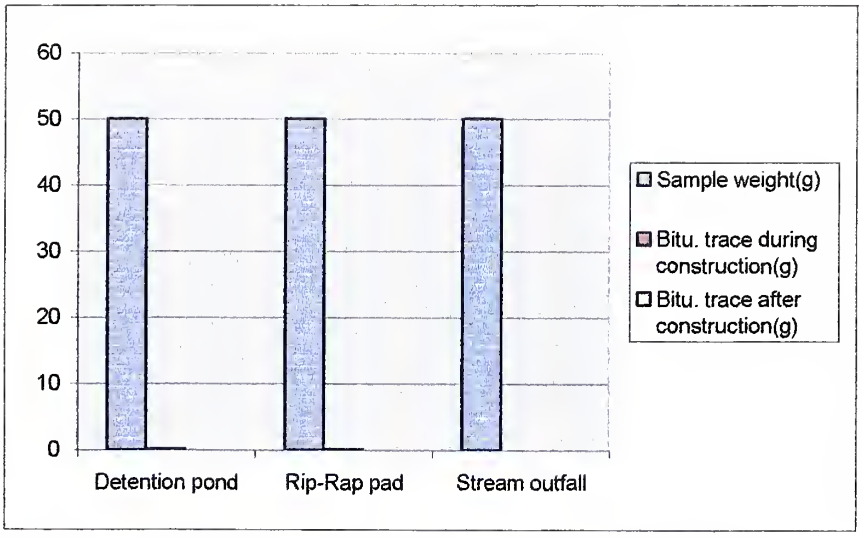



FIGURE:8 Graph showing Bitumen material traced on the Carwash construction site, During and After costruction compared

**INDUSTRIAL WAREHOUSE CONSTRUCTION SITE (EXP.SITE-2)**

| Sample location | Sample weight(g) | Mica trace during construction(g) | Mica. trace after construction(g) |
|---|---|---|---|
| Detention pond | 50 | 46 | 13 |
| Rip-Rap pad | 50 | 44 | 9 |
| Stream outfall | 50 | 24 | 2 |

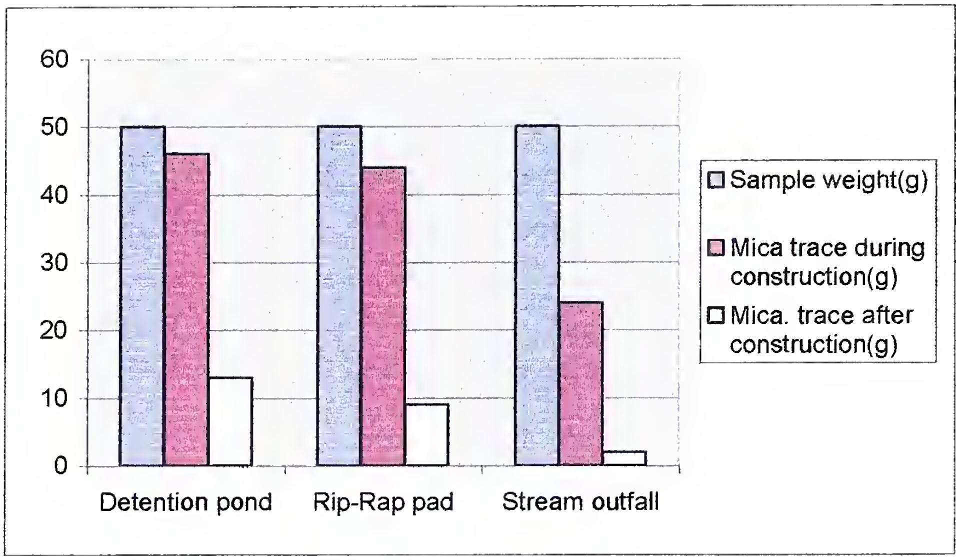



FIGURE:9 Graph showing Mica material traced on the Industrial Warehouse construction site, During and After costruction compared

| Sample location | Sample weight(g) | Bitu. trace during construction(g) | Bitu. trace after construction(g) |
|---|---|---|---|
| Detention pond | 50 | 0.85 | 0.23 |
| Rip-Rap pad | 50 | 0.67 | 0.1 |
| Stream outfall | 50 | 0.52 | 0 |

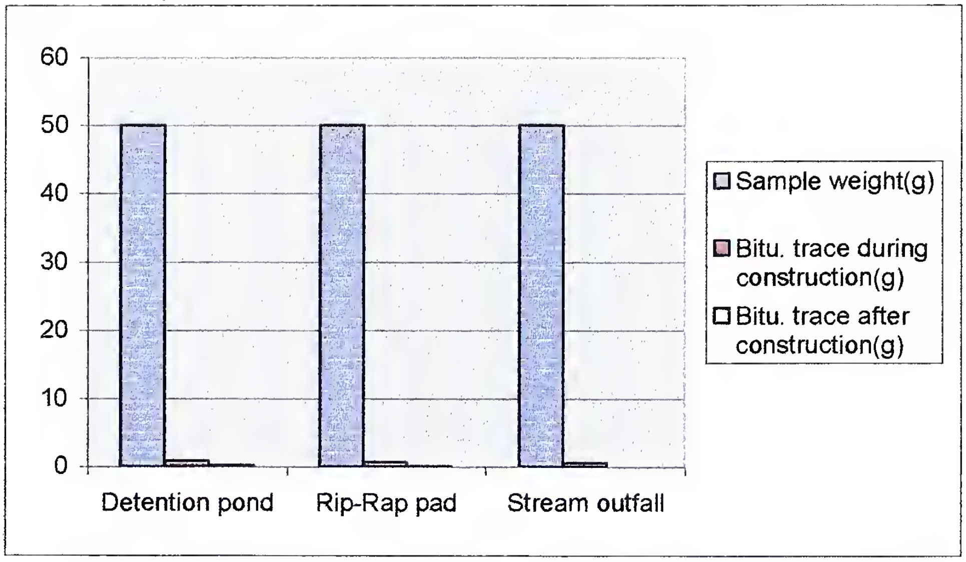



FIGURE:10 Graph showing Bitumen material traced on the Industrial Warehouse construction site, During and After costruction compared

**INDUSTRIAL WAREHOUSE CONSTRUCTION SITE (EXP.SITE-2)**

| Sample location | Sample weight(L) | Paint. trace during construction(mg) | Paint. trace after construction(mg) |
|---|---|---|---|
| Detention pond | 0.5 | 0.06 | 0.02 |
| Rip-Rap pad | 0.5 | 0.02 | 0 |
| Stream outfall | 0.5 | 0 | 0 |

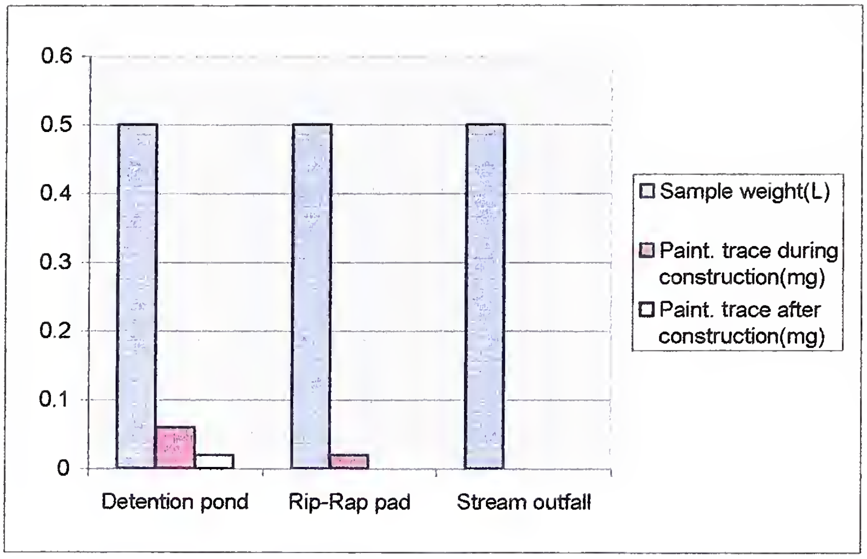



FIGURE:11 Graph showing Paint material traced on the Industrial Warehouse construction site, During and After costruction compared

**MIDDLE SCHOOL CONSTRUCTION SITE (EXP. SITE-3)**

| Sample location | Sample weight(g) | Mica trace during construction(g) | Mica trace after construction(g) |
|---|---|---|---|
| Detention pond | 50 | 33 | 27 |
| Rip-Rap pad | 50 | 32 | 19 |
| Stream outfall | 50 | 26 | 8 |

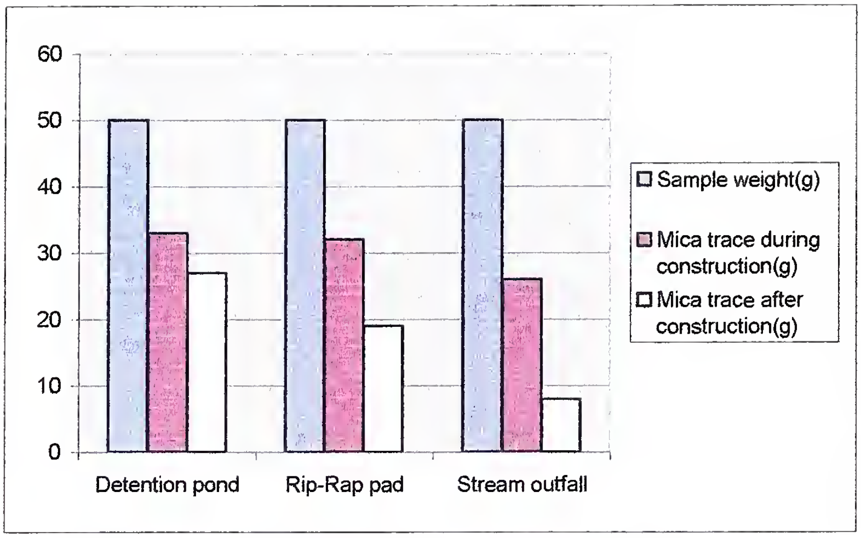



FIGURE: 12 Graph showing Mica material traced on the Middle School construction site, During and After costruction compared

| Sample location | Sample weight(g) | Bitu. trace during construction(g) | Bitu. trace af construction(g) |
|---|---|---|---|
| Detention pond | 50 | 1.69 | 0.7 |
| Rip-Rap pad | 50 | 1.71 | 0.3 |
| Stream outfall | 50 | 1.41 | 0.1 |

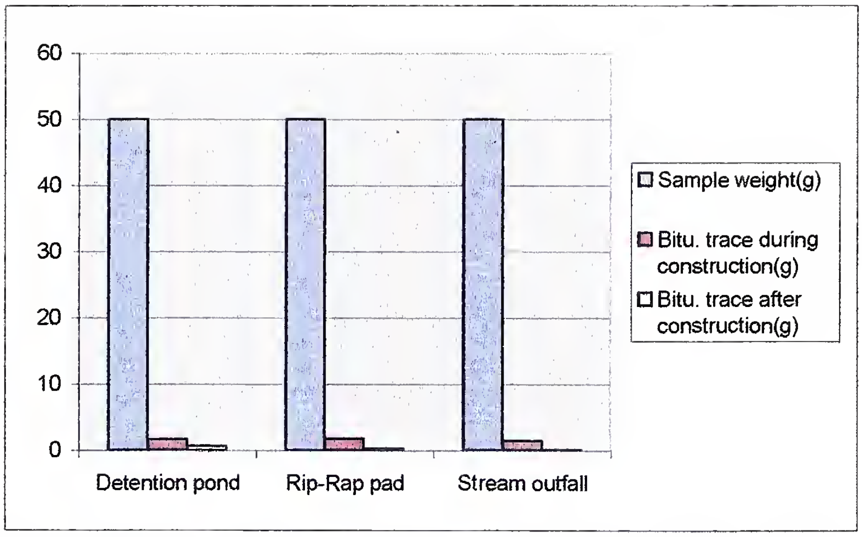



FIGURE: 13 Graph showing Bitumen material traced on the Middle School construction site, During and After costruction compared

**MIDDLE SCHOOL CONSTRUCTION SITE (EXP. SITE-3)**

| Sample location | Sample weight(L) | Paint trace during construction(mg) | Paint trace after construction(mg) |
|---|---|---|---|
| Detention pond | 0.5 | 0.14 | 0.1 |
| Rip-Rap pad | 0.5 | 0.08 | 0.03 |
| Stream outfall | 0.5 | 0.02 | 0.01 |

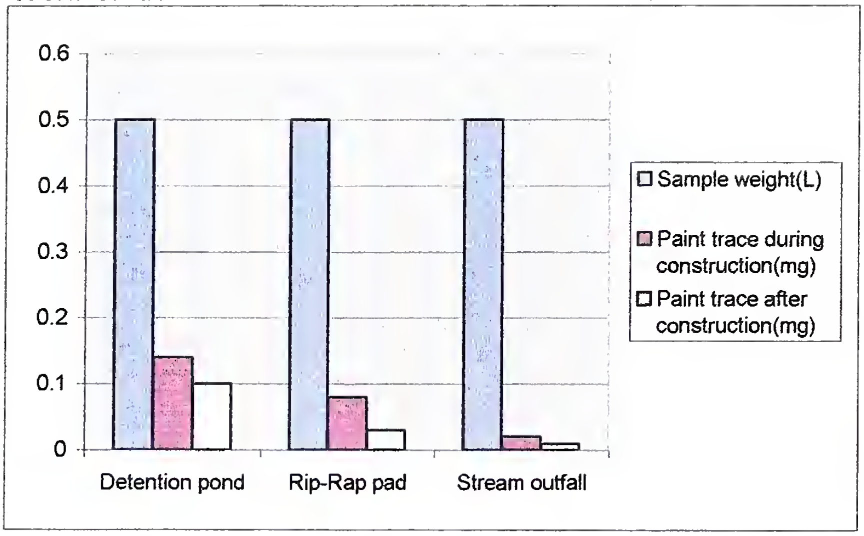



FIGURE:14 Graph showing Paint material traced on the Middle School construction site, During and After costruction compared

**BJ SHOPPING CENTER CONSTRUCTION SITE (EXP. SITE E-4)**

| Sample location | Sample weight(g) | Mica. trace during construction(g) | Mica. trace after construction(g) |
|---|---|---|---|
| Detention pond | 50 | 39 | 23 |
| Rip-Rap pad | 50 | 31 | 17 |
| Stream outfall | 50 | 26 | 6 |

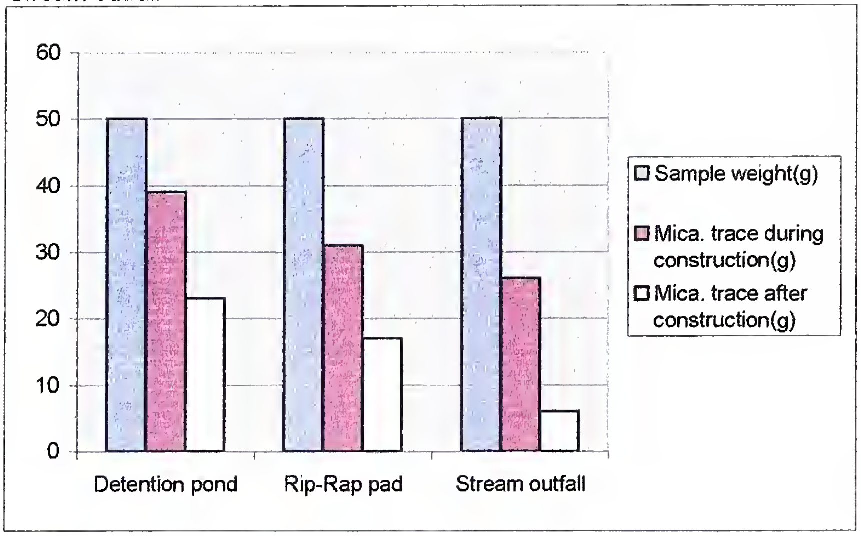



FIGURE:15 Graph showing Mica material traced on the BJ Shopping Center construction site, During and After costruction compared

| Sample location | Sample weight(g) | Bitu. trace during construction(g) | Bitu. trace after construction(g) |
|---|---|---|---|
| Detention pond | 50 | 1.92 | 0.9 |
| Rip-Rap pad | 50 | 1.67 | 0.5 |
| Stream outfall | 50 | 1.54 | 0 |

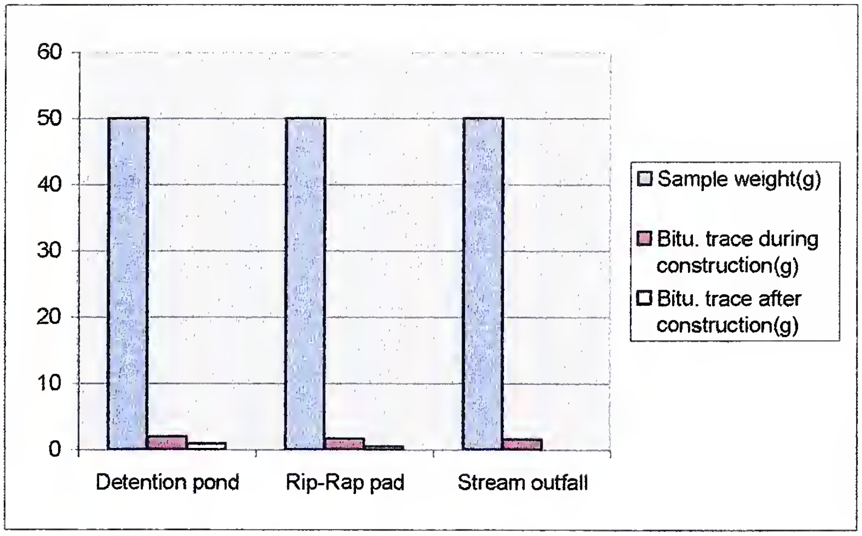



FIGURE:16 Graph showing Bitumen material traced on the BJ Shopping Center construction site, During and After costruction compared

**BJ SHOPPING CENTER CONSTRUCTION SITE (EXP. SITE E-4)**

| Sample location | Sample weight(L) | Paint. trace during construction(mg) | Paint. trace after construction(mg) |
|---|---|---|---|
| Detention pond | 0.5 | 0.04 | 0.15 |
| Rip-Rap pad | 0.5 | 0.02 | 0.01 |
| Stream outfall | 0.5 | 0 | 0 |

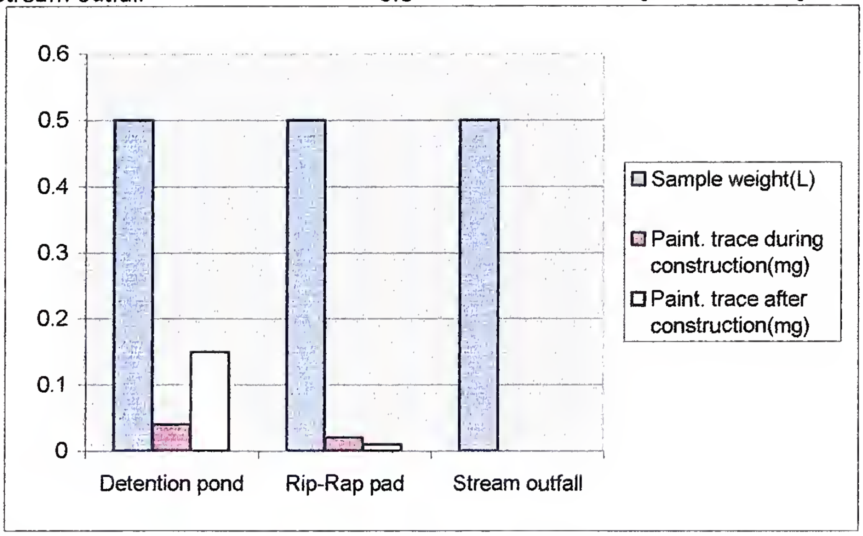



FIGURE:17 Graph showing Paint material traced on the BJ Shopping Center construction site, During and After costruction compared

**OFFICE BUILDING COMPLEX CONSTRUCTION SITE (EXP.SITE-5)**

| Sample location | Sample weight(g) | Mica. trace during construction(g) | Mica trace after construction(g) |
|---|---|---|---|
| Detention pond | 50 | 29 | 11 |
| Rip-Rap pad | 50 | 23 | 8 |
| Stream outfall | 50 | 16 | 2 |

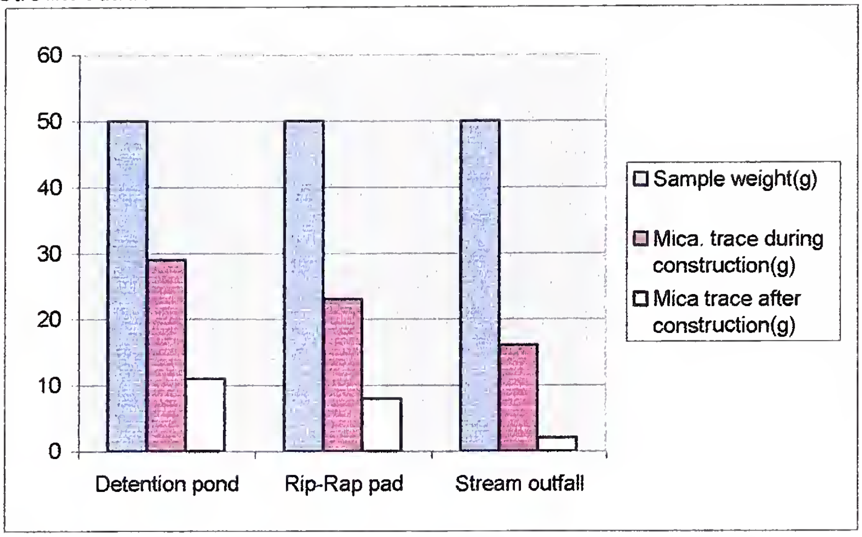



FIGURE: 18 Graph showing Mica material traced on the Office Building Complex construction site, During and After costruction compared

| Sample location | Sample weight(g) | Bitu. trace during construction(g) | Bitu. trace after construction(g) |
|---|---|---|---|
| Detention pond | 50 | 20 | 14 |
| Rip-Rap pad | 50 | 40 | 18 |
| Stream outfall | 50 | 20 | 5 |

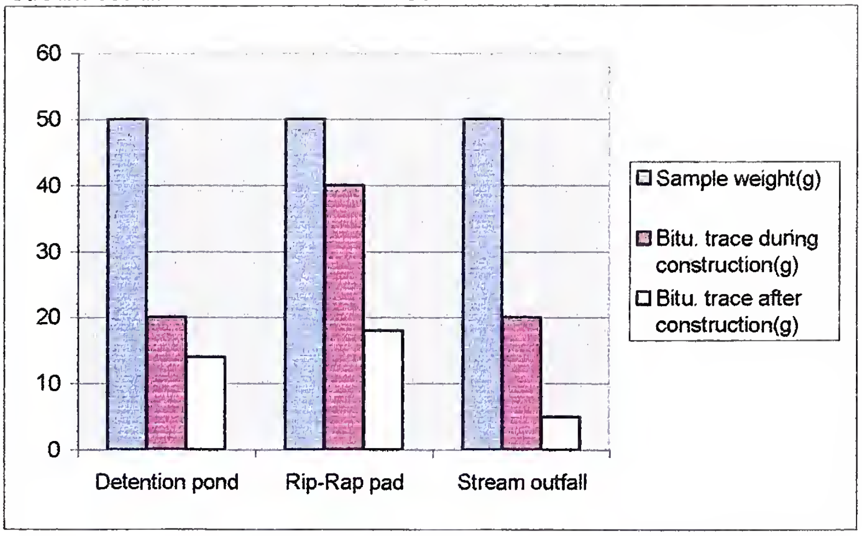



FIGURE: 19 Graph showing Bitumen material traced on the Office Building Complex construction site, During and After costruction compared

**OFFICE BUILDING COMPLEX CONSTRUCTION SITE (EXP.SITE-5)**

| Sample location | Sample weight(L) | Paint. trace during construction(mg) | Paint. trace after construction(mg) |
|---|---|---|---|
| Detention pond | 0.5 | 0.04 | 0.025 |
| Rip-Rap pad | 0.5 | 0.06 | 0.038 |
| Stream outfall | 0.5 | 0.02 | 0.03 |

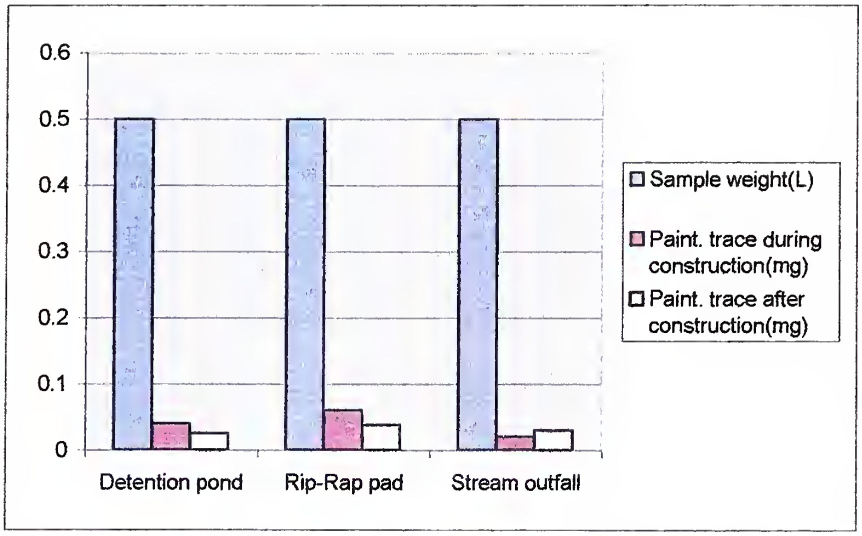



FIGURE:20 Graph showing Paint material traced on the Office Building Complex construction site, During and After costruction compared

# DISCUSSION AND RECOMMENDATIONS

## DISCUSSION

### DURING CONSTRUCTION

The result from the construction sites indicate integration of runoff processes and sedimentary pollution, which enhance the determination that:

- Sediments from construction sites were sources of pollution to watersheds.
- The (pollutants) mica, bitumen and paint were present in soil samples from the construction sites.
- The distribution and the migration pattern of pollutants diminish from the sources toward the stream outfall.

Clearly, developers are following the BMP recommendation and sedimentation control inspectors are doing their best to enforce the CWA laws, but these efforts still underscore the problem of sedimentation. Sedimentation is the key contributor to water quality problems. The separation of non-point pollution-control nomenclature on basis of urban and local, often classified construction sites as non-point source pollution. The EPA's SWMM presented on figure-5 shows a comprehensive approach to storm water management in watersheds that combine rural and urban land uses; therefore, making construction sites prominent point source of watershed pollution.

Evaluation and observation of results on the soil sample analysis show significant presence of the pollutants; mica, bitumen and paint. The estimated pollutant load of mica ranged from 4.58x10 kg at the experiment site-5 to 0.0002 kg at the experiment site-3. Calculations of average estimated pollutant load of bitumen ranged from

3.67x10 kg at the experiment site-2 to 0.0001 kg at the experiment site-1. The estimated pollutant load of paint was expressed in terms of soil weight contaminated with paint. The weight of contaminated soil ranged from 0.0012 kg at the experiment site-5 to 0.081 kg at the experiment site-3. The more elaborate expression of the presence of the pollutants; mica, bitumen and paint in the experiment sites are shown in the appendices. The tables show the amount of pollutant per sample location on the experiment site. Mica is shown on appendixes tables C-1 to C-5 and bitumen is on appendixes tables D-1 to D-5. Paint is shown on appendixes tables E-2 to E-5. The traced amounts of the construction material pollutants (bitumen, mica and paint) were very small. This could be due to the small sample size of fifty grams used.

Information about the sedimentary pollutants on the sites during construction show that little amounts of mica, bitumen and paint were traced per site. At certain sample locations none of these materials were traced. Surprisingly, some of the upstream sample locations had traces of mica. The trace of mica at these locations before outfall may be due to discharge of mica-containing substance upstream or genetic content of soils and rocks along the stream. This situation was encountered at Industrial warehouse and BJ shopping center construction sites. The distribution and migration pattern of pollutants diminish from the sources toward the stream outfall. The major concentration of the pollutants is higher at the detention pond sampling areas. These were expressed on During Construction Summary Log (see Appendixes Tables F-1, F-2, F-3, F-4 and F-5). The During Construction Summary Logs show comprehensive data of each experimental site.

## AFTER CONSTRUCTION

### GENERAL EXPERIMENT SITE CONDITION ONE YEAR LATER

The construction sites (experiment sites) one year later were all covered by vegetation. This is part two of the research study, which determines the presence of the pollutants-(bitumen, mica and paint) in and around construction sites one year later. Evidently, the vegetated terrain obscured traces of the pollutants on the sites, but the only possible means of tracing the pollutant would be sampling soils from the vadose zone; therefore, a guideline addressing collection of soil sample from the vadose zone is the soil boring-process. (See Appendixes tables G-1, G-2, G-3, G-4 and G-5).

### SURFACE SITE CONDITIONS

All the construction experiment sites were sampled at the same locations as during the construction; except at fifty feet upstream and fifty downstream. It was determined to sample locations where accumulations of pollutants were possible; thus, detention pond, rip-rap splash and stream outfall were bore tested. Surprisingly, most of the detention ponds were wet ponds with live fishe, while rip-rap areas and outfalls were covered by vegetation.

### SUBSURFACE CONDITIONS

The subsurface conditions were explored at all the five sites. The sampler was extended to depth of ten inches at each test location below ground surface. The subsurface materials encountered were classified using the Unified Soil Classification System (USCS) as guide. Boring logs which detailed the subsurface conditions encountered at each sample location were expressed for all the construction experiment sites. However, a brief review of the typical subsurface material encountered at the sites fall under three major layers: the alluvium, residuum and ground water. The alluvium is classified as clayey sand with dynamic cone penetrometer results of one to eight blows per foot (bpf) the residual soils are classified as silty sand and sandy silt with (bpf) value between fifteen and thirty-five. Finally, the ground water layer is indicated by cave-ins, signifying the ground water level. Ground water level usually occurs at the sample locations with wet detention ponds and the stream outfall locations.

OBSERVATIONS ONE YEAR LATER

- The (pollutants) mica, bitumen and paint on construction sites, that were identified at the watersheds during construction were still present one year later.
- Some sampling location retained more pollutants than the others did. The pattern of retention diminishes from the detention pond areas toward the stream outfalls, as during the construction.
- Microscopic observations of soil samples revealed that bitumen adheres to larger soil particles; therefore, making the pollutant more permanent on the sites
- Additionally, microscopic observations of the soil samples show tinny particles, that are not soil particles, but colorless polymer-like-material. The observer suspected the material to be paint residue that was once colored pigments.
- Abundant traces of mica on both during and after construction suggests that, the pollutant could be part of the genetic make-up of the native soils.

## CONCLUSIONS AND RECOMMANDATIONS

Observations show that there were traces of bitumen, mica and paint in the soil samples at limited proportions as during construction. Some locations sampled recorded no presence of the pollutants. However, there was significant presence of mica in all the sample locations and the physical appearance of soil samples intend to blend-in with natural environment, concealing the actual make-up of the samples. Microscopic observations of the samples revealed that bitumen tend to adhere to larger sizes of soil aggregates. The colored paint pigments once observed during construction were not noticeable one year later; however, there were tinny particles among soil samples which were not soil grains when observed under microscopes. These thinny particles were suspected to be paint materials.

It was judged on the part of the observer to limit the extent these sedimentary construction pollutants (bitumen, mica and paint) would be traced from the construction sites. This was because taking samples from upstream and downstream might invalidate results of this study due to contamination from other sources. Therefore, the traces of the sedimentary pollutants in and around construction sites (experiment sites) were limited to the stream outfall—one year later. A year later, the concentration of sedimentary pollutants diminishes towards the stream outfall; the same pattern of concentration was noticed during the construction phase of the study.

The Georgia Department of Transportation (GDOT) methods and the American Society for Testing and Material (ASTM) methods used in this research enhanced the technical aspects, procedures and perhaps, a recommendable standard for conducting this sort of study. The methods of the research may be adopted by other researchers if the experiment sites criteria are unchanged, but careful review of regulations associated with discharge of storm water into state waters are recommended.

This research provides a method for quantifying the effect of sedimentary pollution in watersheds and evaluating sediment materials produced during and after construction on construction sites. The research documented erosion sources, amount of sediment concentration in runoff and depositions, which could help to map out solutions to the sedimentation problems. Knowledge from this research may be applicable in designing pollution prevention systems and baseline information on the sedimentary pollutants analysis in similar research. The results from this experiment may be an adoptable module for other researchers, because of the applicable current changing regulations on storm water discharge associated with construction activities.

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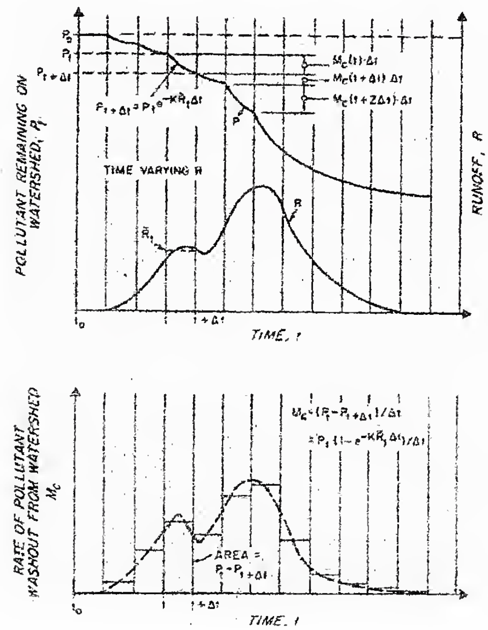
## APPENDIX-A

Development of Pollutograph (Mc versus t) from time history of Pt

Mc= Rate of Pollutant washoff from a Watershed
T = Time
Pt = Pollutant Remaining on Watershed




where

A soil loss per unit area, tons/acre/time step;
R rainfall factor;
K soil erodibility factor;
L slope length gradient ratio;
C cropping management factor;
P erosion control practice factor.

R, in turn, is given by

$$R = EI = \sum_i [(9.16 + 3.31 \log X_i)D_i] I$$

where

E rainfall energy, hundreds of foot-tons/acre;
i rainfall hyetograph interval;
$X_i$ rainfall intensity during time interval;
$D_i$ inches of rainfall during the time interval;
I the maximum average 30-min intensity of rainfall.

Figure 21: Showing Pollutograph (Mc versus Time) Appendix-A
Source: Highway Hydrology (No.13067)

Pollutograph is actually the Time- Pollutant concentration relationship (Mc versus T), and could be expanded to express an entire time history of pollutants (Pt) in a watershed. Additionally, the pollutograph expresses pollutant remaining on watershed over time relative to runoff. Development of a pollutograph is beyond the scope of this research study; however, it is good to know that such a model could be developed from Storm Water Management Model SWMM.

## TABLE:B-1

**Testing for pulverization of soil mortar**
**Method Number used: GDT-51**
**Description: Method of test for determi**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT Wt |
|---|---|---|
| TOP SOIL STOCKPILE | DARK HUMUS SOIL WITH ORGANIC MATERIALS | 50 GRA |
| PROPOSED LOCATION FOR DETENTION POND | REDISH-BROWN CLAY LOAM SOIL WITH ORGANIC MATERIALS | 50 GRA |
| 50-FEET UPSTREAM FROM THE SITE | DARK SANDY LOAM SOIL | 50 GRA |
| OUTFALL TO THE STREAM | **NOTE:** Outfall **location** | |
| 50-FEET DOWNSTREAM FROM THE SITE | DARK BROWN SANDY- CLAY SOIL WITH ORGANIC MATERIALS | 50 GRA |

The percentage of unpulverized soil

Percent passing = 100 – (Wr/W

Where:

Wr = Weight retained on sie
Wt = Weight of total sample

## APPENDIX-B

### TABLE:B-1

**Testing for pulverization of soil mortar at the Carwash construction site project (EXP. SITE-1)**
**Method Number used: GDT-51**
**Description: Method of test for determining pulverization of soil mortar**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT Wt | SAMPLE RETAINED 5/16" SIEVE %Wr 1 | SAMPLE RETAINED #4 SIEVE %Wr 2 | SAMPLE RETAINED #10 SIEVE %Wr 3 | PERCENTAGE CUMMULATION %Wr1+Wr2+Wr3 |
|---|---|---|---|---|---|---|
| TOP SOIL STOCKPILE | DARK HUMUS SOIL WITH ORGANIC MATERIALS | 50 GRAMS | 3.68 | 63.01 | 1.62 | 68.31 |
| PROPOSED LOCATION FOR DETENTION POND | REDISH-BROWN CLAY LOAM SOIL WITH ORGANIC MATERIALS | 50 GRAMS | 54.92 | 15.71 | 0.05 | 70.68 |
| 50-FEET UPSTREAM FROM THE SITE | DARK SANDY LOAM SOIL | 50 GRAMS | 1.20 | 8.76 | 0.00 | 9.96 |
| OUTFALL TO THE STREAM | **NOTE:** Outfall **location was not determined yet on the site** | | | | | |
| 50-FEET DOWNSTREAM FROM THE SITE | DARK BROWN SANDY- CLAY SOIL WITH ORGANIC MATERIALS | 50 GRAMS | 1.87 | 22.32 | 24.75 | 48.94 |

The percentage of unpulverized soil was calculated as follows:

Percent passing = 100 – (Wr/Wt×100)

Where:
Wr = Weight retained on sieve
Wt = Weight of total sample

**TABLE: B-2**

**Testing for pulverization of soil**
**project (EXP. SITE-2)**
**Method Number used: GDT-51**
**Description: Method of test for**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMP WEIG Wt |
|---|---|---|
| TOP SOIL STOCKPILE | DARK CLAY LOAM SOIL WITH SOME ORGANIC MAT'L | 50 GR |
| PROPOSED LOCATION FOR DETENTION POND | RED SILTY CLAY SOIL, EXTREMELY COHESIVE AT OVEN DRY | 50 GR |
| 50-FEET UPSTREAM FROM THE SITE | SANDY LOAM SOIL WITH SMALL GRAVELS AND ORGANIC MAT'L | 50 GR |
| OUTFALL TO THE STREAM | SANDY-CLAY SOIL WITH ORGANIC MAT'L | 50 GR |
| 50-FEET DOWN STREAM FROM THE SITE | SANDY-CLAY SOIL WITH SMALL GRAVLS AND ORGANIC MAT'L | 50 GR |

**TABLE: B-2**

**Testing for pulverization of soil mortar Industrial warehouse construction site project (EXP. SITE-2)**
**Method Number used: GDT-51**
**Description: Method of test for determining pulverization of soil mortar**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT Wt | SAMPLE RETAINRD 5/16" SIEVE %Wr 1 | SAMPLE RETAINRD #4 SIEVE %Wr 2 | SAMPLE RETAINED #10 SIEVE %Wr 3 | PERCENTAGE CUMMULATION %Wr1+Wr2+Wr3 |
|---|---|---|---|---|---|---|
| TOP SOIL STOCKPILE | DARK CLAY LOAM SOIL WITH SOME ORGANIC MAT'L | 50 GRAMS | 51.07 | 25.53 | 0.03 | 76.63 |
| PROPOSED LOCATION FOR DETENTION POND | RED SILTY CLAY SOIL, EXTREMELY COHESIVE AT OVEN DRY | 50 GRAMS | 3.67 | 5.33 | 1.99 | 10.99 |
| 50-FEET UPSTREAM FROM THE SITE | SANDY LOAM SOIL WITH SMALL GRAVELS AND ORGANIC MAT'L | 50 GRAMS | 0.001 | 43.40 | 6.19 | 49.60 |
| OUTFALL TO THE STREAM | SANDY-CLAY SOIL WITH ORGANIC MAT'L | 50 GRAMS | 6.80 | 25.00 | 18.20 | 50.10 |
| 50-FEET DOWN STREAM FROM THE SITE | SANDY-CLAY SOIL WITH SMALL GRAVLS AND ORGANIC MAT'L | 50 GRAMS | 4.70 | 28.5 | 23.8 | 57.00 |

The percentage of unpulverized v

Percent passing = 100 – (Wr/W

Where:

Wr = Weight retained on

Wr = Weight of total sam

The percentage of unpulverized was calculated as follows:

$$\text{Percent passing} = 100 - (Wr/Wt \times 100)$$

Where:

Wr = Weight retained on sieve
Wr = Weight of total sample

**TABLE:B-3**

**Testing for pulverization of soil moı**
**(EXP.SITE-3)**
**Method Number used: GDT-51**
**Description: Method of test for dete**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT Wt | SAMI RETA 5/16" %V |
|---|---|---|---|
| TOP SOIL STOCKPILE | DARK -BROWN SOIL,WITH LOT OF ORGANIC MAT'L | 50 GRAMS | 70.4 |
| PROPOSED LOCATION FOR DETENTION POND | MUDDY SILTY CLAY WITH SAND AND ORGANIC MAT'L | 50 GRAMS | 57.9 |
| 50 FEET UPSTREAM FROM THE SITE | GRAY SANDY CLAY SOIL LOOKS LESS COHESIVE AT OVEN DRY | 50 GRAMS | 1.54 |
| STREAM OUTFALL | SANDY CLAY WITH SOME ORGANIC MAT'L | 50 GRAMS | 2.8( |
| 50 FEET DOWNSTRAM FROM THE SITE | SANDY CLAY SOIL WITH ORGANIC DEPOSITS | 50 GRAMS | 2.5( |

The percentage of unpulverized soil v

Percent passing = 100 – (Wr/Wt

Where:

Wr = Weight retained on sieve
Wt = Weight of total sample

**TABLE:B-3**

**Testing for pulverization of soil mortar at middle school construction site project (EXP.SITE-3)**
**Method Number used: GDT-51**
**Description: Method of test for determining pulverization of soil mortar**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT Wt | SAMPLE RETAINED 5/16" SIEVE %Wr 1 | SAMPLE RETAINED #4 SIEVE %Wr 2 | SAMPLE RETAINED #10 SIEVE %Wr 3 | PERCENTAGE CUMMULATION %Wr1+Wr2+Wr3 |
|---|---|---|---|---|---|---|
| TOP SOIL STOCKPILE | DARK -BROWN SOIL,WITH LOT OF ORGANIC MAT'L | 50 GRAMS | 70.4 | 17.2 | 0.40 | 88.0 |
| PROPOSED LOCATION FOR DETENTION POND | MUDDY SILTY CLAY WITH SAND AND ORGANIC MAT'L | 50 GRAMS | 57.9 | 31.4 | 3.4 | 92.6 |
| 50 FEET UPSTREAM FROM THE SITE | GRAY SANDY CLAY SOIL LOOKS LESS COHESIVE AT OVEN DRY | 50 GRAMS | 1.54 | 4.92 | 45.2 | 51.7 |
| STREAM OUTFALL | SANDY CLAY WITH SOME ORGANIC MAT'L | 50 GRAMS | 2.80 | 5.20 | 43.5 | 51.5 |
| 50 FEET DOWNSTRAM FROM THE SITE | SANDY CLAY SOIL WITH ORGANIC DEPOSITS | 50 GRAMS | 2.50 | 3.7 | 45.7 | 51.9 |

The percentage of unpulverized soil was calculated as follows:

$$\text{Percent passing} = 100 - (Wr/Wt \times 100)$$

Where:

Wr = Weight retained on sieve
Wt = Weight of total sample

**TABLE: B-4**

**Testing for pulverization of soil morta**
**project (EXP.SITE4)**
**Method Number used: GDT-51**
**Description: Method of test for detern**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT Wt | SAMPL RETAIN 5/16" SI %Wr |
|---|---|---|---|
| TOP SOIL STOCKPILE | DARK HUMUS SOIL, FULL OF ORGANIC MAT'L | 50 GRAMS | 2.54 |
| PROPOSED LOCATION FOR DETENTION POND | **NOTE: detention pond location** | | |
| 50 FEET UPSTREAM FROM THE SITE | BROWN SANDY CLAY SOIL WITH ORGANIC MAT'L | 50 GRAMS | 1.30 |
| STREAM OUTFALL | **NOTE: Stream outfall location** | | |
| 50 FEET DOWNSTRAM FROM THE SITE | CLEAR SANDY SOIL WITH SMALL ROCK DEPOSITS | 50 GRAMS | 15.4 |

The percentage of unpulverized soil wa

Percent passing = 100 – (Wr/Wt×

Where:

Wr = Weight retained on sieve
Wt = Weight of total sample

**TABLE: B-4**

**Testing for pulverization of soil mortar at BJ Shopping center construction site project (EXP.SITE4)**
**Method Number used: GDT-51**
**Description: Method of test for determining pulverization of soil mortar**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT Wt | SAMPLE RETAINED 5/16" SIEVE %Wr 1 | SAMPLE RETAINED #4 SIEVE %Wr 2 | SAMPLE RETAINED #10 SIEVE %Wr 3 | PERCENTAGE CUMMULATION %Wr1+Wr2+Wr3 |
|---|---|---|---|---|---|---|
| TOP SOIL STOCKPILE | DARK HUMUS SOIL, FULL OF ORGANIC MAT'L | 50 GRAMS | 2.54 | 1.57 | 0.08 | 4.19 |
| PROPOSED LOCATION FOR DETENTION POND | **NOTE: detention pond location not yet determined on the site** | | | | | |
| 50 FEET UPSTREAM FROM THE SITE | BROWN SANDY CLAY SOIL WITH ORGANIC MAT'L | 50 GRAMS | 1.30 | 25.6 | 23.9 | 50.8 |
| STREAM OUTFALL | **NOTE: Stream outfall location not determined on the site** | | | | | |
| 50 FEET DOWNSTRAM FROM THE SITE | CLEAR SANDY SOIL WITH SMALL ROCK DEPOSITS | 50 GRAMS | 15.4 | 70.2 | 4.5 | 90.1 |

The percentage of unpulverized soil was calculated as follows:

Percent passing = 100 – (Wr/Wt×100)

Where:

Wr = Weight retained on sieve
Wt = Weight of total sample

**TABLE: B-5**

**Testing for pulverization of soil mortar**
**project (EXP.SITE-5)**
**Method Number used: GDT-51**
**Description: Method of test for determi**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT Wt | SAMPLE RETAINEI 5/16" SIEV %Wr 1 |
|---|---|---|---|
| TOP SOIL STOCKPILE | DARK –GRAY CLAY SOIL,WITH ORGANIC MAT'LS | 50 GRAMS | 63.4 |
| PROPOSED LOCATION FOR DETENTION POND | DARK-RED CLAY SOIL IN CLUMPS WITH ORGANIC MAT'LS | 50 GRAMS | 57.8 |
| 50 FEET UPSTREAM FROM THE SITE | BROWN SANDY CLAY SOIL WITH SMALL GRAVELS AND ORGANIIC MAT'LS | 50 GRAMS | 9.6 |
| STREAM OUTFALL | BROWN SANDY CLAY SOIL WITH SMALL GRAVEL AND ORGANIC MAT'LS | 50 GRAMS | 5.7 |
| 50 FEET DOWNSTRAM FROM THE SITE | DARK BROWN SANDY CLAY SOIL WITH ORGANIC MAT'LS | 50 GRAMS | 10.3 |

The percentage of unpulverized soil was c

Percent passing = 100 – (Wr/Wt×10

Where:

Wr = Weight retained on sieve
Wt = Weight of total sample

**TABLE: B-5**

**Testing for pulverization of soil mortar at Office building complex construction site project (EXP.SITE-5)**

**Method Number used: GDT-51**

**Description: Method of test for determining pulverization of soil mortar**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT Wt | SAMPLE RETAINED 5/16" SIEVE %Wr 1 | SAMPLE RETAINED #4 SIEVE %Wr 2 | SAMPLE RETAINED #10 SIEVE %Wr 3 | PERCENTAGE CUMMULATION %Wr1+Wr2+Wr3 |
|---|---|---|---|---|---|---|
| TOP SOIL STOCKPILE | DARK –GRAY CLAY SOIL,WITH ORGANIC MAT'LS | 50 GRAMS | 63.4 | 17.2 | 3.5 | 84.1 |
| PROPOSED LOCATION FOR DETENTION POND | DARK-RED CLAY SOIL IN CLUMPS WITH ORGANIC MAT'LS | 50 GRAMS | 57.8 | 30.0 | 1.3 | 89.1 |
| 50 FEET UPSTREAM FROM THE SITE | BROWN SANDY CLAY SOIL WITH SMALL GRAVELS AND ORGANIIC MAT'LS | 50 GRAMS | 9.6 | 15.4 | 25.5 | 50.5 |
| STREAM OUTFALL | BROWN SANDY CLAY SOIL WITH SMALL GRAVEL AND ORGANIC MAT'LS | 50 GRAMS | 5.7 | 19.8 | 23.1 | 48.5 |
| 50 FEET DOWNSTRAM FROM THE SITE | DARK BROWN SANDY CLAY SOIL WITH ORGANIC MAT'LS | 50 GRAMS | 10.3 | 21.4 | 25.2 | 56.9 |

The percentage of unpulverized soil was calculated as follows:

$$\text{Percent passing} = 100 - (Wr/Wt \times 100)$$

Where:

Wr = Weight retained on sieve
Wt = Weight of total sample

## APP

### TABLE:C-1

**Testing for trace of Cement material (Mi**
**Method Number used: GDT-76**
**Description: Method of test for Mica con**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W 1 | FILTE PAPEI WEIG W 2 |
|---|---|---|---|
| RETROFIT/ DETENTION POND | REDISH-BROWN SANDY CLAY SOIL SUSPECT OF HAVING CEMENT MATERIALS | 50- GRAMS | 8. 0 GRAN |
| RIP-RAP SPLASH PAD | REDISH-BROWN SILTY SANDY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING CEMENT.MAT'L | 50- GRAMS | 8 .1 GRAN |
| STREAM OUTFAL | REDISH-BROWN SANDY CLAY SOIL, SUSPECT OF HAVING CEMENT MAT'L/ ORGANIC MAT'L | 50- GRAMS | 7. 9 GRAN |
| 50- FEET UPSTREAM FROM OUTFALL | BROWN SANDY CLAY SOIL WITH ORGANIC MAT'L | 50- GRAMS | 8. 0 GRAN |
| 50- FEET DOWNSTREAM FROM OUTFALL | GRAY SANDY CLAY SOIL, SUSPECT OF HAVING CEMENT MAT'L | 50- GRAMS | 8 .3 GRAN |

$W_3 - W_2/W_1 \times 100$ = % HEAVY M

$W_5 - W_4/W_1 \times 100$ = % LIGHT MA

**Note: % heavy material reflects t**

## APPENDIX-C

### TABLE:C-1

**Testing for trace of Cement material (Mica) at Carwash construction site project (EXP. SITE-1)**
**Method Number used: GDT-76**
**Description: Method of test for Mica content of fine aggregate**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W 1 | FILTER PAPER WEIGHT W 2 | FILTER PAPER + HEAVY MAT'L W 3 | FILTER PAPER WEIGHT W 4 | FILTER PAPER + LIGHT MAT'L W 5 | HEAVY MAT'L | LIGHT MAT'L | % HEAVY MAT'L | % LIGHT MAT'L |
|---|---|---|---|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | REDISH-BROWN SANDY CLAY SOIL SUSPECT OF HAVING CEMENT MATERIALS | 50- GRAMS | 8. 0 GRAMS | 9. 08 GRAMS | 8 .2 GRAMS | 8 .25 GRAMS | 0. 022 GRAMS | 0. 001 GRAMS | 2 .2 | 0. 1 |
| RIP-RAP SPLASH PAD | REDISH-BROWN SILTY SANDY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING CEMENT.MAT'L | 50- GRAMS | 8 .1 GRAMS | 9 .12 GRAMS | 8 .0 GRAMS | 8 .02 GRAMS | 0 .020 GRAMS | 0 .0004 | 2 .0 | 0 .04 |
| STREAM OUTFAL | REDISH-BROWN SANDY CLAY SOIL, SUSPECT OF HAVING CEMENT MAT'L/ ORGANIC MAT'L | 50- GRAMS | 7. 9 GRAMS | 8 .3 GRAMS | 8. 0 GRAMS | 8 .01 GRAMS | 0 .0008 GRAMS | 0. 0002 | 0. 08 | 0 .02 |
| 50- FEET UPSTREAM FROM OUTFALL | BROWN SANDY CLAY SOIL WITH ORGANIC MAT'L | 50- GRAMS | 8. 0 GRAMS | 8 .003 GRAMS | 8. 2 GRAMS | 8. 2002 GRAMS | 0.00 | 0.00 | 0. 00 | 0. 00 |
| 50- FEET DOWNSTREAM FROM OUTFALL | GRAY SANDY CLAY SOIL, SUSPECT OF HAVING CEMENT MAT'L | 50- GRAMS | 8 .3 GRAMS | 8 .31 GRAMS | 8. 0 GRAMS | 8 .005 GRAMS | 0 .00 | 0 .00 | 0. 00 | 0. 00 |

$W_3 - W_2/W_1 \times 100$ = % HEAVY MATERIAL **(specific gravity > 2.8)**

$W_5 - W_4/W_1 \times 100$ = % LIGHT MATERIAL **(specific gravity < 2.8)**

**Note: % heavy material reflects the Mica content.**

**TABLE:C-2**

**Testing for trace of Cement materi site project (EXP. SITE-2)**
**Method Number used: GDT-76**
**Description: Method of test for Mi**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W 1 | FILT PAP WEI W |
|---|---|---|---|
| RETROFIT/ DETENTION POND | MUDDY GRAY SILTY- CLAY WITH ORGANIC MAT'L, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8.5 GRA |
| RIP-RAP SPLASH PAD | DARK BROWN CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8.3 GRA |
| STREAM OUTFALL | BROWN SANDY- CLAY, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8.0 GRA |
| 50 FEET UPSTREAM FROM OUTFALL | GRAY SANDY-CLAY WITH WHITE PERBLES AND ORGANIC MAT'L | 50 GRAMS | 8.1 GR |
| 50 FEET DOWNSTREAM FROM OUTFALL | LIGHT BROWN SANDY-CLAY WITH WHITE PERBLES AND ORGANIC MAT'L | 50 GRAMS | 8.1 GR |

$W_3 - W_2/W_1 \times 100$ = HEAVY MATI

$W_5 - W_4/W_1 \times 100$ = LIGHT MATE

**Note: % heavy material reflect th**

**TABLE:C-2**

**Testing for trace of Cement material (Mica) at Industrial warehouse construction site project (EXP. SITE-2)**
**Method Number used: GDT-76**
**Description: Method of test for Mica content of fine aggregate**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W I | FILTER PAPER WEIGHT W 2 | FILTER PAPER + HEAVY MAT'L W 3 | FILTER PAPER WEIGHT W 4 | FILTER PAPER + LIGHT MAT'L W 4 | HEAVY MAT'L | LIGHT MAT'L | % HEAVY MAT'L | % LIGHT MAT'L |
|---|---|---|---|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | MUDDY GRAY SILTY-CLAY WITH ORGANIC MAT'L, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8.5 GRAMS | 10.80 GRAMS | 8.20 GRAMS | 10.10 GRAMS | 0.046 GRAM | 0.038 GRAM | 5 | 4 |
| RIP-RAP SPLASH PAD | DARK BROWN CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8.3 GRAMS | 10.50 GRAMS | 7.90 GRAMS | 8.79 GRAMS | 0.044 GRAM | 0.18 GRAM | 4 | 2 |
| STREAM OUTFALL | BROWN SANDY-CLAY, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8.0 GRAMS | 9.20 GRAMS | 8.30 GRAMS | 11.00 GRAMS | 0.024 | 0.0005 | 2 | 0.5 |
| 50 FEET UPSTREAM FROM OUTFALL | GRAY SANDY-CLAY WITH WHITE PERBLES AND ORGANIC MAT'L | 50 GRAMS | 8.1 GRAMS | 8.14 GRAMS | 8.0 GRAMS | 8.01 GRAMS | 0.0008 | 0.0002 | 0.08 | 0.02 |
| 50 FEET DOWNSTREAM FROM OUTFALL | LIGHT BROWN SANDY-CLAY WITH WHITE PERBLES AND ORGANIC MAT'L | 50 GRAMS | 8.1 GRAMS | 8.17 GRAMS | 8.0 GRAMS | 8.05 GRAMS | 0.001 | 0.00 | 0.01 | 0.00 |

$W_3 - W_2/W_1 \times 100$ = HEAVY MATERIAL **(specific gravity $> 2.8$)**

$W_5 - W_4/W_1 \times 100$ = LIGHT MATERIAL **(specific gravity $< 2.8$)**

**Note: % heavy material reflect the Mica content.**

**TABLE:C-3**

**Testing for trace of Cement materi**
**project (EXP. SITE-3)**
**Method Number used: GDT-76**
**Description: Method of test for Mi**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W 1 | FILTI PAPE WEIC W |
|---|---|---|---|
| RETROFIT/ DETENTION POND | GRAY SILTY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8..2 GRA |
| RIP-RAP SPLASH PAD | MUDDY BROWN SILTY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8..5 GRA |
| STREAM OUTFALL | BROWN SANDY-CLAY SOIL,WITH ORGANIC MAT'L SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8..3 GRA |
| 50 FEET UPSTREAM FROM OUTFALL | SANDY LOAM SOIL WITH ORGANIC MAT'L | 50 GRAMS | 8..0 GR |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY-CLAY AND ORGANIC MAT'L | 50 GRAMS | 8.1 GR |

$W_3 - W_2/W_1 \times 100$ = HEAVY MAT

$W_5 - W_4/W_1 \times 100$ = LIGHT MATE

**Note: % heavy material reflect th**

**TABLE:C-3**

**Testing for trace of Cement material (Mica) at Middle school construction site project (EXP. SITE-3)**
**Method Number used: GDT-76**
**Description: Method of test for Mica content of fine aggregate**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W 1 | FILTER PAPER WEIGHT W 2 | FILTER PAPER + HEAVY MAT'L W 3 | FILTER PAPER WEIGHT W 4 | FILTER PAPER + LIGHT MAT'L W 4 | HEAVY MAT'L | LIGHT MAT'L | % HEAVY MAT'L | % LIGHT MAT'L |
|---|---|---|---|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | GRAY SILTY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8..2 GRAMS | 9..85 GRAMS | 8.3 GRAMS | 9.08 GRAMS | 0.033 GRAM | 0.016 GRAM | 0.07 | 0.03 |
| RIP-RAP SPLASH PAD | MUDDY BROWN SILTY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8..5 GRAMS | 10..09 GRAMS | 8.0 GRAMS | 8.53 GRAMS | 0.032 GRAM | 0.011 GRAM | 0.06 | 0.02 |
| STREAM OUTFALL | BROWN SANDY-CLAY SOIL,WITH ORGANIC MAT'L SUSPECT OF HAVING CONCRETE MAT'L | 50 GRAMS | 8..3 GRAMS | 9.58 GRAMS | 8..2 GRAMS | 8.69 GRAMS | 0.026 | 0.0009 | 0.05 | 0.00 |
| 50 FEET UPSTREAM FROM OUTFALL | SANDY LOAM SOIL WITH ORGANIC MAT'L | 50 GRAMS | 8..0 GRAMS | 8.08 GRAMS | 8.0 GRAMS | 8.03 GRAMS | 0.0001 | 0.0005 | 0.00 | 0.00 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY-CLAY AND ORGANIC MAT'L | 50 GRAMS | 8.1 GRAMS | 8..61 GRAMS | 8.3 GRAMS | 8.64 GRAMS | 0.01 | 0.00 | 0.00 | 0.00 |

$W_3 - W_2/W_1 \times 100$ = HEAVY MATERIAL **(specific gravity > 2.8)**

$W_5 - W_4/W_1 \times 100$ = LIGHT MATERIAL **(specific gravity < 2.8)**

**Note: % heavy material reflect the Mica content.**

**TABLE:C-4**

**Testing for trace of concrete matei**
**project (EXP. SITE-4)**
**Method Number used: GDT-76**
**Description: Method of test for Mi**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 | FILTER PAPER WEIGHT W2 |
|---|---|---|---|
| RETROFIT/ DETENTION POND | MUDDY GRAY CLAY-SANDY SOIL, SUSPECT OF CONC. CONT. | 50 GRAMS | 8.0 GRAMS |
| RIP-RAP SPLASH PAD | GRAY SILTY SANDY SOIL, WITH ORGANIC MAT'L SUSPECT OF CONC. CONT. | 50 GRAMS | 8.3 GRAMS |
| STREAM OUTFALL | BROWNISH-GRAY SANDY SOIL, SUSPECT OF CONC. CONT. | 50 GRAMS | 7.9 GRAMS |
| 50 FEET UPSTREAM FROM OUTFALL | DARK BROWN SANDY SOIL, WITH ORGANIC MAT'L | 50 GRAMS | 8.0 GRAMS |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL, FULL OF ORGANIC MAT'L/ SUSPECT OF CONC. CONT | 50 GRAMS | 8.0 GRAMS |

$W_3 - W_2/W_1 \times 100$ = % HEAVY MA1

$W_5 - W_4/W_1 \times 100$ = % LIGHT MA1

**Note: % heavy material reflects th**

**TABLE:C-4**

**Testing for trace of concrete material (Mica) at BJ Shopping center construction site project (EXP. SITE-4)**
**Method Number used: GDT-76**
**Description: Method of test for Mica content of fine aggregate**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 | FILTER PAPER WEIGHT W2 | FILTER PAPER + HEAVY MAT'L W3 | FILTER PAPER WEIGHT W4 | FILTER PAPER + LIGHT WEIGHT W5 | HEAVY MAT'L | LIGHT MAT'L | % HEAVY MAT'L | % LIGHT MAT'L |
|---|---|---|---|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | MUDDY GRAY CLAY-SANDY SOIL, SUSPECT OF CONC. CONT. | 50 GRAMS | 8.0 GRAMS | 9.93 GRAMS | 8.2 GRAMS | 8.8 GRAMS | 0.039 GRAM | 0.012 GRAM | 3.9 | 1.2 |
| RIP-RAP SPLASH PAD | GRAY SILTY SANDY SOIL, WITH ORGANIC MAT'L SUSPECT OF CONC. CONT. | 50 GRAMS | 8.3 GRAMS | 9.87 GRAMS | 8.0 GRAMS | 8.47 GRAMS | 0.031 GRAM | 0.009 GRAM | 3.1 | 0.09 |
| STREAM OUTFALL | BROWNISH-GRAY SANDY SOIL, SUSPECT OF CONC. CONT. | 50 GRAMS | 7.9 GRAMS | 9.22 GRAMS | 8.1 GRAMS | 8.21 GRAMS | 0.026 GRAM | 0.002 | 2.6 | 0.02 |
| 50 FEET UPSTREAM FROM OUTFALL | DARK BROWN SANDY SOIL, WITH ORGANIC MAT'L | 50 GRAMS | 8.0 GRAMS | 8.072 GRAMS | 8.3 GRAMS | 8.33 GRAMS | 0.0001 | 0.0006 | 0.01 | 0.06 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL, FULL OF ORGANIC MAT'L/ SUSPECT OF CONC. CONT | 50 GRAMS | 8.0 GRAMS | 8.52 GRAMS | 8.0 GRAMS | 8.073 GRAMS | 0.01 | 0.001 | 1 | 0.01 |

$W_3 - W_2/W_1 \times 100$ = % HEAVY MATERIAL **(specific gravity > 2.8)**

$W_5 - W_4/W_1 \times 100$ = % LIGHT MATERIAL **( specific gravity < 2.8)**

**Note: % heavy material reflects the Mica content**

**TABLE:C-5**

**Testing for trace of concrete mate**
**construction site project (EXP. SI**
**Method Number used: GDT-76**
**Description: Method of test for Mi**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 | FILTER PAPER WEIGHT W2 |
|---|---|---|---|
| RETROFIT/ DETENTION POND | MUDDY GRAY CLAY-SANDY SOIL, SUSPECT OF CONC. CONT. | 50 GRAMS | 8.0 GRAMS |
| RIP-RAP SPLASH PAD | GRAY SILTY SANDY SOIL, WITH ORGANIC MAT'L SUSPECT OF CONC. CONT. | 50 GRAMS | 8.3 GRAMS |
| STREAM OUTFALL | BROWNISH-GRAY SANDY SOIL, SUSPECT OF CONC. CONT. | 50 GRAMS | 7.9 GRAMS |
| 50 FEET UPSTREAM FROM OUTFALL | DARK BROWN SANDY SOIL, WITH ORGANIC MAT'L | 50 GRAMS | 8.0 GRAMS |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL, FULL OF ORGANIC MAT'L/ SUSPECT OF CONC. CONT | 50 GRAMS | 8.0 GRAMS |

$W_3 - W_2/W_1 \times 100$ = % HEAVY MAT

$W_5 - W_4/W_1 \times 100$ = % LIGHT MAT

**Note: % heavy material reflects th**

**TABLE:C-5**

**Testing for trace of concrete material (Mica) at Office Building Complex construction site project (EXP. SITE-5)**

**Method Number used: GDT-76**

**Description: Method of test for Mica content of fine aggregate**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 | FILTER PAPER WEIGHT W2 | FILTER PAPER + HEAVY MAT'L W3 | FILTER PAPER WEIGHT W4 | FILTER PAPER + LIGHT WEIGHT W5 | HEAVY MAT'L | LIGHT MAT'L | % HEAVY MAT'L | % LIGHT MAT'L |
|---|---|---|---|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | MUDDY GRAY CLAY-SANDY SOIL, SUSPECT OF CONC. CONT. | 50 GRAMS | 8.0 GRAMS | 9.93 GRAMS | 8.2 GRAMS | 8.8 GRAMS | 0.030 GRAM | 0.010 GRAM | 3.0 | 10 |
| RIP-RAP SPLASH PAD | GRAY SILTY SANDY SOIL, WITH ORGANIC MAT'L SUSPECT OF CONC. CONT. | 50 GRAMS | 8.3 GRAMS | 9.87 GRAMS | 8.0 GRAMS | 8.47 GRAMS | 0.021 GRAM | 0.009 GRAM | 2.1 | 0.09 |
| STREAM OUTFALL | BROWNISH-GRAY SANDY SOIL, SUSPECT OF CONC. CONT. | 50 GRAMS | 7.9 GRAMS | 9.22 GRAMS | 8.1 GRAMS | 8.21 GRAMS | 0.016 GRAM | 0.003 | 1.6 | 0.03 |
| 50 FEET UPSTREAM FROM OUTFALL | DARK BROWN SANDY SOIL, WITH ORGANIC MAT'L | 50 GRAMS | 8.0 GRAMS | 8.072 GRAMS | 8.3 GRAMS | 8.33 GRAMS | 0.0001 | 0.0002 | 0.01 | 0.02 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL, FULL OF ORGANIC MAT'L/ SUSPECT OF CONC. CONT | 50 GRAMS | 8.0 GRAMS | 8.52 GRAMS | 8.0 GRAMS | 8.073 GRAMS | 0.02 | 0.001 | 2 | 0.01 |

$W_3 - W_2/W_1 \times 100$ = % HEAVY MATERIAL **(specific gravity > 2.8)**

$W_5 - W_4/W_1 \times 100$ = % LIGHT MATERIAL **( specific gravity < 2.8)**

**Note: % heavy material reflects the Mica content**

**TABLE:D-1**

**Testing for trace of Bitumen (A**
**(EXP. SITE-1)**
**Method Numbers used: GDT-**
**Description: Method of test fo**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SA W |
|---|---|---|
| RETROFIT/ DETENTION POND | DARK BROWN SILTY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING BITUMEN MAT'L | 50 |
| RIP-RAP SPLASH PAD | DARK BROWN SILTY SANDY SOIL, SUSPECT OF MIXTURE OF BITUMEN AND SOIL | 50 |
| STREAM OUTFALL | BROWN GRAYISH SANDY CLAY SOIL WITH ORGANIC MAT'L/ CONTENT OF BITUMEN SUSPECT | 50- |
| 50- FEET UPSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH SMALL GRAVEL AGGRE. AND ORGANIC MAT'L | 50- |
| 50- FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L, GRAVEL AND SUSPECT OF HAVING BITUMEN MAT'L | 50- |

Bitumen content, percent = ($W_1$ –

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate
$W_3$ = Correction factor, (

## APPENDIX-D

**TABLE:D-1**

**Testing for trace of Bitumen (Asphalt material) at Carwash construction site project (EXP. SITE-1)**
**Method Numbers used: GDT-25, 37**
**Description: Method of test for Bitumen content of paving mixture by Centrifuge.**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 | BITUMEN AGGREGATE EXTRACTED W2 | CORRECTION FACTOR W3 | BITUMEN WEIGHT EXTRACTED | PERCENT BITUMEN CONTENT |
|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | DARK BROWN SILTY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING BITUMEN MAT'L | 50- GRAMS | 49 .91 GRAMS | 0.03 | 0.09 GRAM | 0.15 |
| RIP-RAP SPLASH PAD | DARK BROWN SILTY SANDY SOIL, SUSPECT OF MIXTURE OF BITUMEN AND SOIL | 50- GRAMS | 49.94 GRAMS | 0.03 | 0.06 GRAM | 0.09 |
| STREAM OUTFALL | BROWN GRAYISH SANDY CLAY SOIL WITH ORGANIC MAT'L/ CONTENT OF BITUMEN SUSPECT | 50- GRAMS | 49.98 GRAMS | 0.03 | 0.02 GRAM | 0.01 |
| 50- FEET UPSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH SMALL GRAVEL AGGRE. AND ORGANIC MAT'L | 50- GRAMS | 49.99 GRAMS | 0.03 | 0.01 | 0.00 |
| 50- FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L, GRAVEL AND SUSPECT OF HAVING BITUMEN MAT'L | 50- GRAMS | 49.99 GRAMS | 0.03 | 0.01 | 0.00 |

Bitumen content, percent = $(W_1 - W_2/W_1 \times 100) - W_3$

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate less bitumen
$W_3$ = Correction factor, ( **Method: GDT-25)**

**TABLE:D-2**

**Testing for trace of Bitumen (A**
**construction site project (EXP.**
**Method Number used: GDT-25**
**Description: Method of test for**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPL WEIGH W1 |
|---|---|---|
| RETROFIT/ DETENTION POND | DARK SANDY-CLAY SOIL, SUSPECTED MIXTURE OF SOIL AND BITUMEN MAT'L | 50 GRAI |
| RIP-RAP SPLASH PAD | DARK BROWN CLAY SOIL, A MIXTURE OF CLAY AND MUDDY SILT, SUSPECT OF HAVING BITUMEN | 50 GRAM |
| STREAM OUTFALL | DARK SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAM |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L | 50 GRAM |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAM |

Bitumen content, percent = ($W_1$ –

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate
$W_3$ = Correction factor, (M

**TABLE:D-2**

**Testing for trace of Bitumen (Asphalt material) at Industrial warehouse construction site project (EXP. SITE-2)**
**Method Number used: GDT-25, 37**
**Description: Method of test for Bitumen content of paving mixture by Centrifuge**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 | BITUMEN AGGREGATE EXTRACTED W 2 | CORRECTION FACTOR W 3 | BITUMEN WEIGHT EXTRACTED | PERCENT BITUMEN CONTENT |
|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | DARK SANDY-CLAY SOIL, SUSPECTED MIXTURE OF SOIL AND BITUMEN MAT'L | 50 GRAMS | 49.15 GRAMS | 0.03 | 0.85 GRAM | 1.67 |
| RIP-RAP SPLASH PAD | DARK BROWN CLAY SOIL, A MIXTURE OF CLAY AND MUDDY SILT, SUSPECT OF HAVING BITUMEN | 50 GRAMS | 49.33 GRAMS | 0.03 | 0.67 GRAM | 1.31 |
| STREAM OUTFALL | DARK SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS | 49.48 GRAMS | 0.03 | 0.52 GRAM | 1.01 |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L | 50 GRAMS | 49.99 GRAMS | 0.03 | 0.01 | 0.00 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS | 49.97 GRAM | 0.03 | 0.03 GRAM | 0.03 |

Bitumen content, percent = $(W_1 - W_2/W_1 \times 100) - W_3$

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate less bitumen
$W_3$ = Correction factor, **(Method GDT-25)**

**TABLE:D-3**

**Testing for trace of Bitumen (A**
**project (EXP. SITE-3)**
**Method Number used: GDT-25**
**Description: Method of test for**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 |
|---|---|---|
| RETROFIT/ DETENTION POND | DARK SANDY SOIL, WITH ORGANIC MAT'L, SUSPECTED MIXTURE OF SOIL AND BITUMEN MAT'L | 50 GRAM |
| RIP-RAP SPLASH PAD | DARK SILTY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING BITUMEN | 50 GRAM |
| STREAM OUTFALL | DARK SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAM |
| 50 FEET UPSTREAM FROM OUTFALL | SANDY SOIL WITH ORGANIC MAT'L AND SMALL WHITE GRAVEL CRUMPS | 50 GRAM |
| 50 FEET DOWNSTREAM FROM OUTFALL | DARK BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT AND GRAVEL CRUMPS. | 50 GRAM |

Bitumen content, percent = ($W_1$ –

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate
$W_3$ = Correction factor, (M

**TABLE:D-3**

**Testing for trace of Bitumen (Asphalt material) at Middle school construction site project (EXP. SITE-3)**
**Method Number used: GDT-25, 37**
**Description: Method of test for Bitumen content of paving mixture by Centrifuge**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 | BITUMEN AGGREGATE EXTRACTED W 2 | CORRECTION FACTOR W 3 | BITUMEN WEIGHT EXTRACTED | PERCENT BITUMEN CONTENT |
|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | DARK SANDY SOIL, WITH ORGANIC MAT'L, SUSPECTED MIXTURE OF SOIL AND BITUMEN MAT'L | 50 GRAMS | 48.31 GRAMS | 0.03 | 1.69 GRAM | 3.4 |
| RIP-RAP SPLASH PAD | DARK SILTY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING BITUMEN | 50 GRAMS | 48.29 GRAMS | 0.03 | 1.71 GRAM | 3.5 |
| STREAM OUTFALL | DARK SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS | 48.36 GRAMS | 0.03 | 1.64 GRAM | 3.3 |
| 50 FEET UPSTREAM FROM OUTFALL | SANDY SOIL WITH ORGANIC MAT'L AND SMALL WHITE GRAVEL CRUMPS | 50 GRAMS | 49.99 GRAMS | 0.03 | 0.01 | 0.00 |
| 50 FEET DOWNSTREAM FROM OUTFALL | DARK BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT AND GRAVEL CRUMPS. | 50 GRAMS | 49.99 GRAM | 0.03 | 0.01 GRAM | 0.00 |

Bitumen content, percent = $(W_1 - W_2/W_1 \times 100) - W_3$

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate less bitumen
$W_3$ = Correction factor, **(Method GDT-25)**

**TABLE:D-4**

**Testing for trace of Bitumen (A**
**site project (EXP. SITE-4)**
**Method Number used: GDT-25,**
**Description: Method of test for**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 |
|---|---|---|
| RETROFIT/ DETENTION POND | DARK SANDY-CLAY SOIL, WITH ORGANIC MAT'L, SUSPECTED MIXTURE OF SOIL AND BITUMEN MAT'L | 50 GRAM |
| RIP-RAP SPLASH PAD | DARK BROWN SILTY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING BITUMEN | 50 GRAM |
| STREAM OUTFALL | DARK BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAM |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L | 50 GRAMS |
| 50 FEET DOWNSTREAM FROM OUTFALL | DARK BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS |

Bitumen content, percent = ($W_1$ – 

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate
$W_3$ = Correction factor, (M

**TABLE:D-4**

**Testing for trace of Bitumen (Asphalt material) at BJ Shopping center construction site project (EXP. SITE-4)**
**Method Number used: GDT-25, 37**
**Description: Method of test for Bitumen content of paving mixture by Centrifuge**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 | BITUMEN AGGREGATE EXTRACTED W 2 | CORRECTION FACTOR W 3 | BITUMEN WEIGHT EXTRACTED | PERCENT BITUMEN CONTENT |
|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | DARK SANDY-CLAY SOIL, WITH ORGANIC MAT'L, SUSPECTED MIXTURE OF SOIL AND BITUMEN MAT'L | 50 GRAMS | 48.08 GRAMS | 0.03 | 1.92 GRAM | 3.8 |
| RIP-RAP SPLASH PAD | DARK BROWN SILTY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING BITUMEN | 50 GRAMS | 48.33 GRAMS | 0.03 | 1.67 GRAM | 3.2 |
| STREAM OUTFALL | DARK BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS | 48.46 GRAMS | 0.03 | 1.54 GRAM | 3.1 |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L | 50 GRAMS | 49.99 GRAMS | 0.03 | 0.01 | 0.00 |
| 50 FEET DOWNSTREAM FROM OUTFALL | DARK BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS | 49.05 GRAM | 0.03 | 0.95 GRAM | 1.9 |

Bitumen content, percent = $(W_1 - W_2/W_1 \times 100) - W_3$

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate less bitumen
$W_3$ = Correction factor, **(Method GDT-25)**

**TABLE: D-5**

**Testing for trace of Bitumen (Asp**
**construction site project (EXP. S**
**Method Number used: GDT-25, 3**
**Description: Method of test for B**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 |
|---|---|---|
| RETROFIT/ DETENTION POND | DARK BROWN SILTY SAND SOIL, WITH ORGANIC MAT'L, AND SUSPECTED OF HAVING BITUMEN MAT'L | 50 GRAMS |
| RIP-RAP SPLASH PAD | GRAY SILTY SAND SOIL AND SUSPECT OF HAVING BITUMEN | 50 GRAMS |
| STREAM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L | 50 GRAMS |
| 50 FEET DOWNSTREAM FROM OUTFALL | DARK GRAY SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS |

Bitumen content, percent = ($W_1$ – W

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate I
$W_3$ = Correction factor, (Me

**TABLE: D-5**

**Testing for trace of Bitumen (Asphalt material) at Office building complex construction site project (EXP. SITE-5)**
**Method Number used: GDT-25, 37**
**Description: Method of test for Bitumen content of paving mixture by Centrifuge**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | SAMPLE WEIGHT W1 | BITUMEN AGGREGATE EXTRACTED W 2 | CORRECTION FACTOR W 3 | BITUMEN WEIGHT EXTRACTED | PERCENT BITUMEN CONTENT |
|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION POND | DARK BROWN SILTY SAND SOIL, WITH ORGANIC MAT'L, AND SUSPECTED OF HAVING BITUMEN MAT'L | 50 GRAMS | 49.98 GRAMS | 0.03 | 0.02 GRAM | 0.01 |
| RIP-RAP SPLASH PAD | GRAY SILTY SAND SOIL AND SUSPECT OF HAVING BITUMEN | 50 GRAMS | 49.96 GRAMS | 0.03 | 0.04 GRAM | 0.05 |
| STREAM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS | 49.98 GRAMS | 0.03 | 0.02 GRAM | 0.01 |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L | 50 GRAMS | 49.99 GRAMS | 0.03 | 0.01 | 0.00 |
| 50 FEET DOWNSTREAM FROM OUTFALL | DARK GRAY SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF BITUMEN CONTENT | 50 GRAMS | 49.99 GRAM | 0.03 | 0.01 GRAM | 0.00 |

Bitumen content, percent = $(W_1 - W_2/W_1 \times 100) - W_3$

Where:

$W_1$ = Weight of sample
$W_2$ = Weight of aggregate less bitumen
$W_3$ = Correction factor, **(Method GDT-25)**

**TABLE:E-2**

**Testing for trace paint at Indus**
**SITE-2)**
**Method Number used: ASTM**
**Description: This is the standa**
**chemical analysis using SOXH**
**Extractable Residue, mg/L = W**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | BOILING WEIGHT W 1 (mg |
|---|---|---|
| RETROFIT/ DETENTION | MILKY-MUD SILT, SUSPECT OF HAVING PAINT | 15000 |
| RIP-RAP SPLASH PAD | BROWN SILTY SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 |
| STREAM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY-CLAY SOIL WITH WHITE PERBLES AND ORGANIC MAT'L | 15000 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L AND WHITE PERPLES, SUSPECT OF HAVING PAINT | 15000 |

## APPENDIX-E

### TABLE:E-2

**Testing for trace paint at Industrial warehouse construction site project (EXP. SITE-2)**
**Method Number used: ASTM D5369-98**
**Description: This is the standard practice for extraction of solid waste samples for chemical analysis using SOXHLET EXTRACTION.**
**Extractable Residue, mg/L = $W_2 - W_1/V \times 1000$**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | BOILING FLASK WEIGHT W 1 (mg) | BOILING FLASK WEIGHT LESS SOLVENT W2 (mg) | VOLUME OF SAMPLE (liters) V | WEIGHT OF RESIDUE (PAINT) (mg) | RESIDUE EXTRACTED Mg/L |
|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION | MILKY-MUD SILT, SUSPECT OF HAVING PAINT | 15000 | 15000.003 | 0.5 | 0.0006 | 6.00 |
| RIP-RAP SPLASH PAD | BROWN SILTY SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 | 15000.001 | 0.5 | 0.0002 | 2.00 |
| STREAM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY-CLAY SOIL WITH WHITE PERBLES AND ORGANIC MAT'L | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L AND WHITE PERPLES, SUSPECT OF HAVING PAINT | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |

**TABLE: E-3**

**Testing for trace paint at Middl**
**(EXP. SITE-3)**
**Method Number used: ASTM**
**Description: This is the standar**
**chemical analysis using SOXHl**
**Extractable Residue, mg/L = W**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | BOILING F WEIGHT W I (mg) |
|---|---|---|
| RETROFIT/ DETENTION | REDISH BROWN SILTY SANDY SOIL, SUSPECT OF HAVING PAINT | 15000 |
| RIP-RAP SPLASH PAD | BROWN SILTY SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 |
| STREAM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 |
| 50 FEET UPSTREAM FROM OUTFALL | DARK BROWN SANDY-LOAM SOIL WITH ORGANIC MAT'L | 15000 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L AND SUSPECT OF HAVING PAINT | 15000 |

**TABLE: E-3**

**Testing for trace paint at Middle School construction site project (EXP. SITE-3)**
**Method Number used: ASTM D5369-98**
**Description: This is the standard practice for extraction of solid waste samples for chemical analysis using SOXHLET EXTRACTION.**
**Extractable Residue, mg/L = $W_2 - W_1/V \times 1000$**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | BOILING FLASK WEIGHT W 1 (mg) | BOILING FLASK WEIGHT LESS SOLVENT W2 (mg) | VOLUME OF SAMPLE (liters) V | WEIGHT OF RESIDUE (PAINT) (mg) | RESIDUE EXTRACTED Mg/L |
|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION | REDISH BROWN SILTY SANDY SOIL, SUSPECT OF HAVING PAINT | 15000 | 15000.007 | 0.5 | 0.012 | 12.00 |
| RIP-RAP SPLASH PAD | BROWN SILTY SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 | 15000.004 | 0.5 | 0.005 | 5.00 |
| STREAM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 | 15000.001 | 0.5 | 0.001 | 1.00 |
| 50 FEET UPSTREAM FROM OUTFALL | DARK BROWN SANDY-LOAM SOIL WITH ORGANIC MAT'L | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L AND SUSPECT OF HAVING PAINT | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |

**TABLE:E-4**

**Testing for trace paint at BJ Sh**
**(EXP. SITE-4)**
**Method Number used: ASTM I**
**Description: This is the standar**
**chemical analysis using SOXHL**
**Extractable Residue, mg/L = W**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | BOILING FI WEIGHT W 1 (mg) |
|---|---|---|
| RETROFIT/ DETENTION | REDISH BROWN SILTY SANDY SOIL, SUSPECT OF HAVING PAINT | 15000 |
| RIP-RAP SPLASH PAD | BROWN SILTY SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 |
| STREAM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 |
| 50 FEET UPSTREAM FROM OUTFALL | DARK BROWN SANDY-LOAM SOIL WITH ORGANIC MAT'L | 15000 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L AND SUSPECT OF HAVING PAINT | 15000 |

**TABLE:E-4**

**Testing for trace paint at BJ Shopping center construction site project (EXP. SITE-4)**
**Method Number used: ASTM D5369-98**
**Description: This is the standard practice for extraction of solid waste samples for chemical analysis using SOXHLET EXTRACTION.**
**Extractable Residue, mg/L = $W_2 - W_1/V \times 1000$**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | BOILING FLASK WEIGHT W 1 (mg) | BOILING FLASK WEIGHT LESS SOLVENT W2 (mg) | VOLUME OF SAMPLE (liters) V | WEIGHT OF RESIDUE (PAINT) (mg) | RESIDUE EXTRACTED Mg/L |
|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION | REDISH BROWN SILTY SANDY SOIL, SUSPECT OF HAVING PAINT | 15000 | 15000.007 | 0.5 | 0.014 | 14.00 |
| RIP-RAP SPLASH PAD | BROWN SILTY SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 | 15000.004 | 0.5 | 0.008 | 8.00 |
| STREAM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 | 15000.001 | 0.5 | 0.002 | 2.00 |
| 50 FEET UPSTREAM FROM OUTFALL | DARK BROWN SANDY-LOAM SOIL WITH ORGANIC MAT'L | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |
| 50 FEET DOWNSTREAM FROM OUTFALL | BROWN SANDY SOIL WITH ORGANIC MAT'L AND SUSPECT OF HAVING PAINT | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |

**TABLE: E-5**

**Testing for trace paint at Office**
**(EXP. SITE-5)**
**Method Number used: ASTM D**
**Description: This is the standard**
**chemical analysis using SOXHL**
**Extractable Residue, mg/L = W2**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | BOILING FL WEIGHT W 1 (mg) |
|---|---|---|
| RETROFIT/ DETENTION | BROWN-RED SILT , WITH ORGANIC MAT'L SUSPECT OF HAVING PAINT | 15000 |
| RIP-RAP SPLASH PAD | BROWN-RED SILTY SAND SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 |
| STREAM OUTFALL | BROWN-RED SANDY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L | 15000 |
| 50 FEET DOWNSTREAM FROM OUTFALL | LIGHT BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L AND SUSPECT OF HAVING PAINT | 15000 |

**TABLE: E-5**

**Testing for trace paint at Office building complex construction site project (EXP. SITE-5)**
**Method Number used: ASTM D5369-98**
**Description: This is the standard practice for extraction of solid waste samples for chemical analysis using SOXHLET EXTRACTION.**
**Extractable Residue, mg/L = $W_2 - W_1/V \times 1000$**

| SAMPLE LOCATION | SAMPLE DESCRIPTION | BOILING FLASK WEIGHT W 1 (mg) | BOILING FLASK WEIGHT LESS SOLVENT W2 (mg) | VOLUME OF SAMPLE (liters) V | WEIGHT OF RESIDUE (PAINT) (mg) | RESIDUE EXTRACTED Mg/L |
|---|---|---|---|---|---|---|
| RETROFIT/ DETENTION | BROWN-RED SILT , WITH ORGANIC MAT'L SUSPECT OF HAVING PAINT | 15000 | 15000.002 | 0.5 | 0.004 | 4 |
| RIP-RAP SPLASH PAD | BROWN-RED SILTY SAND SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 | 15000.001 | 0.5 | 0.002 | 2 |
| STREAM OUTFALL | BROWN-RED SANDY CLAY SOIL WITH ORGANIC MAT'L, SUSPECT OF HAVING PAINT | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |
| 50 FEET UPSTREAM FROM OUTFALL | BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |
| 50 FEET DOWNSTREAM FROM OUTFALL | LIGHT BROWN SANDY-CLAY SOIL WITH ORGANIC MAT'L AND SUSPECT OF HAVING PAINT | 15000 | 15000.000 | 0.5 | 0.00 | 0.00 |

**APPE**

**TABLE:F-1**

**During construction summary lo**
**SITE-1)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR. ACTIVITIES | SAMPLE LOCATION |
|---|---|---|---|
| DEC./20/2002 | I | CLEARING, GRUBBING, GRADING AND LAY-OUT | -TOP SOIL STOCKPILE<br>-PROPOSED DET. POND<br>-50 FEET UPSTREAM<br>-50 FEET DO STREAM |
| MAR/30/2003 | II | INSTALLING CONCRETE CURB/ GUTTER, PLACING AGG-REGATE BASE AND CONCRETE DRIVEWAY | -RETROFIT/ DET.POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DO STREAM |
| JUNE/15/2003 | III | PLACING ASPHALT PAVMENT | -RETROFIT/I POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DO STREAM |
| **AREA OF CONSTRUCTION SITE = 1.75 ACI** | | | |

## APPENDIX-F

**TABLE:F-1**

**During construction summary log for Carwash construction site project (EXP. SITE-1)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR. ACTIVITIES | SAMPLE LOCATION | RAINF -ALL AMT. | RAINF -ALL INTEN -SITY | ANALYSIS REQUIRED | QUANTITY SAMPLED | TOTAL AMT. TRACED | COMMENT AND REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| DEC./20/2002 | I | CLEARING, GRUBBING, GRADING AND LAY-OUT | -TOP SOIL STOCKPILE<br>-PROPOSED DET. POND<br>-50 FEET UPSTREAM<br>-50 FEET DOWN STREAM | 0.56" OR 14mm | 0.023"/ HR<br>OR 0.57m m/HR | PULVERIZ-ATION OF SOIL SAMPLE MORTAR | 50 GRAMS EACH FROM SAMPLE LOCATION | NOT APPLIC -ABLE | AVERAGE PULVERI-ZATION OF SOIL MORTAR WAS 49.7% AND CON-FORMS WITH THE NATIVE SOIL |
| MAR/30/2003 | II | INSTALLING CONCRETE CURB/ GUTTER, PLACING AGG-REGATE BASE AND CONCRETE DRIVEWAY | -RETROFIT/ DET.POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DOWN STREAM | 0.29"<br>OR<br>7.2mm | 0.012"/ HR<br>OR<br>0.3mm/ HR | MICA, THE MAJOR CONTENT OF CONCRETE MATERIAL | 50 GRAMS EACH FROM SAMPLE LOCATION | 0.15 GRAM | SOME AGGREG. BASE WASHED OFF, BUT COULD NOT REACH THE SAMPLE LOCATION -S DUE TO BULKINES-S |
| JUNE/15/2003 | III | PLACING ASPHALT PAVMENT | -RETROFIT/DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DOWN STREAM | 0.20"<br>OR<br>5mm | 0.008"/ HR<br>OR<br>0.2mm/ HR | BITUMEN, CONTENT OF ASHPALT MIXED WITH SOIL | 50 GRAMS EACH FROM SAMPLE LOCATION | 0.53 GRAM | MAJORITY OF CONST. ACTIVITIE-S AT THIS PHASE WERE DONE WITH PRE-FAB. MAT'L |
| **AREA OF CONSTRUCTION SITE = 1.75 ACRES OR 0.709 Ha** | | | | | | | | | |

## TABLE:F-2

**During construction summary lo**
**project ( EXP. SITE-2)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR. ACTIVITIES | SAMPLE LOCATION |
|---|---|---|---|
| MAR/30/2003 | I | CLEARING, GRUBBING, GRADING AND LAY-OUT | -TOP SOIL STOCKPILE<br>-PROPOSED DET.POND<br>-STREAM OUTFALL<br>-50 FEET UP STREAM<br>-50 FEET DOWNSTREAM |
| JUN/14/2003 | II | INSTALLING DRAINAGE STRUCTURES, CONC. CURB/ GUTTER, STRUCTURAL STEEL FRAMING, MISC. CONC. AND ASPHALT PAVING | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTRAM<br>-50 FEET DOWNSTREAM |
| AUG/30/2003 | III | ERECTION OF STRUCTURAL MASONRY(EXT/ INT.) AND EXTE ROIR AND INTERIOR FINISHES | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DOWNSTREAM |

**AREA OF CONSTRUCTION SITE = 4.50 AC**

**TABLE:F-2**

**During construction summary log for the Industrial warehouse construction site project ( EXP. SITE-2)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR. ACTIVITIES | SAMPLE LOCATION | RAINFALL AMOUNT | RAINFALL INTENSITY | ANALYSIS REQUIRED | QUANTITY SAMPLED | TOTAL AMOUNT TRACED | COMMENT AND REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| MAR/30/2003 | I | CLEARING, GRUBBING, GRADING AND LAY-OUT | -TOP SOIL STOCKPILE<br>-PROPOSED DET.POND<br>-STREAM OUTFALL<br>-50 FEET UP STREAM<br>-50 FEET DOWNSTREAM | 0.34" OR 8.5mm | 0.014"/HR OR 0.4mm/HR | PULVERIZ-ATION OF SOIL SAMPLE MORTAR | 50 GRAMS EACH FROM SAMPLE LOCATION | NOT APPLI-ABLE | MORTAR PULVERIZ-ATION CONFORMED WITH NATIVE SOIL |
| JUN/14/2003 | II | INSTALLING DRAINAGE STRUCTURES, CONC. CURB/ GUTTER, STRUCTURAL STEEL FRAMING, MISC. CONC. AND ASPHALT PAVING | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTRAM<br>-50 FEET DOWNSTREAM | 0.3" OR 7.5mm | 0.013"/HR OR 0.31mm/HR | MICA, THE MAJOR CONTENT OF CONCRETE MAT'L<br>BITUMEN, MAJOR CONTENT OF ASPHALT MAT'L | 50 GRAMS EACH FROM SAMPLE LOCATION | 0.12 GRAM OF MICA<br>0.04 GRAM OF BITUMEN | ASPHALT PAVING AND CURBBING WERE DONE SIMUTENIOUSLY ON THE PROJECT |
| AUG/30/2003 | III | ERECTION OF STRUCTURAL MASONRY(EXT/ INT.) AND EXTE ROIR AND INTERIOR FINISHES | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DOWNSTREAM | 0.65" OR 16.3mm | 0.027"/HR OR 0.67mm/HR | PAINT | 0.5 LITER OF SOIL SAMPLE IN SOLUTION FROM EACH SAMPLE LOCATION | 8.0 mg/L | PAINTS WASH OUT DID NOT REACH THE STREAM OUTFALL |
| AREA OF CONSTRUCTION SITE = 4.50 ACRES OR 1.82 Ha | | | | | | | | | |

**TABLE: F-3**

**During construction summary lo**
**(Exp.Site-3)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR.. ACTIVITIES | SAMPLE LOCATI |
|---|---|---|---|
| JAN/29/2003 | I | CLEARING, GRUBBING, GRADING AND LAY-OUT, UTILITY. ROUGH-IN | TOP SOIL STOCKPI 50 FEET U STREAM 50 FEET DOWNST |
| APR/24/2003 | II | INSTALLING DRAINAGE STRUCTURES, CONC. CURB/ GUTTER, STRUCTURAL STEEL FRAMING. AND ASPHALT PAVING | RETROFIT DET. PONI RIP-RAP SPLASH P STREAM OUTFALI 50 FEET UPSTRAM 50 FEET DOWNSTRI |
| NOV/19/2003 | III | ERECTION OF STRUCTURAL MASONRY(EXT/ INT.) AND EXTE ROIR AND INTERIOR FINISHES INCLUDING ACCOUSTICALS | RETROFIT DET. PONI RIP-RAP SPLASH P STREAM OUTFALL 50 FEET UPSTREAM 50 FEET DOWNSTR |

**TABLE: F-3**

**During construction summary log for the Middle school construction site project (Exp.Site-3)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR.. ACTIVITIES | SAMPLE LOCATION | RAINFALL AMOUNT | RAINFALL INTENSITY | ANALYSIS REQUIRED | QUANTITY SAMPLED | TOTAL AMOUNT TRACED | COMMENT AND REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| JAN/29/2003 | I | CLEARING, GRUBBING, GRADING AND LAY-OUT, UTILITY. ROUGH-IN | TOP SOIL STOCKPILE 50 FEET UP STREAM 50 FEET DOWNSTREAM | 1.40" OR 35mm | 0.06"/HR OR 15mm/HR | PULVERIZ-ATION OF SOIL SAMPLE MORTAR | 50 GRAMS EACH FROM SAMPLE LOCATION | NOT APPLI-ABLE | MORTAR PULVERIZ-ATION CONFORMEI WITH NATIVE SOIL.. |
| APR/24/2003 | II | INSTALLING DRAINAGE STRUCTURES, CONC. CURB/ GUTTER, STRUCTURAL STEEL FRAMING. AND ASPHALT PAVING | RETROFIT/ DET. POND RIP-RAP SPLASH PAD STREAM OUTFALL 50 FEET UPSTRAM 50 FEET DOWNSTREAM | 0.65" OR 16.3mm | 0.022"/HR OR 0.56mm/HR | MICA, THE MAJOR CONTENT OF CONCRETE MAT'L<br>BITUMEN, MAJOR CONTENT OF ASPHALT MAT'L | 50 GRAMS EACH FROM SAMPLE LOCATION | 0.10 GRAM OF MICA<br>0.12 GRAM OF BITUMEN | RETROFIT AND DETENTION ARE LOCATED AT. FARTHER DISTANCE FROM THE RIP-RAP SPLASH PAD |
| NOV/19/2003 | III | ERECTION OF STRUCTURAL MASONRY(EXT/ INT.) AND EXTE ROIR AND INTERIOR FINISHES INCLUDING ACCOUSTICALS | RETROFIT/ DET. POND RIP-RAP SPLASH PAD STREAM OUTFALL 50 FEET UPSTREAM 50 FEET DOWNSTREAM | 1.46" OR 36.5mm | 0.06"/HR OR 152mm/HR | PAINT | 0.5 LITER OF SOIL SAMPLE IN SOLUTION FROM EACH SAMPLE LOCATION | 12 mg/L | STREAM FLOW WAS BLOCKED BY SEDIMENTS DUE TO POOR EROSION CONTROL. THIS CAUSED POND POCKETS ALONG THE STREAM |

**AREA OF CONSTRUCTION SITE = 7.75 AC OR 3.14 Ha**

## TABLE:F-3

**During construction summary lo**
**project ( EXP. SITE-4)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR. ACTIVITIES | SAMPLE LOCATION |
|---|---|---|---|
| FEB/22/2003 | I | CLEARING, GRUBBING, GRADING AND LAY-OUT | -TOP SOIL STOCKPILE<br>-50 FEET UP STREAM<br>-50 FEET DOWNSTREAM |
| MAY/26/2003 | II | INSTALLING DRAINAGE STRUCTURES, CONC. CURB/ GUTTER, STRUCTURAL STEEL FRAMING, CONCRETE WALL PANELS. AND ASPHALT PAVING | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTRAM<br>-50 FEET DOWNSTREAM |
| OCT/09/2003 | III | ERECTION OF STRUCTURAL MASONRY(EXT/ INT.) AND EXTE ROIR AND INTERIOR FINISHES INCLUDING ACCOUSTICALS | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DOWNSTREAM |
| AREA OF CONSTRUCTION SITE = 6.70 AC | | | |

**TABLE:F-3**

**During construction summary log for the BJ Shopping center construction site project ( EXP. SITE-4)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR. ACTIVITIES | SAMPLE LOCATION | RAINFALL AMOUNT | RAINFALL INTENSITY | ANALYSIS REQUIRED | QUANTITY SAMPLED | TOTAL AMOUNT TRACED | COMMENT AND REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| FEB/22/2003 | I | CLEARING, GRUBBING, GRADING AND LAY-OUT | -TOP SOIL STOCKPILE<br>-50 FEET UP STREAM<br>-50 FEET DOWNSTREAM | 0.66" OR 16.5mm | 0.023"/HR OR 0.58mm/HR | PULVERIZ-ATION OF SOIL SAMPLE MORTAR | 50 GRAMS EACH FROM SAMPLE LOCATION | NOT APPLI-ABLE | MORTAR PULVERIZ-ATION CONFORMED WITH NATIVE SOIL. LOCATIONS OF DETENTION POND AND STREAM OUTFALL WERE NOT KNOWN YET. |
| MAY/26/2003 | II | INSTALLING DRAINAGE STRUCTURES, CONC. CURB/ GUTTER, STRUCTURAL STEEL FRAMING, CONCRETE WALL PANELS. AND ASPHALT PAVING | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTRAM<br>-50 FEET DOWNSTREAM | 0.22" OR 5.5mm | 0.09"/HR OR 0.23mm/HR | MICA, THE MAJOR CONTENT OF CONCRETE MAT'L<br>BITUMEN, MAJOR CONTENT OF ASPHALT MAT'L | 50 GRAMS EACH FROM SAMPLE LOCATION | 0.11GRAM OF MICA<br>0.15GRAM OF BITUMEN | PAVMENT MARKING WAS PART OF THIS PHASE. SIZEABLE AMOUNT OF MARKING PAINT CORRUPTED THE ASPHALT MAT'L WHICH MAY REFLECT ON THE BITUMEN. |
| OCT/09/2003 | III | ERECTION OF STRUCTURAL MASONRY(EXT/ INT.) AND EXTE ROIR AND INTERIOR FINISHES INCLUDING ACCOUSTICALS | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DOWNSTREAM | 0.28" OR 7.0mm | 0.012"/HR OR 0.3mm/HR | PAINT | 0.5 LITER OF SOIL SAMPLE IN SOLUTION FROM EACH SAMPLE LOCATION | 24 mg/L | THERE WAS CARELESS HANDLING OF PAINT ON THE SITE. EXAMPLE: MANY UNCLEANED PAINT SPLASH. |
| AREA OF CONSTRUCTION SITE = 6.70 ACRES OR 2.72 Ha | | | | | | | | | |

**TABLE: F-5**

**During construction summary log**
**project ( EXP. SITE-5)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR. ACTIVITIES | SAMPLE LOCATION |
|---|---|---|---|
| JULY/01/2003 | I | CLEARING, GRUBBING, GRADING AND SITE LAY-OUT. | -TOP SOIL STOCKPILE<br>-50 FEET UP STREAM<br>-50 FEET DOWNSTREAM |
| OCT/08/2003 | II | INSTALLING DRAINAGE STRUCTURES, CONC. CURB/ GUTTER, UTILITY ROUGH-IN, STRUCTURAL STEEL FRAMING. AND ASPHALT PAVING | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTRAM<br>-50 FEET DOWNSTREAM |
| JAN/26/2004 | III | ERECTION OF STRUCTURAL MASONRY(EXT/ INT.) AND EXTE ROIR AND INTERIOR FINISHES INCLUDING ACCOUSTICALS | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DOWNSTREAM |
| **AREA OF CONSTRUCTION SITE =4.43ACR** | | | |

**TABLE: F-5**

**During construction summary log for the Office Building complex construction site project ( EXP. SITE-5)**

| DATE SAMPLE COLLECTED | CONSTR. PHASE | CONSTR. ACTIVITIES | SAMPLE LOCATION | RAINFALL AMOUNT | RAINFALL INTENSITY | ANALYSIS REQUIRED | QUANTITY SAMPLED | TOTAL AMOUNT TRACED | COMMENT AND REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| JULY/01/2003 | I | CLEARING, GRUBBING, GRADING AND SITE LAY-OUT. | -TOP SOIL STOCKPILE<br>-50 FEET UP STREAM<br>-50 FEET DOWNSTREAM | 1.19" OR 29.8mm | 0.05"/HR OR 1.24mm/HR | PULVERIZ-ATION OF SOIL SAMPLE MORTAR | 50 GRAMS EACH FROM SAMPLE LOCATION | NOT APPLI-ABLE | MORTAR PULVERIZ-ATION CONFORMED WITH NATIVE SOIL.. |
| OCT/08/2003 | II | INSTALLING DRAINAGE STRUCTURES, CONC. CURB/ GUTTER, UTILITY ROUGH-IN, STRUCTURAL STEEL FRAMING. AND ASPHALT PAVING | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTRAM<br>-50 FEET DOWNSTREAM | 0.33" OR 8.25mm | 0.014"/HR OR 0.34mm/HR | MICA, THE MAJOR CONTENT OF CONCRETE MAT'L<br>BITUMEN, MAJOR CONTENT OF ASPHALT MAT'L | 50 GRAMS EACH FROM SAMPLE LOCATION | 0.07GRAM OF MICA<br>0.02GRAM OF BITUMEN | STORM WATER MGT. ON THIS SITE WERE POOR. INSUFFICIENT EROSION CONTROL CAUSED SLOPE AND EMBARKMENT FAILURES.. |
| JAN/26/2004 | III | ERECTION OF STRUCTURAL MASONRY(EXT/ INT.) AND EXTE ROIR AND INTERIOR FINISHES INCLUDING ACCOUSTICALS | -RETROFIT/ DET. POND<br>-RIP-RAP SPLASH PAD<br>-STREAM OUTFALL<br>-50 FEET UPSTREAM<br>-50 FEET DOWNSTREAM | 1.31" OR 32.8mm | 0.05"/HR OR 1.36mm/HR | PAINT | 0.5 LITER OF SOIL SAMPLE IN SOLUTION FROM EACH SAMPLE LOCATION | 6 mg/L | THERE WERE UNIFORM COLOR OF SOIL SAMPLES COLLECTED. THIS MAY SHOW THAT MULTI-COLOR PAINTS WERE NOT USED ON THE PROJECT |
| AREA OF CONSTRUCTION SITE =4.43ACRES OR 1.79 Ha | | | | | | | | | |

**AP**

BORING LOG FOR THE CARW

| DATE SAMPLE COLLECTED | SAMPLE LOCATION |
|---|---|
| JULY 3, 2004 | RETROFIT/ DETENTION POND |
| | RIP-RAP SPLASH PAD |
| | STREAM OUTFALL |

TABLE: G-1

## APPENDIX-G

BORING LOG FOR THE CARWASH CONSTRUCTION SITE (SITE-1)

| DATE SAMPLE COLLECTED | SAMPLE LOCATION | SAMPLE LAYER (SL) | SAMPLE DEPTH | SAMPLE DESCRIPTION |
|---|---|---|---|---|
| JULY 3, 2004 | RETROFIT/ DETENTION POND | SL-1 | 0 TO 2 INCHES | TOP SOIL WITH VEGETATIVE AND ORGANIC MATERIALS |
| | | SL-2 | 2 TO 5 INCHES | RESIDUUM: RED DARK BROWN FINE SANDY SILT |
| | | SL-3 | 5 TO 7 INCHES | ALLUVIUM: DARK BROWN FINE SANDY SILT & ROOT HAIRS |
| | | SL-4 | 7 TO 10 INCHES | GROUND WATER: SAMPLER INDICATED CAVE-IN & SOIL WASH-OUT |
| | RIP-RAP SPLASH PAD | SL-1 | 0 TO 3 INCHES | DARK ORGANIC SOIL WITH ROOT HAIRS |
| | | SL-2 | 3 TO 7 INCHES | RESIDUUM: BROWN FINE SANY SILT |
| | | SL-3 | 7 TO 10 INCHES | ALLUVIUM: DARK BROWNISH GRAY CLAYEY MEDIUM TO FINE SAND |
| | STREAM OUTFALL | SL-1 | 0 TO 7 INCHES | ALLUVIUM: DARK BROWN FINE SAND |
| | | SL-2 | 7 TO 9 INCHES | RESIDUUM: BROWN FINE SANDY WITH THINY GRAVEL |
| | | SL-3 | 9 TO 10 INCHES | GROUND WATER: SOIL WASH-OUT & CAVE-IN. |

TABLE: G-1

BORING LOG FOR THE INDU
(SITE-2)

| DATE SAMPLE COLLECTED | SAMPLE LOCATION |
|---|---|
| SEPT.6, 2004 | RETROFIT/ DETENTION POND |
| | RIP-RAP SPLASH PAD |
| | STREAM OUTFALL |

TABLE: G-2

BORING LOG FOR THE INDUSTRIAL WAREHOUSE CONSTRUCTION SITE (SITE-2)

| DATE SAMPLE COLLECTED | SAMPLE LOCATION | SAMPLE LAYER (SL) | SAMPLE DEPTH | SAMPLE DESCRIPTION |
|---|---|---|---|---|
| SEPT.6, 2004 | RETROFIT/ DETENTION POND | SL-1 | 0 TO 3 INCHES | REDISH BROWN SOIL WITH ORGANIC MATERIALS |
| | | SL-2 | 3 TO 4 INCHES | ALLUVIUM: DARK RED SOIL WITH VERY DENSE SILTY SAND |
| | | SL-3 | 4 TO 10 INCHES | RESIDUUM: DARK GRAY, EXTENED DENSE SANDY CLAY |
| | RIP-RAP SPLASH PAD | SL-1 | 0 TO 7 INCHES | DARK GRAY SILTY CLAY WITH ORGANIC MATERIALS |
| | | SL-2 | 7 TO 10 INCHES | ALLUVIUM: BROWN SILTY SAND |
| | STREAM OUTFALL | SL-1 | 0 TO 4 INCHES | SANDY TOP SOIL WITH ORGANIC MATERIAL AND THINY GRAVELS |
| | | SL-2 | 4 TO 8 INCHES | RESIDUUM: DARK BROWN SANDY CLAY SOIL |
| | | SL-3 | 8 TO 10 INCHES | GROUND WATER LEVEL: SOIL WASH-OUT & CAVE-IN. |

TABLE: G-2

BORING LOG FOR MIDDLE S

| DATE SAMPLE COLLECTED | SAMPLE LOCATION | SAMP (SL |
|---|---|---|
| NOV.25,2004 | RETROFIT/ DETENTION POND | S |
| | | |
| | RIP-RAP SPLASH PAD | |
| | | |
| | | |
| | | |
| | STREAM OUTFALL | |
| | | |

TABLE: G-3

BORING LOG FOR MIDDLE SCHOOL CONSTRUCTION SITE (SITE-3)

| DATE SAMPLE COLLECTED | SAMPLE LOCATION | SAMPLE LAYER (SL) | SAMPLE DEPTH | SAMPLE DESCRIPTION |
|---|---|---|---|---|
| NOV.25,2004 | RETROFIT/ DETENTION POND | SL-I | 0 TO 4 INCHES | ALLUVIUM: DARK-BROWN CLAY WITH ORGANIC MATERIALS |
| | | SL-2 | 4 TO 10 INCHES | RESIDUUM: REDISH, DARK-BROWN SANDY CLAY WITH THINNY GRAVELS |
| | RIP-RAP SPLASH PAD | SLI | 0 TO 2 INCHES | ALLUVIUM: DARK-BROWN SILT WITH ORGANIC MATERIALS |
| | | SL-2 | 2 TO 6 INCHES | RESIDUUM: DARK-BROWN SILTY CLAY WITH FINE SAND |
| | | SL-3 | 6 TO 8 INCHES | ALLUVIUM: BROWN FINE SANDY SOIL |
| | | SL-4 | 8 TO 10 INCHES | ALLUVIUM: BROWN-REDISH FINE SANDY SOIL WITII SMALL GRAVELS |
| | STREAM OUTFALL | SL-I | 0 TO 8 INCHES | ALLUVIUM: BROWN SANDY SOIL |
| | | SL-2 | 8 TO 10 INCHES | GROUND WATER LEVEL: SOIL W ASH-OUT |

TABLE: G-3

BORING LOG FOR BJ SHOPPI

| DATE SAMPLE COLLECTED | SAMPLE LOCATION |
|---|---|
| NOV.26, 2004 | RETROFIT/ DETENTION POND |
| | RIP-RAP SPLASH PAD |
| | STREAM OUTFALL |

TABLE: G-4

BORING LOG FOR BJ SHOPPING CENTER CONSTRUCTION SITE (SITE-4)

| DATE SAMPLE COLLECTED | SAMPLE LOCATION | SAMPLE LAYER (SL) | SAMPLE DEPTH | SAMPLE DESCRIPTION |
|---|---|---|---|---|
| NOV.26, 2004 | RETROFIT/ DETENTION POND | SL-1 | 0 TO 3 INCHES | RESIDUUM: LIGHT BROWN SILT SANDY SOIL WITH ORGANIC MATERIALS |
| | | SL-2 | 3 TO 6 INCHES | ALLUVIUM: BROWN-GRAYISH, DENSE SILT SAND WITH BAD ODOR |
| | | SL-3 | 6 TO 10 INCHES | SANDY-CLAY WITH ORGANIC MATERIAL AND BAD ODOR |
| | RIP-RAP SPLASH PAD | SL-1 | 0 TO 2 INCHES | RESIDUUM: DARK-BROWN DENSE SILTY CLAY |
| | | SL-2 | 2 TO 8 INCHES | ALLUVIUM: BROWN SILTY CLAY WITH ORGANIC MATERIALS |
| | | SL-3 | 8 TO 10 INCHES | ALLUVIUM: LIGHT BROWN AND LESS DENSED CLAYEY SOIL |
| | STREAM OUTFALL | SL-1 | 0 TO 2 INCHES | ALLUVIUM: BROWNISH SANDY CLAY WITH ORGANIC MATERIALS |
| | | SL-2 | 2 TO 10 INCHES | GROUND WATER LEVEL: SOIL WASH-OUT & CAVE-IN |

TABLE: G-4

BORING LOG FOR OFFICE BUILI

| DATE SAMPLE COLLECTED | SAMPLE LOCATION |
|---|---|
| MAR.03, 2005 | RETROFIT/ DETENTION POND |
| | RIP-RAP SPLASH PAD |
| | STREAM OUTFALL |

TABLE: G-5

BORING LOG FOR OFFICE BUILDING COMPLEX CONSTRUCTION SITE (SITE-5)

| DATE SAMPLE COLLECTED | SAMPLE LOCATION | SAMPLE LAYER (SL) | SAMPLE DEPTH | SAMPLE DESCRIPTION |
|---|---|---|---|---|
| MAR.03, 2005 | RETROFIT/ DETENTION POND | SL-1 | 0 TO 6 INCHES | DARK ORGANIC SOIL WITH DENSE SILTY CLAY |
| | | SL-2 | 6 TO 8 INCHES | RESIDUUM:, DARK-RED SILTY CLAY WITH ORGANIC MATERIALS |
| | | SL3 | 8 TO10 INCHES | ALLUVIUM: DARK-BROWN VERY DENSED CLAY SOIL |
| | RIP-RAP SPLASH PAD | SL-1 | 0 TO 2 INCHES | RESIDUUM: GRAY SILTY SANDY SOIL WITH ORGANIC MATERIALS |
| | | SL-2 | 2 TO 6 INCHES | ALLUVIUM: GRAY SANDY CLAY SOIL WITH SOME REPOLSIVE SMELL |
| | | SL-3 | 6 TO 8 INCHES | ALLUVIUM: DARK-YELLOWISH DENSED CLAY WITH REPOLSIVE SMELL |
| | | SL-4 | 8 TO 10 INCHES | SOIL WASH-OUT INDICATING GROUND WATER PRESENCE |
| | STREAM OUTFALL | SL-1 | 0 TO 4 INCHES | ALLUVIUM: BROWN SILTY SAND SOIL |
| | | SL-2 | 4 TO 6 INCHES | RESIDUUM: LIGHT BROWN SANDY CLAY SOIL |
| | | SL-3 | 6 TO 10 INCHES | GROUND WATER LEVEL: SOIL WASH-OUT |

TABLE: G-5

A

**DURING AND AFTER CONSTRUCTIO**

CARWASH CONSTRUCTION SITE (E

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT OF MICA TRACED | |
|---|---|---|---|
| | 50 GRAMS | DURING CONST. | AFTE CON |
| DETENTION POND | 50 GRAMS | 22 G | 5 G |
| RIP-RAP SPLASH PAD | 50 GRAMS | 20 G | 2 .G |
| STREAM OUTFALL | 50 .GRAMS | 0.8 G | 0.0 G |

TABLE: H-1

**INDUSTRIAL WAREHOUSE CONST**

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT OF MICA TRACED | |
|---|---|---|---|
| | 50 GRAMS | DURING CONST. | AFTE CONS |
| DETENTION POND | 50 GRAMS | 46 G | 13 G |
| RIP-RAP SPLASH PAD | 50 GRAMS | 44 G | 9 G |
| STREAM OUTFALL | 50 GRAMS | 24 G | 2 .G |

TABLE: H -2

# APPENDIX-H

## DURING AND AFTER CONSTRUCTION POLLUTANTS. TRACES COMPARED

### CARWASH CONSTRUCTION SITE (EXP. SITE-1)

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT OF MICA TRACED | | . AMOUNT OF BITUMEN TRACED | | AMOUNT OF PAINT TRACED | |
|---|---|---|---|---|---|---|---|
| | 50 GRAMS | DURING CONST. | AFTER. CONST. | DURING CONST. | AFTER. CONST. | DURING CONST. | AFTER CONST |
| DETENTION POND | 50 GRAMS | 22 G | 5 G | 0.09 G | 0.0 G | ------- | --- |
| RIP-RAP SPLASH PAD | 50 GRAMS | 20 G | 2 .G | 0.06 G | 0.0 G | ------- | --- |
| STREAM OUTFALL | 50 .GRAMS | 0.8 G | 0.0 G | 0.02. G | 0.0 G | ----- | ---- |

TABLE: H-1

### INDUSTRIAL WAREHOUSE CONSTRUCTION SITE (EXP. SITE-2)

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT OF MICA TRACED | | AMOUNT OF BITUMEN TRACED | | AMOUNT OF PAINT TRACED | |
|---|---|---|---|---|---|---|---|
| | 50 GRAMS | DURING CONST. | AFTER. CONST. | DURING CONST. | AFTER. CONST. | DURING CONST. | AFTER. CONST |
| DETENTION POND | 50 GRAMS | 46 G | 13 G | 0.85 .G | 0.023 G | 0.06 G | 0.02 G |
| RIP-RAP SPLASH PAD | 50 GRAMS | 44 G | 9 G | 0.67G | 0.01. G | 0.02 G | 0.0 G |
| STREAM OUTFALL | 50 GRAMS | 24 G | 2 .G | 0.52 .G | 0.0 G | 0.0 G | 0.0 G |

TABLE: H -2

BJ SHOPPING CENTER CONSTI

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT C TRACED |
|---|---|---|
| | 50 GRAMS | DURING CONST. |
| DETENTION POND | 50 GRAMS | 39 G |
| RIP-RAP SPLASH PAD | 50 GRAMS | 31 G |
| STREAM OUTFALL | 50 GRAMS | 26 G |

TABLE: H-3

MIDDLE SCHOOL CONSTRUCT

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT C TRACED |
|---|---|---|
| | 50 GRAMS | DURING CONST. |
| DETENTION POND | 50 GRAMS | 33 G |
| RIP-RAP SPLASH PAD | 50 GRAMS | 32 G |
| STREAM OUTFALL | 50 GRAMS | 26 G |

TABLE: H-4

OFFICE BUILDING COMPLEX C

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT C TRACED |
|---|---|---|
| | 50 GRAMS | DURING CONST. |
| DETENTION POND | 50 GRAMS | 29 G |
| RIP-RAP SPLASH PAD | 50 GRAMS | 23 G |
| STREAM OUTFALL | 50 GRAMS | 16 G |

TABLE: H-5

BJ SHOPPING CENTER CONSTRUCTION SITE (EXP. SITE-3)

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT OF MICA TRACED | | AMOUNT OF BITUMEN TRACED | | AMOUNT OF PAINT TRACED | |
|---|---|---|---|---|---|---|---|
| | 50 GRAMS | DURING CONST. | AFTER CONST. | DURING CONST. | AFTER CONST. | DURING CONST. | AFTER CONST |
| DETENTION POND | 50 GRAMS | 39 G | 23 G | 1.92 G | 0.9 G | 0.14 G | 0.10 G |
| RIP-RAP SPLASH PAD | 50 GRAMS | 31 G | 17 G | 1.67 G | 0.5 G | 0.08 G | 0.03 G |
| STREAM OUTFALL | 50 GRAMS | 26 G | 6 G | 1.54 G | 0.0 G | 0.02 G | 0.01 G |

TABLE: H-3

MIDDLE SCHOOL CONSTRUCTION SITE (EXP. SITE-4)

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT OF MICA TRACED | | AMOUNT OF BITUMEN TRACED | | AMOUNT OF PAINT TRACED | |
|---|---|---|---|---|---|---|---|
| | 50 GRAMS | DURING CONST. | AFTER CONST. | DURING CONST. | AFTER CONST. | DURING CONST. | AFTER CONST |
| DETENTION POND | 50 GRAMS | 33 G | 27 G | 1.69 G | 0,7 G | 0.04 G | 0.25G |
| RIP-RAP SPLASH PAD | 50 GRAMS | 32 G | 19 G | 1.71 G | 0.3 G | 0.06 G | 0.38G |
| STREAM OUTFALL | 50 GRAMS | 26 G | 8 G | 1..41 G | 0.1 G | 0.02 G | 0.03G |

TABLE: H-4

OFFICE BUILDING COMPLEX CONSTRUCTION SITE (EXP. SITE-5)

| SAMPLE LOCATION | SAMPLE WEIGHT | AMOUNT OF MICA TRACED | | AMOUNT OF BITUMEN TRACED | | AMOUNT OF PAINT TRACED | |
|---|---|---|---|---|---|---|---|
| | 50 GRAMS | DURING CONST. | AFTER CONST. | DURING CONST. | AFTER CONST. | DURING CONST. | AFTER CONST |
| DETENTION POND | 50 GRAMS | 29 G | 11 G | 20 G | 14 G | 4 G | 0.15 G |
| RIP-RAP SPLASH PAD | 50 GRAMS | 23 G | 8 G | 40 G | 18 G | 2 G | 0.01G |
| STREAM OUTFALL | 50 GRAMS | 16 G | 2 G | 20 G | 5 G | 0.0 G | 0.0G |

TABLE: H-5