“Water Quality Monitoring of Catch Basins”

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EXECUTIVE SUMMARY

The purpose of this research was to evaluate the effectiveness of four catch basins in the removal of stormwater contaminants for fifteen storm events in the District of Columbia. The four catch basins in this study are known as the: Hydrodynamic, Regular, Filter and Vortex catch basins. From the data that will be presented throughout this report it is our conclusion that the general order of performance in descending order were: Filter, Vortex, Hydrodynamic and Regular catch basin. The Regular catch basin produced more pollutants that it removed for 10 parameters. The Hydrodynamic produced more for 8 of the pollutants, while the Filter and Vortex produced negative values for 2 and 4 of the pollutants. In addition, the Regular catch basin collected some sediment, however it does not remove trash. All of the other catch basins regularly required trash removal before sampling. The Filter and Vortex show some potential for the removal of small particles with TSS removal of 80% and 76%, respectively.

The following are additional recommendations:

1. All catch basins should be maintained quarterly.
2. Street sweeping should be implemented citywide to lower the load of trash and sediment that reaches the catch basins.
3. Inlet grates/screens are most likely the cheapest alternative for improved performance in the short term.
4. DDOT should support DDOE “Plan for a Fishable and Swimmable Anacostia River by 2032” by focusing on trash first, then nutrients and other pollutants.

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INTRODUCTION

1.1 Problem Definition

The U.S. Environmental Protection Agency (U.S.EPA, 2003) has indicated that urban stormwater runoff and combined sewer overflows, or the separate stormwater and sanitary sewage collection system pollute 56,107 km of rivers and streams (5% of the rivers and streams assessed) in the United States. Additionally, urban stormwater runoff and storm sewers degrade nearly 570,000 hectares of lakes (8% of the assessed lakes). Thus, the urban runoff and combined sewer overflows (CSOs) represent serious water quality problems. Moreover, urban runoff is rapidly becoming a major source of non-point source pollution (US EPA, 1996) and has been found to be a leading impairment source for surface waters and ground water. Bang et al., (1997) have indicated that the street solids and sewer-deposited material are major pollutants in urban runoff.

The District of Columbia is served by the Municipal Separate Storm Sewer System (MS4) and Combined Sewer System (CSS). During a storm event, most of the stormwater collected by these systems are discharged directly into the rivers causing human health effects as well as problems for the aquatic species present. Moreover, during runoff, floatables and other debris transported to the sewer systems often cause blockages of the systems, which often leads to flooding. In order to prevent sewer blockages and improve the quality of the stormwater before reaching the sewer systems, catch basins are installed in urban locations.

Catch basins are entry points for the sewer system, which are reasonably effective in protecting sewers from receiving loads of coarse solids greater than 0.04 inches (1 mm) in diameter and receiving waters from excessive sediment deposit (Michigan

Department of Environment, 1992). Studies have shown that the removal of sediment, decaying debris, and highly polluted water by catch basins has aesthetic and water quality benefits, including reducing foul odors and reducing suspended solids (US EPA, 1999).

Several different varieties of catch basin configurations are available today. The District of Columbia has thousands of catch basins that are built as subterranean roadside chambers or wells, usually located at and beneath the curb. The four catch basins being studied in this research are referred as the: Hydrodynamic, Regular, Filter and Vortex catch basins. Results have shown that typical catch basins, similar in design to the Regular catch basin in this study, with a capacity of 0.4 to 1.2 m^3, have been estimated to retain 57% of the coarse solids and 17% of equivalent BOD (Minnesota Pollution Control Agency (MPCA), 1989). A study in Boston, Massachusetts, found catch basins with routine cleaning could reduce solids by 60 to 70%, COD by 10 to 56%, and BOD by 54 to 88% (Aronson et al., 1983, Field 1990). These are broad ranges and stormwater monitoring studies generally have a large variation in performance data. The primary principle of this study is to determine whether the Hydrodynamic, Filter, or Vortex designs provide enhanced removal of pollutants of interest over the Regular catch basin.

The Hydrodynamic and Regular catch basins are located at the Shepard Parkway, SW vicinity of the District of Columbia's Village, directly across from the entrance to the District of Columbia Fire Fighter Training Facility. The Filter and Vortex catch basins are located at the junction of the 17th and S streets SE, which is a residential area.

The Regular catch basin removes the debris from the stormwater by sedimentation into a sump (USEPA, 1999). A Regular catch basin is constructed with a sump below the pipe invert. When it rains, the sump collects sediment and debris entering the catch basin through the grate inlet. In addition, some of the sediment that enters the sump are transported and discharged into the sewer system through the outlet. In this study the Regular catch basin is considered the control device, providing the baseline of performance for evaluation purposes.

The Hydrodynamic catch basin is a rectangular vessel with a series of inverted walls that enables settleable solids and floatable trash to accumulate in a manner that allows the passage of only dissolved material. Instead of having one sump a Hydrodynamic has two chambers separated by an overflow wall. The first chamber has an inverted wall. During a storm event, sediment, trash and floatables get trapped in the first chamber along with oil and grease. In the second chamber stormwater flows over a vertical wall and out of the device.

Aronson et al., (1983) stated that the filtering of solids in the Filter catch basin is dependent on physical properties such as grain size and pore size. During a storm event, debris, trash and other suspended solid materials enter this catch basin through an opening. The filtration that occurs reduces the concentration of stormwater runoff pollutants that include: heavy metals, suspended solids, particles and oil and grease. The filter material is made of granular activated carbon.

According to Brombach Solo et al., 1987, in the Vortex catch basin, a flow stream is introduced tangentially to induce a swirling flow pattern that separates solids from the flow of stormwater. The separation of sediments depends primarily on settling and may be enhanced by the swirling action of flowing water. According to Field (1990), Vortex solids separators remove settleable matter by 2 mechanisms: the sweeping action of solids by secondary vortex flow toward the centroidal axis of rotation, and the transport of particles by gravity in the laminar flow regime of the unit.

Despite being a major component in many drainage systems, the functioning of catch basins has not been widely investigated and little literature exists on this subject. This study investigated the effectiveness of four catch basins in the removal of pollutants in the District of Columbia, with the goal of ranking the four devices in order of performance with respect to pollutant removal.

BACKGROUND AND REVIEW OF LITERATURE

2.1 Background

Historically, the role of catch basins has been to minimize sewer clogging by trapping coarse debris and reducing odor emanating from low-velocity sewers by providing a water seal (Field. 1990). According to Lager et al., (1977), catch basins were considered marginal in performance as early as the turn of the 20th century and their use in many municipalities may be more of a tradition than a practice based on performance. This is because catch basins had the tendency to settle in flat to mildly sloped pipes, causing clogs, backups and overflows which produced noxious odors. Unlike specially designed stormwater treatment vaults, catch basins, like the Regular catch basin in this study, are not intended to remove fine particles (less than 0.04 inches or 1 mm in diameter) or soluble pollutants, and they may only marginally reduce concentrations of contaminants or suspended solids (U.S. EPA. 1987).

Several studies indicate total suspended solids (TSS) may be reduced by approximately 20% in some catch basins. Jordan Palmeri (2005) stated that catch basin efficiency could be improved by; frequent maintenance, implementation of best management practices (BMPs) or with the use of catch basin inserts. Palmeri suggested that catch basins be cleaned when the amount of sediment is greater than 1/3 the distances between the bottom of the basin and the water line. Moreover, retrofitting existing catch basins may also help to improve their performance substantially. A simple retrofit option for catch basins is to ensure that they all have a hooded outlet to prevent floatable materials, such as trash and debris, from entering the storm drain system.

2.2 Literature Review

2.2.1 Water Quality and Pollution

The problem of stormwater pollution is worsening as a result of population growth and density. According to Henry and Heinke (1989), the definition of water quality and pollution most accepted by scientists was “unreasonable interference with beneficial uses of the resources”. However, with the advent of the Water Pollution Control Act Amendments of 1972, today’s interpretation puts a high value on the protection of the environment and supersedes any economic savings that might be achieved by allowing injurious discharges of pollutants (Schroepfer, 1978).

Although stormwater is often viewed by the public as being clean as rain, it contains significant quantities of the same types of constituents more commonly associated with municipal and/or industrial wastewater. These pollutants cause dramatic changes in hydrology and water quality that result in a variety of problems. Hydrologic impact due to urbanization is reported to cause water quality problems such as sedimentation, increased temperatures, habitat changes, and loss of fish population (Natural Resources Defense Council (NRDC), 1999). The most dramatic consequences of increases in the volume and rate of stormwater runoff are flooding, property damage, and erosion (NRDC, 1999).

2.2.2 Effects of Urban Runoff on Water Quality in Catch Basins

The urban runoff containing pollutants flows into storm sewer inlets with sumps, such as catch basins, which are effective at trapping coarse sediments and large debris including fast food containers and leaves. Results have shown that typical catch basins, with a capacity of 0.4 to 1.2 m^3, have been estimated to retain 57% of the coarse solids and 17% of equivalent BOD (Minnesota Pollution Control Agency (MPCA), 1989). A study in Boston, Massachusetts, found catch basins with routine cleaning (at least once or twice a year) could reduce solids by 60 to 70%, COD by 10 to 56%, and BOD by 54 to 88% (Aronson et al., 1983, Field 1990, Law et al., 2006).

In the absence of cleaning, catch basins can actually make water quality conditions worse. It has been reported that once a sump is 40 to 50% full, inflow water can begin to scour sediment and pollutants out of the sump, making the catch basin a source of pollutants (MPCA, 1989). Catch basins need to be cleaned when they reach 30 to 40% of their storage capacity. Moreover, when these catch basins are blocked, they can also create breeding grounds for mosquitoes that can carry the West Nile Virus thereby causing health hazards for the population. Cleaning of catch basins is important because blocked catch basins and pipes will not carry away stormwater, posing the risk that new storms will cause additional flooding. In order to prevent flooding, it is necessary to maximize the sewer line capacity and help control pollution levels.

2.2.3 Impacts of Urban Pollutants on Receiving Waters

With the spread of development and intensified agricultural practices across watersheds, polluted runoff, non-point source pollution and unmanaged development have become the greatest threats to drinking water sources (Trust for Public Land (TPL), 1997). Other sources of pollutants that accumulate and subsequently washoff impervious surfaces include pet droppings, litter, and debris. Several studies suggest that as neighborhoods become mature, some of these sources can become very important (Baltimore Regional Planning Council (BRPC), 1986). Urbanization contributes to urban stormwater pollution through the discharge of pollutants, oil, grease, construction, illicit connections, leaking sanitary sewers and other countless aspects of daily life in urban areas contribute to polluted runoff (NRDC, 1999).

Stormwater runoff has been known to produce significant toxicity to early life stages of aquatic organisms due to the presence of heavy metals. The sources of metals in stormwater are many and the metal release mechanisms are complex. Hvitved-Jacobsen and Yousef (1991) indicated that the heavy metals most prevalent in stormwater are lead, zinc, iron, copper, cadmium, chromium and nickel. Traffic is also a major source of metals, brake linings are a large source of copper and smaller quantities of nickel, chromium, zinc, and lead (Maschak, 1990; Davies et al., 2001). It has been shown that roadway runoff early in storm events contains the greatest numbers of smaller particles (Li et al., 2005). Since many metals and organic pollutants are adsorbed to particles and exist in higher concentrations on smaller particles. First flush is the initial urban runoff in a rainstorm. Water pollution entering storm drains, and subsequently surface waters, during this phase of the storm is typically more concentrated compared to the remainder of the storm. Treating the first flush provides improved opportunity to remove particulate phase metals (Li et al., 2005).

2.2.4 First flush background

In general the term first flush has been used to indicate that the mass emission rate is higher during the initial portions of runoff than during the last portion of the runoff. Several definitions for this phenomenon have been given, but in 1998, Bertrand-Krajewski et al., (1998) defined the first flush as occurring when at least 80% of the pollutant mass is discharged in the first 30% of the runoff volume. The existence of a first flush depends on the type of pollutant, size of the catchment as well as the surfaces. He et al., (2001) observed a first flush of heavy metals from roof tops surfaces. In addition, Ma et al., (2002) observed the first flush in oil, grease, TSS, COD and total organic carbon from highways surfaces.

2.2.5 Catch Basin Cleaning

Catch basins must be cleaned semi-annually to maintain their ability to trap sediment, and consequently their ability to prevent flooding. Catch basin cleaning should be performed at any facility that has an on-site storm sewer system that includes catch basins and manholes. Although catch basin cleaning is easily implemented, it is often overlooked in an overall stormwater management plan. In accordance with the EPA (USEPA, 1999), limitations associated with cleaning catch basins include:

1. Catch basin debris usually contains appreciable amounts of water and offensive organic material which must be properly disposed.
2. Catch basins may be difficult to clean in areas with poor accessibility and in areas with traffic congestion and parking problems.
3. Cleaning is difficult during the winter when snow and ice are present.

Catch basins can be cleaned either manually or by specially designed equipment. This equipment may include bucket loaders and vacuum pumps. Materials removed from catch basins are usually disposed in conventional landfills. Sediment and debris removed from catch basins can potentially be classified as hazardous waste. As a result, the materials must be disposed in a proper manner to avoid negative environmental impacts. Before any material can be disposed, it is necessary to perform a detailed chemical analysis to determine if the materials meet the EPA criteria for hazardous waste. This will help determine how the materials should be stored, treated, and disposed.

Catch basin cleaning costs will vary depending upon the method used, the required cleaning frequency, the amount of debris removed, and debris disposal costs. The

Southeastern Wisconsin Regional Planning Commission (1991) stated that in communities equipped with vacuum street sweepers, a cleaning cost of $8 per basin cleaned is recommended for budgetary purposes. Cleaning catch basins manually costs approximately twice as much as cleaning the basins with a vacuum attached to a sweeper. It should be noted that costs vary depending on local market conditions.

Figure 2.1 Hydrodynamic Catch Basin Installed at Shephard Parkway

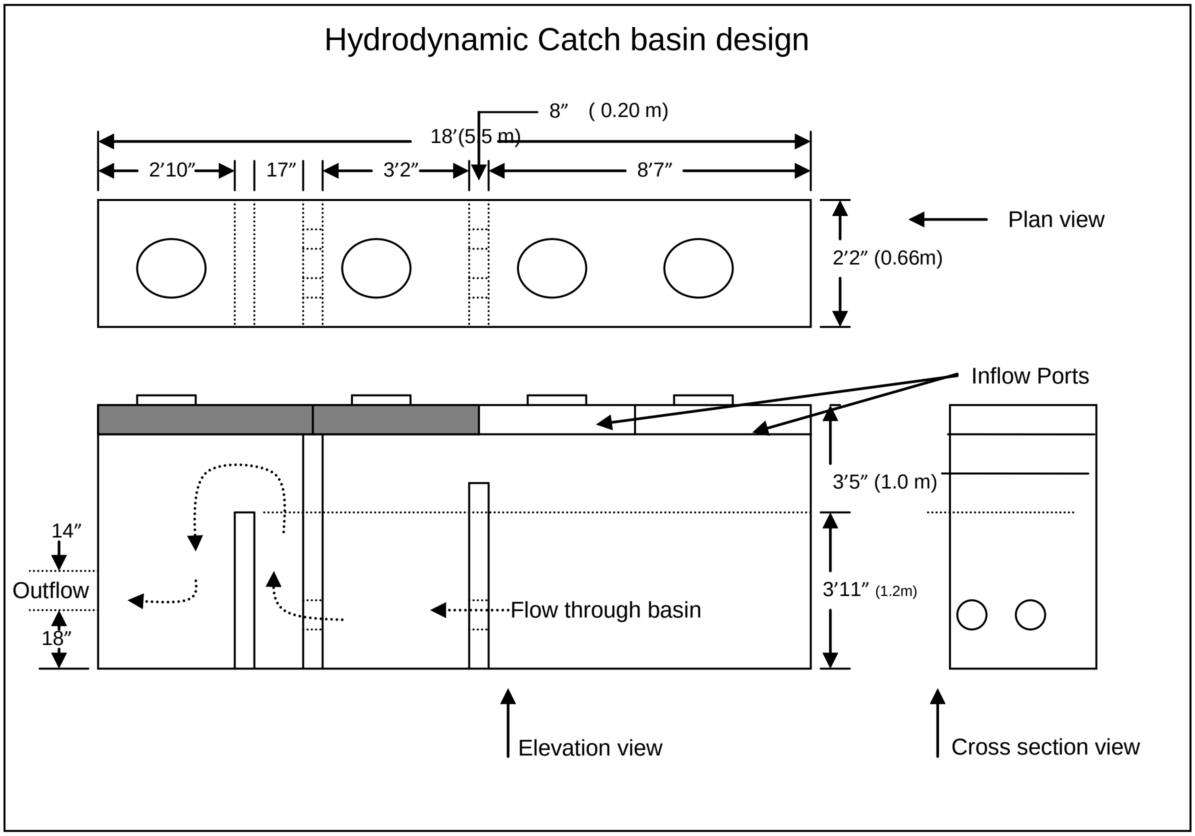


Figure 2.1 shows the Hydrodynamic catch basin with a volume of 72.84 ft^3. The inflow ports of this catch basin have 2 manhole covers representing one chamber. During a storm event, sediment, trash and floatables get trapped in the first and possibly the second chambers.

Figure 2.2. Regular Catch Basin Installed along Shephard Parkway

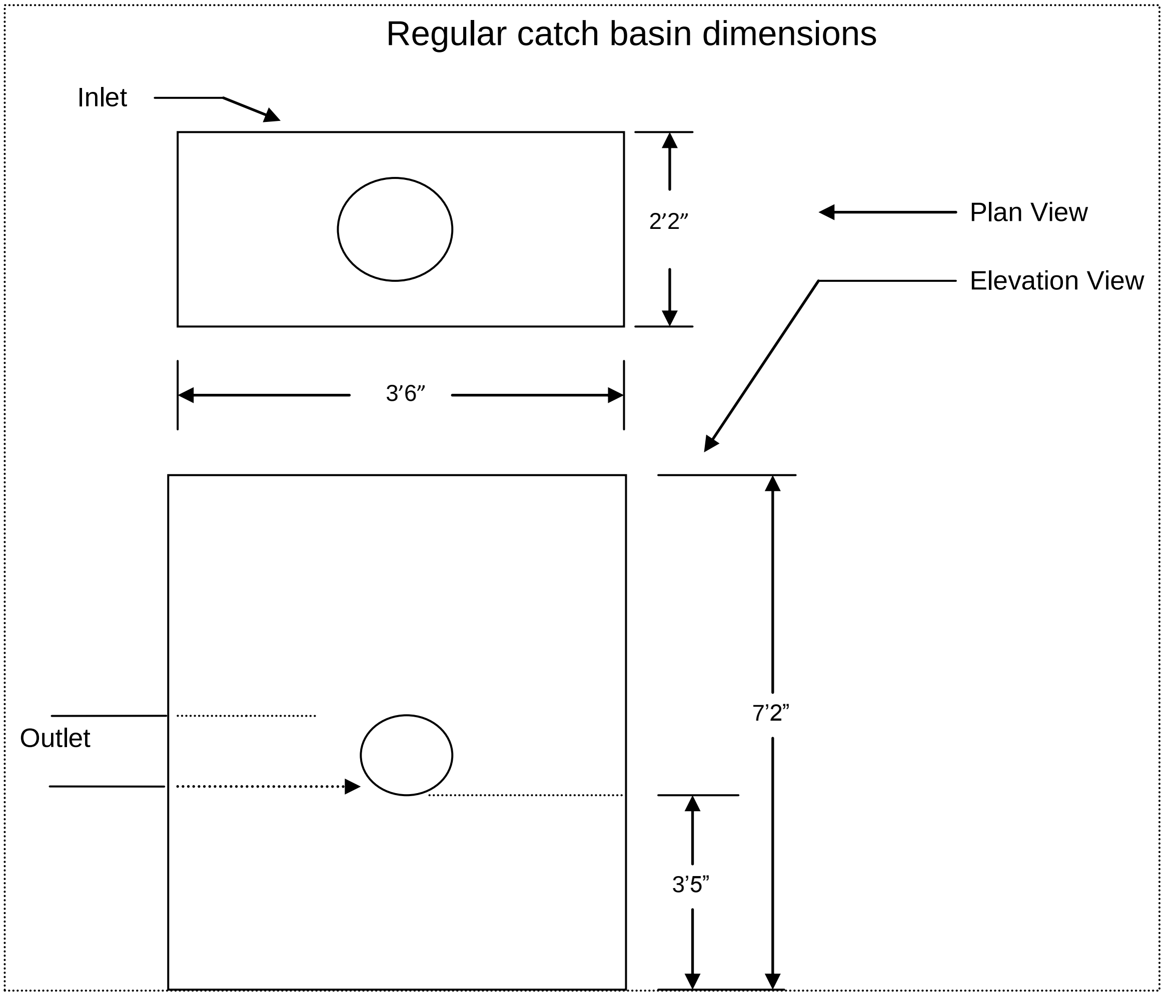
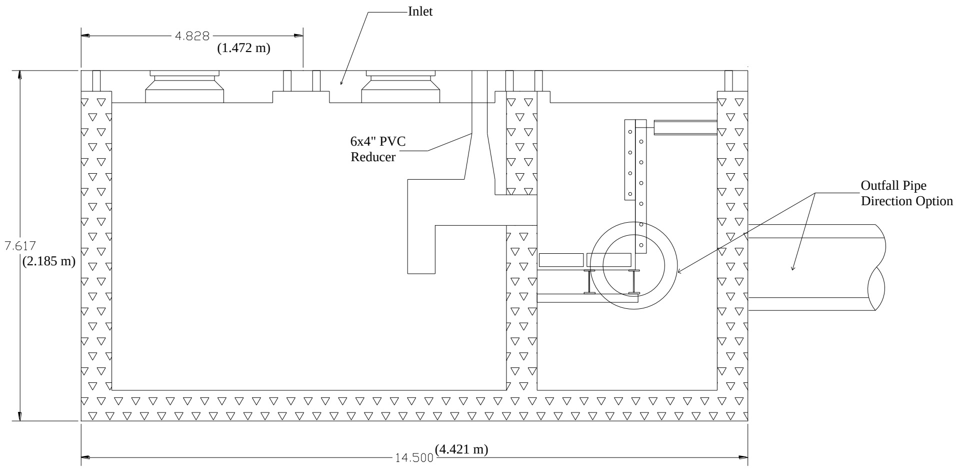


Figure 2.2 presents a schematic diagram of the Regular catch basin with a volume of 25.91 $ft^{3.}$ This catch basin is constructed with a sump below the pipe invert. When it rains, the sump collects sediment and debris entering the catch basin through the inlet. In addition, some of the sediment that enters the sump are transported and discharged into the sewer system through the outlet.

Figure 2.3 Filter Catch Basin Installed on 17th and S Streets S.E.



The Filter catch basin shown in Figure 2.3 has a volume of 111.34 ft^3. During a storm event, debris, trash and other suspended solid materials enter this catch basin through an opening. The filtration that occurs reduces the concentration of storm water runoff pollutants that include: heavy metals, suspended solids, particles and oil and grease. The filter material is made of Granular Activated Carbon.

Figure 2.4 Vortex Catch Basin Installed on 17th and S Streets S.E.

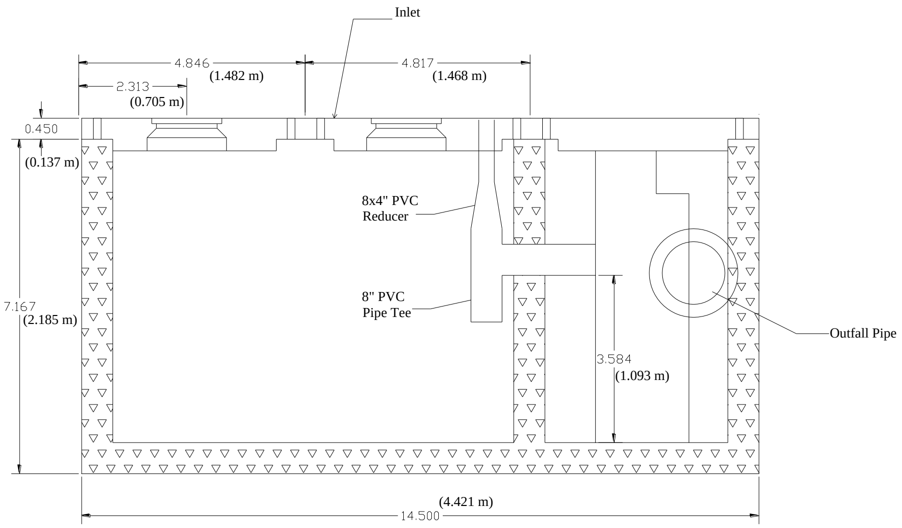


Figure 2.4 shows the Vortex catch basin with a volume of 112.85 ft^3. The separation of sediments depends primarily on settling and is enhanced by the swirling action of flowing water. According to Field (1990), Vortex solids separators remove settleable matter by 2 mechanisms: the sweeping action of solids by secondary vortex flow toward the centroidal axis of rotation, and the transport of particles by gravity in the laminar flow regime of the unit.

MATERIALS AND METHODS

3.1 Stormwater Sampling

This project was contracted to collect influent and effluent for 15 storm events. In actuality 21 storms were sampled conducted from May, 2007 to July, 2008 due to inconsistencies in rainfall and arrival at the sites after storms had ended resulting in missing effluent. Table 3.1 lists the sample dates and the rainfall measurements at the National Airport weather station. Influent and effluent samples were evaluated with a 3 day minimum dry period between collection samples in order to ensure an adequate antecedent dry period for pollutants to accumulate after the previous storm. The samples for the Hydrodynamic and Regular catch basins respectively were collected at the Shepard Parkway vicinity of the District of Columbia's Village. The Filter and Vortex catch basins respectively were collected at the 17th Street, SE in Washington, D.C.

Before the start of a storm event, four jars, each of 2 liter capacity, were placed at each site to collect the inflow water. These jars were secured by a shelf system that had been constructed and installed into the concrete wall in the catch basins to collect the first flush as water flows over the lip of the catch basin. The effluent water was collected from the outlets of these sites with a jar attached to an eight foot pool and then placed into the same size 2 liter jars for storage and transported to the Howard University laboratory for analysis. The effluent from all of the devices is a result of stormwater that has passed through the devices, mixed with the standing water that is ever present in them, and then exits the device. There is no first flush for effluent water given that the water passes through the devices, mixes with standing water inside of the devices, and has a varying hydraulic residence time given the size of the device and the flowrate produced by the storm.

For the Hydrodynamic and the Regular catch basins, the sampling point is located approximately 10 m from the Hydrodynamic catch basin while for Vortex and the Filter, the effluent is located in the middle of the 17th street and S street intersection. Only storms where collection of both influent and effluent occurred simultaneously were used in this study. There were several instances where the research team did not make it to the devices in time to collect the effluent sample.

Table 3.1 Sampling Dates

Sampling Date	Event #	Samples Collected	Rainfall (inches)
5/16/2007	1	All Sites except Hydrodynamic	0.48
6/3/2007	2	All Sites	0.88
6/28/2007	3	Filter and Vortex	0.04
7/29/2007	4	All Sites	0.98
8/5/2007	5	Filter and Vortex	0.09
8/16/2007	6	Filter and Vortex	0.07
10/24/2007	7	Regular and Hydrodynamic	1.5
11/13/2007	8	Regular and Hydrodynamic	0.08
11/26/2007	9	Regular and Hydrodynamic	0.11
1/10/2008	10	All Sites	0.18
2/1/2008	11	All Sites	1.75
2/6/2008	12	All Sites	0.14
2/13/2008	13	All Sites	1.17
3/4/2008	14	All Sites	0.39
3/7/2008	15	All Sites	0.59
3/16/2008	16	All Sites	0.57
4/28/2008	17	All Sites	0.96

5/9/2008	18	All Sites, Filter Completed	2.22
6/14/2008	19	All Remaining Sites	0.13
7/13/08	20	Regular and Hydrodynamic	0.58
7/23/08	21	Hydrodynamic	1.09

3.2 Sample Storage and Preservation

Samples were carefully handled to prevent cross contamination and were also labeled to avoid misidentification. After these samples had been collected, they were prepared for storage or analyzed by the team at the Howard University laboratory in accordance with the protocol of Table 3.2 on the same day.

The following parameters were measured during the course of this research on the influent and effluent water to each of the four catch basins; pH, temperature, total suspended and dissolved solids, dissolved oxygen, chemical oxygen demand and nutrients (ammonia, nitrite, nitrate, phosphate). Moreover, heavy metals such as mercury (Hg), Cadmium (Cd), Copper (Cu), Lead, (Pb), Chromium, Arsenic (As) and 16 Polycyclic Aromatic Hydrocarbons (PAH), associated with oil and grease, were measured during each rain event in order to determine their presence. The 16 PAHs were; Naphthalene, Acenaphthene, Acenaphthylene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(ghi)perylene, Indeno(1, 2, 3-cd)pyrene.

The accuracy of both the equipment and the sampling methodology were determined by performing these tests in triplicate. In addition, the instruments were also calibrated by creating a standard curve with at least five known values, in triplicate.

Table 3.2. Parameters Measured and the Technique Required

Constituent Name	**Analytical Method**	**Collection method**	**Containers**	**Preservative**	**Maximum holding time**
Cadmium	AAS- Furnace	Composite	Plastic, Glass	Filter on site HNO_3 to PH<2	6 mths
Chromium	AAS- Furnace	Composite	Plastic, Glass	Filter on site HNO_3 to PH<2	6 mths
Copper	AAS- Furnace	Composite	Plastic, Glass	Filter on site HNO_3 to PH<2	6 mths
Iron	AAS- Furnace	Composite	Plastic, Glass	Filter on site HNO_3 to PH<2	6 mths
Lead	AAS- Furnace	Composite	Plastic, Glass	Filter on site HNO_3 to PH<2	6 mths
Arsenic	AAS- Furnace	Composite	Plastic, Glass	Filter on site HNO_3 to PH<2	6 mths
Zinc	AAS- Furnace	Composite	Plastic, Glass	Filter on site HNO_3 to PH<2	6 mths
Mercury	Cold Vapor Technique	Composite	Plastic, Glass	Filter on site HNO_3 to PH<2	Glass: 38 days/ Plastic:13 days
TS-Total Solids	Total Solids Dried at 103-105°C	Composite	Plastic, Glass	Cool, 4°C	24 hrs
TDS- Total Dissolved Solids	Total Dissolved Solids Dried at 180°C	Composite	Plastic, Glass	Cool, 4°C	24 hrs
TSS-Total Suspended Solids	Total Suspended Solids Dried at 103-105°C	Composite	Plastic, Glass	Cool, 4°C	24 hrs
COD	Closed reflux, Colorimetric Method	Composite	Glass	Filter on site $H_2 SO_4$ to PH<2	No holding (better)
Nitrogen Ammonia	Ammonia selective Electrode	Composite	Plastic, Glass	Cool, 4°C H_2SO_4 to PH<2	24 hrs

Nitrogen-Nitrite	Ion Chromatography	Composite	Plastic, Glass	Cool, 4°C	No holding (better)
Nitrogen-Nitrate	Ion Chromatography	Composite	Plastic, Glass	Cool, 4°C H_2SO_4 to PH<2	24 hrs
Soluble (dissolved) Phosphorus	Ion Chromatography	Composite	Plastic, Glass	Filter on site Cool, 4°C	48 hrs
PAH-Poly Aromatic Hydrocarbon	HPLC	Composite	Glass	—	—
Temperature	Thermocouple	Measurement on site	Plastic, Glass	Determine on site	No holding
pH	pH-probe	Measurement on site	Plastic, Glass	Cool, 4°C Determine on site	6 hrs

3.3 Analytical Methods

Upon arrival in the laboratory with the samples, the influent and effluent readings were taken for the DO, temperature and pH on the 2 Liter jars from the different catch basins. The Dissolved Oxygen and Temperature were measured using the SympHony VWRSP80DD combined meter with a SympHony 11388 DO probe. The pH was measured using the Fisher Scientific Accumet AR 20 pH/Conductivity meter with a sensION 1 Portable pH Meter. All measurements were performed in triplicate.

Total Suspended Solids: The method used to perform TSS measurements is the Total Suspended Solids at 103-105 °C (Standard Methods, 21st Ed.). In this method, the glass fiber filters were washed and dried and the weight of the glass-fiber filters and the petri-dish were taken and recorded as B, mg. The sample was stirred and 100 ml of sample poured onto a glass-filter with applied vacuum. After the vacuum was turned off, the filter was removed from the filtration apparatus and transferred to an inert aluminum-weighing dish. The sample was dried in an oven at 103-105 °C for 30 minutes.

Chemical Oxygen Demand: The Chemical Oxygen Demand test was used to determine the organic content of samples. The samples were filtered in order to ensure that they were free of sediment and were then analyzed using the HACH COD Reactor and UV Spectrophotometer (HACH company, Loveland, CO, USA). All samples were refrigerated at 4 °C. The method for low range sample concentration (HACH Water Analysis Handbook, 1989) was used throughout the analysis.

Nutrients: The nutrients that were analyzed in the laboratory included, nitrite (NO_2^-N), nitrate (NO_3^-N), phosphate (PO_4^{-3}-P), and ammonia (NH_3-N). The phosphates in the samples were converted to orthophosphate using the Acid Persulphate Digestion Method (HACH, 1989). The organic and Acid Persulfate method were used to measure the total phosphorous content (HACH, 1989).

Nitrite (NO_2-N), nitrate (NO_3-N), phosphate (PO_4^{-3}-P), (NH_3-N) were analyzed using the Dionex ICDX-120 instrument and an attached AS 40 Automated sampler unit. The procedure involved preparing 100 ppm stock solution as standards. In this case, AS14A and CS12 were the guard and analytical columns used to analyze the anions and cations, respectively.

The presence of heavy metals in the samples was analyzed using Atomic Absorption Spectroscopy (AAS) through a furnace module (800 Aanalyst, Perkin-Elmer Corporation, Norfolk, CT). The AAS is composed of AAanalyst 800 and AS 800 Auto sampler including a WinLab 32 software. During the analysis, Matrix modifiers for each of the specific heavy metals were included in the analysis to determine their accuracy. In order to preserve the heavy metal samples, 1.5 mL of HNO_3 per liter of sample was used to lower the pH to approximately 2. The samples were filtered with 0.2 µm non-sterile syringe filters before the analysis and to maintain the accuracy of the results, all lab analysis was performed within required storage time (APHA, 2005).

Polycyclic Aromatic Hydrocarbons: The method for determining the polycyclic aromatic hydrocarbons (PAHs) was accomplished using the high-performance liquid chromatographic (HPLC) method. The HPLC is an analytical system complete with column supplies, high-pressure syringes, detectors, and compatible strip-chart recorder (APHA, 2005). Extraction was done by pouring 1-L of the sample into a 2-L separatory funnel and adding 150 mL of methylene chloride. The sample was shaked and allowed to settle down for about 10 minutes. After the extraction, the sample was separated in a RotoVapor R-210 machine and Acetonitrile added to it. The samples were then filtered with a 0.2 µm non-sterile syringe filters. After placing the filtered samples in vials, analysis of the samples were performed in a Dionex SumMit HPLC machine.

Rainfall Data taken from the National Weather Service Data from the Rain Station at Reagan National, which given the variability of rain is only an estimate of the rain the fell at the four sites. Rain gauges at the sites were repeatedly destroyed or stolen.

3.4 Data Analysis

The USEPA (1983) has two basic methods for computing pollutant removal efficiency of stormwater devices (FHWA, 2002). The average event mean concentration efficiency ratio (E_{emc}) and summation of loads efficiency ratio (E_{sol}), both expressed as percentages:

$$E_{emc} = \left(1 - \frac{AEMC_{out}}{AEMC_{in}}\right) \times 100$$

$$E_{sol} = \left(1 - \frac{AEMC_{out}}{AEMC_{in}}\right) \times 100$$

AEMC is the average event mean concentration and SOL is the summation of loads. In and Out represent inflow and outflow. In order to calculate loads the product of event mean concentration and the volume of storms have to be calculated. AEMC and SOL can be calculated for all of the storms monitored or computed on a per storm basis, which can be more accurate, but is also more expensive and due to budgetary constraints was not considered for this project. In this project, because it was deemed too costly to calculate the flowrates into and out of each device, we are limited to calculating the AEMC only. Using the AEMC can be biased: it does not show the possible values or information on the changes in concentration associated with storm magnitude. However, given the constraints of this project, calculating the AEMC was the only avenue for analyzing the data given the fiscal constraints already mentioned.

RESULTS AND DISCUSSIONS

4.1 Data Analysis

The data analysis involved in this project was difficult. In comparison to controlled experiments in the laboratory, the type of research that most investigators relate to, the regular rules for data analysis did not apply in this project. There were too many variables that influence the performance of the systems and not enough data in a project of this length, to make determinations based on statistical significance. The variations between inflow and outflow, one device and another, and from storm to storm show no mathematical correlation. Numerical methods such as the standard t-test, Annova analysis, and paired t-test showed no statistically significant correlation. Averages and standard deviations were applied to all of the data for each parameter, for each device.

The overall data are presented in Tables 4.1, 4.2, 4.3 and 4.4 for the Regular, Hydrodynamic, Filter and Vortex catch basins, respectively. In addition, every data point collected throughout this project is shown in tabular form and graphically in the Appendix. There are several logical reasons for the variability shown by the standard deviations of the data presented in the tables. From recent research papers the following causes could be leading to the variability in the data:

1. Strecker (1995) points out that for BMPs with a permanent pool computing the removal efficiency may not be meaningful since the outflow may have no or only a limited relationship to inflow. The use of total loads is more appropriate over the monitoring period to compute removal efficiencies (this requires the collection of flow data).

2. The pollutant peak does not necessarily occur at the same point in time with flow during a given storm. The pollutant peak for a given storm can occur before the peak flow (first flush) or after the flow peak. In addition, individual pollutants may vary in how they respond to rainfall (Lee and Bang, 2000).
3. Reactions that are ongoing in the permanent pool (i.e. denitrification, low redox conditions releasing metals) change the concentration of the outflow even though inflow concentrations may have been low (Nanbakhsh, et al., 2007, Morrison, et al., 1995).
4. There are changes in the pollutant load based on changes in the seasons (Nanbakhsh, et al., 2007).

Because inflow water quality variables have high standard deviations, and given that there is a permanent pool in all of these devices, leading to only an indirect relationship between inflow and outflow concentrations over time, some researchers consider in misleading to show mean outflow concentrations (Nanbakhsh, et al., 2007, Strecker, 1995). There is also continued evidence that microbial and geochemical degradation processes occur in the trapped sediments of catch basins, both during and between storm events. The supernatant sump liquors then may at times release organic carbon and reduced products into the stormwater during the next rain event.

The protocols for this research are exactly the same as previous projects that evaluated the performance of two bioretention sites, a DC sandfilter, and a BaySaver. Although statistically significant differences can not be established for multiple reasons, the data does present empirical solutions based on the raw performance of the four devices, especially when considering the randomness of the data and comparing the four catch basins with the four other stormwater devices that have been monitored this decade.

The first major consideration when analyzing the data presented in Tables 4.1 through 4.4 is the overall performance the four devices. For 10 of the 15 parameters for which event mean concentrations (E_{emc}) were calculated for the Regular catch basin a negative value was produced. This effectively means that the Regular catch basin was producing more pollutants that it removed for 10 parameters. From this form of evaluation the Hydrodynamic produced negative E_{emc} values for 8 of the pollutants, while the Filter and Vortex produced negative values for 2 and 4 of the pollutants. Although this is a simplistic form of analysis that does not take into consideration the large standard deviations, it is interesting nevertheless that given the variability in the data, increasing performance could be viewed as: Regular < Hydrodynamic < Vortex < Filter. This general range of performance holds for the majority of the data values calculated.

When considering the parameters pH, dissolved oxygen (D.O.), and temperature it is clear that for all four devices there was no real difference between the influent and effluent values for any of the devices. The pH varied from 6.27 to 6.7 in the influent and effluent water of all the devices showing the slightly acidic nature of rainwater and that the devices due little or nothing to change this. The temperature coming into and out of all of the devices was also consistent, largely correlating to average atmospheric temperatures over the seasons during sampling averaging between 17 and 20°C for all sample water. The D.O. concentration showed more variability. The Regular catch basin showed no real difference in D.O., with a value of 10.2 mg/L coming into the system and a value of 10.3 mg/L leaving the system. The Hydrodynamic, however, averaged an influent D.O of 12.8 mg/L and an effluent D.O. of 11.0 mg/L. The Filter showed an increase in D.O. from 6.4 mg/L in the influent up to 7.6 mg/L in the effluent, while the Vortex had a decrease in the D.O. from 9.2 mg/L to 8.2 mg/L from the influent to the effluent. There seems to be no discernible reason for these differences in D.O. Initially the thought that the devices with larger sumps, which sometimes smelled as though anaerobic processes were taking place in between events, should have lower D.O. in the effluent, for example the Filter often had a large permanent pool. However, the Filter showed an increase in D.O.

The total suspended solids (TSS) and total dissolved solids (TDS) data was consistent when evaluating the E_{emc}, however care must be taken in this analysis given the difference in the concentrations applied to the systems. The Regular catch basin showed an E_{emc} of -21% and 11% for TSS and TDS, respectively. The Hydrodynamic catch basin showed a 37% and 33%, while the Filter results were 80% and 18%, and the Vortex were 76% and 81%, for TSS and TDS. At first glance it seems clear that the Filter and Vortex performed far above the Regular and Hydrodynamic catch basins. However all four of the devices had TSS and TDS effluent values that ranged from 10.9-15.6 and 5.3-11.9 mg/L, respectively. The difference in the performance was largely due to larger concentrations of TSS and TDS that were entering the Filter and Vortex in comparison to the concentrations entering the Regular and Hydrodynamic catch basins. The Filter received influent concentrations of 62 and 36 mg/L TSS and TDS and the Vortex received 46 and 28 mg/L TSS and TDS, while the Regular had 13 and 13 mg/L and the Hydrodynamic 17 and 12 mg/L TSS and TDS. Although at first glance the E_{emc} results give the impression that the Filter and Vortex greatly outperform the Regular and Hydrodynamic catch basins, the actual raw numbers show that the difference is largely due to the differences in influent concentrations based on their locations.

Table 4.1 Regular Catch Basin Performance

Parameter	Influent Avg. & Std.	Effluent Avg & Std.	A_{emc}
pH	6.6 ± 0.6	6.7 ± 0.3	
D.O.	10.2 ± 4.1	10.3 ± 4.3	
Temp. (ºC)	19.4 ± 5.9	19.6 ± 5.3	
TSS	12.8 ± 9.4	15.6 ± 17.3	-21%
TDS	12.9 ± 10.3	11.5 ± 11.6	11%
Cu	3.8 ± 7.7	3.0 ± 5.0	21%
Cd	1.6 ± 3.4	1.6 ± 3.3	0%
Zn	5.7 ± 4.8	7.1 ± 5.8	-25%
Cr	4.3 ± 5.8	5.8 ± 5.6	-32%
Pb	0.9 ± 1.9	2.4 ± 5.2	-169%
As	1.2 ± 0.8	1.1 ± 0.9	7%
Hg	11.7 ± 31.9	16.4 ± 34.4	-40%
Fe	54.5 ± 75.8	60.7 ± 71.6	-11%
PO_4^{-3}	5.9 ± 11.5	6.6 ± 8.6	-12%
NO_2^-	10.8 ± 12.4	17.0 ± 18.7	-57%
NO_3^-	2.2 ± 3.3	4.5 ± 9.9	-104%
NH3-N	0.8 ± 0.4	0.7 ± 0.1	15%
COD	19.2 ± 11.6	21.8 ± 13.0	-14%

Table 4.2 Hydrodynamic Catch Basin Performance

Parameter	Influent Avg. & Std.	Effluent Avg & Std.	A_{emc}
pH	6.27 ± 0.5	6.4 ± 0.4	
D.O.	12.83 ± 4.0	11.0 ± 3.8	
Temp. (ºC)	16.98 ± 5.4	17.2 ± 5.4	
TSS	17.2 ± 17.1	10.9 ± 13.2	37%
TDS	11.7 ± 11.6	7.9 ± 8.1	33%
Cu	3.8 ± 5.3	2.6 ± 3.6	31%
Cd	1.4 ± 3.7	1.4 ± 3.6	2%
Zn	5.0 ± 5.1	7.2 ± 5.1	-43%
Cr	5.9 ± 8.2	12.2 ± 21.4	-107%
Pb	1.1 ± 2.1	1.0 ± 1.9	15%
As	1.4 ± 1.0	1.0 ± 0.8	31%
Hg	20.6 ± 63.8	12.7 ± 28.3	38%
Fe	57.6 ± 80.8	112.9 ± 148.2	-96%
PO_4^{-3}	4.3 ± 6.5	4.8 ± 6.4	-11%
NO_2^-	8.8 ± 11.0	19.8 ± 32.4	-125%
NO_3^-	2.0 ± 2.6	5.7 ± 18.6	-182%
NH_4^+	0.8 ± 0.4	0.9 ± 0.7	-17%
COD	18.5 ± 8.3	20.2 ± 13.7	-9%

Table 4.3 Filter Catch Basin Performance

Parameter	Influent Avg. & Std.	Effluent Avg & Std.	A_{emc}
pH	6.4 ± 0.3	6.6 ± 0.3	
D.O.	6.4 ± 5.1	7.6 ± 5.2	
Temp. (ºC)	20.0 ± 7.7	19.9 ± 7.2	
TSS	61.9 ± 145.7	12.3 ± 18.5	80%
TDS	36.1 ± 104.9	13.5 ± 38.9	18%
Cu	10.5 ± 12.7	3.5 ± 5.5	66%
Cd	3.3 ± 4.1	3.4 ± 4.3	0%
Zn	5.7 ± 6.4	5.2 ± 6.2	9%
Cr	0.4 ± 0.9	0.3 ± 0.7	9%
Pb	13.3 ± 18.1	8.2 ± 6.3	38%
As	2.0 ± 1.4	1.6 ± 0.9	19%
Hg	15.6 ± 27.6	11.2 ± 9.0	28%
Fe	202.8 ± 129.7	192.1 ± 118.7	5%
PO_4^{-3}	3.2 ± 3.4	3.6 ± 5.2	-14%
NO_2^-	22.1 ± 34.4	17.5 ± 15.4	21%
NO_3^-	1.3 ± 1.5	2.4 ± 5.6	-82%
NH_3-N	1.4 ± 0.9	1.3 ± 1.1	5%
COD	79.5± 59.4	47.8 ± 28.7	40%

Table 4.4 Vortex Catch Basin Removal Efficiency

Parameter	Influent Avg. &	Effluent Avg & Std.	A_{emc}
pH	6.6 ± 0.35	6.6 ± 0.18	
D.O.	9.2 ± 5.2	8.2 ± 5.5	
Temp. (ºC)	19.6 ± 6.7	19.3 ± 6.3	
TSS	45.7 ± 77.4	11.2 ± 8.8	76%
TDS	28.0 ± 46.6	5.3 ± 7.0	81%
Cu	8.5 ± 12.6	2.3 ± 5.0	73%
Cd	3.1 ± 4.3	3.2 ± 4.4	0%
Zn	6.5 ± 6.5	6.8 ± 6.8	-4%
Cr	0 ± 0	0.1 ± 0.39	0%
Pb	11.8 ± 12.2	14.3 ± 14.2	-21%
As	2.2 ± 1.5	1.8 ± 1.1	17%
Hg	14.2 ± 42.4	3.6 ± 6.0	75%
Fe	106.1 ± 91.3	133.5 ± 105.1	-26%
PO_4^{-3}	7.4 ± 12.1	7.1 ± 12.2	4%
NO_2^-	15.9 ± 25.9	13.9 ± 19.7	13%
NO_3^-	1.9 ± 3.2	2.5 ± 5.6	-32%
NH_3-N	3.4 ± 8.4	1.9 ± 1.9	46%
COD	72.8 ± 69.2	61.2 ± 57.2	16%

For nutrients, heavy metals, and chemical oxygen demand all of the devices performed poorly in terms of E_{emc}, however the Filter and the Vortex seemed to perform slightly better than the Hydrodynamic and Regular catch basins. For the nutrients; nitrite, nitrate, ammonia, and phosphate, the Regular and the Hydrodynamic produced larger concentrations in the effluent than were present in the influent. This must be the result of biological reactions taking place in the sediments in the permanent pool of these devices. The Filter and the Vortex performed only slightly better in terms of nutrient removal, with both producing more nitrate in the effluent than is present in the influent, which is a sign of the conversion of ammonia to nitrate via nitrification in the permanent pool.

One major additional factor when considering the evaluation of these devices is possible mechanisms for removal. This is generally viewed as a critical first step when establishing a frame of reference in the design of any device. In environmental engineering there are established technologies that are optimal for removal of pollutants. In water treatment and wastewater treatment these unit processes and unit operations are well established. For example, bar screens or bar racks are utilized in the inlet of the majority of water and wastewater treatment plants to keep debris larger than one inch from entering the first pumps into the plant. Later, in both water and wastewater treatment plants coagulants are added to assist in the sedimentation of colloidal particles. In wastewater treatment soluble organic carbon is removed from the water via microbiological degradation.

With the exception of total suspended solids, all of the parameters measured as a function of this project were soluble pollutants. From theory, other than the possible entrapment or agglomeration of particles, there is no expectation that the Regular or

Hydrodynamic catch basins would remove, to any significant level, any of the pollutants other than TSS. The Filter, given that it is filled with granular activated carbon, should have the capability to remove heavy metals, organics, and solid matter. The same technology is used in Brita filters to remove part per billion or μg/L concentrations in drinking water in homes around the world. The primary differences between the filter in homes and the Filter evaluated in this project are the quality of the incoming water and the frequency with which the filters are changed.

In an effort to evaluate the needs for maintaining these devices they were each cleaned on the dates listed in Table 4.5. We removed trash repeatedly when we found it present on multiple days throughout the project; however we only emptied the supernatant and the sediments in the bottom of the sump once for each device. Without the assistance of a vacuum truck this work was performed with a 5 gallon bucket attached to a rope. This was not the most effective way to clean catch basins of this size; however it was the best that we could do within the constraints of this project. We saw no discernable change in the performance of the devices after cleaning, however we were unable to completely empty the permanent pool and bottom sediments in the manner that a vacuum truck would be able to accomplish.

Table 4.5: Catch Basin Cleaning

Date of catch basin cleaning	Catch basin type
11-27-07	Filter catch basin
2-08-08	Hydrodynamic and Regular catch basins
3-13-08	Vortex catch basin

In a study from 2003 the efficiency of a bioretention facility located in the US Navy Yard adjacent to the Anacostia River in terms of temperature, pH, dissolved oxygen, nutrients, and heavy metals removal over a period of 15 rain events. This was performed by collecting representative samples of the stormwater runoff for laboratory analysis of both the influent to and the effluent from the bioretention cell. The bioretention was efficient in terms of pollutant removal in the following order: TSS (~ 98%) > Zn (~ 80%) > Cu (~ 75%) > Pb (~ 71%) > Cd (~ 70%) > NH_3-N (~65%) > Fe (~ 51%) > Cr (~ 42%) > NO^{-}_{2}-N (~ 27%) > Al (~ 17%) > PO^{3-}_{4}-P (~3%). From the field results Cu (II), Zn (II) and Pb (II) were removed significantly at 81%, 79% and 75%. The field results indicate that bioretention facilities can be effective for the removal of heavy metals in the following order: Cu > Zn> Pb > Cd > Fe > Cr > Al.

In 2006 another bioretention device was monitored adjacent to the Benning Road bridge crossing the Anacostia River. This data is presented in Table 4.6. This bioretention did not perform as well the bioretention cell at the US Navy Yard, however it outperformed all of the catch basins for the majority of the pollutants measured. The Navy Yard bioretention outperformed all of the catch basins. This is largely the result of the device being designed with mechanisms for removal. A bioretetion cell provides for pollutant removal through physical, chemical and biological processes: filtration, plant uptake, microbial activity, decomposition, sedimentation, volatilization, and adsorption. None of the catch basins evaluated as a function of this project can compete with this technology.

Table 4.6 Benning Road Bioretention Performance

Parameter	Influent Avg. &	Effluent Avg & Std.	A_{emc}
pH	8.1 ± 0.5	7.8 ± 0.5	
D.O.	5.9 ± 1.9	5.8 ± 0.9	
TSS	176 ± 396	24 ± 28	86%
TDS	146 ± 353	14 ± 24	91%
Cu	23 ± 29	11 ± 29	53%
Cd	9 ± 32	2 ± 7	78%
Zn	70 ± 35	52 ± 27	26%
Cr	10 ± 7	5 ± 4	50%
Pb	47 ± 159	16 ± 56	66%
As	29 ± 112	31 ± 119	6%
Hg	54 ± 126	42 ± 86	75%
NH_3-N	22 ± 55	16 ± 40	27%
COD	112 ± 92	66 ± 43	16%

CONCLUSIONS AND RECOMMENDATIONS

The primary conclusion of this work is that the catch basins ranked from best to worst performance in the following order: Filter, Vortex, Hydrodynamic, and Regular catch basin. This is based on the number of parameters that actually increased in concentration, on average, coming out of the devices. This research indicates that catch basins can reduce concentrations of some contaminants, however in general they are not designed to remove soluble pollutants.

Moreover, in order to reduce the contaminants from entering the natural water bodies, the following measures should be implemented:

1. Frequent cleaning of the streets. This is necessary to prevent or reduce the flow of trash and debris into the catch basins during storm runoff.
2. Catch basin cleaning should be performed periodically. This could lead to improved performance in order to effectively capture sediments.
3. The proper disposal of sediments or debris from catch basins should be performed to avoid negative environmental consequences.

5.1 Recommendations

The following recommendations are made to improve on the efficiency of catch basins in the District of Columbia:

1. Public Education: The public has little knowledge of the role of catch basins and very little literature exists on this portion of sewer systems. The types of trash found in the Filter and Vortex catch basins indicate that these systems are being used as trashcans

2. Trash bins should be located on every corner in neighborhoods with high pedestrian traffic.
3. Catch basins should be cleaned, maintained and inspected at least once every three months.
4. A life cycle cost analysis should be performed for all stormwater best management practices to determine the technology that is the least expensive both in terms of capital and operations and maintenance.
5. Based on prior research, work should be performed to study the obstacles to change in the stormwater community.

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Appendix

Regular Catch Basin Tables

	DO In (mg/L)		DO Out (mg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	2.2	0.2	1.7	0.1	0.23
2(06/03/07)	9.0	0.1	7.8	0	0.13
3(07/29/07)	6.8	0.4	6.9	0.3	-0.01
4(10/24/07)	8	0.7	7.2	0.6	0.10
5(11/13/07)	10.4	0.7	9.8	0.6	0.06
6(02/01/08)	14.4	0.3	13.3	0.2	0.08
7(02/06/08)	10.3	0.1	10.3	0.5	0.00
8(02/13/08)	15.2	0.7	17.7	0.6	-0.16
9(03/04/08)	5.2	0.2	8.5	0.2	-0.63
10(03/07/08)	15.4	0.2	15.4	0.4	0.00
11(03/16/08)	16.0	0.3	16.2	0.2	-0.01
12(04/28/08)	12.1	0.2	11.5	0.1	0.05
13(05/09/08)	10.6	0.2	11.1	0.2	-0.05
14(06/14/08)					
15(07/13/08)	7.6	0.2	7.4	0.1	0.03

	T In (C)		T Out (C)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	27.0	0	26.0	0	0.04
2(06/03/07)	24.3	0.1	24.4	0.1	0.00
3(07/29/07)	27.5	0.2	27.6	0.1	0.00
4(10/24/07)	18.9	0.1	18.8	0.2	0.01
5(11/13/07)	15.5	0.3	16.1	0.1	-0.04
6(02/01/08)	9.5	1.0	12.3	0.6	-0.29
7(02/06/08)	12.4	0.2	13.3	0.1	-0.07
8(02/13/08)	15.5	0	15.6	0	-0.01
9(03/04/08)	17.9	0	17.8	0.2	0.01
10(03/07/08)	16.0	0.1	16.1	0	-0.01
11(03/16/08)	16.0	0.3	16.2	0.2	-0.01
12(04/28/08)	21.3	0	21.3	0	0.00
13(05/09/08)	19.8	0	19.9	0.1	-0.01
14(06/14/08)					
15(07/13/08)	29.4	0.3	28.5	0	0.03

	pH Influent		pH Effluent		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	6.3	0	6.5	0	-0.03
2(06/03/07)	8.1	0.1	7.3	0	0.10
3(07/29/07)	6.5	0	6.8	0.1	-0.05
4(10/24/07)	7.2	0	6.3	0	0.13
5(11/13/07)	6.0	0.1	6.3	0.1	-0.05
6(02/01/08)	6.3	0	6.4	0	-0.02
7(02/06/08)	6.1	0	6.1	0	0.00
8(02/13/08)	6.8	0	6.9	0	-0.01
9(03/04/08)	6.7	0	6.8	0	-0.01
10(03/07/08)	6.3	0	6.7	0	-0.06
11(03/16/08)	6.9	0	6.9	0	0.00
12(04/28/08)	6.9	0	6.9	0	0.00
13(05/09/08)	6.5	0	7.1	0	-0.09
14(06/14/08)	5.9	0	6.2	0	-0.05
15(07/13/08)	6.7	0	6.7	0	0.00

	COD (mg/l) Influent		COD (mg/l) Effluent		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	37.5	1.0	56.3	7.7	-0.50
2(06/03/07)	16.6	0.7	33.4	0.3	-1.01
3(07/29/07)	10.1	2.2	20.1	0.9	-0.99
4(10/24/07)	48.5	1.2	37.7	0.4	0.22
5(11/13/07)	15.1	1.4	16.5	0.4	-0.09
6(02/01/08)	7.4	0.9	5.7	1.8	0.23
7(02/06/08)	19.2	0.5	23.0	1.6	-0.20
8(02/13/08)	22.3	0.3	19.8	0.9	0.11
9(03/04/08)	27.9	0.5	21.0	0.5	0.25
10(03/07/08)	8.5	1.6	8.6	1.2	-0.01
11(03/16/08)	14.0	0.4	13.6	0.8	0.03
12(04/28/08)	15.0	1.6	12.7	0.6	0.15
13(05/09/08)	7.6	1.4	14.6	1.0	-0.92
14(06/14/08)	25.3	1.2	29.5	0.4	-0.17
15(07/13/08)	13.2	0.6	15.2	1.1	-0.15

	TSS In (mg/L)		TSS Out (mg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	31.4	7.7	40.7	4.9	-0.30
2(06/03/07)	7.7	1.0	3.2	3.3	0.58
3(07/29/07)	2.9	3.0	0.7	0.4	0.76
4(10/24/07)					
5(11/13/07)	9.5	0	6.5	0	0.32
6(02/01/08)	29.7	1.7	19.4	1.7	0.35
7(02/06/08)	23.5	7.8	12.3	0.6	0.48
8(02/13/08)	17.9	7.4	58.6	16.3	-2.27
9(03/04/08)	11.8	0.8	35.8	6.6	-2.03
10(03/07/08)	6.2	3.3	5.1	2	0.18
11(03/16/08)	9.6	0.9	5.3	0.8	0.45
12(04/28/08)	5.5	0	4.9	2.8	0.11
13(05/09/08)	2.3	0.7	4.2	3.7	-0.83
14(06/14/08)	7.3	0.8	7.8	3.9	-0.07
15(07/13/08)	13.9	9.6	13.2	6.2	0.05

	TDS In (mg/L)		TDS Out (mg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	20.7	11.1	24.6	3.5	-0.19
2(06/03/07)	5.2	1.4	0.0	1.5	1.00
3(07/29/07)	1.0	1.2	1.9	2.0	-0.90
4(10/24/07)					
5(11/13/07)	34.0	1.3	38.0	0.0	-0.12
6(02/01/08)	23.6	1.7	13.1	2.5	0.44
7(02/06/08)	9.0	0	4.3	1.3	0.52
8(02/13/08)	26.5	8.8	28.3	0.4	-0.07
9(03/04/08)	9.1	1.4	18.1	2.7	-0.99
10(03/07/08)	7.7	0.7	8.7	0.0	-0.13
11(03/16/08)	3.9	0.1	4.7	0.1	-0.21
12(04/28/08)	6.2	0	5.6	0.5	0.10
13(05/09/08)	4.4	1.1	2.0	0.2	0.55
14(06/14/08)	6.9	1.6	2.3	1.4	0.67
15(07/13/08)	21.8	5.8	9.0	1.8	0.59

	NO2 Influent (mg/l)		NO2 Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	35.2	0.4	53.6	0.5	-0.52
2(06/03/07)	19.1	0.2	61.7	0.3	-2.23
3(07/29/07)	5	0.1	22.6	0.2	-3.52
4(10/24/07)	35.7	0.7	27.4	4.2	0.23
5(11/13/07)	11.7	0	20.3	0.2	-0.74
6(02/01/08)	3.3	0.1	4.4	0.5	-0.33
7(02/06/08)	0	0	0	0	
8(02/13/08)	0	0	0	0	
9(03/04/08)	1.9	0.1	4.4	0.1	-1.32
10(03/07/08)	2.3	0.1	1.8	0.1	0.22
11(03/16/08)	2	0.2	2.2	0.4	-0.10
12(04/28/08)	6.9	0.8	12.9	0.3	-0.87
13(05/09/08)	3	0.1	14.6	0.2	-3.87
14(06/14/08)	26.7	0.4	16.8	0.9	0.37
15(07/13/08)	9.3	0.1	12.6	0.2	-0.35

	NO3 Influent (mg/l)		NO3 Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	1.7	0	1.7	0	0.00
2(06/03/07)	12.8	0.1	39.6	0.2	-2.09
3(07/29/07)	1.7	0	1.7	0	0.00
4(10/24/07)	0.4	0	7.5	0.2	-17.75
5(11/13/07)	1.6	0	2.9	0	-0.81
6(02/01/08)	0	0	0.1	0	
7(02/06/08)	0.1	0	0.1	0.1	0.00
8(02/13/08)	3.6	0.5	2.4	0.3	0.33
9(03/04/08)	0.8	0	0.6	0.2	0.25
10(03/07/08)	0.1	0	0.2	0	-1.00
11(03/16/08)	5	0.1	2.6	0.1	0.48
12(04/28/08)	0.5	0	0.8	0	-0.60
13(05/09/08)	0.3	0	2	0	-5.67
14(06/14/08)	1.7	0	2.4	0.4	-0.41
15(07/13/08)	2.7	0	2.7	0	0

	PO4 Influent (mg/l)		PO4 Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	3.5	0	3.4	0	0.03
2(06/03/07)	6.8	0.1	13.4	0	-0.97
3(07/29/07)	3.4	0	3.4	0	0.00
4(10/24/07)	44.9	0.6	27.1	0.5	0.40
5(11/13/07)	13	0.1	18.9	0.1	-0.45
6(02/01/08)	0.0	0.0	0.0	0.0	
7(02/06/08)	0.0	0.0	0.0	0.0	
8(02/13/08)	0.0	0.0	0.0	0.0	
9(03/04/08)	0.1	0.0	0.0	0.0	1.00
10(03/07/08)	0.0	0.0	0.0	0.0	
11(03/16/08)	0.0	0.0	0.0	0.0	
12(04/28/08)	0.0	0.0	0.0	0.0	
13(05/09/08)	2.0	0.1	8.5	0.1	-3.25
14(06/14/08)	6.5	0.1	14.6	1.9	-1.25
15(07/13/08)	8.5	0.1	10.4	0.2	-0.22

	NH3-N Influent (mg/l)		NH3-N Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	0	0	0.5	0.2	
2(06/03/07)	0.6	0.1	0.7	0.1	-0.17
3(07/29/07)	0.8	0.1	0.7	0.1	0.13
4(10/24/07)	1.7	0.1	0.4	0.1	0.76
5(11/13/07)	0.8	0.1	0.6	0.1	0.25
6(02/01/08)	0.7	0	0.7	0.1	0.00
7(02/06/08)	0.8	0.2	0.7	0.1	0.13
8(02/13/08)	1.0	0.1	0.8	0.1	0.20
9(03/04/08)	0.6	0.1	0.6	0	0.00
10(03/07/08)	0.5	0.1	0.6	0	-0.20
11(03/16/08)	1.2	0.1	1.0	0	0.17
12(04/28/08)	0.7	0.1	0.6	0	0.14
13(05/09/08)	0.7	0.1	0.6	0.1	0.14
14(06/14/08)	0.7	0	0.7	0.1	0.00
15(07/13/08)					

	Cu Influent (µg/L)		Cu Effluent (µg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	15.9	0.5	18.8	0.7	-0.18
2(06/03/07)	3.2	0.4	5.4	0.2	-0.69
3(07/29/07)	2.5	0.4	5	0.2	-1.00
4(10/24/07)	27.1	0.6	7.3	0.8	0.73
5(11/13/07)	0	0	0	0	
6(02/01/08)	0	0	0	0	
7(02/06/08)	0	0	0	0	
8(02/13/08)	0	0	0	0	
9(03/04/08)	0	0	0	0	
10(03/07/08)	0	0	0	0	
11(03/16/08)	1.4	0.1	2.2	0.1	-0.57
12(04/28/08)	0	0	1.8	0.1	
13(05/09/08)	0	0	0.6	0	
14(06/14/08)	6.5	0.6	3.4	0.2	0.48
15(07/13/08)	0.3	0	0.7	0.2	-1.33

	Cd Influent (µg/L)		Cd Effluent (µg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	5.9	0.2	6.3	0.1	-0.07
2(06/03/07)	8	1.7	7.9	0	0.01
3(07/29/07)	9.8	0.3	9.6	0.3	0.02
4(10/24/07)	0	0	0.4	0.5	
5(11/13/07)	0	0	0	0	
6(02/01/08)	0	0	0	0	
7(02/06/08)	0	0	0	0	
8(02/13/08)	0	0	0	0	
9(03/04/08)	0	0	0	0	
10(03/07/08)	0	0	0	0	
11(03/16/08)	0	0	0	0	
12(04/28/08)	0	0	0	0	
13(05/09/08)	0	0	0	0	
14(06/14/08)	0	0	0	0	
15(07/13/08)	0	0	0	0	

	Zn Influent (µg/L)		Zn Effluent (µg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	0	0	0	0	
2(06/03/07)	0	0	0	0	
3(07/29/07)	0	0	0	0	
4(10/24/07)	0	0	0	0	
5(11/13/07)	0	0	0	0	
6(02/01/08)	10.8	0.6	11.4	0.2	-0.06
7(02/06/08)	10.6	0.4	7.6	1	0.28
8(02/13/08)	12.1	1.3	11.3	1	0.07
9(03/04/08)	9.8	0.2	9.1	0.3	0.07
10(03/07/08)	7.0	0.4	9.4	0.4	-0.34
11(03/16/08)	8.2	0.9	18.1	2.8	-1.21
12(04/28/08)	8.3	0.4	12.2	0.4	-0.47
13(05/09/08)	3.0	0.4	7.3	0.2	-1.43
14(06/14/08)	4.8	0.4	7.1	0.8	-0.48
15(07/13/08)	10.5	0.8	12.7	0.3	-0.21

	Cr Influent (µg/L)		Cr Influent (µg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	6.3	2.3	11.6	0.7	-0.84
2(06/03/07)	4	0.1	0	0	1.00
3(07/29/07)	0	0	0	0	
4(10/24/07)	0	0	2	0.3	
5(11/13/07)	0	0	0	0	
6(02/01/08)	18.2	1.5	8.2	0.5	0.55
7(02/06/08)	0	0	4.2	0.3	
8(02/13/08)	4.6	0	5.4	0.1	-0.17
9(03/04/08)	0.6	0.1	3.4	0	-4.67
10(03/07/08)	11.6	0	19.7	0.2	-0.70
11(03/16/08)	13.2	0.2	8.9	0.1	0.33
12(04/28/08)	5.3	0.5	10.1	1.1	-0.91
13(05/09/08)	0	0	9.6	0.1	
14(06/14/08)	0.6	0.1	1.6	0.1	-1.67
15(07/13/08)	0.8	0.3	1.6	0.1	-1.00

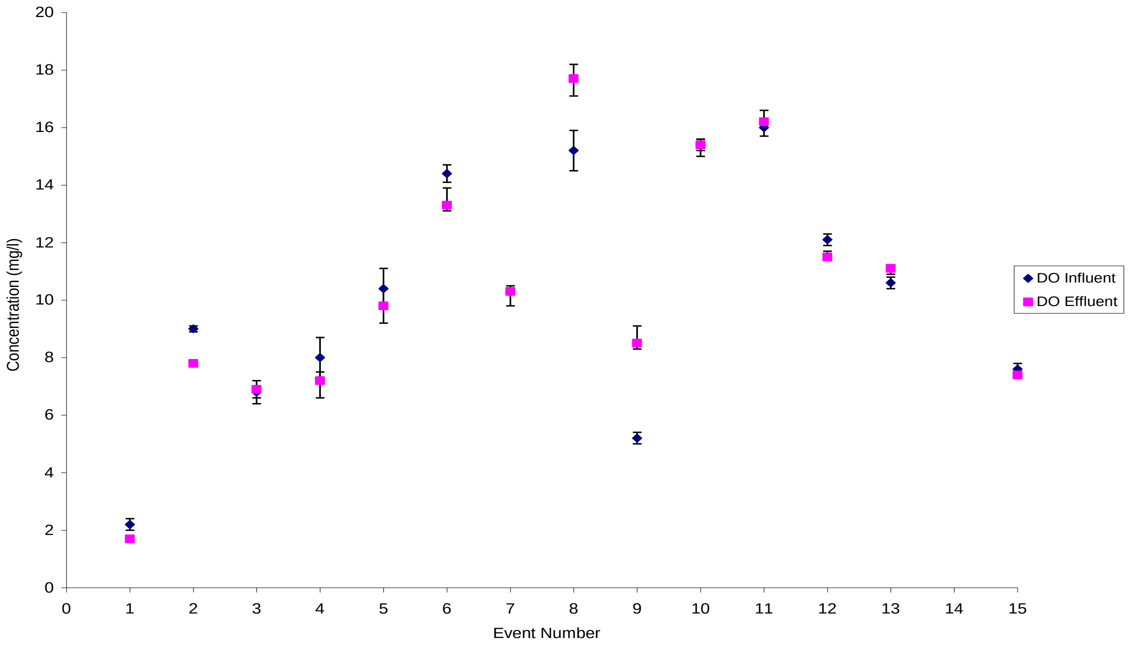
	Pb Influent (µg/L)		Pb Effluent (µg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	0.7	0.1	3.9	0.1	-4.57
2(06/03/07)	1.2	0.8	1.4	0.3	-0.17
3(07/29/07)	0.4	0.1	0.9	0.1	-1.25
4(10/24/07)	0	0	7.2	0.1	
5(11/13/07)	1.8	0.1	1	0.2	0.44
6(02/01/08)	0	0	0	0	
7(02/06/08)	0	0	0	0	
8(02/13/08)	2.3	0	2.3	0.2	0.00
9(03/04/08)	7.2	0.3	19.9	0.1	-1.76
10(03/07/08)	0	0	0	0	
11(03/16/08)	0	0	0	0	
12(04/28/08)	0	0	0	0	
13(05/09/08)	0	0	0	0	
14(06/14/08)	0	0	0	0	
15(07/13/08)	0	0	0	0	

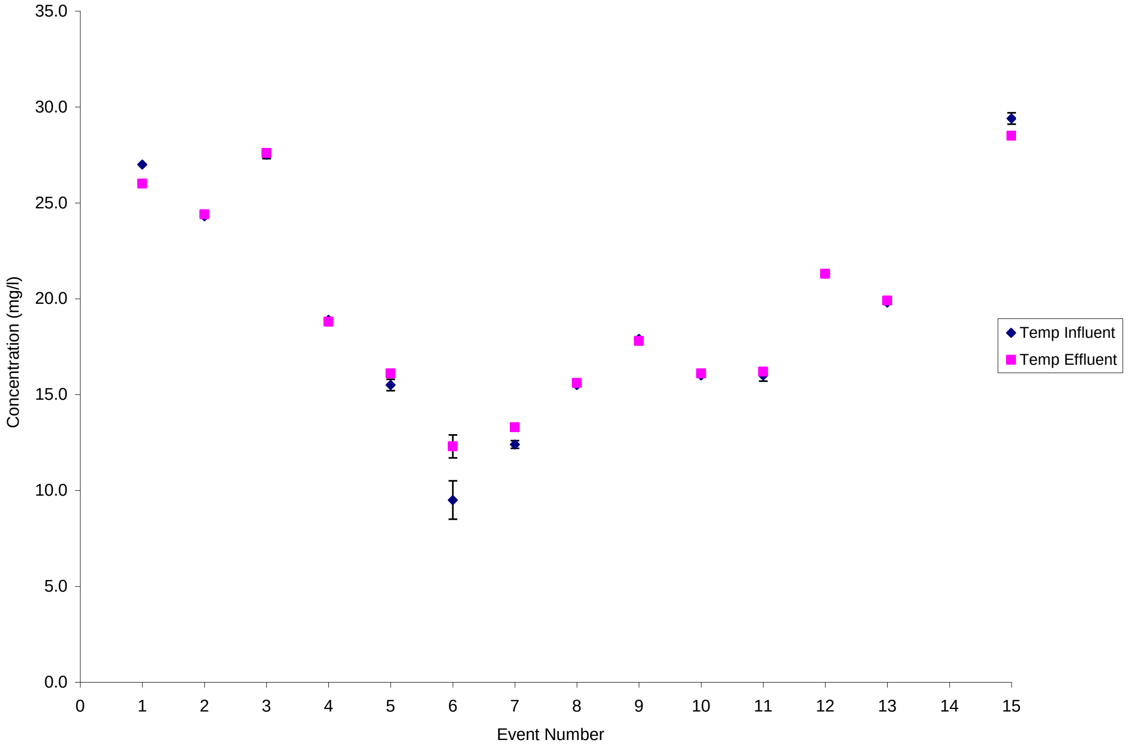
		As Influent (µg/L)		As Effluent (µg/L)		
Event #	Event #	Average	Std	Average	Std	% removal
1(05/16/07)	1(05/16/07)	1.5	0.3	0.7	0.1	0.53
2(06/03/07)	2(06/03/07)	1	0.1	1.1	0.2	-0.10
3(07/29/07)	3(07/29/07)	1.8	0.1	1.5	0.1	0.17
4(10/24/07)	4(10/24/07)	1.8	0	1.1	0.2	0.39
5(11/13/07)	5(11/13/07)	0.7	0.4	0.5	0.1	0.29
6(02/01/08)	6(02/01/08)	1.5	0.4	1.4	0.2	0.07
7(02/06/08)	7(02/06/08)	0.8	0	1.4	0.6	-0.75
8(02/13/08)	8(02/13/08)	1.4	0.2	2.5	0.8	-0.79
9(03/04/08)	9(03/04/08)	0.9	0.1	0.3	0	0.67
10(03/07/08)	10(03/07/08)	0.2	0.1	0	0	1.00
11(03/16/08)	11(03/16/08)	0.5	0.3	0.1	0	0.80
12(04/28/08)	12(04/28/08)	0	0	0.1	0.1	
13(05/09/08)	13(05/09/08)	0.5	0.1	0.9	0.1	-0.80
14(06/14/08)	14(06/14/08)	2.9	0.3	2.4	0.3	0.17
15(07/13/08)	15(07/13/08)	2.3	0.2	2.5	0.3	-0.09

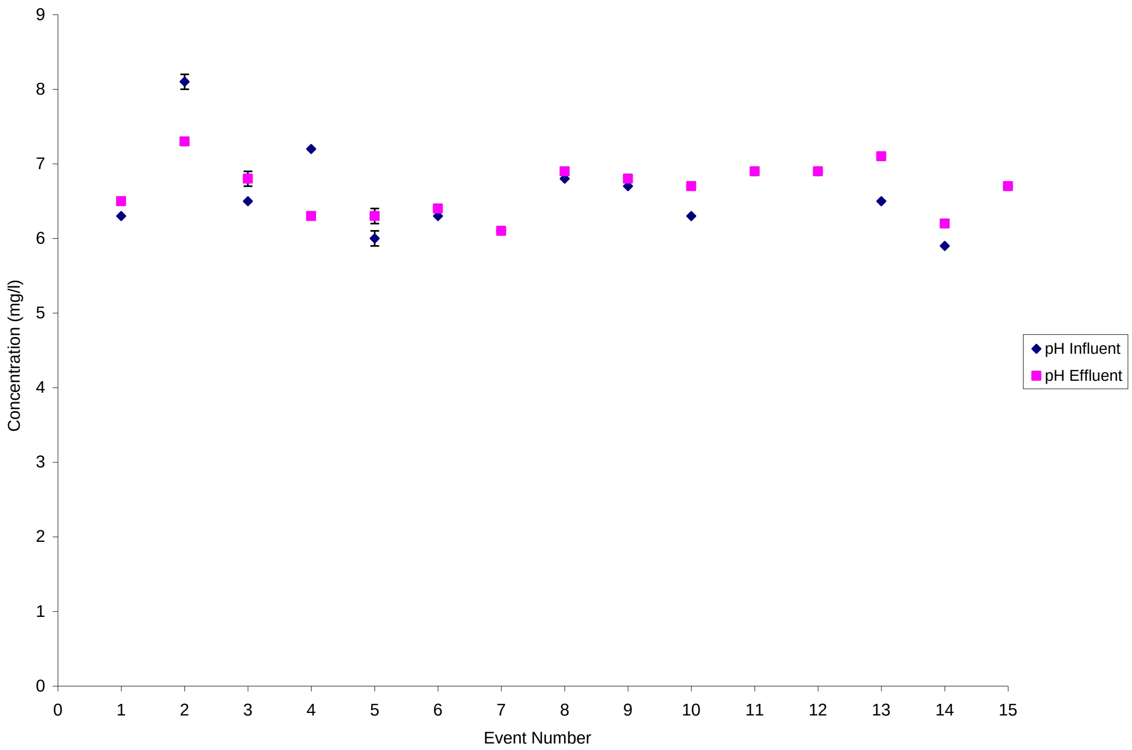
	Hg Influent (µg/L)		Hg Effluent (µg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	9.4	5.9	10.8	7.3	-0.15
2(06/03/07)	2.2	0.5	7.6	0.1	-2.45
3(07/29/07)	12.4	0.9	13.7	1.8	-0.10
4(10/24/07)	0.1	0.2	2.7	0.6	-26.00
5(11/13/07)	6.5	1.7	5.9	0.1	0.09
6(02/01/08)	1.7	0.9	6.4	3.7	-2.76
7(02/06/08)	3.5	0.4	18.7	6	-4.34
8(02/13/08)	126	1.3	138.9	5.8	-0.10
9(03/04/08)	5.7	0.5	17.7	1.4	-2.11
10(03/07/08)	0	0	0	0	
11(03/16/08)	1.7	0	4.9	1.3	-1.88
12(04/28/08)	0	0	0	0	
13(05/09/08)	0	0	8.2	2.9	
14(06/14/08)	6.3	1.8	10.8	0.2	-0.71
15(07/13/08)	0	0	0	0	

	Fe Influent (µg/L)		Fe Effluent (µg/L)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	26.8	10.1	2.2	1.4	0.92
2(06/03/07)	0	0	0	0	
3(07/29/07)	0	0	0	0	
4(10/24/07)	0	0	0	0	
5(11/13/07)	0	0	63.5	2.4	
6(02/01/08)	200.5	40.8	154.8	9.6	0.23
7(02/06/08)	72.4	4	204.6	6.2	-1.83
8(02/13/08)	173.5	3.5	147.5	4.5	0.15
9(03/04/08)	192.9	26.8	142.2	6.3	0.26
10(03/07/08)	68.5	6.8	64.5	7.8	0.06
11(03/16/08)	83.6	7.8	100.1	8.6	-0.20
12(04/28/08)	0	0	0	0	
13(05/09/08)	0	0	0	0	
14(06/14/08)	0	0	30.9	2.8	
15(07/13/08)	0	0	0	0	

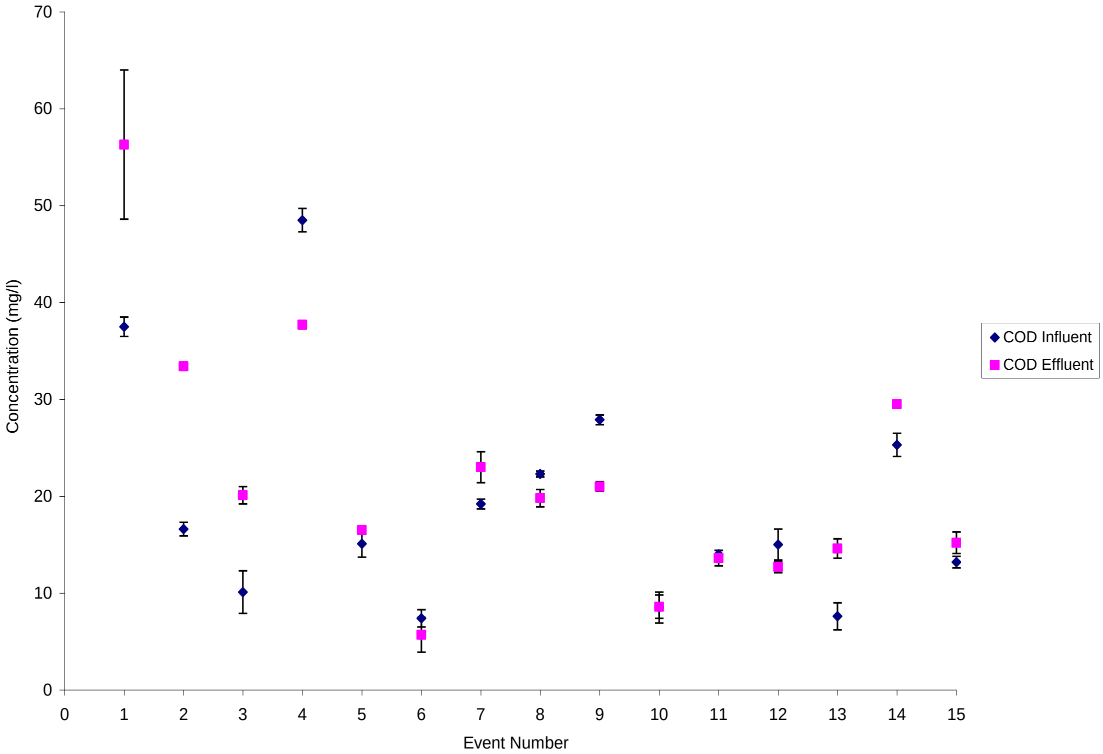
Regular Catch Basin Graphs







Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
Event Number
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
◆ pH Influent
■ pH Effluent



Concentration (mg/l)
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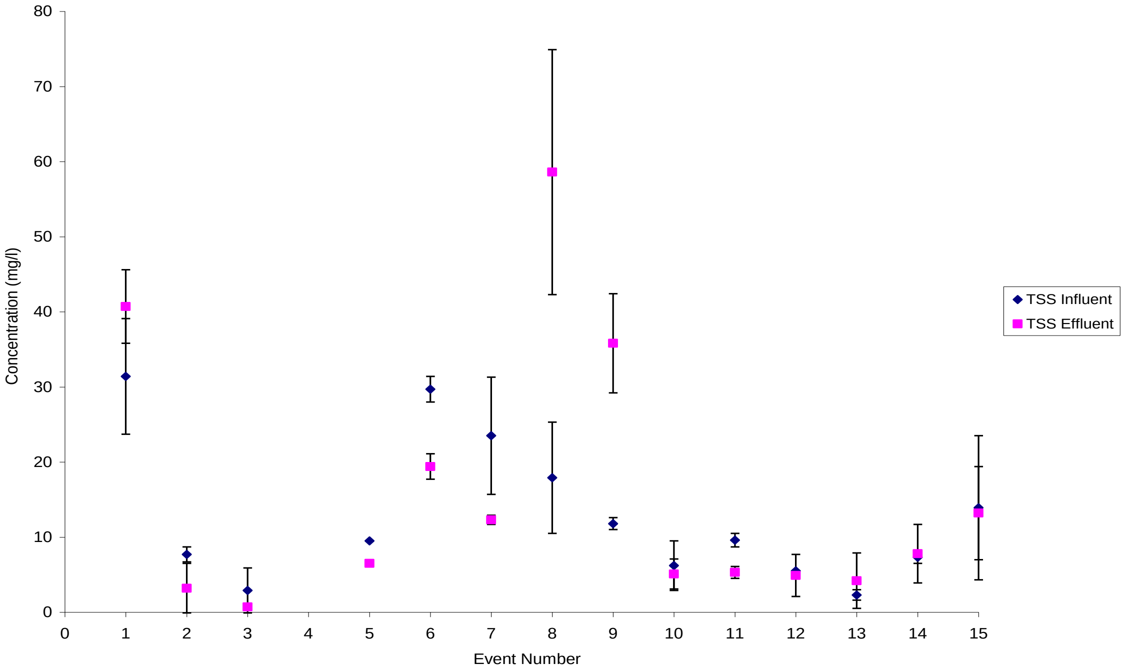
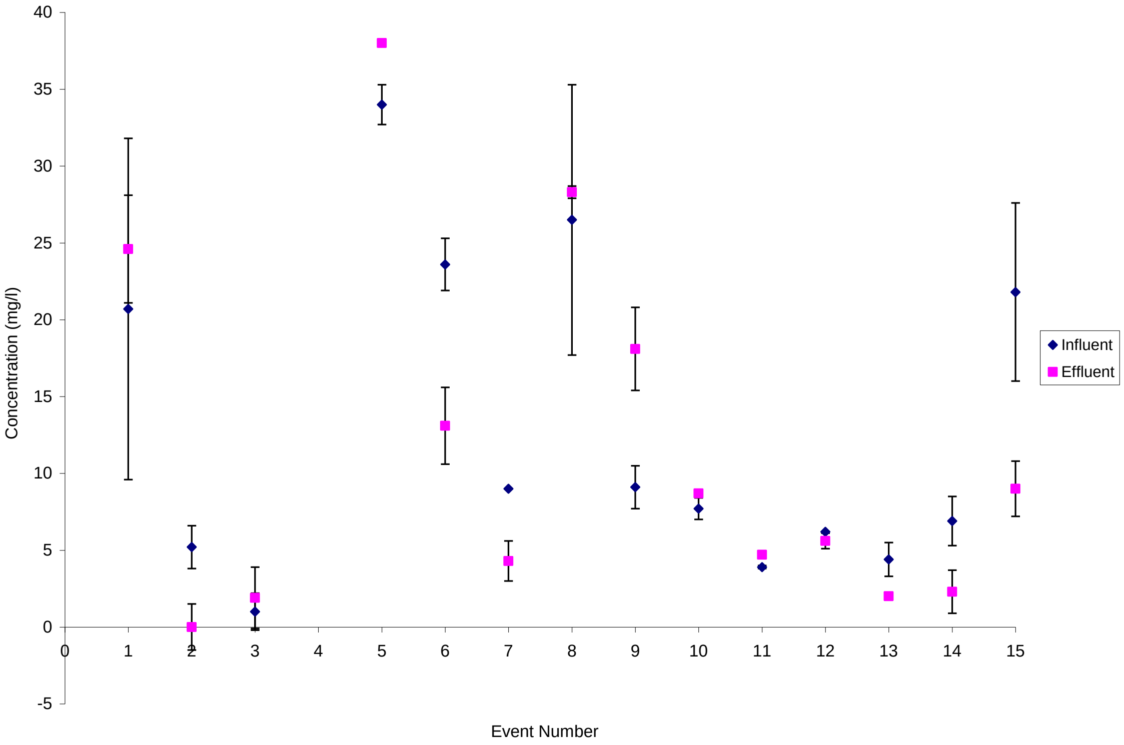
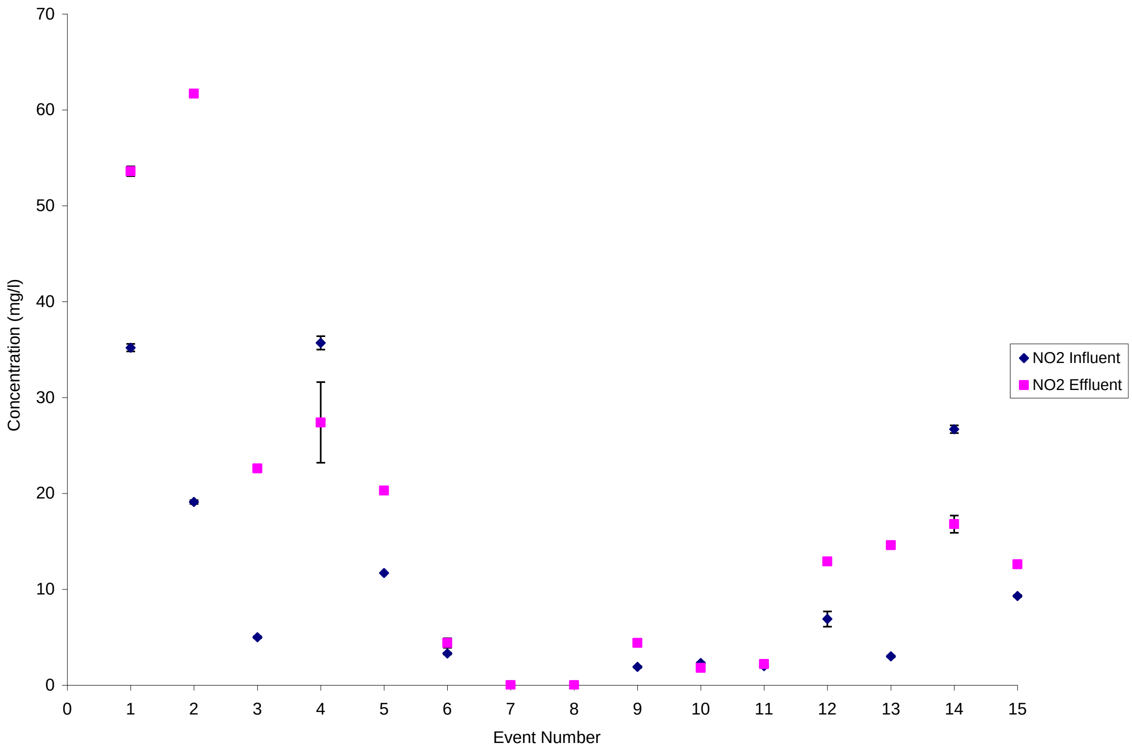
10
20
30
40
50
60
70
Event Number
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
◆ COD Influent
■ COD Effluent

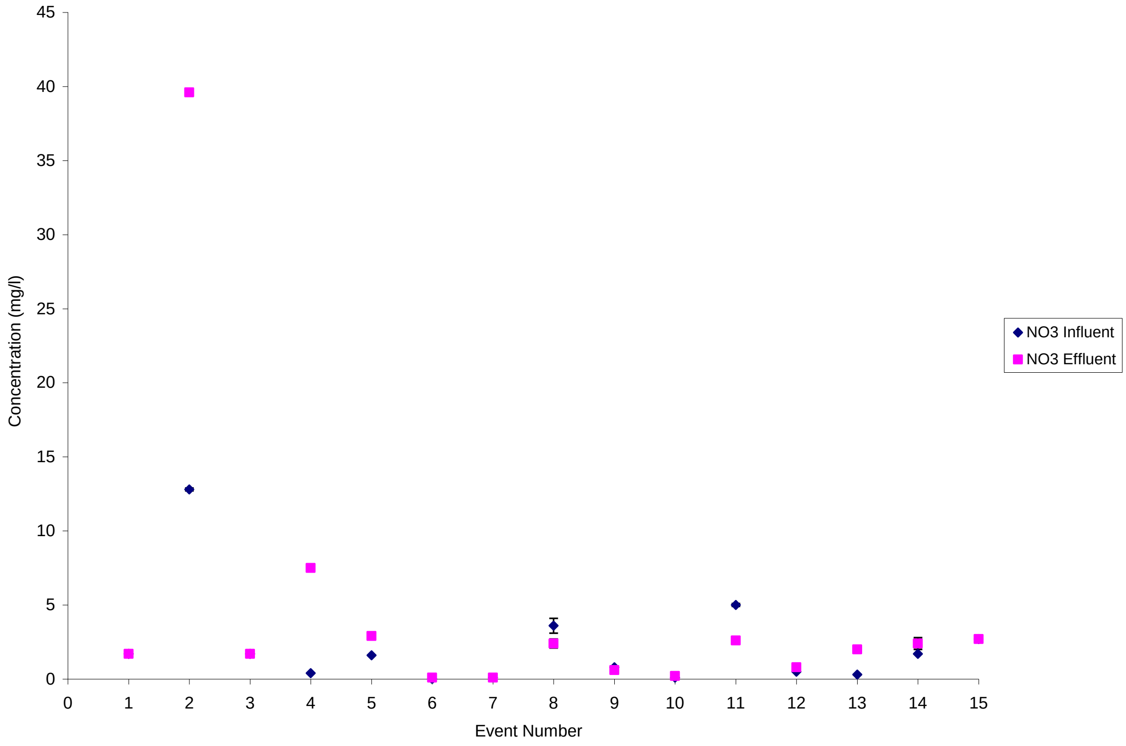


Regular Catch Basin Total Dissolved Solids Graph

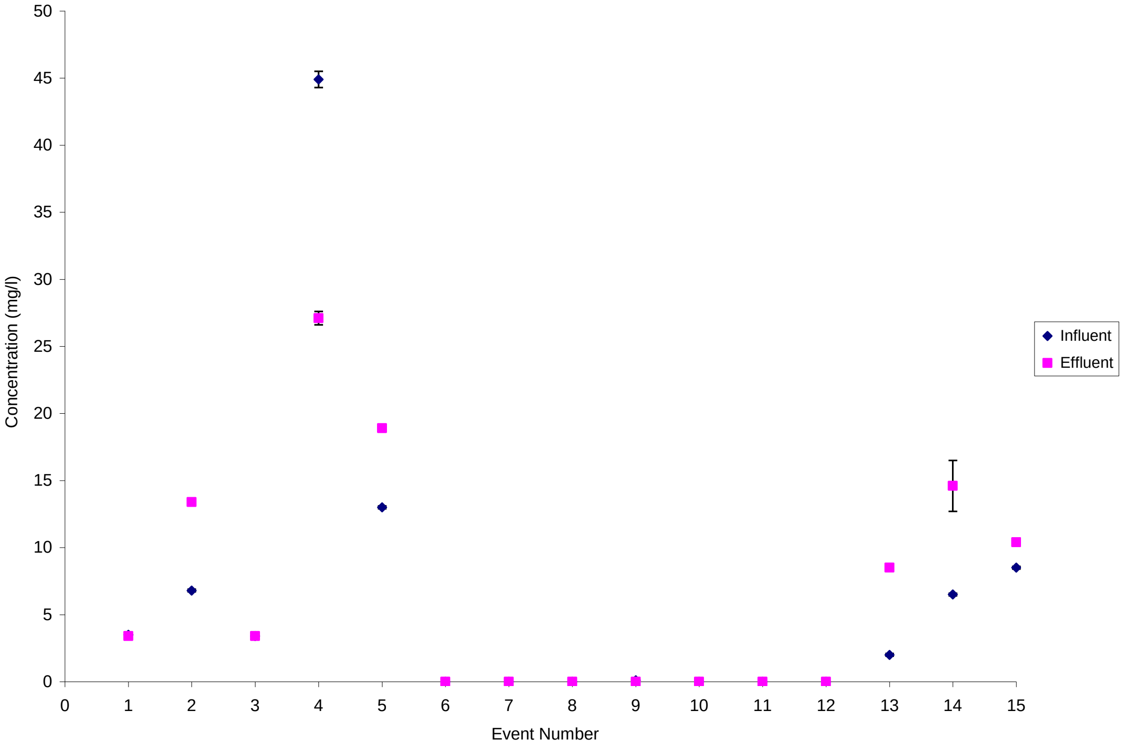




70
60
50
40
30
20
10
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ NO2 Influent
■ NO2 Effluent



45
40
35
30
25
20
15
10
5
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ NO3 Influent
■ NO3 Effluent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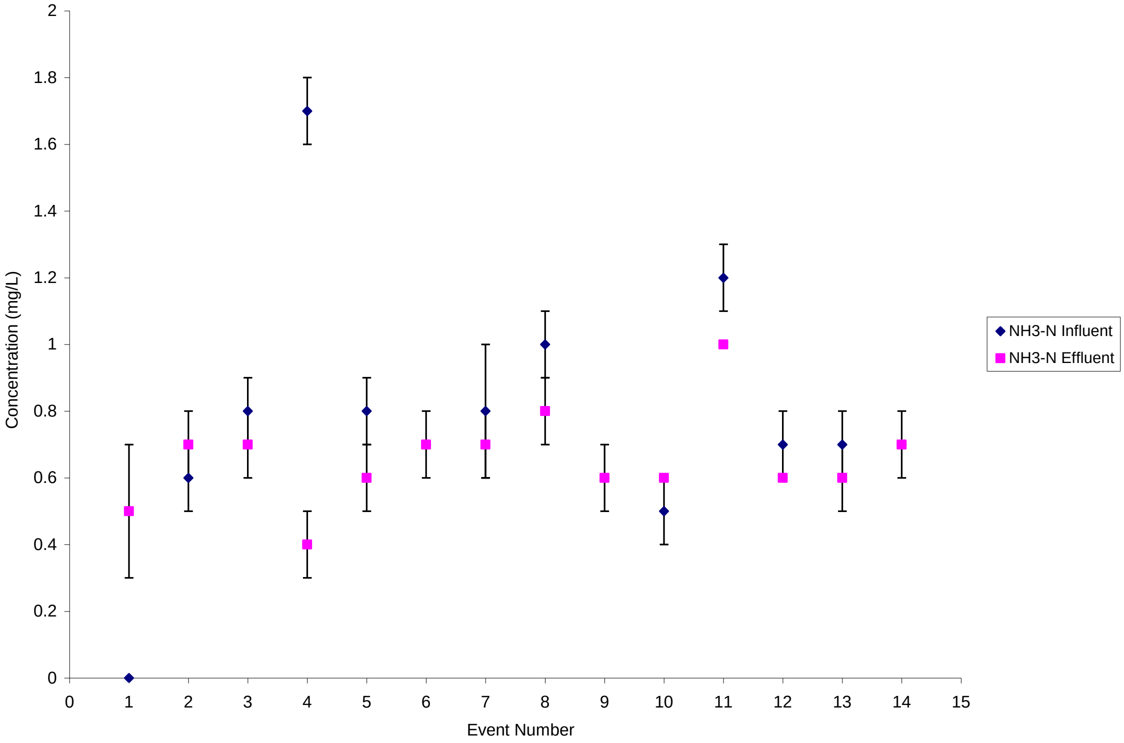
40
35
30
25
20
15
10
5
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Influent
■ Effluent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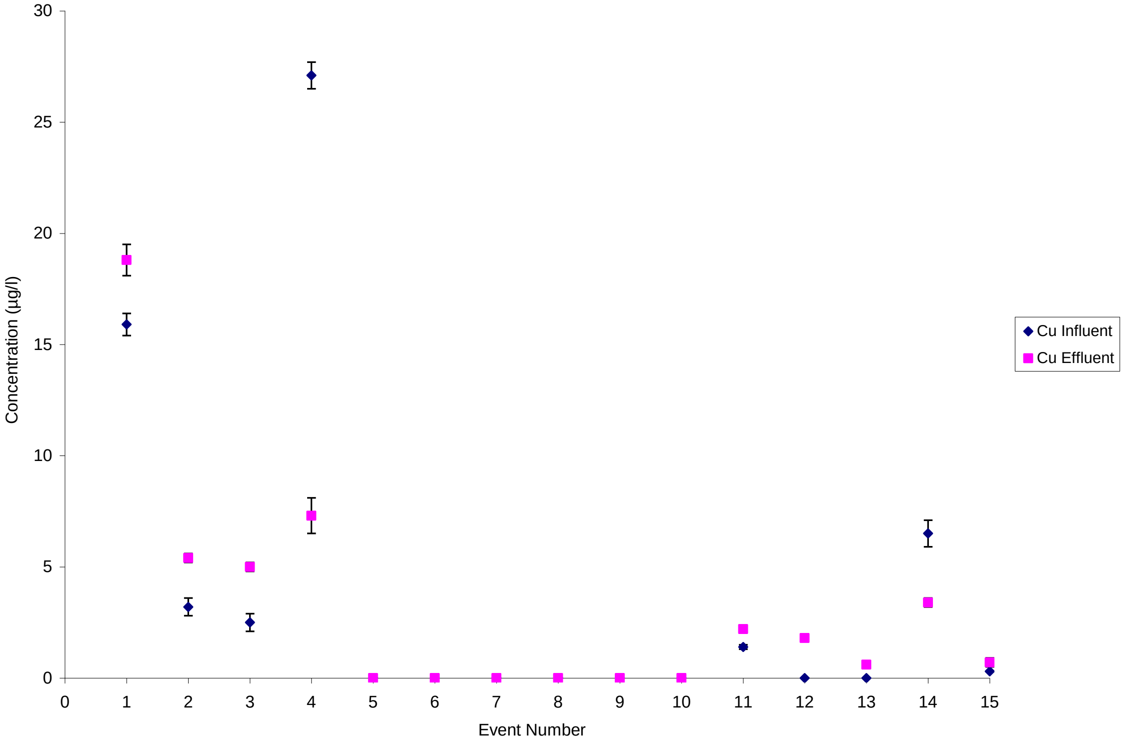
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Concentration (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ NH3-N Influent
■ NH3-N Effluent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15
10
5
0
Concentration (µg/l)
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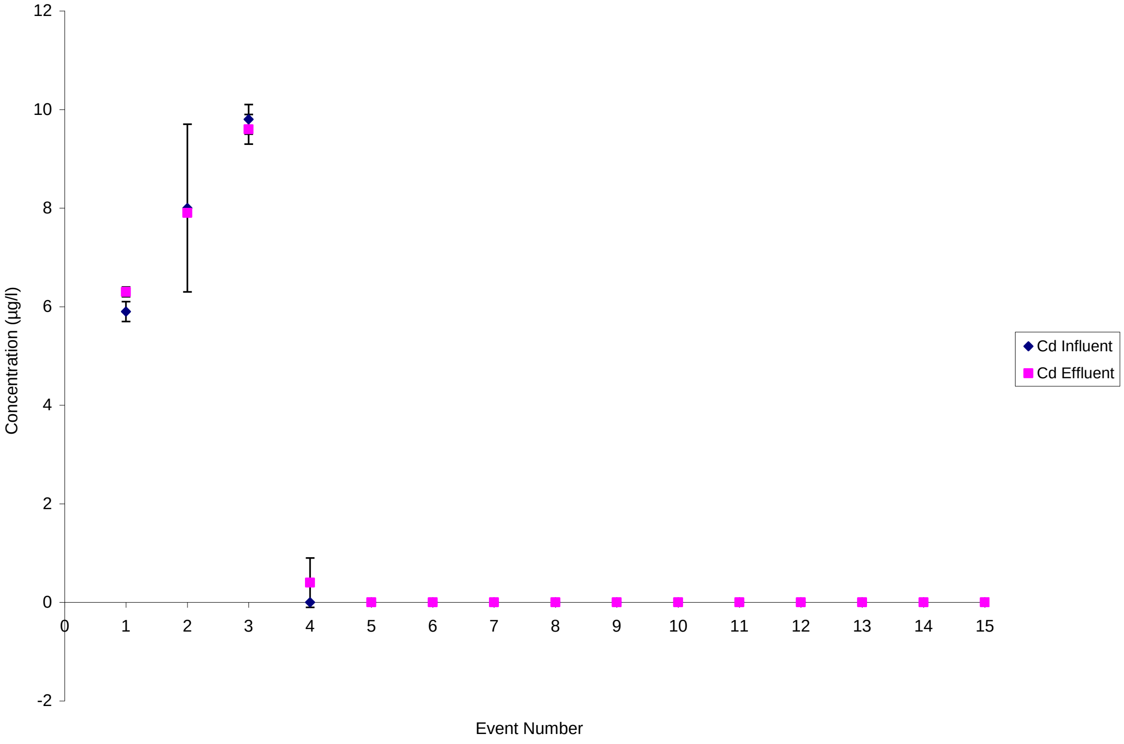
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cu Influent
■ Cu Effluent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8
6
4
2
0
-2
Concentration (µg/l)
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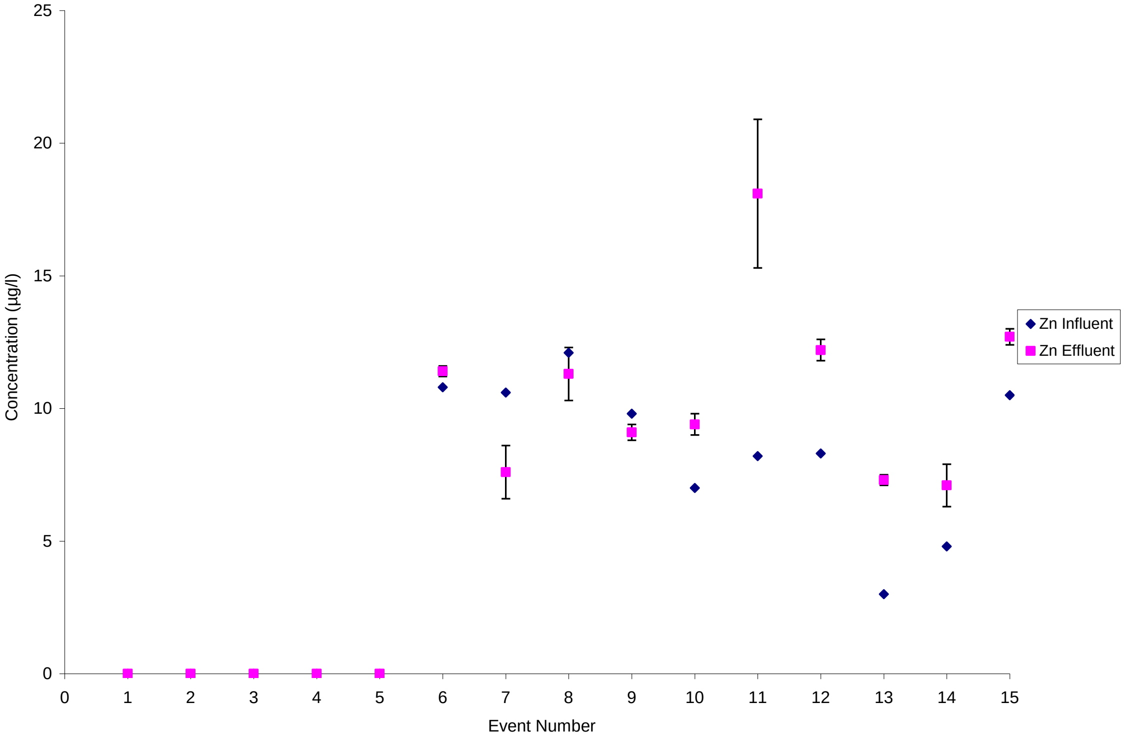
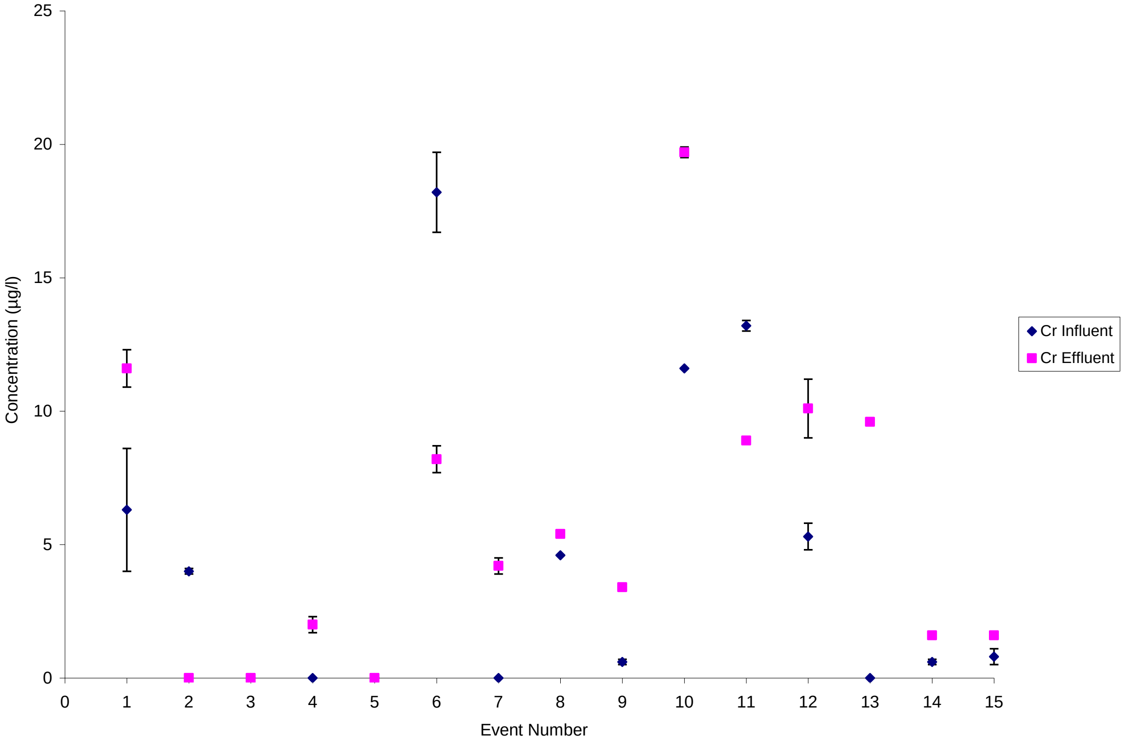
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cd Influent
■ Cd Effluent


25
20
15
10
5
0
Concentration (µg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Zn Influent
■ Zn Effluent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20
15
10
5
0
Concentration (µg/l)
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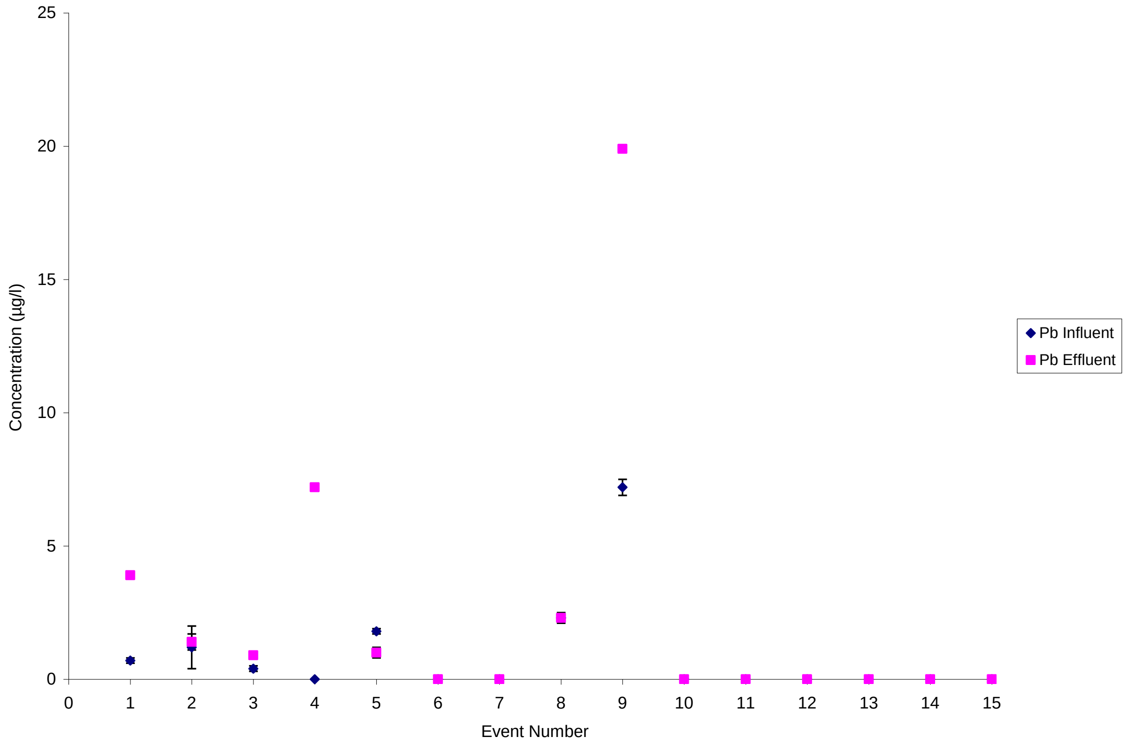
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cr Influent
■ Cr Effluent



25
20
15
10
5
0
Concentration (µg/l)
0
1
2
3
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5
6
7
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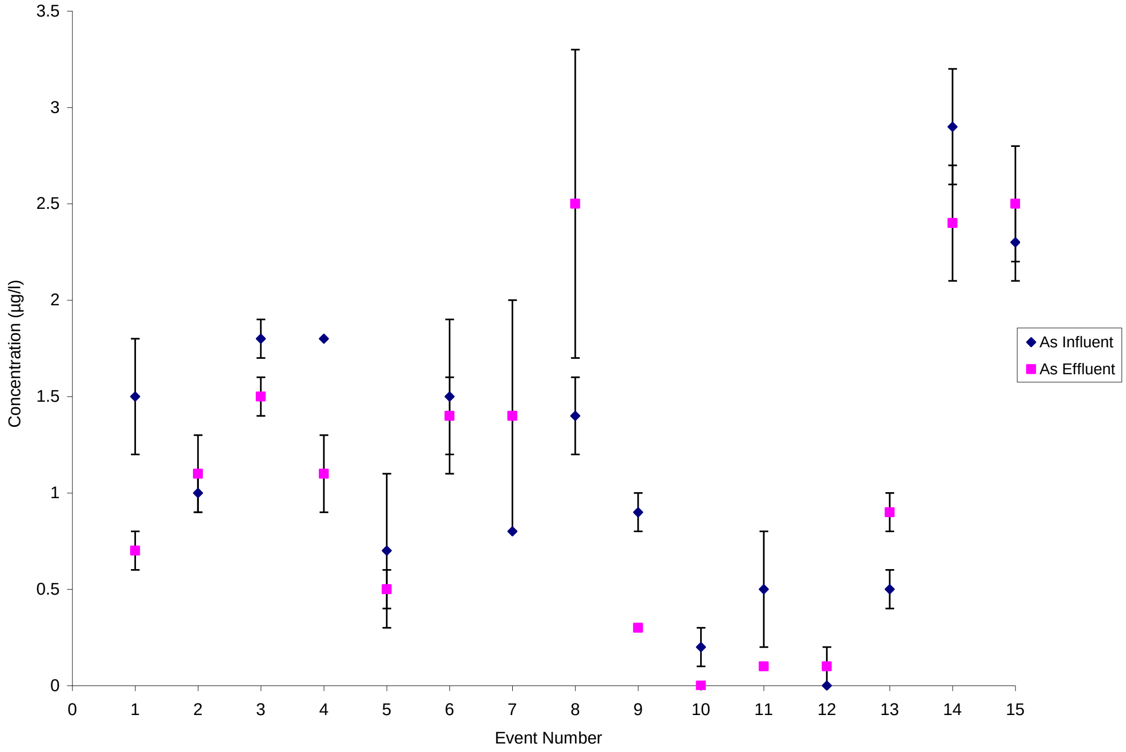
9
10
11
12
13
14
15
Event Number
◆ Pb Influent
■ Pb Effluent



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2
1.5
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0.5
0
Concentration (µg/l)
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1
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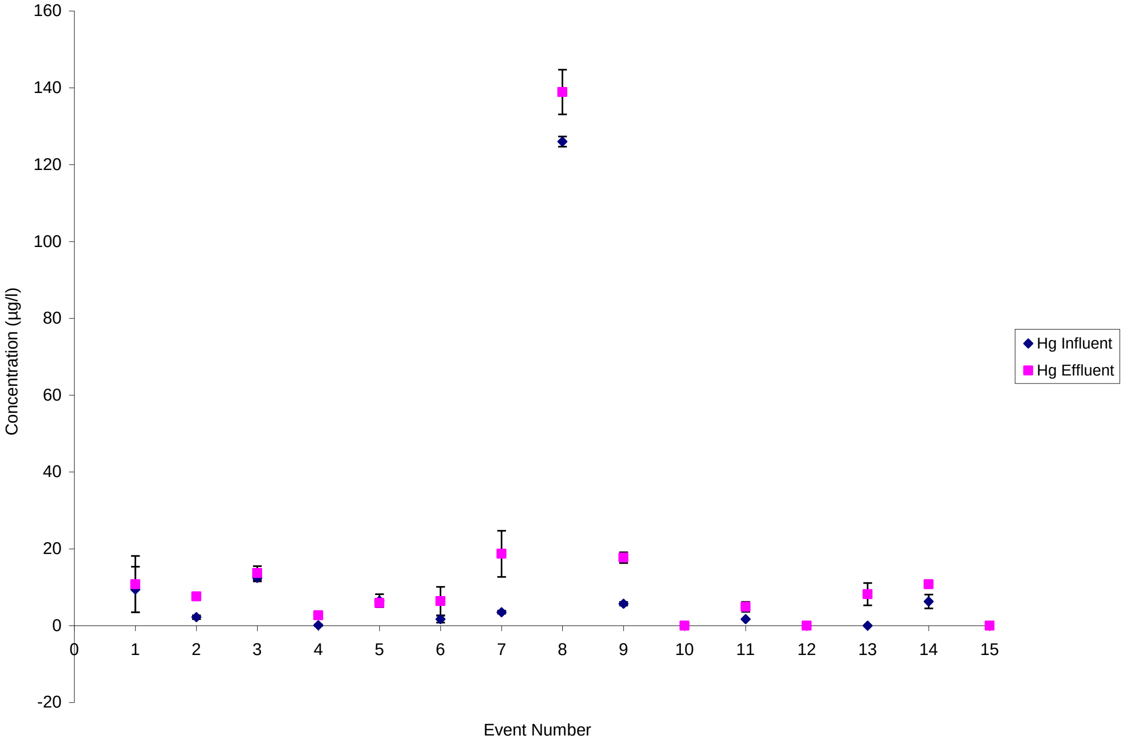
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ As Influent
■ As Effluent



160
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120
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80
60
40
20
0
-20
Concentration (µg/l)
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1
2
3
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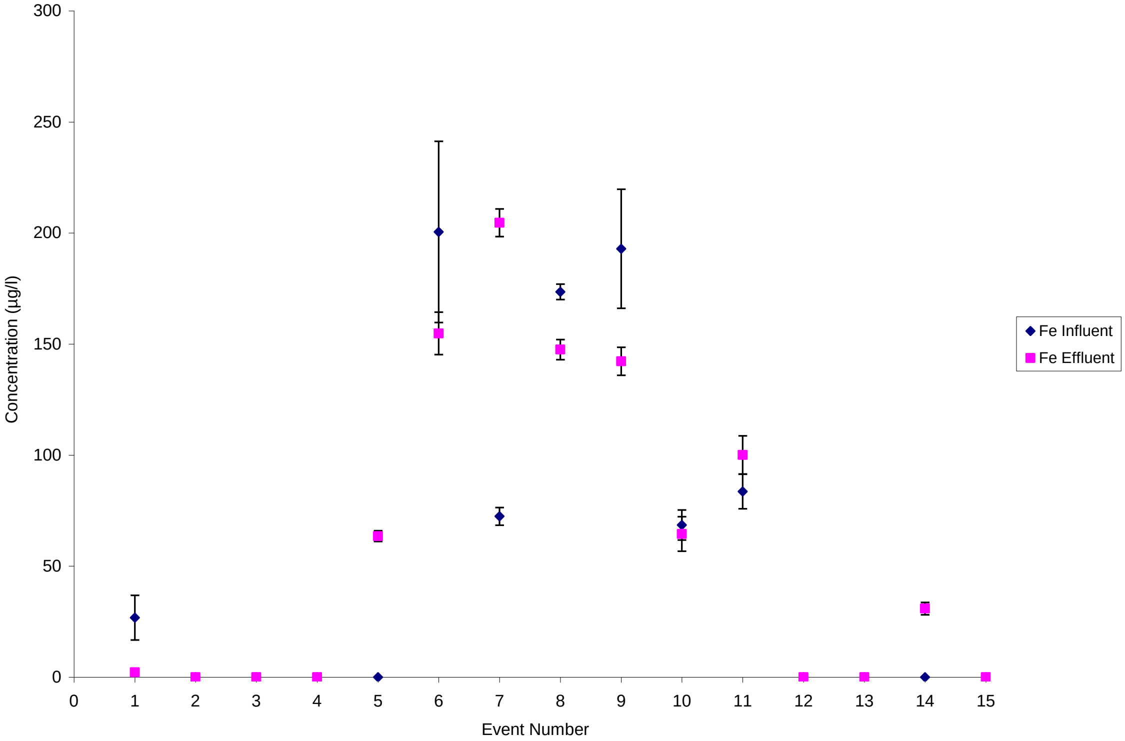
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Hg Influent
■ Hg Effluent



300
250
200
150
100
50
0
Concentration (µg/l)
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1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Fe Influent
■ Fe Effluent

Tables for the Hydrodynamic Catch Basin

	DO In (mg/L)		DO Out (mg/L)	
Event #	Average	Std	Average	Std
1(06/03/07)	8.8	0	7	0
2(07/29/07)	7.6	0.4	6.8	0.1
3(11/13/07)	9.4	0.3	8.2	0
4(11/26/07)	13.8	1.8	6.5	1.2
5(02/01/08)	19.3	0.4	16.2	0.5
6(02/06/08)	14.3	1.7	10.5	0.1
7(02/13/08)	17.5	0.5	16.7	0.7
8(03/04/08)	7.8	0.2	8.2	0.1
9(03/07/08)	14.5	0.5	14.5	0.2
10(03/16/08)	17.5	0.3	15.3	0.2
11(4/28/08)	11.8	0.1	11	0.2
12(5/09/08)	11.7	0.2	11	0.4
13(6/14/08)				
14(7/13/08)	7.3	0.2	7.6	0.2
15(7/23/08)				

	T In (C)		T Out (C)	
Event #	Average	Std	Average	Std
1(06/03/07)	24.2	0.1	24.5	0
2(07/29/07)	27.3	0.1	27.5	0.1
3(11/13/07)	15.5	0.3	15.4	0.2
4(11/26/07)	15.2	0.3	14.2	0.1
5(02/01/08)	8.1	0.1	8.1	0.1
6(02/06/08)	12.3	0.2	13.3	0.3
7(02/13/08)	16.3	0.1	16.8	0.1
8(03/04/08)	17.6	0.1	17.9	0.1
9(03/07/08)	15.2	0.2	15.4	0.1
10(03/16/08)	11.5	0.1	12	0
11(4/28/08)	21.5	0.1	21.3	0
12(5/09/08)	19.1	0	19.7	0
13(6/14/08)				
14(7/13/08)	29.3	0.1	28.8	0
15(7/23/08)	23.5	0	23.5	0

	pH Influent		pH Effluent	
Event #	Average	Std	Average	Std
1(06/03/07)	7.1	0.1	6.8	0
2(07/29/07)	6.2	0	6.6	0
3(11/13/07)	5.6	0.1	5.7	0.1
4(11/26/07)	6.4	0.1	6.4	0
5(02/01/08)	6.0	0	6.0	0
6(02/06/08)	5.5	0	6.0	0
7(02/13/08)	6.7	0	6.9	0
8(03/04/08)	6.6	0	6.7	0
9(03/07/08)	6.1	0	6.1	0
10(03/16/08)	6.4	0	6.6	0
11(4/28/08)	7.0	0	6.8	0
12(5/09/08)	6.3	0	6.6	0
13(6/14/08)	5.6	0	6	0
14(7/13/08)	5.2	0	6.2	0
15(7/23/08)	5.3	0	5.6	0

COD (mg/l) Influent		COD (mg/l) Effluent	
Average	Std	Average	Std
15	1.4	43.4	1.4
11.1	0.5	18.5	1.0
18.4	1.8	10	2.1
34.2	1.5	54	1.0
8.1	0.2	6.8	0
13.8	0.6	21.5	1.8
26.8	1.0	11.6	1.9
23.4	0.9	18.2	1.2
20.5	1.1	12.3	1.0
22.1	1.6	11.5	1.2
12.5	1.6	17	0.5
5.2	0.0	13	0.9
26.7	0.4	37.6	0.5
28.2	0.9	15.2	0.1
12.2	1.9	11.9	1.3

Event #	TSS In (mg/L) Average	TSS In (mg/L) Std	TSS Out (mg/L) Average	TSS Out (mg/L) Std
1(06/03/07)	6.4	4.2	4.9	1.4
2(07/29/07)	1.7	0.6	0.7	0.2
3(11/13/07)	2.3	0.6	0.8	0.2
4(11/26/07)	0.9	0.8	1.7	0.4
5(02/01/08)	13.8	1.6	13.6	0.9
6(02/06/08)	17.8	5.3	5.5	0.5
7(02/13/08)	46.7	16.4	30.7	6.2
8(03/04/08)	42.3	9.5	3.7	1.4
9(03/07/08)	11.2	1.3	25.6	7.8
10(03/16/08)	12.5	0.3	45.9	2.8
11(4/28/08)	9.9	0.3	6.8	3.6
12(5/09/08)	1.5	1.1	0.8	0.2
13(6/14/08)	5.9	1	3.3	2
14(7/13/08)	41.2	14.4	9.5	2.6
15(7/23/08)	43.2	26.6	9.4	2.8

Event #	TDS In (mg/L) Average	TDS In (mg/L) Std	TDS Out (mg/L) Average	TDS Out (mg/L) Std
1(06/03/07)	4.7	0.7	1.8	1.1
2(07/29/07)	1.5	1.4	1.1	0.5
3(11/13/07)	2.8	1.6	2.5	0
4(11/26/07)	2.5	1.3	0.8	0.2
5(02/01/08)	9.6	1.2	9.9	1.3
6(02/06/08)	15.0	1.0	1.9	0.7
7(02/13/08)	23.4	2.1	25.1	5.1
8(03/04/08)	29.9	11.5	24.3	6.3
9(03/07/08)	14.0	2.4	6.2	0.4
10(03/16/08)	1.5	0.7	0.8	0.3
11(4/28/08)	5.2	1.9	10.8	2.4
12(5/09/08)	0.8	0.4	3.3	2.9
13(6/14/08)	7.3	0.5	5.9	0.1
14(7/13/08)	17.6	3.3	15.2	4.5
15(7/23/08)	39.0	12.1	8.2	1.8

Event #	NO2 Influent (mg/l) Average	Std	NO2 Effluent (mg/l) Average	Std
1(06/03/07)	12.4	1	114.3	0.5
2(07/29/07)	5.6	0.1	19.2	0.4
3(11/13/07)	13.3	0.3	10.6	0.2
4(11/26/07)	40.6	0.5	77.6	1.5
5(02/01/08)	2.4	0	6.3	0.4
6(02/06/08)	0.3	0	0	0
7(02/13/08)	0	0	0	0
8(03/04/08)	2.6	0.2	4.5	0
9(03/07/08)	3.2	0.5	1.8	0.2
10(03/16/08)	2.3	0.2	2.3	0.1
11(4/28/08)	9.6	0.7	19.8	0.6
12(5/09/08)	1.4	0.1	18.2	0.3
13(6/14/08)	17.8	0.6	8.4	0.8
14(7/13/08)	20	0.7	11.5	0.1
15(7/23/08)	0.5	0	2.4	0

Event #	NO3 Influent (mg/l) Average	Std	NO3 Effluent (mg/l) Average	Std
1(06/03/07)	8.6	0.6	72.8	0.3
2(07/29/07)	1.7	0	1.7	0
3(11/13/07)	1	0	2.2	0.1
4(11/26/07)	1	0	0	0
5(02/01/08)	0.1	0.1	0.1	0
6(02/06/08)	0.1	0	0.2	0
7(02/13/08)	6.3	0.4	1.4	0.1
8(03/04/08)	0.4	0	0.3	0
9(03/07/08)	0.2	0.1	0.1	0
10(03/16/08)	3.3	0.1	2	0.1
11(4/28/08)	0.6	0.1	1	0
12(5/09/08)	0.2	0	0.5	0
13(6/14/08)	1.6	0	0.1	0
14(7/13/08)	5	0.1	2.4	0
15(7/23/08)	0	0	0	0

	PO4 Influent (mg/l)		PO4 Effluent (mg/l)	
Event #	Average	Std	Average	Std
1(06/03/07)	5.8	0.3	11.5	0.2
2(07/29/07)	3.4	0	3.4	0
3(11/13/07)	12.7	0.1	13.6	0.4
4(11/26/07)	16.4	0.1	18.5	0.4
5(02/01/08)	0	0	0	0
6(02/06/08)	0	0	0	0
7(02/13/08)	0	0	0	0
8(03/04/08)	0.2	0.1	0	0
9(03/07/08)	0	0	0	0
10(03/16/08)	0.1	0	0	0
11(4/28/08)	0	0	0	0
12(5/09/08)	1.4	0	3	0.1
13(6/14/08)	6.5	0.8	12.7	0.3
14(7/13/08)	18.6	0.1	9.3	0.1
15(7/23/08)	0	0	0	0

	NH3-N Influent (mg/l)		NH3-N Effluent (mg/l)	
Event #	Average	Std	Average	Std
1(06/03/07)	0.5	0	1.3	0
2(07/29/07)	0.9	0.1	0.9	0.1
3(11/13/07)	0.6	0.1	0.6	0.1
4(11/26/07)	1.8	0	3.1	0.1
5(02/01/08)	0.6	0	0.7	0.2
6(02/06/08)	0.6	0	0.7	0
7(02/13/08)	1.1	0.1	0.9	0.1
8(03/04/08)	0.7	0.1	0.6	0.1
9(03/07/08)	0.5	0.1	0.6	0.1
10(03/16/08)	1.0	0.1	0.9	0.1
11(4/28/08)	0.6	0.1	0.6	0.1
12(5/09/08)	0.7	0	0.6	0
13(6/14/08)	0.7	0.1	0.6	0
14(7/13/08)				
15(7/23/08)				

Event #	Cu Influent (µg/L) Average	Std	Cu Effluent (µg/L) Average	Std
1(06/03/07)	5.9	0.5	7.9	2.1
2(07/29/07)	3.7	0.2	5	0.2
3(11/13/07)	0	0	0	0
4(11/26/07)	12.1	0.4	7	2.5
5(02/01/08)	0	0	0	0
6(02/06/08)	0	0	0	0
7(02/13/08)	0	0	0	0
8(03/04/08)	0	0	0	0
9(03/07/08)	0	0	0	0
10(03/16/08)	14	1.8	0.1	0.1
11(4/28/08)	0	0	0	0
12(5/09/08)	0	0	4.5	0.3
13(6/14/08)	8.3	1	10.7	0.5
14(7/13/08)	12.3	1.4	3.5	0.1
15(7/23/08)	0	0	0	0

Event #	Cd Influent (µg/L) Average	Std	Cd Effluent (µg/L) Average	Std
1(06/03/07)	9.8	1.1	10.5	0.4
2(07/29/07)	11	0.1	9.9	0.3
3(11/13/07)	0	0	0	0
4(11/26/07)	0	0	0	0
5(02/01/08)	0	0	0	0
6(02/06/08)	0	0	0	0
7(02/13/08)	0	0	0	0
8(03/04/08)	0	0	0	0
9(03/07/08)	0	0	0	0
10(03/16/08)	0	0	0	0
11(4/28/08)	0	0	0	0
12(5/09/08)	0	0	0	0
13(6/14/08)	0	0	0	0
14(7/13/08)	0	0	0	0
15(7/23/08)	0	0	0	0

	Zn Influent (µg/L)		Zn Effluent (µg/L)	
Event #	Average	Std	Average	Std
1(06/03/07)	0	0	0	0
2(07/29/07)	0	0	0	0
3(11/13/07)	0	0	0	0
4(11/26/07)	0	0	0	0
5(02/01/08)	10.9	2.9	10.1	0.3
6(02/06/08)	16.1	0.4	11.8	0.6
7(02/13/08)	0	0	13.2	0.2
8(03/04/08)	8.4	0.2	10.2	1.4
9(03/07/08)	7.7	0.4	9.1	0.6
10(03/16/08)	10.0	0.2	8.9	1.2
11(4/28/08)	8.8	1.5	13.2	0.4
12(5/09/08)	4.3	0.4	8.0	0.4
13(6/14/08)	4.7	1.2	7.5	0.4
14(7/13/08)	2.9	0.4	12.5	0.3
15(7/23/08)	1.7	0.1	3.8	0.2

	Cr Influent (µg/L)		Cr Influent (µg/L)	
Event #	Average	Std	Average	Std
1(06/03/07)	3	1.2	0	0
2(07/29/07)	0	0	0	0
3(11/13/07)	0	0	0	0
4(11/26/07)	0	0	0	0
5(02/01/08)	5.7	0.4	7.3	0.3
6(02/06/08)	4.4	0.4	1.8	0.2
7(02/13/08)	7.1	1.3	10.2	0.1
8(03/04/08)	1.7	0.2	82.9	1
9(03/07/08)	29.6	0.7	28.8	0.9
10(03/16/08)	12.9	0.2	10.9	0.1
11(4/28/08)	15.8	0.4	18.7	0.8
12(5/09/08)	0	0	17.2	2.5
13(6/14/08)	1.1	0.1	0.2	0
14(7/13/08)	6.9	2.6	4.8	0.6
15(7/23/08)	0	0	0	0

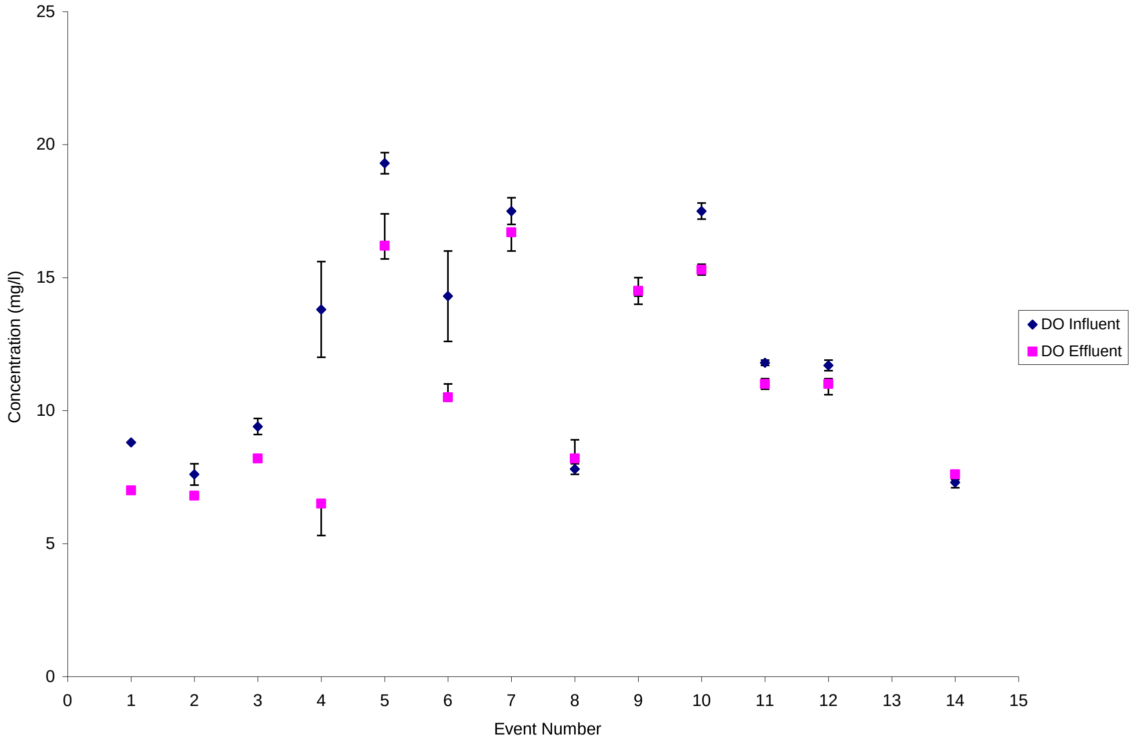
	Pb Influent (µg/L)		Pb Effluent (µg/L)	
Event #	Average	Std	Average	Std
1(06/03/07)	0.8	0.2	2.6	0.1
2(07/29/07)	2.7	0.2	1.1	0.1
3(11/13/07)	2.4	0.1	0.3	0.1
4(11/26/07)	0.9	0.2	2.8	0.1
5(02/01/08)	0	0	0.8	0.4
6(02/06/08)	0	0	0	0
7(02/13/08)	2.9	0.5	0	0
8(03/04/08)	7.5	2.2	7	0.3
9(03/07/08)	0	0	0	0
10(03/16/08)	0	0	0	0
11(4/28/08)	0	0	0	0
12(5/09/08)	0	0	0	0
13(6/14/08)	0	0	0	0
14(7/13/08)	0	0	0	0
15(7/23/08)	0	0	0	0

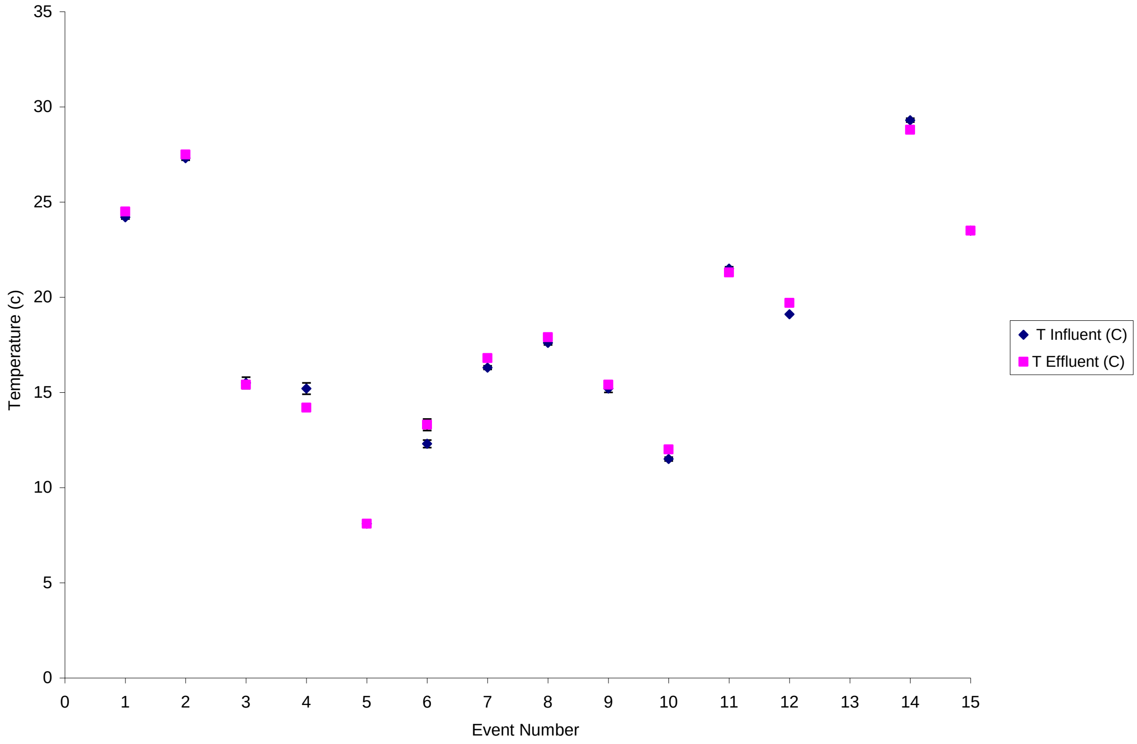
	As Influent (µg/L)		As Effluent (µg/L)	
Event #	Average	Std	Average	Std
1(06/03/07)	1.2	0.4	1.2	0.1
2(07/29/07)	1.7	0.2	1.5	0.1
3(11/13/07)	1.3	0.2	0.6	0.3
4(11/26/07)	1	0.1	0.8	0.1
5(02/01/08)	2.3	0.9	1.9	0.8
6(02/06/08)	0.6	0.1	0.3	0.1
7(02/13/08)	2.3	1.3	0.9	0.2
8(03/04/08)	0.4	0	0.3	0.2
9(03/07/08)	0.3	0.1	0	0
10(03/16/08)	0.3	0.2	0.1	0
11(4/28/08)	0.5	0.3	0.1	0
12(5/09/08)	0.5	0.2	0.4	0.1
13(6/14/08)	2.5	0.2	2.1	0.1
14(7/13/08)	3.1	0.5	2.6	0.2
15(7/23/08)	2.9	0.3	1.7	0.2

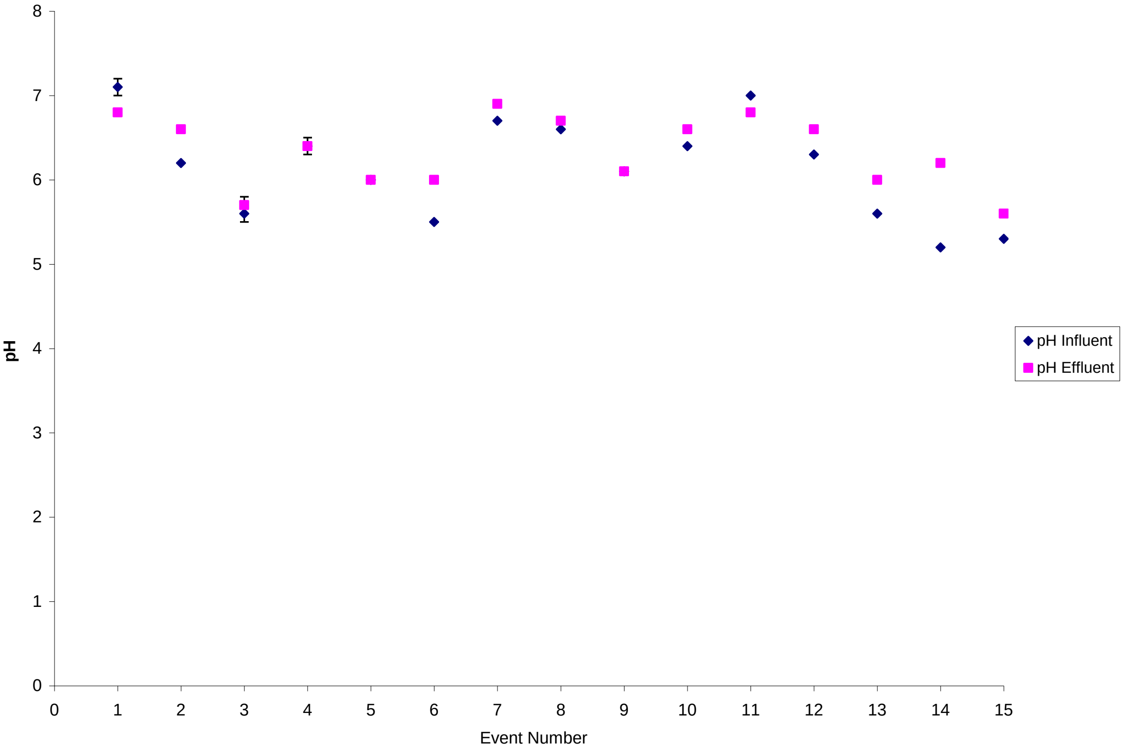
	Hg Influent (µg/L)		Hg Effluent (µg/L)	
Event #	Average	Std	Average	Std
1(06/03/07)	0.9	0.8	6.2	2.8
2(07/29/07)	13.5	3	11.7	1.1
3(11/13/07)	5.3	1.6	6	1.7
4(11/26/07)	9.5	1.4	7.9	1.4
5(02/01/08)	6.9	4.8	7	2.1
6(02/06/08)	2.3	1.9	6.5	0.9
7(02/13/08)	250.7	6.5	112.3	3.9
8(03/04/08)	3.6	0.1	24.1	4
9(03/07/08)	0	0	0	0
10(03/16/08)	2.1	1	1.2	0.3
11(4/28/08)	0	0	0	0
12(5/09/08)	0	0	0	0
13(6/14/08)	8.5	0.6	4	1
14(7/13/08)	5.5	0.5	3.1	0.4
15(7/23/08)	0	0	0	0

	Fe Influent (µg/L)		Fe Effluent (µg/L)	
Event #	Average	Std	Average	Std
1(06/03/07)	0	0	266.3	38.7
2(07/29/07)	0	0	0	0
3(11/13/07)	5	1	35	4.2
4(11/26/07)	85.4	7.5	556.5	12.4
5(02/01/08)	149.5	14.5	155.5	6.4
6(02/06/08)	43.4	1.3	86.3	6.7
7(02/13/08)	281.7	51.2	139.2	27.1
8(03/04/08)	104.8	2.6	148.3	9.3
9(03/07/08)	81.6	5.1	62.2	3.1
10(03/16/08)	112.2	6.9	50.1	0.5
11(04/28/08)	0	0	0	0
12(05/09/08)	0	0	0	0
13(06/14/08)	0	0	194.1	3.8
14(07/13/08)	0	0	0	0
15(07/23/08)	0	0	0	0

Graphs for the Hydrodynamic Catch Basin



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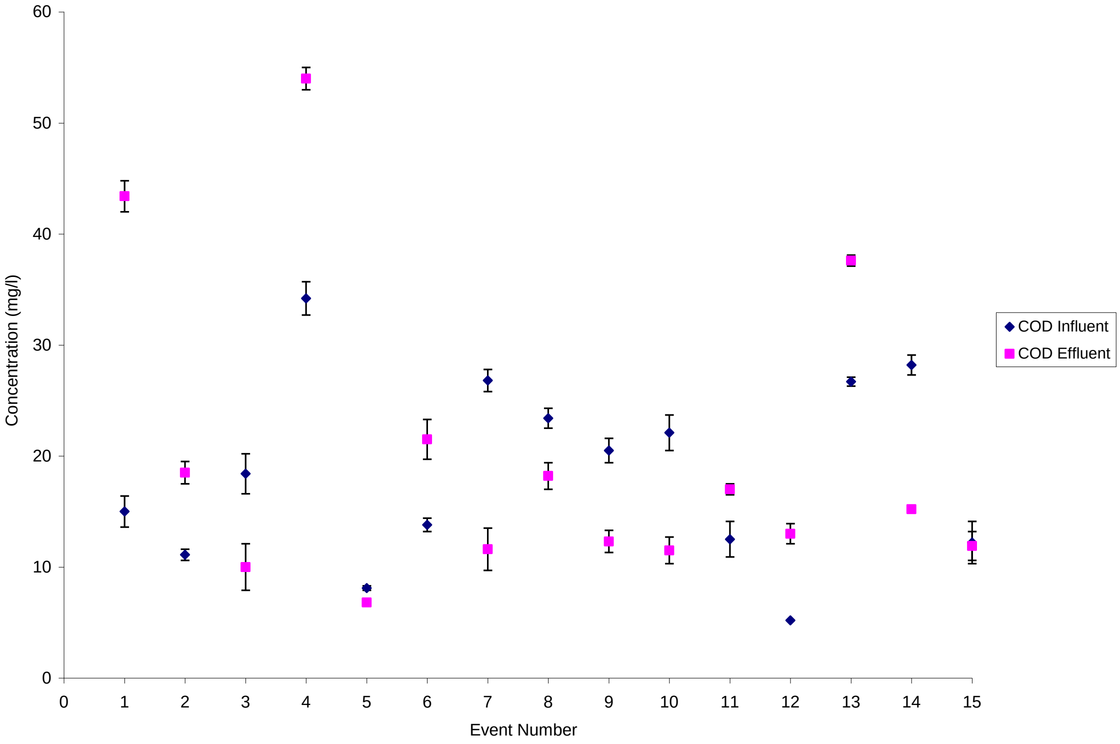
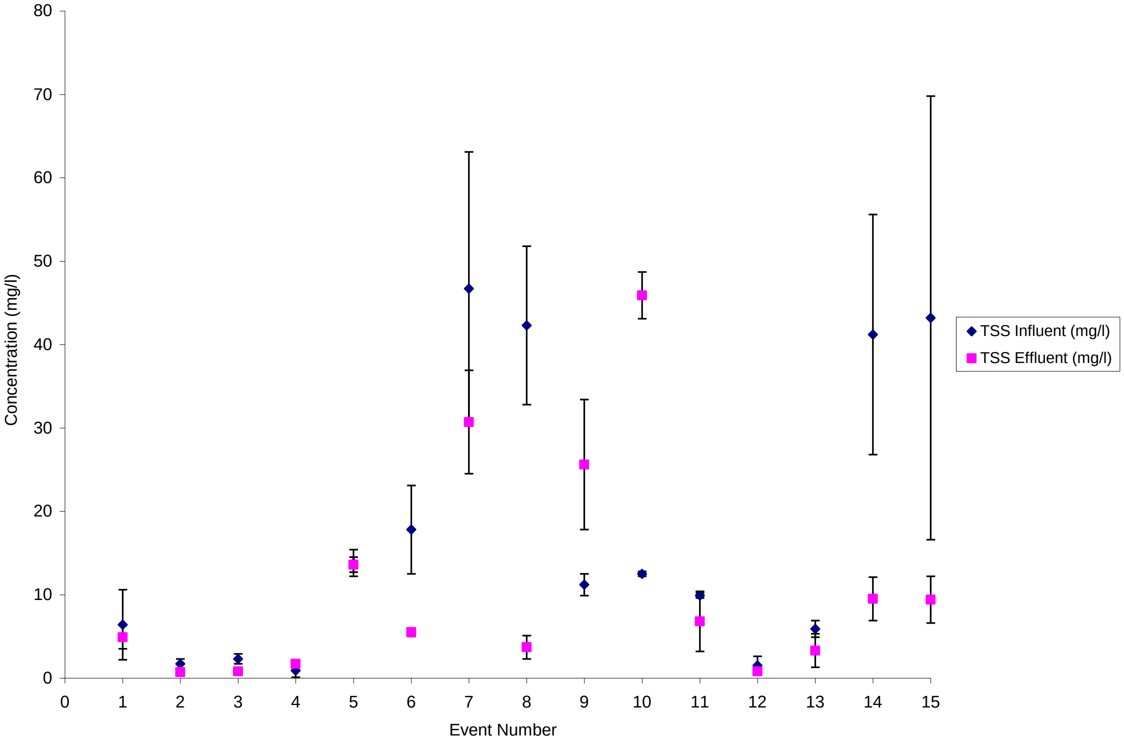
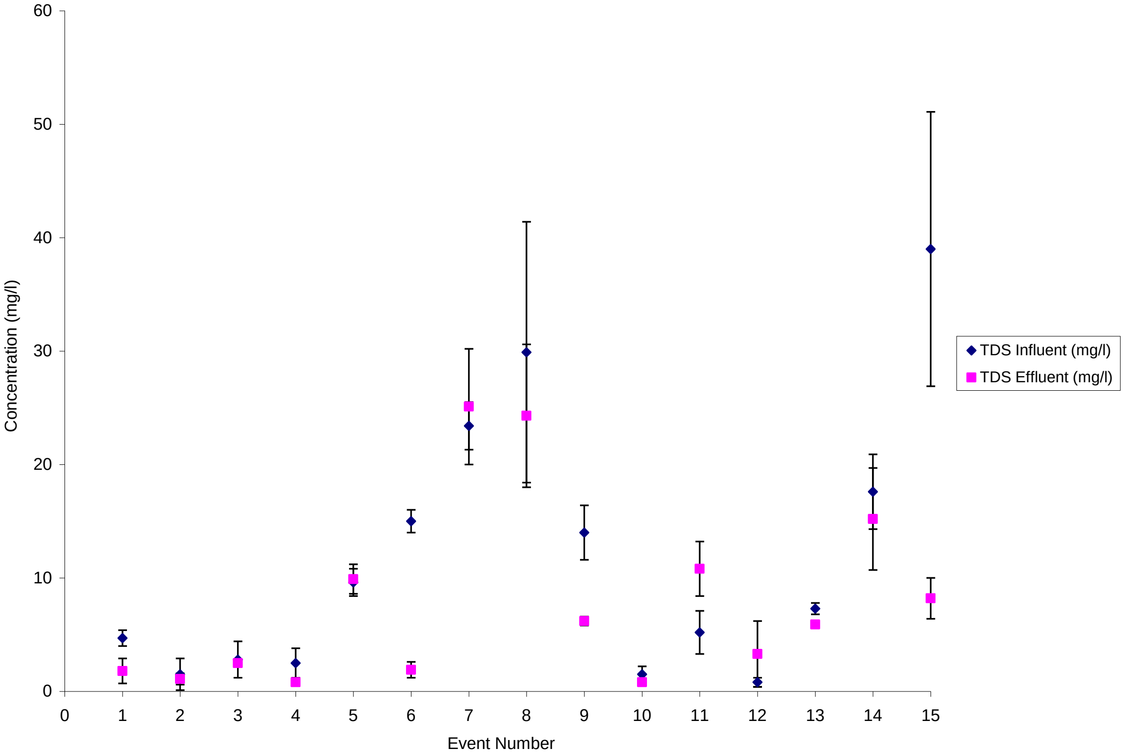
8
9
10
11
12
13
14
15
Event Number
◆ pH Influent
■ pH Effluent

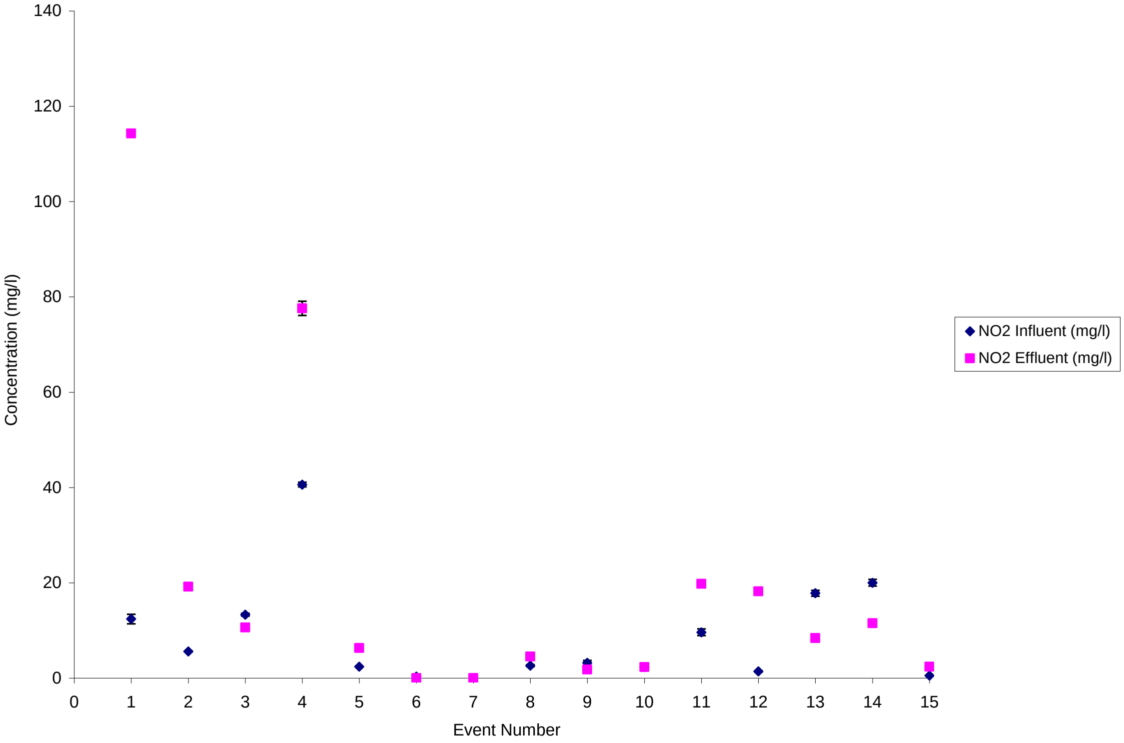

60
50
40
30
20
10
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ COD Influent
■ COD Effluent

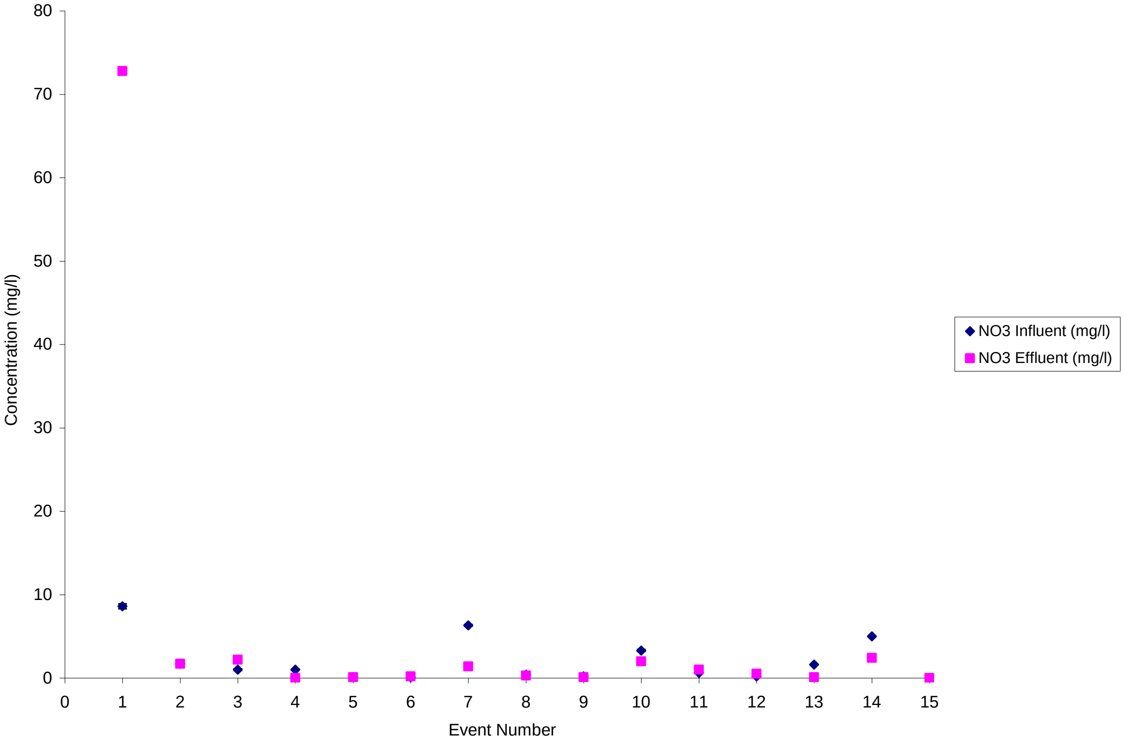


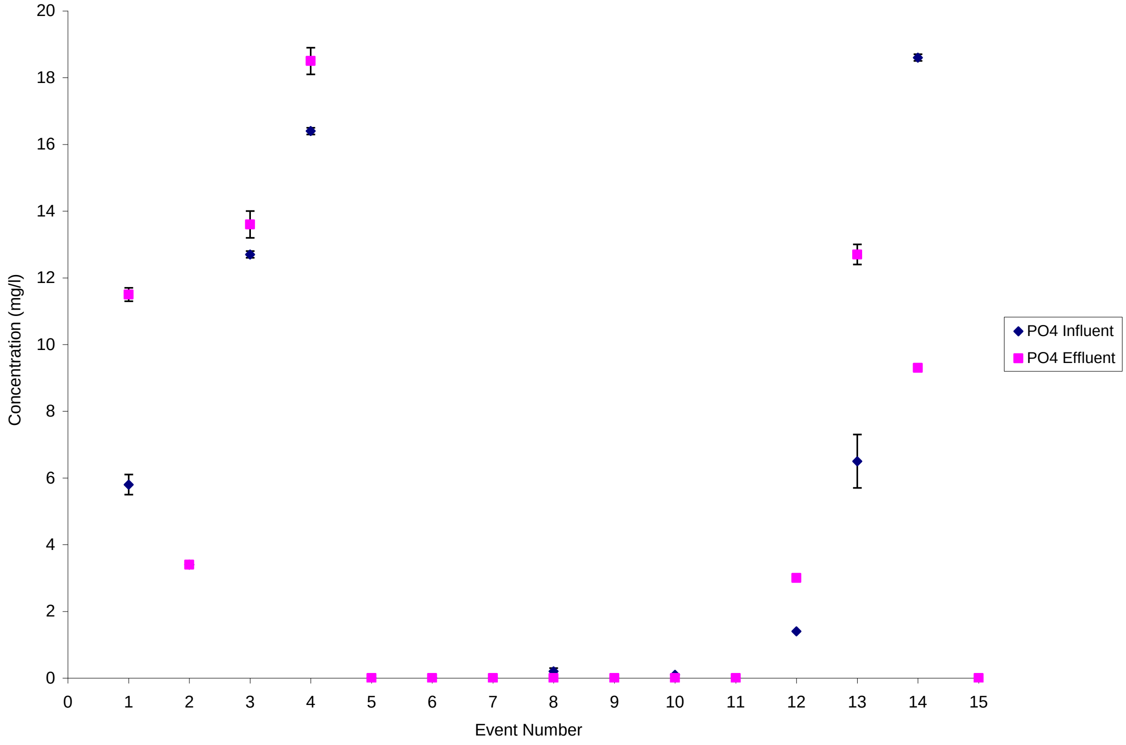
80
70
60
50
40
30
20
10
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ TSS Influent (mg/l)
■ TSS Effluent (mg/l)



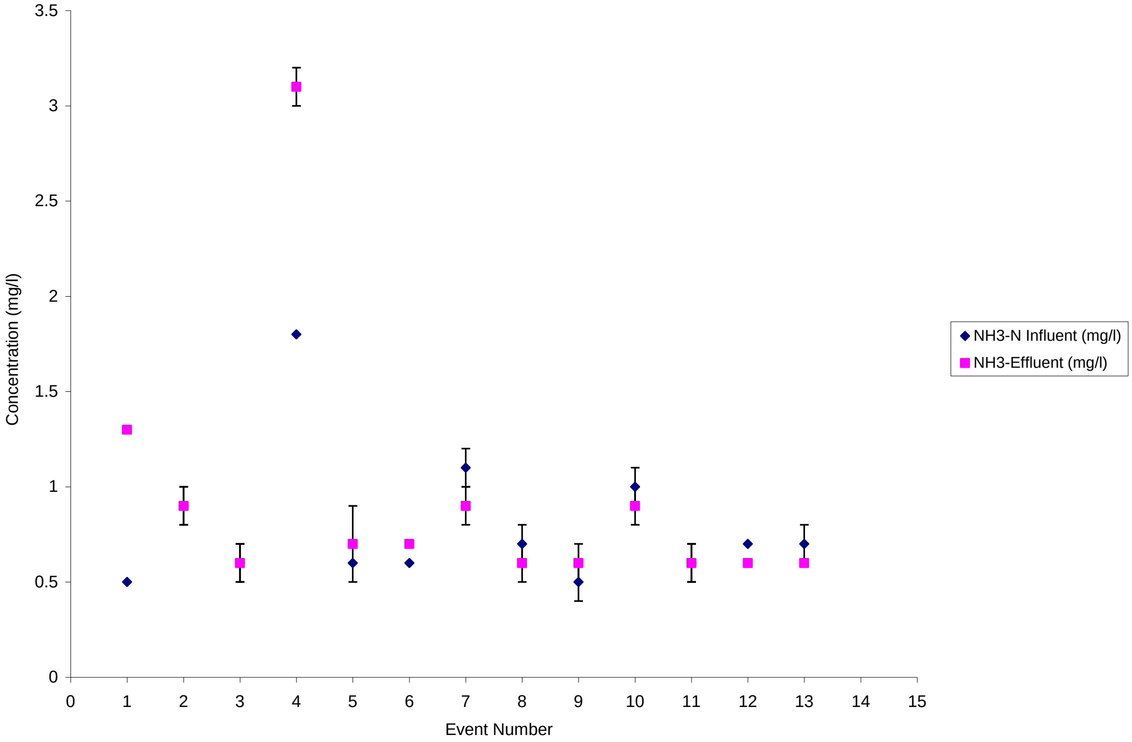
60
50
40
30
20
10
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ TDS Influent (mg/l)
■ TDS Effluent (mg/l)


140
120
100
80
60
40
20
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ NO2 Influent (mg/l)
■ NO2 Effluent (mg/l)

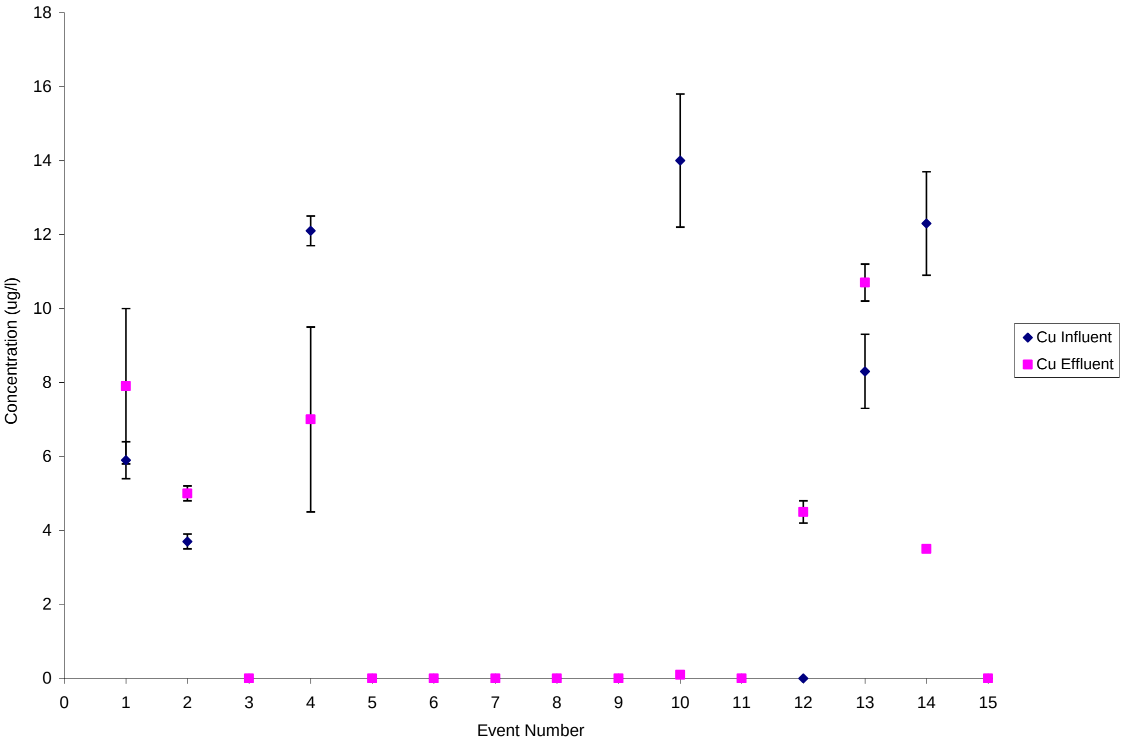

80
70
60
50
40
30
20
10
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ NO3 Influent (mg/l)
■ NO3 Effluent (mg/l)



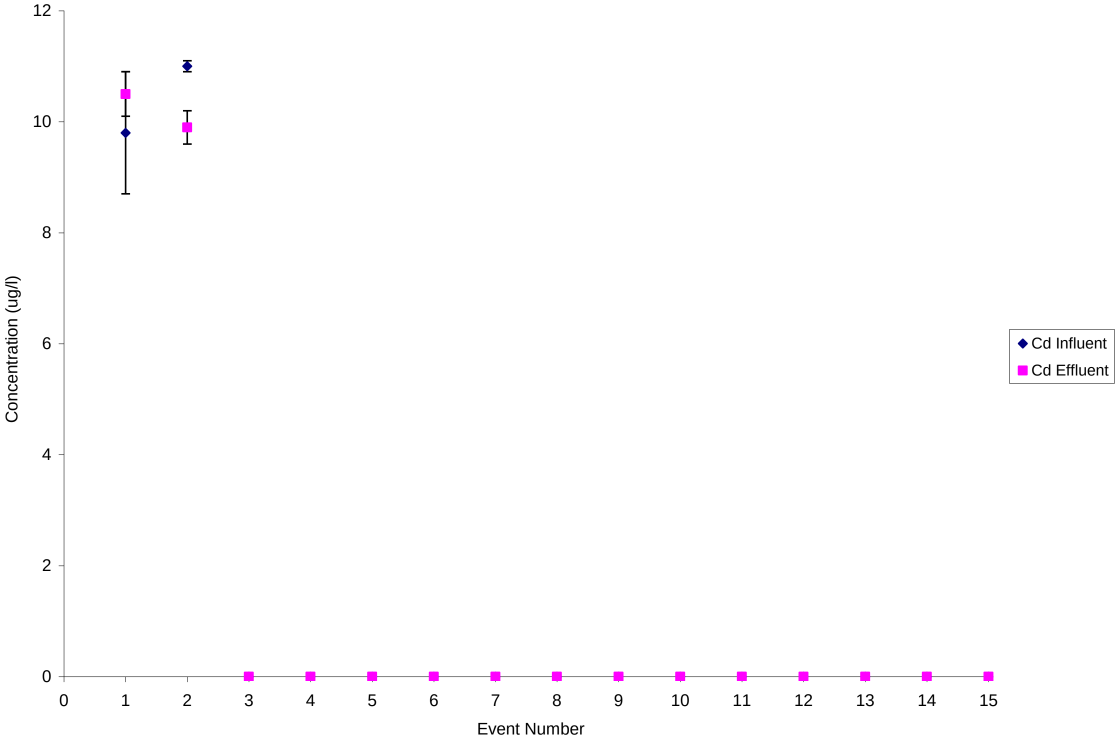
20
18
16
14
12
10
8
6
4
2
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ PO4 Influent
■ PO4 Effluent



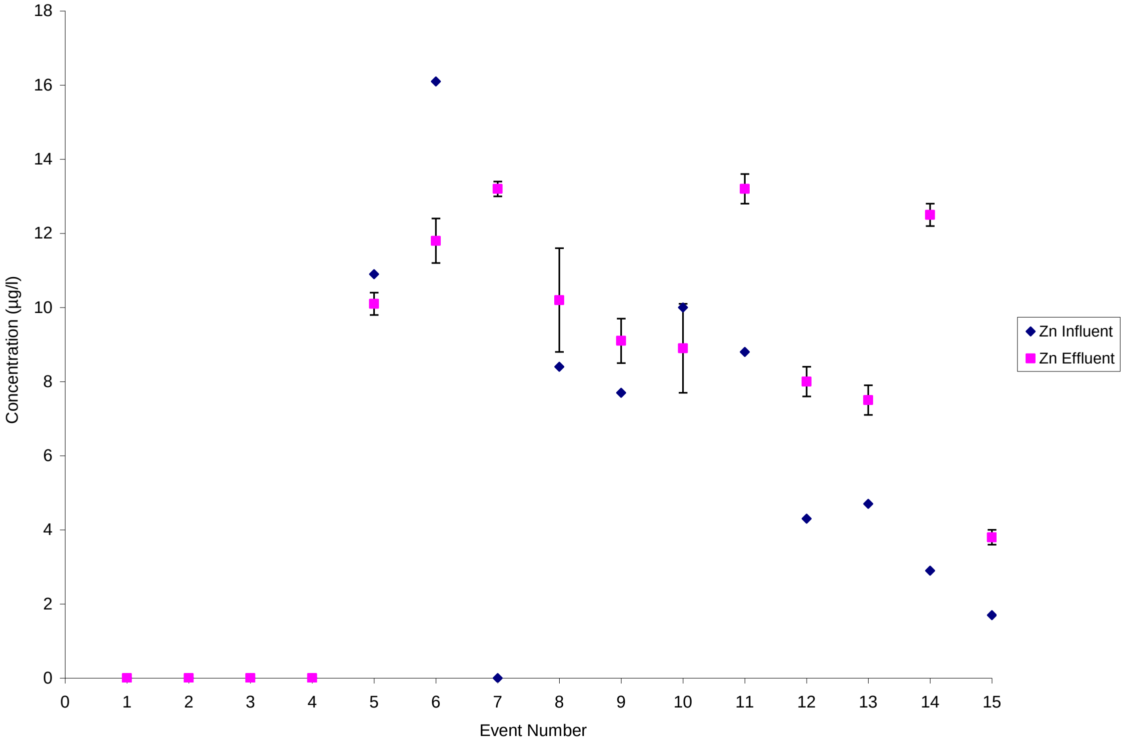
3.5
3
2.5
2
1.5
1
0.5
0
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ NH3-N Influent (mg/l)
■ NH3-Effluent (mg/l)



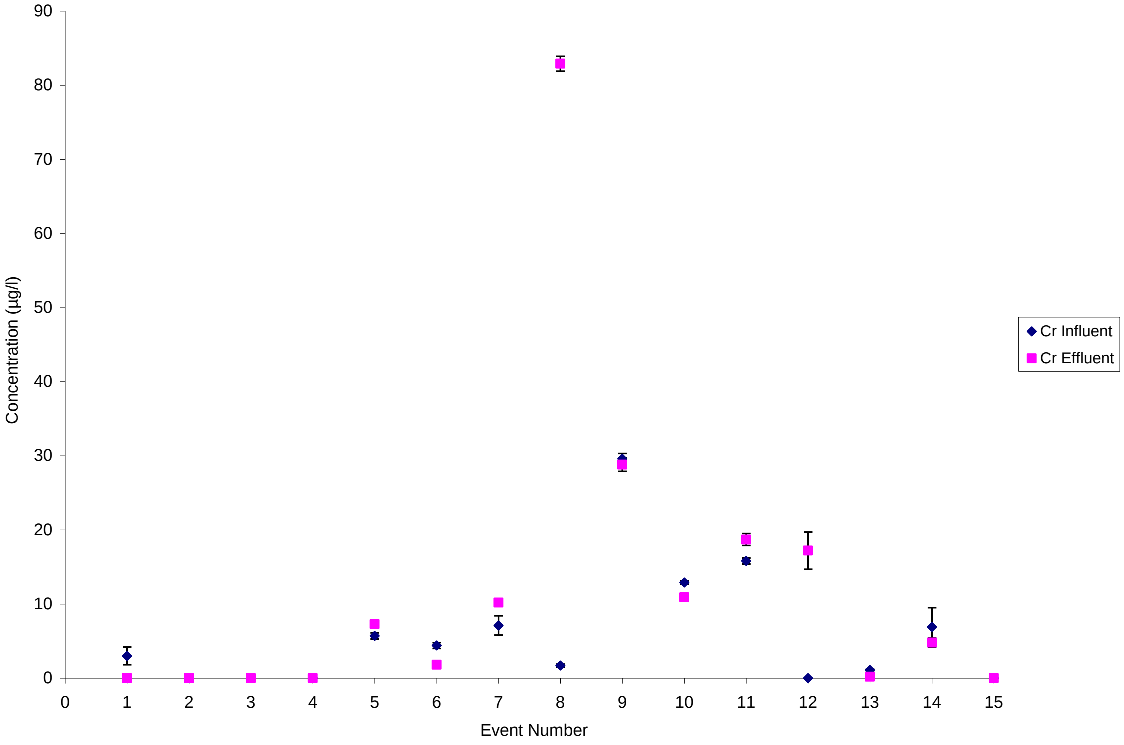
18
16
14
12
10
8
6
4
2
0
Concentration (ug/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cu Influent
■ Cu Effluent



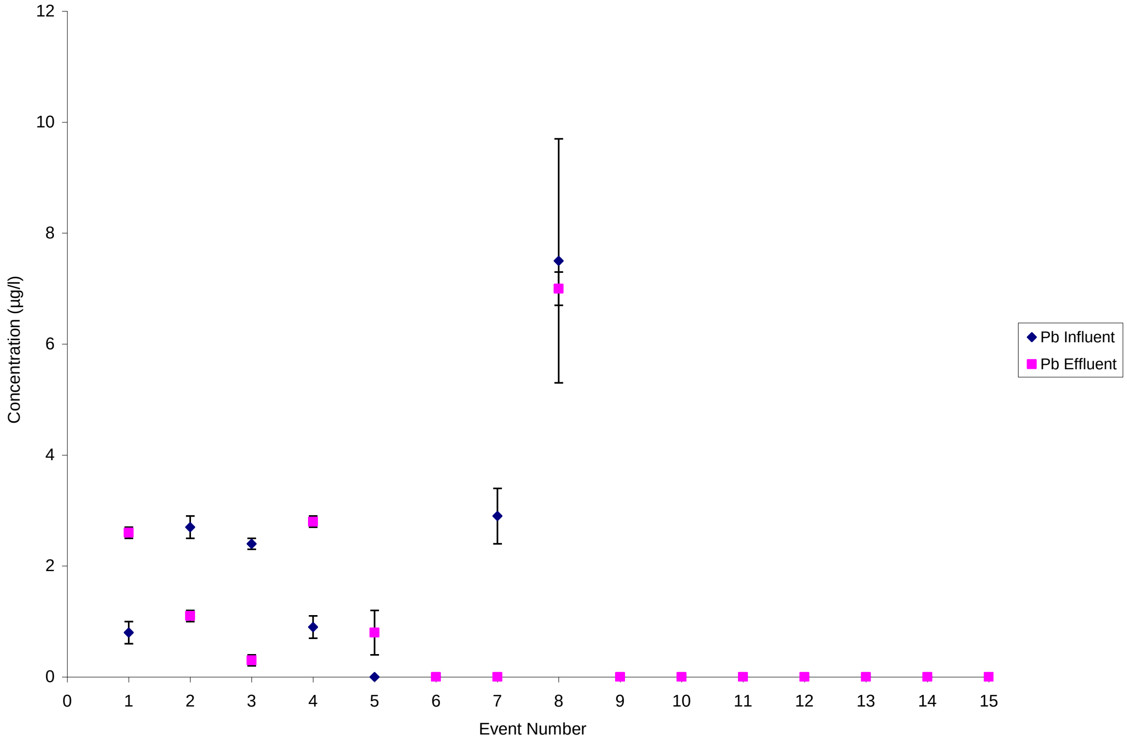
12
10
8
6
4
2
0
Concentration (ug/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cd Influent
■ Cd Effluent



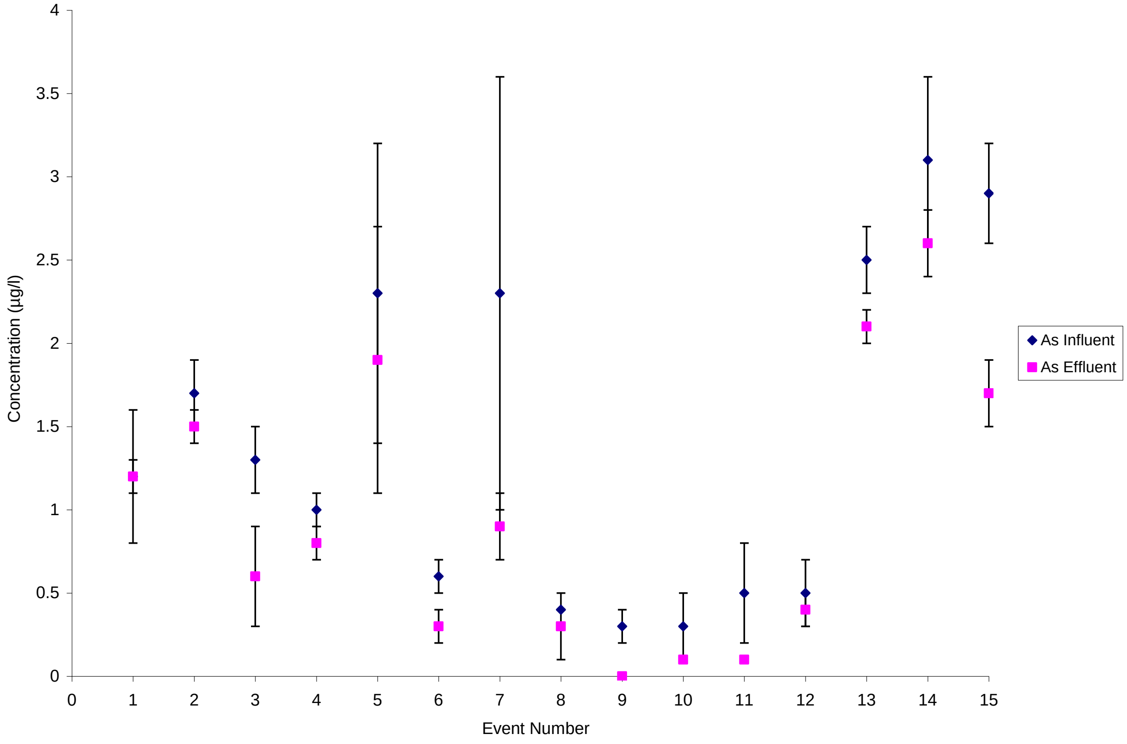
18
16
14
12
10
8
6
4
2
0
Concentration (µg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Zn Influent
■ Zn Effluent



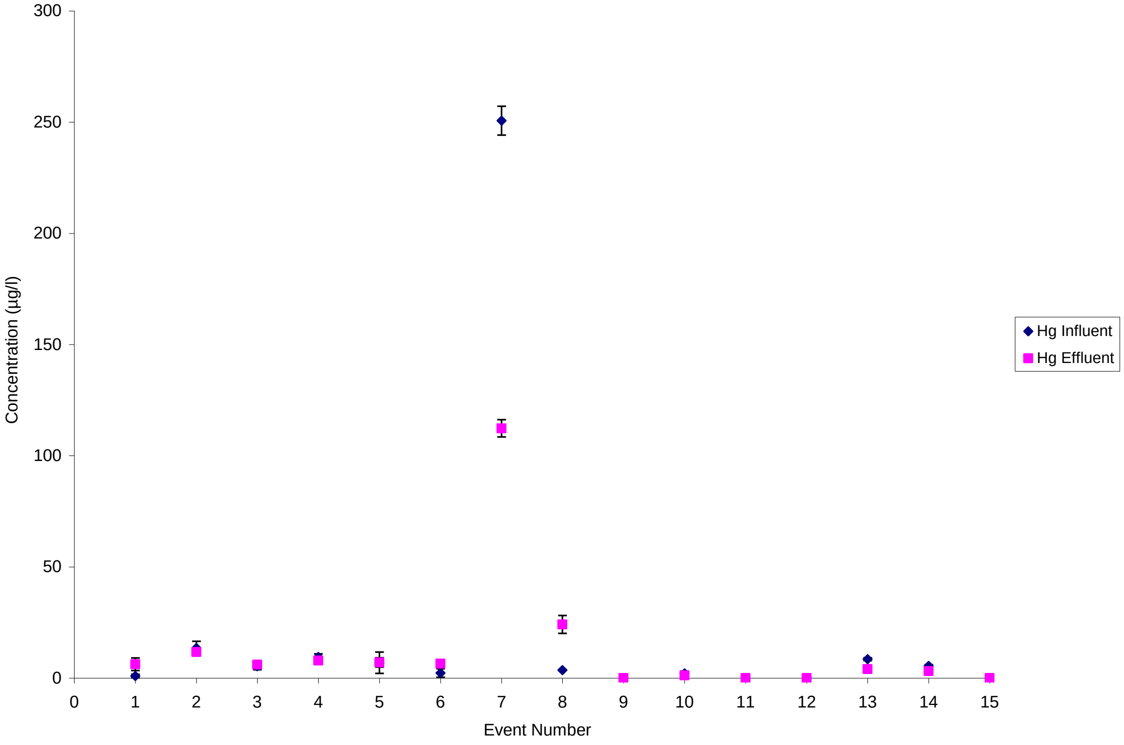
90
80
70
60
50
40
30
20
10
0
Concentration (µg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cr Influent
■ Cr Effluent

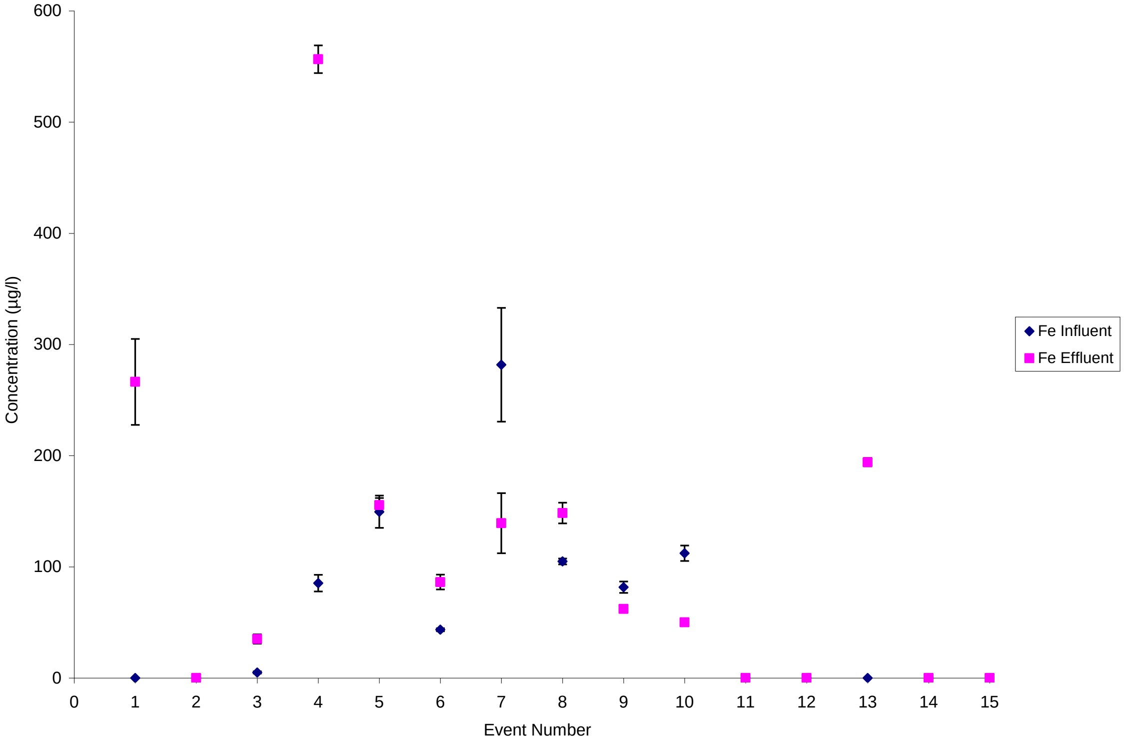


12
10
8
6
4
2
0
Concentration (µg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Pb Influent
■ Pb Effluent



4
3.5
3
2.5
2
1.5
1
0.5
0
Concentration (µg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ As Influent
■ As Effluent


300
250
200
150
100
50
0
Concentration (µg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Hg Influent
■ Hg Effluent


600
500
400
300
200
100
0
Concentration (µg/l)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Fe Influent
■ Fe Effluent

Tables for the Filter Catch Basin

Event #	DO Influent (mg/L) Average	Std	DO Effluent (mg/L) Average	Std
1(05/16/07)	0.5	0.1	0.5	0.1
2(06/03/07)	7.7	0.2	4.8	0.1
3(06/28/07)	5.7	0.4	6.4	0.1
4(07/29/07)	0.3	0.1	0.9	0.1
5(08/05/07)	1.4	0.1	5.8	0.1
6(08/16/07)	5.1	0.1	4.4	0
7(11/13/07)	0.3	0	5.8	0.1
8(01/10/08)	10.4	0.6	12.2	0.4
9(02/01/08)	12.8	0.3	15.4	0.4
10(02/06/08)	10.1	0.6	7.7	0.9
11(02/13/08)	15.4	0.2	18.3	0.4
12(03/04/08)	3.7	0.1	5.6	0.1
13(03/07/08)	2.7	0.3	5.5	0.8
14(03/16/08)	14.1	0.6	14.5	0.1
15(04/28/08)	6.2	0.4	5.8	0.1

Event #	Temp. Influent (C) Average	Std	Temp. Effluent (C) Average	Std
1(05/16/07)	27.0	0	26.0	0
2(06/03/07)	23.0	0.1	22.3	0.1
3(06/28/07)	30.8	0.9	29.2	0.1
4(07/29/07)	27.8	0.1	27.5	0
5(08/05/07)	31.0	0.1	31.2	0
6(08/16/07)	29.6	0.2	28.7	0.3
7(11/13/07)	14.8	0.2	15.5	0.2
8(01/10/08)	12.6	0.5	13.4	0.6
9(02/01/08)	8.7	0.1	8.7	0.1
10(02/06/08)	13.0	0.1	13.0	0.1
11(02/13/08)	14.5	0.2	15.1	0.3
12(03/04/08)	18.8	0	18.4	0
13(03/07/08)	15.3	0.1	15.1	0.2
14(03/16/08)	12.2	0.1	12.4	0
15(04/28/08)	21.2	0	21.3	0

Event #	pH Influent Average	Std	Effluent pH Average	Std
1(05/16/07)	6.3	0	6.7	0
2(06/03/07)	6.9	0	6.8	0
3(06/28/07)	6.3	0	6.8	0.1
4(07/29/07)	6.2	0	7.0	0
5(08/05/07)	6.6	0	6.9	0
6(08/16/07)	6.0	0	7.1	0
7(11/13/07)	6.2	0	6.7	0
8(01/10/08)	6.8	0.1	6.6	0
9(02/01/08)	6.4	0	6.2	0
10(02/06/08)	6.1	0	6.0	0
11(02/13/08)	6.9	0	7.0	0
12(03/04/08)	6.2	0	6.3	0
13(03/07/08)	6.0	0	6.2	0
14(03/16/08)	6.4	0	6.6	0
15(04/28/08)	6.1	0	6.3	0

Event #	COD Influent (mg/L) Average	Std	COD Effluent (mg/L) Average	Std
1(05/16/07)	65.2	0.7	59.7	0.3
2(06/03/07)	94.6	2.0	106.3	1.2
3(06/28/07)	201.3	0.7	45.2	1.4
4(07/29/07)	158.9	1.0	112.0	1.2
5(08/05/07)	63.0	2.2	46.7	3.4
6(08/16/07)	198.6	0.2	56.3	0.3
7(11/13/07)	43.1	1.0	30.8	1.4
8(01/10/08)	44.6	1.1	32.3	1.1
9(02/01/08)	37.3	0.6	17.0	2.0
10(02/06/08)	38.2	0.5	39.4	1.9
11(02/13/08)	21.9	2.1	10.0	0.6
12(03/04/08)	44.4	1.5	31.4	0.3
13(03/07/08)	67.2	2.3	42.0	1.2
14(03/16/08)	85.7	2.4	59.2	1.8
15(04/28/08)	28.5	1.2	28.3	0.5

	TSS Influent (mg/L)		TSS Effluent (mg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	576.9	174.0	72.3	43
2(06/03/07)	18.2	5.5	9.3	1.5
3(06/28/07)	6.0	0.6	34.5	6.3
4(07/29/07)	14.7	4.8	8.4	0.2
5(08/05/07)	17.1	1.9	9.2	0.6
6(08/16/07)	21.3	4.8	2.2	1.7
7(11/13/07)	3.5	0.5	2.5	0.2
8(01/10/08)	16.2	5.8	6.2	1.6
9(02/01/08)	4.1	0.4	2.5	1.4
10(02/06/08)	27.2	0	8.2	4.1
11(02/13/08)	66.5	19.0	4.5	1.4
12(03/04/08)	12.7	2.7	0.2	0
13(03/07/08)	21.3	3.2	9.8	0.1
14(03/16/08)	119.7	29.2	12	6.8
15(04/28/08)	3.5	1.3	2.1	0.2

	TDS Influent (mg/L)		TDS Effluent (mg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	384.7	257.7	142.7	15.9
2(06/03/07)	1.6	0.5	0.4	0.7
3(06/28/07)	0.3	0.5	11.8	9.6
4(07/29/07)	3.0	0.7	1.5	1.0
5(08/05/07)	9.5	1.0	4.2	1.4
6(08/16/07)	18.3	2.8	0.5	0.5
7(11/13/07)	1.0	0.4	3.8	0.6
8(01/10/08)	2.8	1.4	8.4	3.0
9(02/01/08)	5.0	3.6	0.7	0.4
10(02/06/08)	1.5	0.5	7.2	2.1
11(02/13/08)	20	9.1	1.9	1.1
12(03/04/08)	4.8	0.6	3.7	0.8
13(03/07/08)	3.1	0.6	1.9	0.1
14(03/16/08)	8.5	0.7	3.0	1.0
15(04/28/08)	6.9	5.5	2.3	0.1

	NO2 Influent (mg/L)		NO2 Effluent (mg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	10.7	0.2	0.0	0
2(06/03/07)	8.4	0.1	34.3	0.8
3(06/28/07)	121.7	1.4	23.5	0.2
4(07/29/07)	45.5	0.6	52.3	0.2
5(08/05/07)	16.2	0.2	24.9	0.3
6(08/16/07)	77.7	7.4	30.9	0.2
7(11/13/07)	15.0	0.3	32.0	0
8(01/10/08)	7.8	0.7	12.6	0
9(02/01/08)	7.6	0.8	5.0	0
10(02/06/08)	1.0	0	14.7	0.4
11(02/13/08)	0.0	0	0.0	0
12(03/04/08)	3.4	0.3	5.8	0.3
13(03/07/08)	3.3	0.1	4.1	0.2
14(03/16/08)	2.1	0.3	2.3	0
15(04/28/08)	10.6	0.1	20.5	0.6

	NO3 Influent (mg/L)		NO3 Effluent (mg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	1.7	0	1.7	0
2(06/03/07)	6.1	0.1	22.4	0.5
3(06/28/07)	1.8	0	1.7	0
4(07/29/07)	1.7	0	1.8	0
5(08/05/07)	1.7	0	1.7	0
6(08/16/07)	1.7	0	1.7	0
7(11/13/07)	0	0	0	0
8(01/10/08)	0	0	1	0.1
9(02/01/08)	0.3	0.1	0.1	0
10(02/06/08)	0.3	0	0.3	0.1
11(02/13/08)	0.2	0.1	0.1	0
12(03/04/08)	2.1	0.1	0.9	0
13(03/07/08)	0	0	0.1	0
14(03/16/08)	1.7	0.1	1.9	0
15(04/28/08)	0.6	0.1	0.9	0.1

	PO4 nfluent (mg/L)		PO4 Effluent (mg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	4	0	3.5	0
2(06/03/07)	8.8	0.1	16.2	0.2
3(06/28/07)	4.2	0.1	4.4	0.1
4(07/29/07)	4.9	0	3.7	0
5(08/05/07)	3.6	0	3.6	0
6(08/16/07)	5.4	0.4	3.6	0.2
7(11/13/07)	11.2	0.1	14.9	0.3
8(01/10/08)	3.5	0.3	3.8	0.3
9(02/01/08)	0	0	0	0
10(02/06/08)	0	0	0	0
11(02/13/08)	0	0	0	0
12(03/04/08)	0.8	0	0.1	0
13(03/07/08)	0.5	0	0	0
14(03/16/08)	0.8	0.1	0.4	0
15(04/28/08)	0	0	0	0

	NH3-N Influent (mg/L)		NH3-N Effluent (mg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	1.2	0.2	0	0
2(06/03/07)	0.5	0.1	0.9	0.2
3(06/28/07)	3.2	0.2	2.3	0.1
4(07/29/07)	2.4	0.1	4.3	0.1
5(08/05/07)	1.5	0	2.4	0.1
6(08/16/07)	2.9	0.2	2.4	0.1
7(11/13/07)	1.3	0.1	0.8	0.1
8(01/10/08)	0.5	0.1	0.6	0
9(02/01/08)	1.1	0.1	0.9	0.1
10(02/06/08)	1.3	0.1	1.2	0
11(02/13/08)	0.5	0	0.6	0
12(03/04/08)	1.6	0.1	1.0	0.1
13(03/07/08)	0.6	0.1	0.5	0
14(03/16/08)	1.7	0.1	1.3	0.1
15(04/28/08)	0.6	0	0.7	0.1

	Cu Influent (μg/L)		Cu Effluent (μg/L)	
Event #	Average	Std	Average	OUT
1(05/16/07)	19.3	0.5	16.4	0.2
2(06/03/07)	10.1	0	7	0.1
3(06/28/07)	35.6	3.3	9	0.3
4(07/29/07)	26.5	2.7	4.9	0.3
5(08/05/07)	5.1	0.6	1.7	0.5
6(08/16/07)	12.1	0.7	0	0
7(11/13/07)	0	0	0	0
8(01/10/08)	0	0	0	0
9(02/01/08)	0	0	0	0
10(02/06/08)	0	0	0	0
11(02/13/08)	0	0	0	0
12(03/04/08)	32.7	5.9	0	0
13(03/07/08)	0	0	0	0
14(03/16/08)	14.6	0.6	13.4	0.8
15(04/28/08)	1.1	0	0.6	0.3

	Cd Influent (μg/L)		Cd Effluent (μg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	6	0.5	6.3	0
2(06/03/07)	7.9	0.1	9.2	1.2
3(06/28/07)	8.2	0.5	8.6	0.1
4(07/29/07)	10.6	0.2	11	0
5(08/05/07)	3.6	0	3.5	0
6(08/16/07)	3.9	0	2.7	0.3
7(11/13/07)	0	0	0	0.1
8(01/10/08)	10	0.2	10.1	0.4
9(02/01/08)	0	0	0	0
10(02/06/08)	0	0	0	0
11(02/13/08)	0	0	0	0
12(03/04/08)	0	0	0	0
13(03/07/08)	0	0	0	0
14(03/16/08)	0	0	0	0
15(04/28/08)	0	0	0	0

	Zn Influent (µg/L)		Zn Effluent (µg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	0	0	0	0
2(06/03/07)	0	0	0	0
3(06/28/07)	0	0	0	0
4(07/29/07)	0	0	0	0
5(08/05/07)	0	0	0	0
6(08/16/07)	0	0	0	0
7(11/13/07)	0	0	0	0
8(01/10/08)	0	0	0	0
9(02/01/08)	12.5	1	7	0.6
10(02/06/08)	10.2	0.1	9	1.1
11(02/13/08)	10.5	1	11.5	0.3
12(03/04/08)	10.6	0.2	7.2	0.3
13(03/07/08)	13.8	1.2	14	0.8
14(03/16/08)	15	0.9	14.5	1.9
15(04/28/08)	13.1	0.6	14.8	0

	Cr Influent (µg/L)		Cr Effluent (µg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	0	0	0	0
2(06/03/07)	0	0	0	0
3(06/28/07)	0	0	0	0
4(07/29/07)	0	0	0	0
5(08/05/07)	0	0	0	0
6(08/16/07)	0	0	0	0
7(11/13/07)	0	0	2.1	0.1
8(01/10/08)	0	0	0	0
9(02/01/08)	3.4	0.1	1.4	0.7
10(02/06/08)	0	0	0	0
11(02/13/08)	0	0	0	0
12(03/04/08)	0	0	0	0
13(03/07/08)	1.7	0.1	1.4	0
14(03/16/08)	0	0	0	0
15(04/28/08)	0.3	0.2	0	0

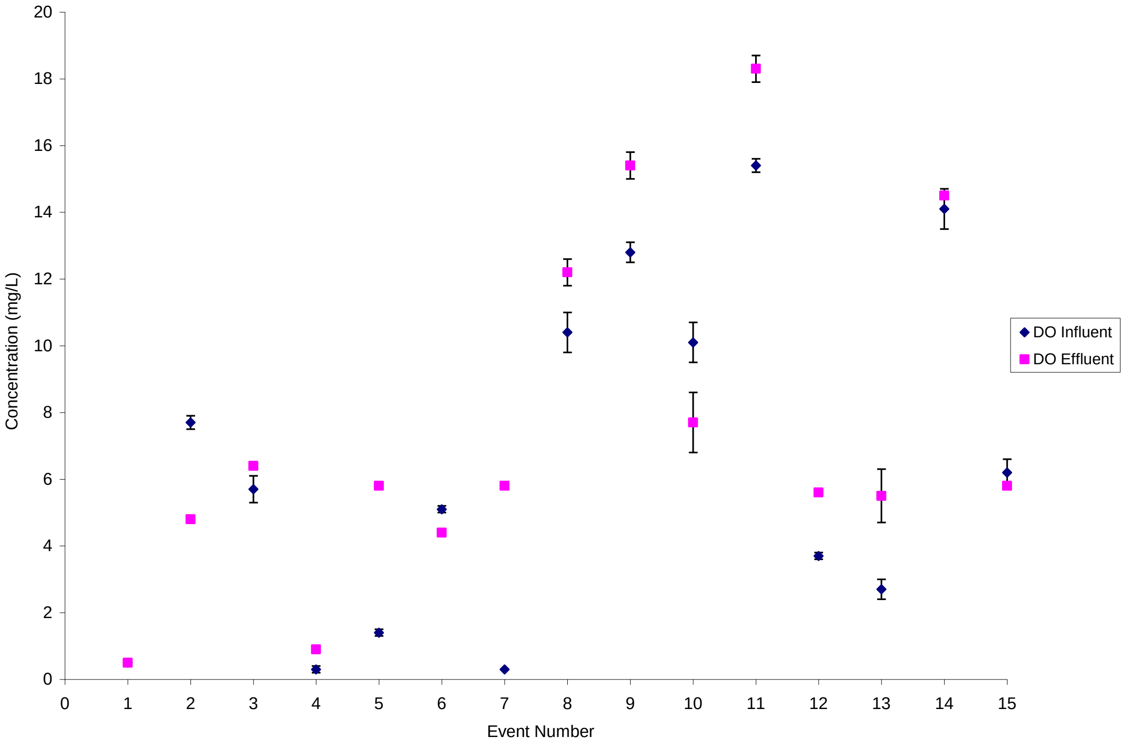
	Pb Influent (μg/L)		Pb Effluent (μg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	15.3	0.5	15.9	0.3
2(06/03/07)	9.1	0.1	14.8	0.1
3(06/28/07)	7.1	0.2	4.8	0.1
4(07/29/07)	6.4	0.1	9.5	0.1
5(08/05/07)	11.4	0.7	9.1	0.1
6(08/16/07)	18.2	0.6	14	0.2
7(11/13/07)	4	0.1	3.6	0
8(01/10/08)	4.1	0.2	2.2	0.2
9(02/01/08)	6.2	0.1	1.0	0.1
10(02/06/08)	10.5	0.3	3.4	0.2
11(02/13/08)	2.4	0.1	0.2	0
12(03/04/08)	76.2	0.2	20.4	0.1
13(03/07/08)	8.2	0.9	6.2	0.3
14(03/16/08)	18.1	0.3	14.5	0.2
15(04/28/08)	2.7	0	4.1	0.3

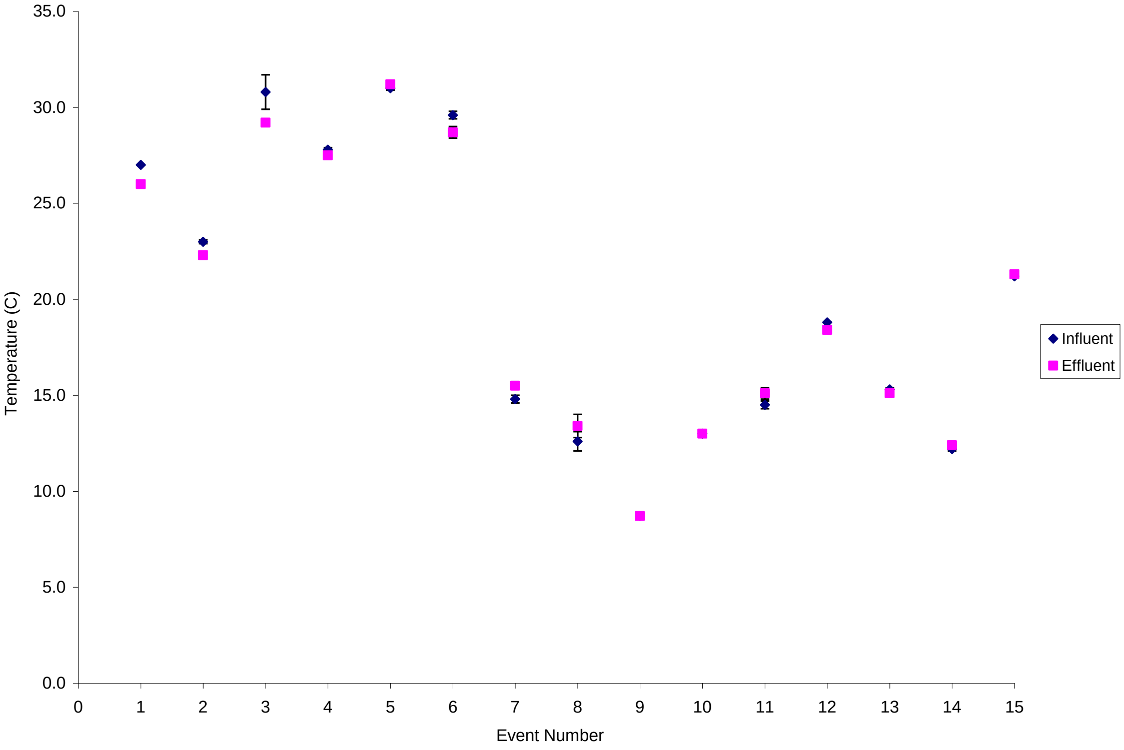
	As Influent (μg/L)		As Effluent (μg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	3.1	0	2.7	0.2
2(06/03/07)	1.4	0.2	1.6	0.1
3(06/28/07)	0.6	0.3	1.7	0.1
4(07/29/07)	2.9	0.2	2.5	0.1
5(08/05/07)	2.2	0.1	2.5	0.1
6(08/16/07)	2	0.1	1.4	0.2
7(11/13/07)	1	0.3	2.6	0.2
8(01/10/08)	0.8	0.3	0.5	0.1
9(02/01/08)	2	0.2	1.5	0.2
10(02/06/08)	2.2	0.7	1.6	0.4
11(02/13/08)	6.4	0.3	2.6	0.9
12(03/04/08)	1.3	0.4	0.1	0
13(03/07/08)	1.1	0.2	0.5	0.1
14(03/16/08)	1.8	1.1	1.4	0.3
15(04/28/08)	0.7	0.1	0.6	0.2

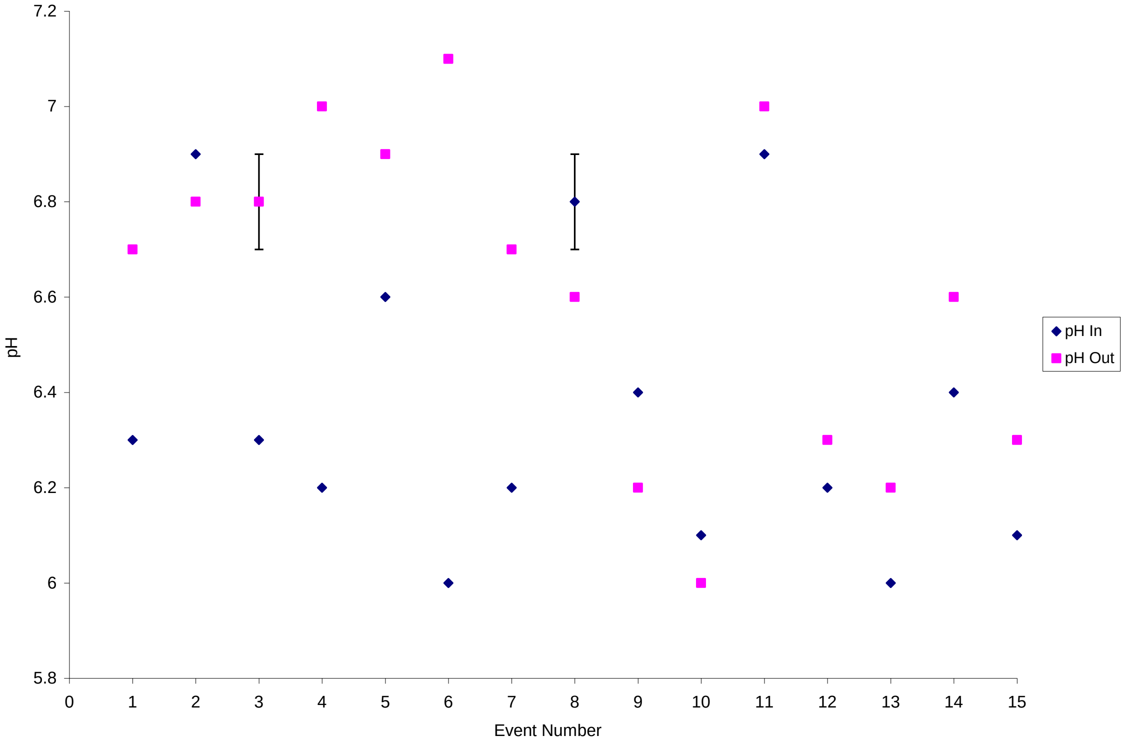
	Hg Influent (μg/L)		Hg Effluent (μg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	111.8	8.8	9.3	0.8
2(06/03/07)	3.6	0.2	3.2	2.7
3(06/28/07)	7.9	1.8	6.9	2.8
4(07/29/07)	18.8	1.6	21.6	2.3
5(08/05/07)	8.3	3	3.8	2.1
6(08/16/07)	4.3	2.4	3.3	2.4
7(11/13/07)	7	1.5	14.7	2.1
8(01/10/08)	2.5	2.2	2.5	0.7
9(02/01/08)	16.3	5.2	13.6	6.1
10(02/06/08)	9.7	3	29.2	1.3
11(02/13/08)	27.4	0.6	11.5	2.8
12(03/04/08)	7.4	3.2	27.3	5.7
13(03/07/08)	5.1	0.5	7.8	0.2
14(03/16/08)	3.2	0.1	13.2	1.2
15(04/28/08)	0	0	0	0

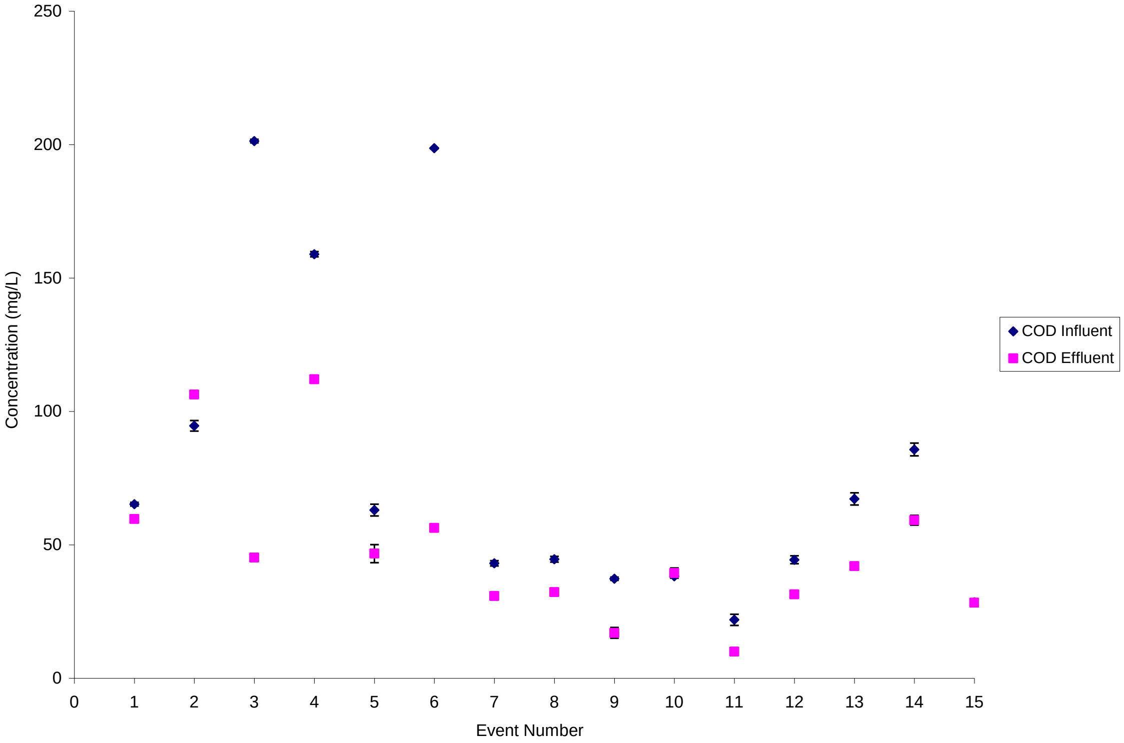
	Fe Influent (μg/L)		Fe Effluent (μg/L)	
Event #	Average	Std	Average	Std
1(05/16/07)	44.1	1.5	217.4	4.1
2(06/03/07)	0	0	0	0
3(06/28/07)	118.4	5.9	0	0
4(07/29/07)	116.6	9.5	248.8	31.3
5(08/05/07)	329.1	22.6	273.4	5
6(08/16/07)	378.2	18.4	298.4	9.9
7(11/13/07)	504.7	10.7	460.5	1.9
8(01/10/08)	191.8	6.4	29.5	3.2
9(02/01/08)	185.2	5.7	162.2	3.7
10(02/06/08)	147.3	2.7	177.2	17.5
11(02/13/08)	193.7	12.9	169.6	27.7
12(03/04/08)	272	7.1	214	0.7
13(03/07/08)	174.3	6	205.8	3.8
14(03/16/08)	254	39.2	221.3	1.6
15(04/28/08)	132.5	5.9	203	5.6

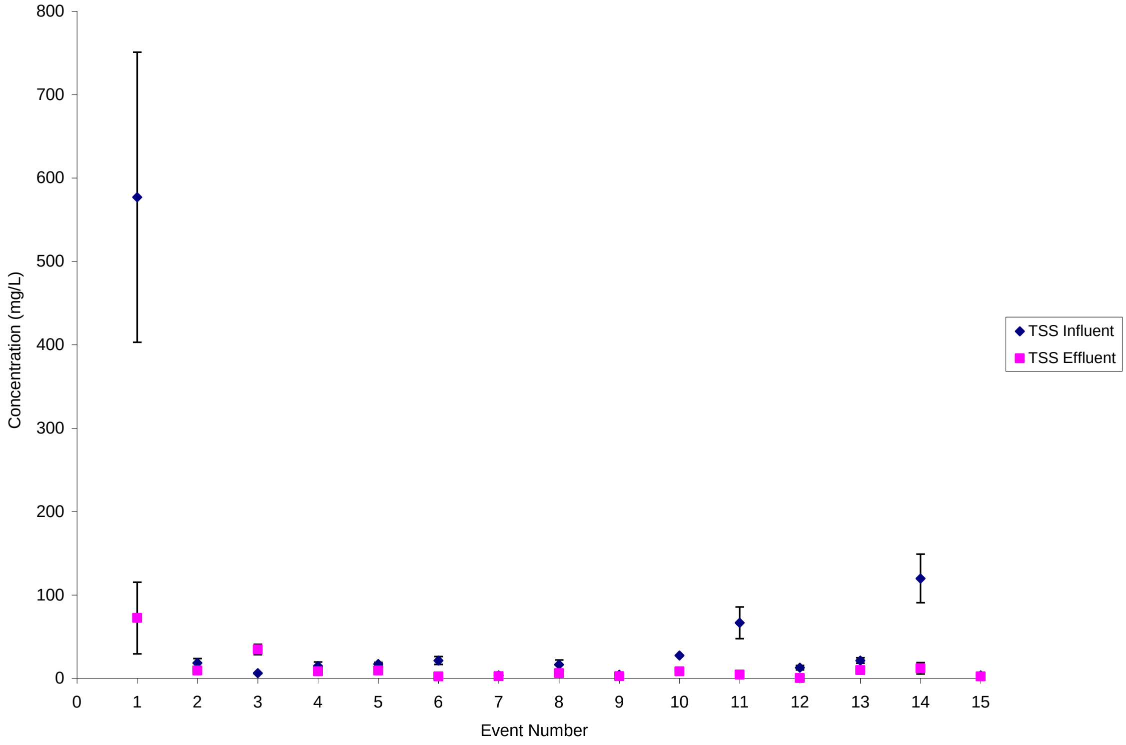
Graphs for the Filter Catch Basin

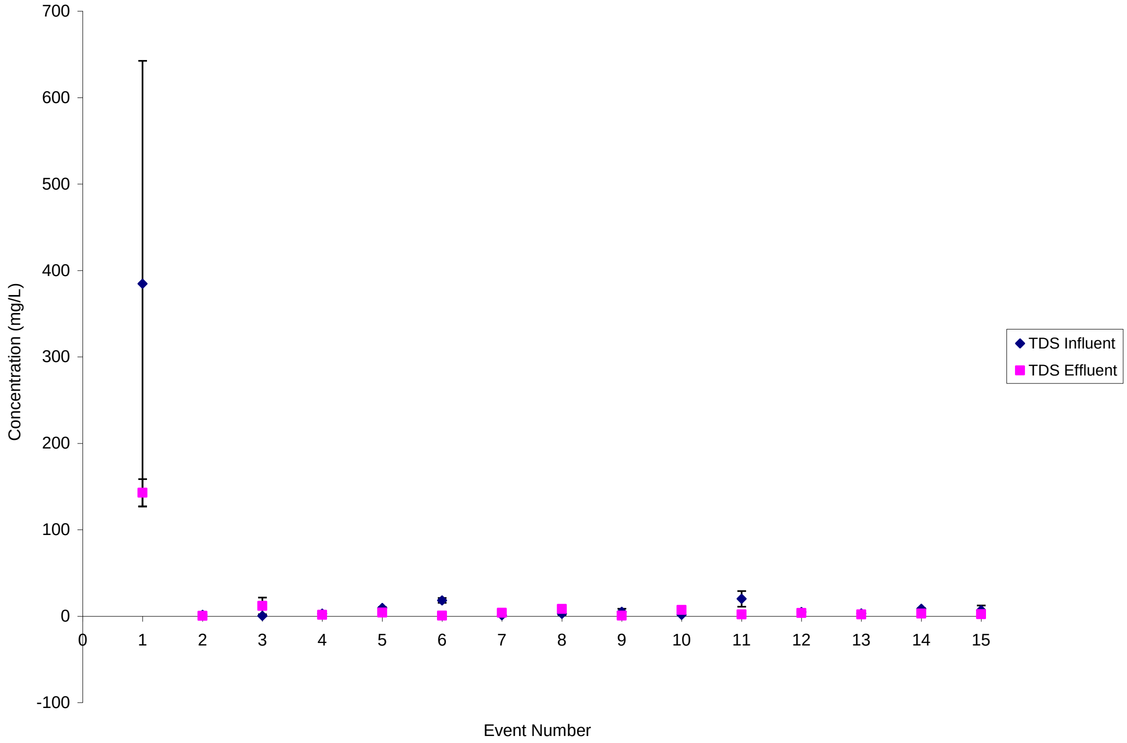


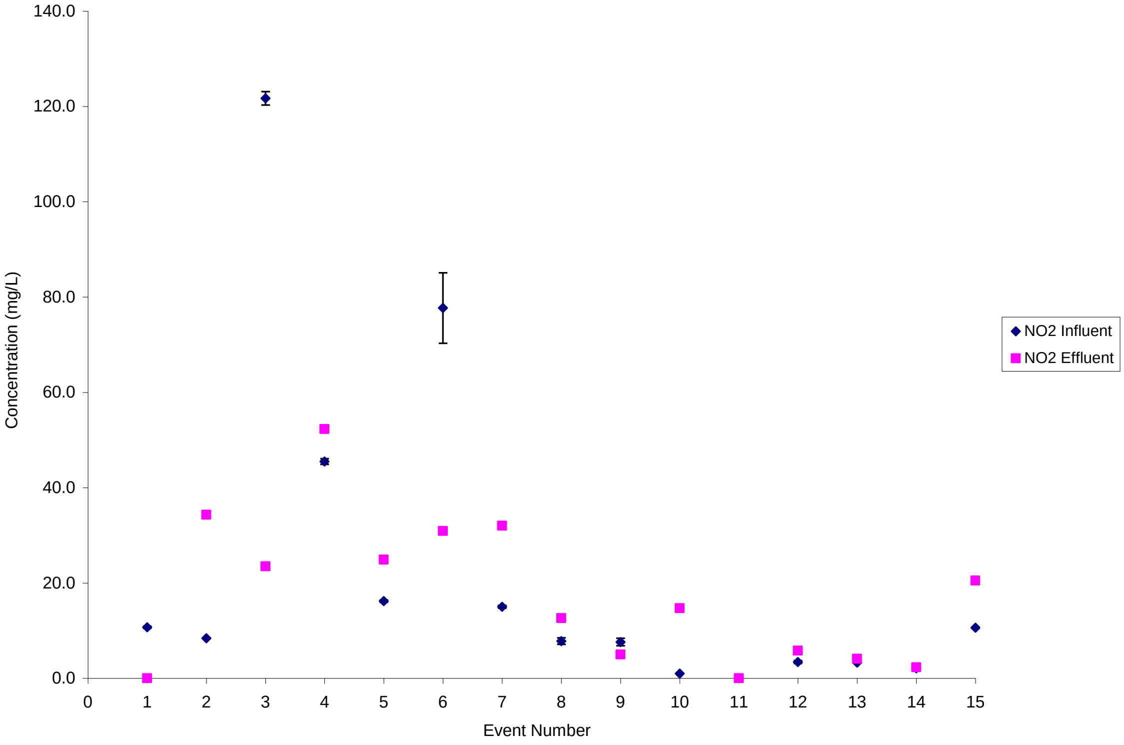



7.2
7
6.8
6.6
6.4
6.2
6
5.8
pH
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ pH In
■ pH Out

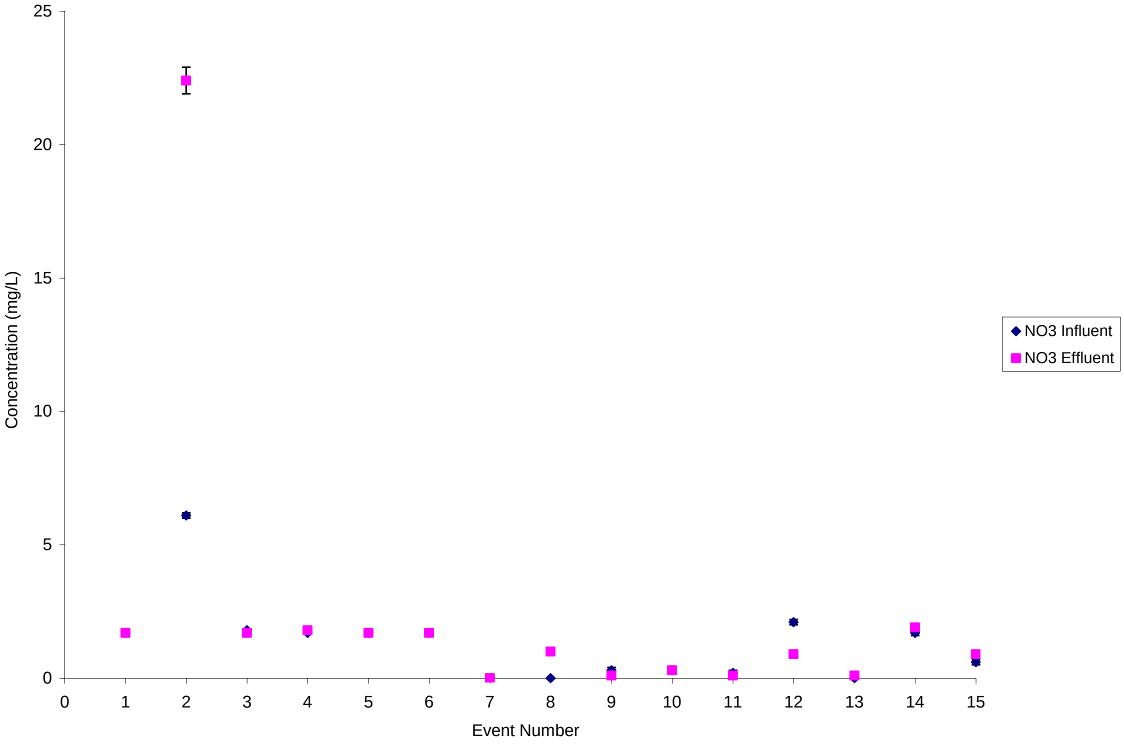

250
200
150
100
50
0
Concentration (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ COD Influent
■ COD Effluent


800
700
600
500
400
300
200
100
0
Concentration (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ TSS Influent
■ TSS Effluent

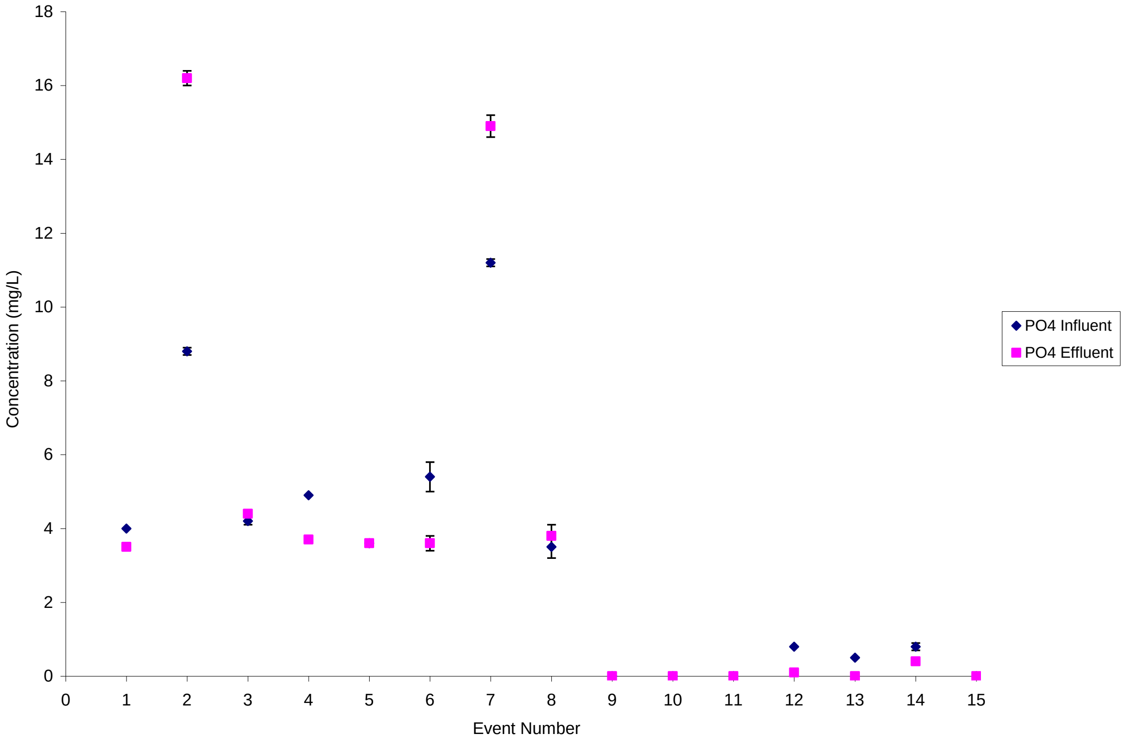

700
600
500
400
300
200
100
0
-100
Concentration (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ TDS Influent
■ TDS Effluent



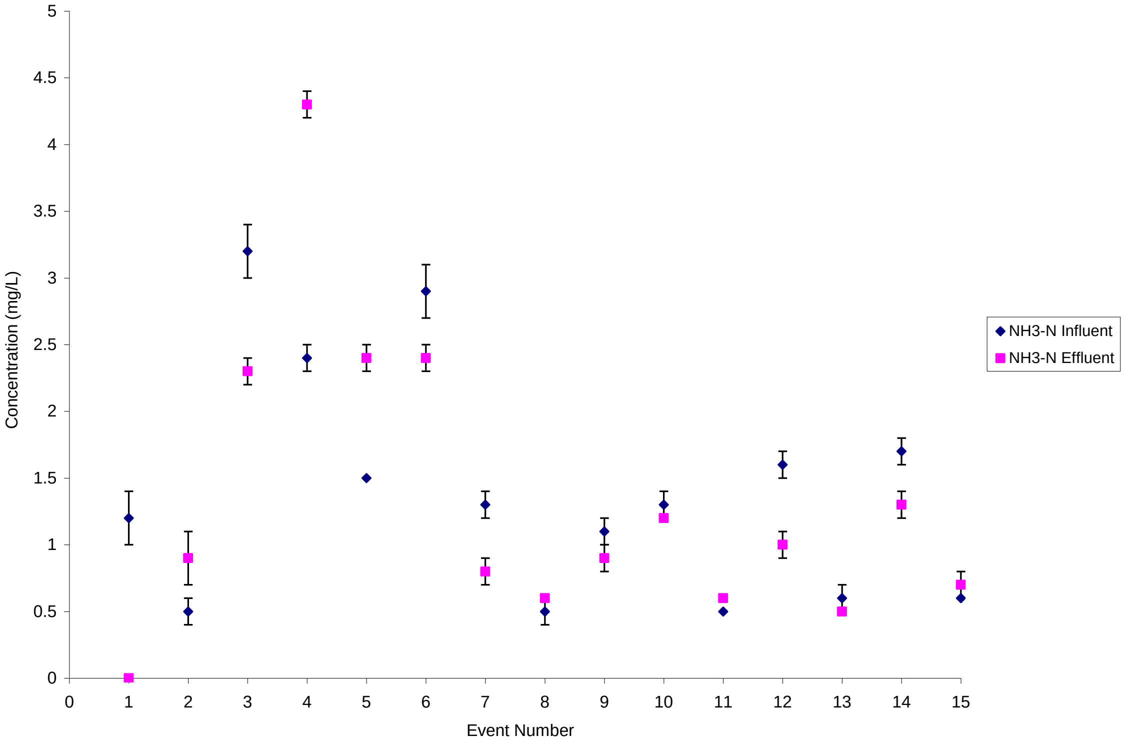
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Concentration (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ NO2 Influent
■ NO2 Effluent



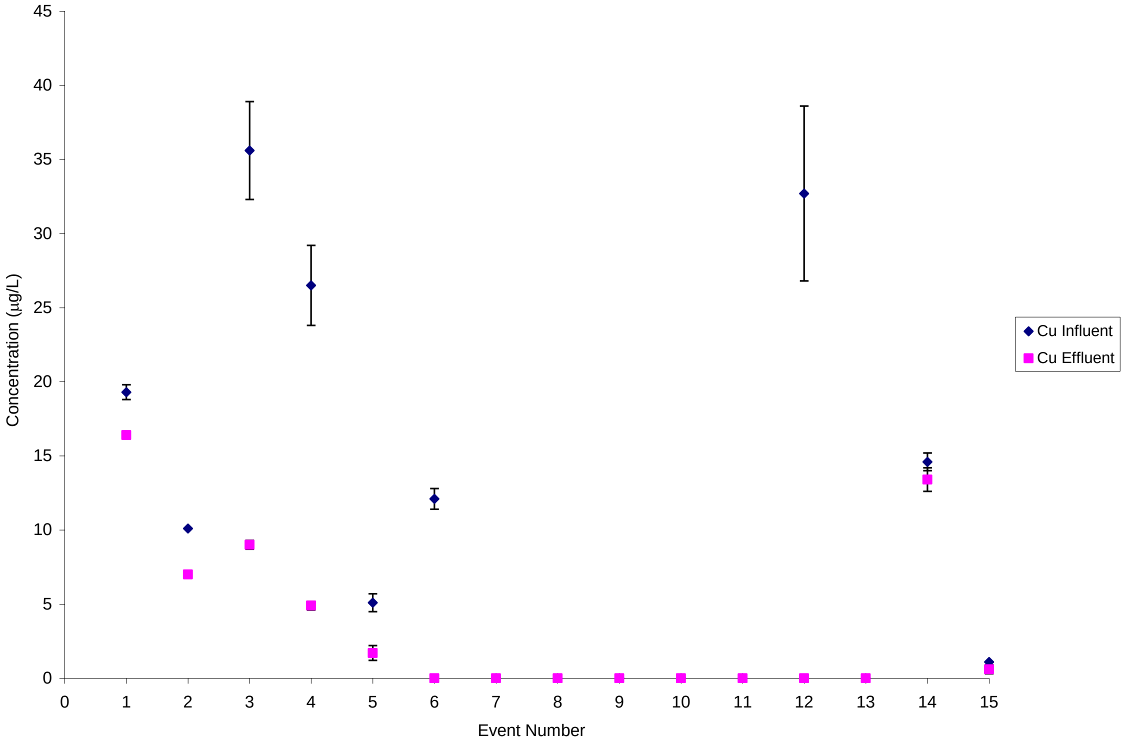
25
20
15
10
5
0
Concentration (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ NO3 Influent
■ NO3 Effluent



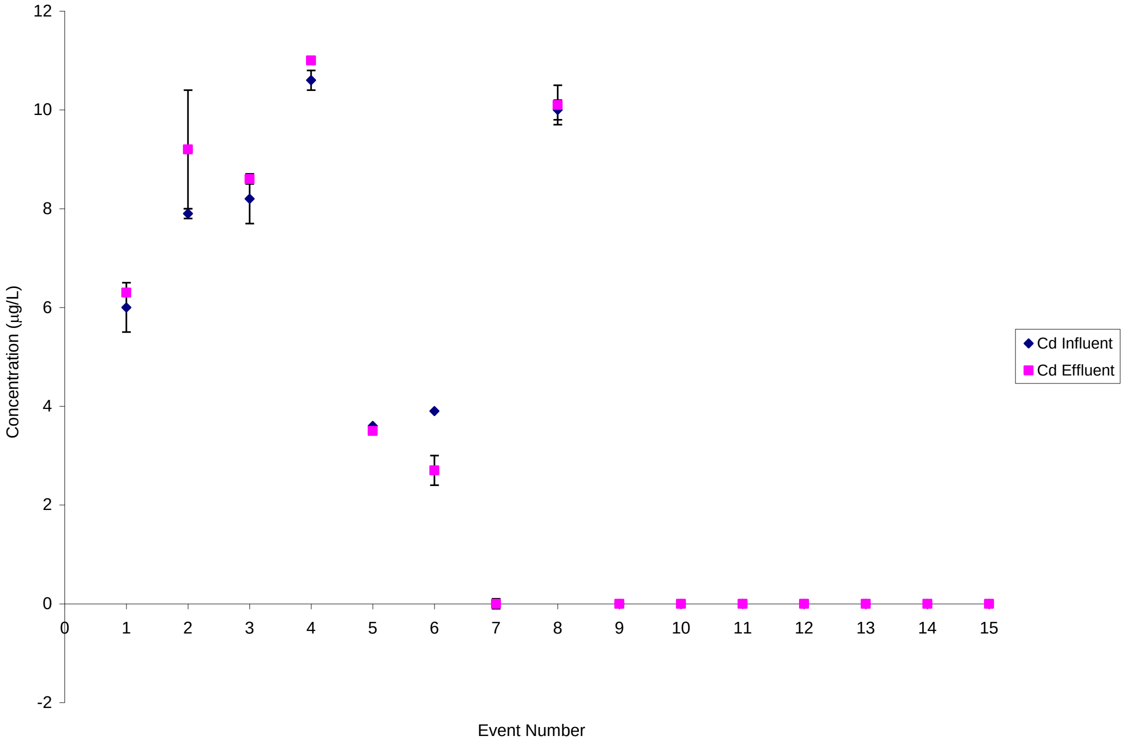
Concentration (mg/L)
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
PO4 Influent
PO4 Effluent



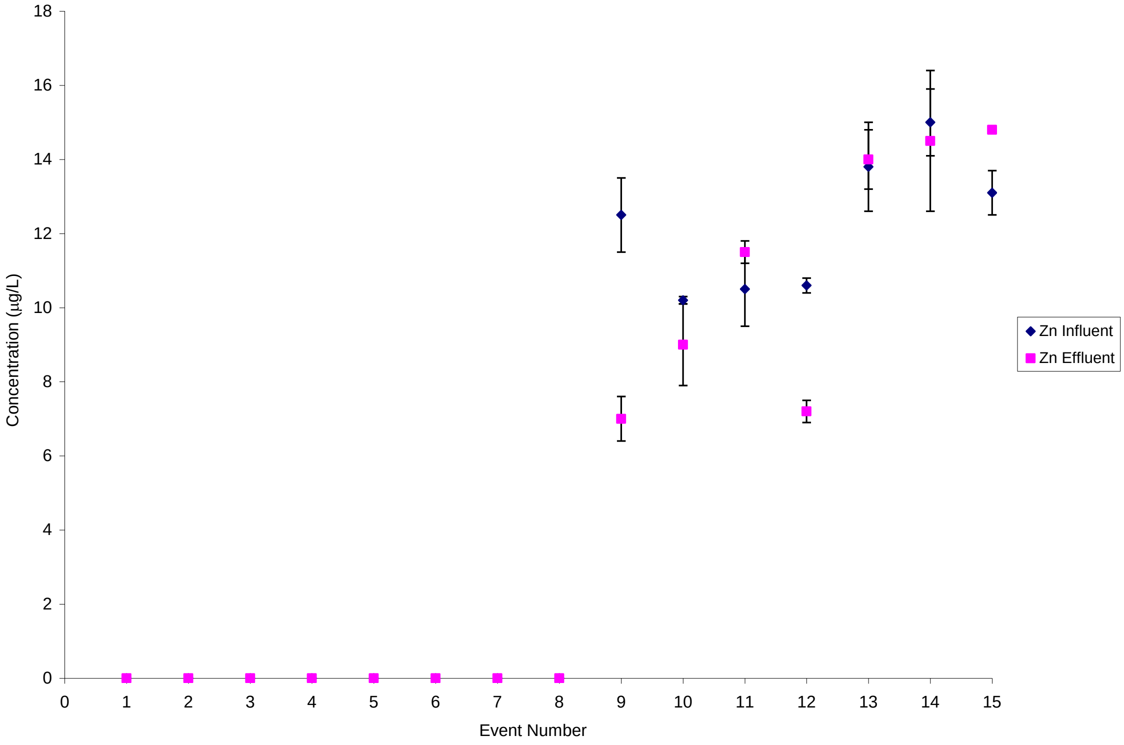
Concentration (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
NH3-N Influent
NH3-N Effluent

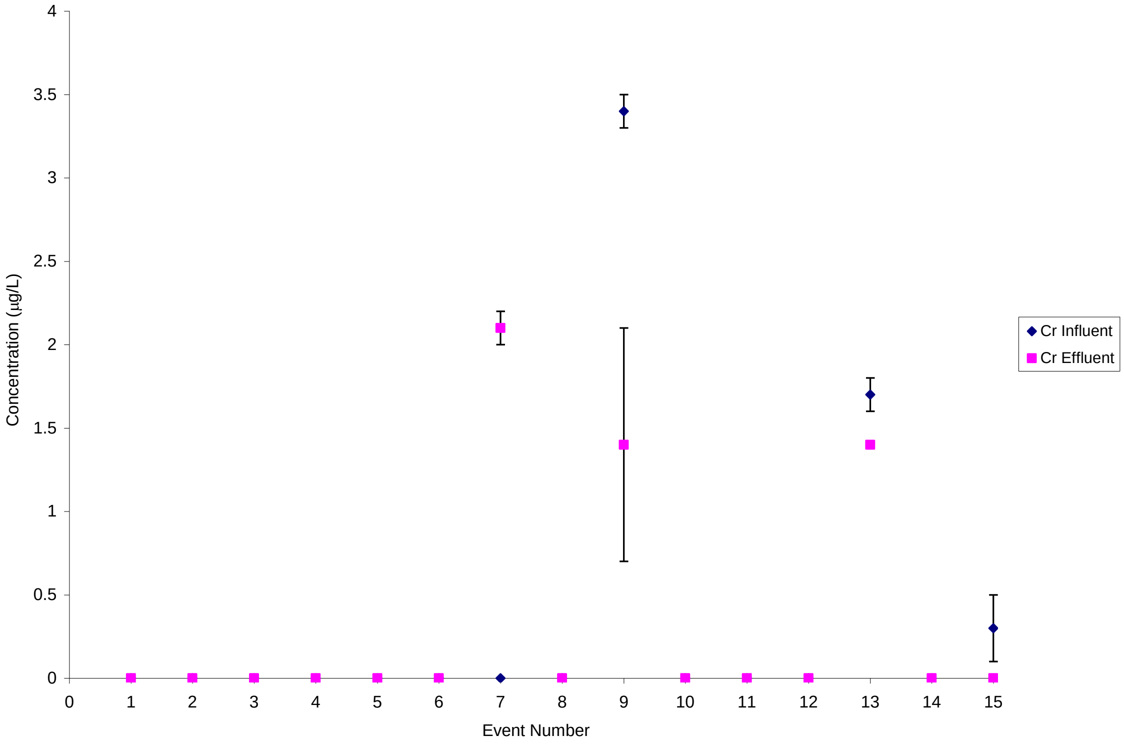


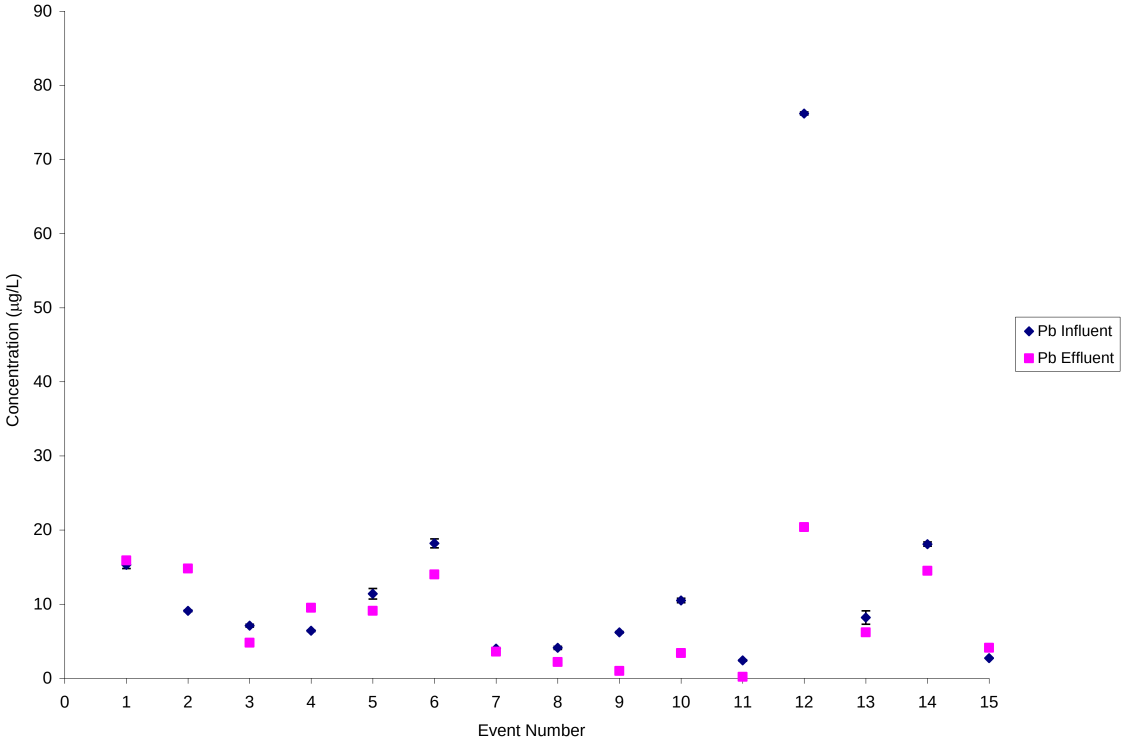
45
40
35
30
25
20
15
10
5
0
Concentration (µg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
Cu Influent
Cu Effluent



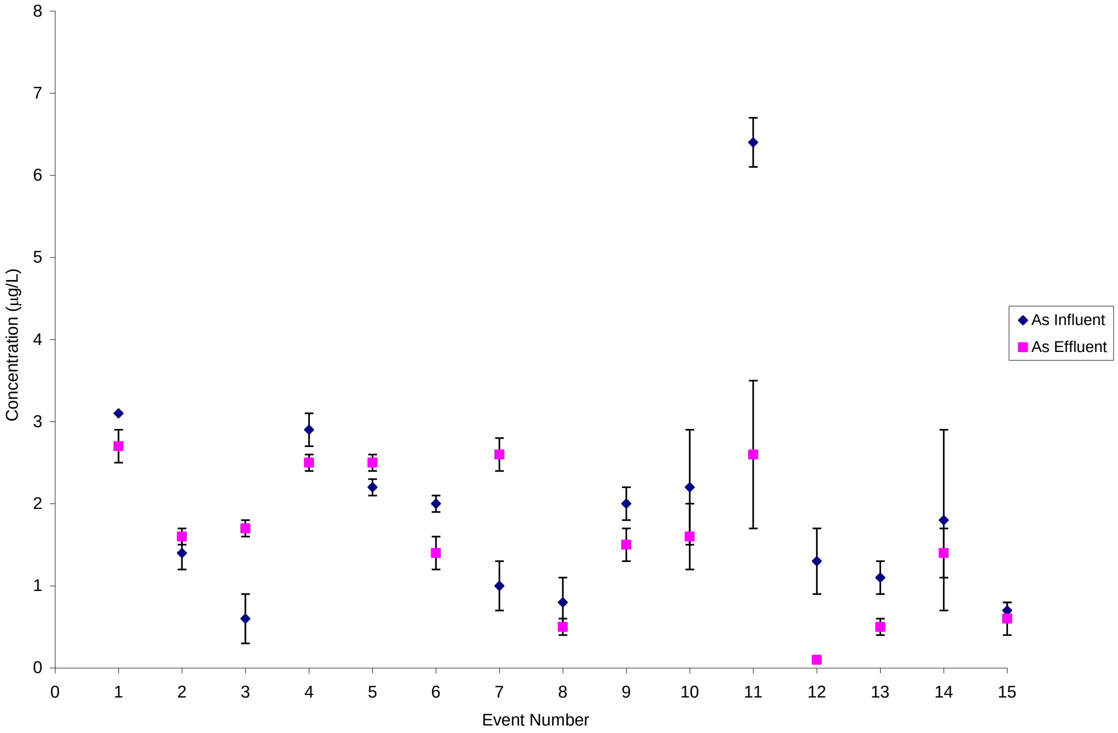
12
10
8
6
4
2
0
-2
Concentration (µg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
Cd Influent
Cd Effluent


18
16
14
12
10
8
6
4
2
0
Concentration (µg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Zn Influent
■ Zn Effluent

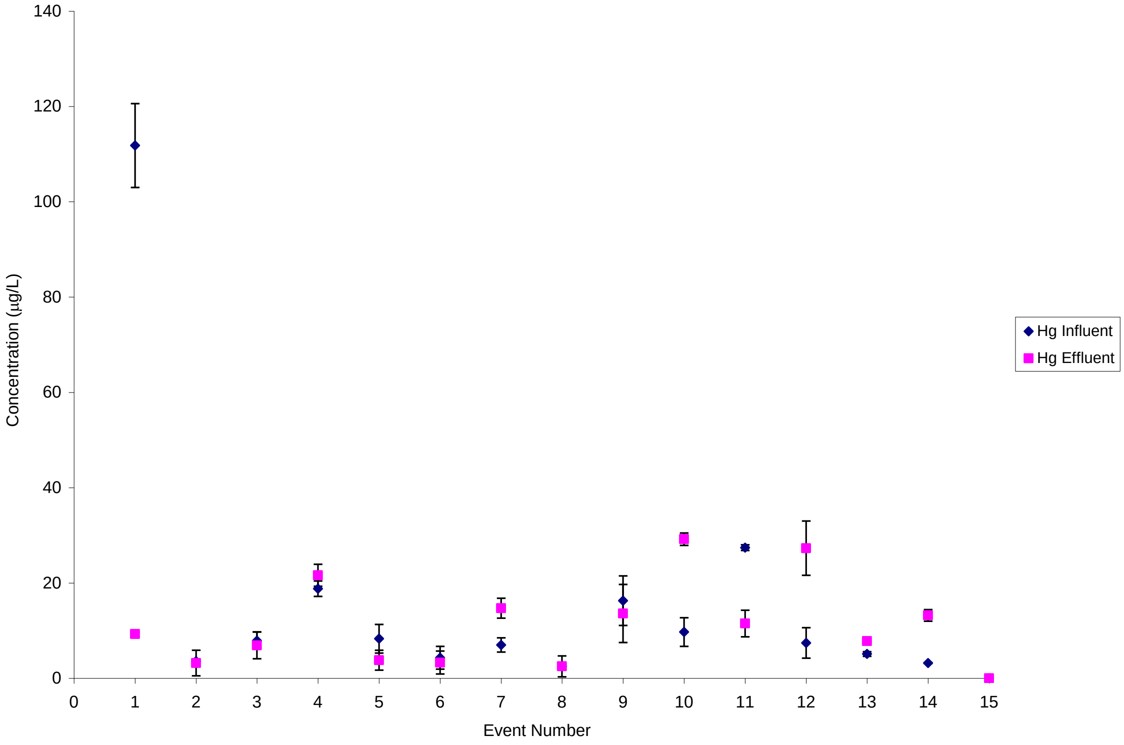

4
3.5
3
2.5
2
1.5
1
0.5
0
Concentration (µg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cr Influent
■ Cr Effluent

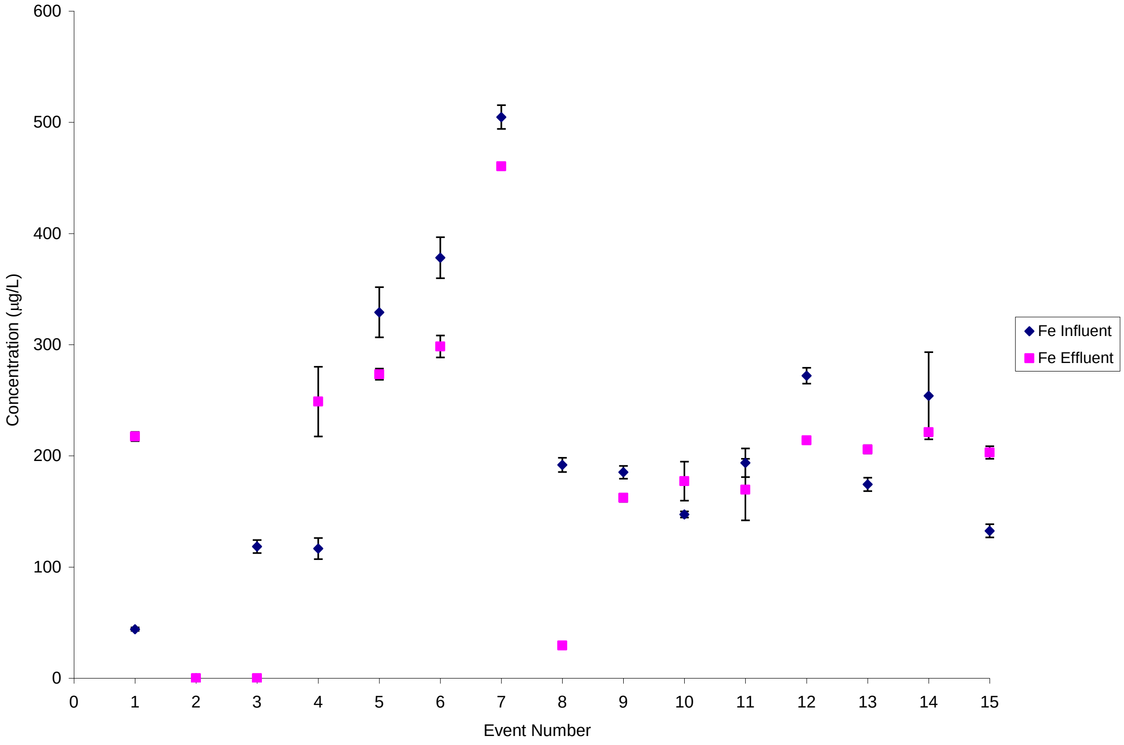


Concentration (µg/L)
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Pb Influent
■ Pb Effluent



Concentration (µg/L)
8
7
6
5
4
3
2
1
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ As Influent
■ As Effluent


Concentration (µg/L)
140
120
100
80
60
40
20
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
Hg Influent
Hg Effluent


Concentration (µg/L)
600
500
400
300
200
100
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
Fe Influent
Fe Effluent

Tables for the Vortex Catch Basin

	DO In (mg/l)		DO Out (mg/l)		
Event #	Average	Std	Average	Std	% Removal
1(05/16/07)	0.5	0.1	0.7	0.2	-0.40
2(06/03/07)	7.3	0.1	6.9	0.2	0.05
3(06/28/07)	6.2	0.2	1.0	0.2	0.84
4(07/29/07)	1.3	0.1	0.5	0.1	0.62
5(08/16/07)	5.7	0.1	2.3	0	0.60
6(11/13/07)	8.5	0.5	6.5	0.4	0.24
7(01/10/08)	12.0	0.6	14.4	0.7	-0.20
8(02/01/08)	14.4	0.5	16.0	0.2	-0.11
9(02/06/08)	9.3	0.6	7.5	0.3	0.19
10(02/13/08)	19.0	1.5	14.8	0.6	0.22
11(03/04/08)	7.2	0.1	8.0	0.1	-0.11
12(03/07/08)	10.5	0.3	11.4	0.2	-0.09
13(03/16/08)	18.1	0.2	15.6	0.1	0.14
14(04/28/08)	8.7	0.1	6.6	0.3	0.24
15(05/09/08)	9.3	0.6	11.2	0.5	-0.20

	T In (C)		T Out (C)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	26	0	26	0	0.00
2(06/03/07)	23.9	0.1	23.6	0.1	0.01
3(06/28/07)	31.1	0.5	28.3	0	0.09
4(07/29/07)	27.9	0.1	27.7	0.1	0.01
5(08/16/07)	29.6	0.2	28.8	0.2	0.03
6(11/13/07)	15.4	0.5	15.2	0.2	0.01
7(01/10/08)	13.7	0.6	13.4	0.5	0.02
8(02/01/08)	11.3	0.3	10.3	0.5	0.09
9(02/06/08)	13.3	0.2	13.8	0	-0.04
10(02/13/08)	14.5	0.2	15.1	0.3	-0.04
11(03/04/08)	18.8	0	18.7	0	0.01
12(03/07/08)	15.1	0.3	14.9	0.1	0.01
13(03/16/08)	12.6	0	12.5	0	0.01
14(04/28/08)	21.5	0	21.3	0	0.01
15(05/09/08)	19.4	0.1	19.6	0.1	-0.01

	pH Influent (mg/l)		pH Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	6.4	0	6.4	0	0.00
2(06/03/07)	6.8	0	6.4	0	0.06
3(06/28/07)	6.2	0	6.5	0	-0.05
4(07/29/07)	6.0	0	6.6	0	-0.10
5(08/16/07)	6.3	0	6.6	0	-0.05
6(11/13/07)	6.7	0.1	6.6	0	0.01
7(01/10/08)	6.6	0.1	6.6	0	0.00
8(02/01/08)	7.4	0	6.9	0	0.07
9(02/06/08)	6.3	0	6.2	0	0.02
10(02/13/08)	6.3	0	6.5	0	-0.03
11(03/04/08)	6.8	0	6.6	0	0.03
12(03/07/08)	6.6	0	6.7	0	-0.02
13(03/16/08)	6.7	0	6.8	0	-0.01
14(04/28/08)	6.4	0	6.4	0	0.00
15(05/09/08)	6.9	0	6.8	0	0.01

	COD Influent(mg/l)		COD Effluent (mg/l)	
Event #	Average	Std	Average	Std
1(05/16/07)	60.7	0.5	66.8	2.1
2(06/03/07)	189.1	0.9	174.1	1.4
3(06/28/07)	197.6	1.7	63.5	1.7
4(07/29/07)	177.9	1	174.4	0.2
5(08/16/07)	151.4	3.5	154.0	0.4
6(11/13/07)	58.8	2.6	40.1	1.5
7(01/10/08)	66.0	1.1	28.6	1.4
8(02/01/08)	18.7	0.3	13.6	0.8
9(02/06/08)	31.9	0.9	39.4	1.9
10(02/13/08)	5.6	1	42.7	0.5
11(03/04/08)	18	0.7	25.1	0.8
12(03/07/08)	30.7	0.5	20.7	1.6
13(03/16/08)	49.8	2	35.3	0.4
14(04/28/08)	19.8	0.5	22	1.9
15(05/09/08)	16.5	0.3	17.4	0.7

	TSS Influent (mg/l)		TSS Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	280.4	94.5	27.7	23	0.90
2(06/03/07)	25.7	2.6	26.2	1	-0.02
3(06/28/07)	9.9	3.2	4.2	0.4	0.58
4(07/29/07)	18.5	4.4	14	0.8	0.24
5(08/16/07)	19.3	9	9.6	3	0.50
6(11/13/07)	9.3	2.2	1.1	1	0.88
7(01/10/08)	11.1	2	8.3	1.9	0.25
8(02/01/08)	10.1	0.9	5.1	0.3	0.50
9(02/06/08)	177.3	87.3	8	2.7	0.95
10(02/13/08)	42.1	17.2	6.5	4.7	0.85
11(03/04/08)	23.9	7.4	11.3	1	0.53
12(03/07/08)	5	0.4	23.1	12.1	-3.62
13(03/16/08)	10.1	0.2	2.4	0.4	0.76
14(04/28/08)	19.6	1.5	17.9	8.8	0.09
15(05/09/08)	23.9	13.1	2.3	1.1	0.90

	TDS Influent (mg/l)		TDS Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	166.8	107.4	5.6	5	0.97
2(06/03/07)	2.3	0.9	2	1.8	0.13
3(06/28/07)	0.9	0.8	0.5	0.4	0.44
4(07/29/07)	4.4	1	1.2	1.4	0.73
5(08/16/07)	3.3	3.8	2.9	1.3	0.12
6(11/13/07)	1.4	1	1	0.8	0.29
7(01/10/08)	3.2	1.1	7	0.7	-1.19
8(02/01/08)	101.5	50.9	1.3	0.5	0.99
9(02/06/08)	1.6	1.1	1.2	0.3	0.25
10(02/13/08)	45.1	20.5	3.4	1.4	0.92
11(03/04/08)	19.9	3.2	4.6	0.7	0.77
12(03/07/08)	21.5	12.2	18.1	0	0.16
13(03/16/08)	24	0.6	25	2.8	-0.04
14(04/28/08)	3.1	0.8	4.7	1.7	-0.52
15(05/09/08)	20.6	4.4	0.6	0.3	0.97

	NO2 Influent (mg/l)		NO2 Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	10.0	0.1	10.8	0.1	-0.08
2(06/03/07)	19.7	0.3	34.3	0.2	-0.74
3(06/28/07)	44.5	0	31.3	0.3	0.30
4(07/29/07)	36.6	0.4	66.8	0.1	-0.83
5(08/16/07)	16.8	0.5	37.8	0.1	-1.25
6(11/13/07)	95.2	0.8	9.1	0.1	0.90
7(01/10/08)	5.7	0.4	3.7	0.2	0.35
8(02/01/08)	0.2	0.1	0.3	0.2	-0.50
9(02/06/08)	0	0	0	0	
10(02/13/08)	0	0	0	0	
11(03/04/08)	2.2	0.3	2.1	0.2	0.05
12(03/07/08)	2.3	0.4	1.8	0.4	0.22
13(03/16/08)	1.3	0.1	1.9	0.1	-0.46
14(04/28/08)	1.9	0.1	2.9	0.2	-0.53
15(05/09/08)	2.3	0	6	0.1	-1.61

	NO3 Influent (mg/l)		NO3 Effluent (mg/l)	
Event #	Average	Std	Average	Std
1(05/16/07)	1.7	0	1.7	0
2(06/03/07)	13.2	0.2	22.4	0.1
3(06/28/07)	1.8	0.1	1.7	0
4(07/29/07)	1.7	0	1.8	0
5(08/16/07)	1.7	0	1.8	0
6(11/13/07)	0	0	0.1	0
7(01/10/08)	0	0	0.2	0.1
8(02/01/08)	0.1	0	0.1	0
9(02/06/08)	0.3	0.1	0.3	0.1
10(02/13/08)	0.2	0	0.1	0
11(03/04/08)	1.9	0.1	1.8	0.1
12(03/07/08)	0.8	0.1	0.6	0.1
13(03/16/08)	2.6	0.1	2.2	0
14(04/28/08)	0.9	0	0.9	0.1
15(05/09/08)	1.4	0	1.6	0

	PO4 Influent (mg/l)		PO4 Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	4.1	0	4	0	0.02
2(06/03/07)	17.3	0.2	19	0.3	-0.10
3(06/28/07)	5	0.2	4.5	0	0.10
4(07/29/07)	4.6	0	4.5	0.1	0.02
5(08/16/07)	4.6	0.3	4.3	0	0.07
6(11/13/07)	39.2	0.4	21.2	0.4	0.46
7(01/10/08)	4.7	0.8	4.3	0.1	0.09
8(02/01/08)	0	0	0	0	
9(02/06/08)	0	0	0	0	
10(02/13/08)	0	0	0	0	
11(03/04/08)	0.2	0	0.2	0	0.00
12(03/07/08)	0.1	0	0.1	0	0.00
13(03/16/08)	0.2	0	0.1	0	0.50
14(04/28/08)	0.2	0	0.2	0	0.00
15(05/09/08)	30.6	0.9	43.8	0.7	-0.43

	NH3-N Influent (mg/l)		NH3-N Effluent (mg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	0.8	0.1	0.4	0.2	0.50
2(06/03/07)	1.5	0	3.2	0.1	-1.13
3(06/28/07)	3.4	0	2.5	0.1	0.26
4(07/29/07)	1.4	0.1	6.7	0.3	-3.79
5(08/16/07)	1.3	0.1	5.5	0.2	-3.23
6(11/13/07)	33.7	0.6	1	0.1	0.97
7(01/10/08)	0.5	0.1	0.8	0.1	-0.60
8(02/01/08)	0.9	0	0.9	0.1	0.00
9(02/06/08)	1.2	0	1.1	0.1	0.08
10(02/13/08)	0.8	0.1	0.6	0.2	0.25
11(03/04/08)	1.3	0.1	1.4	0.1	-0.08
12(03/07/08)	0.9	0.2	0.8	0.1	0.11
13(03/16/08)	1.4	0.1	1.2	0.1	0.14
14(04/28/08)	0.9	0	0.8	0	0.11
15(05/09/08)	1.1	0.1	0.9	0.1	0.18

	Cu Influent (µg/l)		Cu Effluent (µg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	23.7	0.5	19.5	1.7	0.18
2(06/03/07)	15.7	2.1	2.5	0.3	0.84
3(06/28/07)	33.6	4	2.9	0.4	0.91
4(07/29/07)	35.1	4.4	3.9	0.7	0.89
5(08/16/07)	10.2	0.2	0.3	0.3	0.97
6(11/13/07)	3.6	0.2	0	0	1.00
7(01/10/08)	0	0	0	0	
8(02/01/08)	0	0	0	0	
9(02/06/08)	0	0	0	0	
10(02/13/08)	0	0	0	0	
11(03/04/08)	0	0	0	0	
12(03/07/08)	0	0	0	0	
13(03/16/08)	5.8	0.3	2.4	0.4	0.59
14(04/28/08)	0	0	0	0	
15(05/09/08)	0.5	0	3.4	0.2	-5.80

	Cd Influent (µg/l)		Cd Effluent (µg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	6.2	0.5	6.1	0.1	0.02
2(06/03/07)	7.9	3.1	9.1	0.2	-0.15
3(06/28/07)	8.2	0.3	9.2	0	-0.12
4(07/29/07)	10.3	0.6	10	1	0.03
5(08/16/07)	2.6	0.4	2.3	0.2	0.12
6(11/13/07)	0	0	0.3	0.4	
7(01/10/08)	10.7	0.4	10.3	0.1	0.04
8(02/01/08)	0	0	0	0	
9(02/06/08)	0	0	0	0	
10(02/13/08)	0	0	0	0	
11(03/04/08)	0	0	0	0	
12(03/07/08)	0	0	0	0	
13(03/16/08)	0	0	0	0	
14(04/28/08)	0	0	0	0	
15(05/09/08)	0	0	0	0	

	Zn Influent (µg/l)		Zn Effluent (µg//)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	0	0	0	0	
2(06/03/07)	0	0	0	0	
3(06/28/07)	0	0	0	0	
4(07/29/07)	0	0	0	0	
5(08/16/07)	0	0	0	0	
6(11/13/07)	0	0	0	0	
7(01/10/08)	0	0	0	0	
8(02/01/08)	13.3	0.3	12.9	0.4	0.03
9(02/06/08)	11.9	0.3	10.5	0.1	0.12
10(02/13/08)	8.7	0.4	13.1	0.5	-0.51
11(03/04/08)	13.3	0.4	14.9	0.5	-0.12
12(03/07/08)	10.1	0.3	9	0.1	0.11
13(03/16/08)	13.7	0.9	13.5	0.2	0.01
14(04/28/08)	13.9	1.3	14.6	0.4	-0.05
15(05/09/08)	13.2	0.6	13.7	0.2	-0.04

	Cr Influent (µg/l)		Cr Effluent (µg/l)	
Event #	Average	Std	Average	Std
1(05/16/07)	0	0	0	0
2(06/03/07)	0	0	0	0
3(06/28/07)	0	0	0	0
4(07/29/07)	0	0	0	0
5(08/16/07)	0	0	0	0
6(11/13/07)	0	0	0	0
7(01/10/08)	0	0	0	0
8(02/01/08)	0	0	0	0
9(02/06/08)	0	0	0	0
10(02/13/08)	0	0	0	0
11(03/04/08)	0	0	0	0
12(03/07/08)	0	0	1.5	0
13(03/16/08)	0	0	0	0
14(04/28/08)	0	0	0	0
15(05/09/08)	0	0	0	0

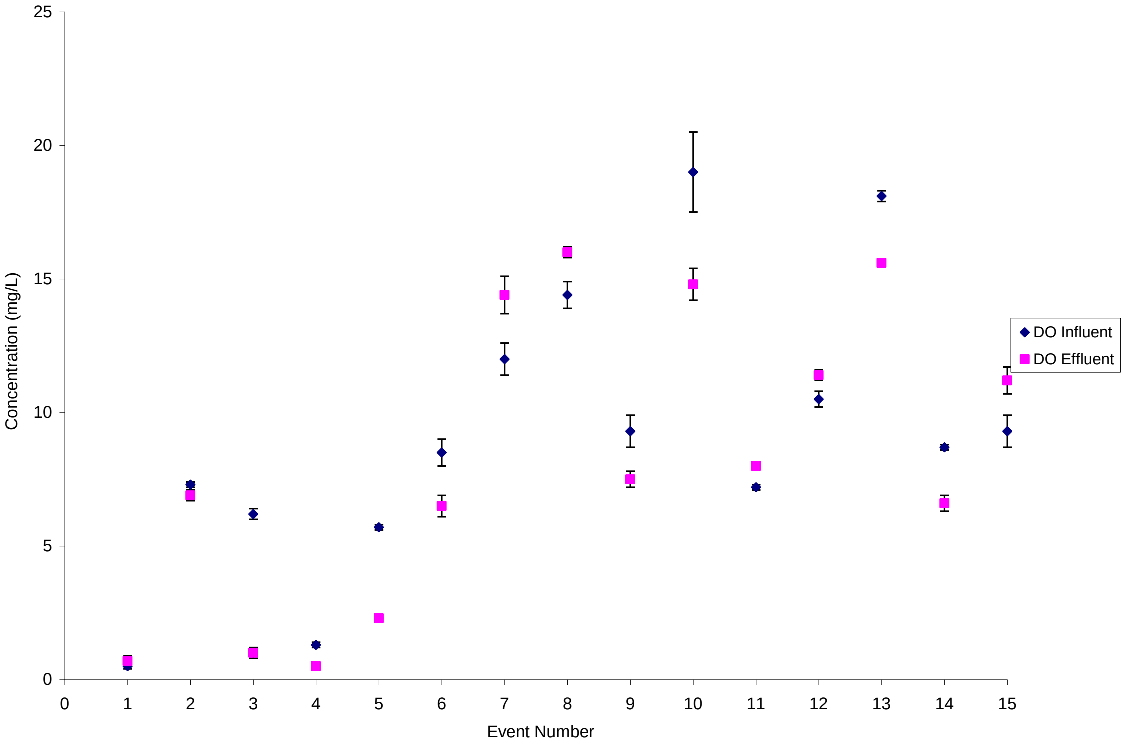
	Pb Influent (µg/l)		Pb Effluent (µg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	5.5	0.1	4.4	0.1	0.20
2(06/03/07)	10.4	0.9	10.9	0.1	-0.05
3(06/28/07)	3.9	0.1	5.4	0.1	-0.38
4(07/29/07)	5.2	0.3	8.4	0.1	-0.62
5(08/16/07)	4.5	0.1	3.9	0.1	0.13
6(11/13/07)	15	0.2	9.4	0.2	0.37
7(01/10/08)	39.8	0.2	28.6	0.7	0.28
8(02/01/08)	18.4	0.7	11.3	0.2	0.39
9(02/06/08)	38.5	0.7	55.3	0.4	-0.44
10(02/13/08)	1.7	0.1	33	0.7	-18.41
11(03/04/08)	4.7	0.2	11.1	0.3	-1.36
12(03/07/08)	8.1	1.2	13.9	0.2	-0.72
13(03/16/08)	14.6	2.4	10.5	0.2	0.28
14(04/28/08)	5.8	0.1	6.4	0.2	-0.10
15(05/09/08)	1.2	0	1.9	0	-0.58

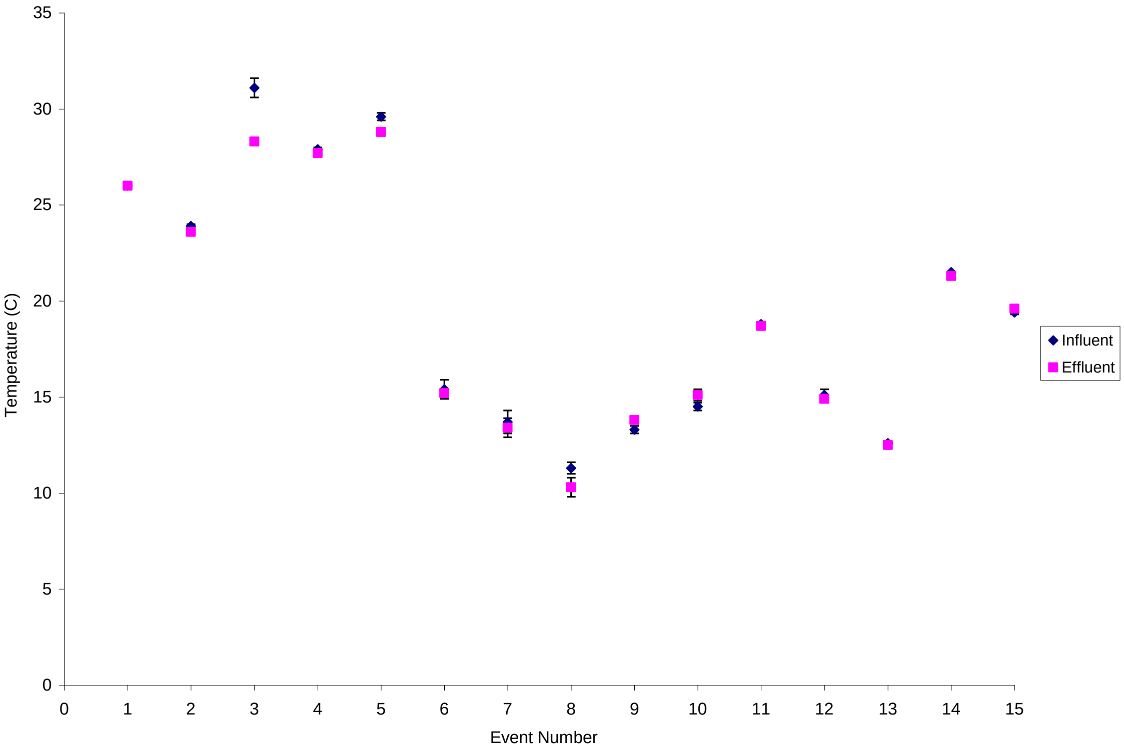
	As Influent (µg/l)		As Effluent (µg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	3.4	0	2.5	0.1	0.26
2(06/03/07)	2.5	0.2	2.5	0.3	0.00
3(06/28/07)	1.8	0.1	1.9	0.3	-0.06
4(07/29/07)	3.3	0.1	2.6	0.1	0.21
5(08/16/07)	1.9	0	1.5	0.1	0.21
6(11/13/07)	2.1	0.1	1.1	0.2	0.48
7(01/10/08)	0.8	0.2	0.8	0	0.00
8(02/01/08)	3.1	0.1	1.7	0.4	0.45
9(02/06/08)	2.7	0.3	2.6	0.3	0.04
10(02/13/08)	1.5	0.2	3	0.1	-1.00
11(03/04/08)	6.5	0	3.4	0	0.48
12(03/07/08)	0.5	0.2	0.5	0.2	0.00
13(03/16/08)	0.6	0.1	0.1	0	0.83
14(04/28/08)	0.5	0.1	0.4	0.2	0.20
15(05/09/08)	1.9	0.2	2.9	0.1	-0.53

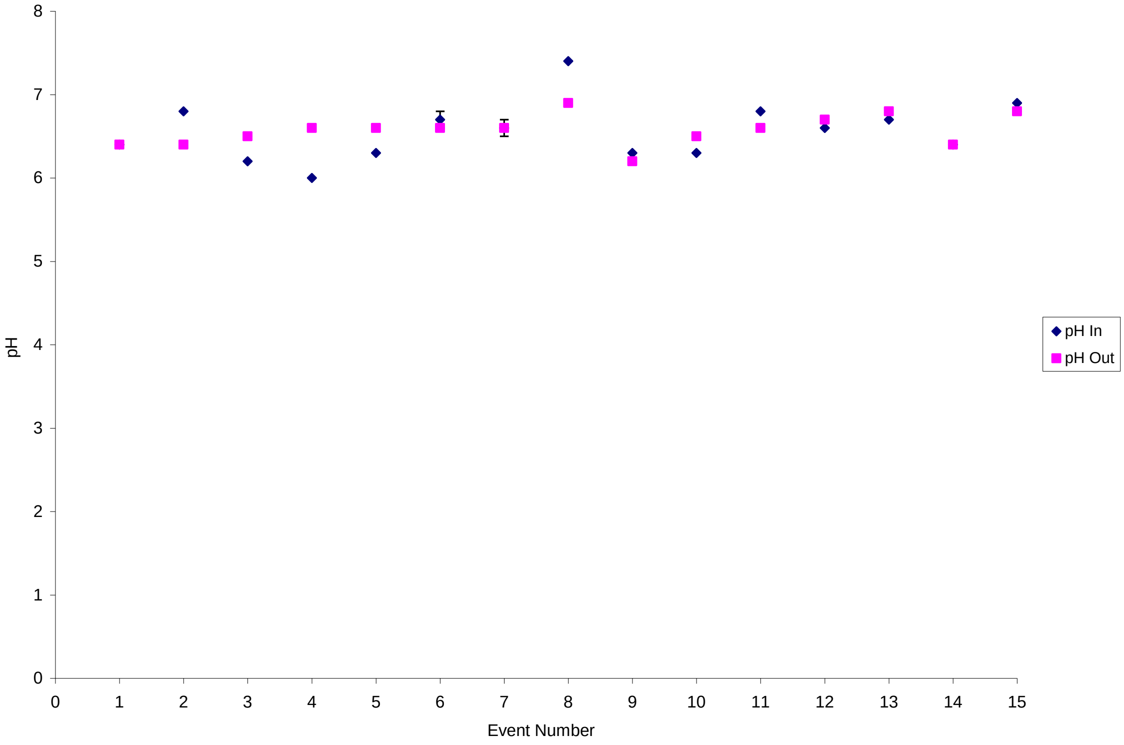
	Hg Influent (µg/l)		Hg Effluent (µg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	166.2	16.8	0.8	0.9	1.00
2(06/03/07)	8	0.9	5.2	1	0.35
3(06/28/07)	0	0	1.8	1.9	
4(07/29/07)	19	1	22.5	5.9	-0.18
5(08/16/07)	3.9	1.6	8.9	1.6	-1.28
6(11/13/07)	9.1	1.1	7.8	1.3	0.14
7(01/10/08)	2.6	0.1	2.1	0.9	0.19
8(02/01/08)	0	0	0	0	
9(02/06/08)	0	0	1.7	0.1	
10(02/13/08)	0	0	0	0	
11(03/04/08)	0.6	0.6	0	0	1.00
12(03/07/08)	0	0	0	0	
13(03/16/08)	0.7	0.6	2.6	2.3	-2.71
14(04/28/08)	0	0	0	0	
15(05/09/08)	3.1	0.1	0	0	1.00

	Fe Influent (µg/l)		Fe Effluent (µg/l)		
Event #	Average	Std	Average	Std	% removal
1(05/16/07)	0	0	0	0	
2(06/03/07)	105.3	3.6	283.7	4.4	-1.69
3(06/28/07)	26.3	1.7	147.8	19.5	-4.62
4(07/29/07)	157.7	9.1	221.6	7.1	-0.41
5(08/16/07)	291.5	5	320.2	5.1	-0.10
6(11/13/07)	281.7	8.5	198.6	3.1	0.29
7(01/10/08)	73.6	3.7	0	0	1.00
8(02/01/08)	108.2	9.6	94.3	2.6	0.13
9(02/06/08)	182.3	21.4	217.3	5.5	-0.19
10(02/13/08)	81.5	15.6	183	9.2	-1.25
11(03/04/08)	94	17	135.8	3.4	-0.44
12(03/07/08)	73	3.5	116.8	13.7	-0.60
13(03/16/08)	116	2.2	83.8	4.4	0.28
14(04/28/08)	0	0	0	0	
15(05/09/08)	0	0	0	0	

Graphs for the Vortex Catch Basin







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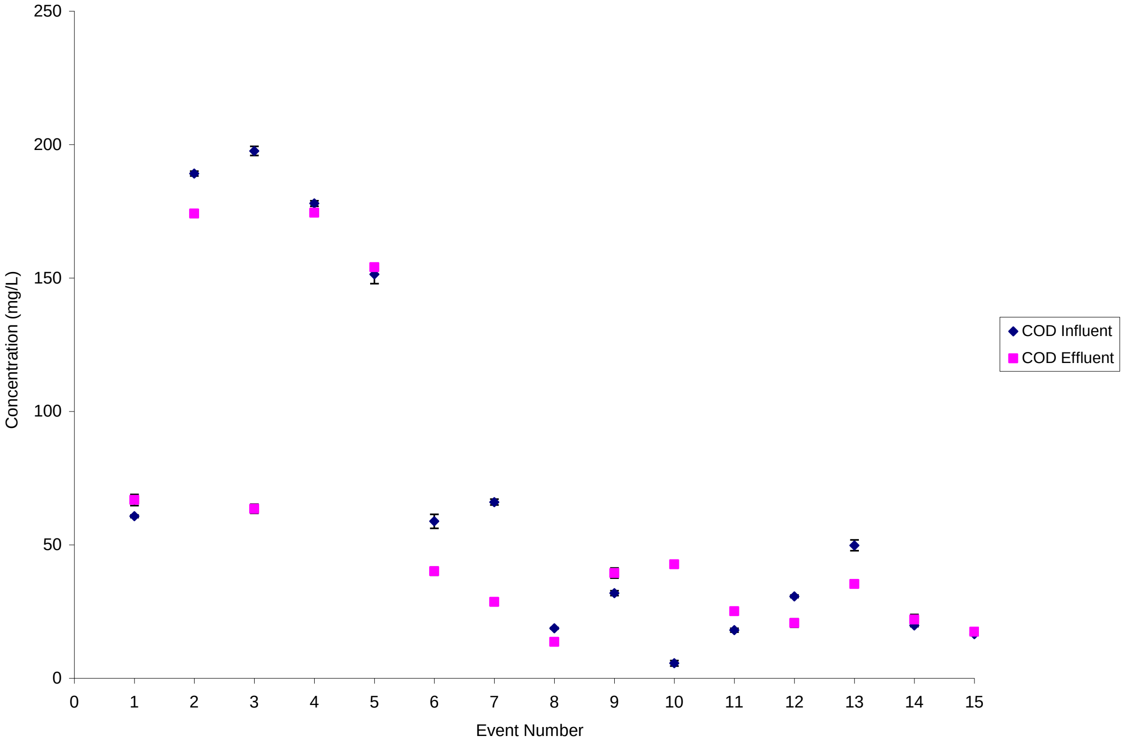
11
12
13
14
15
Event Number
◆ pH In
■ pH Out



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Concentration (mg/L)
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2
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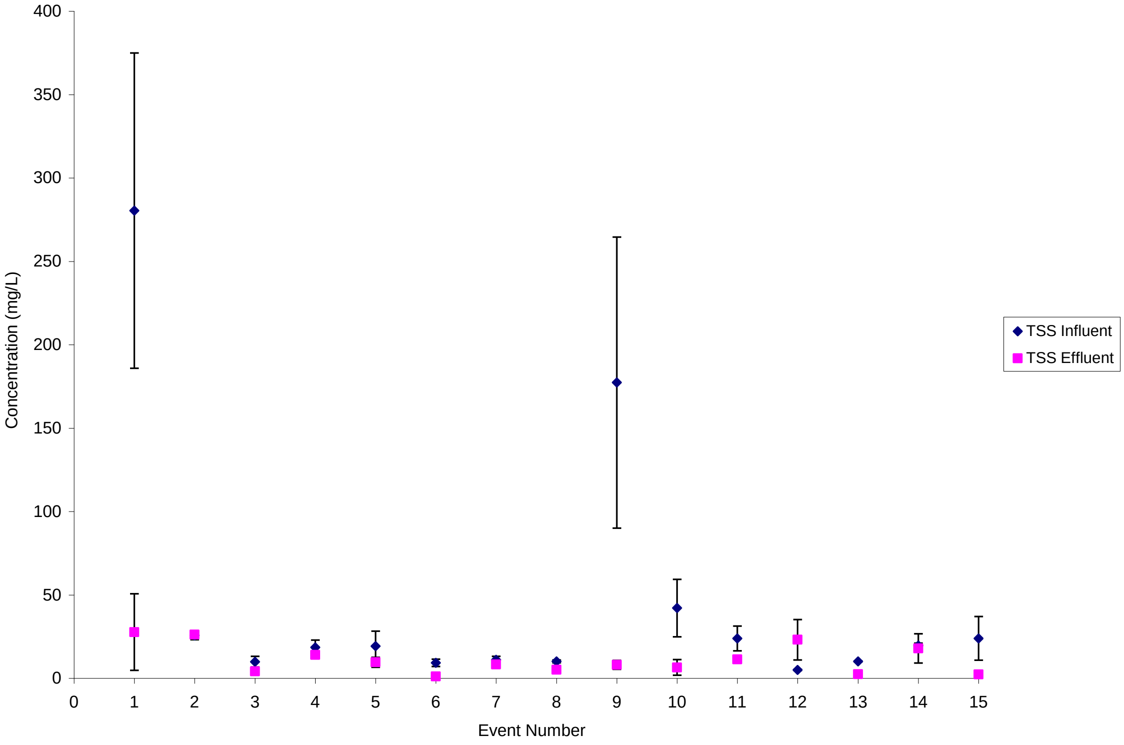
11
12
13
14
15
Event Number
◆ COD Influent
■ COD Effluent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200
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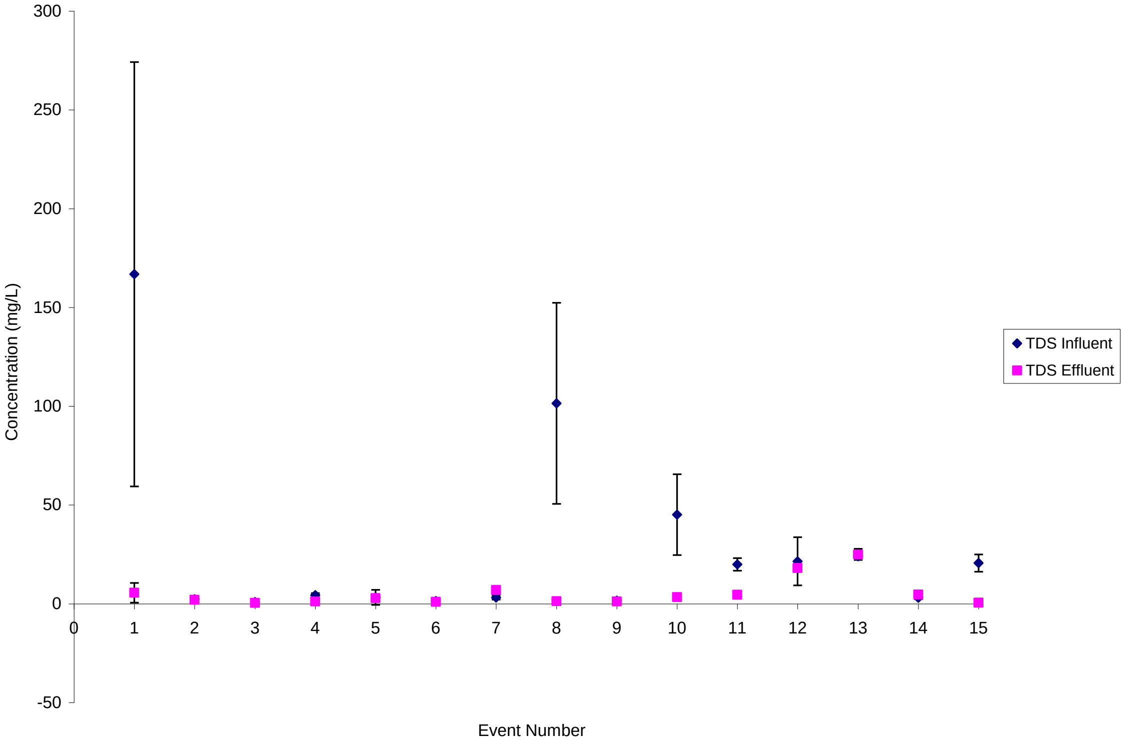
14
15
Event Number
◆ TSS Influent
■ TSS Effluent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-50
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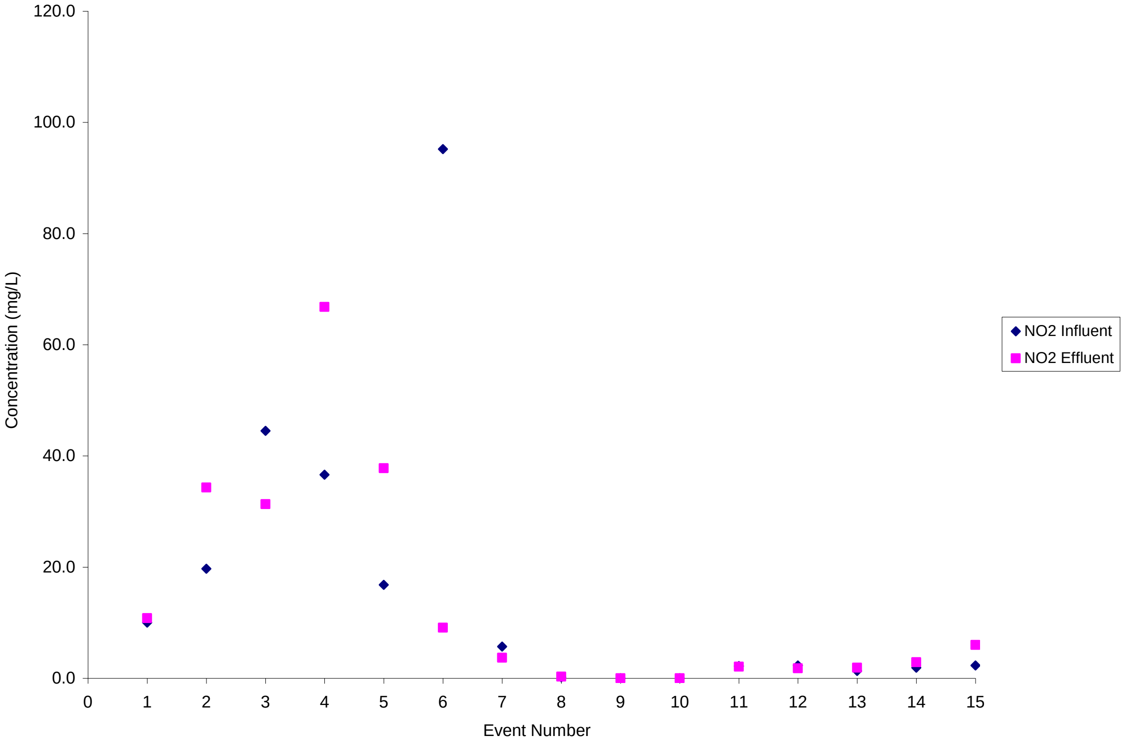
11
12
13
14
15
Event Number
◆ TDS Influent
■ TDS Effluent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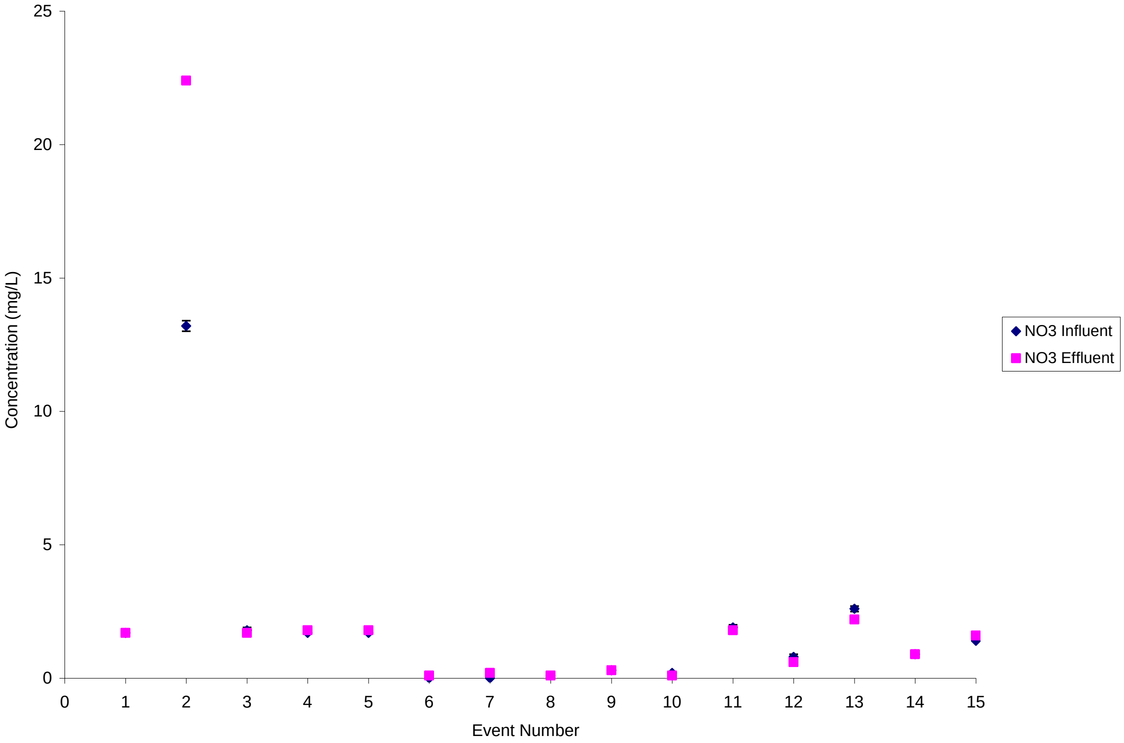
7
8
9
10
11
12
13
14
15
Event Number
NO2 Influent
NO2 Effluent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15
10
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3
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6
7
8
9
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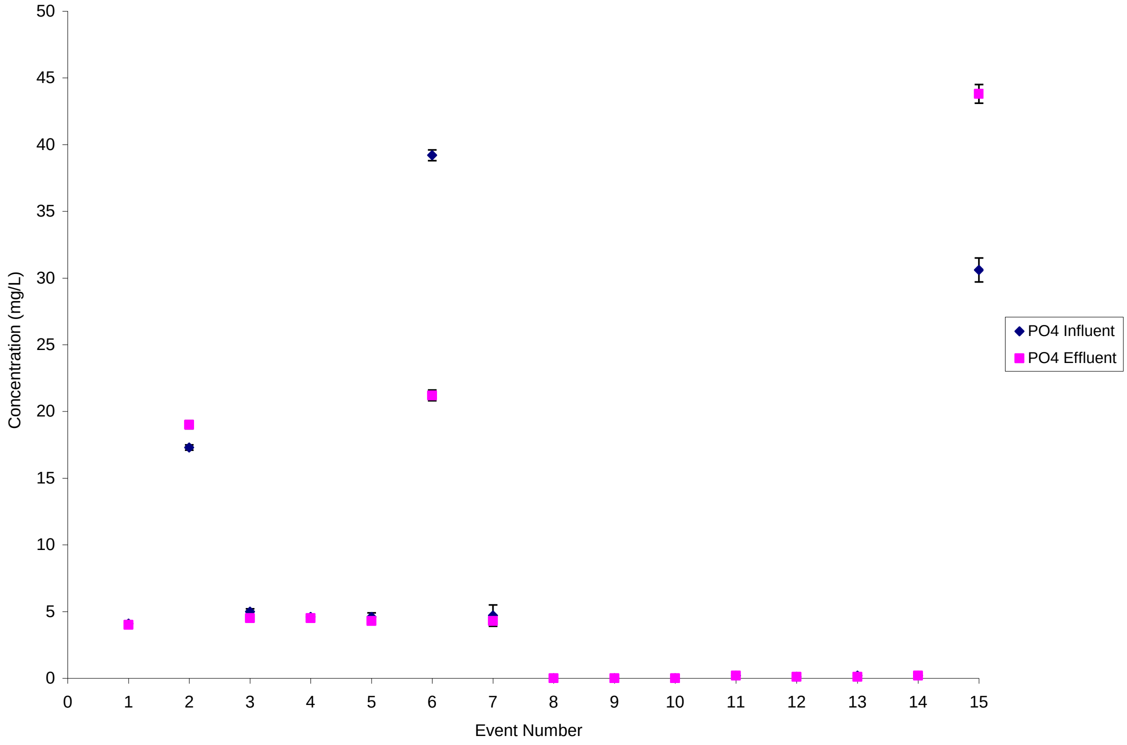
11
12
13
14
15
Event Number
NO3 Influent
NO3 Effluent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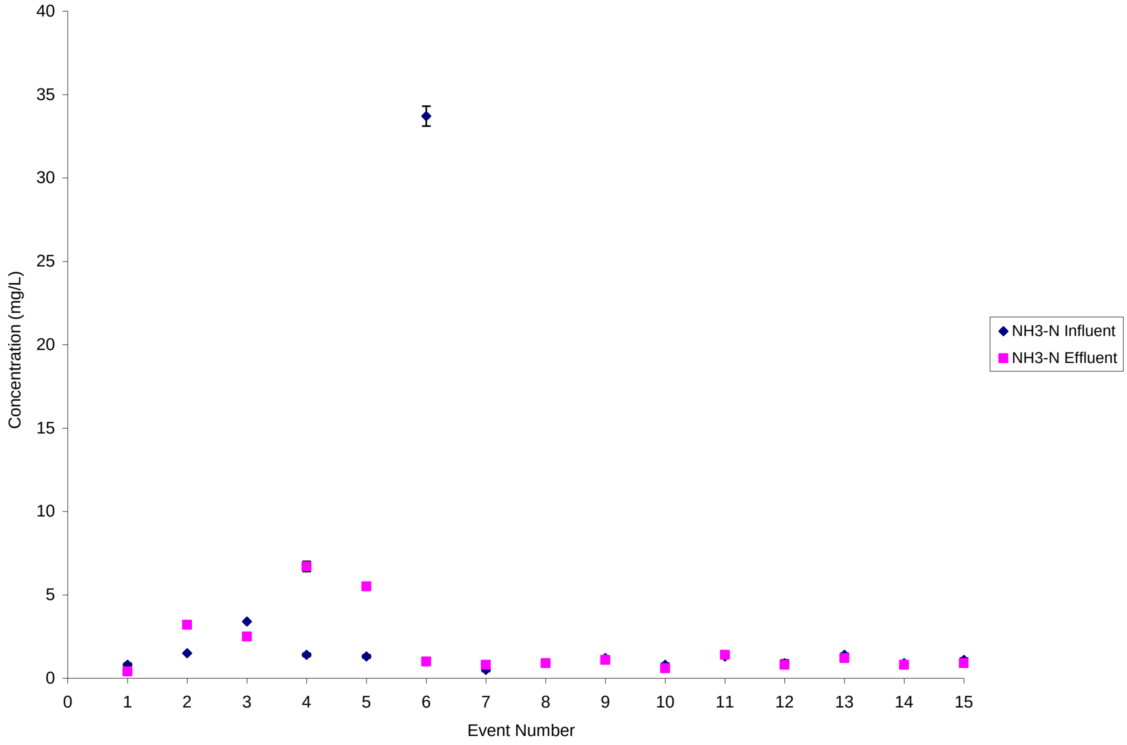
7
8
9
10
11
12
13
14
15
Event Number
PO4 Influent
PO4 Effluent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30
25
20
15
10
5
0
Concentration (mg/L)
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1
2
3
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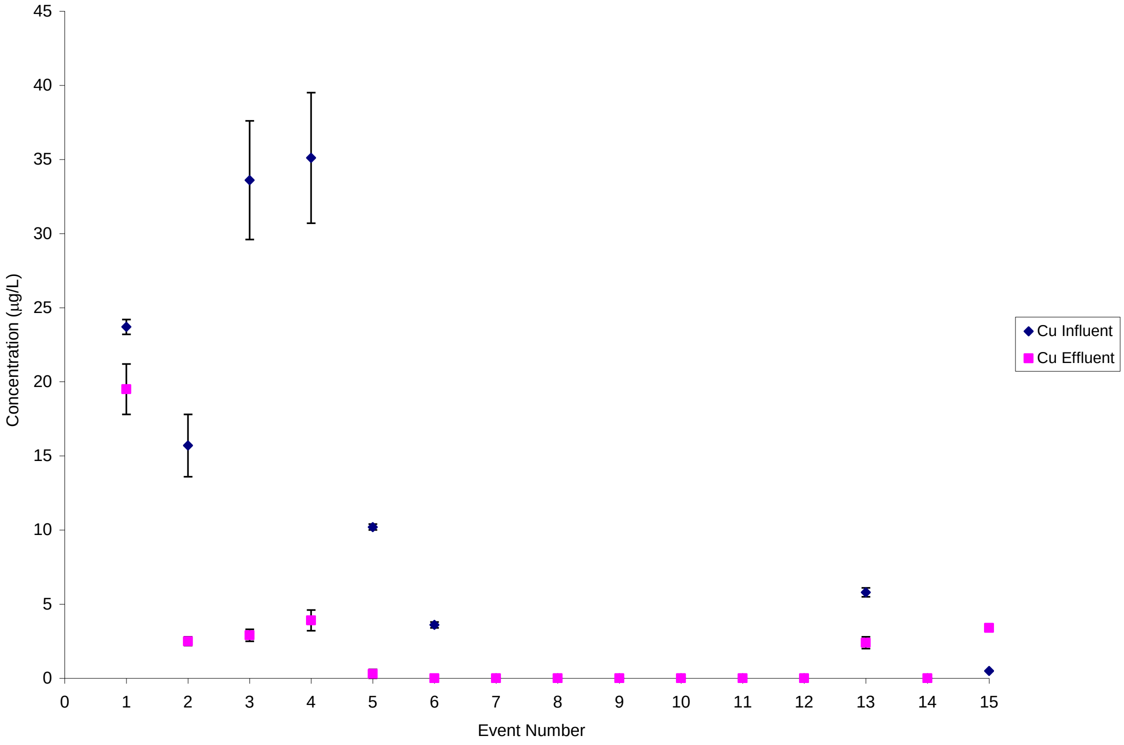
6
7
8
9
10
11
12
13
14
15
Event Number
NH3-N Influent
NH3-N Effluent



Concentration (µg/L)
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20
15
10
5
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1
2
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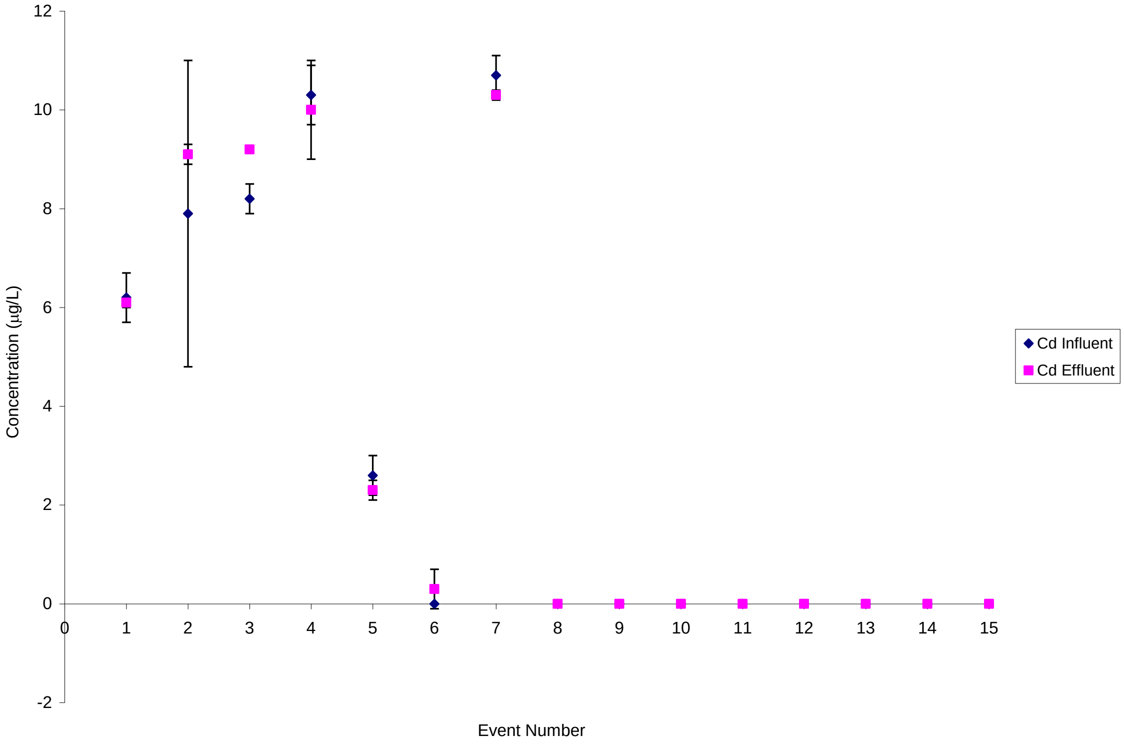
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cu Influent
■ Cu Effluent



Concentration (µg/L)
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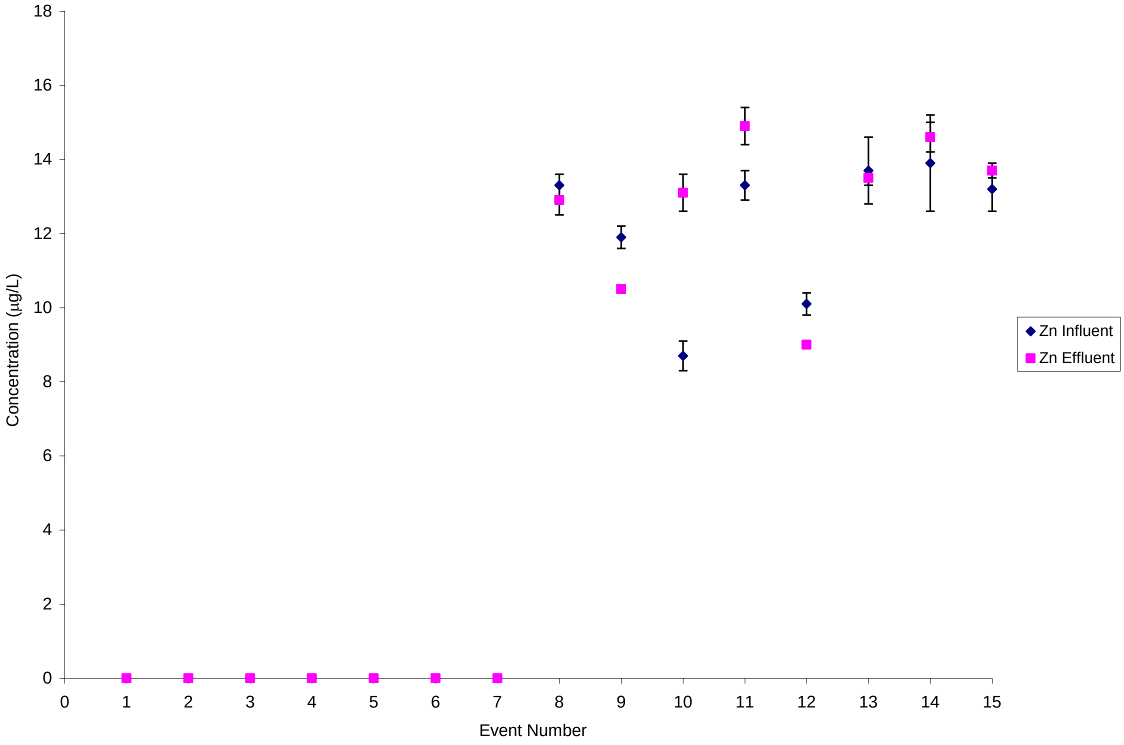
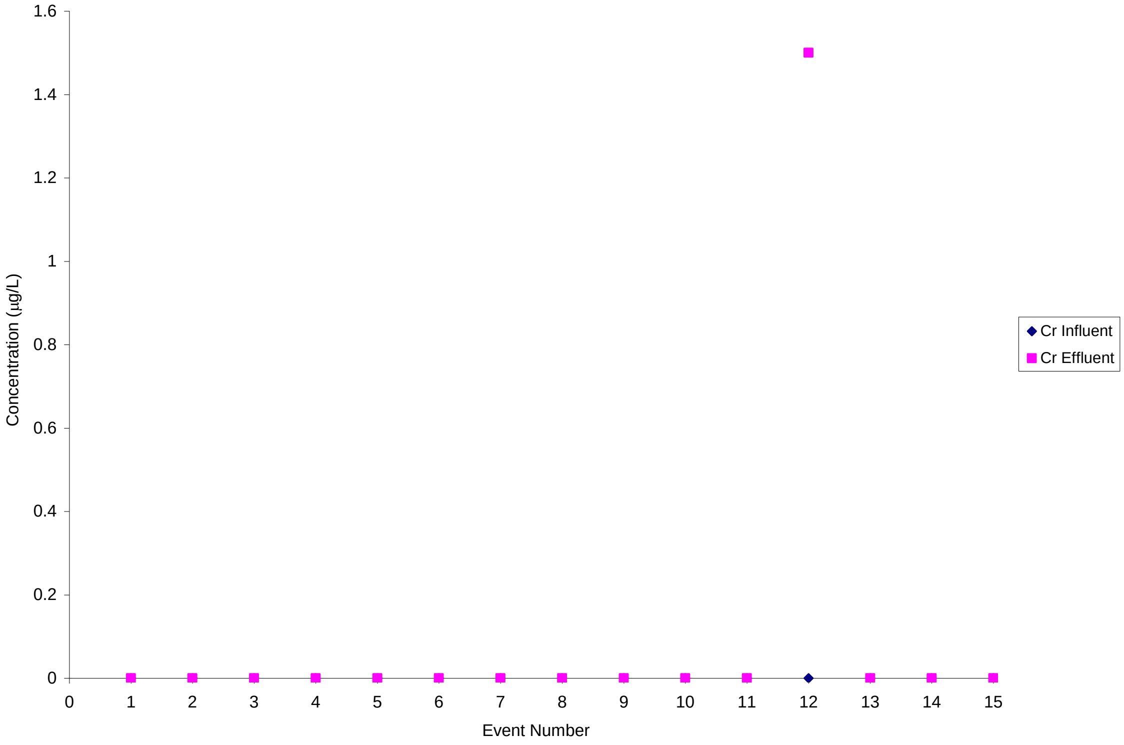
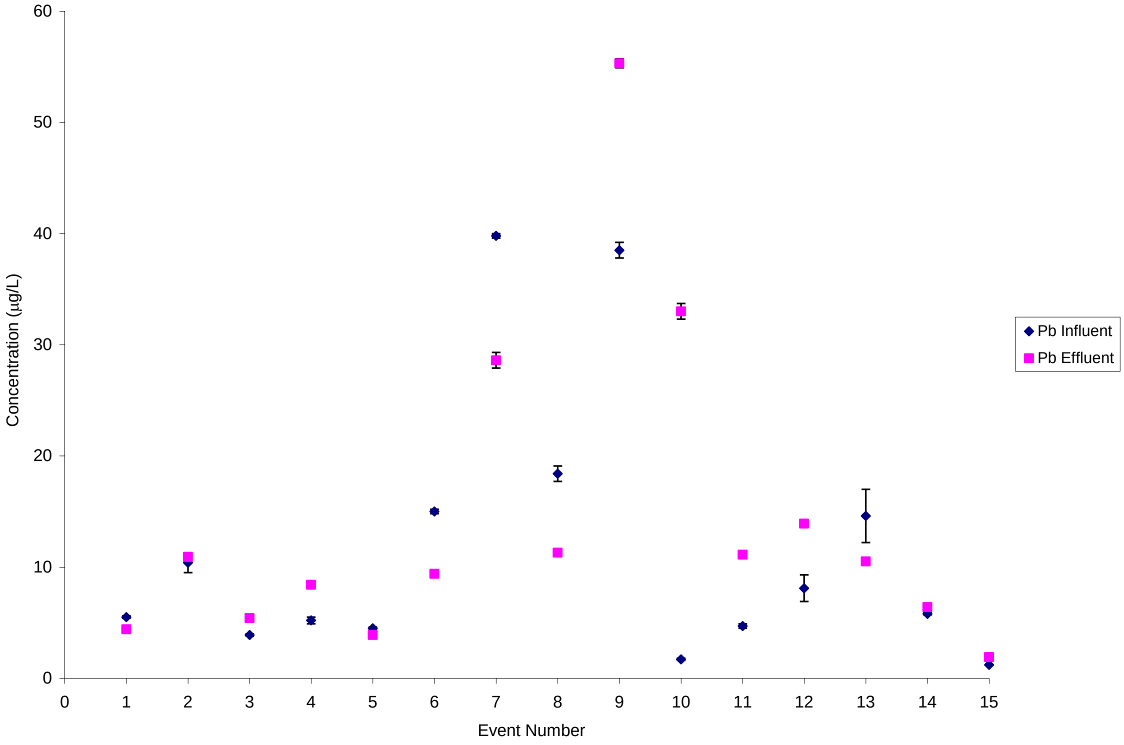
10
8
6
4
2
0
-2
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cd Influent
■ Cd Effluent



18
16
14
12
10
8
6
4
2
0
Concentration (µg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Zn Influent
■ Zn Effluent



1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Concentration (µg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Cr Influent
■ Cr Effluent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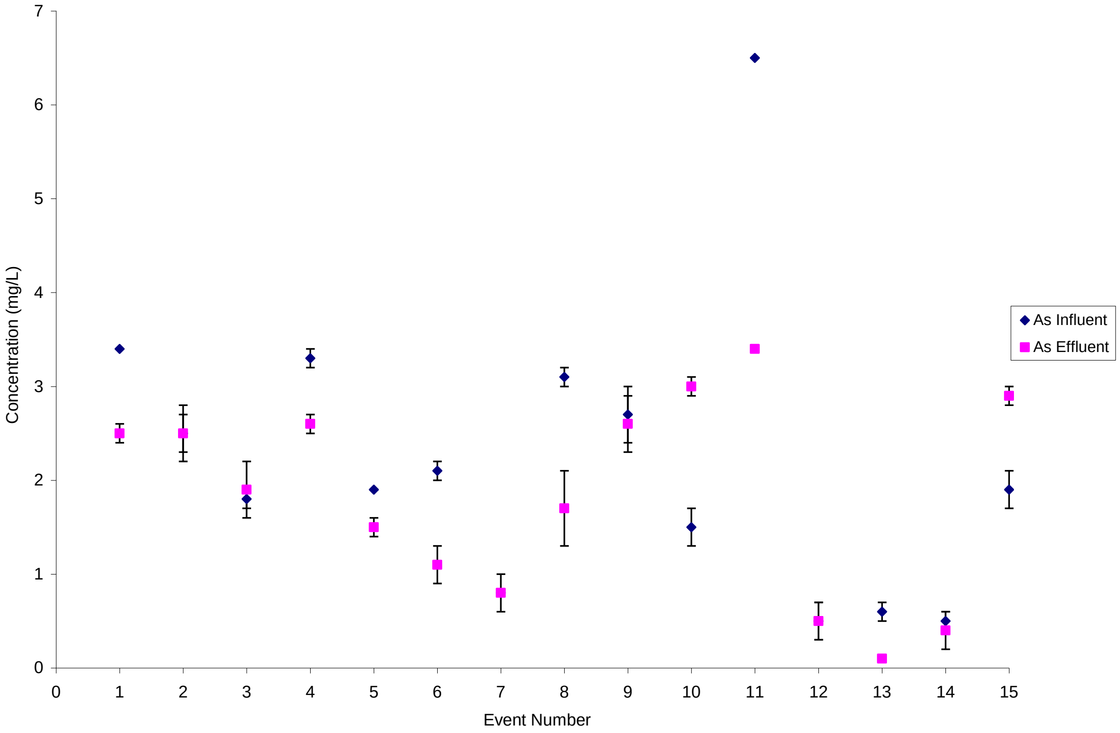
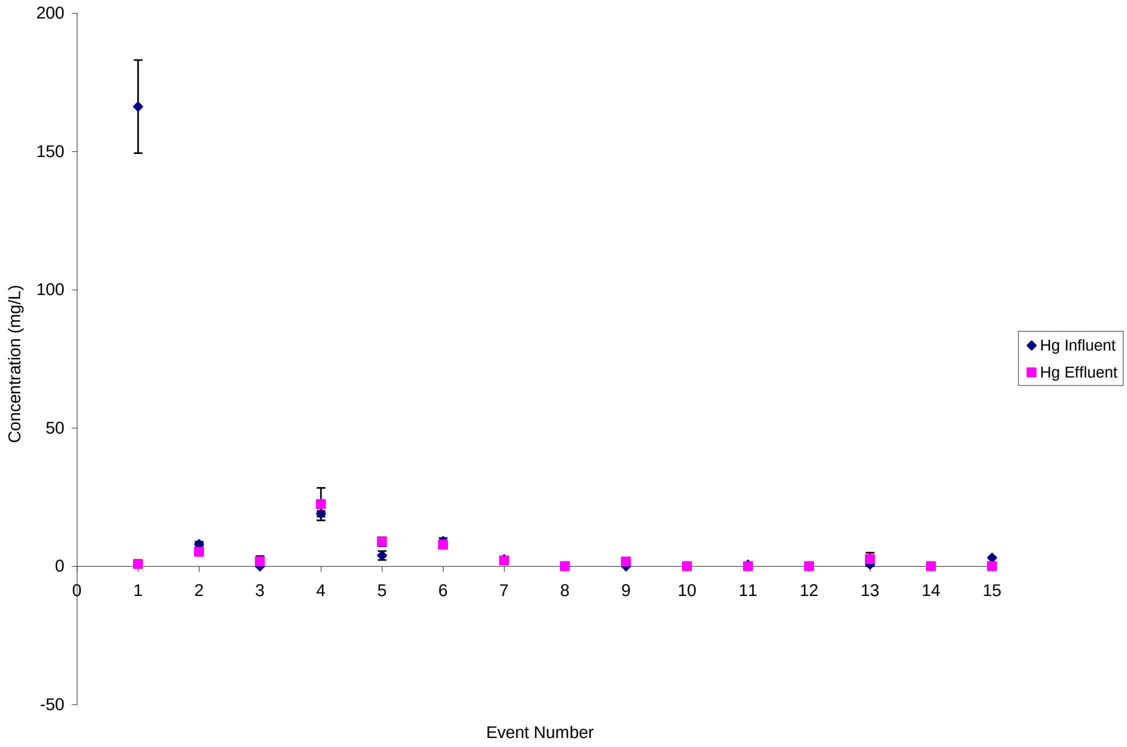
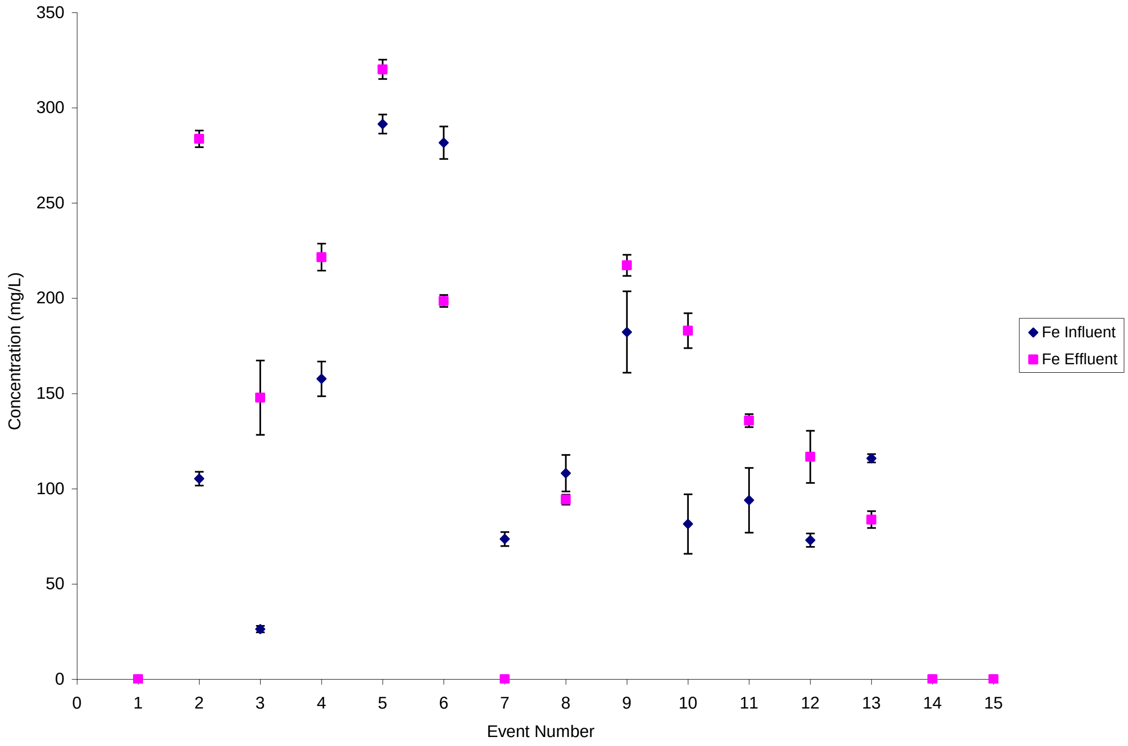
40
30
20
10
0
Concentration (µg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Pb Influent
■ Pb Effluent


7
6
5
4
3
2
1
0
Concentration (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ As Influent
■ As Effluent


200
150
100
50
0
-50
Concentration (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Hg Influent
■ Hg Effluent


350
300
250
200
150
100
50
0
Concentration (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Event Number
◆ Fe Influent
■ Fe Effluent