DELAWARE RIVER REACH C MAIN CHANNEL DEEPENING PROJECT

KILLCOHOOK (CELLS 2 AND 3) CONFINED DISPOSAL FACILITY MONITORING AND WATER QUALITY MONITORING AT THE POINT OF DREDGING



-FINAL-

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EXECUTIVE SUMMARY

Dredging for the first portion of the Delaware River Main Channel Deepening Project was conducted from March to September 2010. The first construction contract was for Reach C of the channel, which extends approximately 12 miles from the Delaware Memorial Bridge to just below the Chesapeake and Delaware Canal. In conjunction with the dredging, monitoring for potential water quality impacts was conducted at the point of active dredging and at the Federally-owned Killcohook confined disposal facility (CDF). The monitoring program was coordinated with the Delaware Department of Natural Resources and Environmental Control (DNREC).

Two hydraulic cutterhead suction dredges were used to deepen Reach C. Hydraulic cutterhead suction dredges work by pumping a mixture of dredged material and water (called a slurry) from the channel bottom through a pipeline to the CDF. The cutterhead, located on the suction end of the pipe, has rotating blades or teeth to break up and loosen the bottom material so that it can be pumped through the pipeline. The cutterhead is buried in the bottom sediment during operation. Contaminants associated with the sediment can be released to the water column if sediment is suspended in the water column rather than being drawn into the intake pipe. The point of dredging is one location where water quality impacts can occur.

Water quality was monitored at the point of active dredging. Water samples were also collected at background locations in the Delaware River for comparison to dredge plume data. In addition to the water samples, over 16,000 turbidity measurements were collected at 0.5, 6 and 11-meter depth increments during active dredging 200 feet from the cutterhead. TSS concentrations at the point of dredging were similar to background levels. Samples were also analyzed for inoganics, pesticides, polychlorinated biphenyls (PCBs) and semi-volatile organics. Sample data indicated that for the point of dredging, contaminants were either non-detect, or at similar concentrations detected in the background samples.

The dredged material for Reach C was pumped into the Killcohook confined disposal facility (CDF). The Killcohook facility is divided into three separate areas called cells. Cells 2 and 3 at the Killcohook CDF were utilized during the deepening of Reach C. At the CDF, dredged material is pumped into a diked cell, which contains the mixture of dredged material and water for a sufficient time to allow the suspended sediment to dewater, and the effluent water to return to the river. As the water moves through the cell, it slows, allowing sediment particles to settle out. Finally, water reaches the weir and is discharged from the site. Some suspended sediment is released back to the river at this discharge point. Contaminants dissolved in the water and contaminants associated with suspended sediment will also be released. The CDF discharge point is the second location where water quality impacts can occur.

Water quality was monitored at the Killcohook discharge points over the period of dredging. The environmental monitoring program for Cells 2 and 3 included material flowing into the containment cells (influent), water and associated suspended solids discharging from the cells back to the Delaware River (weir), water samples collected in the Delaware River in the

vicinity of the discharge point (mix), and water samples collected in the Delaware River at a location that provided ambient water quality data (background). Samples were analyzed in the laboratory for inorganics, pesticides, PCBs, and semi-volatile organics including PAHs.

CDF weir effluent results were compared to DNREC water quality criteria, after proper consideration of near field and far field dilution as well as background concentrations. Comparisons indicated that almost all of the concentrations of parameters met water quality criteria, and when background concentrations were considered there were no impacts to the water quality as a result of the placement of deepening sediments into the Killcohook CDF.

A mass balance evaluation of the contaminant load entering and leaving Cell 2 of the Killcohook facility indicated that for most contaminants including PCBs, pesticides, PAHs, and mercury close to 99 percent of the contaminant load was retained by the CDF and not released back to the Delaware River.

The following conclusions are made based on monitoring data collected over the entire dredging project:

- Suspended solids and contaminant levels down-current of the cutterhead were consistent with or less than background levels, indicating that water quality was not impacted at the point of dredging;
- Weir discharges from the Killcohook CDF did not adversely impact water quality;
 and
- A mass balance evaluation of the contaminant loads entering and leaving Cell 2 of the Killcohook facility indicates a large net removal of contaminants from the Delaware River during main channel deepening of Reach C.

In summary, the deepening of the Delaware River navigation channel in Reach C to 45 feet resulted in no adverse water quality impacts with respect to toxics, and in fact removes far more contaminants from the river than it liberates, thus providing for an overall net benefit to the water quality in the river.

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1.0 INTRODUCTION

Environmental monitoring was conducted associated with the Deepening of Reach C, the first construction contract for the Delaware River Main Channel Deepening Project. The project calls for deepening the existing Delaware River Federal Navigation Channel from 40 to 45 feet from Philadelphia Harbor, Pa., and Beckett Street Terminal, Camden, N.J., to the mouth of the Delaware Bay, appropriate bend widening, and partial deepening of the Marcus Hook anchorage and relocation of and addition of aids to navigation. Dredged material is to be placed by hydraulic and hopper dredges in confined upland containment areas in the Delaware River portion of the project and for beneficial uses in Delaware Bay.

On March 1, 2010 the dredge Pullen, owned and operated by Norfolk Dredging Company, began dredging in Reach C of the Delaware River Federal navigation channel (Figure 1-1). Dredging for deepening in Reach C extends from channel station 182+000 (vicinity of the Delaware Memorial Bridge) to channel station 242+514.5 (vicinity of Elsinboro Point, NJ). The Pullen is a 24-inch hydraulic cutterhead suction dredge. The Pullen began dredging in the navigation channel at station 231+000 (vicinity of Salem River, NJ). Dredged material was pumped via pipeline from the Pullen to Cell 2 of the Federally-owned Killcohook confined upland dredged material containment facility (Figure 1-1). The Pullen completed dredging on September 18, 2010.

On April 18, 2010 a second Norfolk Dredging Company dredge, the Charleston, also began dredging in Reach C. The Charleston is also a 24-inch hydraulic cutterhead suction dredge. The Charleston began dredging in the navigation channel at station 216+000 (vicinity of the Killcohook dredged material containment facility). Dredged material was pumped via pipeline from the Charleston to cell 3 of the Federally-owned Killcohook confined upland dredged material containment facility (Figure 1-1). The Charleston left the Reach C project area approximately a month earlier than the Pullen.

Two types of environmental monitoring were conducted during Reach C construction for the deepening project. Water quality was monitored at cells 2 and 3 of the Killcohook dredged material confined disposal facility (CDF). Sampling included material flowing into the containment cells (influent), water and associated suspended solids that were discharged from the cells back to the Delaware River (effluent), water samples were collected in the Delaware River in the vicinity of the discharge point (representing some initial mixing), and at a location near Pennsville, New Jersey that can provided background water quality data.

In addition to monitoring at the Killcohook facility, periodic water quality monitoring was conducted on the dredge boat at a distance of 200 feet directly down-current to capture plume generated turbidity and contaminant re-suspension caused by the dredge boat's cutterhead. Monitoring included the collection of detailed data on total suspended solids (TSS) and turbidity in the dredge plume. A TSS performance standard of 250 mg/L at a distance of 200 feet down-current of the cutterhead has been established through modeling calculations as a TSS level at which water quality criteria would be met. Water samples for contaminant testing were collected

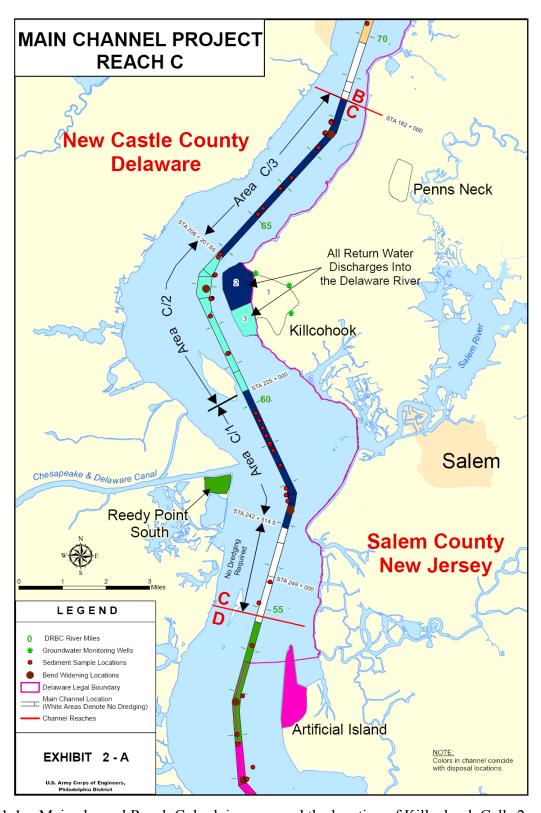


Figure 1-1. Main channel Reach C dredging area and the location of Killcohook Cells 2 and 3

within the dredge plume and at upriver and downriver background locations in the Delaware River.

1.1 THE DREDGING PROCESS

Dredging is the underwater excavation of sediment from the bottom of the channel. A dredge is a machine that scoops or suctions sediment from the bottom of waterways or is used to mine materials underwater. Modern dredgers use satellite information and computers to help dig channels. Dredge captains use global positioning systems (GPS), which use satellite information to calculate the location of the dredge in the channel. On the dredge, information about the channel, the location of the shoal, and even the position of the dredge in the channel is displayed on a computer screen while they are working. Using computers to process and display information about the job and the dredge allows the dredging to be done with great efficiency. It saves time and money, and results in safer navigation channels.

Two hydraulic cutterhead suction dredges were used for this contract. Figure 1-2 depicts a typical hydraulic cutterhead suction dredge. Hydraulic dredges work by pumping a mixture of dredged material and water from the channel bottom. The amount of water taken up with the material is controlled to make the best mixture. Too little water and the dredge will bog down; too much water and the dredge will not be efficient in moving sediment. A typical dredging operation in the Delaware River navigation channel hydraulically pumps dredged material through a pipeline to an upland CDF with a sediment to water ratio of about 25% to 75%.

For this contract, dredged material was pumped into the federally owned Killcohook upland confined disposal facility. In CDFs, dredged material is placed behind dikes, which contain and isolate it from the surrounding environment. The Killcohook facility is divided into three separate areas called cells. A mixture of dredged material and water is pumped into a cell and the flow of water is controlled by placement of training dikes to lengthen the path water must take to reach a weir discharge location, where water is discharged back to the river (Figure 1-3). Water pumped with the dredged material is contained in the disposal site until the solids settle out. It is then discharged back into the waterway. Heavier, coarser-grained sands and gravels drop out of the water column close to where material enters the cell. As the water moves through the cell, it slows, allowing finer-grained sediment particles to settle out. Finally, water reaches the weir and is discharged from the site. The purpose of the weir structure is to regulate the release of ponded water from the cell. Proper weir design and operation can control resuspension and release of settled solids. As the height of the weir is increased, the depth of the pond increases and only the cleaner surface waters of the pond are released.

A pipeline dredge pumps dredged material through one end, the intake pipe, and then pushes it out the discharge pipeline directly into the CDF. Because pipeline dredges pump directly to CDFs, they operate continuously and can be very cost efficient. Most pipeline dredges have a cutterhead on the suction end. A cutterhead is a mechanical device that has





Figure 1-2. Configuration of a typical cutterhead dredge

rotating blades or teeth to break up or loosen the bottom material so that it can be pumped through the dredge. The cutterhead is buried in the bottom sediment during operation. Pipeline dredges are mounted (fastened) to barges and are not usually self-powered, but are towed to the dredging site and secured in place by special anchor piling, called spuds. During operation, the cutterhead dredge swings from side to side alternately using the port and starboard spuds as a pivot. Cables attached to anchors on each side of the dredge control lateral movement. Figure 1-4 is an overhead view of the operation of a cutterhead dredge.

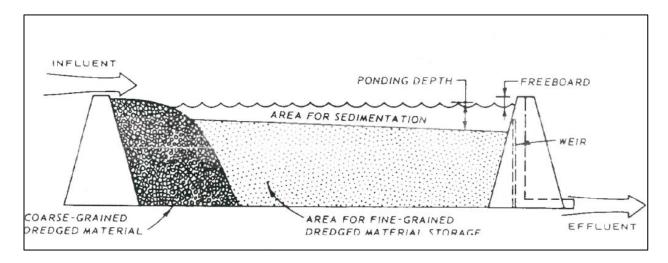


Figure 1-3. Generic Confined Disposal Facility design

1.2 CONTAMINANTS IN THE AQUATIC ENVIRONMENT

Contaminants move within the aquatic environment in a variety of ways. Contaminants generally enter the aquatic environment in dissolved or suspended form in runoff, in dissolved form in groundwater, and in wet and dry deposition from the atmosphere. Once in the aquatic environment, dissolved contaminants are usually rapidly taken up through adsorption to suspended sediment particles or organic matter. Contaminants bound to particles are most likely to settle to the bottom. Dissolved contaminants will stay within the water column. The largest reservoir of contaminants in the aquatic environment is in the bottom sediment. Bottom sediments in the aquatic environment are not static but continuously in flux. Bottom sediments can become resuspended in the water column by natural processes such as winds, waves, currents, tidal action and episodic events such as storms. In the Delaware River bottom sediments are also resuspended through human activities such as ship traffic and dredging. Contaminants associated with suspended sediment are affected by a variety of chemical factors within the water column which control the rate of adsorption or desorption of dissolved contaminants to either sediment particles or organic matter. Once contaminants are resuspended in the water column with sediment they may resettle to the bottom, be swept away by currents or become dissolved in the water column. A complex set of processes continuously in flux define the concentrations of contaminants in the water column of the aquatic environment.

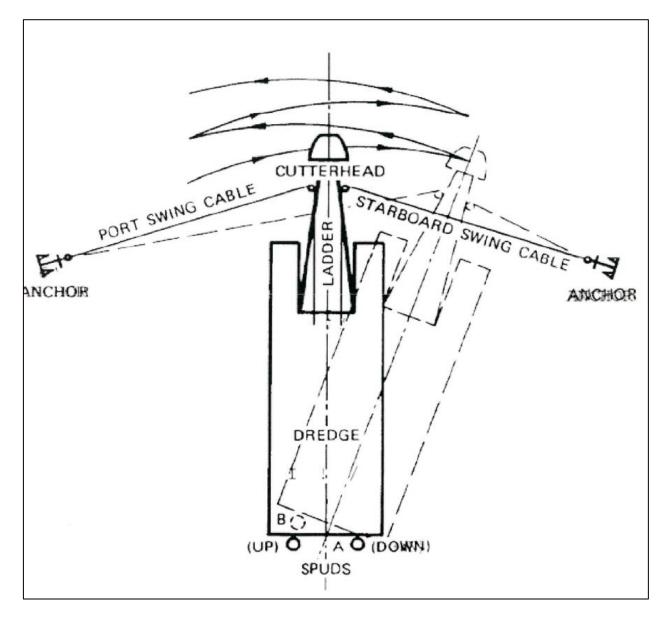


Figure 1-4. Anchoring and cabling system used to swing dredge back and forth during active dredging

Because of contaminant concerns in the waters of the Delaware Estuary, the states of Delaware, New Jersey, and Pennsylvania have issued fish consumption advisories that indicate by species the safe number of meals an individual can eat over a period of time. Fish can absorb contaminants from the water and the food they eat and chemicals may build up over time in fish tissues even with extremely small amounts of chemicals in the water. The amount of contaminants in fish depends on the species, size, age, sex and feeding area of the fish. Chemicals, such as polychlorinated biphenyls (PCBs), mercury, and dioxin in fish are a health risk for people who regularly consume their catch.

1.3 ENVIRONMENTAL MONITORING APPROACH

There are two potential pathways resulting from the dredging process that can increase exposure of contaminants associated with the bottom sediments to aquatic life. The first route of possible exposure occurs when the cutterhead disturbs the sediment in the area being dredged. Sediment resuspended into the water column may result in the release of sediment contaminants, which can then be available for uptake by aquatic organisms. A second possible exposure pathway is the release of contaminants associated with water and suspended sediment discharged from the CDF. In addition to resuspension of sediment and contaminants associated with the dredging process, it is also important to consider the overall contaminant load within the aquatic system. The dredging process removes contaminants associated with dredged sediments from the aquatic environment by permanently sequestering them in the CDF. From a mass balance perspective it is important to consider how sediment and contaminant mass are added to the water column (mobilization at the cutterhead and discharges from the CDF) versus how sediment and contaminant mass are removed from the water column (resettling of suspended sediments mobilized at the cutterhead but not drawn into the pipeline and retention within the CDF). Two types of environmental monitoring were conducted during Reach C construction for the deepen-Scopes of work to guide sample collection and analysis were prepared and coordinated with the Delaware Department of Natural Resources and Environmental Control (DNREC) for their comment and approval prior to the start of construction. Water quality was monitored at cells 2 and 3 of the Killcohook dredged material confined disposal facility (CDF). The scope of work for this effort is titled: FY-2010 Delaware River Deepening Project Killcohook CDF Water Quality Monitoring (see Appendix A). Sampling included material flowing into the containment cells (influent), water and associated suspended solids discharging from the cells back to the Delaware River (effluent), water samples collected in the Delaware River in the vicinity of the discharge point (representing some initial mixing), and water samples collected in the Delaware River at a location that can provide background water quality data.

In addition to monitoring at the Killcohook facility, periodic water quality monitoring took place at the working dredge at a distance of 200 feet directly down-current so as to capture any plume generated by the dredge. The scope of work for this effort is titled: *Delaware River Main Channel Deepening Project Reach C Water Quality Monitoring at the Point of Dredging* (see Appendix A). Monitoring included the collection of detailed data on total suspended sediments (TSS) and turbidity in the dredge plume. A TSS performance standard of 250 mg/L at a distance of 200 feet down-current of the cutterhead has been established through modeling calculations as a TSS level at which acute water quality criteria for the protection of aquatic life would be met. Water samples were also collected within the dredge plume and at background locations in the Delaware River for contaminant testing.

2.0 POINT OF DREDGE MONITORING

2.1 FIELD METHODS

TSS and water samples for contaminant testing were conducted off the dredge Pullen (Figure 2-1) in eight specific events. Events 1 through 7 included simultaneous TSS and turbidity measurements while events 2, 4, 5, 6, and 8 also included water sampling for contaminants (Table 2-1).



Figure 2-1. Pullen dredge boat working in Reach C of the Delaware River during the 2010 monitoring

Table 2-1.	Point of Dredge sampling dates and parameters sampled in 8 monitoring events
	for Reach C deepening

		Number of				
	Event	Sampling	Tide			Water Column
Date	Number	Rounds	Stage	TSS	NTU	Contaminants
3/16-17/2010	1	4	Flood	X	X	
4/1/2010	2	2	Flood	X	X	X
4/30/2010	3	2	Flood	X	X	
5/20/2010	4	1	Flood	X	X	X
7/20/2010	5	1	Ebb	X	X	X
8/11/2010	6	1	Ebb	X	X	X
8/18/2010	7	2	Ebb	X	X	
9/10/2010	8	2	Flood			X

For each sampling event several rounds of sampling were attempted unless the dredger stopped dredging during a scheduled sampling event. The sampling was conducted from Versar's vessel moored onto the starboard side of the Pullen dredge approximately 200 feet downstream of where the cutterhead contacted the river bottom (Figure 2-2). For most of the lower sections of Reach C the Dredge Pullen cutterhead was pointing downriver while in the upper reaches the Pullen pointed upriver (except on the last event). Because the dredge boat swings from side to side during active dredging and the presence of pipelines, anchor chain, high currents, and mobile workboats, sampling could only be safely conducted while moored to the dredge boat. Therefore in any given sampling event only one tidal cycle (6 hour duration) could be taken in a given work day. Turbidity and TSS samples were taken at 0.5, 6, and 11-meter depths while water samples for contaminant testing were only taken at the 6 and 11-meter increments. Using a data logging YSI 6600 water quality meter turbidity, temperature, salinity, dissolved oxygen, and pH were recorded every 2 seconds at each of three depths for a total of 15 minutes during active dredging. Since the dredge boat swings in a 400 foot swatch while dredging, the swing position was recorded on field sheets every minute during the data logging. Dredge boat swing position and swing rate varied according to bottom hardness, depth of cut, ambient depth, and other conditions deemed necessary by the captain who operated independently of the environmental sampling team.

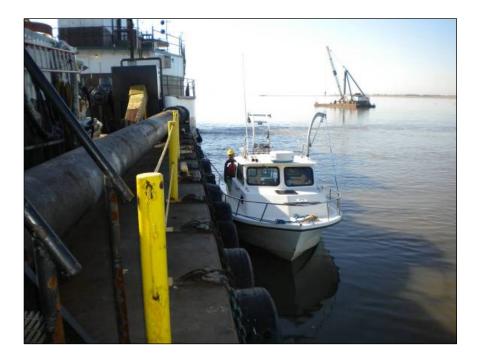


Figure 2-2. Versar sampling vessel, RV Integrity, moored along the starboard side of the Pullen dredge approximately 200 feet from where the cutterhead contacted the river bottom

The YSI meter was attached horizontally to a Wildco® opening and closing sample bottle (Figure 2-3). After 15 minutes of data logging at depth three water samples for TSS measurements were taken by sending a weighted tripping mechanism down the cable to close the bottle. The field NTU on the YSI hand held display was recorded when the bottle tripped shut. TSS samples were taken at port, center, and starboard swing positions whenever possible. Water samples for contaminant testing were taken during Events 2, 4, 5, 6 and 8 (Table 2-1) using a peristaltic pump and a Teflon® hose attached to the closing sample bottle. Upriver and downriver background samples were taken approximately 1/2 mile away from the dredge boat for each sampling event. A data logging water quality cast from surface to 11-meters was taken along with TSS and contaminant sampling at 0.5, 6 and 11-meter depths similar to the collection taken while moored to the Pullen. Only one round of background samples was taken per event. To characterize the grain size and chemical composition of the dredged material sediment samples were taken in front of the cutterhead with a ponar grab. The ponar grab was decontaminated with an alconox wash, an acetone rinse, and a final deionized water rinse before obtaining sediment samples for bulk sediment testing.



Figure 2-3. YSI water quality meter attached to open sample bottle for the Point of Dredge TSS and turbidity testing in Reach C of the Delaware River Deepening project

All water and sediment samples were labeled and shipped on ice to TestAmerica laboratories in Pittsburgh, PA for analysis. TSS samples were processed the next day in Versar's sediment laboratory in Columbia, MD. Contaminant testing included pesticides, PCBs (as Aroclors and congener-specific), dioxins and furans, semi-volatile organics, inorganics, and

dissolved and particulate organic carbon. Only the 11-meter depth water samples were tested for high resolution congener specific PCBs and dioxins and furans. Laboratory methods for the various parameters tested are presented in Section 5.2 and Table 5-2.

The field measurements of turbidity (NTUs) fluctuated in real time due to the flow-by of particles making the exact turbidity at the time the Wildco® bottle closed subject to some uncertainty. Therefore turbidity was re-measured in the laboratory using the same YSI meter just before filtering the water for the TSS analysis. Regression analysis was run on both field and laboratory NTUs against the sample specific gravimetric measurement of TSS.

2.2 POINT OF DREDGE MONITORING DATA ASSESSMENT METHODS

Water quality monitoring was conducted during dredging operations in Reach C to evaluate the magnitude of the turbidity plume and the level of contaminant releases at the cutterhead of the working dredge deepening Reach C. Data and analyses for this assessment are provided in Appendix B. The frequency of turbidity observations in various data bins were calculated for the 11-m, 6-m, and 0.5-m measurements taken 200 feet down-current from the working cutterhead with a data logging water quality meter. It was anticipated that if a significant turbidity plume was generated by the cutterhead a higher percentage of the observations at the 11-m depths would be above 250 mg/L TSS and that the turbidity pattern would be dramatically dissimilar to background turbidity casts. Previous turbidity plume studies by USACE and subsequent reviews by DNREC suggested that if TSS levels are kept below 250 mg/L 200 feet from the point of dredging then Delaware River acute water quality criteria for the protection of aquatic life will likely be maintained. To identify the level of NTU that represents 250 mg/L TSS a regression analysis was first required to correlate turbidity (measured in Nephelometer Units - NTUs) to Total Suspended Solids (i.e., TSS). Real time measurements for turbidity can only be accomplished with a turbidity meter that records NTUs. Turbidity is an optical measurement of light attenuation caused by particles in the water column. To convert NTUs into TSS site specific water sampling and simultaneous NTU measurements were needed to develop a regression equation to accurately convert turbidity into TSS.

Contaminant mobilization and potential toxic effects at the cutterhead were assessed by comparing the Point of Dredge samples taken at 11-m and 6-m depths to DNREC acute and chronic freshwater protection of aquatic life criteria relative to concentrations observed in upriver and downriver background samples (Appendix C). For this assessment a conservative hardness of 75 mg/L was assumed for calculating hardness based criteria. Mean contaminant concentrations were also computed for the 11-m and 6-m dredge plume samples and compared to background concentrations by computing a ratio of mean plume to mean background concentrations. Ratios over 1.0 suggest an increase in contaminant concentration was caused by the cutterhead.

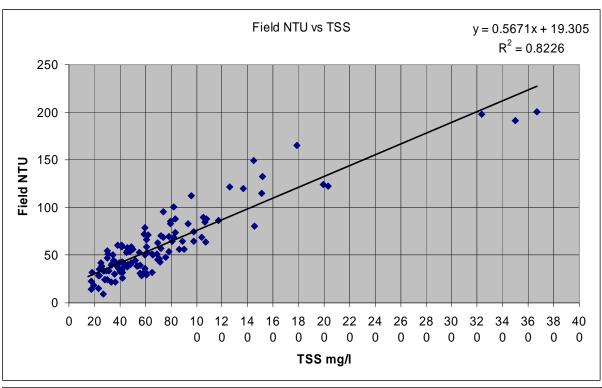
3.0 POINT OF DREDGE MONITORING RESULTS

3.1 TURBIDITY

Among seven sampling events for TSS and turbidity a total of 157 paired samples were collected. The highest TSS concentration measured was 367 mg/L with a corresponding lab NTU of 228 while the lowest values in the data series was a TSS of 14.8 mg/L and a lab NTU of 22.1. Figure 3-1 presents the regression analysis of the field and lab turbidity, respectively. In the controlled laboratory environment the lab NTU regression had a slightly better R² of 0.89 relative to the field turbidity regression with an R² of 0.82. Table 3-1 presents the expected turbidity values that correspond to various TSS concentrations using the laboratory based regression. Based on the regression, turbidity readings of 170 or less met the 250 mg/L TSS water quality goal 200 feet from the hydraulic cutterhead.

Table 3-1. Expected NTUs at various mg/L $(y = 0.5985x + 20.572)$	TSS using lab based regression equation;
y (NTU)	x (TSS)
170.2	250
140.3	200
110.3	150
80.4	100
50.5	50

During the point of dredge monitoring over 16,000 measurements of turbidity were logged at 0.5, 6 and 11 meter depth increments during active dredging. These data were binned into 5 NTU categories from 0 to 300 NTUs (for a total of 60 bins) and the frequency of occurrence in each category was calculated for each depth increment (Figure 3-2). At the point of dredging essentially no values over 170 NTUs were observed at the surface during active dredging and only a small percentage of the 6 and 11 meter observations were over 170 NTUs. Background measurements logged during a slowly descending surface to 11 meter cast had a similar turbidity pattern to that observed at the 11-m depth increment 200 feet behind the working cutterhead. Fourteen percent of the background turbidity measurements were higher than 170 NTUs (primarily recorded from the lower depths), while 9% of the 11-m and 3% of the 6-m turbidity values at the point of dredging were over this benchmark.



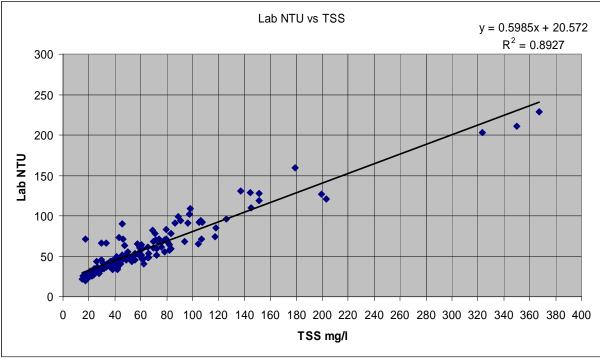
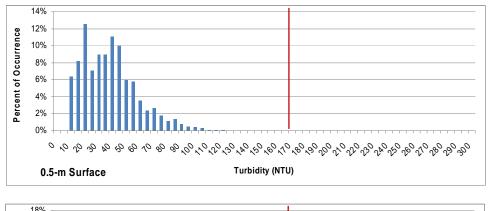
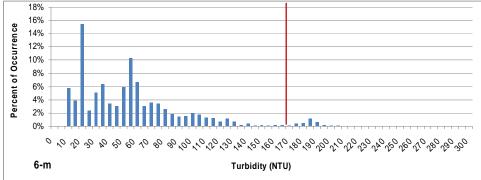


Figure 3-1. Results of regression analysis of field and laboratory turbidity measurements relative to TSS concentrations for samples collected on and around the Pullen dredge boat during the 2010 monitoring





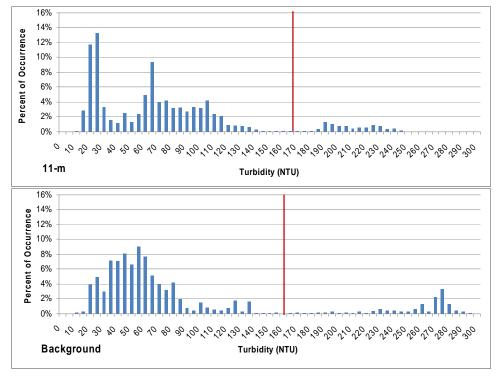


Figure 3-2. Frequency distribution of turbidity measurements in 5 NTU increments observed at 0.5, 6, and 11 meter depths 200 feet down current of the working cutterhead and at upriver and downriver background stations monitored in Reach C during 2010

3.2 CONTAMINANTS

Samples collected for chemical analysis at the 6 and 11 meter depth increments suggest that water quality behind the working dredge was maintained. Tables 3-2 through 3-13 present the Pesticides/Aroclor PCBs, semi-volatile organics, total inorganics, and dissolved inorganics for the 11-m and 6-m point of dredge samples and background samples. At the 11-m depth, with the exception of total aluminum, all of the parameters were measured in concentrations below DNREC's published freshwater acute criteria for the protection of aquatic life (Appendix C). Although total aluminum concentrations at the 11-m sample depth were over the acute criterion (Table 3-4), the observed concentrations were within the range reported for the upriver and downriver background samples (Table 3-12). Selenium concentrations were over the chronic criterion of 5 ug/L during events 5, 6 and 8. Similar concentrations above the chronic criterion were observed in background samples during events 6 and 8. The pesticide DDT and its breakdown byproducts DDE and DDD were slightly over the chronic criterion of 0.001 ug/L in the point of dredge 11-m samples during Events 2 and 8 (Table 3-2), but similar concentrations over the chronic criterion were observed in the background 11-m samples (Table 3-10). All other pesticides and semi-volatile organics were either not detected or below applicable chronic water quality criteria. Contaminant sampling at the 6-m depth increment resulted in total aluminum (all events), and one observation of cyanide (in event 8) over the acute criteria, and total selenium over the chronic criterion (in events 6 and 8; Table 3-8) and DDT over the chronic criterion (event 8; Table 3-6). However, concentrations near the point of dredging were in the same range as the background samples and all background selenium concentrations were over the chronic criterion during events 6 and 8 (Table 3-12) and all background DDT concentrations were over the chronic criterion during event 8 (Table 3-10). All other pesticides and semivolatile organics at the 6 meter depth increment were either not detected or below existing chronic water quality criteria for protection of aquatic life (Tables 3-6 and 3-7).

Congener specific high resolution PCB analyses were conducted on the 11- m point of dredge and the 11-m upriver and downriver background samples (Tables 3-14 and 3-15). At the point of dredge, the sum of congeners were all below DNREC's chronic aquatic life water quality criterion (14 ng/L) for total PCBs (Table 3-14). Background total PCB concentrations were all below chronic criterion as well (Table 3-15). All point of dredge and background samples were above DNREC's human health carcinogen water quality criterion (0.064 ng/L) for PCBs. All point of dredge and background samples were above DNREC's human health carcinogen water quality criterion (0.064 ng/L) for PCBs. While there are no direct water quality criteria established for dioxin and furans for the Delaware River, the sum of homologs suggests point of dredge concentrations were in a similar range to those observed in the background samples (Tables 3-16 and 3-17). DNREC does have a human health criterion for Dioxin and Furan expressed as 2,3,7,8-TCDD TEQ (0.0051 pg/L). The toxic equivalence for a sample is the sum of the concentration for specific congeners multiplied by its associated Toxicity Equivalence Factor (TEF). A listing of these TEFs is presented on page 31 of DNREC's surface water standards as amended on July 11, 2004. With the exception of a single 11-m plume sample during event 8, round 1 where the TEQ was 510 pg/L the resulting TEQ's ranged from 0.00029 to 1.1 pg/L for all 11-m plume and 11-m background samples. The reported 2,3,7,8TCDD concentration of 510 pg/L was flagged as an estimated maximum possible concentration by the laboratory. Both plume and background samples were typically over the 0.0051~pg/L human health TEQ for Dioxins and Furans.

Table 3-2. Point of	of Dr	edge 11-m P	esticide and	PCB Aroclo	r Data					
Sample ID		C-11M (EVENT 2 ROUND 1)	C-11M (EVENT 2 ROUND 2)	C-11M (EVENT 4 ROUND 1)	C-11M (EVENT 5 ROUND 1)	C-11M (EVENT 6 ROUND 1)	C-11M (EVENT8 ROUND 1)	C-11M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID						C0H170507005	/	,	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
GCSEMI	_								_	
4,4-DDD	μg/L	< 0.0012	0.0013	< 0.0062	< 0.0062	< 0.0012	0.0051	< 0.0062	1.1	0.001
4,4-DDE	μg/L	0.0014	0.0016	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062	1.1	0.001
4,4-DDT	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	0.0013	0.016	< 0.0062	1.1	0.001
Aldrin	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062	3.0	none
alpha-BHC	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062		
alpha-Chlordane	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062		
Aroclor 1016	μg/L	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1221	μg/L	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1232	μg/L	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1242	μg/L	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1248	μg/L	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1254	μg/L	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1260	μg/L	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
beta-BHC	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062		
Chlordane (technical)	μg/L	< 0.012	< 0.012	< 0.060	< 0.060	< 0.012	< 0.060	< 0.060	2.4	0.0043
Chlorpyrifos	μg/L	< 0.95	< 0.95	< 0.96	< 0.95	< 0.95	< 0.95	< 0.95	0.083	0.041
delta-BHC	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062		
Dieldrin	μg/L	0.0012	0.0015	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062	0.24	0.056
Endosulfan I	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062	0.22	0.056
Endosulfan II	μg/L	< 0.0012	0.0011	< 0.0062	0.0077	< 0.0012	< 0.0063	< 0.0062	0.22	0.056
Endosulfan sulfate	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062		
Endrin	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062	0.086	0.036
Endrin aldehyde	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062		
Endrin ketone	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062		
gamma-BHC (Lindane)	μg/L	< 0.0012	0.0035	0.0053	0.0047	0.0041	< 0.0063	< 0.0062	none	none
gamma-Chlordane	μg/L	< 0.0012	< 0.0012	0.0092	< 0.0062	< 0.0012	< 0.0063	< 0.0062		
Heptachlor	μg/L	0.0022	0.0022	< 0.0062	< 0.0062	< 0.0012	< 0.0063	< 0.0062	0.52	0.0038
Heptachlor epoxide	μg/L	< 0.0012	< 0.0012	0.012	< 0.0062	0.0013	< 0.0063	< 0.0062		
Methoxychlor	μg/L	< 0.0024	< 0.0024	< 0.012	< 0.012	< 0.0024	< 0.012	< 0.012	none	0.03
Parathion	μg/L	< 0.95	< 0.95	< 0.96	< 0.95	< 0.95	< 0.95	< 0.95	0.065	0.013
Toxaphene	μg/L	< 0.095	< 0.096	< 0.48	< 0.48	< 0.095	< 0.48	< 0.48	0.73	0.0002

Table 3-3. Point of I	Γable 3-3. Point of Dredge 11-m Semi-volatile Data									
Sample ID		C-11M (EVENT 2 ROUND 1)	C-11M (EVENT 2 ROUND 2)	C-11M (EVENT 4 ROUND 1)	C-11M (EVENT 5 ROUND 1)	C-11M (EVENT 6 ROUND 1)	C-11M (EVENT8 ROUND 1)	C-11M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501013	C0D060501015	C0E250505005	C0G220562005	C0H170507005	C0I140570005	C0I140570007	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
MSSEMI										
1,1-Biphenyl	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
1,2,4-Trichlorobenzene	μg/L	< 0.19	< 0.19	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
1,2-Dichlorobenzene	μg/L	< 0.19	< 0.19	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
1,2-Diphenylhydrazine	μg/L	< 0.19	< 0.19	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
1,3-Dichlorobenzene	μg/L	< 0.19	< 0.19	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
1,4-Dichlorobenzene	μg/L	< 0.19	< 0.19	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
2,4,5-Trichlorophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
2,4,6-Trichlorophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
2,4-Dichlorophenol	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
2,4-Dimethylphenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
2,4-Dinitrophenol	μg/L	<4.8	<4.8	<4.8	<4.7	<4.7	<4.8	<4.8		
2,4-Dinitrotoluene	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
2,6-Dinitrotoluene	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
2-Chloronaphthalene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
2-Chlorophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
2-Methylnaphthalene	μg/L	< 0.19	0.013	0.03	< 0.19	0.021	< 0.19	< 0.19		
2-Methylphenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
2-Nitroaniline	μg/L	<4.8	<4.8	<4.8	<4.7	<4.7	<4.8	<4.8		
2-Nitrophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
3,3-Dichlorobenzidine	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
3-Nitroaniline	μg/L	<4.8	<4.8	<4.8	<4.7	<4.7	<4.8	<4.8		
4,6-Dinitro-2-methylphenol	μg/L	<4.8	<4.8	<4.8	<4.7	<4.7	<4.8	<4.8		
4-Bromophenyl phenyl ether	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
4-Chloro-3-methylphenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
4-Chloroaniline	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
4-Chlorophenyl phenyl ether	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
4-Methylphenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		1

Table 3-3. (Continue	ed)									
Sample ID	/	C-11M (EVENT 2 ROUND 1)	C-11M (EVENT 2 ROUND 2)	C-11M (EVENT 4 ROUND 1)	C-11M (EVENT 5 ROUND 1)	C-11M (EVENT 6 ROUND 1)	C-11M (EVENT8 ROUND 1)	C-11M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501013	C0D060501015	C0E250505005	C0G220562005	С0Н170507005	C0I140570005	C0I140570007	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
4-Nitroaniline	μg/L	<4.8	<4.8	<4.8	<4.7	<4.7	<4.8	<4.8		
4-Nitrophenol	μg/L	<4.8	<4.8	<4.8	<4.7	<4.7	<4.8	<4.8		
Acenaphthene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Acenaphthylene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Acetophenone	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
Anthracene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Atrazine	μg/L	< 0.95	< 0.96	< 0.95	0.096	< 0.94	< 0.95	< 0.95		
Benzaldehyde	μg/L	< 0.95	0.89	0.66	1.4	1.1	< 0.95	< 0.95		
Benzidine	μg/L	<19	<19	<19	<19	<19	<19	<19		
Benzo(a)anthracene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Benzo(a)pyrene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.43	< 0.19		
Benzo(b)fluoranthene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Benzo(ghi)perylene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Benzo(k)fluoranthene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
bis(2-Chloroethoxy)methane	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
bis(2-Chloroethyl) ether	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
bis(2-Chloroisopropyl) ether	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
bis(2-Ethylhexyl) phthalate	μg/L	< 0.95	< 0.96	<1.9	1.3	1	0.8	<1.9		
Butyl benzyl phthalate	μg/L	0.7	0.63	0.31	0.31	0.2	0.32	0.21		
Caprolactam	μg/L	<4.8	<4.8	<4.8	1.1	<4.7	1.3	1.4		
Carbazole	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Chrysene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Di-n-butyl phthalate	μg/L	< 0.95	0.12	< 0.95	0.16	0.14	0.15	< 0.95		
Di-n-octyl phthalate	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	0.97	< 0.95		
Dibenz(a,h)anthracene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.54	< 0.19		
Dibenzofuran	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
Diethyl phthalate	μg/L	< 0.95	< 0.96	< 0.95	0.14	1.2	0.21	0.2		
Dimethyl phthalate	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		

Table 3-3. (Continued)										
Sample ID		C-11M (EVENT 2 ROUND 1)	C-11M (EVENT 2 ROUND 2)	C-11M (EVENT 4 ROUND 1)	C-11M (EVENT 5 ROUND 1)	C-11M (EVENT 6 ROUND 1)	C-11M (EVENT8 ROUND 1)	C-11M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501013	C0D060501015	C0E250505005	C0G220562005	C0H170507005	C0I140570005	C0I140570007	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
Fluoranthene	μg/L	0.041	0.031	< 0.19	0.018	0.025	< 0.19	< 0.19		
Fluorene	μg/L	< 0.19	< 0.19	< 0.19	0.027	0.043	< 0.19	< 0.19		
Hexachlorobenzene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Hexachlorobutadiene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Hexachlorocyclopentadiene	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
Hexachloroethane	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
Indeno(1,2,3-cd)pyrene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.47	< 0.19		
Isophorone	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
N-Nitrosodi-n-propylamine	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
N-Nitrosodimethylamine	μg/L	< 0.19	< 0.19	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
N-Nitrosodiphenylamine	μg/L	< 0.19	< 0.19	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95		
Naphthalene	μg/L	0.026	< 0.19	0.062	< 0.19	< 0.19	< 0.19	< 0.19		
Nitrobenzene	μg/L	< 0.19	< 0.19	<1.9	<1.9	<1.9	<1.9	<1.9		
Pentachlorophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	8.72	6.69
Phenanthrene	μg/L	0.082	0.099	0.076	0.099	0.25	< 0.19	0.1		
Phenol	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Pyrene	μg/L	0.035	< 0.19	< 0.19	< 0.19	0.02	< 0.19	< 0.19		

Table 3-4. Point of Dredge 11-m Total Inorganics Data										
Sample ID		C-11M (EVENT 2 ROUND 1)	C-11M (EVENT 2 ROUND 2)	C-11M (EVENT 4 ROUND 1)	C-11M (EVENT 5 ROUND 1)	C-11M (EVENT 6 ROUND 1)	C-11M (EVENT8 ROUND 1)	C-11M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501013	C0D060501015	C0E250505005	C0G220562005	С0Н170507005	C0I140570005	C0I140570007	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
MET					_	_	_	_		
Aluminum	μg/L	2280	3660	6460	793	817	1180	1120	750	87
Antimony	μg/L	0.38	0.42	0.5	0.37	0.12	0.3	0.9		
Arsenic	μg/L	1.6	2.5	4.5	2.4	3.8	4	4.4	340	150
Barium	μg/L	36	44.5	51	39.8	38.7	48.9	49.1		
Beryllium	μg/L	0.14	0.24	0.32	0.079	0.042	<1.0	<1.0		
Cadmium	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		
Calcium	μg/L	11700	12500	56600	54200	78000	88500	86400		
Chromium	μg/L	10.1	14	20.7	9.6	4.3	7	6.8		
Cobalt	μg/L	1.6	2.5	3.3	0.72	0.67	0.92	0.92		
Copper	μg/L	5.7	7.8	8.1	3.9	3.5	3.1	3.4		
Cyanide, Total	μg/L	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	22	5.2
Iron	μg/L	3530	5600	7940	1140	1170	1610	1550		
Lead	μg/L	5.5	8.1	12.2	1.9	2.3	2.3	2.2		
Magnesium	μg/L	3970	4890	133000	96600	175000	228000	228000		
Manganese	μg/L	188	272	331	47.1	54.5	79	77.4		
Mercury	μg/L	2.1	6.6	58	3.2	3.5	3.7	2.7	1400	77
Nickel	μg/L	3.3	4.8	7.6	2.5	2.2	3.2	3.7		
Potassium	μg/L	2100	2550	37700	32000	57100	63700	66100		
Selenium	μg/L	0.81	0.83	3.4	5.8	10.6	16.2	15.6	20	5.0
Silver	μg/L	<1.0	0.053	0.077	<1.0	<1.0	<1.0	<1.0		
Sodium	μg/L	13500	17500	994000	768000	1200000	1560000	1480000		
Thallium	μg/L	<1.0	<1.0	0.091	0.039	0.02	0.022	0.03		
Vanadium	μg/L	5.1	8.8	13.1	7.3	1.4	4.5	2.3		
Zinc	μg/L	35.7	47.7	55.2	14	11	10.8	10.3		

Table 3-5. Point of Dredge 11-m Dissolved Inorganics Data										
Sample ID		C-11M (EVENT 2 ROUND 1)	C-11M (EVENT 2 ROUND 2)	C-11M (EVENT 4 ROUND 1)	C-11M (EVENT 5 ROUND 1)	C-11M (EVENT 6 ROUND 1)	C-11M (EVENT8 ROUND 1)	C-11M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501013	C0D060501015	C0E250505005	C0G220562005	C0H170507005	C0I140570005	C0I140570007	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
MET										
Aluminum-Diss	μg/L	15.8	8	3.5	<30.0	<30.0	36.8	30.8		
Antimony-Diss	μg/L	0.34	0.8	0.53	0.33	0.2	0.32	0.3		
Arsenic-Diss	μg/L	0.84	0.46	4.6	1.4	2.6	3	3.3		
Barium-Diss	μg/L	18.1	17.1	25	34.2	34.6	43.1	41		
Beryllium-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		
Cadmium-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.52	0.20
Calcium-Diss	μg/L	11400	12500	54700	52400	79100	89300	86000		
Chromium-Diss	μg/L	5.2	4.8	8.2	6.3	2.8	6.1	5.5	16	11
Cobalt-Diss	μg/L	0.057	0.035	0.19	0.23	0.21	0.35	0.29		
Copper-Diss	μg/L	1.6	1.4	1.6	2.3	2.8	1.9	2.1	10.25	7.00
Iron-Diss	μg/L	46.6	30.4	26.1	16.2	< 50.0	64.8	56		
Lead-Diss	μg/L	0.37	0.42	0.11	<1.0	<1.0	0.12	0.13	47.15	1.84
Magnesium-Diss	μg/L	3510	4160	126000	95200	186000	226000	218000		
Manganese-Diss	μg/L	14.5	8.9	0.66	1.1	1	3.5	2.9		
Nickel-Diss	μg/L	1.8	1.3	1.3	1.5	1.4	1.3	1.3	367.08	40.77
Potassium-Diss	μg/L	1490	1710	35800	30900	57400	60600	59600		
Selenium-Diss	μg/L	1.3	1.1	4	4	6.8	11.7	12.3		
Silver-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.96	none
Sodium-Diss	μg/L	14000	18300	970000	757000	1240000	1670000	1550000		
Thallium-Diss	μg/L	<1.0	<1.0	<1.0	0.026	<1.0	0.017	<1.0		
Vanadium-Diss	μg/L	<1.0	0.4	<1.0	4.7	0.59	1.6	1.6		
Zinc-Diss	μg/L	12.1	9.8	2.4	3.7	3.7	3.6	4.6	91.83	92.58

Table 3-6. Point	ofl	Dredge 6-m	Pesticides and	d PCB Aroc	lor Data					
Sample ID		C-6M (EVENT 2 ROUND 1)	C-6M (EVENT 2 ROUND 2)	C-6M (EVENT 4 ROUND 1)	C-6m (EVENT 5 ROUND 1)	C-6M (EVENT 6 ROUND 1)	C-6M (EVENT 8 ROUND 1)	C-6M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501014	C0D060501016	C0E250505006	C0G220562006	C0H170507006	C0I140570006	C0I140570008	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		<u> </u>
GCSEMI										
4,4-DDD	μg/L	< 0.0012	0.00094	< 0.0062	< 0.0062	< 0.0012	0.0049	< 0.0062	1.1	0.001
4,4-DDE	μg/L	< 0.0012	0.001	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062	1.1	0.001
4,4-DDT	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	0.013	0.0073	1.1	0.001
Aldrin	μg/L	< 0.0012	< 0.0012	< 0.0062	0.0052	< 0.0012	< 0.0062	< 0.0062	3.0	none
alpha-BHC	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	0.0021	< 0.0062	< 0.0062		
alpha-Chlordane	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062		
Aroclor 1016	μg/L	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1221	μg/L	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1232	μg/L	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1242	μg/L	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1248	μg/L	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1254	μg/L	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
Aroclor 1260	μg/L	< 0.0096	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	none	0.014
beta-BHC	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	0.007	< 0.0062	< 0.0062		
Chlordane (technical)	μg/L	< 0.012	< 0.012	< 0.060	< 0.060	< 0.012	< 0.060	< 0.060	2.4	0.0043
Chlorpyrifos	μg/L	< 0.95	< 0.95	< 0.96	< 0.95	< 0.95	< 0.95	< 0.95	0.083	0.041
delta-BHC	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062		
Dieldrin	μg/L	< 0.0012	0.0016	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062	0.24	0.056
Endosulfan I	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062	0.22	0.056
Endosulfan II	μg/L	0.0011	0.0013	< 0.0062	0.0071	< 0.0012	< 0.0062	< 0.0062	0.22	0.056
Endosulfan sulfate	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062		
Endrin	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062	0.086	0.036
Endrin aldehyde	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062		
Endrin ketone	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062		
gamma-BHC (Lindane)	μg/L	0.0013	0.002	0.0084	0.0068	0.0065	< 0.0062	< 0.0062	none	none
gamma-Chlordane	μg/L	< 0.0012	< 0.0012	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062		
Heptachlor	μg/L	0.0032	0.0021	< 0.0062	< 0.0062	< 0.0012	< 0.0062	< 0.0062	0.52	0.0038

Table 3-6. (Cont													
Sample ID		C-6M (EVENT 2 ROUND 1)	C-6M (EVENT 2 ROUND 2)	C-6M (EVENT 4 ROUND 1)	C-6m (EVENT 5 ROUND 1)	C-6M (EVENT 6 ROUND 1)	C-6M (EVENT 8 ROUND 1)	C-6M (EVENT 8 ROUND 2)	DNDFC	DNREC			
Lab Report ID			C0D060501016			,				Chronic			
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010					
Heptachlor epoxide	μg/L	< 0.0012	< 0.0012	< 0.0062	0.015	< 0.0012	< 0.0062	< 0.0062					
Methoxychlor	μg/L	< 0.0024	< 0.0024	< 0.012	< 0.012	< 0.0024	< 0.012	< 0.012	none	0.03			
Parathion	μg/L	< 0.95	< 0.95	< 0.96	< 0.95	< 0.95	< 0.95	< 0.95	0.065	0.013			
Toxaphene	μg/L	< 0.096	< 0.095	< 0.48	< 0.48	< 0.095	< 0.48	< 0.48	0.73	0.0002			

Table 3-7. Point of	Dre	dge 6-m Sen	ni-volatile Da	ata						
Sample ID		C-6M (EVENT 2 ROUND 1)	C-6M (EVENT 2 ROUND 2)	C-6M (EVENT 4 ROUND 1)	C-6M (EVENT 5 ROUND 1)	C-6M (EVENT 6 ROUND 1)	C-6M (EVENT 8 ROUND 1)	C-6M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501014	C0D060501016	C0E250505006	C0G220562006	C0H170507006	C0I140570006	C0I140570008	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
MSSEMI										
1,1-Biphenyl	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
1,2,4-Trichlorobenzene	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
1,2-Dichlorobenzene	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
1,2-Diphenylhydrazine	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
1,3-Dichlorobenzene	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
1,4-Dichlorobenzene	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
2,4,5-Trichlorophenol	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
2,4,6-Trichlorophenol	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
2,4-Dichlorophenol	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
2,4-Dimethylphenol	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
2,4-Dinitrophenol	μg/L	<4.8	<4.8	<4.7	<4.7	<4.7	<4.7	<4.8		
2,4-Dinitrotoluene	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
2,6-Dinitrotoluene	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
2-Chloronaphthalene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
2-Chlorophenol	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
2-Methylnaphthalene	μg/L	< 0.19	< 0.19	< 0.19	0.02	0.02	< 0.19	< 0.19		
2-Methylphenol	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
2-Nitroaniline	μg/L	<4.8	<4.8	<4.7	<4.7	<4.7	<4.7	<4.8		
2-Nitrophenol	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
3,3-Dichlorobenzidine	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
3-Nitroaniline	μg/L	<4.8	<4.8	<4.7	<4.7	0.45	<4.7	<4.8		
4,6-Dinitro-2-methylphenol	μg/L	< 0.96	< 0.95	<4.7	<4.7	<4.7	<4.7	<4.8		
4-Bromophenyl phenyl ether	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
4-Chloro-3-methylphenol	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
4-Chloroaniline	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
4-Chlorophenyl phenyl ether	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
4-Methylphenol	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		

Table 3-7. (Continu	ied)									
Sample ID		C-6M (EVENT 2 ROUND 1)	C-6M (EVENT 2 ROUND 2)	C-6M (EVENT 4 ROUND 1)	C-6M (EVENT 5 ROUND 1)	C-6M (EVENT 6 ROUND 1)	C-6M (EVENT 8 ROUND 1)	C-6M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501014	C0D060501016	C0E250505006	C0G220562006	С0Н170507006	C0I140570006	C0I140570008	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
4-Nitroaniline	μg/L	< 0.96	< 0.95	<4.7	<4.7	<4.7	<4.7	<4.8		
4-Nitrophenol	μg/L	<4.8	<4.8	<4.7	<4.7	<4.7	<4.7	<4.8		
Acenaphthene	μg/L	< 0.96	< 0.95	< 0.19	0.024	< 0.19	< 0.19	< 0.19		
Acenaphthylene	μg/L	< 0.96	< 0.95	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Acetophenone	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
Anthracene	μg/L	< 0.96	< 0.95	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Atrazine	μg/L	< 0.96	< 0.95	< 0.94	0.14	0.16	< 0.94	< 0.95		
Benzaldehyde	μg/L	<4.8	<4.8	0.63	1.4	< 0.94	< 0.94	< 0.95		
Benzidine	μg/L	<4.8	<4.8	<19	<19	<19	<19	<19		
Benzo(a)anthracene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Benzo(a)pyrene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.4	< 0.19		
Benzo(b)fluoranthene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Benzo(ghi)perylene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Benzo(k)fluoranthene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
bis(2-Chloroethoxy)methane	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
bis(2-Chloroethyl) ether	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
bis(2-Chloroisopropyl) ether	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
bis(2-Ethylhexyl) phthalate	μg/L	< 0.96	< 0.95	2.4	2.5	5.9	<1.9	<1.9		
Butyl benzyl phthalate	μg/L	0.91	0.51	< 0.94	0.25	0.16	0.16	0.2		
Caprolactam	μg/L	<4.8	<4.8	<4.7	2.1	<4.7	<4.7	<4.8		
Carbazole	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Chrysene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Di-n-butyl phthalate	μg/L	< 0.96	0.12	< 0.94	0.16	0.13	< 0.94	< 0.95		
Di-n-octyl phthalate	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	0.95	< 0.95		
Dibenz(a,h)anthracene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.51	< 0.19		
Dibenzofuran	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
Diethyl phthalate	μg/L	< 0.96	< 0.95	< 0.94	0.2	1.2	0.21	0.2		
Dimethyl phthalate	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		

Table 3-7. (Continu	ied)									
Sample ID		C-6M (EVENT 2 ROUND 1)	C-6M (EVENT 2 ROUND 2)	C-6M (EVENT 4 ROUND 1)	C-6M (EVENT 5 ROUND 1)	C-6M (EVENT 6 ROUND 1)	C-6M (EVENT 8 ROUND 1)	C-6M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501014	C0D060501016	C0E250505006	C0G220562006	С0Н170507006	C0I140570006	C0I140570008	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
Fluoranthene	μg/L	< 0.19	0.059	< 0.19	0.017	0.029	< 0.19	< 0.19		
Fluorene	μg/L	< 0.19	< 0.19	< 0.19	0.027	0.045	< 0.19	< 0.19		
Hexachlorobenzene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Hexachlorobutadiene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Hexachlorocyclopentadiene	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
Hexachloroethane	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
Indeno(1,2,3-cd)pyrene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.43	< 0.19		
Isophorone	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
N-Nitrosodi-n-propylamine	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
N-Nitrosodimethylamine	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
N-Nitrosodiphenylamine	μg/L	< 0.19	< 0.19	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95		
Naphthalene	μg/L	< 0.19	< 0.19	< 0.19	0.031	0.05	< 0.19	< 0.19		
Nitrobenzene	μg/L	< 0.19	< 0.19	<1.9	<1.9	<1.9	<1.9	<1.9		
Pentachlorophenol	μg/L	< 0.96	< 0.95	< 0.94	< 0.94	< 0.94	< 0.94	< 0.95	8.72	6.69
Phenanthrene	μg/L	0.055	0.1	0.094	0.11	0.22	< 0.19	< 0.19		
Phenol	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.066	0.16		
Pyrene	μg/L	< 0.19	0.041	< 0.19	0.02	< 0.19	< 0.19	< 0.19		

Table 3-8. Po	oint of	Dredge 6-m To	otal Inorganics	s Data						
Sample ID		C-6M (EVENT 2 ROUND 1)	C-6M (EVENT 2 ROUND 2)	C-6M (EVENT 4 ROUND 1)	C-6M (EVENT 5 ROUND 1)	C-6M (EVENT 6 ROUND 1)	C-6M (EVENT 8 ROUND 1)	C-6M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501014	C0D060501016	C0E250505006	C0G220562006	C0H170507006	C0I140570006	C0I140570008	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
MET										
Aluminum	μg/L	970	2720	14100	2110	678	1180	1090	750	87
Antimony	μg/L	0.34	0.36	0.64	0.81	0.15	0.26	0.39		
Arsenic	μg/L	1.3	2.2	8.9	2.3	2.7	4.7	4.8	340	150
Barium	μg/L	26.4	36.3	81.4	43.4	38.2	48.9	49.3		
Beryllium	μg/L	0.067	0.11	0.79	0.12	<1.0	0.066	<1.0		
Cadmium	μg/L	<1.0	<1.0	0.26	<1.0	<1.0	<1.0	<1.0		
Calcium	μg/L	11700	13200	44300	45000	69200	89800	87900		
Chromium	μg/L	6.9	11.7	36.2	13.1	4.3	6.9	6.7		
Cobalt	μg/L	0.7	1.7	7.3	1.5	0.59	0.95	0.93		
Copper	μg/L	3.4	6	15.4	5.7	3.5	3.5	3.5		
Cyanide, Total	μg/L	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	38.3	22	5.2
Iron	μg/L	1550	4040	17900	2990	942	1680	1590		
Lead	μg/L	2.4	5.7	28.2	5.1	1.8	2.5	2.5		
Magnesium	μg/L	3750	5270	94000	72700	146000	227000	226000		
Manganese	μg/L	94.7	186	784	140	42.9	84.7	83.3		
Mercury	ng/L	5.6	6.1	35.8	3.2	2.7	4.4	2.5	1400	77
Nickel	μg/L	1.5	3.7	15.4	4	2.1	4.2	3.7		
Potassium	μg/L	1860	2600	27600	24400	47900	63700	64500		
Selenium	μg/L	0.74	0.78	3.3	2.9	7.5	18.1	15.4	20	5.0
Silver	μg/L	<1.0	<1.0	0.16	<1.0	<1.0	<1.0	<1.0		
Sodium	μg/L	13800	22400	671000	559000	1020000	1450000	1400000		
Thallium	μg/L	<1.0	<1.0	0.14	0.042	<1.0	0.024	0.026		
Vanadium	μg/L	3.9	6	26.9	10.7	1.3	4.5	3.2		
Zinc	μg/L	20.8	38.4	110	31.4	10.7	11	10.7		

Table 3-9.	Point (of Dredge 6-m	Dissolved Inor	ganics Data						
Sample ID		C-6M (EVENT 2 ROUND 1)	C-6M (EVENT 2 ROUND 2)	C-6M (EVENT 4 ROUND 1)	C-6M (EVENT 5 ROUND 1)	C-6M (EVENT 6 ROUND 1)	C-6M (EVENT 8 ROUND 1)	C-6M (EVENT 8 ROUND 2)	DNREC	DNREC
Lab Report ID		C0D060501014	C0D060501016	C0E250505006	C0G220562006	C0H170507006	C0I140570006	C0I140570008	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
MET								_		
Aluminum-Diss	μg/L	6.2	43.5	19.4	<30.0	10.4	70.6	51.1		
Antimony-Diss	μg/L	0.3	0.34	0.52	0.29	0.87	0.26	0.3		
Arsenic-Diss	μg/L	0.65	0.73	4	0.92	2.2	2.2	2.7		
Barium-Diss	μg/L	17.7	17.7	24.4	32.2	35.1	41.7	43.7		
Beryllium-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		
Cadmium-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.52	0.20
Calcium-Diss	μg/L	11100	12500	43600	43600	71100	86000	87400		
Chromium-Diss	μg/L	5.6	5	9.2	6.6	3.2	5.9	6.3	16	11
Cobalt-Diss	μg/L	0.064	0.072	0.17	0.2	0.21	0.34	0.35		
Copper-Diss	μg/L	1.4	1.5	1.5	2.2	4	2	2.1	10.25	7.00
Iron-Diss	μg/L	32.8	76.7	27.6	15.3	<50.0	106	92.9		
Lead-Diss	μg/L	0.29	0.39	<1.0	<1.0	<1.0	0.2	0.3	47.15	1.84
Magnesium-Diss	μg/L	3400	4610	89300	68600	156000	215000	218000		
Manganese-Diss	μg/L	25.4	11.9	0.7	7.5	0.88	6	7.5		
Nickel-Diss	μg/L	1.4	1.3	1.3	1.5	1.6	1.3	1.3	367.08	40.77
Potassium-Diss	μg/L	1420	1860	25500	22300	48900	58400	59200		
Selenium-Diss	μg/L	0.92	1.1	2.7	2.3	5.3	10.3	12.4		
Silver-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.96	none
Sodium-Diss	μg/L	13700	22500	679000	532000	1040000	1500000	1500000		
Thallium-Diss	μg/L	<1.0	<1.0	<1.0	0.022	<1.0	<1.0	<1.0		
Vanadium-Diss	μg/L	<1.0	0.2	<1.0	4.9	0.79	3.1	1.3		
Zinc-Diss	μg/L	11.3	9.7	2.6	3.2	5.6	3.4	5.6	91.83	92.58

Table 3-10. Poin	nt of	`Dredge l	Backgrou	nd Pestici	de and PC	CB Aroclo	r Data					
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M
		C0D060	C0D060	C0D060	C0D060	C0E250	C0E250	C0E250	C0E250	C0G220	C0G220	C0G220
Lab Report ID		501009	501010	501011	501012	505001	505002	505003	505004	562001	562002	562003
Sample Date		4/1/2010	4/1/2010	4/1/2010	4/1/2010	5/20/2010	5/20/2010	5/20/2010	5/20/2010	7/20/2010	7/20/2010	7/20/2010
GCSEMI												
4,4-DDD	μg/L	0.00074	0.00078	0.00077	0.00092	< 0.0063	< 0.0062	0.0068	< 0.0063	< 0.0062	< 0.0062	< 0.0062
4,4-DDE	μg/L	0.0013	0.0014	0.0017	0.00088	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
4,4-DDT	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
Aldrin	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
alpha-BHC	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
alpha-Chlordane	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
Aroclor 1016	μg/L	< 0.0095	< 0.0097	< 0.0095	< 0.0094	< 0.0096	< 0.0095	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095
Aroclor 1221	μg/L	< 0.0095	< 0.0097	< 0.0095	< 0.0094	< 0.0096	< 0.0095	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095
Aroclor 1232	μg/L	< 0.0095	< 0.0097	< 0.0095	< 0.0094	< 0.0096	< 0.0095	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095
Aroclor 1242	μg/L	< 0.0095	< 0.0097	< 0.0095	< 0.0094	< 0.0096	< 0.0095	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095
Aroclor 1248	μg/L	< 0.0095	< 0.0097	< 0.0095	< 0.0094	< 0.0096	< 0.0095	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095
Aroclor 1254	μg/L	< 0.0095	< 0.0097	< 0.0095	< 0.0094	< 0.0096	< 0.0095	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095
Aroclor 1260	μg/L	< 0.0095	< 0.0097	< 0.0095	< 0.0094	< 0.0096	< 0.0095	< 0.0095	< 0.0096	< 0.0095	< 0.0095	< 0.0095
beta-BHC	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
Chlordane (technical)	μg/L	< 0.012	< 0.012	< 0.012	< 0.012	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060
Chlorpyrifos	μg/L	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95
delta-BHC	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	0.014	< 0.0063	< 0.0062	< 0.0062	< 0.0062
Dieldrin	μg/L	0.0011	0.0012	0.0014	0.0012	< 0.0063	< 0.0062	< 0.0062	0.0061	< 0.0062	< 0.0062	< 0.0062
Endosulfan I	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
Endosulfan II	μg/L	0.001	0.0011	0.001	0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	0.0054	0.0052	< 0.0062
Endosulfan sulfate	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
Endrin	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
Endrin aldehyde	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
Endrin ketone	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
gamma-BHC (Lindane)	μg/L	0.0014	0.0014	0.0015	0.0018	< 0.0063	0.0043	0.006	0.0081	< 0.0062	0.0084	0.0073
gamma-Chlordane	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	0.0079	< 0.0063	< 0.0062	< 0.0062	0.0098
Heptachlor	μg/L	0.0013	0.0012	0.0011	< 0.0012	< 0.0063	< 0.0062	< 0.0062	< 0.0063	< 0.0062	< 0.0062	< 0.0062
Heptachlor epoxide	μg/L	< 0.0012	< 0.0013	< 0.0012	< 0.0012	< 0.0063	< 0.0062	0.022	0.009	< 0.0062	< 0.0062	< 0.0062
Methoxychlor	μg/L	< 0.0024	< 0.0024	< 0.0024	< 0.0024	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012

Table 3-10. (Co.	ntinı	ued)									
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M		
Lab Report ID		C0H170 507001	C0H170 507002	C0H170 507003	C0H170 507004	C0I140 570001	C0I140 570002	C0I140 570003	C0I140 570004	DNREC Acute	DNREC Chronic
Sample Date		8/11/2010	8/11/2010	8/11/2010	8/11/2010	9/10/2010	9/10/2010	9/10/2010	9/10/2010		
4,4-DDD	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	0.0035	0.007	0.0061	1.1	0.001
4,4-DDE	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062	1.1	0.001
4,4-DDT	μg/L	0.0037	< 0.0012	< 0.0012	< 0.0025	0.0097	0.012	0.016	0.017	1.1	0.001
Aldrin	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062	3.0	none
alpha-BHC	μg/L	< 0.0025	0.0027	0.0029	0.0013	< 0.0062	< 0.0062	< 0.0062	< 0.0062		
alpha-Chlordane	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062		
Aroclor 1016	μg/L	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	< 0.048	< 0.048	none	0.014
Aroclor 1221	μg/L	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	< 0.048	< 0.048	none	0.014
Aroclor 1232	μg/L	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	< 0.048	< 0.048	none	0.014
Aroclor 1242	μg/L	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	< 0.048	< 0.048	none	0.014
Aroclor 1248	μg/L	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	< 0.048	< 0.048	none	0.014
Aroclor 1254	μg/L	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	< 0.048	< 0.048	none	0.014
Aroclor 1260	μg/L	< 0.0095	< 0.0095	< 0.0095	< 0.0095	< 0.048	< 0.048	< 0.048	< 0.048	none	0.014
beta-BHC	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062		
Chlordane (technical)	μg/L	< 0.024	< 0.012	< 0.012	< 0.024	< 0.060	< 0.060	< 0.060	< 0.060	2.4	0.0043
Chlorpyrifos	μg/L	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	0.083	0.041
delta-BHC	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062		
Dieldrin	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062	0.24	0.056
Endosulfan I	μg/L	< 0.0025	0.0014	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062	0.22	0.056
Endosulfan II	μg/L	0.0022	< 0.0012	< 0.0012	0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062	0.22	0.056
Endosulfan sulfate	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062		
Endrin	μg/L	< 0.0025	0.0014	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062	0.086	0.036
Endrin aldehyde	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062		
Endrin ketone	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062		
gamma-BHC (Lindane)	μg/L	< 0.0025	0.0044	< 0.0012	0.002	< 0.0062	< 0.0062	< 0.0062	< 0.0062	none	none
gamma-Chlordane	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062		
Heptachlor	μg/L	< 0.0025	< 0.0012	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062	0.52	0.0038
Heptachlor epoxide	μg/L	< 0.0025	0.0017	< 0.0012	< 0.0025	< 0.0062	< 0.0062	< 0.0062	< 0.0062		

Table 3-10. (Co	Table 3-10. (Continued)													
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M					
Lab Report ID		C0H170 507001	C0H170 507002	C0H170 507003	C0H170 507004	C0I140 570001	C0I140 570002	C0I140 570003	C0I140 570004	DNREC Acute	DNREC Chronic			
Sample Date		8/11/2010	8/11/2010	8/11/2010	8/11/2010	9/10/2010	9/10/2010	9/10/2010	9/10/2010					
Methoxychlor	μg/L	< 0.0048	< 0.0024	< 0.0024	< 0.0048	< 0.012	< 0.012	< 0.012	< 0.012	none	0.03			
Parathion	μg/L	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	0.065	0.013			
Toxaphene	μg/L	< 0.19	< 0.095	< 0.095	< 0.19	< 0.48	< 0.48	< 0.48	< 0.48	0.73	0.0002			

Table 3-11. Point of Dro	edge :	Backgrou	nd Semi	i-volatile	Data								
Sample ID		BGU-11M		BGD-11M			BGU-6M	BGD-11M		BGU-11M	BGU-6M	BGD-11M	BGD-6M
		C0D060	C0D060	C0D060	C0D060	C0E250	C0E250	C0E250	C0E250	C0G220	C0G220	C0G220	C0G220
Lab Report ID		501009	501010	501011	501012	505001	505002	505003	505004	562001	562002	562003	562004
Sample Date		4/1/2010	4/1/2010	4/1/2010	4/1/2010	5/20/2010	5/20/2010	5/20/2010	5/20/2010	7/20/2010	7/20/2010	7/20/2010	7/20/2010
MSSEMI		1			<u> </u>					1		1	
1,1-Biphenyl	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
1,2,4-Trichlorobenzene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
1,2-Dichlorobenzene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	0.088	< 0.95	< 0.95	0.08	< 0.95	< 0.95	< 0.94	<2.0
1,2-Diphenylhydrazine	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
1,3-Dichlorobenzene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
1,4-Dichlorobenzene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
2,4,5-Trichlorophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
2,4,6-Trichlorophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	< 2.0
2,4-Dichlorophenol	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.40
2,4-Dimethylphenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
2,4-Dinitrophenol	μg/L	<4.8	<4.8	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<10
2,4-Dinitrotoluene	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
2,6-Dinitrotoluene	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
2-Chloronaphthalene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.40
2-Chlorophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
2-Methylnaphthalene	μg/L	< 0.19	< 0.19	0.014	< 0.19	< 0.19	< 0.19	0.044	< 0.19	0.018	0.015	0.023	0.076
2-Methylphenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
2-Nitroaniline	μg/L	<4.8	<4.8	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<10
2-Nitrophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
3,3-Dichlorobenzidine	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
3-Nitroaniline	μg/L	<4.8	<4.8	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<10
4,6-Dinitro-2-methylphenol	μg/L	<4.8	<4.8	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<10
4-Bromophenyl phenyl ether	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
4-Chloro-3-methylphenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
4-Chloroaniline	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
4-Chlorophenyl phenyl ether	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
4-Methylphenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
4-Nitroaniline	μg/L	<4.8	<4.8	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<10
4-Nitrophenol	μg/L	<4.8	<4.8	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<4.8	<4.8	<4.7	<10

Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M
		C0D060	C0D060	C0D060	C0D060	C0E250	C0E250	C0E250	C0E250	C0G220	C0G220	C0G220	C0G220
Lab Report ID		501009	501010	501011	501012	505001	505002	505003	505004	562001	562002	562003	562004
Sample Date		4/1/2010	4/1/2010	4/1/2010	4/1/2010	5/20/2010	5/20/2010	5/20/2010	5/20/2010	7/20/2010	7/20/2010	7/20/2010	7/20/2010
Acenaphthene	μg/L	< 0.19	0.016	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.018	0.027	0.082
Acenaphthylene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.043
Acetophenone	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	< 2.0
Anthracene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.21	< 0.19	< 0.19	< 0.19	< 0.40
Atrazine	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	0.15	0.16	0.1	<2.0
Benzaldehyde	μg/L	0.79	0.8	0.8	0.88	0.64	0.64	0.69	0.66	1.4	1.4	1.4	3
Benzidine	μg/L	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19	<40
Benzo(a)anthracene	μg/L	< 0.19	0.23	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	1.5	< 0.19	< 0.19	< 0.19	0.078
Benzo(a)pyrene	μg/L	< 0.19	0.25	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.96	< 0.19	< 0.19	< 0.19	< 0.40
Benzo(b)fluoranthene	μg/L	< 0.19	0.43	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	1.5	< 0.19	< 0.19	< 0.19	< 0.40
Benzo(ghi)perylene	μg/L	< 0.19	0.43	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	1.6	< 0.19	< 0.19	< 0.19	< 0.40
Benzo(k)fluoranthene	μg/L	< 0.19	0.37	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	1.7	< 0.19	< 0.19	< 0.19	< 0.40
bis(2-Chloroethoxy)methane	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	< 2.0
bis(2-Chloroethyl) ether	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.40
bis(2-Chloroisopropyl) ether	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.40
bis(2-Ethylhexyl) phthalate	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	0.79	0.81	3.4	2	4.9	6.8	6.6	2.3
Butyl benzyl phthalate	μg/L	0.23	< 0.96	< 0.95	1	0.14	0.2	0.51	1.1	< 0.95	< 0.95	< 0.94	<2.0
Caprolactam	μg/L	<4.8	<4.8	<4.8	<4.8	<4.7	<4.8	3.4	<4.7	<4.8	<4.8	<4.7	<10
Carbazole	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.40
Chrysene	μg/L	< 0.19	0.27	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	1.9	< 0.19	< 0.19	< 0.19	0.078
Di-n-butyl phthalate	μg/L	< 0.95	< 0.96	< 0.95	0.14	< 0.94	< 0.95	0.2	0.39	< 0.95	0.14	0.16	< 2.0
Di-n-octyl phthalate	μg/L	< 0.95	0.34	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	1.1	< 0.95	< 0.95	< 0.94	< 2.0
Dibenz(a,h)anthracene	μg/L	< 0.19	0.4	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	1.9	< 0.19	< 0.19	< 0.19	< 0.40
Dibenzofuran	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	0.07	< 0.94	< 0.95	< 0.95	< 0.94	0.13
Diethyl phthalate	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	0.15	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	< 2.0
Dimethyl phthalate	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	< 2.0
Fluoranthene	μg/L	0.02	0.042	0.026	0.031	< 0.19	< 0.19	0.085	0.25	0.02	0.023	0.026	0.039
Fluorene	μg/L	0.02	0.042	0.026	0.031	< 0.19	< 0.19	< 0.19	< 0.19	0.021	0.032	0.032	0.093
Hexachlorobenzene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.40
Hexachlorobutadiene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.40
Hexachlorocyclopentadiene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
Hexachloroethane	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0

Table 3-11. (Continued)													
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M
Lab Report ID		C0D060 501009	C0D060 501010	C0D060 501011	C0D060 501012	C0E250 505001	C0E250 505002	C0E250 505003	C0E250 505004	C0G220 562001	C0G220 562002	C0G220 562003	C0G220 562004
Sample Date		4/1/2010	4/1/2010	4/1/2010	4/1/2010	5/20/2010	5/20/2010	5/20/2010	5/20/2010	7/20/2010	7/20/2010	7/20/2010	7/20/2010
Indeno(1,2,3-cd)pyrene	μg/L	< 0.19	0.45	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	1.7	< 0.19	< 0.19	< 0.19	< 0.40
Isophorone	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
N-Nitrosodi-n-propylamine	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.40
N-Nitrosodimethylamine	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
N-Nitrosodiphenylamine	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
Naphthalene	μg/L	< 0.19	0.027	0.035	0.015	< 0.19	< 0.19	0.079	< 0.19	0.037	0.032	0.039	0.11
Nitrobenzene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<4.0
Pentachlorophenol	μg/L	< 0.95	< 0.96	< 0.95	< 0.96	< 0.94	< 0.95	< 0.95	< 0.94	< 0.95	< 0.95	< 0.94	<2.0
Phenanthrene	μg/L	0.054	0.06	0.08	0.084	0.087	0.073	0.23	0.13	0.084	0.11	0.087	0.28
Phenol	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.16	< 0.19	< 0.19	< 0.19	< 0.19	< 0.40
Pyrene	μg/L	0.021	0.043	0.031	0.023	< 0.19	< 0.19	0.075	0.28	0.027	0.026	0.025	0.044

Table 3-11. (Continued)	١										
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M		
Lab Report ID		C0H170 507001	C0H170 507002	C0H170 507003	C0H170 507004	C0I140 570001	C0I140 570002	C0I140 570003	C0I140 570004	DE Acute	DE Chronic
Sample Date		8/11/2010	8/11/2010	8/11/2010	8/11/2010	9/10/2010	9/10/2010	9/10/2010	9/10/2010		
MSSEMI											
1,1-Biphenyl	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
1,2,4-Trichlorobenzene	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
1,2-Dichlorobenzene	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
1,2-Diphenylhydrazine	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
1,3-Dichlorobenzene	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
1,4-Dichlorobenzene	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
2,4,5-Trichlorophenol	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
2,4,6-Trichlorophenol	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
2,4-Dichlorophenol	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
2,4-Dimethylphenol	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
2,4-Dinitrophenol	μg/L	<4.7	<4.8	<4.7	<4.7	<4.8	<4.8	<4.8	<4.8		
2,4-Dinitrotoluene	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
2,6-Dinitrotoluene	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
2-Chloronaphthalene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
2-Chlorophenol	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
2-Methylnaphthalene	μg/L	0.023	0.013	0.021	0.025	0.025	0.025	0.039	< 0.19		
2-Methylphenol	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
2-Nitroaniline	μg/L	<4.7	<4.8	<4.7	<4.7	<4.8	<4.8	<4.8	<4.8		
2-Nitrophenol	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
3,3-Dichlorobenzidine	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	0.5		
3-Nitroaniline	μg/L	0.42	0.42	<4.7	0.42	<4.8	<4.8	<4.8	<4.8		
4,6-Dinitro-2-methylphenol	μg/L	<4.7	<4.8	<4.7	<4.7	<4.8	<4.8	<4.8	<4.8		
4-Bromophenyl phenyl ether	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
4-Chloro-3-methylphenol	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
4-Chloroaniline	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
4-Chlorophenyl phenyl ether	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
4-Methylphenol	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	0.18		
4-Nitroaniline	μg/L	<4.7	<4.8	<4.7	<4.7	<4.8	<4.8	<4.8	<4.8		
4-Nitrophenol	μg/L	<4.7	<4.8	<4.7	<4.7	<4.8	<4.8	<4.8	<4.8		

Table 3-11. (Continued)											
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M		
Lab Report ID		C0H170 507001	C0H170 507002	C0H170 507003	C0H170 507004	C0I140 570001	C0I140 570002	C0I140 570003	C0I140 570004	DE Acute	DE Chronic
Sample Date		8/11/2010	8/11/2010	8/11/2010	8/11/2010	9/10/2010	9/10/2010	9/10/2010	9/10/2010		
Acenaphthene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.024	0.096		
Acenaphthylene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Acetophenone	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
Anthracene	μg/L	< 0.19	< 0.19	< 0.19	0.014	0.016	< 0.19	0.015	0.1		
Atrazine	μg/L	< 0.94	< 0.95	0.16	0.13	< 0.95	< 0.95	< 0.95	< 0.95		
Benzaldehyde	μg/L	1.1	< 0.95	1.1	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
Benzidine	μg/L	<19	<19	<19	<19	<19	<19	<19	<19		
Benzo(a)anthracene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.16		
Benzo(a)pyrene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.51		
Benzo(b)fluoranthene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.047	0.17		
Benzo(ghi)perylene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.015	0.21		
Benzo(k)fluoranthene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.17		
bis(2-Chloroethoxy)methane	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
bis(2-Chloroethyl) ether	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
bis(2-Chloroisopropyl) ether	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
bis(2-Ethylhexyl) phthalate	μg/L	1.6	2.4	3.7	1.8	<1.9	<1.9	7.2	2.7		
Butyl benzyl phthalate	μg/L	0.19	0.18	0.28	0.26	0.16	0.16	0.24	0.31		
Caprolactam	μg/L	<4.7	<4.8	1.9	2.4	<4.8	2.6	<4.8	1.7		
Carbazole	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Chrysene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.16		
Di-n-butyl phthalate	μg/L	0.12	0.14	0.18	0.15	0.21	0.2	0.15	0.22		
Di-n-octyl phthalate	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	1.1		
Dibenz(a,h)anthracene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.65		
Dibenzofuran	μg/L	< 0.94	0.059	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	0.1		
Diethyl phthalate	μg/L	0.89	1	1.5	1	< 0.95	0.25	0.19	0.29		
Dimethyl phthalate	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
Fluoranthene	μg/L	0.027	0.031	0.04	0.028	0.032	0.025	0.031	0.14		
Fluorene	μg/L	< 0.19	< 0.19	0.056	< 0.19	< 0.19	< 0.19	< 0.19	0.086		
Hexachlorobenzene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.088		
Hexachlorobutadiene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
Hexachlorocyclopentadiene	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
Hexachloroethane	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		

Table 3-11. (Continued)											
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M		
Lab Report ID		C0H170 507001	C0H170 507002	C0H170 507003	C0H170 507004	C0I140 570001	C0I140 570002	C0I140 570003	C0I140 570004	DE Acute	DE Chronic
Sample Date		8/11/2010	8/11/2010	8/11/2010	8/11/2010	9/10/2010	9/10/2010	9/10/2010	9/10/2010		
Indeno(1,2,3-cd)pyrene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.42	0.57		
Isophorone	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
N-Nitrosodi-n-propylamine	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19		
N-Nitrosodimethylamine	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95		
N-Nitrosodiphenylamine	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	0.095		
Naphthalene	μg/L	< 0.19	0.049	0.038	0.05	0.045	0.044	0.081	0.088		
Nitrobenzene	μg/L	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	0.1		
Pentachlorophenol	μg/L	< 0.94	< 0.95	< 0.94	< 0.94	< 0.95	< 0.95	< 0.95	< 0.95	8.72	6.69
Phenanthrene	μg/L	0.23	0.22	0.27	0.2	0.075	0.097	0.1	0.16		
Phenol	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	0.19		
Pyrene	μg/L	< 0.19	< 0.19	< 0.19	< 0.19	0.019	0.017	0.025	0.11		

Table 3-12. Poi	nt of D	redge bac	kground	Total Ino	ganics D	ata							
Sample ID		BGU-11M	BGU-6M	BGD-11M				BGD-11M		BGU-11M		BGD-11M	
Lab Report ID		C0D060 501009	C0D060 501010	C0D060 501011	C0D060 501012	C0E250 505001	C0E250 505002	C0E250 505003	C0E250 505004	C0G220 562001	C0G220 562002	C0G220 562003	C0G220 562004
Sample Date		4/1/2010	4/1/2010	4/1/2010	4/1/2010	5/20/2010	5/20/2010	5/20/2010	5/20/2010	7/20/2010	7/20/2010	7/20/2010	7/20/2010
MET						_						_	
Aluminum	μg/L	1460	2460	5200	2700	2500	2830	11500	6630	3190	2220	1940	1270
Antimony	μg/L	0.83	0.5	0.54	0.39	0.53	0.49	0.65	0.52	0.35	0.39	0.34	0.28
Arsenic	μg/L	0.78	1.4	2.2	1.5	4.7	3	7.7	6.3	2.8	2.6	3.2	2.2
Barium	μg/L	29.4	37.8	55.3	36.4	36.2	37.4	72.9	52.4	48.2	44.3	41.2	39.3
Beryllium	μg/L	0.1	0.16	0.3	0.089	0.16	0.12	0.7	0.36	0.17	0.14	0.11	0.072
Cadmium	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.4	0.18	<1.0	<1.0	<1.0	<1.0
Calcium	μg/L	12000	12200	13600	13000	36100	35100	43500	39100	44000	46000	46600	47400
Chromium	μg/L	7.3	9.8	17.9	11.6	12.3	13.1	31.4	21.5	14.6	12.7	12.4	10.8
Cobalt	μg/L	0.95	1.7	3.5	1.9	1.4	1.7	6.3	3.7	2.1	1.6	1.4	0.94
Copper	μg/L	3.9	5.7	10.1	6.1	4.9	5.2	13.8	9.3	6.7	5.6	4.9	4.4
Cyanide, Total	μg/L	<10.0	<10.0	<10.0	<10.0	1.6	<10.0	<10.0	2.4	<10.0	<10.0	<10.0	<10.0
Iron	μg/L	2150	3760	7890	4230	5.3	6.4	24.6	15.2	6.7	5	4	2.6
Lead	μg/L	3.5	5.7	11.6	6.2	5.3	6.4	24.6	15.2	6.7	5	4	2.6
Magnesium	μg/L	3930	4160	5750	5110	61100	56600	86800	67100	68000	69400	78700	76400
Manganese	μg/L	108	193	378	198	141	180	689	407	211	151	126	78.7
Mercury	ng/L	10.4	4.7	37.6	5.6	9.6	9.2	48.7	37.2	17.2	7.5	6.5	4.2
Nickel	μg/L	2.1	3.3	6.9	3.9	4.2	4.9	13.2	8.6	5.2	4.2	3.9	3.2
Potassium	μg/L	2020	2170	3030	2520	18000	16500	25300	19600	23100	23300	26300	25500
Selenium	μg/L	1.2	0.52	0.7	0.58	2.4	2.3	3	2.7	2.5	3.7	4.1	4.5
Silver	μg/L	<1.0	<1.0	0.069	<1.0	0.045	0.045	0.14	0.085	<1.0	<1.0	<1.0	<1.0
Sodium	μg/L	14400	14200	20500	20600	437000	400000	614000	470000	518000	535000	616000	602000
Thallium	μg/L	<1.0	<1.0	<1.0	<1.0	0.078	0.075	0.14	0.081	0.069	0.054	0.054	0.041
Vanadium	μg/L	4.4	5.3	9.4	5.3	1.8	5.7	24.1	13.9	11.8	11.3	8.6	8.8
Zinc	μg/L	26.6	36.6	66.4	35.8	45.5	44.3	99.3	64.8	31.6	38.2	20.9	16.4

Table 3-12. (Co	ntinue	d)									
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M		
		C0H170	C0H170	C0H170	C0H170	C0I140	C0I140	C0I140	C0I140	DNREC	DNREC
Lab Report ID		507001	507002	507003	507004	570001	570002	570003	570004	Acute	Chronic
Sample Date		8/11/2010	8/11/2010	8/11/2010	8/11/2010	9/10/2010	9/10/2010	9/10/2010	9/10/2010		
Aluminum	μg/L	3160	1540	2180	2140	4540	3860	9670	3720	750	87
Antimony	μg/L	0.23	0.19	0.14	0.12	0.74	0.65	0.75	0.7		
Arsenic	μg/L	4.2	4.1	3.9	4.7	5.8	5	9.2	5	340	150
Barium	μg/L	49.2	41.8	43.6	43.7	64.5	59.5	86.6	59.8		
Beryllium	μg/L	0.2	0.088	0.12	0.11	0.23	0.12	0.51	0.15		
Cadmium	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.23	<1.0		
Calcium	μg/L	75100	74600	74400	77700	72000	68900	71500	68000		
Chromium	μg/L	11.4	6.9	8.3	8.3	16.3	14.2	29.9	13.2		
Cobalt	μg/L	2.4	1.2	1.7	1.6	3	2.6	6.6	2.5		
Copper	μg/L	6.5	4.2	4.9	4.9	7.9	6.6	14.1	6.6		
Cyanide, Total	μg/L	2.2	2.3	<10.0	<10.0	<10.0	10.9	<10.0	<10.0	22	5.2
Iron	μg/L	6.5	3.1	4.7	4.5	11.5	8.8	24.8	8.6		
Lead	μg/L	6.5	3.1	4.7	4.5	11.5	8.8	24.8	8.6		
Magnesium	μg/L	167000	163000	166000	175000	167000	166000	164000	155000		
Manganese	μg/L	236	110	170	161	367	295	789	277		
Mercury	ng/L	21.3	6	5.6	7.2	35.3	31.2	104	14.5	1400	77
Nickel	μg/L	5.5	3.2	4	4	7.3	6.4	14	6.5		
Potassium	μg/L	53300	52600	53600	56700	47200	47200	47300	44600		
Selenium	μg/L	10.1	11.3	9.8	12.8	11.5	10.5	12	9.6	20	5.0
Silver	μg/L	<1.0	<1.0	<1.0	<1.0	0.037	0.047	0.12	<1.0		
Sodium	μg/L	1160000	1120000	1160000	1200000	1090000	1100000	1080000	1020000		
Thallium	μg/L	0.1	0.056	0.039	0.038	0.064	0.048	0.12	0.045		
Vanadium	μg/L	7.3	2.9	4.9	4.9	12.8	9.4	25.6	9.9		
Zinc	μg/L	31.6	15.9	23.6	24.8	41	36.1	84.5	34.9		

Table 3-13. P	Table 3-13. Point of Dredge Background Dissolved Inorganics Data												
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M
		C0D060	C0D060	C0D060	C0D060	C0E250	C0E250	C0E250	C0E250	C0G220	C0G220	C0G220	C0G220
Lab Report ID		501009	501010	501011	501012	505001	505002	505003	505004	562001	562002	562003	562004
Sample Date	<u> </u>	4/1/2010	4/1/2010	4/1/2010	4/1/2010	5/20/2010	5/20/2010	5/20/2010	5/20/2010	7/20/2010	7/20/2010	7/20/2010	7/20/2010
MET													
Aluminum-Diss	μg/L	7	9.9	8.3	126	5.8	3.8	176	3.9	<30.0	<30.0	<30.0	<30.0
Antimony-Diss	μg/L	0.33	0.91	0.33	0.27	0.49	1.6	0.7	0.61	0.33	0.28	0.75	0.45
Arsenic-Diss	$\mu g/L$	0.63	1.2	0.42	0.89	3.6	1.7	3.2	3.4	0.95	1.2	1.3	1.8
Barium-Diss	$\mu g/L$	17.8	18.4	15.8	16.8	21.8	20.4	22.2	21.4	32.6	31.6	33.9	33.5
Beryllium-Diss	$\mu g/L$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cadmium-Diss	$\mu \text{g/L}$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Calcium-Diss	$\mu g/L$	12000	12000	12400	12400	31800	29700	36700	32000	45200	43200	49100	45300
Chromium-Diss	$\mu \text{g/L}$	5.2	6	5.7	5.8	8.7	6.2	8.1	9.4	7.8	7.3	7.3	6.8
Cobalt-Diss	$\mu g/L$	0.058	0.063	0.035	0.11	0.12	0.096	0.21	0.12	0.22	0.19	0.23	0.2
Copper-Diss	$\mu \text{g/L}$	1.1	1.4	1.4	1.7	1.5	1.5	1.6	1.5	2.5	2.3	2.3	2.4
Iron-Diss	$\mu g/L$	30.6	30.3	29.6	218	29.6	33.8	243	26.5	16.4	16.7	17.5	16.2
Lead-Diss	$\mu \text{g/L}$	0.42	0.4	0.45	0.66	<1.0	<1.0	0.34	<1.0	<1.0	<1.0	<1.0	<1.0
Magnesium-Diss	$\mu \text{g/L}$	3620	3640	4280	4440	53000	47400	70100	56100	69400	65800	82800	75800
Manganese-Diss	μg/L	11.2	14.1	3.7	12.1	2	0.58	8.9	0.9	0.82	0.98	1.1	1.3
Nickel-Diss	$\mu \text{g/L}$	3.4	1.5	1.6	2.2	1.2	1.2	1.3	1.2	1.6	1.5	1.6	1.5
Potassium-Diss	μg/L	1570	1500	1730	1790	15400	13900	20300	16400	22600	21800	26900	24600
Selenium-Diss	μg/L	1.2	1.2	1.1	1	1.9	1.6	2.4	1.9	2.9	2.9	3.4	3.4
Silver-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	0.047	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sodium-Diss	$\mu g/L$	14600	14600	19800	20600	393000	350000	531000	419000	541000	512000	646000	593000
Thallium-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	0.057	0.017	<1.0	<1.0	0.12	0.081	0.032	0.029
Vanadium-Diss	μg/L	<1.0	0.2	0.78	1.7	<1.0	<1.0	<1.0	<1.0	4.8	5.6	4.8	4.7
Zinc-Diss	μg/L	15.1	10.2	10.6	11.9	2.7	1.9	3.2	2.2	3.7	4.3	4.5	3.6

Table 3-13. (Continued)													
Sample ID		BGU-11M	BGU-6M	BGD-11M	BGD-6M	BGU-11M	BGU-6M	BGD-11M	BGD-6M				
T 1 D 1 TD		C0H170	C0H170	C0H170	C0H170	C0I140	C0I140	C0I140	C0I140		DNREC		
Lab Report ID		507001	507002	507003	507004	570001	570002	570003	570004	Acute	Chronic		
Sample Date	<u> </u>	8/11/2010	8/11/2010	8/11/2010	8/11/2010	9/10/2010	9/10/2010	9/10/2010	9/10/2010		_		
MET													
Aluminum-Diss	μg/L	27.9	3.9	<30.0	29.7	11.1	10.8	4.6	9.2				
Antimony-Diss	μg/L	0.4	0.31	0.29	0.25	0.51	0.43	0.36	0.32				
Arsenic-Diss	μg/L	3.3	2.4	2.4	2.6	1.8	2.2	2.3	2.5				
Barium-Diss	μg/L	35.3	35.3	34.9	35.1	41.7	43	42	39.9				
Beryllium-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0				
Cadmium-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.52	0.20		
Calcium-Diss	μg/L	75800	75400	78300	81100	69400	71200	69100	65200				
Chromium-Diss	μg/L	5.9	5.3	4.2	3.8	6	6.7	5.8	5	16	11		
Cobalt-Diss	μg/L	0.33	0.26	0.25	0.25	0.28	0.28	0.26	0.22				
Copper-Diss	μg/L	2.8	2.9	2.7	2.7	1.8	1.9	2.1	1.8	10.25	7.00		
Iron-Diss	μg/L	17.1	< 50.0	< 50.0	7.7	27.5	30.4	19.6	25.1				
Lead-Diss	μg/L	0.066	<1.0	<1.0	0.046	0.11	0.064	0.025	0.047	47.15	1.84		
Magnesium-Diss	μg/L	174000	174000	183000	192000	160000	163000	161000	149000				
Manganese-Diss	μg/L	3.5	0.96	0.68	2.8	1.4	1.4	0.79	1.3				
Nickel-Diss	μg/L	1.6	1.5	1.4	1.4	1.3	1.5	1.4	1.3	367.08	40.77		
Potassium-Diss	μg/L	53900	53100	56400	58700	44000	45400	44200	41000				
Selenium-Diss	μg/L	7.1	7.2	7	8	7.6	7.4	7.8	7.3				
Silver-Diss	μg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.96	none		
Sodium-Diss	μg/L	1160000	1140000	1220000	1280000	1070000	1100000	1080000	998000				
Thallium-Diss	μg/L	0.09	0.038	0.025	0.019	0.024	0.025	0.016	<1.0				
Vanadium-Diss	μg/L	0.86	1.4	0.56	0.34	2.3	1.6	2.1	4				
Zinc-Diss	μg/L	5.1	4.2	4.2	3.6	3.4	3.4	3.1	3.5	91.83	92.58		

Table 3-14. PCB homolog concentrations observed at the 11 meter depths 200 feet down current of the working cutterhead sampled in Reach C during the 2010 monitoring

		C-11M (Event 2	C-11M (Event 2	C-11M (Event 4	C-11M (Event 5	C-11M (Event 6	C-11M (Event 8	C-11M (Event 8		
Sample ID		Round 1)	Round 2)	Round 1)	Round 1)	Round 1)	Round 1)	Round 2)		
		C0D060	C0D060	C0E250	C0G220	C0H170	C0I140	C0I140	DNREC	DNREC
Lab Report ID		501013	501015	505005	562005	507005	570005	570007	Acute	Chronic
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010		
Monochlorobiphenyl	ng/L	0.018	0.014	0.018	0.0037	0.0053	0.0056	0.0026		
Dichlorobiphenyl	ng/L	0.13	0.1	0.16	0.068	0.064	0.066	0.067		
Trichlorobiphenyl	ng/L	0.4	0.32	0.3	0.14	0.082	0.1	0.097		
Tetrachlorobiphenyl	ng/L	0.89	0.82	0.78	0.33	0.21	0.28	0.28		
Pentachlorobipheny	ng/L	1.7	1.5	1.2	0.49	0.23	0.33	0.22		
Hexachlorobiphenyl	ng/L	1.3	1.3	1.1	0.28	0.21	0.28	0.19		
Heptachlorobiphenyl	ng/L	0.68	0.61	0.55	0.13	0.088	0.12	0.084		
Octachlorobiphenyl	ng/L	0.26	0.26	0.31	0.064	0.052	0.081	0.052		
Nonachlorobiphenyl	ng/L	0.48	0.53	0.82	0.16	0.16	0.25	0.2		
Decachlorobiphenyl	ng/L	0.65	0.58	1.1	0.21	0.21	0.31	0.29		
Sum of PCB Congeners	ng/L	6.508	6.034	6.338	1.8757	1.3113	1.8226	1.4826	none	14

Table 3-15. PCB homolog concentrations observed at the 11 meter depths at upriver and downriver background stations sampled in Reach C during the 2010 monitoring

Sample ID		BGU- 11M	BGD- 11M	DNREC	DNREC								
Sample Date		4/1/2010	4/1/2010	5/20/2010	5/20/2010	7/20/2010	7/20/2010	8/11/2010	8/11/2010	9/10/2010	9/10/2010	Acute	Chronic
Monochlorobiphenyl	ng/L	0.033	0.014	0.01	0.022	0.0047	< 0.038	0.017	0.011	0.016	0.025		
Dichlorobiphenyl	ng/L	0.17	0.15	0.09	0.18	0.093	0.022	0.14	0.095	0.12	0.2		
Trichlorobiphenyl	ng/L	0.45	0.46	0.18	0.39	0.17	0.019	0.22	0.15	0.27	0.52		
Tetrachlorobiphenyl	ng/L	0.89	1.2	0.41	0.93	0.47	0.029	0.5	0.37	0.76	1.6		
Pentachlorobipheny	ng/L	1.7	2.5	0.82	1.6	0.57	0.023	0.72	0.58	0.93	2		
Hexachlorobiphenyl	ng/L	1.5	2	0.56	1.4	0.51	0.008	0.55	0.41	0.82	1.8		
Heptachlorobiphenyl	ng/L	0.85	1	0.29	0.71	0.24	0.0048	0.28	0.2	0.41	0.87		
Octachlorobiphenyl	ng/L	0.34	0.47	0.14	0.41	0.13	< 0.038	0.18	0.13	0.25	0.54		
Nonachlorobiphenyl	ng/L	0.49	1.2	0.3	1.3	0.4	< 0.038	0.4	0.34	0.79	1.8		
Decachlorobiphenyl	ng/L	0.48	1.6	0.36	1.6	0.49	< 0.038	0.53	0.43	1	2.2		
Sum of PCB Congeners	ng/L	6.903	10.594	3.16	8.542	3.0777	0.1058	3.537	2.716	5.366	11.555	none	14

Table 3-16. Point of I	Oredge	Table 3-16. Point of Dredge 11 meter Dioxin homolog concentrations observed at the 11 meter depths 200 feet down current of the working cutterhead sampled in Reach C during the 2010 monitoring												
Sample ID		C-11M (EVENT 2 ROUND 1)	C-11M (EVENT 2 ROUND 2)	C-11M (EVENT 4 ROUND 1)	C-11M (EVENT 5 ROUND 1)	C-11M (EVENT 6 ROUND 1)	C-11M (EVENT 8 ROUND 1)	C-11M (EVENT 8 ROUND 2)						
Lab Report ID		C0D060 501013	C0D060 501015	C0E250 505005	C0G220 562005	C0H170 507005	C0I140 570005	C0I140 570007						
Sample Date		4/1/2010	4/1/2010	5/20/2010	7/20/2010	8/11/2010	9/10/2010	9/10/2010						
Total HpCDD	pg/L	17	26	37	15	21	31	24						
Total HpCDF	pg/L	3.3	2.6	25	1.7	<48	1.7	<48						
Total HxCDD	pg/L	<48	9	11	4.1	3.3	4.2	5						
Total HxCDF	pg/L	<48	<48	6.8	<48	<48	<48	<48						
Total PeCDD	pg/L	<48	<48	<48	<48	<48	<48	<48						
Total PeCDF	pg/L	<48	<48	<48	<48	<48	<48	<48						
Total TCDD	pg/L	<9.5	<9.5	<9.5	<9.5	<9.5	510	<9.5						
Total TCDF	pg/L	<9.5	8.5	<9.5	<9.5	<9.5	<9.5	<9.5						
OCDD	pg/L	130	270	270	120	160	270	230						
OCDF	pg/L	9.6	7	25	4.5	0.29	5.6	5.6						
Sum of Dioxin Homologs	pg/L	159.9	323.1	374.8	145.3	184.59	822.5	264.6						
DIOXIN TEQs	pg/L	0.084	0.125	0.147	0.063	0.089	510.124	0.097						
FURAN TEQs	pg/L	0.03396	0.0267	0.5555	0.01745	0.000029	0.01756	0.00056						

Table 3-17. Dioxin and Furan homolog concentrations observed at the 11 meter depths at upriver and downriver background stations sampled in Reach C during the 2010 monitoring

Sample ID		BGU-11M	BGD-11M	BGU-11M	BGD-11M	BGU-11M	BGD-11M	BGU-11M	BGD-11M	BGU-11M	BGD-11M
Sample Date		4/1/2010	4/1/2010	5/20/2010	5/20/2010	7/20/2010	7/20/2010	8/11/2010	8/11/2010	9/10/2010	9/10/2010
Total HpCDD	pg/L	12	15	58	30	18	17	110	22	160	200
Total HpCDF	pg/L	<48	<48	5.7	2.1	4	3.3	11	1.9	14	17
Total HxCDD	pg/L	3.5	<48	11	9.2	3	3.8	32	5.9	33	45
Total HxCDF	pg/L	1.1	<48	1.4	<48	<48	<48	2.7	<48	2.1	6.5
Total PeCDD	pg/L	<48	<48	<48	<48	<48	<48	<48	<48	<48	<48
Total PeCDF	pg/L	1.6	<48	<48	<48	<48	<48	3.3	<48	<48	<48
Total TCDD	pg/L	<9.5	<9.5	<9.5	<9.5	<9.5	<9.5	<9.5	<9.5	<9.5	<9.5
Total TCDF	pg/L	<9.5	<9.5	<9.5	<9.5	<9.5	<9.5	3.3	<9.5	<9.5	<9.5
OCDD	pg/L	0.49	1.2	440	230	130	110	790	140	1100	1400
OCDF	pg/L	110	140	16	5.9	7.8	4.4	21	8.5	18	23
Sum of Dioxin Homologs	pg/L	128.69	156.2	532.1	277.2	162.8	138.5	973.3	178.3	1327.1	1691.5
DIOXIN TEQs	pg/L	0.046049	0.06612	0.244	0.133	0.079	0.066	0.419	0.092	0.67	1.1
FURAN TEQs	pg/L	0.011	0.014	0.0586	0.02159	0.02578	0.01844	0.0841	0.01985	0.1018	0.2923

3.3 CONTAMINANT LEVELS RELATIVE TO BACKGROUND

To evaluate whether the dredging activities elevated contaminant concentrations the minimum, maximum, and average concentrations were calculated for all the 6 and 11 meter samples taken at the point of dredge and compared to the concentrations reported for the background samples. Only parameters that were detected in both cutterhead plume and background samples were included in this comparison. With the exception of heptachlor and total cyanide the ratio of mean point of dredge concentration to mean background concentration was near or below 1.0. The results of this analysis suggest that concentrations behind the cutterhead (e.g., the 6 and 11 meter samples) were not dramatically altered relative to parameters measured in the background collections (Table 3-18).

Table 3-18. Comparison of the minimum, maximum, and average contaminant concentrations observed at the Point of Dredge samples relative to those recorded in the background samples taken near the dredge boat Pullen while working in Reach C during the 2010 monitoring. Values above 1.0 in the ratio column indicate Point of Dredge concentration was higher than background. Values less than 1.0 indicate background concentration was higher than Point of Dredge concentration.

		Point						Ratio
		of	Point of	Ave	Back-	Back-	Ave	Dredge/
		Dredge	Dredge	Point of	ground	ground	Back-	Back-
		Min	Max	Dredge	Min	Max	ground	ground
GCSEMI								
4,4-DDD	μg/L	0.0009	0.0051	0.0031	0.0007	0.0070	0.0033	0.92
4,4-DDE	μg/L	0.0010	0.0016	0.0013	0.0009	0.0017	0.0013	1.01
4,4-DDT	μg/L	0.0013	0.0160	0.0094	0.0037	0.0170	0.0117	0.80
alpha-BHC	μg/L	0.0021	0.0021	0.0021	0.0013	0.0029	0.0023	0.91
Dieldrin	μg/L	0.0012	0.0016	0.0014	0.0011	0.0061	0.0022	0.65
Endosulfan II	μg/L	0.0011	0.0077	0.0037	0.0010	0.0130	0.0036	1.01
gamma-BHC (Lindane)	μg/L	0.0013	0.0084	0.0047	0.0014	0.0086	0.0046	1.03
gamma-Chlordane	μg/L	0.0092	0.0092	0.0092	0.0079	0.0098	0.0089	1.04
Heptachlor	μg/L	0.0021	0.0032	0.0024	0.0011	0.0013	0.0012	2.02
Heptachlor epoxide	μg/L	0.0013	0.0150	0.0094	0.0017	0.0220	0.0109	0.87
MET								
Aluminum	μg/L	678.00	14100.00	2797.00	1270.00	11500.00	3735.50	0.75
Aluminum-Diss	μg/L	3.50	70.60	26.92	3.80	176.00	29.19	0.92
Antimony	μg/L	0.12	0.90	0.42	0.12	0.83	0.47	0.91
Antimony-Diss	μg/L	0.20	0.87	0.41	0.25	1.60	0.50	0.82
Arsenic	μg/L	1.30	8.90	3.58	0.78	9.20	4.01	0.89
Arsenic-Diss	μg/L	0.46	4.60	2.11	0.42	3.60	1.99	1.06
Barium	μg/L	26.40	81.40	45.14	29.40	86.60	48.98	0.92
Barium-Diss	μg/L	17.10	43.70	30.40	15.80	43.00	29.67	1.02
Beryllium	μg/L	0.04	0.79	0.20	0.07	0.70	0.20	0.98
Cadmium	μg/L	0.26	0.26	0.26	0.18	0.40	0.27	0.96

Table 3-18. (Continued)									
Tuote 3 To. (Continue		Point of Dredge Min	Point of Dredge Max	Ave Point of Dredge	Back- ground Min	Back- ground Max	Ave Back- ground	Ratio Dredge/ Back- ground	
Calcium	μg/L	11700	89800	53500	12000	77700	48540	1.10	
Calcium-Diss	μg/L	11100	89300	52907	12000	81100	47365	1.12	
Chromium	μg/L	4.30	36.20	11.31	6.90	31.40	14.20	0.80	
Chromium-Diss	μg/L	2.80	9.20	5.76	3.80	9.40	6.35	0.91	
Cobalt	μg/L	0.59	7.30	1.74	0.94	6.60	2.44	0.71	
Cobalt-Diss	μg/L	0.04	0.35	0.20	0.04	0.33	0.19	1.05	
Copper	μg/L	3.10	15.40	5.46	3.90	14.10	6.82	0.80	
Copper-Diss	μg/L	1.40	4.00	2.03	1.10	2.90	2.00	1.02	
Cyanide, Total	μg/L	38.30	38.30	38.30	1.60	10.90	3.88	9.87	
Iron D:	μg/L	942	17900	3802	1750	15600	5507	0.69	
Iron-Diss	μg/L	15.30	106.00	49.28	7.70 2.60	243.00	46.42	1.06	
Lead Lead-Diss	μg/L	1.80 0.11	28.20 0.42	5.91 0.26	0.03	24.80 0.66	8.47 0.24	0.70 1.08	
Magnesium	μg/L μg/L	3750	228000	117441	3930	175000	95303	1.08	
Magnesium-Diss	μg/L μg/L	3400	226000	115270	3620	192000	94619	1.23	
Manganese	μg/L μg/L	42.90	784.00	176.04	78.70	789.00	263.29	0.67	
Manganese-Diss	μg/L μg/L	0.66	25.40	6.60	0.58	14.10	3.53	1.87	
Mercury	μg/L μg/L	2.10	58.00	10.01	4.20	104.00	21.18	0.47	
Nickel	μg/L	1.50	15.40	4.42	2.10	14.00	5.73	0.77	
Nickel-Diss	μg/L	1.30	1.80	1.40	1.20	3.40	1.56	0.90	
Potassium	μg/L	1860	66100	35272	2020	56700	29492	1.20	
Potassium-Diss	μg/L	1420	60600	33220	1500	58700	28260	1.18	
Selenium	μg/L	0.74	18.10	7.28	0.52	12.80	5.79	1.26	
Selenium-Diss	μg/L	0.92	12.40	5.44	1.00	8.00	4.22	1.29	
Silver	μg/L	0.05	0.16	0.10	0.04	0.14	0.07	1.32	
Sodium	μg/L	13500	1560000	797800	14200	1200000	659585	1.21	
Sodium-Diss	μg/L	13700	1670000	821893	14600	1280000	655130	1.25	
Thallium	μg/L	0.02	0.14	0.05	0.04	0.14	0.07	0.70	
Thallium-Diss	μg/L	0.02	0.03	0.02	0.02	0.12	0.04	0.49	
Vanadium	μg/L	1.30	26.90	7.07	1.80	25.60	9.41	0.75	
Vanadium-Diss	μg/L	0.20	4.90	1.92	0.20	5.60	2.38	0.80	
Zinc	μg/L	10.30	110.00	29.84	15.90	99.30	40.94	0.73	
Zinc-Diss	μg/L	2.40	12.10	5.81	1.90	15.10	5.22	1.11	
DOC	mg/L	2	12.2	3.214286	2.2	3	2.575	1.25	
POC	mg/L	1.1	14.3	3.8	1.9	13.5	4.64	0.82	
TSS	mg/L	20.2	349.8	107.08	25.2	182	78.84	1.36	
MSSEMI									
2-Methylnaphthalene	μg/L	0.0130	0.0300	0.0208	0.0130	0.0760	0.0278	0.75	
3-Nitroaniline	μg/L	0.4500	0.4500	0.4500	0.4200	0.4200	0.4200	1.07	
Acenaphthene	μg/L	0.0240	0.0240	0.0240	0.0160	0.0960	0.0438	0.55	
Atrazine	μg/L	0.0960	0.1600	0.1320	0.1000	0.1600	0.1400	0.94	

Table 3-18. (Continued)									
		Point of Dredge Min	Point of Dredge Max	Ave Point of Dredge	Back- ground Min	Back- ground Max	Ave Back- ground	Ratio Dredge/ Back- ground	
Benzaldehyde	μg/L	0.6300	1.4000	1.0133	0.6400	3.0000	1.0929	0.93	
Benzo(a)pyrene	μg/L	0.4000	0.4300	0.4150	0.2500	0.9600	0.5733	0.72	
bis(2-Ethylhexyl) phthalate	μg/L	0.8000	5.9000	2.3167	0.7900	7.2000	3.3571	0.69	
Butyl benzyl phthalate	μg/L	0.1600	0.9100	0.3746	0.1400	1.1000	0.3543	1.06	
Caprolactam	μg/L	1.1000	2.1000	1.4750	1.7000	3.4000	2.4000	0.61	
Di-n-butyl phthalate	μg/L	0.1200	0.1600	0.1400	0.1200	0.3900	0.1846	0.76	
Di-n-octyl phthalate	μg/L	0.9500	0.9700	0.9600	0.3400	1.1000	0.8467	1.13	
Dibenz(a,h)anthracene	μg/L	0.5100	0.5400	0.5250	0.4000	1.9000	0.9833	0.53	
Diethyl phthalate	μg/L	0.1400	1.2000	0.4450	0.1500	1.5000	0.6588	0.68	
Fluoranthene	μg/L	0.0170	0.0590	0.0314	0.0200	0.2500	0.0509	0.62	
Fluorene	μg/L	0.0270	0.0450	0.0355	0.0210	0.0930	0.0533	0.67	
Indeno(1,2,3-cd)pyrene	μg/L	0.4300	0.4700	0.4500	0.4200	1.7000	0.7850	0.57	
Naphthalene	μg/L	0.0260	0.0620	0.0423	0.0150	0.1100	0.0513	0.82	
Phenanthrene	μg/L	0.0550	0.2500	0.1168	0.0540	0.2800	0.1356	0.86	
Phenol	μg/L	0.0660	0.1600	0.1130	0.1600	0.1900	0.1750	0.65	
Pyrene	μg/L	0.0200	0.0410	0.0290	0.0170	0.2800	0.0547	0.53	

4.0 POINT OF DREDGE MONITORING DISCUSSION

4.1 INORGANICS

Among the 12 inorganic parameters with DNREC total and dissolved water quality criteria for protection of aquatic life, three were occasionally measured in concentrations above criteria in the point of dredge monitoring (total aluminum, total selenium, and one observation of total cyanide). Table 4-1 summarizes the exceedance frequencies for the 11- and 6-m depth samples and background samples (11- and 6-m collections combined). Aluminum concentrations were over DNREC acute criteria in all samples including background but these criteria are dated and do not properly account for the effect of pH on solubility and toxicity according to Greene (2010, see Section 6.2). Total selenium was observed over chronic criteria in four of the seven 11-m collections, three of the 6-m samples and eight out of 20 background samples. In addition all elevated concentrations of selenium occurred in the later dates of the program (August and September) suggesting a river-wide increase of selenium occurred during the study. The only other inorganic observed over DNREC criteria was total cyanide when one 6-m point of dredge sample was nearly twice the concentration of the 22 μ g/L acute water quality criterion.

Table 4-1. Summary of water quality exceedances observed during the Point of Dredge Monitoring program.									
		11-1	m	6-m			Background (11, 6-m)		
	N >Acute >Chronic			N	>Acute	>Chronic	N	>Acute	>Chronic
			Total I	norg	anics				
Aluminum	7	7		7	7		20	20	
Selenium	7		4	7		3	20		8
Cyanide	7			7	1		20		
	Pesticides								
4,4 DDD	7		2	7			20		3
4,4 DDE	7		2	7			20		3
4,4 DDT	7		1	7		2	20		4
High Resolution PCB									
Sum of Congeners	7		1	0			10		2

Analysis of mean inorganic concentrations in the 11- and 6-m collections relative to mean background levels indicated that with the exception of cyanide the action of the cutterhead did not alter down-current concentrations in the water column. Forty-three comparisons of total and dissolved concentration versus background concentrations resulted in plume/background ratios near 1.0 suggesting little if any change in concentration behind the working cutterhead occurred (see Table 3-18). The cyanide exception was skewed by the one high concentration observed at the 6-m depth. There were no other detections of cyanide at the dredge. Given that

the TSS monitoring behind the working dredge indicated that the cutterhead did not create large turbidity plumes, it can be concluded that most of the dredged material was entrained into the hydraulic pipeline and not released to the water column at the point of dredging.

4.2 PESTICIDES

Among the 21 pesticide parameters with DNREC water quality criteria only DDT and its breakdown products DDE and DDD were occasionally measured in concentrations slightly over chronic criteria at the point of dredging. However, as Table 4-1 shows the frequencies of samples above criteria were similar in the background samples taken during the point of dredge monitoring. Furthermore, the ratios of mean 11- and 6-m concentrations of DDT, DDE, and DDD pesticide with mean background concentrations were near 1.0 indicating no change at the cutterhead (Table 3-18). Most of the remaining pesticides included in the tests were not detected in the plume sample or the background collections. These results indicate that pesticides were not mobilized to the water column during the Reach C deepening.

4.3 PCBs/DIOXINS AND FURANS

High resolution PCBs, Dioxin and Furan testing was conducted only on the 11-m plume and background samples. One sample out of seven plume samples had a sum of congeners over DNREC's chronic criterion for protection of aquatic life (Table 4-1) while two of the 10 background samples were over this benchmark. All point of dredge and background samples were above DNREC's human health water quality criterion (0.064 ng/L) for PCBs. While there are no direct water quality criteria established for dioxin and furans for the Delaware River, the sum of homologs suggests point of dredge concentrations were in a similar range to those observed in the background samples (Tables 3-16 and 3-17). DNREC does have a human health criterion for Dioxin and Furan expressed as 2,3,7,8-TCDD TEQ (0.0051 pg/L). equivalence for a sample is the sum of the concentration for specific congeners multiplied by its associated Toxicity Equivalence Factor (TEF). A listing of these TEFs is presented on page 31 of DNREC's surface water standards as amended on July 11, 2004. With the exception of a single 11-m plume sample during event 8, round 1 where the TEQ was 510 pg/L the resulting TEQ's ranged from 0.000029 to 1.1 pg/L for all 11-m plume and 11-m background samples. The reported 2,3,7,8-TCDD concentration of 510 pg/L was flagged as an estimated maximum possible concentration by the laboratory. Both plume and background samples were typically over the 0.0051 pg/L human health TEQ for Dioxins and Furans.

4.4 PAHs

Most of the organic compounds were not detected in the plume and background samples. For the 20 parameters that were detected, mean concentrations in the plume were the same or lower than background based on the plume/background ratio analysis presented in Table 3-18.

5.0 CONFINED DISPOSAL FACILITY MONITORING

5.1 CDF MONITORING FIELD METHODS

The weir discharges were sampled using ISCO® automatic samplers to obtain composite samples throughout the discharge period as well as daily TSS samples. The sampler consists of a peristaltic pump, controlled by a computer, which allows for collecting fixed amounts of water into sample containers over a period of time. The samples were collected through Teflon tubing that was suspended into the weir at the mouth of the outfall pipe or at the weir structure in the CDF. The sample routine for this project was designed to collect water at 6-hour intervals. Sample jars for inorganics, pesticides, PCBs, and TSS were filled over the course of 3-4 days. Daily samples of TSS were analyzed and the remaining parameters were composited for the 3-4 day time series. Semi-volatile organic samples and low resolution mercury samples at the weir were not collected in this manner, since the samples must be sealed immediately following collection. A grab sample was collected when the field crew arrived at the site, by manually starting the sampler pump.

Mix samples were collected at the point of discharge where the weir water initially mixes with river water. A grab sample was taken using a swing-arm sampler with individual sample containers fixed onto the end of the pole.

Background samples were collected with the swing-arm sampler (i.e., grab samples) similar to the methods used in the mix area. The background sample was taken approximately 3 miles north of Killcohook at Pennsville, New Jersey. This site was similar to the shallow discharge plume site and free from direct chemical influence from any known source of pollutants.

Given the high-pressure flow out of the influent pipe, a grab sample of the sediment slurry (influent) was taken using a swing-arm sampler with individual sample containers fixed onto one end. The sample container was lowered into the influent flow, at the point where the dredged material was falling into the accumulated dredged material in the CDF. This is an area of rapid mixing, which allowed for sampling the influent as close to the hydraulic pipeline discharge point as possible. In the laboratory the influent sample was allowed to settle and only the sediment portion was extracted for chemical testing. Table 5-1 summarizes the sampling dates and number of samples collected at each site during the monitoring period.

Table 5-1. Summary of sampling dates by location for the Killcohook CDF monitoring										
conducted during the deepening of Reach C in the Delaware River in 2010										
Sample Site				S	ample D	ates				N
	3/1,	3/22	3/24	3/29	4/2	4/6	4/8	4/14	4/19	
	4/22	4/27	4/29	5/4	5/6	5/11	5/13	5/17	5/21	
Cell 2 Weir	5/25	5/27	6/2	6/4	6/7	6/9	6/15	6/17	6/21	38
	6/25	6/28	6/30	7/6	7/8	7/15	7/21	7/28	8/4	
	8/11	9/29								
	3/18	3/22	3/24	3/29	4/2	4/6	4/8	4/19	4/27	
C-11 2 M:	4/29	5/4	5/6	5/11	5/13	5/17	5/21	5/25	5/27	22
Cell 2 Mix	6/2	6/4	6/7	6/9	6/15	6/21	6/25	6/28	7/6	33
	7/8	7/15	7/21	7/28	8/4	8/11				
Cell 2 Inlet	3/18	3/24	4/19	5/17	5/25	6/4	6/15	6/25	7/15	9
	4/27	4/29	5/4	5/6	5/11	5/13	5/17	5/21	5/25	
C-11 2 W-:-	5/27	6/2	6/4	6/7	6/9	6/15	6/17	6/21	6/25	2.4
Cell 3 Weir	6/28	6/30	7/6	7/8	7/13	7/15	7/21	7/28	8/4	34
	8/11	8/18	8/25	9/1	9/8	9/15	9/22			
	4/27	4/29	5/4	5/6	5/11	5/13	5/17	5/21	5/25	
C 11 2 M:	5/27	6/2	6/4	6/7	6/9	6/15	6/17	6/21	6/25	2.4
Cell 3 Mix	6/28	6/30	7/6	7/8	7/13	7/15	7/21	7/28	8/4	34
	8/11	8/18	8/25	9/1	9/8	9/15	9/22			
Cell 3 Inlet	4/22	5/4	5/13	5/25	6/15	6/25	7/6			7
	3/18	3/24	4/2	4/6	5/4	5/11	5/17	5/27	6/4	
Background	6/9	6/15	6/21	6/28	7/6	7/13	7/21	7/28	8/4.	21
-	8/11	8/18	8/25							

5.2 CDF MONITORING LABORATORY METHODS

Samples were packed with ice in coolers and shipped the same day via over-night mail to the TestAmerica environmental analytical laboratory in Pittsburgh, PA. This laboratory is accredited by the National Environmental Laboratory Accreditation Conference (NELAC) for analysis of non-potable water and solids. NELAC is a cooperative association of States and Federal agencies, formed to establish and promote mutually acceptable national performance standards for the operation of environmental laboratories. The standards cover both analytical testing of environmental samples and the laboratory accreditation process. The goal of NELAC is to foster the generation of environmental laboratory data of known and acceptable quality on which to base public health and environmental management decisions. TestAmerica's NELAC accreditation documents that the laboratory adheres to all NELAC quality assurance requirements. Specific requirements vary between analytical methods, but in general include the analysis of method blanks, laboratory control samples (LCS), matrix spikes (MS) and matrix spike duplicates (MSD). Specific criteria for each analytical method are documented in

method-specific standard operating procedures (SOPs) maintained by each laboratory, and may include calibration linearity requirements, initial and continuing calibration verifications, calibration blanks, and instrument tuning requirements. Details on the QA/QC results are included in the certificates of analyses presented in Appendix D.

Table 5-2 summarizes the analytical methods used for each parameter category. Bulk sediment results were all reported on a dry weight basis. All samples were appropriately labeled upon collection, shipped and stored at 4 °C until analysis. All samples were processed within required hold times unless flagged in the certificate of analysis. Contaminant data were submitted in MS Excel spreadsheets for data analysis and reporting purposes. Copies of the laboratory certificates are included in Appendix D.

Table 5-2. List of parameter specific	c laboratory methods used for	the monitoring program							
Parameter	Analytical Method	Preparation Method							
Inorganics									
ICP-MS (6020)	SW846 6020	SW846 3005A							
ICP-MS (6020)	SW846 6020	SW846 3010							
ICP-MS (6020)	SW846 6020	SW846 3050B							
Mercury, Low Level Mercury, CVA	CFR136A 1631E	EPA 1631							
Fluorescence									
Cyanide, Total	SW846 9012A	SW846 9012A							
	Pesticides								
Organochlorine Pesticides SW846	SW846 8081A LOW								
8081A Low Level									
Organophosphorous Compounds by GC	SW846 8141A	SW846 3510							
Organophosphorous Compounds by GC	SW846 8141A	SW846 3541							
	Organics								
Semivolatile Organics GCMS BNA	SW846 8270C								
8270C									
	Particulates								
Total Residue as Percent Solids	SM20 2540G								
Total Suspended Solids SM 2540 D	SM20 2540D	SM20 2540D							
Dissolved Organic Carbon 5310B	SM20 5310B								
POC Method 440.0 440.0	EPA 440.0								
	PCBs/Dioxins								
PCBs by SW-846 8082 PCBs (8082)	SW846 8082 Low	SW846 3541							
Low Level									
PCB Screen	KNOX PCB Screen								
PCBs, HRGC/HRMS	EPA-22 1668A								
Dioxins/Furans, HRGC/HRMS	EPA-5 1613B	EPA-5 1613							

5.3 CDF MONITORING DATA ASSESSMENT METHODS

Potential environmental impacts of the dredging operations were evaluated using a number of different approaches including comparisons to DNREC's protection of aquatic life

and human health water quality criteria, estimating the mass balance of contaminants removed by the dredging to loadings released at the discharge weir, and statistical analyses to determine if concentrations were increased at the weir relative to background levels. Several of DNREC's water quality criteria are hardness-based and as such sample specific hardness was used to calculate sample specific criteria for those parameters. Freshwater aquatic life criteria were used, as measured salinity over the dredging period was consistently below 5 parts per thousand. DNREC's acute and chronic criteria for the protection of aquatic life and human health criteria for systematic toxicants and human carcinogens were evaluated. These criteria apply at specific locations in the river, not at the weir discharge. Fresh water acute aquatic life criteria apply at the edge of the zone of initial dilution (ZID). This is a near-field assessment. A dilution factor was calculated at the edge of the ZID using a CORMIX mixing zone model previously developed for the Reedy Point South CDF (Farrar et al.2001¹). Fresh water chronic aquatic life and human health criteria apply after complete mixing in the water body (far-field assessment). 7Q10 and mean harmonic flow far-field concentrations were calculated using the loading from the CDF. Both the near-field and far-field analyses factored in mean background concentrations measured during the monitoring program. Data and analyses for this assessment are provided in Appendix D.

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¹ Farrar, J., S. Schreiner, and T. Howard. 2001. Reedy Point South Water Quality Modeling. Prepared for J. Pasquale, U.S. Army Corps of Engineers. Contract No. DACW61-00-D-0009.

6.0 CONFINED DISPOSAL FACILITY MONITORING RESULTS

6.1 CDF EFFLUENT CHARACTERIZATION

Tables 6-1 through 6-4 summarize the average concentrations observed for pesticides, total inorganics, dissolved inorganics, and semi-volatile organics, respectively. The tables present mean, minimum, and maximum observed concentrations for background samples, mix samples (Cells 2 and 3) and weir samples (Cells 2 and 3). High resolution PCB, Dioxin and Furan analyses were conducted on some of the spring weir (9 samples), mix (4 samples), and background (1) sample (Table 6-5). The sum of PCB homologs ranged from 2.3 ng/L in a background sample to 115.03 ng/L in a Cell 2 weir sample. Dioxin and Furan TEQ's ranged from 0.0004 to 3.01 pg/L for all samples (Table 6-5).

Table 6-1. Mean concentrations (μg/L) of pesticides observed among the background, mix (Cells 2 and 3), and weir (Cells 2 and 3) samples at the 2010 Killcohook CDF monitoring project

Analyze		В	ackgroun	d				Mix					Weir		
Anaryze	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max
4,4-DDD	19	0.0001	0.0001	0	0.0013	57	0.0003	0.0001	0	0.0043	72	0.0009	0.0004	0	0.023
4,4-DDE	19	0.0001	0.0001	0	0.0021	57	0.0002	0.0001	0	0.0039	72	0.0004	0.0003	0	0.017
4,4-DDT	19	0.0002	0.0002	0	0.0041	57	0.0008	0.0003	0	0.014	72	0.0007	0.0003	0	0.018
Aldrin	19	0.0001	0.0001	0	0.0017	57	0.0002	0.0001	0	0.0072	72	0.0006	0.0004	0	0.026
alpha-BHC	19	0.0002	0.0001	0	0.0016	57	0.0000	0.0000	0	0.0014	72	0.0040	0.0032	0	0.23
alpha-Chlordane	19	0	0	0	0	57	0.0000	0.0000	0	0.0017	72	0	0	0	0
Aroclor 1016	19	0	0	0	0	57	0	0	0	0	72	0	0	0	0
Aroclor 1221	19	0	0	0	0	57	0	0	0	0	72	0	0	0	0
Aroclor 1232	19	0	0	0	0	57	0	0	0	0	72	0	0	0	0
Aroclor 1242	19	0.001	0.001	0	0.019	57	0	0	0	0	72	0.0006	0.0006	0	0.044
Aroclor 1248	19	0	0	0	0	57	0.0014	0.0008	0	0.03	72	0.0012	0.0008	0	0.043
Aroclor 1254	19	0.0008	0.0008	0	0.016	57	0.0001	0.0001	0	0.0071	72	0	0	0	0
Aroclor 1260	19	0	0	0	0	57	0	0	0	0	72	0.0007	0.0007	0	0.047
beta-BHC	19	0.0008	0.0004	0	0.007	57	0.0008	0.0002	0	0.0088	72	0.0013	0.0007	0	0.042
Chlordane (technical)	19	0	0	0	0	57	0	0	0	0	72	0	0	0	0
Chlorpyrifos	19	0	0	0	0	57	0	0	0	0	72	0	0	0	0
delta-BHC	19	0.0005	0.0003	0	0.0041	57	0.0006	0.0002	0	0.0093	72	0.0129	0.0124	0	0.89
Dieldrin	19	0.0003	0.0002	0	0.0035	57	0.0001	0.0000	0	0.0013	72	0.0005	0.0003	0	0.019
Endosulfan I	19	0	0	0	0	57	0	0	0	0	72	0.0000	0.0000	0	0.0012
Endosulfan II	19	0.0008	0.0003	0	0.0049	57	0.0006	0.0002	0	0.0093	72	0.0001	0.0001	0	0.0036
Endosulfan sulfate	19	0.0002	0.0001	0	0.0026	57	0.0000	0.0000	0	0.0015	72	0.0000	0.0000	0	0.0027
Endrin	19	0	0	0	0	57	0.0000	0.0000	0	0.0019	72	0.0004	0.0003	0	0.018
Endrin aldehyde	19	0.0002	0.0002	0	0.0024	57	0.0003	0.0003	0	0.014	72	0.0002	0.0002	0	0.012
Endrin ketone	19	0.0001	0.0001	0	0.0021	57	0	0	0	0	72	0.0002	0.0002	0	0.011
gamma-BHC (Lindane)	19	0.0011	0.0004	0	0.0047	57	0.0028	0.0014	0	0.081	72	0.0040	0.0018	0	0.12
gamma-Chlordane	19	0.0013	0.0008	0	0.012	57	0.0029	0.0023	0	0.13	72	0.0011	0.0005	0	0.027
Heptachlor	19	0.0006	0.0005	0	0.0085	57	0.0002	0.0001	0	0.0036	72	0.0015	0.0004	0	0.022
Heptachlor epoxide	19	0	0	0	0	57	0	0	0	0	72	0.0003	0.0002	0	0.015
Methoxychlor	19	0	0	0	0	57	0.0005	0.0003	0	0.014	72	0.0003	0.0002	0	0.012
Parathion	19	0	0	0	0	57	0	0	0	0	72	0	0	0	0
Toxaphene	19	0	0	0	0	57	0	0	0	0	72	0	0	0	0

Table 6-2. Mean concentrations (μg/L) of total inorganics observed among the background, mix (Cells 2 and 3), and weir (Cells 2 and 3) samples at the 2010 Killcohook CDF monitoring project

,		В	ackgroun	d				Mix					Weir		
Analyte	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max
Aluminum	21	1563.9	409.1	446	7610	67	5940.75	597.66	790	23800	72	5344.15	1854.53	376	121000
Antimony	21	0.66	0.27	0.24	6.1	67	0.68	0.04	0.2	1.9	72	1.06	0.05	0.3	2.9
Arsenic	21	3.74	0.75	0	16.6	67	6.07	0.41	1	16.6	72	14.44	5.35	2	386
Barium	21	49.93	14.73	21.5	341	67	79.22	6.61	34.2	301	72	176.79	15.42	25	578
Beryllium	21	0.08	0.02	0	0.37	67	0.30	0.03	0	1.2	72	0.41	0.17	0	9.8
Cadmium	21	0.02	0.02	0	0.35	67	0.09	0.02	0	0.72	72	0.32	0.13	0	7.6
Chromium	21	9.30	1.04	5.3	23.5	67	19.66	1.48	7.2	68.9	72	22.28	7.60	5	520
Cobalt	21	1.23	0.34	0.37	6.6	67	4.04	0.39	0.77	17.3	72	6.62	2.12	1.1	143
Copper	21	4.32	0.68	2.2	13.7	67	9.44	0.81	2.8	37.6	72	8.45	2.12	1.5	113
Cyanide, Total	21	0.47	0.34	0	6.6	67	0.87	0.31	0	15.8	72	1.37	0.35	0	15.5
Lead	21	4.08	1.14	1.3	19.9	67	13.47	1.39	0.9	61.2	72	17.87	8.01	0.62	487
Mercury (ng/L)	19	7.61	1.80	1.8	34.5	57	34.13	5.11	3.8	216	71	14.28	6.44	0.49	458
Nickel	21	3.26	0.65	1.1	12.8	67	8.78	0.75	2.4	33.8	72	12.90	4.02	2.3	281
Selenium	21	3.87	0.79	0	12.9	67	4.66	0.48	0	17	72	5.75	0.55	0	30.4
Silver	21	0.0067	0.0050	0	0.1	67	0.06	0.01	0	0.41	72	0.04	0.02	0	1.2
Thallium	21	0.11	0.02	0	0.29	67	0.13	0.01	0	0.34	72	0.12	0.02	0	1.1
Vanadium	21	6.05	1.08	0.56	17.6	67	15.03	1.38	0	60.9	72	36.73	24.90	0	1790
Zinc	21	24.70	4.58	7.2	84.4	67	68.49	6.99	13.4	338	72	83.08	27.25	7.1	1780

Table 6-3. Mean concentrations (μg/L) of dissolved inorganics observed among the background, mix (Cells 2 and 3), and weir (Cells 2 and 3) samples at the 2010 Killcohook CDF monitoring project

		В	ackgrour	ıd				Mix					Weir		
Analyte	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max
Aluminum-Diss	21	27.23	11.00	0	184	67	138.71	62.44	0	3680	72	157.76	65.92	0	3700
Antimony-Diss	21	0.52	0.06	0.14	1.4	67	0.59	0.03	0.16	1.4	72	1.05	0.05	0.28	2.7
Arsenic-Diss	21	2.19	0.29	0.33	5.6	67	2.56	0.16	0	7.5	72	4.33	0.26	0.69	16.2
Barium-Diss	21	37.82	11.82	12.8	272	67	51.81	6.92	16	281	72	139.93	12.49	12.6	407
Beryllium-Diss	21	0	0	0	0	67	0.01	0.00	0	0.2	72	0.01	0.003	0	0.16
Cadmium-Diss	21	0	0	0	0	67	0.00	0.00	0	0.27	72	0.09	0.04	0	2
Chromium-Diss	21	5.24	0.24	3.4	7	67	6.31	0.35	3.3	21.4	72	6.38	0.29	2.9	16.3
Cobalt-Diss	21	0.25	0.10	0.033	2.2	67	0.49	0.06	0.073	2.9	72	2.09	0.19	0.29	7.3
Copper-Diss	21	2.13	0.15	1.1	3.8	67	2.40	0.17	1.2	9.9	72	2.86	0.35	0.64	24.4
Lead-Diss	21	0.17	0.06	0	0.74	67	0.30	0.08	0	4.6	72	0.37	0.17	0	11.7
Nickel-Diss	21	1.41	0.20	0.58	4.8	67	2.09	0.18	0.82	8.4	72	4.88	0.57	1.5	33.8
Selenium-Diss	21	2.58	0.46	0	7.6	67	3.43	0.30	0	11	72	4.20	0.26	0.84	10.2
Silver-Diss	21	0	0	0	0	67	0.03	0.02	0	0.79	72	0.01	0.003	0	0.16
Thallium-Diss	21	0.10	0.02	0	0.28	67	0.09	0.01	0	0.3	72	0.07	0.01	0	0.25
Vanadium-Diss	21	1.75	0.36	0	5	67	1.88	0.23	0	8.1	72	2.17	0.27	0	15.6
Zinc-Diss	21	6.63	0.60	2.8	14.6	67	8.80	1.33	3.4	73.1	72	14.86	2.71	2.6	155

Table 6-4. Mean concentrations (μg/L) of semi-volatiles observed among the background, mix (Cells 2 and 3), and weir (Cells 2 and 3) samples at the 2010 Killcohook CDF monitoring project

2 4.74 5 7 54.7			Backgrou				<u> </u>	Mix					Weir		
Analyte	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max
1,1-Biphenyl	19	0	0	0	0	57	0.0025	0.0018	0	0.093	69	0.0014	0.0010	0	0.049
1,2,4-Trichlorobenzene	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
1,2-Dichlorobenzene	19	0.0397	0.0358	0	0.68	57	0.0042	0.0024	0	0.083	69	0.0169	0.0146	0	1
1,2-Diphenylhydrazine	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
1,3-Dichlorobenzene	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
1,4-Dichlorobenzene	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2,4,5-Trichlorophenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2,4,6-Trichlorophenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2,4-Dichlorophenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2,4-Dimethylphenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2,4-Dinitrophenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2,4-Dinitrotoluene	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2,6-Dinitrotoluene	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2-Chloronaphthalene	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2-Chlorophenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2-Methylnaphthalene	19	0.0112	0.0032	0	0.055	57	0.0201	0.0035	0	0.18	69	0.0146	0.0040	0	0.24
2-Methylphenol	19	0	0	0	0	57	0	0	0	0	69	0.0002	0.0002	0	0.014
2-Nitroaniline	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
2-Nitrophenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
3,3-Dichlorobenzidine	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
3-Nitroaniline	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
4,6-Dinitro-2-methylphenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
4-Bromophenyl phenyl ether	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
4-Chloro-3-methylphenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
4-Chloroaniline	19	0.4263	0.4263	0	8.1	57	0	0	0	0	69	0.0043	0.0043	0	0.3
4-Chlorophenyl phenyl ether	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
4-Methylphenol	19	0	0	0	0	57	0.0015	0.0015	0	0.085	69	0.3527	0.3478	0	24
4-Nitroaniline	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
4-Nitrophenol	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
Acenaphthene	19	0.0068	0.0031	0	0.037	57	0.0082	0.0024	0	0.096	69	0.0107	0.0037	0	0.16
Acenaphthylene	19	0	0	0	0	57	0.0008	0.0008	0	0.044	69	0.0004	0.0004	0	0.028
Acetophenone	19	0.0379	0.0261	0	0.37	57	0.0212	0.0120	0	0.42	69	0.0496	0.0143	0	0.39

		F	Backgrou	nd				Mix					Weir		
Analyte	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max
Anthracene	19	0.0029	0.0029	0	0.055	57	0.0218	0.0094	0	0.37	69	0.0059	0.0027	0	0.15
Atrazine	19	0.0367	0.0151	0	0.2	57	0.0563	0.0100	0	0.22	69	0.0143	0.0045	0	0.13
Benzaldehyde	19	1.0063	0.1121	0	1.7	57	0.9968	0.0649	0	1.7	69	0.8606	0.0640	0	1.7
Benzidine	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
Benzo(a)anthracene	19	0.0348	0.0279	0	0.53	57	0.1623	0.0847	0	3.5	69	0.0542	0.0218	0	1.2
Benzo(a)pyrene	19	0.0230	0.0192	0	0.36	57	0.1098	0.0575	0	2.4	69	0.0417	0.0172	0	0.98
Benzo(b)fluoranthene	19	0.0284	0.0219	0	0.4	57	0.1414	0.0751	0	3.3	69	0.0577	0.0224	0	1.2
Benzo(ghi)perylene	19	0.0411	0.0302	0	0.53	57	0.1649	0.0850	0	3.6	69	0.0750	0.0262	0	1.4
Benzo(k)fluoranthene	19	0.0421	0.0324	0	0.59	57	0.1809	0.0933	0	3.7	69	0.0687	0.0262	0	1.4
bis(2-Chloroethoxy)methane	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
bis(2-Chloroethyl) ether	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
bis(2-Chloroisopropyl) ether	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
bis(2-Ethylhexyl) phthalate	19	1.8258	0.3916	0	4.6	57	1.2893	0.1915	0	5.7	69	1.9023	0.3018	0	11
Butyl benzyl phthalate	19	0.2284	0.0455	0	0.71	57	0.1967	0.0285	0	1	69	0.2628	0.0604	0	3.9
Caprolactam	19	1.0684	0.2807	0	3.3	57	0.8702	0.1422	0	3.5	69	0.7667	0.1341	0	4.7
Carbazole	19	0	0	0	0	57	0.0029	0.0015	0	0.062	69	0.0009	0.0006	0	0.035
Chrysene	19	0.0403	0.0312	0	0.59	57	0.1771	0.0911	0	3.7	69	0.0620	0.0242	0	1.3
Dibenz(a,h)anthracene	19	0.0421	0.0317	0	0.57	57	0.1826	0.0961	0	4	69	0.0795	0.0280	0	1.5
Dibenzofuran	19	0	0	0	0	57	0.0028	0.0020	0	0.1	69	0.0048	0.0022	0	0.09
Diethyl phthalate	19	0.0589	0.0209	0	0.25	57	0.0712	0.0134	0	0.38	69	0.0945	0.0225	0	1.2
Dimethyl phthalate	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
Di-n-butyl phthalate	19	0.0563	0.0239	0	0.41	57	0.0593	0.0133	0	0.35	69	0.0821	0.0252	0	1.6
Di-n-octyl phthalate	19	0	0	0	0	57	0.0775	0.0433	0	1.7	69	0.0120	0.0088	0	0.53
Fluoranthene	19	0.0404	0.0185	0	0.35	57	0.0971	0.0277	0	1.2	69	0.0312	0.0072	0	0.33
Fluorene	19	0.0111	0.0042	0	0.052	57	0.0174	0.0029	0	0.11	69	0.0220	0.0032	0	0.11
Hexachlorobenzene	19	0	0	0	0	57	0.0175	0.0127	0	0.63	69	0	0	0	0
Hexachlorobutadiene	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
Hexachlorocyclopentadiene	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
Hexachloroethane	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
Indeno(1,2,3-cd)pyrene	19	0.0416	0.0312	0	0.56	57	0.1700	0.0896	0	3.8	69	0.0786	0.0278	0	1.5
Isophorone	19	0	0	0	0	57	0	0	0	0	69	0.0009	0.0009	0	0.065
Naphthalene	19	0.0364	0.0214	0	0.41	57	0.0471	0.0151	0	0.78	69	0.0289	0.0095	0	0.59
Nitrobenzene	19	5.3053	5.2609	0	100	57	0.0035	0.0035	0	0.2	69	0.0138	0.0138	0	0.95

Table 6-4. (Continued)															
		I	Backgrou	nd				Mix					Weir		
Analyte	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max	N	Mean	Stderr	Min	Max
N-Nitrosodimethylamine	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
N-Nitrosodi-n-propylamine	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
N-Nitrosodiphenylamine	19	0	0	0	0	57	0	0	0	0	69	0	0	0	0
Pentachlorophenol	19	0	0	0	0	57	0.0014	0.0014	0	0.08	69	0.0435	0.0435	0	3
Phenanthrene	19	0.0948	0.0093	0.042	0.18	57	0.1028	0.0071	0	0.32	69	0.0945	0.0074	0	0.46
Phenol	19	0.0039	0.0039	0	0.074	57	0.0127	0.0076	0	0.39	69	0.0106	0.0049	0	0.23
Pyrene	19	0.0175	0.0054	0	0.097	57	0.0823	0.0322	0	1.4	69	0.0215	0.0062	0	0.33

Table 6-5. Results of high resolution PCB and Dioxin and Furan tests for weir, mix, and background samples collected during the 2010 monitoring at the Killcohook CDF.

| Weir |

Boring ID:		WEIR 0329	WEIR 0414	WEIR 0429	WEIR 0513	WEIR 0521	WEIR 0527	WEIR 0513	WEIR 0521	WEIR 0527	MIX 0521	MIX 0527	MIX 0521	MIX 0527	BG 0527
Cell #		2	2	2	2	2	2	3	3	3	2	2	3	3	0321
Sample Date:		3/29/10	4/14/10	4/29/10	5/13/10	5/21/10	5/27/10	5/13/10	5/21/10	5/27/10	5/21/10	5/27/10	5/21/10	5/27/10	5/27/10
Monochlorobiphenyl (total)	ng/L	0.05	0.019	0.49	5.6	12	5.6	0.065	0.042	1.1	1.7	0.56	1.8	0.46	0.4
Dichlorobiphenyl (total)	ng/L	0.51	0.19	0.33	2.3	0.87	28	0.034	0.016	0.28	1.2	0.79	1.3	0.39	0.2
Trichlorobiphenyl (total)	ng/L	1.4	0.32	0.072	0.64	1	2	0.045	0.031	1.8	0.44	0.2	0.49	0.18	0.18
Tetrachlorobiphenyl (total)	ng/L	3.8	0.85	0.29	4.6	9.7	3.7	0.099	0.041	2.9	1.2	0.44	1.2	0.43	0.41
Pentachlorobiphenyl (total)	ng/L	5.2	1.3	0.56	10	20	3.2	0.12	0.099	2.2	2	0.6	2.7	0.58	0.42
Hexachlorobiphenyl (total)	ng/L	3.5	1.1	0.23	1.6	3.4	2.6	0.024	0.013	0.45	1	0.28	0.96	0.22	0.19
Heptachlorobiphenyl (total)	ng/L	1.7	0.57	0.05	0.16	0.22	0.93	0.027	0.059	0.61	0.22	0.12	0.24	0.094	0.077
Octachlorobiphenyl (total)	ng/L	0.97	0.37	12	50	13	21	5.9	53	4.4	61	<95	20	<95	<95
Nonachlorobiphenyl (total)	ng/L	2.2	0.91	0.0011	0.045	0.027	20	0.024	0.011	0.2	1.1	0.64	1.1	0.31	0.17
Decachlorobiphenyl (total)	ng/L	3.1	1.1	0.33	2.3	0.87	28	0.034	0.016	0.28	1.2	0.79	1.3	0.39	0.2
Sum of PCB Congeners	ng/L	22.43	6.729	14.3531	77.245	61.087	115.03	6.372	53.328	14.22	71.06	4.42	31.09	3.054	2.247
Total HpCDD	pg/L	400	240	62	110	48	32	14	62	4.5	260	16	100	3.8	26
Total HpCDF	pg/L	42	24	5.5	44	4.8	23	4.1	40	<48	31	<48	14	<48	<48
Total HxCDD	pg/L	67	62	8.4	22	5.5	8.3	<48	9.3	<48	71	<48	29	<48	<48
Total HxCDF	pg/L	18	12	1.4	15	0.89	6.3	2.3	24	<48	17	<48	4	<48	<48
Total PeCDD	pg/L	<48	<48	<48	<48	<48	<48	<48	<48	<48	<48	<48	<48	<48	<48
Total PeCDF	pg/L	6.7	8.1	<48	7.6	<48	6.8	<48	8.8	<48	6	<48	<48	<48	<48
Total TCDD	pg/L	4.4	<9.5	<9.5	1.3	<9.5	<9.5	<9.5	<9.5	<9.5	12	<9.5	<9.5	<9.5	<9.5
Total TCDF	pg/L	10	7.4	<9.5	8.4	9.7	9.8	<9.5	5.9	<9.5	12	<9.5	<9.5	<9.5	< 9.5
OCDD	pg/L	2800	1800	580	1100	590	20	140	530	45	2100	96	680	55	190
OCDF	pg/L	51	31	12	50	13	270	5.9	53	4.4	61	<95	20	<95	<96
Sum of Dioxin and Furan Homologs	pg/L	3399	2185	657.6	1310	660.1	376.2	160.4	680	49.7	2510	112.6	828.1	59.11	216.2
DIOXIN TEQs	pg/L	3.01	1.84	0.268	0.7	0.219	0.094	0.076	0.383	0.0045	3.01	1.84	0.268	0.7	0.219
FURAN TEQs	pg/L	1.1651	0.3331	0.0562	0.621	0.0493	0.187	0.00059	1.2353	0.00044	1.1651	0.3331	0.0562	0.621	0.0493

6.2 NEAR-FIELD CORMIX EVALUATION OF CDF MONITORING RESULTS

Mean concentrations of total aluminum in the background, mix, and weir samples were all over the DNREC acute criterion of 750 μ g/L. According to Greene (2010²), the aluminum criterion is dated and fails to properly account for the effect of pH on solubility and toxicity. Greene (2010) conducted geochemical speciation modeling that indicated for the range of pH values observed in the Delaware Estuary, the majority of the aluminum exists in the solid, non-toxic form. Greene's analysis suggested that only 4% of the total aluminum observed in the estuary exists in the toxic form of the metal. As such, the detected concentrations of total aluminum discharged from the Killcohook CDF are not considered detrimental to aquatic life in the Delaware River system and near and far field evaluations were not conducted for aluminum.

No weir or mix sample concentrations of pesticides or semi-volatile organic parameters were above DNREC acute criteria. Three inorganics (chromium, arsenic, and selenium) were observed slightly higher than their respective acute criteria in a few weir and mix samples. Of 139 weir and mix samples collected over the monitoring period, two chromium samples, one arsenic sample and one selenium sample were above criteria. From a regulatory perspective, acute water quality criteria for the protection of aquatic life must be met at the edge of the zone of initial dilution (ZID). Based on DNREC's mixing zone guidelines, the ZID distance is defined as five times the local water depth or 50 times the discharge length scale, whichever is smaller. In this part of the Delaware Estuary the tidal range is six feet. For this evaluation an average water depth of three feet was selected and the edge of the ZID is 15 feet. To estimate the expected amount of dilution of the discharge at the edge of the ZID CORMIX mixing zone model results from a similar CDF study at Reedy Point South were used (Farrar et al. 2001³). These analyses were performed for a CDF with a similar discharge configuration into a shallow tidal area and represent a reasonable estimate of initial mixing that would be expected to occur at the Killcohook CDF (Table 6-6). Results of that study predicted that at 15 feet from the discharge point the dilution factor would be 30.4 percent during tidal flow. This dilution factor was applied to the chromium, arsenic, and selenium concentration that were above acute water quality criteria; this analysis included mixing with the mean background concentrations of these parameters. Results indicate that with initial mixing, all acute aquatic life criteria were met at the edge of the ZID.

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² **Greene, R. 2010**. An Evaluation of Toxic Contaminants in the Sediments of the Tidal Delaware River and Potential Impacts Resulting from Deepening the Main Navigation Channel in Reach C. Delaware Department of Natural Resources and Environmental Control, Division of Water Resources Watershed Assessment Branch, Dover, DE. Final of June 7, 2010.

³ **Farrar, J., S. Schreiner, and T. Howard. 2001**. Reedy Point South Water Quality Modeling. Prepared for J. Pasquale, U.S. Army Corps of Engineers. Contract No. DACW61-00-D-0009.

Table 6-6.	Dilutio	n of K	Cillcoho	ook cor	centrati	ons exc	eeding	acute c	riteria u	sing R	eedy Po	oint
	South C	Cormi	x diluti	ion fact	ors with	n specifi	ed back	ground	d concer	ntration	levels	
	DNREC Acute		Backgrou	nd								
Chromium μg/L	16		9.3									
Arsenic μg/L	340		3.74									
Selenium μg/L	20		3.87									
					Floo	d Tide						
Dist	ance from pi	ipe (m)	0	0.5	1	2	5	9	10	25	50	100
	% original	plume	100	69.73	39.45	30.62	30.17	30.13	30.11	29.95	29.67	29.11
Chromium Mix	21.4	μg/L	21.40	14.92	8.44	6.55	6.46	6.45	6.44	6.41	6.35	6.23
Chromium Weir	16.3	μg/L	16.30	11.37	6.43	4.99	4.92	4.91	4.91	4.88	4.84	4.74
Arsenic Weir	386	μg/L	386.00	269.16	152.28	118.19	116.46	116.30	116.22	115.61	114.53	112.36
Selenium Weir	30.4	μg/L	30.4	21.20	11.99	9.31	9.17	9.16	9.15	9.10	9.02	8.85
					Ebb	Tide						
Dista	ance from pi	ipe (m)	0	0.5	1	2	5	9	10	25	50	100
	% original	plume	100	70.00	40.00	30.84	30.37	30.32	30.31	30.14	29.86	29.29
Chromium Mix	21.4	μg/L	21.40	14.98	8.56	6.60	6.50	6.49	6.49	6.45	6.39	6.27
Chromium Weir	16.3	μg/L	16.30	11.41	6.52	5.03	4.95	4.94	4.94	4.91	4.87	4.77
Arsenic Weir	386	μg/L	386.00	270.20	154.40	119.04	117.23	117.04	117.00	116.34	115.26	113.06
Selenium Weir	30.4	μg/L	30.40	21.28	12.16	9.38	9.23	9.22	9.21	9.16	9.08	8.90

6.3 FAR-FIELD EVALUATION OF CDF MONITORING RESULTS

Chronic water quality criteria for the protection of aquatic life apply after consideration of complete mixing in the water body. Chronic criteria were evaluated with a far-field assessment. Sample concentrations of several parameters were above their respective chronic criteria in a few weir and mix samples. For these parameters the mass balance loadings (see Section 6.8) were mixed with a river flow volume equivalent to 1 week of the net 7Q10 discharge flows for a section of the Delaware River near the Killcohook CDF. The 7010 is the 7-day, 10-year low flow past a particular location across a body of water. In the present case it's the 7-day low flow with a 10-year recurrence interval based on 90 + years of flow monitoring in the Delaware River (132.64 m³/sec or 80,220,672 m³ for 1 week). Using the background concentrations observed during the Killcohook monitoring period, the discharge loads for 9 months from the CDF weirs were added to the 7Q10 flow over a 1 week period to estimate worst-case far field concentrations. CDF loadings did not change background concentrations of any parameter due to the high amount of far-field dilution and relatively low loadings discharging from the weirs (Table 6-7). As such, chronic water quality criteria for the protection of aquatic life were met during the monitoring period. This analysis is very conservative since it assumes nine months of CDF loadings were discharged to the river within a 1-week period which is clearly not the case.

Consideration of DNREC human health criteria also requires a far-field evaluation. Human health criteria include systemic toxicants and human carcinogens. DNREC (2004⁴) defines a systemic toxicant as a toxic substance that has the ability to cause effects within the body at sites distant from the entry point due to its absorption and distribution. DNREC defines a carcinogen as a substance that increases the risk of benign or malignant neoplasms (tumors) in humans or other animals. In accordance with DNREC section 4.6.3.3.2.1 the Delaware River is not State designated as a Public Water Supply Source. Therefore only the "Fish Ingestion" criteria in Table 2 of DNREC (2004⁴) section 4.6.3.3.2.1 apply. The "Fish and Water Ingestion" criteria do not apply.

Human health criteria also apply after consideration of complete mixing in the water body. Sample concentrations of several parameters were above their respective human health criteria in a few weir and mix samples. For these parameters the mass balance loadings (see Section 6.8) were mixed with a river flow volume equivalent to 1 week of the net mean harmonic discharge flows for a section of the Delaware River near the Killcohook CDF, based on 90 + years of flow monitoring in the Delaware River (283.67 m³/sec or 171,563,616 m³ for 1 week). Using the background concentrations observed during the Killcohook monitoring period, the discharge loads for 9-months from the CDF weirs were added to the net mean harmonic flow over a 1-week period to estimate worst-case far-field concentrations. CDF loadings did not change background concentrations of any parameter due to the high amount of far-field dilution

Delaware Department of Natural Resources and Environmental Control. 2004. State of Delaware Surface Water Quality Standards as Amended, July 11, 2004.

and relatively low loadings discharging from the weirs (Table 6-7). As such, human health water quality criteria were met during the monitoring period. This analysis is very conservative since it assumes nine months of CDF loadings were discharged to the river within a week period which is clearly not the case.

Table 6-7. Results of far field analysis using 7Q10 and mean harmonic flow for weir parameters with at least one observation over chronic or human health criteria for carcinogens

Analyte	Unit	Ave Weir Concentration	Total kg Discharged from Cell 2 Weir in 9 Months	Average Background Concentration	Concentration Resulting from Weir Discharge Using 7Q10 Flow for 1 Week	Concentration Resulting from Weir Discharge Using Mean Harmonic Flow for 1 Week
4,4-DDD	μg/L	0.0009	0.005	0.0001	0.000100065	0.000100030
4,4-DDE	μg/L	0.0004	0.003	0.0001	0.000100032	0.000100015
4,4-DDT	μg/L	0.0007	0.004	0.0002	0.000200053	0.000200025
Aroclor 1242	μg/L	0.0006	0.004	0.0010	0.001000045	0.001000021
Aroclor 1248	μg/L	0.0012	0.007	0.0000	0.000000092	0.000000043
Aroclor 1260	μg/L	0.0007	0.004	0.0000	0.000000049	0.000000023
Dieldrin	μg/L	0.0005	0.003	0.0003	0.000300036	0.000300017
gamma-Chlordane	μg/L	0.0011	0.006	0.0013	0.00130008	0.001300037
Heptachlor	μg/L	0.0015	0.009	0.0006	0.000600109	0.000600051
Antimony	μg/L	1.06	6.387	0.66	0.660079621	0.660037230
Arsenic	μg/L	14.44	86.953	3.740	3.741083924	3.740506827
Barium	μg/L	176.79	1064.453	49.9300	49.94326906	49.936204420
Beryllium	μg/L	0.41	2.469	0.0800	0.080030783	0.080014394
Cadmium	μg/L	0.32	1.918	0.0200	0.020023913	0.020011182
Chromium	μg/L	22.28	134.176	9.3000	9.301672588	9.300782078
Cobalt	μg/L	6.62	39.831	1.2300	1.230496512	1.230232162
Copper	μg/L	8.45	50.869	4.32	4.320634114	4.320296502
Cyanide	μg/L	1.37	8.262	0.470	0.470102993	0.470048158
Lead	μg/L	17.87	107.623	4.0800	4.081341583	4.080627305
Mercury	ng/L	14.28	0.086	7.611	7.610501072	7.610500501
Nickel	μg/L	12.90	77.671	3.2600	3.260968214	3.260452723
Selenium	μg/L	5.75	34.605	3.870	3.87043137	3.870201702
Silver	μg/L	0.04	0.239	0.0067	0.006702976	0.006701392
Thallium	μg/L	0.12	0.693	0.1100	0.110008643	0.110004041
Vanadium	μg/L	36.73	221.164	6.0500	6.05275695	6.051289110
Zinc	μg/L	83.08	500.227	24.7000	24.70623564	24.702915696
Benzo(a)pyrene	μg/L	0.0417	0.251	0.0230	0.023003131	0.023001464
Dibenz(a,h)anthracene	μg/L	0.0795	0.479	0.0421	0.04210597	0.042102791
Benzo(a)anthracene	μg/L	0.0542	0.326	0.0348	0.03480407	0.034801901
Benzo(b)fluoranthene	μg/L	0.0577	0.347	0.0248	0.02480433	0.024802024
Indeno(1,2,3- cd)pyrene	μg/L	0.0786	0.473	0.0416	0.04160590	0.041602757
PCB sum of Congeners	ng/L	49.500	0.298	2.2470	2.24700372	2.247001737
Dioxin and Furan sum of Congeners	pg/L	1443.000	0.009	216.2000	216.20000000	216.200000000

6.4 ORGANOCHLORINE DDT AND METABOLITES

The organochlorine pesticide DDT and its metabolites DDD and DDE (collectively called DDX) were evaluated separately since DDX contributes to fish advisories in the riverine portion of the Delaware River. DDX is particle reactive tending to sorb to sediments and is therefore a contaminant of concern particularly during dredging operations which can mobilize suspended sediments in CDF weir discharges. DDX is simply the sum of DDT, DDD, and DDE concentrations in a given sample which can be compared to DNREC and EPA's freshwater chronic criterion of 0.001 μ g/L as well as DNREC's human health criterion of 0.0022 μ g/L. Figure 6-1 displays DDX concentrations observed at the Killcohook weir, mix and background sites. Chronic aquatic life and human health criteria are a far field analysis. As is shown on Table 6-7, using appropriate river flows, dilution of DDX levels discharged from the weirs with background levels did not change background concentrations of DDX in this portion of the river. Mass balance calculations (see Section 6.8) indicate that 99% of the DDX pumped into the CDF stayed in the CDF.

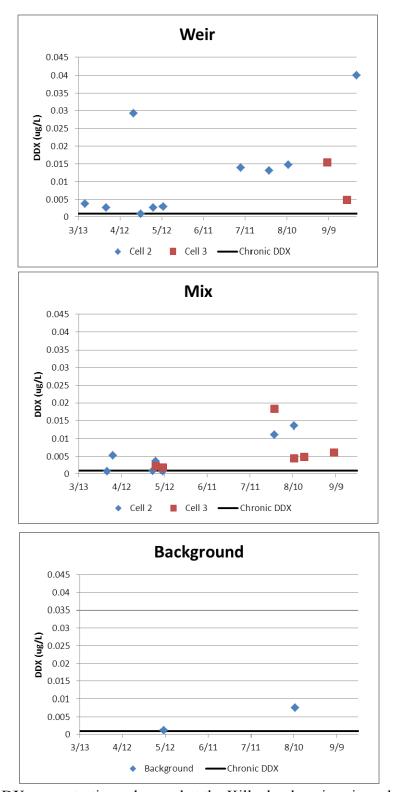


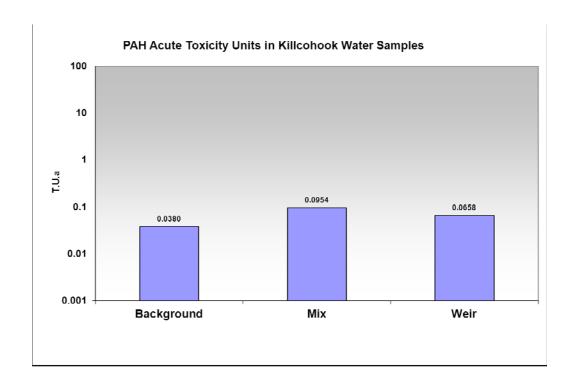
Figure 6-1. DDX concentrations observed at the Killcohook weir, mix and background sites

6.5 POLYAROMATIC HYDROCARBON TOXICITY

Polyaromatic Hydrocarbons (PAHs) were detected in the weir, mix, and background samples. PAHs are of interest in the Delaware Estuary due to the large presence of petrochemical refineries, heavy industry, and past oil spills such as the Altos I spill in November 2004. Studies in the estuary have routinely detected PAHs in channel sediments. Scientific methods have been developed to assess potential environmental impacts of the release of a suite of PAH compounds expressed as chronic toxicity units (Di Toro and J.A. McGrath 2000⁵). Acute and chronic toxicity units greater than 1 indicate that a type I narcosis effect is expected for aquatic life. For this analysis PAHs (measured as total concentration in this study) were converted to dissolved concentrations using equilibrium partitioning theory and each compound's respective K_{ow}. The procedure provides a method to evaluate the effect of mixtures of PAHs on aquatic organisms. Final Acute Values (FAVs) and Final Chronic Values (FCVs) are derived using National Water Quality Guidelines which are PAH concentrations intended to be protective of aquatic life. The dissolved concentration of the detected PAH compound is divided by compound-specific FAVs or FCVs and summed. Sums <1 can be considered protective of aquatic life while values >1 indicate a potential toxic effect. This analysis was conducted by populating spreadsheets supplied by DNREC (R. Greene) with the Killcohook monitoring data. Non-detected compounds were assumed to have zero concentration and mean weir, mix, and background concentrations for detected PAHs were entered into the DNREC spreadsheet. A copy of this spreadsheet is presented in Appendix D. The results of this analysis are presented in Figure 6-2 and show that both the Acute and Chronic Toxicity units were less than 1.0 for all weir, mix, and background samples with detected PAHs. Weir samples had slightly more detected PAHs (19) than the Mix samples (16), and Background samples (15).

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⁵ **Di Toro, D.M and J.A. McGrath. 2000.** Technical Basis for Narcotic Chemicals and Polyaromatic Hydrocarbon Criteria. II.. Mixtures and Sediments. Environmental Toxicology and Chemistry. Vol 19, No. 8.



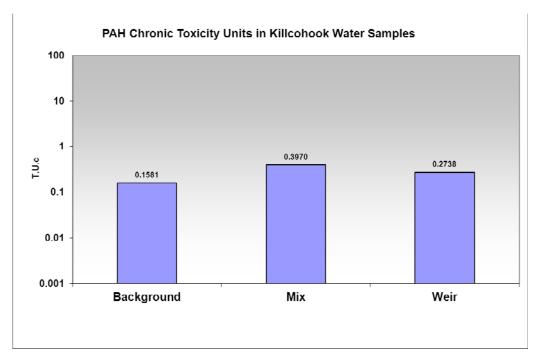


Figure 6-2. Results of PAH Acute and Chronic Toxicity Units.

6.6 STATISTICAL ANALYSIS

Prior to statistical testing, all chemical data were examined using the Shapiro–Wilk test to determine if the data were normally distributed to meet the assumptions of ANOVA modeling. Ninety percent of the parameters were not normally distributed so all data were converted to natural logs for further statistical analyses. When a particular parameter was not detected 1/2 the detection limit was used. Calcium, sodium, magnesium, manganese, and potassium were excluded from the statistical analyses due to their non-toxic nature. The first step in the analysis of the data was to determine if significant differences were observed between Cell 2 and Cell 3 weir and mix samples. ANOVA testing determined that there were primarily no significant differences in contaminant concentrations of pesticides, inorganics, and semi-volatile organics between Killcohook Cells 2 and 3 (both mix and weir) so Cells 2 and 3 mix and weir data were combined for further analysis.

Two types of ANOVA testing were performed on the data. The first tested for significant differences in parameter groups that included GCSEMI (pesticides), MET (total inorganics), MET-DISS (dissolved inorganics), and MSSEMI (semi-volatile organics) by sample type (background, mix, and weir; Table 6-8). The second ANOVA was conducted for each individual parameter to determine if there were parameter specific differences among sample types (Table 6-9). Only significant differences (p < 0.05) are presented in Table 6-9. For each ANOVA test Duncan's Multiple Range tests were included to determine which of the mean concentrations among the three treatment groups (background, mix, and weir) were different from each other. In the summary tables means with similar letters are not significantly different from each other.

Among parameter groupings there were no significant differences in concentrations detected for pesticides and semi-volatile organics among the background, mix, and weir samples (Table 6-8). However significant differences were detected in the total and dissolved inorganic tests. For total inorganics, mean concentrations in the mix and weir samples were not significantly different from each other but both were significantly higher than the background concentrations. For dissolved inorganics, weir concentrations were significantly higher than background, but background and mix concentrations were not significantly different from each other. This analysis suggests that the inorganic contaminants are more soluble than organic contaminants and that the Killcohook CDF increased the inorganic concentrations in the discharge waters. Table 6-9 presents the parameter specific significant ANOVA results for the total and dissolved inorganics showing that the mix and weir concentrations were consistently higher than those observed at the background site.

Table 6-8	3. ANOVA result	ts of par	rameter	grou	ping b	y sampl	e type	;			
			Duncan	's grou	pings		N]	Mean value	
Analyte Group	Analyte	p- value	Back- ground	Mix	Weir	Back- ground	Mix	Weir	Back- ground	Mix	Weir
GCSEMI	Pesticides	0.9144	A	A	A	589	1767	2232	0.040	0.041	0.042
MET	Total Inorganics	<.0001	В	A	A	376	1196	1295	94.310	347.632	319.739
MET-DISS	Dissolved Inorganics	<.0001	В	В	A	336	1072	1152	5.761	14.043	21.708
MSSEMI	Semi-volatile Organics	0.5255	A	A	A	1368	4104	4968	0.753	0.689	0.678

Table 6-9	. ANOVA	results o	of signific	cant i	norgai	nic param	eters	by san	nple type	2	
			Duncan'	s group	ings		N	•		Mean value	;
Analyte Group	Analyte	p- value	Back- ground	Mix	Weir	Back- ground	Mix	Weir	Back- ground	Mix	Weir
MET	Aluminum	<.0001	В	A	В	21	67	72	1563.86	5940.75	5344.15
MET	Antimony	<.0001	В	В	A	21	67	72	0.662	0.676	1.061
MET	Arsenic	<.0001	С	В	A	21	67	72	3.767	6.075	14.442
MET	Barium	<.0001	С	В	A	21	67	72	49.933	79.219	176.790
MET	Cadmium	0.0221	AB	В	A	21	67	72	0.476	0.428	0.687
MET	Chromium	<.0001	В	A	В	21	67	72	9.295	19.663	22.285
MET	Cobalt	<.0001	В	A	A	21	67	72	1.229	4.037	6.615
MET	Copper	<.0001	В	A	В	21	67	72	4.324	9.436	8.449
MET	Lead	<.0001	В	A	В	21	67	72	4.081	13.475	17.875
MET	Mercury	<.0001	В	A	В	19	57	71	7.611	34.132	14.278
MET	Nickel	<.0001	В	A	A	21	67	72	3.262	8.776	12.900
MET	Silver	0.0013	A	В	A	21	67	72	0.459	0.306	0.408
MET	Vanadium	0.0002	В	A	В	21	67	72	6.050	15.077	36.781
MET	Zinc	<.0001	С	A	В	21	67	72	24.700	68.494	83.081
MET-DISS	Antimony-Diss	<.0001	В	В	A	21	67	72	0.517	0.590	1.048
MET-DISS	Arsenic-Diss	<.0001	В	В	A	21	67	72	2.192	2.563	4.328
MET-DISS	Barium-Diss	<.0001	В	В	A	21	67	72	37.819	51.812	139.932
MET-DISS	Cobalt-Diss	<.0001	С	В	A	21	67	72	0.251	0.493	2.089
MET-DISS	Nickel-Diss	<.0001	С	В	A	21	67	72	1.407	2.092	4.878
MET-DISS	Selenium-Diss	0.0077	В	AB	A	21	67	72	2.819	3.502	4.205
MET-DISS	Zinc-Diss	0.0095	В	В	A	21	67	72	6.633	8.801	14.860

A Multi-dimensional analysis using the Primer-E Ltd. statistical package was also performed on the data to visually present differences and similarities in contaminant concentrations between sample type (background, mix, and weir) by parameter grouping (pesticides, total inorganics, dissolved inorganics, and semi-volatile organics). Primer-E output placed the samples into natural groupings of similar chemical compositions and constructed a map of sample similarity on a two dimensional unit-less plot. The closer two points are on the MDS plot the more similar the samples are to each other. By plotting all the data for each parameter grouping by sample type we can determine how similar or different the background, mix, and

weir data are relative to each other. The first series of MDS plots included all the data which showed that most of the background, mix, and weir points are superimposed on each other suggesting that the treatment groups were similar (Figure 6-3). However mix and weir samples are more dispersed in space, while background samples are densely clustered. This result indicates that the chemical composition of the mix and weir samples have a larger variance than the background samples taken far from any known discharge source. To further visualize the major cluster of sample grouping, a second series of MDS plots were produced eliminating the two pesticide outliers to the right of the original plot, the three outliers to the right and bottom of the total and dissolved inorganics plots, and the four semi-volatile organic outliers to the top and right hand corner (Figure 6-3). MDS plots without the outliers show a slight separation of the total and dissolved inorganics for mix and weir samples, a tight grouping of background samples (with the exception of total inorganics), and no dramatic clustering of pesticides and semi-volatile organics (Figure 6-4).

6.7 TOTAL SUSPENDED SOLIDS

Figure 6-5 presents the daily TSS data for the weir discharge of Cells 2 and 3, the biweekly Delaware River mix samples for Cells 2 and 3, and weekly background measurements. As can be seen from the data series for Cells 2 and Cell 3 weir discharge, the dredged material containment cells were very efficient at retaining sediment as TSS levels are generally well below 250 mg/L and very similar to background measurements at Pennsville, New Jersey. There were occasional spikes in the time series above 200 mg/L but those observations were typically short lived (i.e., a single event). The low TSS level observed in the weir samples indicates that the Killcohook CDF was working in optimum fashion as the heavy sediment loads seen at the inlet (Figure 6-6) were removed by the time the water reached the weir for discharge back into the Delaware River (Figure 6-7). The mix samples were grab samples taken the day the automatic sampler was serviced and were much more variable relative to the weir and background data. Mix samples taken along the Delaware River shoreline where the CDFs discharged often had much higher TSS levels than weir samples. This was largely due to the shallow nature of the shoreline at Killcohook where wind and vessel induced wave action increased the TSS levels along the entire shoreline (Figure 6-7).

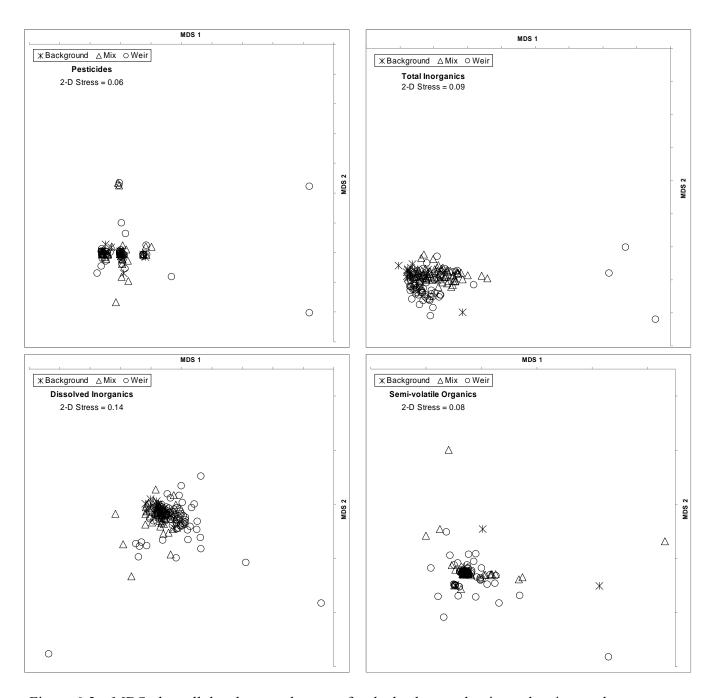


Figure 6-3. MDS plots all data by sample group for the background, mix, and weir sample types

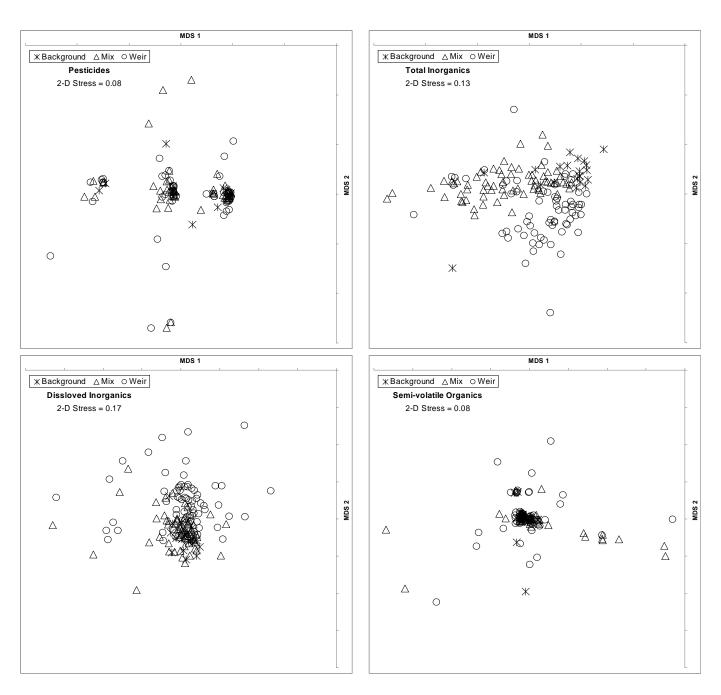
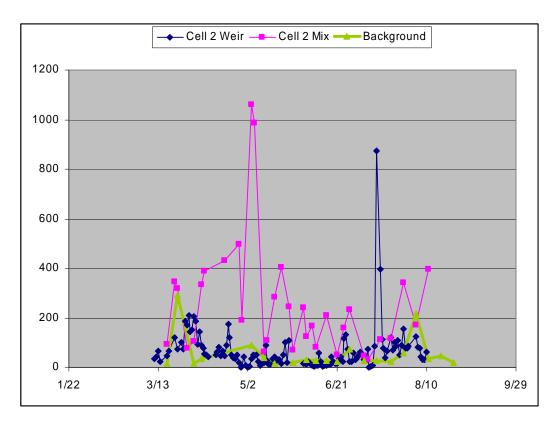


Figure 6-4. MDS plots with outliers removed by sample group for the background, mix, and weir sample types



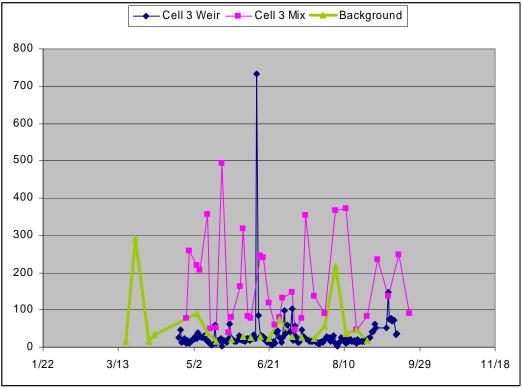


Figure 6-5. Weir, mix, and background TSS observed at the Killcohook CDF in 2010



Figure 6-6. Dredged slurry being pumped into the Killcohook CDF during Reach C Deepening during the 2010 monitoring



Figure 6-7. Killcohook Cell 2 weir discharge during Reach C Deepening during the 2010 monitoring

6.8 MASS BALANCE EVALUATION

The act of hydraulic dredging removes Delaware River sediments and associated contaminants and places them in a CDF where the pumped slurry is dewatered. Most of the contaminants in the sediment settle out and remain in the upland disposal site while a small fraction stays in suspension and is ultimately discharged back into the river through the weir. Previous studies funded by the Philadelphia District evaluating maintenance dredging operations in the Marcus Hook area indicated that over 95% of the contaminants are sequestered in the CDF⁶, a net benefit from an aquatic toxicology perspective. CDF retention efficiencies can be calculated by multiplying the mean contaminant concentration in the inlet samples by an estimate of the total kilograms of material pumped into the CDF and comparing that to similar estimates of total kilograms of contaminants discharged at the weir over a prescribed period of time.

To evaluate the CDF efficiencies for the Reach C deepening work, dredging logs from the Pullen were obtained and the accumulative cubic yards pumped into Cell 2 (2,200,000 cubic yards) was entered into a mass balance spread sheet. Total cubic yards of dredged material were converted to total kg of dry sediment by multiplying cubic yards by 595.85 as per a recent Killcohook specific sediment density analysis⁷. All inlet sample data were used to calculate average inlet contaminant concentrations. Using the weir discharge flow data recorded by ISCO area velocity meters installed in the discharge pipes the total liters discharged for the monitoring time period was calculated. Multiplying the total discharge (6,020,990,988 liters) by the mean weir concentrations measured among all Cell 2 weir samples provides an estimate of the total kilograms of contaminants that were released back into the Delaware River. Only parameters detected in both the inlet and weir samples were included in the analysis and non-detections were assumed to be zero. Total inorganic data, which includes dissolved inorganics, was used for this analysis. Mass balance calculations were only conducted on Cell 2 (where most of the material was placed) because Cell 3 outflows were not monitored.

The estimated contaminant sequestering efficiencies for Cell 2 of the Killcohook CDF were mostly above 90% (Table 6-10). The pesticide delta-BHC had the lowest retention efficiency of 83.7% while alpha-BHC had a retention rate of 93.4%. Heptachlor had a retention efficiency of 91.0%, while 97.8% of gamma-BHC (Lindane) was captured by the CDF. All other pesticides had retention efficiencies of 99% or better. Inorganic retention rates ranged from 96.8 to 99%. Similarly, semi-volatile organic retention efficiencies were mostly 99% with the exception of bis(2-Ethylhexyl) phthalate which had an efficiency of 93.7%. Of particular

⁶ **Burton and Farrar 2003.** Contaminant Sequestering And Water Quality Discharges At Confined Disposal Facilities. In: M. Pellei and A. Porta (eds.), Remediation of Contaminated Sediments—2003. Proceedings of the Second International Conference on Remediation of Contaminated Sediments (Venice, Italy; 30 Sep–3 Oct 2003). ISBN 1-57477- 143-4, published by Battelle Press, Columbus, OH, www.battelle.org/bookstore.

⁷ **Greene, R.W. 2011**. Bulk Density of Delaware River Main Channel Sediments, spreadsheet analysis dated May 22, 2011.

note were the retention efficiencies of the sum of PCB congeners (measured using a smaller subset of samples with high resolution laboratory methods). The mass balance analysis indicates that 80.5 kg of PCBs were pumped into the CDF and only 0.3 kg was released back into the Delaware River through the weir discharge. The retention of PCBs in the CDF was 99.6%.

Table 6-10. Mass balance estimate and estimated Cell 2 sequestering efficiencies (%) at Killcohook among the various contaminants detected in both the inlet and weir samples.

detected in both		t and wen s		ı			
Total Liters Discharged from Cell 2			6,020,990,988				
Total Kg pumped into Cell 2	1		1,002,474,000		i	1	
	#T **	Ave Weir	Total kg Discharged	Ave Inlet	T. •.		Percent (%)
Weir/Inlet Parameters Detected	Unit	Con.	from Weir	Con.	Unit	Total kg into CDF	Sequestered in CDF
GCSEMI				1		-	
4,4-DDD	μg/L	0.0009	0.005	202.6814	μg/kg	265.689	99.9980
4,4-DDE	μg/L	0.0004	0.003	22.7929	μg/kg	29.878	99.9913
4,4-DDT	μg/L	0.0007	0.004	128.5911	μg/kg	168.566	99.9975
Aldrin	μg/L	0.0006	0.003	0.3083	μg/kg	0.404	99.1372
alpha-BHC	μg/L	0.0040	0.024	0.2808	μg/kg	0.368	93.4884
Aroclor 1248	μg/L	0.0012	0.007	5.1000	μg/kg	6.685	99.8899
Aroclor 1260	μg/L	0.0007	0.004	5.3220	μg/kg	6.976	99.9437
beta-BHC	μg/L	0.0013	0.008	2.3817	μg/kg	3.122	99.7461
delta-BHC	μg/L	0.0129	0.078	0.3637	μg/kg	0.477	83.6708
Dieldrin	μg/L	0.0005	0.003	0.5006	μg/kg	0.656	99.5629
Endosulfan II	μg/L	0.0001	0.001	1.1500	μg/kg	1.508	99.9495
Endosulfan sulfate	μg/L	0.0000	0.000	2.2857	μg/kg	2.996	99.9925
Endrin	μg/L	0.0004	0.003	1.1100	μg/kg	1.455	99.8218
Endrin aldehyde	μg/L	0.0002	0.001	2.7000	μg/kg	3.539	99.9716
Endrin ketone	μg/L	0.0002	0.001	1.6568	μg/kg	2.172	99.9576
gamma-BHC (Lindane)	μg/L	0.0040	0.024	0.8514	μg/kg	1.116	97.8354
gamma-Chlordane	μg/L	0.0011	0.006	40.3900	μg/kg	52.946	99.9879
Heptachlor	μg/L	0.0015	0.009	0.0740	μg/kg	0.097	91.0000
Heptachlor epoxide	μg/L	0.0003	0.002	7.0550	μg/kg	9.248	99.9797
Methoxychlor	μg/L	0.0003	0.002	5.8500	μg/kg	7.669	99.9796
MET	_						
Aluminum	μg/L	5344.15	32177.096	12445.56	mg/kg	16314505.411	99.8028
Antimony	μg/L	1.06	6.387	0.38	mg/kg	498.131	98.7178
Arsenic	μg/L	14.44	86.953	10.64	mg/kg	13953.483	99.3768
Barium	μg/L	176.79	1064.453	59.02	mg/kg	77370.460	98.6242
Beryllium	μg/L	0.41	2.469	0.81	mg/kg	1064.718	99.7681
Cadmium	μg/L	0.32	1.918	0.61	mg/kg	793.950	99.7584
Chromium	μg/L	22.28	134.176	38.71	mg/kg	50745.234	99.7356
Cobalt	μg/L	6.62	39.831	10.17	mg/kg	13327.178	99.7011
Copper	μg/L	8.45	50.869	23.39	mg/kg	30659.793	99.8341

Table 6-10. (Continued)											
Total Liters Discharged from Cell 2			6,020,990,988								
Total Kg pumped into Cell 2			1,002,474,000								
		Ave Weir	Total kg Discharged	Ave Inlet			Percent (%)				
Weir/Inlet Parameters Detected	Unit	Con.	from Weir	Con.	Unit	Total kg into CDF	Sequestered in CDF				
MET (Continued)											
Iron	μg/L	1.37	8.262	2.32	mg/kg	3045.588	99.7287				
Lead	μg/L	17.87	107.623	41.18	mg/kg	53978.714	99.8006				
Mercury	ng/L	14.28	0.086	143.83	μg/kg	188.547	99.9544				
Nickel	μg/L	12.90	77.671	20.10	mg/kg	26348.487	99.7052				
Selenium	μg/L	5.75	34.605	0.84	mg/kg	1098.218	96.8490				
Silver	μg/L	0.04	0.239	0.30	mg/kg	394.900	99.9395				
Thallium	μg/L	0.12	0.693	0.18	mg/kg	237.704	99.7083				
Vanadium	μg/L	36.73	221.164	34.93	mg/kg	45793.059	99.5170				
Zinc	μg/L	83.08	500.227	152.53	mg/kg	199951.371	99.7498				
MSSEMI											
2-Methylnaphthalene	μg/L	0.0146	0.088	31.0000	μg/kg	40.637	99.7838				
2-Methylphenol	μg/L	0.0002	0.001	19.0000	μg/kg	24.907	99.9951				
4-Chloroaniline	μg/L	0.0043	0.026	23.0000	μg/kg	30.150	99.9132				
4-Methylphenol	μg/L	0.3527	2.124	38.6000	μg/kg	50.600	95.8027				
Acenaphthene	μg/L	0.0107	0.064	13.2333	μg/kg	17.347	99.6288				
Acenaphthylene	μg/L	0.0004	0.002	20.0000	μg/kg	26.217	99.9907				
Anthracene	μg/L	0.0059	0.036	30.4286	μg/kg	39.888	99.9107				
Benzaldehyde	μg/L	0.8606	5.182	263.0000	μg/kg	344.759	98.4971				
Benzo(a)anthracene	μg/L	0.0542	0.326	69.7500	μg/kg	91.433	99.6433				
Benzo(a)pyrene	μg/L	0.0417	0.251	85.7500	μg/kg	112.407	99.7766				
Benzo(b)fluoranthene	μg/L	0.0577	0.347	102.2500	μg/kg	134.036	99.7410				
Benzo(ghi)perylene	μg/L	0.0750	0.451	64.1429	μg/kg	84.083	99.4630				
Benzo(k)fluoranthene	μg/L	0.0687	0.413	67.0000	μg/kg	87.828	99.5294				
bis(2-Ethylhexyl) phthalate	μg/L	1.9023	11.454	137.8000	μg/kg	180.638	93.6592				
Butyl benzyl phthalate	μg/L	0.2628	1.582	125.7500	μg/kg	164.842	99.0403				
Caprolactam	μg/L	0.7667	4.616	380.0000	μg/kg	498.131	99.0733				
Carbazole	μg/L	0.0009	0.005	10.1333	μg/kg	13.283	99.9599				
Chrysene	μg/L	0.0620	0.373	83.1250	μg/kg	108.966	99.6577				
Dibenz(a,h)anthracene	μg/L	0.0795	0.479	37.2250	μg/kg	48.797	99.0186				
Dibenzofuran	μg/L	0.0048	0.029	24.5000	μg/kg	32.116	99.9093				
Diethyl phthalate	μg/L	0.0945	0.569	30.0000	μg/kg	39.326	98.5535				

Table 6-10. (Continued)										
Total Liters Discharged from Cell 2			6,020,990,988							
Total Kg pumped into Cell 2			1,002,474,000							
		Ave Weir	Total kg Discharged	Ave Inlet			Percent (%)			
Weir/Inlet Parameters Detected	Unit	Con.	from Weir	Con.	Unit	Total kg into CDF	Sequestered in CDF			
MSSEMI (Continued)										
Di-n-butyl phthalate	μg/L	0.0821	0.495	730.0000	μg/kg	956.935	99.9483			
Di-n-octyl phthalate	μg/L	0.0120	0.072	140.0000	μg/kg	183.522	99.9605			
Fluoranthene	μg/L	0.0312	0.188	101.2444	μg/kg	132.718	99.8582			
Fluorene	μg/L	0.0220	0.133	23.4000	μg/kg	30.674	99.5679			
Indeno(1,2,3-cd)pyrene	μg/L	0.0786	0.473	60.5714	μg/kg	79.401	99.4042			
Naphthalene	μg/L	0.0289	0.174	47.2857	μg/kg	61.985	99.7189			
Phenanthrene	μg/L	0.0945	0.569	66.8444	μg/kg	87.624	99.3509			
Phenol	μg/L	0.0106	0.064	20.0000	μg/kg	26.217	99.7567			
Pyrene	μg/L	0.0215	0.129	108.4778	μg/kg	142.200	99.9091			
High Resolution PCBs										
Mean Sum of Congeners	ng/L	49.500	0.298	61.385	ng/g	80.468	99.63			

7.0 CONFINED DISPOSAL FACILITY MONITORING DISCUSSION

7.1 INORGANICS

Among the inorganics discharged from the Killcohook CDF very few sample concentrations were over DNREC's freshwater acute criteria for protection of aquatic life during the nine month monitoring period, except for aluminum. Aluminum concentrations were over the DNREC acute criterion in most samples including background, but the criterion is dated and does not properly account for the effect of pH on solubility and toxicity according to Greene (2010). Of the 139 weir and mix samples collected over the monitoring period, two chromium samples, one arsenic sample and one selenium sample were over their respective criteria. To evaluate these samples a near-field assessment was conducted to determine the contaminant concentration at the edge of the zone of initial dilution (ZID). DNREC defines the ZID as five times the local water depth at the point of discharge, and for this location 15 feet was selected as the edge of the ZID. When CORMIX mixing zone model results developed for a similar USACE-maintained CDF were applied, the model predicted that the observed concentrations would be below the acute criteria at the edge of the ZID. As such, DNREC's freshwater acute criteria for protection of aquatic life during the nine month monitoring period were not exceeded. For inorganic parameters with observed concentrations above DNREC chronic freshwater criteria for the protection of aquatic life or DNREC human health criteria, a far-field assessment was conducted to determine the contaminant concentration after complete mixing for this location in the Delaware Estuary. Nine months of contaminant load discharged from the CDF was added to observed background concentrations and diluted by the appropriate flows for both aquatic life and human health criteria. The result was that no parameter increased background concentrations. As such, DNREC chronic freshwater criteria for the protection of aquatic life and DNREC human health criteria were met during the nine month monitoring period. Furthermore, mass balance calculations using inlet concentrations and CDF discharge loadings demonstrated that 96 to 99 percent of dredged inorganics stayed in the CDF.

7.2 PESTICIDES

No pesticide had an observed sample concentration at the discharge over DNREC's freshwater acute criteria for protection of aquatic life during the nine month monitoring period. A few parameters had some sample concentrations above DNREC chronic criteria for protection of aquatic life and human health criteria. The far field assessment as conducted for inorganics indicated again that when nine months of contaminant load discharged from the CDF was added to observed background concentrations and diluted by the low flows for one week no parameter increased background concentrations. As such, DNREC chronic freshwater criteria for the protection of aquatic life and DNREC human health criteria for pesticides were met during the nine month monitoring period. The mass balance analysis showed that 99 percent of the pesticides entering the CDF were retained by the CDF. In addition, ANOVA analysis of the

pesticide data indicated that there were no significant differences among weir, mix and background concentrations.

7.3 PCBs

There is no DNREC acute freshwater criterion for protection of aquatic life for PCBs. A few samples had PCB concentrations above the chronic criterion for protection of aquatic life (14 ng/L) and all samples including background were above the DNREC human health carcinogen criterion (0.064 ng/L). The far field assessment indicated that background concentrations of PCBs were not increased when nine months of the PCB load discharged from the CDF was added to observed background concentrations and diluted by the low flows for one week. Mass balance calculations indicated that 80.5 kg of PCBs were removed from the bottom of Reach C and pumped into the CDF while only a small fraction (0.3 kg) was released back into the Delaware River through the weir discharge.

7.4 PAHs

There are no DNREC acute or chronic freshwater criteria for protection of aquatic life for PAHs. There are DNREC human health carcinogen criteria for several PAHs. Several PAH parameters had a few sample concentrations above DNREC human health carcinogen criteria. The far field assessment indicated that when nine months of contaminant load discharged from the CDF was added to observed background concentrations and diluted by one week low flows no parameter increased background concentrations. As such, DNREC human health criteria for PAHs were met during the nine month monitoring period. The mass balance analysis showed that 99 percent of the PAHs entering the CDF were retained by the CDF. In addition, ANOVA analysis of the semi-volatile organic data indicated that there were no significant differences among weir, mix and background concentrations. PAH toxicity units computed using DNREC methods revealed that weir samples were below the 1.0 threshold above which PAH mixtures can be harmful to biota.

8.0 CONCLUSIONS

Dredging for the Delaware River Main Stem Channel Deepening Project began on March 1, 2010. The first construction contract was for Reach C of the channel, which extends from the Delaware Memorial Bridge to Elsinboro Point, NJ. Environmental monitoring for potential water quality impacts was intensively monitored at the Federally owned Killcohook dredged material containment facility and at the point of active dredging. The following conclusions are made based on monitoring data collected over the entire dredging project:

- A near-field assessment of contaminant concentrations within the zone of initial dilution for the CDF discharge points indicates that DNREC acute water quality criteria for the protection of aquatic life were met during the dredging period;
- A far-field assessment of contaminant loads discharged from the CDF indicates that no parameter increased background concentrations, as such DNREC chronic freshwater criteria for the protection of aquatic life, and DNREC human health criteria were met during the dredging period;
- Suspended solids and contaminant levels down-current of the cutterhead were consistent with or less than background levels, indicating that acute water quality criteria for the protection of aquatic life were met at the point of dredging; and
- A mass balance evaluation of the contaminant loads entering and leaving Cell 2 of the CDF indicates a large net removal of contaminants from the Delaware River.