NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

BUFFALO RIVER SEDIMENT STUDY
BUFFALO(C), ERIE COUNTY

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New York State Department of Environmental Conservation
GEORGE E. PATAKI, Governor DENISE M. SHEEHAN, Commissioner

BUFFALO RIVER SEDIMENT STUDY

CITY OF BUFFALO, ERIE COUNTY

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1.0 INTRODUCTION

Since the 1940s, the Buffalo River has experienced pollution problems such as excess nutrients, bacteria, and toxic chemicals. Municipal wastewater treatment plants and controls on industrial discharges have reduced many waterborne pollutants. Currently, the most pressing problems are discharges of persistent toxic pollutants, careless disposal of hazardous wastes near water bodies, combined sewer overflows (CSOs), and sediments contaminated with toxic metals, industrial organic chemicals, polychlorinated biphenyls (PCBs), pesticides, and polynuclear aromatic hydrocarbons (PAHs). Both surficial as well as deeper sediments throughout the Buffalo River are contaminated from years of industrial activity. As a result of this contamination, fisheries and benthic populations in the Buffalo River are severely impaired; fish consumption advisories exist for many fish species. An increased frequency in the number of tumors and other deformities found in fish has also been reported. River sediments at some locations are also contaminated with cyanide and metals to levels that prohibit open lake disposal of dredge materials.

Although numerous studies of sediment quality have been performed since the initiation of the Buffalo River Remedial Action Report in 1986, no comprehensive work has been performed resulting in remedial alternatives to address contaminated sediment in the River.

2.0 PROJECT DESCRIPTION AND SUMMARY

2.1 Project Description and Objective

The purpose of this study is to collect representative and comprehensive sediment

samples from the Buffalo River in the area of the Buffalo River Area of Concern (AOC). The data in this report will be used in various other studies and reports produced by other agencies or groups to evaluate the effects that the actual or perceived nature of the sediment has on the River's ecosystem and environment. Data collected in this study will also be used to assess possible remedial alternatives for the River sediment, define the nature and extent of sediment contamination within the AOC, and determine the extent of recontamination of sediments within the dredge channel from sediments outside the dredge channel area.

The specific requirements of the sampling program can be found in the report entitled, *Field Sampling Plan for the Buffalo River Sediment Study, Buffalo(c), Erie County*, dated August 2005.

2.2 Rationale of Monitoring Design

The number of samples to be collected was determined based on a consideration of cost, total area, known or potential contaminant sources, and spatial variability of the sediment and the water body. A sampling bias toward areas known to be affected by tributaries, outfalls, other industrial sources or historical spills was exercised. Areas that were previously sampled in past studies were also sampled for comparison purposes.

Sediment sample locations were determined by the New York State Department of Environmental Conservation (DEC) with input from the United States Army Corp of Engineers (USACE), the Buffalo Niagara Riverkeeper (BNRK) and the United States Environmental Protection Agency (USEPA) Great Lakes Program Office (GLNPO). Sample locations and

depths were designed to assess impairment to habitat due to chemical contamination of shallow sediments (surface sediment samples along shorelines), chemical contaminant levels in recently deposited sediments (center channel samples), and historical chemical contaminants in undisturbed sediment (deep sediment samples along shoreline in non-dredged areas).

Sediment studies can provide information on the levels of contamination for organic chemicals and trace metals. The sampling plan for this study was determined by the type of data needed . Surficial samples provide a representation of current, ambient conditions for the biologically active sediment strata (usually the top 1-6 cm). They can be used for benthic toxicity, biological assessment and to determine what chemicals may be bioavailable. Core samples are used to characterize sediments prior to dredging, establish the physical properties of the deeper sediments or determine a chronological history of chemical deposition.

This sediment study will provide information on the levels of contamination for organic chemicals and trace metals. Analytical parameters were chosen in response to previous findings, to identify known or suspected contaminants of concern, or to supplement existing information (Table 1). Due to the uncertainty in the ability to obtain sediment cores, considerable flexibility regarding the exact locations and numbers of cores was provided to achieve study objectives. Table 2 presents the rationale used to select sample locations and collection methods.

All samples were field screened at the time of collection with a Photo Ionization Detector (PID) and visually logged for material characterization. Field notes (Attachment A) provide documentation on whether the discreetly sampled interval accurately represents the balance of the sediment core or a specific interval in the core. This information will be important to the

subsequent volume estimation process as well as other pertinent information relative to sample characteristics.

In addition to the collection of sediment samples for chemical analysis, 13 river sediment samples were collected and provided to the USACE for toxicity testing (Attachments B, C & D). Sample locations and collection information are included in DEC's field notes.

2.3 Sample Distribution

Table 3 provides a list of sample details such as location, type of sample, and number to be collected. sample identification number structure was establishedto identify the date, the type and the location that the sample was collected. Standard USACE H&H designations for left and right bank are based on a downstream looking position, thus the Left and Right banks will correspond to the South and North banks, respectively. Sample identification will therefore include the appropriate designation as right "R" and left "L". Samples collected within the centerline area of the dredge channel would be designated with a "C".

For example, a sample collected from sample Group 2, from the right bank, at transect location 795+00, from 0-6" below the surface (surface sample) would have a sample ID number of 2-795-00-R06. At the same date and location, a 12" sample from the bottom of the core at the native soil interface depth of 8 feet would have the sample ID of: 2-795-00-R78. Figures 3 through 7 show specific locations of sample collection.

Immediately after sampling, a global positioning system (GPS) unit was used to determine

exact sampling locations. If a planned sampling site could not be sampled, up to three attempts were made to sample from an alternative nearby site, using best professional judgment. When the alternative sites could not be sampled, the field notes indicate that no sample recovery was made.

2.4 Sampling Methods

Specific sampling procedures for chemistry, toxicity testing and benthic assessment samples are detailed in the Field Sampling Plan. The following is a synopsis of the detailed methods contained in the Plan.

In cooperation with the Great Lakes National Program Office of the USEPA, the *R/V Mudpuppy* was used as the primary vessel for sample collection. The *Mudpuppy* is a 32-foot flat-bottom boat specifically designed for sediment sampling in shallow rivers and harbors. It is equipped with a vibro-coring unit that allows the sampling of cores up to 15 feet long from locations with water depth between 2 and 50 feet. It is also equipped with a differentially corrected GPS with sub-meter accuracy that allows for precise and accurate determinations of sample locations.

Once samples were collected using the Mudpuppy's vibro-coring unit, excess core tube was removed. The sample core was then either transferred to the USACE pontoon craft or to a land-based sample preparation area where the core was cut and the specific sample collections were made. For the collection of the surficial samples a Petit Ponar sampler was used and a similar collection procedure was followed

Sufficient attempt was made to collect ample sample quantity at a specific location including the placement of multiple sample points. If multiple sample points were conducted, field records document the specific details of multiple attempts and the results so that this information could be made available during the future interpretation of the data. Volatile organic compounds (VOCs) were also analyzed from several cores that exhibited elevated PID values or showed visual evidence of petroleum contamination.

2.4.1. Core Samples

All core sampling was performed from the Great Lakes National Program Office vessel equipped with an electric vibro core sampler. The specific protocols for sediment core collection are detailed in the Field Sampling Plan. In general, a visual inspection of the sediment cores was performed upon retrieval. The overall core length and individual horizons or strata within each core was measured. These measurements, including depth of water column and all significant features were documented in the field notebook along with the date, time, and location of sample collection. Specific notes pertinent to the sampling program are included in Table 2.

The core tubes were laid out on a work surface suitable to support the entire core. The core samples were examined and sub-sectioning was dictated by the objectives of the study. Sediment core sub-sections were selected for analysis by a visual determination of the depositional strata present in the core. As noted by the rationale above, specific zones of the core material were sampled or the entire core was composited for one sample dependent on location and program goals as shown in Table 1. Additional sub-samples were also selected

from layers that appeared to be dark in color and rich in organic content, exhibited a sheen, odor or color, or had an elevated photoionization value above background. Sample containers were labeled using a permanent marker to indicate the date, time, and sampling location and this information was recorded in a field logbook and on a chain of custody form. After collection, all sample bottles were immediately placed in coolers with ice, and picked up from the site at the end of each day by laboratory personnel or laboratory-supplied couriers.

2.4.2 Surficial Samples

All surficial sediment samples for chemical analysis were collected using the vibro core sampler. The only surface samples that were collected using the ponar dredge were the biotoxicity samples, which were all collected using the USACE's pontoon craft. These samples were collected by DEC & USACE staff for later analysis by a USACE laboratory. Sample locations (designated as No. 11) for the biotoxicity testing are described in Table 2 and shown in Figures 3 through 7.

2.4.3 Surface Water Samples

DEC, in consultation with the USACE and BNRK, selected 17 locations for the collection of surface water samples in the Buffalo River. These sample locations were based upon the 25 locations that have been surveyed for human contact by USACE and BNRK. In choosing the sample locations the sites that have been surveyed to have the actual or highest potential for human contact were selected. Sites that were surveyed and found to have the actual or highest potential for human contact were selected as sampling locations as follows:

- Foot of Hamburg St.
- Cargill's Grain Elevator
- Concrete Central Grain Elevator
- First CSX Railway Bridge
- Smith St. Habitat Remediation Site
- Smith St. CSO
- Second CSX Railway Bridge
- Third CSX Railway Bridge
- Boone St. CSO

Additional sampling points were added based upon potential habitat areas located on the Buffalo River. Sampling proceeded from downstream locations to upstream locations so that disturbance related to the sampling did not affect the samples collected on the upstream side. The water sampling was conducted separately from the sediment sampling program. Samples for this study were collected from the bow of the sampling boat atpredetermined locations as show in Figures 3 through 7. The rationale for the location of surface water samples is further discussed in Table 2, and the list of parameters to be analyzed is shown in Table 3. Samples were collected using new polyethylene tubing and Tygon drive tubing fitted to a variable-speed peristaltic pump for each sample location. Specific methods for water sample collection are further described in the Field Sampling Plan.

2.4.4 Sample Custody Procedures

All sample handling, transport, and custody procedures are detailed in Field Sampling Plan. Field notes were taken to document sample collection times, locations, dates, and

sampling personnel. Individual sample containers were marked to identify each station number, collection time, date, and location. Laboratory analysis sheets included this information in addition to a description of the specific analyses to be performed, and the time and date of shipment to the lab.

2.4.5 Analytical Methods

For the purpose of this study, DEC employed the services of Severn Trent Laboratories (STL). Analytical methods employed for this study are listed in Tables 1 and Tables 7-1, 7-2 and 7-3 of the STL QAPP. The STL laboratory in Buffalo performed the analysis for the surface water and VOC sediment samples, while the STL Burlington laboratory performed the analysis of SVOCs, pesticides, metals and PCBs.

3.0 NATURE AND EXTENT OF CONTAMINATION

The purpose of this study did not include the analysis and/or interpretation of the analytical results that were collected . As such, only a brief review of the sampling information will be provided in this document.

3.1 Surface Water

- While all four groups of parameters were analyzed, only 8 individual metals and bis(2-ethylhexyl) phthalate were detected in surface water samples from all 18 sample locations. All other parameters, such as

PCBs, pesticides and the remaining SVOCs, were below detectable analytical levels.

3.2 Surface Sediments

- While numerous SVOCs were detected at levels near or below the quantifiable detection limit, benzo(a)anthracene, benzo(g,h,i)perylene, chrysene, and dibenz(a,h)anthracene were routinely detected at levels that exceeded guidance values. Levels of SVOCs varied significantly throughout the project area from a total high of 164,510 ug/kg at location 2-675-00-R06 to a total low of Non-detectable at location 2-695-00-L06.

3.3 Subsurface Sediments

- The prominent metals of concern found in the subsurface sediment above guidance values were: Arsenic, Chromium, Copper, Iron, Lead, Manganese, Nickel, Zinc, and Mercury.
- The prominent PCB aroclors detected were 1242, 1254, and 1260. Total PCBs were also generally less than 1 part per million. The highest levels of PCBs appear to be scattered throughout the AOC and are not specifically affiliated with a particular industrialize area. PCB levels greater than 1 ppm were detected in areas downstream of grain elevators (652+00L and 608+00L), downstream of the Buffalo Color Area D peninsula (693+00R), in a center channel sample between the Buffalo Color Area D peninsula and the former Republic Steel Site (720+00C) and along the western property line of the Mobil Oil facility (748+00R).
- While numerous SVOCs were detected at levels near or below the quantifiable detection limit, benzo(a)anthracene, benzo(g,h,i)perylene,

chrysene, and dibenz(a,h)anthracene were routinely detected at levels that exceeded guidance values. Levels of SVOCs varied significantly throughout the project area from a total high of 1,6238,400 ug/kg at location 6-698-00-L35 (adjacent to the Norfolk-South Rail Yard) to a total low of 3,152 ug/kg at location 6-623-00-L35 (across form the Katherine Street Pennisula).

- In general terms, the concentrations of contaminants in the subsurface sediments appears higher than the levels found in surface sediments. The subsurface samples may therefore represent older sediments that are indicative of historical discharges from past industrial operations.

3.4 USACoE Studies

At the request of the United States Army Corp of Engineers (USACE), Buffalo District ASci-Environmental Testing Laboratory (ASci-ETL) performed toxicity tests with bulk sediment samples collected from Buffalo River. The 10-day tests were performed to measure the toxicity of selected sediment samples to Hyalellu azteca (amphipod) and larval Chironomus tentans (midge). The Hyalella test endpoint was survival, and the Chironomus endpoints were survival and growth (ash-free dried weight (AFDW)).

Samples used in the study were collected at station locations noted in Table 3 and in accordance with the procedures discussed in section 2.4.2 of this report. Exposures to determine the toxicity of whole sediment samples from Buffalo River were performed following suggested United States Environmental Protection Agency (USEPA)/USACE methods

(USEPAIUSACE 1998). Ten-day tests exposing Hyalella and Chironomus were conducted in a manner to determine the effect of each test sediment on organism survival and Chironomus growth. Effect was determined by comparison to organism performance following exposure to the selected reference site sediment. Exposure conditions were maintained using an intermittent flow system for renewal of overlying water. Following are detailed descriptions of test performance, test results, data reduction, and results interpretation.

The following conclusions can be drawn from the study results.

1. The laboratory control sediment used for this study supported acceptable organism survival for both test species and acceptable Chironomus growth.
2. One sediment collected from the Buffalo River, 11-673-00-L00, caused significant mortality to Hyalella when compared to the laboratory control (West Bearskin).
3. None of the sediments collected from the Buffalo River caused significant mortality to Chironomus when compared to the laboratory control (West Bearskin).
4. Sediment collected from the Buffalo River management unit 11-695-00-R00 caused significant growth impairment to Chironomus when compared to the laboratory control (West Bearskin).

In addition to the above biotoxicity study, the USACoE also conducted measurement of pore water pH, ammonia levels, particle size analysis and specific gravity for Buffalo River sediments. The results of these studies can be found in Attachment B.