United States Environmental Protection Agency

October 2003

DREDGING OF WHITE LAKE AND DEWATERING ACTIVITIES

Summer 2003

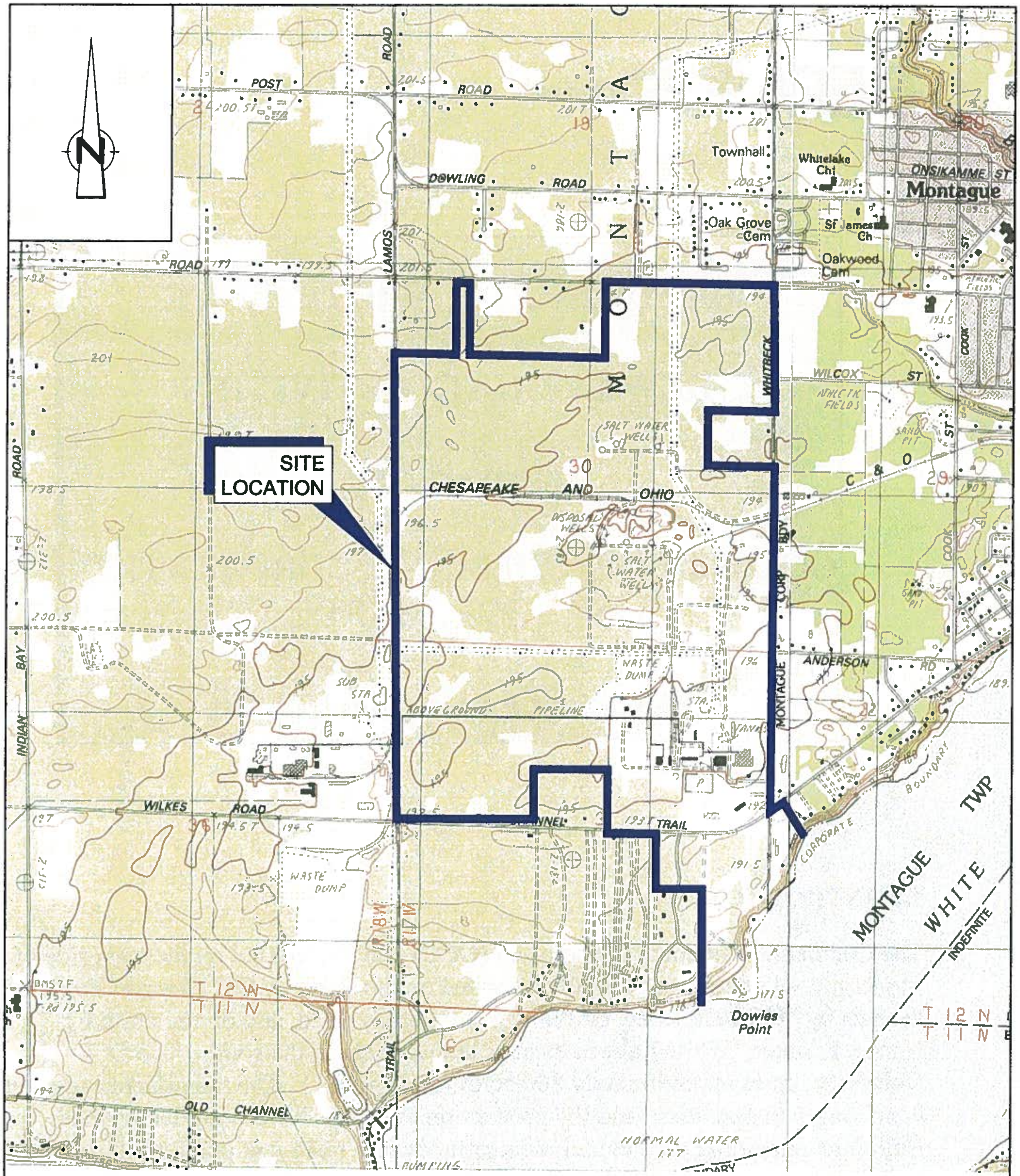
OCCIDENTAL CHEMICAL CORPORATION
MONTAGUE, MICHIGAN

EPA ID NO. MID 006 014 906

1.0 INTRODUCTION

The Occidental Chemical Corporation (OCC) facility, located on the west side of Montague, Michigan, is generally bounded on the south by Old Channel Trail, on the east by Whitbeck Road, on the west by Lamos Road, and on the north by Hancock Street. White Lake is located immediately to the south. The OCC facility occupies approximately 860 acres (see figure 1). The manufacturing plant is no longer in operation, and the production buildings have been demolished. Buildings remaining on-site include a groundwater treatment plant, trailer/office building, and storage outbuildings.

Past activities at the OCC facility have resulted in polychlorinated biphenyls (PCBs) and hexachlorobenzene (C-66) contamination of White Lake sediment.



REFERENCE:

UNITED STATES GEOLOGIC SURVEY
MONTAGUE, FLOWER CREEK, MICHIGAN QUADRANGLES
TOPOGRAPHIC, 7.5 MINUTES SERIES 1983
SCALE: 1:25,000

figure 1

SITE LOCATION
MILLER SPRINGS REMEDIATION MANAGEMENT INC.
Montague, Michigan

2.0 PROJECT DESCRIPTION

EPA issued an Administrative Order to OCC in March 1993 requiring corrective action at the facility. A Final Decision for remediating the OCC facility was published in July 2001. Part of the remedy required OCC to dredge approximately 8,500 cubic yards of contaminated sediment from a 1.6-acre area of White Lake near the OCC outfall off Dowies Point. The purpose of this dredging project was to remove sediment containing over 2 milligrams per kilogram (mg/kg) of PCBs or 0.45 mg/kg of C-66. This cleanup goal is derived from a risk assessment and is necessary to protect human health based on fish consumption.

OCC submitted a plan for dredging activities in March 2003, entitled "Final Dredging Design for Dredging White Lake Sediment Near the Occidental Chemical Corporation Site in Montague, Michigan" (Dredging Design). A second plan, "Final Dewatering Design for Dredging White Lake Sediment" (Dewatering Design), March 2003, describes the final design for dewatering and disposing of sediment after it is removed from White Lake. Both plans were approved by EPA.

Miller Springs Remediation Management, Inc. (MSRMI), managed the dredging project for OCC. The dredging contractor was Faust, Inc. (Faust), and sediment sampling and turbidity monitoring was provided by Earth Tech, Inc. (Earth Tech). Earth Tech also operated the dewatering area and associated water treatment plant. Field mobilization for the dredging began in June 2003, as described in the Dredging Design. Dredging was performed from July 21 to September 10, 2003.

2.1 Dredging Design

Sediment was characterized prior to developing the Dredging Design. The total amount of sediment to be dredged to meet the cleanup goal was 8,500 cubic yards. Approximately 1,300 cubic yards of sediment was found to contain PCBs with concentrations over 50 mg/kg [the regulatory level for management as Toxic Substances Control Act (TSCA) PCB remediation waste]. The sediment dredge zone was divided into five subsections where PCB concentrations exceeded 50 mg/kg. Each subsection was one to two-feet in thickness.

The Dredging Design discussed the proposed dredging equipment and dredging sequence, surface water quality monitoring plan, bathymetric survey and bottom terrain modeling, confirmation and post-removal verification sampling plans, and equipment decontamination procedures.

2.1.1 Dredging Equipment

Sediment was dredged using a cable crane equipped with a Cable Arm environmental bucket. The crane was mounted on a barge with a flat work deck and positioned within the dredging area by anchorage cables. The position of the barge was changed by varying the length of the anchorage cables using on-board winches. Once the bucket was closed, sediment contained in the bucket was raised to the surface. The operator attempted to ensure that free water remained above the sediment such that sediment was not released through vents in the bucket after closure. The bucket assembly was equipped with an alarm, which would sound to notify the operator if the bucket failed to close completely.

The bucket was lowered using a slow, controlled descent. A differential global positioning system (GPS) placed on the cable crane boom tip determined the "x" and "y" coordinates of the bucket (areal location), while a pressure transducer mounted on the bucket to measured the depth (the "z" coordinate). A shoreline benchmark allowed the dredge to reference a fixed elevation, rather than a water depth, and provided a consistent control point for the removal operation. The bucket was also equipped with Windows operating system Offshore Positioning System (WINOPS), a dredge positioning and location tracking software. Pressure transducers and echo sounders attached to the pivot axle of the bucket measured the distance of the bucket cutting lip to the lake bottom, to within two inches of accuracy. Readings from these instruments were recorded on the WINOPS data logger.

2.1.2 Surface Water Quality Monitoring Plan

The surface water quality in White Lake was monitored at five locations and two depths (10 total monitoring points) to document whether the dredging activities altered the water quality in the lake. Four locations were placed approximately 300 feet from the boundary of the dredging area to monitor turbidity, and one location was placed 800 feet north of the dredging area to monitor background turbidity in the lake.

A thermocline develops in summer at White Lake, which causes substantial differences in shallow and deep water quality parameters, including turbidity.

Therefore, at each of the five locations, turbidity monitoring equipment was installed approximately 10 feet below the lake surface (above the thermocline) and 10 feet above the bottom of the lake (below the thermocline). A temperature survey was conducted to determine the depth of the thermocline in the lake prior to the start of dredging, and water temperatures were re-measured periodically during dredging. A turbidity monitor was set to record turbidity every 10 minutes at each location. Monitoring began seven days before the start of dredging activities to record background turbidity values.

The turbidity values were compared to the greatest of the following values:

- Two times the pre-dredging background;
- Two times the current background during dredging; or
- A value of 20 nephelometric turbidity units (NTUs), which represented the upper range of the approximate background levels from turbidity measurements in April 2002.

Actions taken when turbidity measurements exceeded the criteria are discussed in Section 3.1.

2.1.3 Bathymetric Surveys and Bottom Terrain Modeling

An initial bathymetric survey was performed before dredging began to map the approximate lake bed elevations. Daily bathymetric surveys of the dredging were performed to evaluate the accuracy of the WINOPs dredge positioning software. A post-dredge survey was performed and compared to the initial survey to confirm the total volume of sediments removed. The data were collected on survey lines of 20-foot spacing, to provide adequate resolution for bathymetry maps and cross-sections.

2.1.4 Dredging Sequence and Confirmation Sampling

Contaminated sediment was dredged in one-foot intervals using the Cable Arm environmental bucket, as measured by the on-bucket instruments and the WINOPS dredging software package. Prior to beginning, a dredging pattern was developed for each area, which outlined the targeted bucket contact locations and degree of overlap between those locations. The planned dredging sequence consisted of three phases to maintain separation of TSCA and non-TSCA sediment.

Dredging activities were generally performed six days a week between the hours of 7 AM and 7 PM. During Phase I of the dredging, one to two feet of non-TSCA material that overlaid a known TSCA layer of sediment was removed. Phase I began on July 21 and ended on August 1. Approximately 2,521 cubic yards of non-TSCA sediment was dredged.

In Phase II, the known TSCA layer was removed. The dredging was completed August 8 and approximately 1,334 cubic yards of TSCA sediment was dredged. After allowing the suspended particles to settle for 24 hours, Earth Tech collected 15 TSCA boundary confirmation samples on August 11, 2003 using a Ponar dredge. These samples were collected to demonstrate that the remaining sediment contained less than 50 mg/kg of PCBs and was not a PCB remediation waste. The confirmation sample point coordinates were entered into the GPS unit, and the Ponar was lowered to the bottom of the lake when the boat was positioned over the sample collection point. Once the Ponar reached the bottom of the lake, it was closed, and the sample was pulled to the surface.

The TSCA boundary confirmation sampling showed that two areas had sediment containing greater than 50 mg/kg of PCBs. The two areas were re-dredged on August 12 and confirmation sampling on August 14 showed that no PCB remediation waste remained.

The final one-foot layer was removed in Phase III of dredging. This work was completed on August 26 and an estimated 4,506 cubic yards of non-TSCA sediment was dredged. A total in-place volume of 8,361 cubic yards of sediment had been removed by August 26.

2.1.5 Post-Removal Verification Samples

Earth Tech collected 32 post-removal verification samples beginning on August 28 after completion of the Phase III dredging. The dredge area was evaluated using a grid of approximately 100-foot by 100-foot spacing, creating eight polygons. Each of these eight polygons was further divided into four quarter sections. Samples were collected within each quarter section with a petite Ponar sampler lowered and raised manually.

If adequate sample volume was not obtained in the first pass, additional sediment was collected using the petite Ponar. The samples were emptied into a stainless steel bin, collected in groups of four or five and then transported to the shore for sample packaging.

Twenty-two of the 32 samples collected on August 28 contained over 2 mg/kg of PCBs. No samples contained over 0.45 mg/kg of C-66 and the cleanup of C-66 was complete. Additional dredging was performed from September 3 through 6 and September 9 and 10. Verification sampling performed on September 11 confirmed that no sediment contained over 2 mg/kg PCBs and dredging was complete. A total of 10,500 cubic yards (in-place) of sediment was dredged from White Lake.

2.2 Dewatering Design

The Dewatering Design describes the planned methods for transfer of sediment to the dewatering area and management, including:

- Sediment dewatering
- Containment of sediment during and after dewatering
- Treatment of water removed from sediment
- Dewatered sediment handling, transportation, and disposal
- Decontamination procedures
- Air monitoring.

2.2.1 Sediment Transfer to the Work Area

Sediment was transferred from the dredging barge to the dewatering area through the use of the two methods described in the Dredging Design. The sediment was deposited from the Cable Arm environmental bucket into a transfer barge, which transported the sediment to an unloading station on a loading barge. The sediments were transferred from the transfer barge by a hydraulic material handler with a sealed clamshell bucket. The area beneath the swinging bucket on the transfer barge and the loading barge was covered with a steel drip pan, which was also used for setting aside the large dredged debris. The material was loaded into trucks through a hopper. Spilled material was contained, loaded into trucks, and transferred to the pumping station.

Trucks transported the dredged material to a pumping station. The trucks had a sealed tailgate and drip overflow protection. A chute was created for the tailgate of the truck, which was fitted to the opening of the sump pump. Any sediment material that did spill was containerized at the pump station and then transferred to the dewatering area by truck. The majority of sediment was transported to the dewatering area by being pumped through a pipeline, which extended under Old Channel Trail and led to the western end of the dewatering area.

During the week of August 4, 2003, a pipeline was installed to pump water from the transport barge to the pumping station. This reduced the truck loads of dredged material transported up the hill to the pumping station. The pipeline was controlled by four valve units.

2.2.2 Dewatering

Geotubes constructed of woven polypropylene geosynthetic material were used to dewater the sediment, as described in the Dewatering Design. Nine Geotubes, each 200 feet long and 45 feet in circumference, were constructed in three containment areas at the dewatering area. Each containment area contained the Geotubes, a filtrate collection sump, and wastewater treatment equipment. The containment pads were lined with 60 milli-inch (mil), double-textured, high density polyethylene (HDPE) geomembrane, and had continuous, two-foot high perimeter berms to contain water discharged from the Geotubes and prevent storm water run-on. The containment pads were sloped to one end, where the collected water drained to a lined collection ditch. The ditch then conveyed the water to the filtrate sump, located in an adjacent lined pond. Drainage nets were placed beneath the Geotubes to protect the membrane liners and enhance drainage.

Separate Geotubes were used for TSCA and non-TSCA sediment. MSRMI anticipated that a total of seven Geotubes would be required to contain all of the dredged sediments, but constructed one additional for each type of sediment. The Geotube containment area and water treatment system can accommodate up to 13 Geotubes. Each Geotube was connected to the common distribution header connected to the slurry transfer pipe, but had a dedicated control/check valve.

A low-charge cationic polymer was injected into the slurry transfer line before the slurry reached the Geotubes to promote flocculation of the sediment solids and retention of the contaminants within the solids. A polymer injection system controlled the dose rate and concentration of the polymer in the slurry.

The sediment slurry was pumped into one Geotube at a time, reaching an initial height of six feet. An operator, in direct communication with the slurry pump operator, was present at all times to ensure that the Geotubes were not overfilled. The majority of excess water was discharged from the Geotubes within 24 hours of filling, and additional slurry was added to the Geotube. Each Geotube was typically filled three times to meet its design capacity of approximately seven feet in height.

2.2.3 Water Treatment

The water treatment plant was installed on a containment pad located on the road separating the Geotube containment pad from the filtrate sump. This pad was lined with 60-mil, double-textured, HDPE geomembrane and sloped toward the filtrate sump. The filtration basin contained two submersible pumps that transferred water from the sump into the water treatment system. Filtrate collected in the sump was first processed through pressure sand filters to remove suspended sediments, then further treated by activated carbon adsorption to remove soluble organic compounds. After treatment, the water flowed by gravity to the National Pollutant Discharge Elimination System (NPDES)-permitted outfall discharging to White Lake.

2.2.4 Handling and Disposal of Dewatered Sediment

Sediment dewatering is expected to be completed in November 2003. At that time, the Geotubes will be cut open and dewatered sediment will be loaded into trucks and disposed off-site. TSCA sediment and non-TSCA sediment will be managed separately and disposed at appropriately permitted landfills.

2.3 Decontamination Procedures

The dredge and sediment transport equipment was decontaminated after removal of the TSCA sediment by washing down the sides of the dredging transfer barge and bucket and flushing the transport system with lake water. The wash water was directed to the water treatment plant at the dewatering area (see Section 2.2.3 above). The truck beds and side walls of trucks used to transport dredged sediments to the dewatering site were decontaminated using the same procedures.

For the sediment slurry transfer system, a volume of non-TSCA sediment and water equal to the full length of the pipeline was then flushed through the transfer system and directed to one of the PCB remediation waste Geotubes. The transfer barge, trucks, and slurry line were further decontaminated by processing at least an additional 500 cubic yards of sediment that was not classified as PCB remediation waste. Similarly, the dredge bucket was decontaminated by processing this 500 cubic yards of sediment.

2.4 Air Monitoring

Air monitoring was performed at four locations near the dewatering facility (upwind, downwind, and in the direction of the nearest residences) to ensure that the air leaving the facility did not contain constituents harmful to people adjacent to the Facility. The air was monitored for PCBs and asbestos (asbestos was found to be present in the sediment).

Ambient air concentrations of asbestos, PCBs, and dust [as particulate matter less than 10 microns (PM_{10})] were monitored for two days before dredging and dewatering began to obtain estimated site background concentrations. Once filling of the Geotubes began, air samples were collected daily for seven days and compared to the air toxics screening levels and other relevant criteria developed by the Michigan Department of Environmental Quality (MDEQ). Activities generating particulate emissions (which also could have contained asbestos and/or PCBs adsorbed to the dust) were evaluated and changed if any parameters exceeded the MDEQ screening levels. The ambient data did not exceed two times the site background levels or the MDEQ screening levels during the first week of monitoring; therefore, the monitoring frequency was decreased to weekly thereafter.

Assessment monitoring to determine occupational exposure to workers at the site was also performed as outlined in the Site Health and Safety Plan.

3.0 PROBLEMS ENCOUNTERED AND RESPONSE ACTIONS TAKEN

A few problems were encountered which were not anticipated in either the Dredging or Dewatering Designs.

3.1 Turbidity

Several turbidity exceedances occurred in White Lake during the dredging project. The first abnormal turbidity reading occurred on Wednesday, July 30, 2003, from 3:00 AM to 5:30 AM. The turbidity readings increased considerably during this time period; however, dredging was not taking place during this time and had been halted at least eight hours prior to this increase. The increase in turbidity appeared not to be caused by dredging activities but by biological activities within the water column.

Earth Tech personnel observed gradual increases in the turbidity measurements and were informed by the instrument manufacturer that the lens on the monitors should be cleaned on a regular basis. When the monitors were first cleaned, an algal layer was removed, as well as small zebra mussel larvae. Thereafter, the monitors were cleaned on a regular basis to remove zebra mussel larvae, algal growth, and small zebra mussel shells.

During the weekly cleaning performed during the week of August 18, 2003, Earth Tech observed that the wires on the turbidity monitors were rubbing on the polyvinyl chloride (PVC) pipe housing, causing fraying. Monitors at four locations were fixed to prevent rubbing and reconnected; however, the monitor at one location could not be immediately repaired. The background turbidity monitors were temporarily relocated to this location at the dredging area so that dredging could continue.

3.2 Large Dredged Material

During dredging activities, large material (debris) was encountered, including support beams to a deck and tires. Dredged material was loaded into the truck beds through a hopper, which had a screen to recover large material prior to entering the truck and prevent damage to the pumping system. The material blocked by the hopper screen was removed from the screen into a dumpster on the loading barge. Large material was also moved directly from the transport barge and set to the side on the loading barge. When the dumpster filled and/or there was large material (deck support beams) on the loading barge, a smaller roll-on dumpster was moved onto the loading barge, and the materials were placed into this dumpster.

On August 25, 2003, a roll-off dumpster was filled with large material and moved for storage to the northeast of the loading barge, at the end of the gravel area at the bottom of the road. As the roll-off dumpster was unloaded from the truck, the cable from the truck to the dumpster broke and some of the dredged material spilled out of the back of the dumpster. Prior to unloading the roll-off dumpster, a plastic liner had been placed over the area on which the dumpster was to be placed. When Faust personnel attempted to move the container, the sliding action tore the plastic liner, and some of the impacted material leaked through onto the ground.

The material released to the underlying gravel and dirt was placed in the roll-off dumpster by means of a skid-steer loader, with a vertical lift path. The remaining spilled material and concrete mix, along with the dumpster, was covered with a clear plastic liner on the same day. On August 27, 2003, the skid-steer loader was used to load a majority of the remaining spilled material into an empty, lined dumpster. Materials that did not fit into this dumpster, mainly the dirt and gravel underlying the liner, was stockpiled until it could be placed in another dumpster. Earth Tech took a confirmation sample during the week of September 1, 2003, to verify the cleanup.

In order to prevent future spillage of material from the small dumpsters, a large roll-off dumpster was placed on the loading barge. Within this dumpster, large debris and dredged material was mixed with concrete, and this mixture was then loaded into several smaller roll-off, plastic-lined dumpsters. Once the smaller dumpsters were loaded and the waste inside was tested for disposal classification, they were covered with plastic liners. The plastic liners were then tied down and sandbagged to secure them in place.

3.3 PCB Exceedances in Treated Water Effluent

Earth Tech collected samples of the treated water effluent periodically during the treatment system's operation. On August 11, 2003, analytical results from the previous week's sampling were received from the laboratory and reviewed by Earth Tech personnel. These results showed the PCB concentration in the effluent exceeded the discharge limit in the NPDES permit. Discharging of water was halted, and Earth Tech installed additional treatment equipment and processes, as discussed below.

Earth Tech subsequently determined that algal growth on the surface of the Geotubes and within the containment pond contributed to the increase in total PCB concentrations in the effluent. Earth Tech then installed an alum injection pump and a polymer injection pump system ahead of the existing treatment system. After testing the water through the new treatment train, the water effluent still exceeded the requirements of the NPDES permit. Earth Tech altered the treatment train in various manners, in order to attempt to meet the requirement of the NPDES permit. The final treatment system configuration routed raw effluent from the containment pond, through the alum injection pump, then the polymer injection pump, and then into a series of four frac tanks. The frac tanks acted as a clarifying system, and the time it took for the water to travel through the frac tanks provided time for the alum and polymer to flocculate, coagulate, and settle suspended solids out of the water. For polishing, the water was next pumped into sandbags, through a 1-micron (µm) filter, and finally through four activated carbon filters (previously only two of the carbon filters on site were utilized). On August 29, 2003, Earth Tech received compliant results from the final treatment effluent samples and was able to resume discharging treated water through the NPDES outfall.

3.4 Water Containment

While the water treatment system was not discharging due to the problems described above, the water level within the containment pond increased as the sediment slurry continued to be pumped into the Geotubes. The water level reached between five feet six inches and six feet, or approximately two feet below the top of the berm surrounding the containment pond. In order to continue dredging sediment, Earth Tech proposed to develop a second containment pond to the east of the already existing containment pond. The area of the proposed second containment pond was a previous concrete containment structure. Earth Tech lined this concrete containment structure with clean sand, and then American Liners lined the second pond with 60-mil, double-textured HDPE geomembrane and constructed continuous, two-foot high perimeter berms.

Originally, discharged water from the Geotubes had entered the first containment pond through a spillway. Once the second (new) pond was developed, this spillway was dammed with sandbags, and water was pumped from the spillway reservoir into the new containment pond. During construction of the new containment pond, water was pumped from the first containment pond into several

20,000-gallon lined frac tanks for temporary holding. Once the treatment effluent met the NPDES permit standards and treated water was discharged, water from the frac tanks was emptied into the new containment pond. During this time, water was also pumped from the first containment pond, to the western end of the dewatering area. Earth Tech believed pumping this water to the end of the dewatering area would promote evaporation as the water traveled east, downward to the first containment pond.

4.0 SUMMARY

Approximately 10,500 cubic yards of contaminated sediment was removed from White Lake between July 21 and September 10, 2003. As a result, over 1,100 pounds of persistent, bioaccumulative, and toxic compounds such as PCBs and hexachlorobenzene were removed from the White Lake environment. Long-term fish monitoring will be conducted over the next 10 years to evaluate the environmental success of the dredging project.