PROJECT NOTE 1: MIDDLE RIVER COMPLEX SEDIMENT REMEDIATION

TO: Sharon Kenny, Remedial Project Manager (EPA Region 3)
Mark Ma

bioavailability or toxicity of contaminants in sediment. MNR usually requires assessment, modeling, and monitoring to demonstrate that risk is actually being reduced. Natural processes that can reduce risk include the following:

- Processes that convert contaminants to less toxic forms (e.g., biodegradation)
- Processes that bind contaminants more tightly to the sediment (e.g., sorption)
- Processes that bury contaminated sediment beneath clean sediment (e.g., sedimentation)

General site conditions that are conducive to MNR include:

- Risk is low to moderate
- Anticipated land uses or new structures are not incompatible with natural recovery
- Natural recovery processes have a reasonable degree of certainty to continue at rates that will contain, destroy, or reduce the bioavailability or toxicity of contaminants within an acceptable time frame
- Expected human exposure is low and/or reasonably controlled by institutional controls
- Site includes sensitive, unique environments that could be irreversibly damaged by capping or dredging
- Sediment bed is reasonably stable and likely to remain so
- Sediment is resistant to resuspension, e.g., cohesive or well-armored sediment
- Contaminant concentrations in biota and in the biologically active zone of sediment are moving towards risk-based goals
- Contaminants readily biodegrade or transform to lower toxicity forms
- Contaminant concentrations are low and cover diffuse areas
- Contaminants have low ability to bioaccumulate

USEPA. 2004. Presenter's Manual for: Remediation of Contaminated Sediments. Office of Solid Waste and Emergency Response, 58 pp. http://www.clu-in.org/download/contaminantfocus/sediments/Presenters-Manual-Dredging.pdf

USEPA. 2005. Contaminated Sediment Remediation Guidance for Hazardous Waste Sites. OSWER 9355.0-85. EPA-540-R-05-012. http://www.epa.gov/superfund/health/conmedia/sediment/guidance.htm

MNR Case Studies:

An MNR Technical Guidance was developed by Environmental Security Technology Certification Program (ESTCP) through collaboration with DOD, EPA, and the Navy (ESCTP 2009). This MNR Guidance document presents more than a dozen case study sites for which MNR was evaluated and selected as the approved remedy or as a remedy component. Natural recovery timelines usually ranged from 5 30 years, and costs associated with MNR usually were orders of magnitude lower than those associated with dredging and capping. A summary of remedy selection at selected case study sites, the status as of 2008 and the success of MNR is presented in below tables, which were extracted from the 2009 MNR guidance document:

TABLE A-4

Bathymetric surveys

TABLE A-4

Isolation

Aerial photogr

TABLE A-4 [illegible]

[illegible]

receptor risk

[illegible]

ndwater contaminated

[illegible]

Environmental Security Technology Certification Program (ESTCP). 2009. Magar, V.S., D.B. Chadwick, T.S. Bridges, P.C. Fuchsman, J.M. Conder, T.J. Dekker, J.A.

Long Island Sound:

In Long Island Sound, a comprehensive study was initiated in 1982 to evaluate the environmental consequences of dredged material placement under aquatic conditions. The results of MNR nearly thirty years after the experimental aquatic placement of uncapped dredged material in Long Island Sound were presented. Thirty years of MNR, through bioturbation and ambient sedimentation result that there is now little biological or chemical difference relative to reference area sediments:

REFERENCES IN THE ORDER APPEARED IN THE TEXT

Wisconsin Department of
Natural Resources
101 S. Webster Street
Madison, Wisconsin

Lower Fox River Operable Unit 1 Post-Remediation Executive Summary

By the Agencies/Oversight Team

FINDINGS

BACKGROUND

The Record of Decision (ROD) issued for Operable Unit 1 (OU1), also known as Little Lake Buttes des Morts, based its polychlorinated biphenyls (PCBs) remedy on attaining sediment concentrations that corresponded with expected risk reductions to human health and ecological factors. The ROD called for remediation of all sediment that was contaminated with PCB concentrations greater than 1.0 parts per million (ppm or mg/kg) on a dry weight basis. The remedy also specified that all targeted sediment be removed, covered, and/or capped.

The OU1 remedy was implemented from 2004 through 2009 and resulted in a reduction of PCB concentrations in 2010 for the three media of interest: fish, sediment, and water. Natural recovery was occurring in these media pre-remedy, i.e., the PCB concentrations in fish, sediment, and water were declining; however, the remedy has markedly accelerated the rate of decline for PCB concentrations in all three media.

The following comparative analyses were performed on natural recovery data collected prior to 2004 and Long-Term Monitoring (LTM) results collected in 2010. The required baseline monitoring program collected samples in 2006/2007 but was not used in this analysis since this data was collected in the middle of the remedial action. The baseline monitoring program results showed elevated concentrations, which may have been due to OU1's ongoing remedial action.

These elevated results were expected and have been documented at other large dredging and remedial projects. PCB concentrations for fish and water increased above background levels during active remediation for fish and water but declined rapidly to substantively lower than expected levels post-remedy. If the following analysis had used the baseline monitoring program results for comparison, the reduction percentages for fish and water would show greater improvements.

FISH

PCB concentrations in walleye fillets decreased an average of 73% as a result of the sediment remediation as shown in Figure 1. Walleye were selected as the primary indicator species for the long-term monitoring program.

The primary concern, regarding PCBs in the Lower Fox River, is human health risks directly associated with p woul

WATER

For OU1's water column PCB concentrations, the post-remedy (2010) results are significantly lower than pre-remedy (1998) results and even more of a reduction when compared to the baseline monitoring (2006/2007) results. Since the most recent pre-remedy monitoring period (1998) was 12 years prior to remedial activities, and because laboratory analysis and field sampling methods varied among studies over the last few decades; the percentage change effected by the remedy, relative to expectations, cannot be reliably estimated for water column PCB concentrations. See Figure 3.

Note: As has been observed at other large dredging and remedial projects, water-column PCB concentrations increased above background levels during dredging but declined rapidly to substantively lower than expected levels post-remedy.

CONCLUSION

The 2010 post-remedy results for fish, sediment, and water show substantive improvements over natural recovery; however, a full understanding of the effects of the ROD remedy will be

Introduction:

The Lower Fox River (LFR) is one of the most industrialized rivers in Wisconsin. It has experienced water quality problems related to municipal, industrial and non-point sources of contaminants since the early 1900s. Thick algal remedial action for OU1, alternate approaches, including engineered caps, and remedy sand covers, could be used under certain specified conditions.

The ROD Amendment continued the two standards used to judge the completion of the OU1 Remedial Action while allowing the contingent remedy to be used in addition to dredging. Simply stated: the Amended ROD declared that the remedial action (RA) Performance Standard was satisfied if all sediment exceeding the 1.0 ppm (1.0 mg/kg) PCBs' RAL was removed and/or contained using the primary remedial action and/or the alternate remedial action. If the RAL Performance Standard was not satisfied throughout the OU, but all sediment exceeding the RAL had been addressed, using the primary remedial action and/or the alternate remedial actions, the RA will be deemed complete if the Agencies determine that the SWAC goal of 0.25 ppm (0.25 mg/kg) PCBs had been satisfied.

However, the primary measure for compliance with the ROD is to reduce risks due to PCBs' exposure to fish consumers - both human and ecological. In an effort to understand remedial effectiveness, PCB samples from fish and water have been collected under the Baseline Monitoring Plan (BMP) and subsequently under the Long-Term Monitoring Plan (LTMP). These monitoring plans were developed collaboratively between the Agencies/Oversight Team (A/OT) and the Responsible Parties (RPs). Members of both groups were composed of experts in a range of technical disciplines including environmental engineering, analytical chemistry, toxicology, fish and wildlife management and statistics.

In addition to the BMP and LTMP, ecological PCB data are also available from other programs providing additional useful insight into the remedial effectiveness. The State of Wisconsin has analyzed fish tissue samples for PCBs since 1973 under its fish contaminant monitoring program. Water samples have also been collected under several programs since 1989 including other remedial investigations such as Lake Michigan Mass Balance studies. Sediment PCBs' data documenting pre-remedy conditions are available from RI investigations conducted in the 1980s and 1990s as well as pre-remedy design sampling conducted in 2003.

Remedial actions at Little Lake Buttes des Morts on the Lower Fox River, Wisconsin (OU1) were completed in (2009) and sediment, fish, and water samples were collected in 2010 for comparison with historical and baseline/pre-remedy action samples to evaluate effectiveness of the remedy.

A full understanding of the effects of the remedy will be accomplished through the observation of PCB concentrations in sediment, fish, and water over a period of years. PCB concentrations in these three media are influenced by many factors that may vary through time, including lipid content and size/age of fish, organic carbon content in the sediment, river flow and temperatures, as well as the new hydro-dynamics that may develop as a result of the remedy. The analyses reported in this document were conducted to minimize the potential effects of these factors regarding interpretation of the sample results.

Specific results of monitoring each individual media (fish, sediment, and water) are discussed below.

Fish Tissue

PCBs in fish consumed from OU1 are the source of health risks to humans and wildlife. OU1 fish, sampled since the late 1970s, have shown elevated levels of PCBs compared to fish from upstream Lake Winnebago.

The concentration of PCBs in fish is dependent on the level of PCBs in the system and the length, weight, age, and fat or lipid content of the fish. To assure that scientifically valid

Sediment

In order to demonstrate compliance with the ROD's remedial design, post-remedy sediment samples were collected and analyzed for sediment PCB concentrations under a quality assurance project plan (QAPP) and construction quality assurance project plan (CQAPP). These tasks were conducted by the RPs and overseen by the A/OT. This confirmation program, composed of over 2200 analytical PCB tests, provided documentation of surface PCB concentrations in sediment immediately upon completion of the remedy, however long-term

Water

OU1 is the most upstream reach of the Fox River site. LTM data (2010) shows the ROD's remedy has apparently reduced the level of PCBs in the water column when compared with the pre-remedy and BMP results.

Water PCB concentrations are thought to be dependent on PCB concentrations in sediment along with the river's flow rate and temperature. Given these variables, the comparison must be made by accounting for natural variations in river flow rates and temperatures through the years prior to the remedial activities. Figure 3 shows the remediation resulted in apparent lower concentrations.

However, the pre-remedy data results were irregularly (1989, 1990, 1998, 2005) collected, and laboratory analysis and field sampling methods varied among studies over this time period; therefore, the percentage change effected by the remedy cannot be estimated for water column PCB concentrations with an appropriate level of statistical confidence.

Note: As has been observed at other large dredging and remedial projects, water-column PCB concentrations increased above background levels during dredging but declined rapidly to substantively lower than expected levels post-remedy.

Figure 1

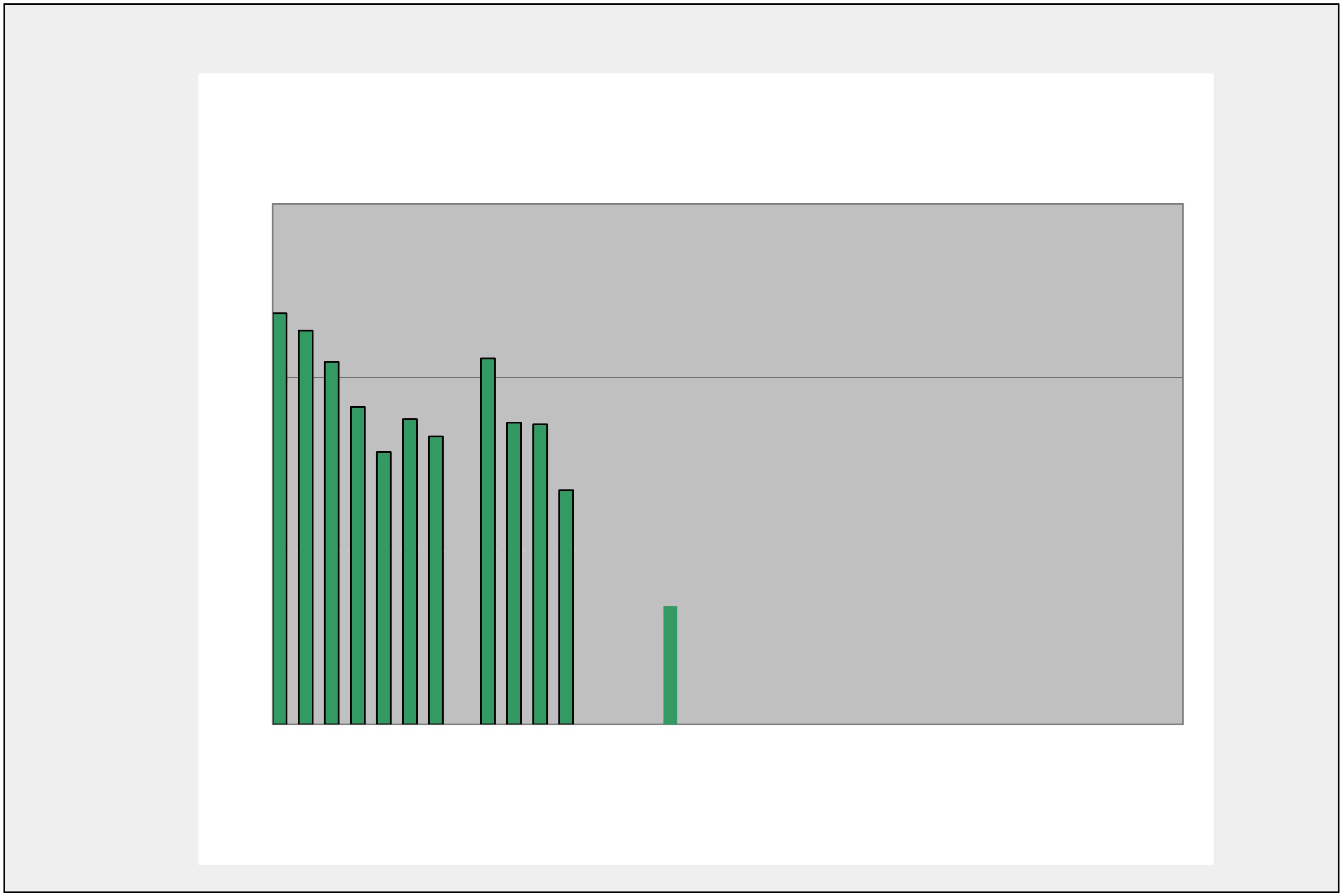
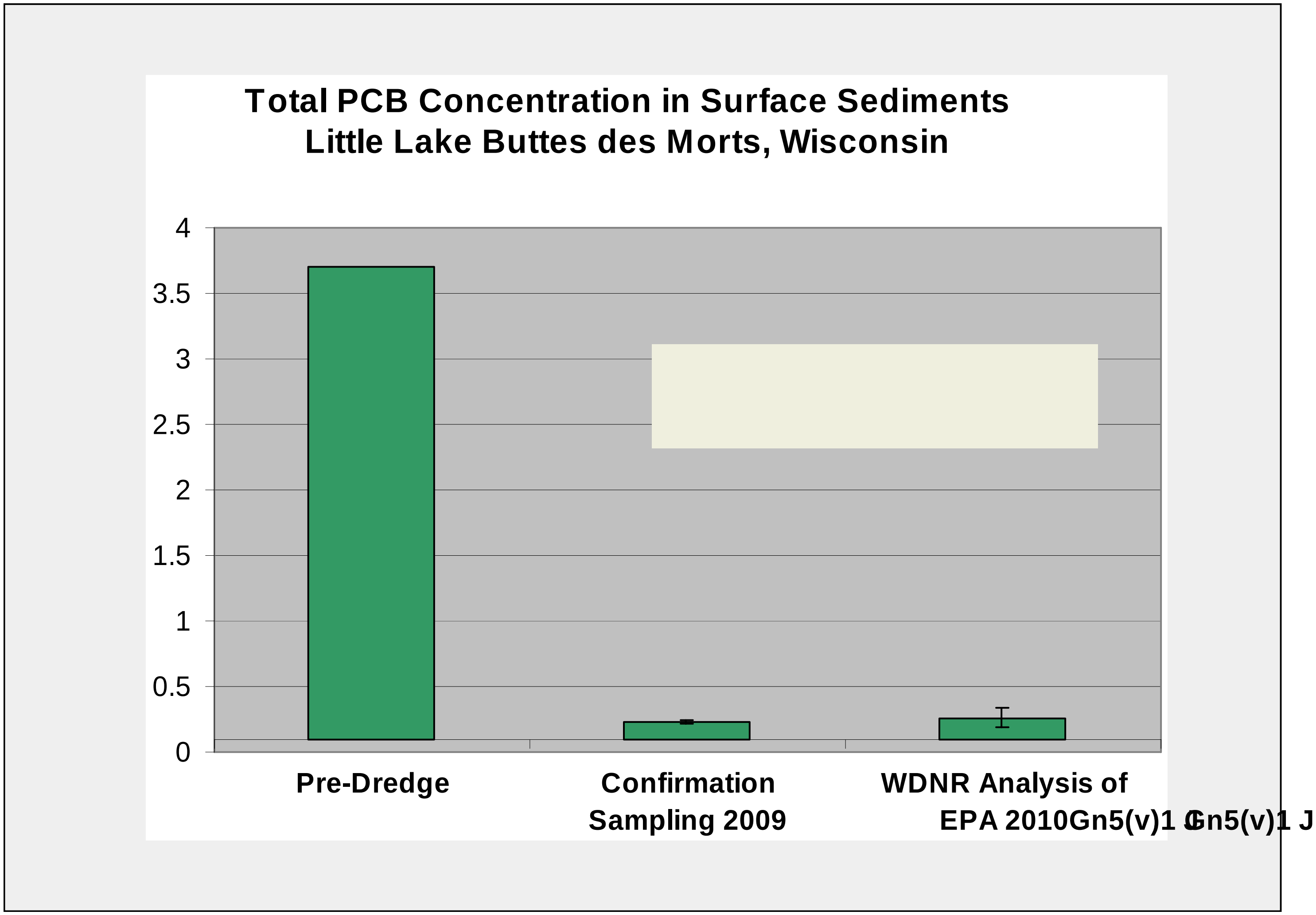


Figure 2


Total PCB Concentration in Surface Sediments
Little Lake Buttes des Morts, Wisconsin
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3.5
3
2.5
2
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1
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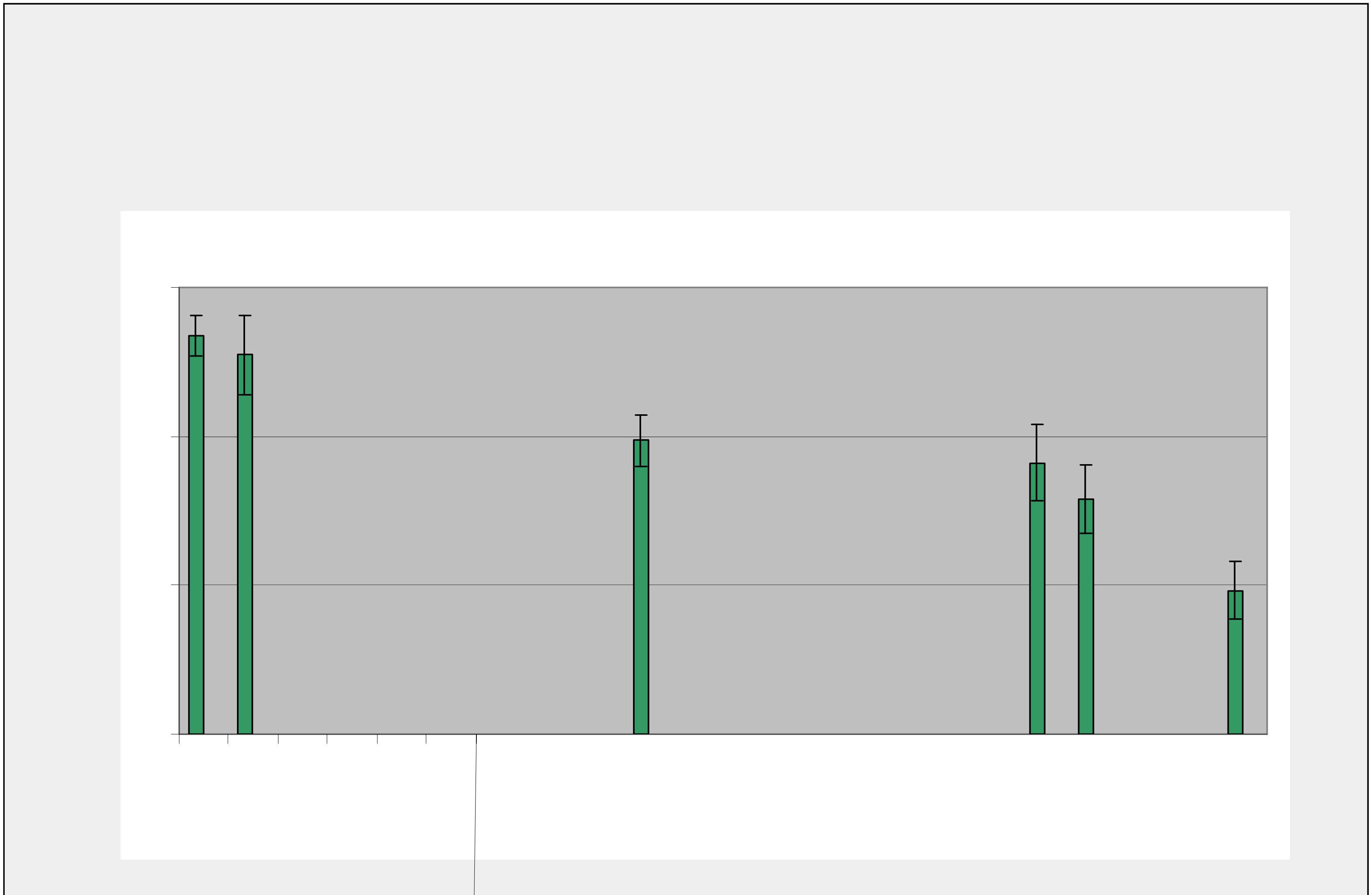
0
Pre-Dredge
Confirmation Sampling 2009
WDNR Analysis of EPA 2010Gn5(v)1 JGn5(v)1 J

Figure 3



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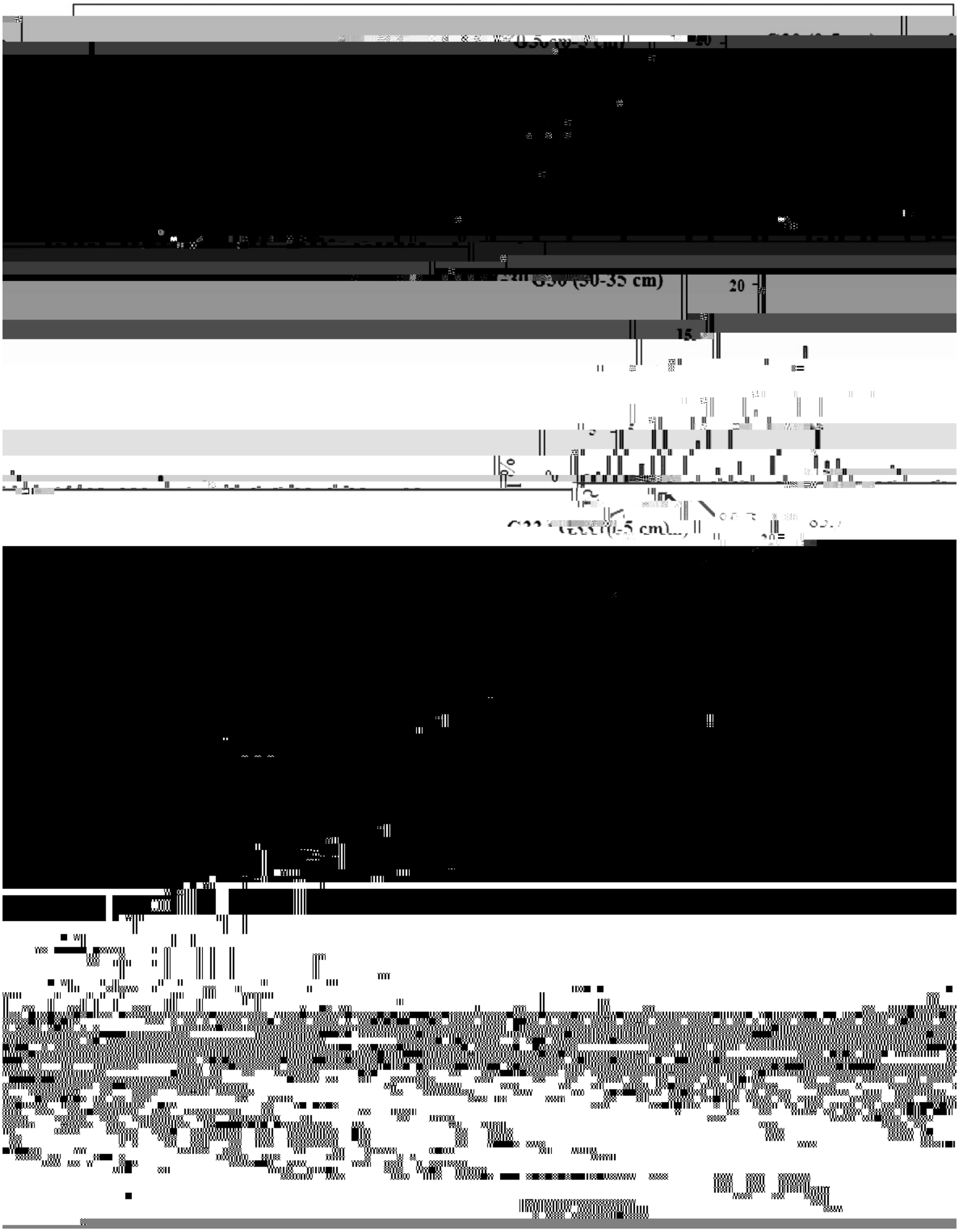

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3.5. Site comparisons

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Monitored Natural Recovery at a Submarine Wood Waste Site: 10 Years after Baseline

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Background/Objectives. Sawmill Cove is located near the mouth of Silver Bay in southeast Alaska and was the receiving point for effluent and storm water discharges from the Alaska Pulp Mill, which produced pulp at the site from 1959 to 1993. Operations at the mill resulted in the accumulation of wood solids in some areas up to 20 ft or more in thickness on approximately 100 acres of the seafloor adjacent to the site. A remedial investigation and ecological risk assessment of the Bay Operable Unit (OU), encompassing Sawmill Cove, were conducted during 1996 and 1997. The results of these studies were used to delineate an Area of Concern (AOC) in Sawmill Cove. The Remedial Action Objective (RAO) for the AOC in Sawmill Cove, as defined in the Record of Decision (ROD), is to reduce to an acceptable level ecologically significant adverse effects to populations of bottom-dwelling life from hazardous substances, including wood waste degradation chemicals. The Alaska Department of Environmental Conservation (ADEC) determined that the RAO would best be obtained by natural recovery with long-term monitoring every 10 years. The ultimate goal is to have 75 percent of the AOC in an equilibrium community by the year 2040.

Approach/Activities. The long-term monitoring program was designed to measure the degree of natural recovery toward the natural resource management milestones outlined in the ROD. The baseline survey was carried out in the spring and fall of 2000 using sediment profile imaging (SPI), epifaunal video surveys, benthic community analyses, and sediment chemical analyses. Based on the positive results from the baseline monitoring, a cost-effective strategy was recommended for future monitoring that would save more than 50% of the projected 3(e)4(c)4(on
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Monitored Natural Recovery for Onondaga Lake: A Progress Report

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Background/Objectives. The Onondaga Lake (in Central New York State) Record of Decision specifies monitored natural recovery (MNR) as the remedy to achieve sediment performance criteria established for the profundal zone (deep-water areas that comprise 70 percent of the lake surface area). To evaluate the effectiveness of MNR, site-specific numerical modeling supported by several types of ongoing monitoring data was used to predict mercury concentrations into the future and estimate the time to recovery and to determine the likely future effectiveness of MNR. The remedy is predicted to successfully meet the sediment performance criteria prior to the end of the prescribed MNR period, which is the 10 years following the remediation of upland sources and the littoral zone (2027).

Approach/Activities. A site-specific model, developed in Microsoft® Excel using Visual Basic for Applications (VBA), is based on sediment processes that are well established in literature and incorporates site-specific monitoring data on sedimentation rates, sediment mixing depth, and surface sediment mercury concentrations. Mixing and rate of sedimentation are primary processes resulting in natural recovery in the profundal zone. Both typical and innovative monitoring data collected on these processes included sediment traps, high-resolution mercury cores, radioisotope cores, frozen cores, and most recently, deployment and monitoring of fluorescent microbead markers that marked the mudline elevation to quantify the thickness of newly deposited material. Supported by this monitoring data, the model was calidadddd1-0.004 T

C1. MNR and Enhanced MNR