

Western Dredging Association
Attn: Craig Vogt, Chair, Environmental Commission

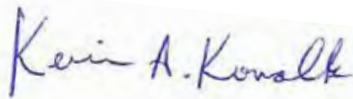
Dear Mr. Vogt:

Please find the attached EA Engineering, Science, and Technology, Inc., PBC (EA) and Severson Environmental Services (SES) application for the 2019 WEDA Environmental Excellence Awards in the category of Environmental Dredging for the dredging and restoration of the Former Zephyr Refinery: Fire Suppression Ditch project (Zephyr project) along the North Branch of the Muskegon River within the Muskegon Lake Area of Concern (AOC), Muskegon, Michigan. The Zephyr Oil Refinery operated for more than 40 years, with historical releases of petroleum and metals to the Muskegon Lake watershed that contributed to significant contamination of the sediment and wetlands surrounding the site and beneficial use impairments (BUIs) to the AOC such as the loss of fish and wildlife habitat. This Zephyr project was identified in the Stage 2 Remedial Action Plan for the Muskegon Lake AOC for restoration in order to support BUI removal and was completed under the Great Lakes Legacy Act (GLLA) through the strong partnership formed by the United States Environmental Protection Agency (USEPA) Great Lakes National Program Office (GLNPO) with the Michigan Department of Environmental Quality (MDEQ).

This project fulfills all of the criteria for the Environmental Dredging Award including: numerous environmental benefits contributing to the future removal of BUIs within the AOC; innovative partnerships and contracting approach utilized through the GLLA and USEPA GLNPO, respectively; economic benefits specific to the Muskegon Lake area and Great Lakes region; multiple lessons learned that will be beneficial for future projects; and thorough public outreach activities as this site is located adjacent to residential areas, requiring multiple avenues for engagement with residents and other concerned citizens.

The environmental dredging of the Former Zephyr Refinery: Fire Suppression Ditch area showcased the potential for success created through innovative partnerships while remediating legacy contamination and restoring native habitat within a Great Lakes AOC. Unique aspects of this project will be carried forward in future remedial designs and construction activities to build upon this success and address contaminated sediments and restoration needs under similar circumstances. Thank you for your time and consideration of the Zephyr project.

Sincerely,



Kevin Kowalk
EA Project Manager



Steve Shaw
SES Corporate Project Manager



FORMER ZEPHYR REFINERY: FIRE SUPPRESSION DITCH AREA PROJECT



FORMER ZEPHYR REFINERY: FIRE SUPPRESSION DITCH AREA PROJECT

SUMMARY

EA Engineering, Science, and Technology, Inc., PBC (EA; Design Engineer), in conjunction with Severson Environmental Services (SES; Dredge Contractor) provided remedial and restoration services to the U.S. Environmental Protection Agency (USEPA) and project partner, Michigan Department of Environmental Quality (MDEQ) to remove contaminated (lead and petroleum) sediments from the Former Zephyr Refinery Fire Suppression Ditch (and surrounding wetlands) area located within the Muskegon Lake Area of Concern (AOC). This project was completed under the Great Lakes Legacy Act (GLLA) to support removal of beneficial use impairments (BUIs) such as the loss of fish and wildlife habitat.

The Zephyr project site, located in a mixed industrial, commercial, and residential area, included sediment areas with hazardous levels of lead, involved organic sediments with highly variable moisture content, and confronted historically high water levels during construction, which presented numerous logistical and technical challenges. The innovative and invaluable partnerships that were created and utilized to complete this project proved to be a critical element in overcoming these challenges. The project team maintained continuous contact throughout the construction in order to efficiently respond to these challenges while including all stakeholders in the discussions, resulting in a successful wetland restoration that will benefit the site owners and the community at large. The Zephyr project provided economic benefits through implementation of cost-saving measures and efficiencies during design and construction while contributing to the overall socio-economic impact of restoration work within the Muskegon Lake AOC and the Great Lakes Region.

GOALS

- ▶ Dredge wetlands and ditch to remove contaminated sediment.
- ▶ Meet clean-up goals for lead and total petroleum hydrocarbons.
- ▶ Remove and control invasive species.
- ▶ Restore wetlands and create diverse habitat.

ACCOMPLISHMENTS

- ▶ Successful completion of the project on schedule and budget while in compliance with all applicable permits.
- ▶ Thorough public outreach resulted in zero complaints to the project hotline during construction.
- ▶ Limited disposal quantities and costs through innovative dredged material dewatering pad configuration and management practices.
- ▶ Rendered all hazardous sediment non-hazardous following first pass of in-situ mixing and stabilization.
- ▶ Removed nearly 50,000 CY of contaminated sediment.
- ▶ Treated over 90 million gallons of water during construction due to historically high water levels.
- ▶ Preserved a healthy and safe work environment without incident (60,975 safe person-hours).
- ▶ Restored monotypic wetland dominated by invasive plant species with four different wetland types dominated by native plant species.
- ▶ Successfully completed project with no impacts to adjacent railroads, on-site buried petroleum pipelines, on-site commercial operations (fertilizer mixing), and adjacent residential properties.

PROJECT TEAM

PROJECT OWNERS: USEPA and MDEQ • **NOMINATING ENTITY:** EA (Design Engineer) & SES (Dredge Contractor)

TEAM MEMBERS:

Matt Bowman*

Construction Quality Manager, EA

Kathy Evans

Environmental Program Manager,
West Michigan Shoreline Regional
Development Commission

Pat Faessler

Project Superintendent, SES

Kristen Isom

USEPA GLNPO

Dennis Kirksey

Chairperson, Muskegon Lake
Watershed Partnership

Kevin Kowalk*

Project Manager, EA

Mark Loomis

USEPA GLNPO

Caitlin Nigrelli

Outreach Leader,
Illinois, Indiana Sea Grant

John Pawloski

MDEQ

Sarah Pearson

MDEQ

Steve Shaw*

Corporate Project Manager, SES

Jon Trombino

Engineer of Record, EA

Heather Williams

USEPA GLNPO

ENVIRONMENTAL BENEFITS

The Zephyr project provided numerous environmental benefits related to the remediation of legacy sediment contamination as well as the restoration of low-quality wetland habitat with a more diverse wetland system.

ENVIRONMENTAL BENEFITS BY THE NUMBERS

- ▶ Treated a total of 91.9 million gallons of contaminated water (process and contact water).
- ▶ Removed all contaminated sediments over a 13.6-acre wetland area with concentrations above 2,000 mg/kg total petroleum hydrocarbons and 128 mg/kg lead to protect benthic organisms and wildlife populations.
- ▶ Dredged a total of 49,491 CY of contaminated sediment from the site including:
 - 38,272 CY from wetland areas.
 - 11,219 CY from the approximately 1,350-linear-foot ditch portion of the site. Dredging of the ditch required a phased approach for sheet pile installation/removal to stabilize the ditch banks, allow for dredging in the wet, and provide stabilization for haul roads which were constructed adjacent to the ditch to allow access along the entirety of the quarter-mile-long ditch and into the wetland areas.
- ▶ Treated 1,370 CY of characteristically hazardous sediment (lead) in-situ, rendering it non-hazardous via mixing with specialized equipment (Lang Tool) prior to removal.
- ▶ Restored a 13.6-acre monotypic submergent wetland dominated by invasive species with 3 acres of emergent marsh, 5.1 acres of submergent marsh, 1.2 acres of deep marsh, and mitigation of 4.3 acres of temporarily impacted wetland.
- ▶ Restored 1.6 acres of open water habitat (ditch).
- ▶ Planted 223 trees and shrubs and 13,620 live herbaceous plugs and bare-root native plants.
- ▶ Seeded over 1.5 acres of wetlands with native seed mix.
- ▶ Installed 6 habitat structures (root wads, brush piles, etc.) per acre of restored wetland.

Contractors staging native plantings in emergent wetlands.



UNIQUE ENVIRONMENTAL CHALLENGES AND MITIGATION MEASURES

Unique environmental challenges that required mitigation were overcome in an expedited manner with minimal disruption to project schedule due to the nature of the project partnership between the USEPA and MDEQ as well as extensive coordination (including three construction progress calls per week) between both agencies, the design engineer (EA) and the dredge contractor (SES).

- ▶ Contaminated sediments had high organic matter content with varying moisture levels requiring a strict dewatering management plan with a minimum five days of gravity dewatering prior to addition of stabilization additives, which reduced disposal weights and costs.
- ▶ Historically high Great Lakes water levels, which increased by approximately 2.5 feet between design and construction, posed challenges including redesign of the earthen cofferdam to allow placement of materials in a high-water environment and redesign of emergent wetland areas to allow for native vegetation establishment during high water and future vegetation creep as water levels fluctuate.
- ▶ Hazardous lead levels in sediment required in-situ mixing to meet Resource Conservation and Recovery Act (RCRA) land disposal restrictions. Completed through use of a specialized equipment (Lang Tool) to mix the stabilization agent with the hazardous sediment.
- ▶ A historic production oil well was discovered following observations of oil bubbling up from a recently dredged section of the wetland. This resulted in coordination with a specialized drilling company to access the well area for over-drilling (300 feet) and capping. These activities required additional redesign of emergent wetland areas to facilitate access to the area for both the over-drilling and capping as well as provide for future access needs.
- ▶ Discovery of asbestos-containing materials during initial shallow excavation in upland staging areas required immediate coordination between contractors and project partners. This required an interim removal of asbestos and soil and redesign and movement of the dewatering pad.
- ▶ Unique combination of ditch and wetland sediments with extreme variations in moisture content and access limitations presented challenges. Mitigation included the use of multiple dredging methods including removal in the wet (ditch) and dry (wetlands) with both traditional excavation equipment and environmental bucket. Additional mitigation measures included sheet pile and access road installation for dredging of the ditch in the wet and full site and zoned dewatering plans for excavation of the wetland in a relatively dry condition.



WORKING WITH AND ENGINEERING WITH NATURE

The Zephyr project incorporated guiding principles of working with and engineering with nature including:

- ▶ **Holistic:** The Zephyr project was completed using a holistic approach—from the feasibility and design stages focusing on ecological risks and developing remedial action cleanup goals to benefit benthic microorganisms and wildlife, to the consideration of potential human health impacts during construction, such as fugitive dust and air contaminants requiring extensive air monitoring and mitigation measures (e.g., foam suppression for dust).
- ▶ **Sustainable:** The Zephyr project adjusted to high water levels by redesigning the wetland areas and adjusting the planting areas to allow the restoration to be sustainable in the future. These adjustments were made during construction to allow for establishment of native species that otherwise would not survive in the elevated water level. Emergent islands were created so that when the historically high water levels recede in the future, the submergent/emergent vegetation has a chance to propagate and spread down into new submergent/emergent areas.
- ▶ **Science-Based:** The remedial cleanup goals and dredging footprint were determined through a thorough site characterization and feasibility study process that included an ecological risk assessment to determine potential impacts to benthic organisms and wildlife.
- ▶ **Collaborative:** Collaboration among multiple federal, state, and local agencies and contractors was critical to the efficient completion of the Zephyr project to meet all Remedial Action Objectives (RAOs). The collaboration comprised more than 10 entities including: USEPA GLNPO, USACE, MDEQ, Illinois Sea Grant, MDEQ–Oils, Gas and Minerals Division, West Michigan Shoreline Regional Development Commission, Michigan Department of Natural Resources Office of the Great Lakes, EA, and SES.
- ▶ **Efficient and Cost-Effective:** Multiple design elements led to an efficient and cost effective project, including dewatering to reduce disposal weights, reuse of on-site materials for habitat structures, and in-situ treatment of hazardous sediment to render non-hazardous. Construction-initiated savings included use of asphalt in place of stone for the dewatering pad, re-use of the haul road for an adjacent project, and redesign of the fertilizer pipe inlet.
- ▶ **Adaptive:** The project incorporated adaptive management throughout construction to respond to issues such as asbestos in soil, high water levels, a leaking historic oil production well, and redesign of emergent and deep marsh areas adjacent to the berm along the property boundary based on structural concerns.

Top: Planting native vegetation to preserve biodiversity.

Middle: Emergent wetland designed to adapt to fluctuating water levels.

Bottom: Reuse of woody debris on site to create habitat structures.

INNOVATION

GROUNDBREAKING AND NON-TRADITIONAL ENVIRONMENTAL PROTECTION METHODS

In order to address some of the unique environmental challenges faced, the Zephyr project team took steps beyond traditional environmental protection efforts, including:

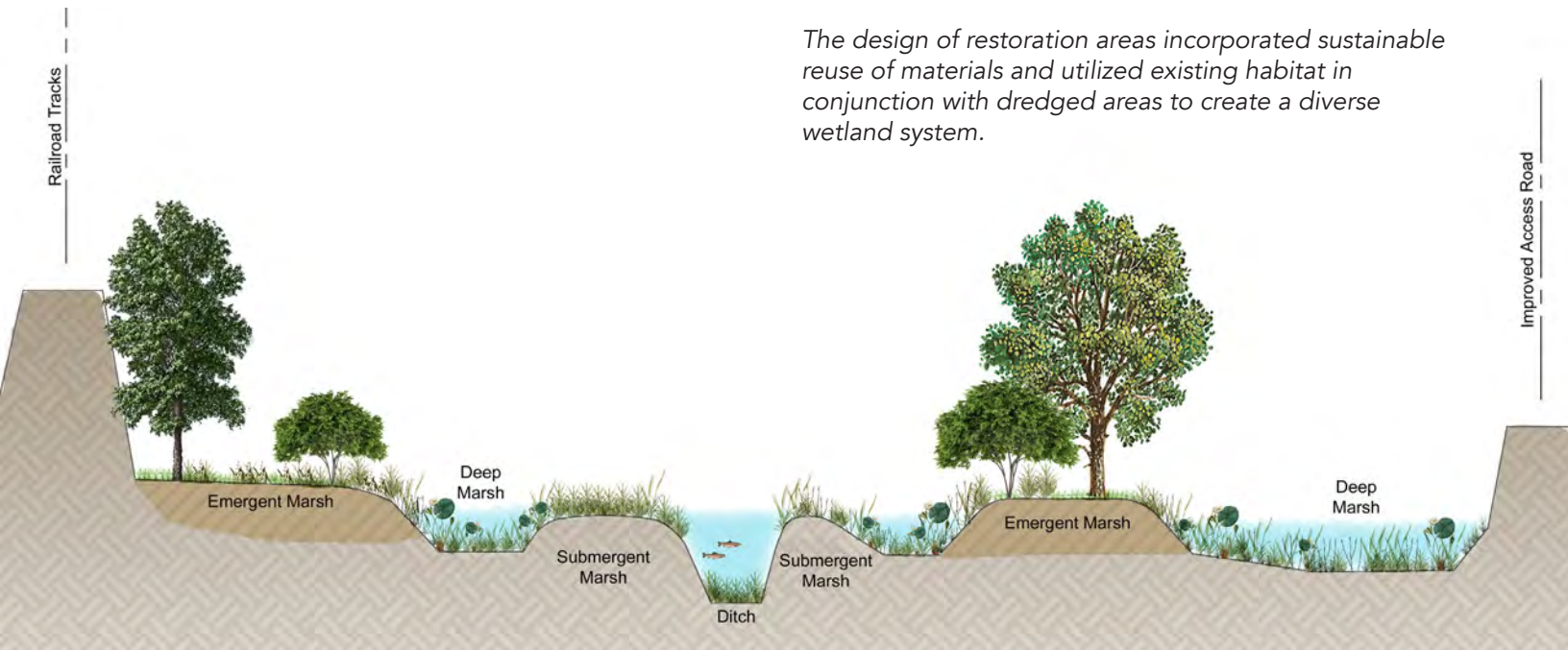
- ▶ Utilized emerging technology (bench-scale testing of multiple stabilization agents) to determine appropriate in-situ stabilization, and an innovative tool (Lang Tool mixing head for excavator) to render characteristically hazardous lead sediments non-hazardous.
- ▶ With the abundance of wet wastes in western Michigan, acceptance criteria presented by multiple landfills included challenging percent solids/percent moisture requirements. In order to address these challenges, the dewatering pad was configured with a combination of primary gravity dewatering bins and secondary stabilization bins. Critical dewatering management practices were developed, including initial placement in gravity dewatering bin for 24 hours, followed by wet sediment being overturned and placed in a second gravity dewatering bin and further division into six small stabilization bins where wet sediments were mixed with Portland cement and then stacked to allow for a three-day cure. This vertical stacking drove out more free liquids and allowed the sediments to dewater for a longer period and produce materials that were acceptable to landfills using less Portland cement—ultimately saving material and disposal costs.

SUSTAINABLE APPROACHES

Sustainable approaches were implemented, including the reuse of all woody debris/trees removed during remediation on the site for habitat structures as well as leaving approximately 8% of the haul road material in place for an upcoming restoration project on the adjacent property, therefore reducing disposal quantities and reusing material in a beneficial manner.

The greatest innovation employed for the project, however, is associated with the unique partnership employed through the GLLA between multiple federal, state, and local agencies as well as the utilization of a new contracting model for the design and construction. These partnerships required a new way of thinking about the project “client,” as multiple agencies were funding work and shared a vested interest in the outcome. The project team maintained a highly responsive approach to communication between all stakeholders and contractors throughout construction, which proved essential in reacting in an expedited and efficient manner when unforeseen issues arose. This partnership and approach were critical to maintain project progress and engagement of all stakeholders and allowed the contractors to work through challenges quickly and effectively by maintaining an atmosphere of open communication, transparency, and consistent communication.

The design of restoration areas incorporated sustainable reuse of materials and utilized existing habitat in conjunction with dredged areas to create a diverse wetland system.



ECONOMIC BENEFITS IMPLEMENTATION, EFFICIENCIES AND COST-SAVINGS

Implementation-related economic benefits included:

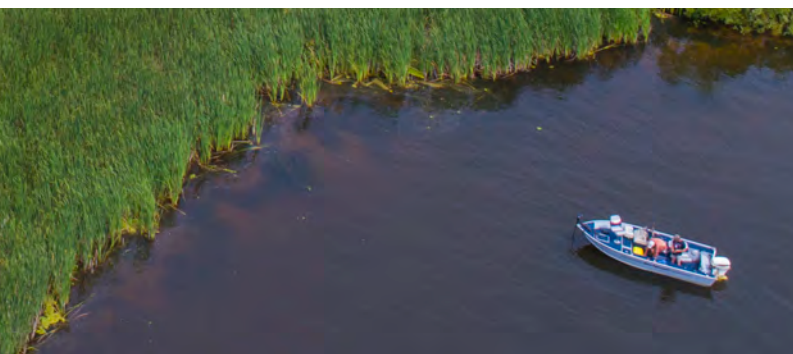
- ▶ Utilized a 4-inch asphalt cap on the dewatering pad in place of 18 inches of stone. While this created a larger capital cost on the front end, cost-savings were realized during restoration as approximately 5,700 CY of stone did not require transport and disposal upon project completion.
- ▶ Left approximately 8% of the haul roads in place, which provided a haul road for an adjacent and ongoing restoration project to utilize during construction. Economic benefits were realized through the reduction of disposal quantities for road stone as well as the re-use of material.
- ▶ Electrical power drop left in place for future on-site use, realizing a future \$10,000 savings.
- ▶ Redesigned the water intake for the property owner's fertilizer operation from approximately 1,200 linear feet of pipe to 20 feet with a debris screen and inlet at the end of the ditch.
- ▶ Reduced disposal costs through in-situ stabilization of hazardous sediments.

SOCIO-ECONOMIC IMPACTS AND CONTRIBUTIONS TO ECONOMY

While direct socio-economic impacts of the Zephyr project have not yet been identified since its completion in late 2018, the restoration project as a whole contributes to the economic impacts within the Muskegon Lake AOC as realized from past habitat restoration projects as detailed in *A socioeconomic analysis of habitat restoration in the Muskegon Lake area of concern* (Isley, P., et. al. 2017). Results of this analysis indicated that:

- ▶ Property values around the shoreline of Muskegon Lake increased by \$11.9 million.
- ▶ There is an estimated 6:1 return on investment based on the value of improved recreation and property values.
- ▶ An additional \$3.2 million in recreation is generated per year due to restoration.

The contaminated sediment removal and restoration will support increased recreation along the Muskegon River.



As the Zephyr project also contributes to the overall socio-economic impacts related to similar restoration work completed in the Great Lakes Region under the Great Lakes Restoration Initiative (GLRI), the results of the *Socioeconomic Impacts of the Great Lakes Restoration Initiative* (University of Michigan Research Seminar in Quantitative Economics, September 30, 2018) can be utilized to assess the impacts of the Zephyr project. Results of this study, completed for the time period of 2010-2016, include:

- ▶ For every dollar spent on restoration, \$3.35 of additional economic output is produced through 2036.
- ▶ Every \$1 of GLRI spending increased local house prices by \$1.08, suggesting that restoration projects provide amenities that were valuable to residents. With the proximity of local residences to the Zephyr site, it is highly likely these benefits will be realized.
- ▶ Additional tourism activity generated by restoration activities in the Great Lakes will increase regional economic output by \$1.62 through 2036 for every \$1 in federal government spending.

TRANSFERABILITY

The Zephyr project included many elements that will be transferable and adaptable to future contaminated sediment remediation and restoration projects.

- ▶ With the ever-growing issues related to climate change, the Great Lakes are impacted by unusually high precipitation events and have recently experienced record high water levels over the past three to four years. In dealing with these elevated water levels during construction at Zephyr, redesigns were necessary for wetland area in order to allow for establishment of native vegetation and ability for that vegetation to adapt to future changing water levels and climate. Designing these wetland areas and plantings to allow for the native vegetation to establish and then adapt and spread into the future is an element of the Zephyr project that will be carried forward in future restoration.
- ▶ Reuse of materials is another lesson learned that will be transferred to other projects in the future. Working with property owners and other restoration or remediation projects adjacent to or in the vicinity of a project to identify all means of sustainable reuse of materials should be a priority of every contaminated sediment project. From electrical hookups, haul roads, dead trees on properties, and utilizing earthen cofferdam material or haul road material as clean fill for restoration are some examples of this sustainable reuse that should be examined.

OUTREACH & EDUCATION

The Zephyr project partners initiated an extensive public outreach and education program during remedial design activities. The program was carried through prior to and during remedial construction and restoration activities to ensure that all community members and concerned citizens potentially affected by this project were informed of the activities and had appropriate communication avenues to state concerns and ask questions.

STAKEHOLDER INVOLVEMENT

- ▶ Sea Grant created the Zephyr Outreach Team in 2015 with representatives from USEPA, Sea Grant, MDEQ, Michigan Department of Human and Health Services, West Michigan Shoreline Regional Development Commission, Muskegon Lake Watershed Partnership, Muskegon County, EA, SES, and the residential neighborhood. It met regularly from 2015-2018 (approximately six to eight times per year) to establish outreach goals and target audiences and develop and implement an outreach plan.
- ▶ Sea Grant performed a needs assessment in 2015, interviewing 27 diverse stakeholders to understand how the community had related to the Zephyr project site, perceived the sediment cleanup plan, and engaged in past outreach efforts. These findings were synthesized in a report and guided the Zephyr Outreach Team outreach plan.
- ▶ The Zephyr Outreach Team created a comprehensive mailing list of 200 individuals, including those in the neighborhood located next to the project as well as diverse stakeholders identified in the needs assessment. Three informational mailings were sent out in 2017 and 2018 to provide updates and invite the community to the public meetings.
- ▶ The Zephyr Outreach Team went door-to-door in 2018, canvassing more than 150 homes in the project site neighborhood with an updated project fact sheet, including a project hotline for complaints during construction and information about potential neighborhood impacts.

OUTREACH AND EDUCATION

- ▶ In partnership with the West Michigan Great Lakes Stewardship Initiative summer institute, in 2016 the Zephyr Outreach Team led more than 20 teachers from the Muskegon Intermediate School District on a tour of the project site, providing information on the site history, clean-up plan, and science classroom applications from the Helping Hands curriculum. The Helping Hands curriculum is aligned with Michigan state standards and Next Generation Science Standards.
- ▶ In 2017, the Zephyr Outreach Team provided 250 Muskegon-area students a virtual bird's-eye view of the Zephyr project. The team visited 18 different classrooms to deliver drone video footage, explaining the importance of sediment remediation for ecosystem health.
- ▶ The Zephyr Outreach Team presented the Feasibility Study at the Muskegon Lake Watershed Partnership in 2015, the Remedial Design in 2017, and Remedial Action in 2018, with attendance well into the 40s for most meetings.
- ▶ Since 2015, the Zephyr Outreach Team created and maintained a project website for the entire project (www.greatlakesmud.org/zephyr-site---muskegon-lake-aoc) which included information on the clean-up plan, community involvement opportunities, educational curriculum, and more.
- ▶ The Zephyr Outreach Team created a flyer in 2018 describing short-term construction disruptions and long-term community benefits. They posted the flyer at more than 50 local businesses in the project site neighborhood.
- ▶ A project hotline was open throughout the construction activities to allow for the public to call in for any questions or complaints. No complaints were received during the project.
- ▶ The Zephyr Outreach Team hosted a press event in 2018 with regional media, state and federal elected officials, project team VIPs, and dozens of community representatives to celebrate the completion of major remediation and restoration activities at the site.
- ▶ Produced outreach video to highlight successful project completion and partnerships and promote the GLLA.



Public outreach meetings were critical to inform local stakeholders of the project's status and gather support.

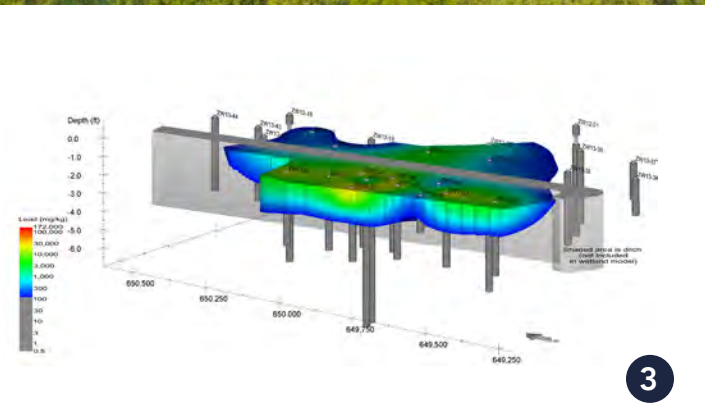
PROJECT PHOTOS: SITE CHARACTERIZATION



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- 1. Site prior to remediation and restoration
- 2. Sediment coring to delineate impacts
- 3. Spatial modeling to determine dredge area

- 4. Porewater sampling to support design
- 5. Cone penetrometer testing to determine geotechnical properties of sediment

- 6. Sediment coring in Muskegon River
- 7. Artistic rendering of restored wetlands that was used for public outreach

2012

2013

2014

2015

2016

Site characterization begins

Feasibility study and pre-design investigation completed

Remedial design and community outreach begins

PROJECT PHOTOS: CONSTRUCTION



8



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10

You're invited to a Muskegon Lake Watershed Partnership public meeting to learn about upcoming efforts to clean up the former Zephyr Oil Refinery.

6:00 p.m., Thursday, September 7, 2017
 Reeths-Puffer Intermediate Cafe
 1500 N. Getty St.
 Muskegon, Michigan

The meeting will provide updates on a number of projects planned to take place this year and next year at the former Zephyr Oil Refinery on Holton Rd. This includes a cleanup of contaminated sediment under the Great Lakes Legacy Act. EPA and MDEQ will be available to answer questions.

For more information, contact Heather Williams, EPA Project Manager, at 312-886-5993 or williams.heather@epa.gov.

Partners: U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, Michigan Department of Environmental Quality, and Muskegon County.

ZEPHYR OIL RESTORATION



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8. Protection of buried petroleum pipeline
 9. Air monitoring to determine if mitigation measures required

10. Three-part cofferdam to control water level
 11. Invitation to one of several public meetings to inform community of project activities

12. In-situ mixing to stabilize hazardous sediment
 13. Multiple dredging methods utilized and constructed haul roads for site access

2017

Remedial design finalized

Community outreach continues with public meetings

2017

Site preparation for dredging begins

PROJECT PHOTOS: CONSTRUCTION



14



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16



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18



19

14. Portland cement addition as last step in dewatering of sediments

15. Mitigating unique environmental challenges including capping historic oil well

16. Innovative dewatering pad and process that was used during project

17. Extensive sampling to confirm clean-up goals met

18. Restoration included fill to create diverse wetland zones

19. Redesign of emergent wetland "islands" utilized to deal with historically high water levels and future fluctuations

2018

Dredging begins

In-situ treatment of hazardous sediment

Dredging of wetlands and ditch complete

Site restoration complete

2018

CONTACT:

Kevin A. Kowalk, P.E.

EA Engineering, Science, and Technology, Inc., PBC
5918 Meridian Blvd, Suite 4
Brighton, MI 48116
Office: 734-369-3410; ext. 303 • kkowalk@eaest.com

Steven C. Shaw, P.E.

Sevenson Environmental Services, Inc.
1105 North Point Blvd., Suite 324
Baltimore, MD 21224
(716) 284-0431 • SCShaw@sevenson.com

