MIDDLEGROUND ISLAND
ENGINEERING EVALUATION/ COST ANALYSIS
THE TITTABAWASSEE RIVER/ SAGINAW RIVER AND BAY SITE

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Acronyms and Abbreviations

AOC	Administrative Settlement Agreement and Order on Consent
ARAR	applicable or relevant and appropriate requirements
BMP	best management practice
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CDF	confined disposal facility
CSM	conceptual site model
CY	cubic yards
Dow	The Dow Chemical Company
EECA	engineering evaluation/cost analysis
EGLE	Michigan Department of Environment, Great Lakes, and Energy
ft	foot/feet
ICIAP	Institutional Control Implementation and Assurance Plan
ICS	Incremental Composite Samples
MDEQ	Michigan Department of Environmental Quality
MGI	Middleground Island
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NTCRA	non-time-critical removal action
OSWER	Office of Solid Waste and Emergency Response
ppt	parts per trillion
RAO	response action objective
RCRA	Resource Conservation and Recovery Act
SU	Sampling unit
Site	Tittabawassee River/Saginaw River & Bay Site
SOW	Statement of Work
TBC	to be considered
TEQ	toxicity equivalent quotient
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1 Introduction

This Engineering Evaluation/ Cost Analysis (EECA) was prepared to evaluate potential response options for Middleground Island (MGI), located within the Saginaw River, per the Administrative Settlement Agreement and Order on Consent (AOC) for the Tittabawassee River/Saginaw River & Bay Site (Site) (Settlement Agreement No. V-W-10-C-942) and associated Statement of Work (SOW), effective January 21, 2010. These documents set forth requirements for assessing current conditions and evaluating response options to manage potential risks to human health and the environment.

Initial screening results from Incremental Composite Samples (ICS) collected from some residential areas of the MGI in November 2018 indicated exceedances of furan and dioxin levels over the site-specific cleanup goal established for Tittabawassee floodplain soil. This led to collection of additional surficial samples (0 – 6 inches below ground surface) of individual residences and non-residential areas located on the MGI in 2019 pursuant to the MGI ICS Plan (Dow 2019a) and the Addendum to the MGI ICS Plan (Dow 2019b). Additional sampling of deeper soil at each residence was then conducted pursuant to the MGI Core Sampling Plan and associated addendum submitted by The Dow Chemical Company (Dow) to the U.S. Environmental Protection Agency (USEPA) in September 2019 (Dow 2019c, 2019d). The USEPA in consultation with the Michigan Department of Environment, Great Lakes, and Energy (EGLE)[1], submitted a memorandum on August 12, 2019 requesting Dow to prepare this EECA to evaluate non-time critical removal actions (NTCRA) to address dioxin-contaminated soil at the MGI within the Site.

Consistent with the SOW requirements, the primary objectives of this EECA include the following:

- Characterize the nature and extent of dioxin contamination in MGI soil
- Develop response action objectives (RAOs)
- Identify and evaluate alternatives for achieving the RAOs

[1] Formerly Michigan Department of Environmental Quality or MDEQ.

2 MGI Characterization

2.1 MGI Description

MGI is located within the Saginaw River, in Bay City, Michigan, approximately 15 miles downstream from the confluence with the Tittabawassee River and approximately seven miles upstream and south of the confluence with Saginaw Bay, as shown on Figure 2-1.

MGI is approximately 175 acres comprised of residential, recreational, commercial, and closed waste disposal properties. Figure 2-1 shows current land use. Approximately 30 acres of the southern portion of MGI consists of residential properties and some of these properties date back to the 1950s. Since then, additional development of residential properties on the island has resulted in a current total of 37 residential homes. Recreational areas are located on the northern portion of the island and include the Bigelow Park, Bay City Rowing Club, and Boys and Girls Club of the Great Lakes Bay Region. Additionally, there is a vacant property repurposed into Michigan Sugar Trails with dedicated trails for mountain biking, running, and hiking. Northwest of the residential properties are the Bay City Middleground Landfill, which is currently closed, and the former U.S. Army Corps of Engineers' (USACE) Middleground confined disposal facility (CDF). Commercial properties are located northeast of the residential area. The soil elevations within the residential areas are thought to have been partially adjusted over the years by using dredged sediments from the Saginaw River as fill material.

2.2 MGI History and Background

Historically, portions of MGI were primarily wetlands until the island was developed for more industrial use by logging and salt industries in the 1800s and early 1900s. Starting around the turn of the twentieth century, MGI was used for both controlled and uncontrolled landfilling and dumping of waste materials including construction debris, brush, and river dredge material. The more well-documented disposal sites on the island were operated by the City of Bay City in the central portion of the island along the western bank, and prior to that the northern portion of the island just north and south of Lafayette Avenue.

Bay City Middleground Landfill operated from 1956 until 1984 when the State of Michigan ordered this landfill closed. It was proposed to the National Priorities List in 1995 but was addressed under the State's remediation program. Adjacent to the landfill was the USACE Middleground CDF which was used as a disposal location for Saginaw River dredge material from 1973 until 1984. Dredged sediments from Middleground CDF were used as daily cover material for the Bay City Middleground Landfill. In addition, some of the continued development of the residential area on the island is thought to have used dredged sediments from the Site as fill material to adjust land elevations on the island.

In 2014, USEPA, working with Michigan Department of Environmental Quality (MDEQ; now EGLE), established site-specific dioxin cleanup goals for Tittabawassee floodplain soil. The term "dioxins" refers to a large family of similar chemicals, including furans. Dioxins are likely carcinogenic or can cause other health effects such as skin problems, liver damage, and reproductive issues, depending on exposures. The cumulative concentrations of dioxins and furans at the Site (i.e., the sum of 17 individual furan and dioxin congeners) are expressed as

2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent quotients (TEQs), calculated based on human/mammalian toxic equivalency factors developed by the World Health Organization (Van den Berg et al. 2006). USEPA's Tittabawassee floodplain soil cleanup goal for maintained residential properties is 250 parts per trillion (ppt) TEQ. The number is based on potential non-cancer effects for the most sensitive receptor – the young child resident (i.e., a Hazard Index of approximately 1). Maintained residential areas include mowed lawns and other maintained portions a residential property. The USEPA's cleanup number for areas of the floodplain that are not maintained residential properties is 2,000 ppt TEQ. USEPA's cleanup numbers were established to ensure protectiveness for everyone who lives, works, or recreates along the river, and are being applied as the criteria for the MGI soil.

In 2018 and 2019 Dow collected soil ICS samples from MGI residential and non-residential areas. Some of the residential samples demonstrated TEQ levels greater than the USEPA clean up goal of 250 ppt TEQ.

2.3 Anticipated Future Use of MGI

The overall future use of the island is not expected to change. The MGI residential properties are located on the southern portion of the island, and the central portion of the island consists of commercial properties, a closed landfill and CDF, and recreational areas. Recreational use also makes up the northern portion of the island.

2.4 Nature and Extent of TEQ Levels

In 2018 and 2019 Dow collected soil ICS from MGI. The sampling procedures, locations, and results are discussed in this subsection.

2.4.1 Sampling Conducted

In November 2018, Dow collected soil ICS from multi-property areas along the Saginaw River, including three samples from the residential (south) end of MGI, to provide an initial screening of soil conditions along the Saginaw River. Sample collection and processing procedures are outlined in the Saginaw River Sampling and Analysis Work Plan (Dow 2018). In summary, 60 discrete samples, at depth of 0-6 inches, were collected from each sampling unit (SU) and composited into one ICS. The locations and results of the November 2018 MGI ICS are provided in Figure 2-2. All three of the MGI composite samples collected in November 2018 had dioxin levels greater than USEPA's cleanup goal of 250 ppt TEQ for maintained residential properties.

As a result of the November 2018 ICS results, USEPA asked Dow to sample individual residences on MGI which was conducted in 2019. Pursuant to the MGI ICS Plan (Dow 2019a and 2019b), Dow collected 60 discrete surface soil samples (0-6 inches) from each SU. The discrete samples from each SU were combined into one ICS per SU. ICS were collected from 45 SUs at individual residential properties or anticipated future residential properties at the south end of the island, as shown on Figure 2-3. An additional nine ICS were collected from non-residential areas, in the middle and northern areas of the island, as shown on Figure 2-4. Depending on the area of the non-residential SUs, either 60 or 90 discrete samples were collected from each SU.

Because fill may have been the source of contamination, additional sampling of deeper soil (6 to 30 inches below the soil surface) at residential properties was conducted pursuant to the MGI Core Sampling Plan and associated addendum submitted by Dow to the USEPA in September 2019 (Dow 2019c, 2019d). Deeper samples were collected on all residential properties where access was granted, as shown on Figure 2-5.

2.4.2 Sampling Results

The results of the November 2018 surface soil sampling are shown on Figure 2-2. All three surface soil samples from November 2018 had TEQ levels exceeding 250 ppt. The 2019 MGI residential soil ICS results are provided in Table 4-1. Samples were collected at depths of 0-6 inches, 12-24 inches, and 24-30 inches. Sixteen of the 45 residential SUs sampled at depth 0-6 inches in 2019 had TEQ levels exceeding 250 ppt, with the maximum of 1,290 ppt. Ten of the SUs sampled at depth 12-24 inches had TEQ levels exceeding 250 ppt, and five of the SUs sampled at depth 24-30 inches had TEQ levels exceeding 250 ppt. Except for one location, all deeper samples (12-24 inches and 24-30 inches) that exceeded the 250 ppt criterion are located in the SUs where the surface samples (0-6 inches) also exceeded 250 ppt TEQ. In total, 17 residential SUs had TEQ levels exceeding 250 ppt at one or more depths.

Dow also sampled nine non-residential SUs on the island. All results in the non-residential areas were well below USEPA's site-specific non-residential cleanup criterion of 2,000 ppt TEQ, as listed in Table 4-2.

3 Conceptual Site Model / Response Action Goals

RAOs provide a basis for evaluating different MGI response options by describing what the actions are intended to accomplish. RAOs also provide a framework for developing effective response action alternatives. The remedy evaluation process, presented in Section 6, evaluates the effectiveness, implementability, and cost of the different response action alternatives and assesses the extent to which each alternative is expected to achieve RAOs.

RAOs are developed based on an understanding of the media, exposure pathways, and receptors that are the focus of the response action. They are closely tied to the site-specific conceptual site model (CSM). The CSM describes contaminant sources and the status of source controls; summarizes the nature, extent, and fate of the dioxins and furans; and identifies potential exposure pathways that will be mitigated by response actions. Based on the nature and extent of dioxins and furans on MGI, concentrations of dioxins and furans in surface soils at some residential properties are the basis for action in this EECA. The information in these sections helped inform the development of MGI CSM and RAOs.

The MGI CSM and RAOs were developed in accordance with the AOC/SOW. The MGI data presented in Section 2 meet the requirements of an EECA as set forth in the AOC/SOW and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The 2018 and 2019 MGI soil data support the development and evaluation of response action alternatives for the potential direct human contact pathway. Moreover, in accordance with the AOC/SOW, the site characterization data available for MGI have been reviewed by Dow and the Agencies.

3.1 Conceptual Site Model

Dioxins and furans are found in and along the Tittabawassee and Saginaw Rivers and in Saginaw Bay from past waste disposal practices at Dow's plant in Midland, Michigan. Contamination extends over 50 miles downstream of the Dow Midland facility. Dow's Midland plant began operations in 1897 and eventually grew to be a 1,900-acre facility. One major historical process used at the Midland plant was the chloralkali process, which used electric current to extract chemicals from brine. Early in the history of the Midland plant, process cleaning waters were discharged directly into the Tittabawassee River and, later, the cleaning waters were stored and partially treated in settling ponds prior to discharge to the river. Much of the TEQ found in soil and sediment at the Site is believed to have been released in the early 1900s in the form of furan-contaminated graphitic particles that came from breakdown of carbon anodes used in the chloralkali process. Once released to the river, the graphitic particles mixed with the sediment and moved downstream, depositing where hydrodynamic conditions were favorable. Over time, changes in waste management practices included the installation and operation of a modern wastewater treatment plant. Waste management practices at the Midland plant have controlled non-permitted releases from the Midland plant.

The Site starts at the confluence of the Tittabawassee and Chippewa Rivers, adjacent to Dow's Midland plant. The Site includes the lower 24 miles of the Tittabawassee River, the entire 22 miles of the Saginaw River, and portions of Saginaw Bay where the release of dioxins and furans has migrated. In 1910, the entire length of the Saginaw River became an authorized federal navigation channel from the confluence with the Shiawassee and Tittabawassee Rivers

downstream to Saginaw Bay. Regular maintenance dredging has been conducted within the federal navigation channel to ensure sufficient water depths needed for the passage of ships, barges, and other aquatic vessels. Dioxin and furan congener patterns observed in the dredged sediment from the Saginaw River demonstrate the presence of dioxins and furans in the sediment is likely due to releases from the Dow Midland plant primarily during the early 1900s. MGI was used for the disposal of waste materials in some areas, including river dredge material. A USACE CDF was also used as a disposal location for Saginaw River dredge material from 1973 until 1984. Dredged sediments from the CDF were used as daily cover material for the Bay City Middleground Landfill. Reportedly, the dredged sediments were also available to island residents as fill material in order to raise the elevations in their yards. The elevated TEQ soil levels measured on MGI in 2018 and 2019 are likely due to the use of dredged sediments as fill material at some locations on the island.

3.2 RAOs and Soil Response Action Criteria

The MGI RAO is consistent with the RAO developed for the Tittabawassee River floodplain soil. In accordance with the AOC/SOW, the RAO for MGI consists of the following:

- General response objectives
- Performance objectives
- Measurable metrics

General response objectives identify the exposure pathway to be addressed in order to effectively reduce exposure potential. Performance objectives identify specific targets intended to fulfill the general response objective. Measurable metrics consist of quantitative criteria that establish whether performance objectives have been met.

MGI RAO

General Response Objective: Limit the potential for human TEQ exposure from MGI soil to reduce risks. Consistent with the AOC/SOW, this is a short-term RAO, and additional pathways and/or receptors may need to be evaluated in the future to assess the need for potential further actions at the site.

Performance Objectives: Conduct and/or maintain response actions that reduce soil TEQ levels to soil response action criteria.

Measurable Metric: Surface soil TEQ levels

Soil Response Action Criteria

The site-specific soil response action criteria provided by the Agencies (USEPA 2014) are as follows:

- Residential maintained areas: criterion of 250 ppt TEQ
- Other land use areas: criterion of 2,000 ppt TEQ

3.3 Identification and Compliance with ARARs

Any NTCRA response actions implemented on-site must comply with substantive elements of applicable or relevant and appropriate requirements (ARARs), to the extent practicable. ARARs may be waived in certain circumstances. Although on-site response actions performed under formal CERCLA authorities (e.g., an AOC) are exempt from the administrative requirements of federal, state, and local environmental laws, the action must nevertheless comply with the substantive technical requirements of such environmental laws or those ARARs must be waived.

Applicable requirements are defined in the NCP (40 CFR 300.5) as those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

A requirement may not be applicable, but nevertheless could be relevant and appropriate. As defined in the NCP (40 CFR 300.5), relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

In addition, per the NCP (40 CFR 300.400(g)(3)), USEPA, other federal agencies, or states may develop other criteria, advisories, or guidance that are not legally enforceable but that may be useful in developing response actions, and that may, as appropriate, be considered for a particular release. These fall into the category of criteria “to be considered” (referred to as TBCs).

ARARs may be categorized as 1) chemical-specific, 2) action-specific, or 3) location-specific. Some ARARs fit neatly into a single category, while others may fall into more than one category. Tables 3-1 to 3-3 identify chemical-, action-, and location-specific ARARs that may be applicable to response actions on MGI.

4 MGI Areas Requiring Response

The MGI soil ICS results from 2019 were compared to the site-specific USEPA dioxin and furan soil criteria to identify MGI properties that require a response action. The complete list of surface soil ICS TEQ results for residential SUs is provided in Table 4-1. The residential property ICS results were compared to the USEPA maintained residential criterion of 250 ppt TEQ. Based on this comparison, 17 residential SUs on MGI, for a total of approximately 15.3 acres, require a response action.

The non-residential properties were compared to the site-specific non-residential clean up criterion of 2,000 ppt TEQ. None of the nine non-residential ICS results exceed this criterion, thus none of the non-residential properties require a response action. As a result, this EECA focuses on the evaluation of remedy alternatives for the MGI residential properties identified for cleanup. Continued evaluations are expected to be conducted in non-residential areas.

5 Response Technologies and Response Action Alternatives

This section discusses the identification of remedial technologies that were subsequently assembled into response action alternatives for MGI. The identification and assembly of response actions/remedial technologies into a focused set of alternatives was performed in accordance with CERCLA guidance (USEPA 1988) and USEPA's national policy (USEPA 2005), consistent with the AOC/SOW, and as detailed in the sections below. An initial screening of potentially applicable remedial technologies was performed to identify technologies that would be technically feasible and implementable at MGI. The following technologies have been identified as potentially applicable to the MGI residential properties:

- **Capping/ Soil Cover:** Includes capping or placement of soil cover over the contaminated areas.

- **Soil Removal and Backfill:** Includes excavation of contaminated soil followed by placement of clean backfill material, with long-term management of the contaminated soil at an approved location.

5.1 Common Elements

There are several elements that are common to the alternatives evaluated in this section. Common elements that are relevant to the MGI response action alternatives include the following:

- **Source Control.** Control of primary sources of hazardous substances, pollutants, or contaminants from the Dow facility has been completed. The effectiveness of primary source control measures is being monitored under separate National Pollutant Discharge Elimination Systems (NPDES) and Resource Conservation and Recovery Act (RCRA) authorities administered by EGLE.

- **Hydraulic Assessment.** A hydraulic assessment may be performed to determine whether the USEPA-selected response actions for implementation at MGI have a potential to affect flooding elevations.

- **Construction Monitoring.** Construction monitoring will be performed for any response action implemented. Details of the construction monitoring will be addressed during remedial design.

- **Revegetation.** Vegetation will be re-established on the residential properties following remedy implementation.

The two technologies discussed herein were used to develop the response action alternatives presented in this EECA. The remedial technologies included in the alternatives have not been defined with respect to remedial process options (e.g., what type of removal method to employ). Selection of specific process options depends on the context in which the technology is applied

and will be resolved during remedial design. A description of how each component is applied is provided below.

5.2 Alternative 1 – Capping/ Cover

The soil cover alternative provides a clean surface over the existing contaminated soil on the MGI. This alternative achieves the RAO by establishing a clean soil surface and/or further burying and isolating subsurface contamination, which reduces the potential of human contact with the impacted soils beneath the soil cover. The total cover area for the 17 properties requiring a response action is 15.3 acres. While this alternative does control human exposure to contaminated soil and does reduce the surface soil TEQ levels, the buried soil TEQ levels are not reduced. Monitoring and maintenance activities are used to identify and address potential disruptions to the soil cover, and institutional controls also may be used to ensure the long-term effectiveness of the soil cover.

5.3 Alternative 2 – Removal and Backfill

The soil removal and backfill option involves the permanent removal of contaminated surface soil and long-term management at an approved location. For those properties requiring a response action, soil will be removed to a depth such that TEQ levels of the soil left in place are less than 250 ppt, with a maximum soil removal depth of 24 inches. The total removal volume for the 17 properties requiring a response action is approximately 35,600 cubic yards (CY). Soil removal will result in a new surface elevation following removal, which will be filled with clean backfill. The total removal and backfill area is 15.3 acres. The removal of contaminated surface soil combined with clean backfill achieves the RAO and is protective of human health by removing impacted soils, therefore eliminating potential exposures. To contribute to the overall protectiveness, the excavated soil would be placed in an approved location.

6 Evaluation of Response Alternatives

The two alternatives discussed in Section 5—soil capping/ cover and soil removal followed by placement of backfill— can effectively manage potential exposures to contaminated soil on the residential areas of MGI.

For each alternative, there are tradeoffs associated with the effectiveness, implementability, and cost criteria. Some of these tradeoffs include the following:

- **Flexibility of future land use** - The range of land uses that can be applied to an area may be impacted after implementation of an alternative. For example, the placement of a soil cover would restrict activities that would significantly disturb or disrupt the soil cover.

- **Monitoring and maintenance requirements** – The capping/ cover alternative requires long-term monitoring and any needed maintenance, along with property access to support long-term monitoring and maintenance activities to ensure the alternative is effective in the long-term.

- **Short-term worker and community impacts** – Both alternatives can result in impacts to workers, including safety concerns during remedy implementation. The community may be impacted during the implementation of alternatives involving large-scale heavy construction that contribute to an increase in noise, emissions, and traffic.

- **Cost** – Cost is a factor that is evaluated for both the alternatives. The removal and backfill alternative is larger in scale, can take longer to implement, and tends to be more costly.

6.1 Evaluation Criteria

This Section evaluates the Criteria established in *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, OSWER 9360.0-32, August 1993, and *Use of Non-Time-Critical Removal Authority in Superfund Response Actions*, OSWER 9360.0-40P, February 2000, and other considerations relative to the conditions at Middleground. The evaluation criteria for each response alternative include effectiveness, implementability and cost. Under the criteria, effectiveness, the following elements are further evaluated:

- Overall protection of human health and the environment,

- Short-term effectiveness,

- Long-term effectiveness and performance,

- Compliance with ARARs, and

- Reduction of toxicity, mobility, or volume through treatment.

The effectiveness evaluation for MGI soils focuses on the long-term control of potential direct human contact exposure pathways. Effectiveness also considers the potential impacts of an alternative on the environment and the community. Short term impacts can be physical or safety impact to workers and physical, safety or social impacts to the community. Alternatives involving large-scale heavy construction are likely to cause impacts to the community during the time required to implement the alternative due to noise, equipment and truck traffic, exhaust fumes, etc.

The implementability evaluation for an alternative considers the technical feasibility, administrative feasibility, and availability of services and materials required for implementation. Both the alternatives evaluated in this section can be implemented in a manner that would comply with the ARARs. Action-specific ARARs such as soil management requirements are remedy-specific and action-specific, and compliance with ARARs will be managed in the design and implementation phases of the work. Chemical-specific ARARs will be achieved by meeting the site-specific soil response action criteria, as outlined in Section 3.2.

The reduction of chemical constituent toxicity, mobility, or volume of through treatment is a remedy alternative evaluation criterion listed above. Neither of the alternatives being evaluated in this EECA include a treatment component as means of reducing contaminant toxicity, mobility, or volume of TEQ in soil. Therefore, this evaluation criterion is not further evaluated in Section 6.2. Through the soil removal alternative, TEQ-impacted surface soil would be removed and transported to an approved location. Although the soil removal alternative does not include treatment of soils, removal results in a reduction of toxicity, mobility, and volume of TEQ within the residential areas of MGI. In some cases, soil treatment following removal can be used to remove, destroy, or reduce the mobility of contaminants, making the treated material suitable for beneficial reuse as structural or nonstructural fill. However, ex situ soil treatment technologies have challenges associated with the potential volumes and concentrations of the soil. Treatment tends to have very high costs and likely involves the transport of the soil to a treatment facility located in another region or country. Ex situ soil treatment requires large volumes of soil to be treated in order to target relatively low concentrations of contaminants. Thus, the treatment of the removed soils was not considered to be efficient or cost-effective and was not included as part of the soil removal and management alternative.

Per USEPA guidance, cost refers to the costs necessary to implement the alternative, as well as long-term costs to monitor and maintain effectiveness. The costs discussed here reflect costs for each alternative on a per acre basis. As part of the process for implementing response actions, these cost estimates will be refined later to include both implementation and long-term costs. For the comparison of alternatives, a 30-year monitoring period will be assumed when monitoring is required. Consistent with USACE/USEPA guidance (2000), those refined cost estimates are anticipated to be accurate within the range of -30% to +50%. In developing the cost estimates, a future discount rate of 7% will be used for the present worth calculation as specified by USACE/USEPA guidance.

6.2 Evaluation of Remedy Alternative 1 - Capping/ Cover

The capping/cover alternative discussed in this section is applicable to certain residential properties of MGI. Monitoring and maintenance of the cap/cover is included as part of this alternative to help ensure the remedy is effective over the long term. In addition, institutional controls would be established to prevent future disruptions to the cap/cover.

6.2.1 Effectiveness

The soil cover alternative achieves the RAO by establishing a clean soil surface, which reduces the potential of human contact with the impacted soils that become isolated beneath the soil cover. While this alternative does control human exposure to contaminated soil and does reduce the surface soil TEQ levels, the buried soil TEQ levels are not reduced. Monitoring and maintenance activities are used to identify and address potential disruptions to the soil cover, and institutional controls also may be used to ensure the long-term effectiveness of the soil cover. The covering of the soils would limit the exposure to TEQ-containing soils and would therefore be protective in the short term. The soil cover would be considered effective at meeting the RAO as soon as placement is complete, as the placement of the cover would immediately reduce exposure to the island soils. The soil cover alternative can also be effective in the long term. Direct contact with the TEQ-impacted soils is the primary route of potential human exposure; therefore, the long-term effectiveness of this alternative is attributed to the cover, which limits potential access to the TEQ-impacted soils. The long-term effectiveness of the soil cover option relies on behavior and compliance of individual property owners, and institutional controls will be used to control the potential risk associated with soil cover management of impacted soil. Appropriate monitoring and maintenance will make sure that the soil cover is effective in the long-term and will be used to ensure that potential future disruptions to the cover are repaired. Under CERCLA, a five-year review process is required to document the continued protectiveness of the remedy.

In residential areas, a soil cover is expected to be effective over the long term with appropriate maintenance. However, heavily trafficked areas of residential properties may require gravel or some other aggregate material in place of soil to protect against disturbances.

Short-term impacts of this alternative may affect the community and worker safety. For example, over 100 truckloads of clean material per acre (assuming a 2-ft cover depth) would need to be transported to each soil cover location. Some residential areas on the island have large trees and shrubs, and in these areas construction activities may include the removal of existing vegetation. This wood and vegetation debris may need to be trucked through the community to reach the final disposal location. These activities would impact the community through an increase in noise and air pollution due to the use of diesel machinery, airborne dust, and construction related traffic. Increased traffic could also lead to potential accidents, particularly since the only vehicle access to the island is via one road with two bridges; the Salzburg Avenue bridge (west side) and the Lafayette Avenue bridge (east side), as shown on Figure 2-1. The bridges consist of two lanes and currently include no traffic controls to turn on or off the island. On MGI there is only one narrow, two-lane road that extends the entire length of the island (Evergreen Drive). As a result, remedy-related construction traffic on the island will need to be carefully planned and managed.

6.2.2 Implementability

Capping/ cover is technically feasible, and services and materials are expected to be available. In most maintained residential areas, a soil cover can be readily implemented because clean soil can be placed over existing impacted soils. Placing soil in maintained areas requires careful consideration of morphology and hydrologic conditions to ensure that the cover is appropriately designed. In general, for the soil cover alternative to be affective, soil disturbances will need to be avoided in the response area.

Implementability for this alternative may be affected by administrative feasibility considerations. The soil cover alternative would have to demonstrate that the placement of a cover material would not negatively impact flood elevations beyond the limit mandated by the Michigan Flood Plain Act, using procedures similar to those used to assess compliance of previous response actions in the Tittabawassee River with this ARAR.

Future land uses must ensure that the cover remains effective over the long term; therefore, the soil cover alternative includes the use of institutional controls, monitoring, and maintenance activities. From an implementability perspective, agreements to allow access to the areas for monitoring and possibly maintenance may be required, and some property owners may be reluctant to place ICs. Additionally, the limited vehicle access discussed above may cause implementation challenges from managing construction traffic.

6.2.3 Cost

The preliminary estimated cost for placing a 1-ft thick soil cover over maintained residential area is listed below and the breakdown is provided in Table 6-1. The cost includes transportation of clean material from a suitable source. Restoration activities have been assumed to primarily consist of placing topsoil and reseeding.

- Soil cover - $750,000

6.3 Evaluation of Remedy Alternative 2 - Removal and Backfill

The removal of the contaminated soil and placement of clean backfill discussed in this section is applicable to certain residential properties of MGI.

6.3.1 Effectiveness

The soil removal and backfill alternative involves the permanent removal of contaminated surface soil on MGI and transport to an approved location, followed by importing clean backfill material and placement in excavated areas. The removal of contaminated surface soil and replacement with clean fill is the primary mechanism used to establish a clean soil surface. As a result, this alternative achieves the RAO and is protective of human health by reducing the potential exposure to impacted soils. To contribute to the overall protectiveness, the excavated soil would be placed at an approved location and would be managed over time.

The removal and management of impacted surface soils is effective in the short term as well as long term due to the permanent removal of impacted material. This alternative also includes placing a clean backfill layer in the removal area to restore properties to grade.

Similar to Alternative 1, short-term impacts of this alternative may affect both the MGI and Bay City community and worker safety. This alternative would require the removal of approximately 35,600 CY of material from the 17 residential SUs warranting a response action. To transport the 35,600 CY of removed soil, approximately 1,160 truck and trailer loads of contaminated materials would be hauled to the approved location followed by transport of another 1,160 truck and trailer loads of clean backfill material to these areas for placement. In addition, wood and vegetation debris may need to be removed from the site and trucked through the community to reach the final location. Heavy construction also increases noise and air pollution due to the use of diesel machinery, airborne dust, and construction-related traffic. Increased traffic could also lead to potential accidents, particularly since the only vehicle access points to the island is via the Salzburg Avenue and Lafayette Avenue bridges, discussed above. The bridges consist of two lanes and currently include no traffic controls to turn on or off the island. On MGI there is only one narrow, two-lane road (Evergreen Drive) that extends the entire length of the island.

Two possible locations have been preliminarily identified to accept the soil removed under this alternative: an area on MGI, and a location in Midland, Michigan, approximately 21 miles west of MGI. A map showing the locations of these two sites, as well as an evaluation of the implementability and effectiveness of using these two sites are provided in Appendix A. If this alternative is selected, other long-term management locations for the removed soil may be evaluated during the design phase.

Worker safety concerns involve working around and operating construction equipment and removing and transporting debris, vegetation, and soil. Clearing of trees presents additional worker safety challenges since it involves working with chainsaws when climbing trees or working from elevating equipment. However, these concerns would be managed by appropriate health and safety and operational plans.

The impacts to the existing habitat are expected to be similar to that of Alternative 1. In summary, long-term impacts to the existing habitat are expected to be limited in maintained residential areas, but in designated residential portions that are heavily vegetated, much of the existing habitat would need to be removed, resulting in short-term and long-term environmental impacts. Restoration efforts are typically part of this alternative; however, preconstruction conditions may require decades to fully return.

6.3.2 Implementability

Removal and backfill is technically feasible, and services and materials are expected to be available. This response action has been successfully conducted at numerous properties along the Tittabawassee River. The soil removal and backfill alternative is generally implementable on maintained residential properties, where densely vegetated areas are limited.

The long-term management of contaminated soil involves transport from the removal locations via trucks to an approved location. The residential area of MGI and other properties along the truck route would be impacted. Transporting the removed soil from the residential areas will require the use of Evergreen Drive, the two-lane road that runs along the island and possibly Lafayette Avenue bridge and Salzburg Avenue depending on the approved location.

This alternative will also require the use of Salzburg Avenue and/or Lafayette Avenue bridges and the northern and central sections of Evergreen Drive for the import of clean backfill materials, and mobilization and demobilization activities.

6.3.3 Cost

The preliminary estimated cost for removing 2 ft of TEQ-impacted soil and refilling the area to grade with clean material is listed below and the breakdown of the cost is provided in Table 6-2. The cost includes transportation of impacted soil to the approved location and transportation of clean material from a suitable source. A range in costs is provided, which reflects the difference in costs for transporting the soil to an on-island or off-island site, as further discussed in Appendix A. Restoration activities have been assumed to primarily consist of placing topsoil and reseeding.

- Soil removal and backfill - $1.67M - $2.13M

7 Integrating Green and Sustainable Remediation Practices

In addition to the NCP evaluation, efforts will be made to examine and incorporate green and sustainable remediation practices into the design and implementation of MGI response options, including actions and the incorporation of best management practices (BMPs) that minimize the footprint of the remediation. The core green and sustainable remediation elements include the following:

- Material and waste: The quantification of the amount of materials used and the amount of waste generated. The use of recycled or biodegradable materials and recycling wastes are also identified.

- Energy: The primary energy uses will be related to the use of vehicles and construction equipment. The soil relocation options, as outlined in Appendix A, will have an impact on energy and fuel use due to the difference in trucking distances of the removed soil.

- Air and atmosphere: Air emissions are primarily related to the use of vehicles and construction equipment. The soil relocation options, as outlined in Appendix A, will have an impact on fuel use and associated air emissions due to the difference in trucking distances of the removed soil.

- Water: The primary water uses are associated with dust control and irrigation of replanted areas post-construction.

- Land and ecosystem: This criterion factors in the types and quantity of habitats affected and the subsequent impacts to recreation and other land uses. Short- and long-term changes are addressed.

Green and sustainable remediation practices are consistent with USEPA's green remediation framework and Dow's corporate sustainability goals. USEPA's recent guidance (USEPA 2010, 2012) encourages incorporating site footprint analysis and net results analysis and using BMPs associated with core elements important to green remediation. Dow's corporate sustainability goals and core values reflect similar elements.

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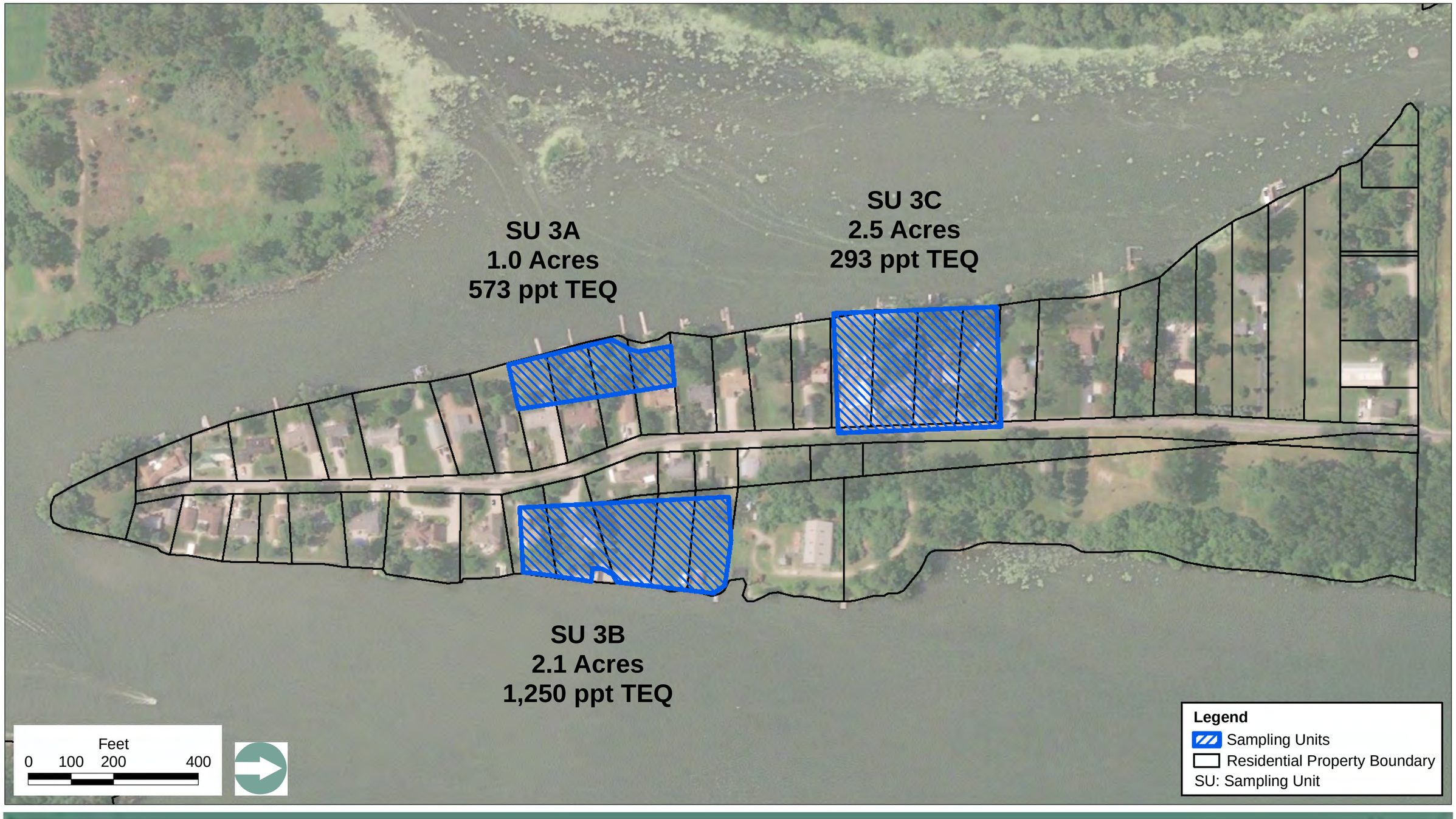
Figures

Notes:
Aerial Imagery - 2019

Middleground Island Location
Middleground Island Engineering Evaluation/Cost Analysis

Figure
2-1



Notes:
Aerial Imagery - 2019

November 2018 ICS Locations and Results
Middleground Island Engineering Evaluation/Cost Analysis

Figure
2-2

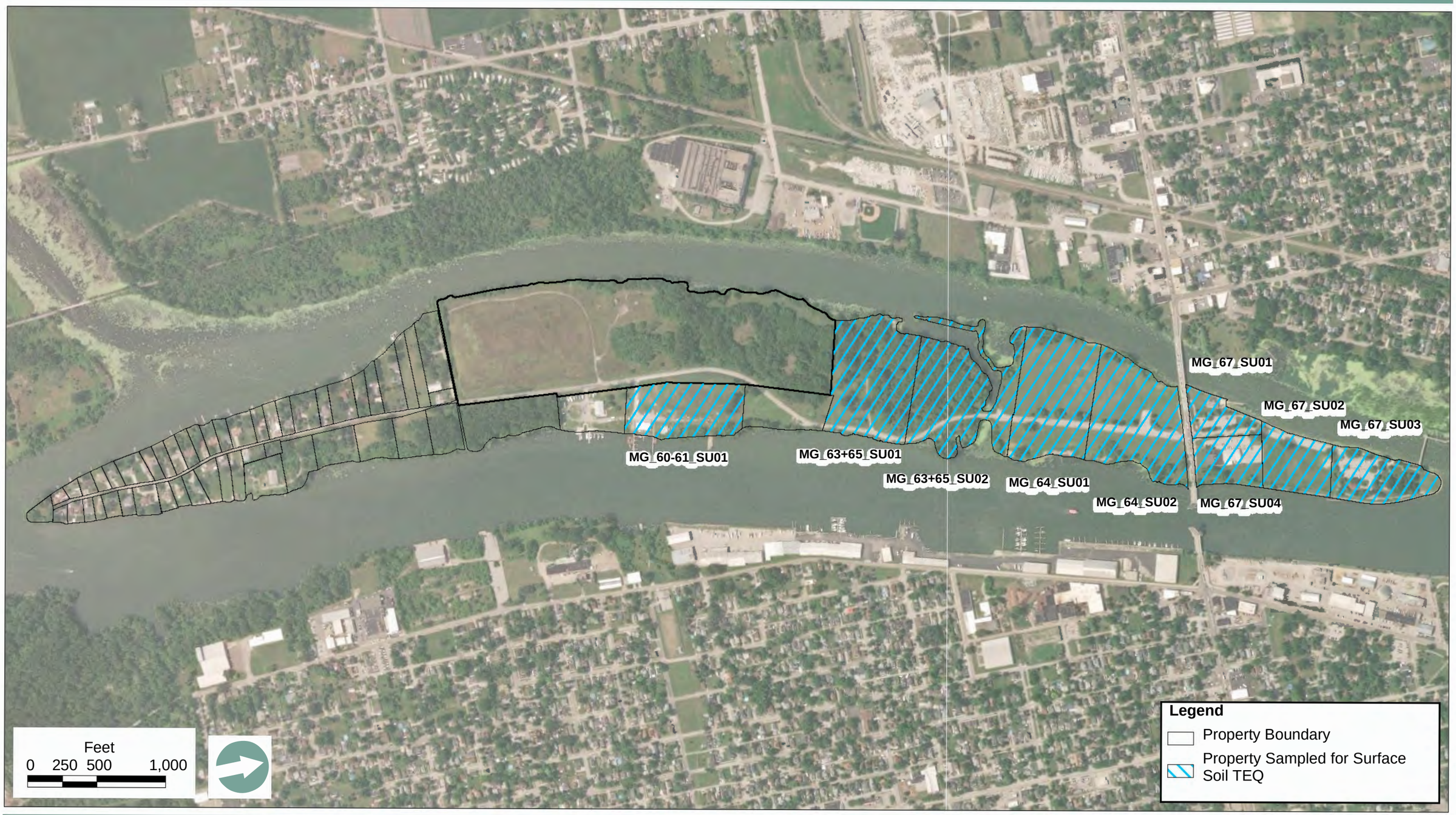
Notes:
Aerial Imagery - 2019

SU: Sampling Unit

2019 Residential ICS Locations (0 - 6 inches)

Middleground Island Engineering Evaluation/Cost Analysis

Figure
2-3



Notes:
Aerial Imagery - 2019

SU: Sampling Unit

2019 Non-Residential ICS Locations (0 - 6 inches)

Middleground Island Engineering Evaluation/Cost Analysis

Figure
2-4

Notes:
Aerial Imagery - 2019

2019 Deep Soil Core Locations
Middleground Island Engineering Evaluation/Cost Analysis

Figure 2-5

Tables

Table 3-1
Potential Chemical-Specific ARARs
Middleground Island EECA

Medium	Standard or Requirement	Regulatory Citiation			Comments
		Federal	State	Local	
Soil	Site-specific cleanup criteria	None	Part 201 of NREPA	None	Soil cleanup criteria are based on human health evaluations
Surface Water	National Recommended Water Quality Criteria	304(a)(1) of CWA (33 U.S.C. § 1314[a][1]) and 303(c) of CWA (33 U.S.C. § 1313[c])	None	None	May be applicable for discharges to surface water, depending on the selected remedy
	Michigan cleanup criteria	None	Part 4 of Michigan Water Quality Standards	None	May be applicable for discharges to surface water, depending on the selected remedy

Notes:

ARAR: Applicable or Relevant and Appropriate Requirement
CWA: Clean Water Act
NREPA: Natural Resources and Environmental Protection Act

Table 3-2
Potential Action-Specific ARARs
Middleground Island EECA

Action	Standard	Regulatory Citation			Comments
		Federal	State	Local	
Excavation/Fill Activities/Earth Changes	Requirements for activities that could impact surface waters through sedimentation or erosion		Part 91 of NREPA (Soil Erosion and Sedimentation Control; MCL 324.9101 et seq.)		May be applicable to any remedy that involves earth changes including excavation, cut and fill activities that may contribute to soils erosion and sedimentation of surface water
Waste Generation and Land Disposal	Requirements for solid and liquid waste management and disposal	Solid Waste Disposal Act (aka RCRA) (42 USC 6901 et seq.; 40 CFR 257, 258, 260 et seq.); Subtitle D of RCRA; RCRA Land Disposal Restrictions	Part 115 of NREPA (Solid Waste Management; MCL 324.11501 et seq.) Part 111 of NREPA (Hazardous Waste Management; MCL 324.11101 et seq.) Part 201 of NREPA (Relocation of Contaminated Soil; 324.20120c et seq.) Part 121 of NREPA		May be applicable to extent remedy generates excavated soil, or other material that qualifies as a solid, liquid, industrial, and/or hazardous waste
Discharges to Surface Water	Floodplain protection		Part 31 of NREPA (Water Resources Protection; MCL 324.3101 et seq.)		Actions may not cause harmful interference with floodway flow
	Surface water quality standards		Part 31 of NREPA (Water Resources Protection; MCL 324.3101 et seq.)		May be applicable for discharges to surface water, depending on the selected remedy
		Part 402 of the CWA			

Table 3-2
Potential Action-Specific ARARs
Middleground Island EECA

Action	Standard	Regulatory Citation			Comments
		Federal	State	Local	
All Response Actions	Endangered Species Act	16 U.S.C. Section 1531 et seq.; 50 CFR Part 17	Part 365 of NREPA (Endangered Species, MCL 324.36501 et seq.)		Actions may not jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats, or must take appropriate mitigation steps
	Bald and Golden Eagle Protection Act	16 USC 668 et seq.			May be applicable if bald or golden eagles or their nests are encountered during the response action
	Injurious air emissions		Mich. Admin. Code Rule 336.1901(a) Part 55 of NREPA		Prohibits air emissions, including dust and fumes, that are injurious to human health, animal or plant life, or property
	Invasive Species		Part 413 of NREPA		Restricts introduction of a prohibited species, a restricted species, or a genetically engineered or nonnative aquatic plant, bird, crustacean, fish, mammal, or mollusk

Notes:
ARAR: Applicable or Relevant and Appropriate Requirement
CFR: Code of Federal Regulations
CWA: Clean Water Act
MCL: Michigan Compiled Laws
NREPA: Natural Resources and Environmental Protection Act
USC: United States Code

Table 3-3
Potential Location-Specific ARARs
Middleground Island EECA

Location	Standard or Requirement	Regulatory Citation			Comments
		Federal	State	Local	
Within Floodplain	Requirements for occupying, filling or grading the floodplain	Executive Order 11988 40 CFR 264.18(b)	Part 31 of NREPA (Water Resources Protection, MCL 324.3101 et seq.)		May be applicable to selected remedy if it involves construction or waste management activities within a floodplain
Within/Adjacent to Wetlands	Requirements for dredging or filling a regulated wetland	Section 404 of the Clean Water Act (33 USC 1251 et seq.) Executive Order 11990	Part 303 of NREPA (Wetland Protection, MCL 324.30301 et seq.)		May be applicable if selected remedy involves activities in or adjacent to wetlands
Historic or American Indian Sites or Structures	Avoidance, minimization, or mitigation of impacts to historic or American Indian sites or structures	National Historic Preservation Act (16 USC 470 et seq; 36 CFR Parts 60, 63 and 800) Archeological and Historic Preservation Act (16 USC 469-469c) Archeological Resources Protection Act (16 U.S.C. 470aa-mm) Native American Graves Protection and Repatriation Act (25 U.S.C. 3001 et seq.) American Indian Religious Freedom Act (42 U.S.C. 1996 et seq.)			May be applicable if the selected remedy involves removal of or limitations on access to a historical or American Indian site or structure
Bird Habitat	Avoidance of harm to protected migratory birds and nests	Migratory Bird Treaty Act, 16 USC 703 et seq.			May be an ARAR to the extent that listed migratory birds or their nests are present

Notes:
ARAR: Applicable or Relevant and Appropriate Requirement
CFR: Code of Federal Regulations
MCL: Michigan Compiled Laws
NREPA: Natural Resources and Environmental Protection Act
USC United States Code

Table 4-1
2019 Residential ICS TEQ Results
Middleground Island EECA

TEQ Results (ppt)		
0-6 inch	**12-24 inches**	**24-30 inches**
14	21	NA
24	20	NA
26	106	NA
27	38	NA
29	72	NA
36	41	NA
38	34	NA
39	96	NA
40	21	NA
41	32	NA
46	23	NA
47	38	NA
48	67	NA
70	51	NA
72	75	NA
85	214	NA
87	125	NA
88	147	NA
91	146	NA
100	245	NA
111	151	NA
128	95	NA
137	65	NA
148	77	NA
175	351	226
224	54	NA
201	211	NA
204	153	NA
204	84	NA
256	112	NA
272	70	NA
297	517	492
307	125	NA
332	72	NA
364	289	320
458	238	NA
470	272	94
577	780	230
631	996	597
686	169	NA
745	723	1060
904	550	136

Table 4-1
2019 Residential ICS TEQ Results
Middleground Island EECA

TEQ Results (ppt)		
0-6 inch	**12-24 inches**	**24-30 inches**
1040	378	62
1210	764	384
1290	128	NA

Note: Each TEQ result represents a residential sampling unit. Results are sorted from lowest to highest TEQ based on the 0 – 6 inch sample. Deeper results are not sorted by concentration, they are from the same sampling unit as the 0 – 6 inch sample. Highlighted values indicate TEQ levels greater than the RAO of 250 ppt.

ICS: incremental composite sample

ppt: parts per trillion

TEQ: toxic equivalent quotient

Table 4-2
2019 Non-Residential Surface (0-6 inches) ICS TEQ Results
Middleground Island EECA

Surface ICS TEQ Results (ppt)
53
83
86
99
107
190
620
689
757

Note: Each TEQ result represents a non-residential sampling unit. Results are sorted from lowest to highest TEQ.

ICS: incremental composite sample

ppt: parts per trillion

TEQ: toxic equivalent quotient

Table 6-1
Cost Estimate for Alternative 1 - Capping/ Cover
Middleground Island EECA

Soil Capping/ Cover	
	Total Costs
Clean material placed as cover	**$612,000**
Tree removal and vegetation restoration	**$53,600**
Total	**$665,600**
Project safety and management	**$84,200**
Grand Total Costs	**$750,000**

Assumptions:

Placement of one foot of clean material over existing soil.

Minimal clearing and grubbing is required.

Restoration includes seeding for turf grass.

Table 6-2
Cost Estimate for Alternative 2 - Removal and Backfill
Middleground Island EECA

Soil Removal and Management	
	Total Costs
Remove and haul contaminated soil	**$0.61M - $1.07M**
Clean material placed in removal area	**$612,000**
Tree removal and vegetation restoration	**$336,600**
Total	**$1.56M - $2.02M**
Project safety and management	**$110,200**
Grand Total Costs	**$1.67M - $2.13M**

Assumptions:

The range in costs reflects the difference for transporting the removed soil to an on-island or off-island location.

Removal of two feet of soil and refilling the area to grade with clean material.

Removed soil will be managed at an approved location.

Minimal clearing and grubbing is required.

Restoration includes seeding for turf grass.

APPENDIX A

EVALUATION OF SOIL RELOCATION ALTERNATIVES

APPENDIX A
EVALUATION OF SOIL RELOCATION ALTERNATIVES

PREPARED BY:

TITTABAWASSEE AND SAGINAW RIVER TEAM

PREPARED FOR AND SUBMITTED BY:

THE DOW CHEMICAL COMPANY

JANUARY 17, 2020

CONTENTS

Figures

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Acronyms and Abbreviations

CDF	Confined Disposal Facility
HAP	hazardous air pollutant
lbs	pounds
MGI	Middleground Island
NO_x	nitrogen oxides
PM	particulate matter
SEFA	Spreadsheets for Environmental Footprint Analysis
SO_x	sulfur oxides
USEPA	United States Environmental Protection Agency

1 Introduction

The two remedy alternatives—soil capping/ cover and soil removal followed by placement of backfill—are being evaluated for the management of potential exposures to contaminated soil on the residential areas of Middleground Island (MGI). Part 201 of NREPA allows for the relocation of contaminated soil in some circumstances (Relocation of Contaminated Soil; 324.20120c et seq.). For the soil removal and backfill alternative, two different soil relocation sites have been preliminarily identified. The purpose of this document is to evaluate the soil relocation alternatives against effectiveness, implementability, and cost. The two potential soil relocation options are shown on Figure A-1 and further described below.

- **On-Island Relocation Site:** The on-island relocation site is a former confined disposal facility (CDF) on the island just north of the currently closed and inactive Bay City Middlegrounds Landfill. This is reportedly the location where the contaminated sediment was acquired for placement on the residential properties. It was reported that the residents were given permission to recycle sediments that were located in the former CDF; the material was used as fill on their properties to adjust the elevation of their yards. The preferred on-island relocation option is to place the soils excavated from the yards back to the CDF that is approximately 0.6 miles from the MGI residential area. The transportation of removed soils from the residential area to the on-island relocation site would include the use of off-road trucks traveling on Evergreen Drive which serves as the only road connecting the residential portion to other areas of the island (Figure A-1). Most of this transportation route is located within the residential area with the exception of two commercial properties located southeast of the relocation site. Traffic on this route is expected to be minimal and predominantly residential. No traffic lights are present in this transportation route, however, residential speed limits and stop signs would result in a one-way transport time of approximately 2 minutes.
- **Dow Midland Relocation Site:** The off-island relocation site is operated by Dow in Midland, Michigan, and located approximately 21 miles west from the MGI residential area. The transportation route of removed soils from MGI to the Dow Midland relocation site consists primarily of highways and city roads. The one-way transportation time along this route is expected to be approximately 35 minutes to reach the Dow facility, and an additional 10 minutes to access the relocation site once on Dow property. The soil removed from the yards will be transported to a location on the island (yet to be determined) where the soil will be stock piled and loaded onto on road trucks (truck and trailer combination called trains). The Lafayette Street Bridge, which accesses the island from the east, and the Salzburg Avenue Bridge, to the west of the island, will be used by both construction vehicles and the public to access to MGI. Due to the traffic patterns and the use of Lafayette Street, additional traffic control measures will need to be employed at the intersection of Lafayette Street and Evergreen Drive. This will be necessary so that trucks can make a left hand turn off Evergreen Drive onto Lafayette Street. The traffic control measures will have an impact not only on the heavy truck traffic coming to and leaving the site, but will also have an impact on the local traffic crossing the island on Lafayette Street.

2 Evaluation of Soil Relocation Alternatives

2.1 Effectiveness

The short-term effectiveness for the on-island and off-island soil relocation alternatives is evaluated based on impacts to the environment, community, and worker safety. For both on-island and off-island soil relocation options, approximately 46,300 cubic yards of material (assuming 30% swell during excavation) will need to be transported from the residential area. The soil removed from the yards will be loaded directly into off-road trucks that will transport the soils either to the on-island relocation site or to a soil stock pile where on-road trucks will be used to transport the material to the off-island relocation site in Midland. The impacts and costs for the on-island work, either on-island relocation or stock piling the removed material on the island, are similar. However, the additional loading and longer transportation distance associated with the off-island relocation alternative results in more short-term environmental impacts due to increased fuel use and air emissions, and more impacts to the community and worker safety due to increased traffic within city limits and overall transportation distances.

Assuming a truck train capacity of 40 cubic yards will be loaded for the off-island relocation option, the transportation of removed soil off the island is estimated to require approximately 1,160 total round trips. The increased air emissions associated with off-island alternative were calculated using the U.S. Environmental Protection Agency's (USEPA's) Spreadsheets for Environmental Footprint Analysis (SEFA) version 3.0 (USEPA 2012). Table A-1 presents the total estimated transportation distance, fuel use, and results from the SEFA analysis, which demonstrates the increase in emissions for transporting the excavated soil to the Dow Midland relocation site. Emissions include greenhouse gases, nitrogen and sulfur oxides (NO_x and SO_x), particulate matter (PM), and hazardous air pollutants (HAPs). In summary, the total additional roundtrip transportation distance for off-island relocation is estimated to be 53,000 miles, which results in the following additional fuel use and emissions:

- 20,500 gallons of fuel
- 522,000 pounds (lbs) of greenhouse gas emissions (measured as carbon dioxide equivalents)
- 3,500 lbs NO_x
- 240 lbs SO_x
- 100 lbs PM
- 20 lbs HAPs

It is a goal of USEPA and Dow to incorporate green and sustainable remediation practices into the design and implementation of response actions. Energy use and air emissions are sustainable remediation elements that are evaluated as part of this goal. Therefore, the additional fuel use and air emissions resulting from the off-island transportation of removed soil, as outlined above and in Table A-1, will be heavily considered when selecting a soil relocation site.

If the off-island relocation site is selected, the use of Salzburg Avenue Bridge for off-island relocation can also impact worker and public safety as an increase in traffic congestion can lead to potential accidents, particularly since there are currently no traffic controls to turn on or off the island and this bridge will serve as the only vehicle access point to the island during remedy implementation. The longer transport distance to the off-island relocation site can also increase the potential for spillage of excavated materials during transport and also contribute to elevated levels of dust and particulates.

2.2 Implementability

The off-island relocation alternative is implementable. However, the off-island relocation can pose significant challenges associated with planning, executing, and managing construction traffic logistics, and mitigation of short-term impacts to the community and worker safety. The short-term impacts to public safety due to traffic congestion for the off-island relocation alternative can be mitigated by adding traffic controls at the intersection of Evergreen Drive and Salzburg Avenue, although there will be increased risk compared to the on-island relocation alternative for both the local traffic and the project personnel. The off-island alternative will result in truck train traffic traveling an additional 53,000 miles and over 10,000 of those miles are within city limits. A total of approximately 22,000 traffic lights and 2,300 stop signs will be driven through by this additional truck traffic.

An assessment would need to be conducted to determine whether the on-island relocation option is implementable, because the former CDF may have existing land use restrictions.

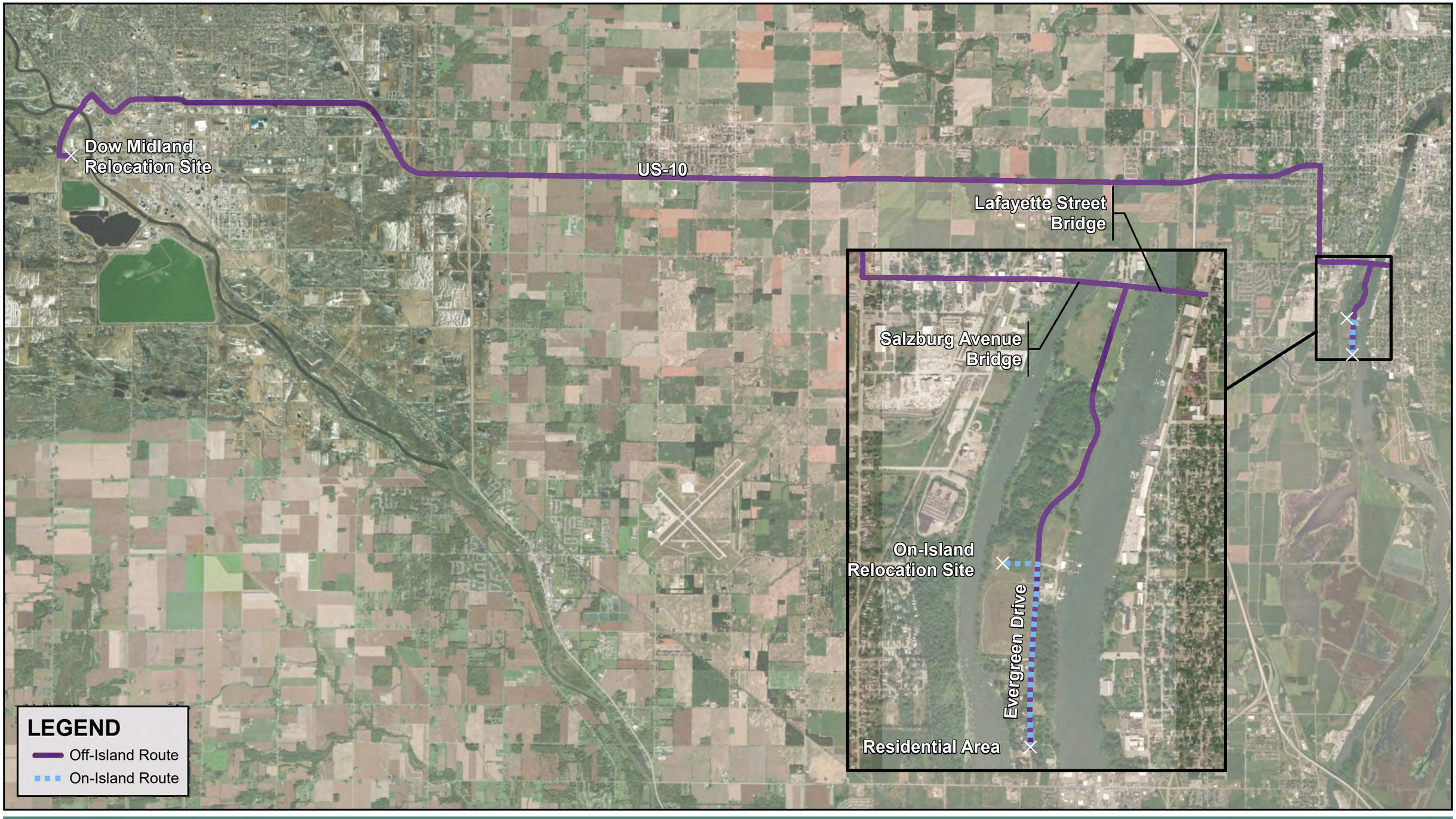
2.3 Cost

The longer transportation distance associated with the Dow Midland relocation site, as compared to the on-island relocation site, results in increased costs due to the increased fuel consumption, trucking fees, and labor required to transport the material to Midland. The additional costs associated with transporting 46,300 cubic yards of contaminated soil from MGI to the off-island relocation site are listed in Table A-2. The total additional costs to for the off-island relocation alternative is approximately $478,200.

3 References

USEPA. 2012. Methodology for Understanding and Reducing a Project's Environmental Footprint. February 2012. (accessed at: https://clu-in.org/greenremediation/SEFA/docs/GC_Footprint_Methodology_Feb2012.pdf)

Figures



NOTES:
Aerial Imagery: ESRI

Miles
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Soil Relocation Route
Middleground Island Engineering Evaluation/Cost Analysis

Figure A-1

Tables

Table A-1
Additional Fuel Usage and Emissions for Off-Island Soil Relocation
Middleground Island EECA, Appendix A

Relocation Option	Additional Total Transportation Distance (miles)	Additional Total Fuel Use (gallons)	Additional Emissions				
			GHG (lbs CO_2e)	NOx (lbs)	SOx (lbs)	PM (lbs)	HAPs (lbs)
Off-Island (Midland, MI)	53,200	20,500	522,000	3,500	240	100	20

Notes:

Total emissions were calculated using Spreadsheets for Environmental Footprint Analysis (SEFA) version 3.0, November 2019

GHG:	Greenhouse gas expressed as CO_2 equivalent
NOx and SOx:	Oxides of nitrogen and sulfur
PM:	Particulate matter
HAPs:	Hazardous air pollutants as defined by USEPA

Table A-2
Additional Costs for Off-Island Soil Relocation
Middleground Island EECA, Appendix A

Relocation Option	Additional Fuel Cost for Transport[1]	Additional Trucking Fees[2]	Additional Other Costs[3]	Total Additional Cost
Off-Island (Midland, MI)	$50,500	$318,700	$109,000	$478,200

Notes:

[1]Calculated assuming a fuel cost of $3.25/gallon

[2]Calculated assuming 6 trucks used per day and 5 trips per truck with truck use fee of $145 per hour and 11 hour work days

[2]Includes the cost for security at the Midland relocation site at $25 per hour and 11 hour work days, excavator costs at MGI to load truck trains from the stockpile location at $175 per hour and the use of an additional water truck at $125 per hour for 5 hours per day.