

Final Phase II - Carbon Amendment Pilot Study Work Plan, Velsicol Chemical/Pine River Site, Operable Unit 4, St. Louis, Michigan

To: Tom Alcamo/US EPA

From: CH2M

Date: March 29, 2021

Introduction

This technical memorandum summarizes the findings of Phase I of the Carbon Amendment Pilot Study (CAPS) and presents the work planned for Phase II of the CAPS to further evaluate the effectiveness of activated carbon amendments in reducing the bioavailability of dichlorodiphenyltrichloroethane (DDT) isomers, hexabromobenzene (HBB) and polybrominated biphenyls (PBB) in the floodplain soils within Operable Unit 4 (OU4) of the Velsicol Chemical Company Superfund Site. The results of this work will be used to further evaluate potential remedial strategies in support of the OU4 Feasibility Study.

Food web analyses and field studies performed to date have documented adverse ecological impacts to soil invertebrates (specifically, earthworms) and organisms that feed on the invertebrates in the floodplain soils in OU3 and OU4. The adverse impacts include reduced biomass and diversity of earthworms, as well as poor reproduction and diminished abundance. In addition, the field studies indicated abnormal behavior for American robins and shrews (vermivores, or worm-eating organisms).

Phase I Carbon Amendment Study

Phase I of the CAPS was conducted from August 2019 through May 2020 in Floodplain 1.2, depicted on Figure 1. The implementation, findings and conclusions of Phase I of the CAPS are presented in the Carbon Amendment Pilot Study – Phase I Technical Memorandum (CH2M – September 2020). The primary objectives of Phase I of the CAPS were:

- Assess the application/implementability of the granular activated carbon (GAC) within the floodplain including placement accuracy and the potential for full-scale application if this technology is determined to be a viable remedy component for the OU4 floodplain soils.
- Evaluate the effectiveness of GAC in reducing the bioavailability of DDT, HBB and PBB in the floodplain soils to ecological receptors.
- Assess the use of solid phase micro-extraction (SPME) fibers to predict the GACs effects on reducing bioavailability to ecological receptors. The relationship between SPME fiber concentrations and tissues concentrations were evaluated to determine the applicability for using SPME in long-term monitoring at the site.

Results of Phase I of the CAPS indicated the following:

- Adding organic carbon increased the total organic carbon in 8 of the 9 grid areas (highlighted yellow) depicted on Figure 2. Grid area 3 could not be sampled as it was inundated with water during both post carbon application sampling events.
- The addition of GAC reduced the tissue concentrations in field-collected earthworms in 8 of 9 grid areas. The decrease in earthworm tissue concentrations from the pre-GAC application in August 2019 to the second post-GAC application sampling event in May 2020 were between 21 and 79 percent.
- The reduction in exposure also corresponded to decreased mortality in laboratory earthworms exposed to field collected soils. There was 85 to 100 percent survival of laboratory-exposed earthworms at all grid areas after GAC application.
- There is a consistent linear relationship between SPME fiber concentrations and earthworm tissue concentrations. Since this relationship is consistent, SPME fiber concentrations could be used to estimate tissue concentrations in earthworms.
- Visual observations made during the May 12, 2020 sampling event indicate the activated carbon is being incorporated into the soil profile.

Based on the findings from Phase I of the CAPS, Phase II of the CAPS was recommended to further assess the use of GAC to reduce bioavailability to ecological receptors and evaluate its use as a potential remedial strategy in support of the OU4 Feasibility Study.

Phase II Carbon Amendment Study

Phase II of the CAPS will be continued in the Phase I carbon amendment study area and the Phase II adjacent additional study area in Floodplain 1.2 depicted on Figures 1 and 2.

Six additional grid areas highlighted in green on Figure 2 will be added for soil and biota (earthworm) sample collection, SPME analysis and subsequent carbon application. The 13 grid areas (including 3 background areas) sampled during Phase I of the CAPS will continue to be sampled and SPME will be conducted as part of Phase II of the CAPS.

Three sample collection events (spring – April or May, summer – July or August, and fall – September or October) will be conducted in 2021 and 2022.

During the first sample collection event (spring 2021), soil and earthworm samples will be collected from the 6 new grid areas depicted on Figure 2, prior to carbon application to assess pre-carbon application DDT, HBB and PBB concentrations. Surface soil samples will be collected from surface to approximately 1 inch below ground surface (bgs). Worms will be collected from surface to approximately 4 inches bgs, if necessary, to obtain enough biomass to run the required analyses. Surface soil samples will be analyzed for DDT isomers, HBB, PBB, total organic carbon, and black carbon. The earthworms will be depurated and the earthworm tissue will be homogenized from within each grid and analyzed for DDT isomers, HBB, PBB, and percent lipids. A subsample of each soil sample

will be sent to Alma College for SPME analysis. The SPME extract elution will be analyzed for DDT isomers, HBB and PBB. Soil and earthworm samples will also be collected for laboratory analysis including SPME from the 13 grid areas sampled during Phase I of the CAPS to assess the effects of GAC over a longer period post GAC application.

GAC will be applied to the Phase II grid areas located in the additional study area depicted on Figure 2. GAC will not be applied over the entire additional study area to assess application accuracy as was conducted on the original carbon amendment study area during Phase I of the CAPS.

The GAC will be applied using the application method used during Phase I of the CAPS. The GAC will be applied by the field team using hand spreaders along transects through each grid area to achieve a consistent application. Vegetation and undergrowth will not be cleared. To achieve the target application rate of 2 percent by weight carbon to the top 1-inch of soil, approximately 165 pounds of carbon will be applied per 10-yard by 10-yard grid area. The 2 percent by weight carbon in the top 1-inch of soil will be the standard application rate with the exceptions presented in the following study questions.

The following study questions are being assessed during Phase II of the CAPS:

Question 1: Does GAC continue to reduce bioavailability to earthworms over time?

Study Approach: Seven grid areas previously sampled during Phase I of the CAPS (Grids 3, 23, 25, 34, 36, 45 and 48) will continue to be sampled in 2021 and 2022 to assess if the GAC applied in 2019 continues to reduce bioavailability to earthworms over a longer period (3 years).

Question 2: Does reapplication of GAC improve the reduction of bioavailability to earthworms?

Study Approach: The same brand of GAC used during Phase I of the CAPS (Evoqua AC1240C), will be re-applied at 2% by weight of the top 1-inch of soil to three grid areas previously sampled during Phase I of the CAPS (Grids 9, 12 and 19).

Question 3: Does applying a higher percentage of GAC (4% percent by weight of the top 1-inch of soil) improve the reduction in bioavailability to earthworms?

Study Approach: GAC (Evoqua AC1240C) will be applied at 4% by weight of the top 1-inch of soil to 3 new grid areas located in the additional study area. Grids will be selected after initial soil and worm concentration data is assessed. A parallel 28-day exposure of laboratory exposed earthworms will be conducted to assess bioaccumulation, survival, and growth pre- and post- carbon addition.

Question 4: Does tilling the GAC into the subsurface improve the reduction of bioavailability to earthworms?

Study Approach: After applying GAC (Evoqua AC1240C) at 2% by weight to the top 1-inch of soil at 3 new grid areas located in the additional study area, the GAC will be tilled into the subsurface to a depth of approximately 4 inches using a rototiller and hand tools. Grids

will be selected after the initial soil and worm concentration data is assessed. A parallel 28-day exposure of laboratory exposed earthworms will be conducted to assess bioaccumulation, survival, and growth pre- and post- carbon addition.

Question 5: Is the GAC being incorporated into the subsurface through bioturbation or other natural processes?

Study Approach: Acetate liners will be hand driven into each sample location during each sampling event to visually assess movement of GAC into the subsurface.

Question 6: Can SPME be used to accurately predict the bioavailability of DDT, PBB and HBB in soil to earthworms?

Study Approach: Initial SPME results from Phase I of the CAPS indicated there is a direct correlation between DDT concentrations in earthworm tissue and SPME fiber concentrations; therefore, SPME fibers could potentially be used to assess bioavailability. Soil samples from each grid area sampled during Phase II of the CAPS will be provided to Alma College to further assess the effectiveness of SPME to predict bioavailability.

Question 7: What is the toxicity of GAC on earthworms?

Study Approach: Alma college will conduct a bench study to assess at what GAC concentrations do adverse effects such as reductions in weight gain and potentially a reduction in survival occur.

Invertebrate and Small Mammal Population Study

Worms, arthropods, and small mammals will be collected to assess population counts in Floodplain 1.2. Worms collected during Phase II of the CAPS will be used to assess worm population. Insects will be collected using nets, traps, or other devices. Small mammals will be collected in live traps. Mammals caught in live traps will be identified by species and then released to a similar-type floodplain environment located on the northern portion of Floodplain 1.2 outside the carbon amendment study area. Details regarding the insect and small mammal collection will be detailed in the ecological risk assessment work plan scheduled for submittal in April 2021.

Results will be compared to the population study conducted in 2016-2017 to assess if the GAC application has improved the local invertebrate and small mammal population.

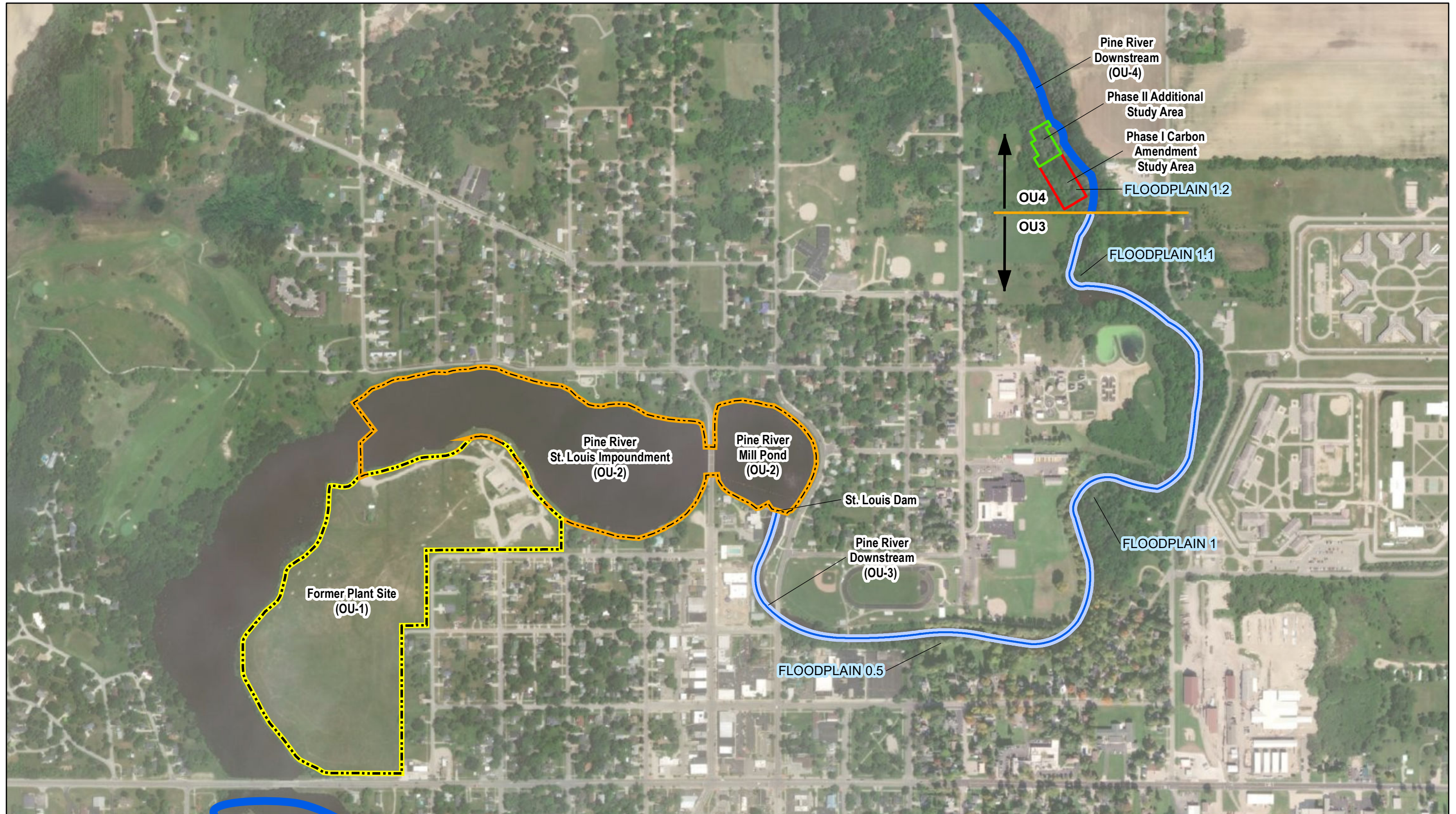
Investigation-derived Waste Characterization and Disposal

Waste generated from the field pilot test is anticipated to include used personal protective equipment, disposable single-use sampling equipment and other debris and decontamination solutions. Investigation-derived waste will be characterized and disposed of in accordance with local, state, and federal regulations as specified in the site management plan. All investigation-derived waste will be held at a staging area located on the former Velsicol Plant Site until disposal.

Data Management, Evaluation, and Reporting

Data will be managed and validated in accordance with the project Quality Assurance Project Plan. CH2M will prepare an interim technical memorandum at the end of 2021 summarizing the 2021 soil, tissue and SPME data collected in 2021 and present the interim findings. A final Phase II CAPS report presenting the findings and conclusion from the soil, tissue, and SPME data collected from 2019 through 2022 during Phase I and Phase II of the CAPS will be prepared after all data collected during Phase II of the CAPS is validated and assessed. The report will include a description of field activities, field logs and data sheets, analytical results and associated laboratory reports, a description of any deviations from this work plan, and a discussion of the data evaluation conducted to meet the objectives presented in the Phase I and Phase II CAPS work plans.

FIGURES



- Legend**
- Former Plant Site (OU-1)
 - Pine River - St. Louis Impoundment (OU-2)
 - Pine River OU3
 - Pine River OU4
 - Phase I Carbon Amendment Study Area
 - Phase II Additional Study Area

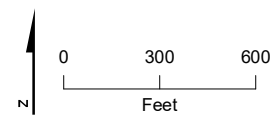
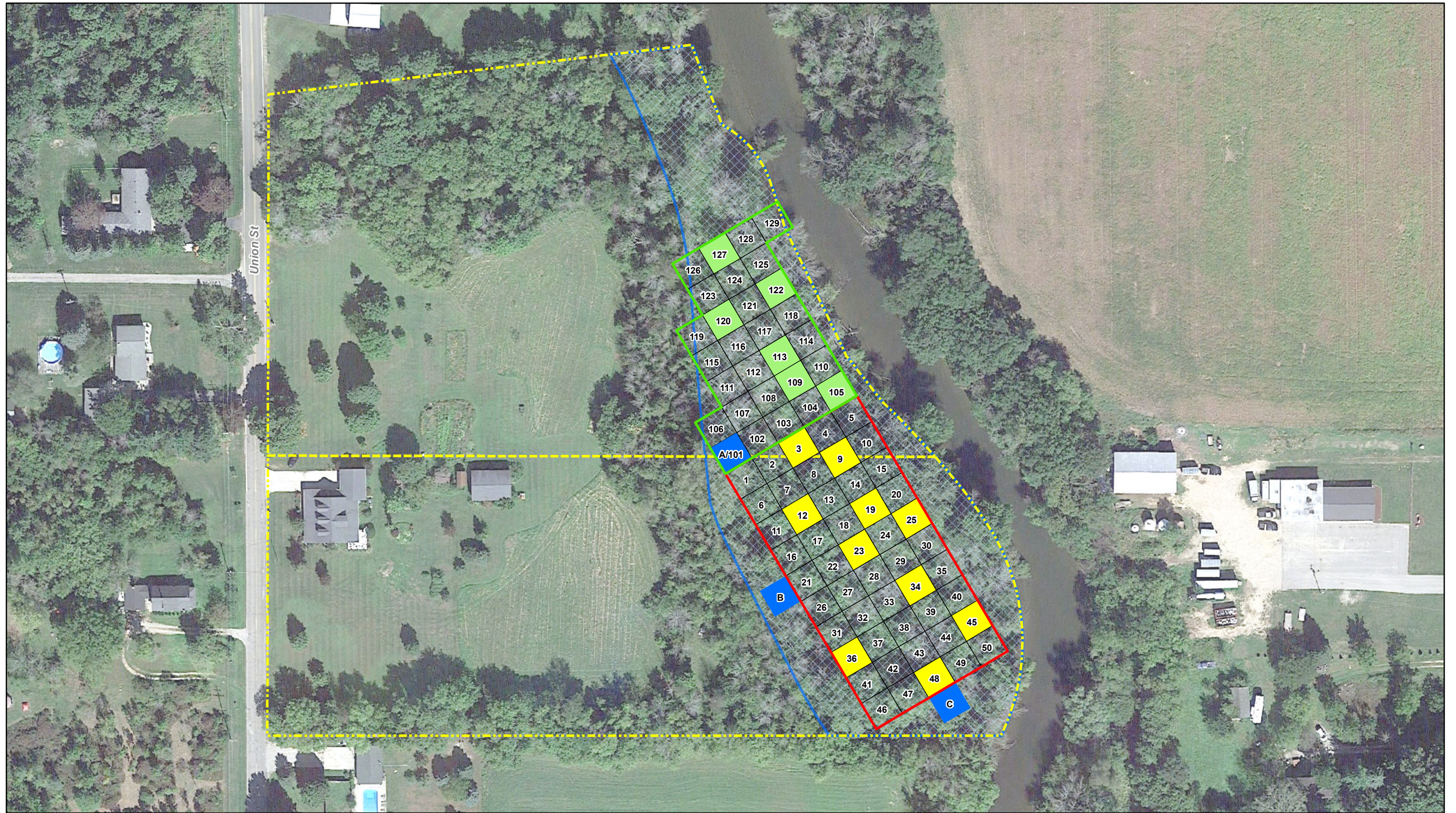


Figure 1
Phase II – Carbon Amendment Pilot Study
Study Areas and Operable Units
Velsicol Chemical Company Superfund Site
St. Louis, Michigan



Legend

- Phase I Carbon Amendment Study Area
- Phase II Additional Study Area
- Phase II Proposed Pilot Study Grid
- Background Sample
- Pilot Study Grid Sampled
- Parcel Boundary
- Approximate Floodplain

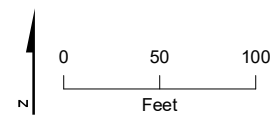


Figure 2
 Phase II – Carbon Amendment Pilot Study
 Carbon Amendment Study Area
 Velsicol Chemical Company Superfund Site
 St. Louis, Michigan