FINAL REPORT

OTSEGO TOWNSHIP DAM AREA
TIME CRITICAL REMOVAL ACTION
OPERABLE UNIT 5, AREA 3
ALLIED PAPER, INC. / PORTAGE CREEK / KALAMAZOO RIVER SUPERFUND SITE
Docket V-W-16-C-009

Allegan County
Otsego Township, Michigan

Prepared for:
USEPA Region 5
Emergency Response Branch
77 West Jackson
Chicago, IL 60604

Prepared by:
Wood Environment & Infrastructure Solutions, Inc.
46850 Magellan Drive, Ste. 190
Novi, MI 48827

July 26, 2019

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Wood Environment and Infrastructure Solutions Inc.

Anita Emery-DeVisser
Project Coordinator
July 26, 2019

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LIST OF ACRONYMS

amsl	above mean sea level
ANC	Aquatic Nuisance Control
BRSA	bank removal/stabilization area
CERCLA	Comprehensive Environmental Response Compensation and Liability Act of 1980
cyd	cubic yards
DMR	discharge monitoring report
EGLE	Michigan Department of Environment, Great Lakes, and Energy
ESI	Environmental Solutions & Innovations, Inc.
FSP	Field Sampling Plan
GAC	granular activated carbon
gpm	gallons per minute
HASP	Health and Safety Plan
LDB	left descending bank
M&M	maintenance and monitoring
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDOT	Michigan Department of Transportation
mg/kg	milligram per kilogram
MI	Michigan
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
OSC	On-Scene Coordinator
OTDA	Otsego Township Dam Area
OU-5	Operable Unit 5
PCB	polychlorinated biphenyl
PRSCP	Post-Removal Site Control Plan
QAPP	Quality Assurance Project Plan
RAL	remedial action level
RDB	right descending bank
RS	river station
SESC	soil erosion and sedimentation control
SRD	Substantive Requirement Document
STA	bank station
START	Superfund Technical Assessment and Response Team
TCRA	time critical removal action
TM	Technical Memorandum
TSCA	Toxic Substances Control Act
TSS	total suspended solids
UAO	Unilateral Administrative Order
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WCS	water control structure
WTP	water treatment plant

1.0 INTRODUCTION

Georgia-Pacific LLC, Georgia-Pacific Consumer Products LP and Fort James LLC (collectively Georgia-Pacific), International Paper Company (International Paper), and Weyerhaeuser NR Company (Weyerhaeuser) (Parties), are respondents to the Unilateral Administrative Order (UAO) (V-W-16-C-009) (located *here*) issued by the U.S. Environmental Protection Agency (USEPA) on April 14, 2016. The Parties, in response to the UAO, conducted a Time Critical Removal Action (TCRA) to address polychlorinated biphenyls (PCBs) in bank soil and sediment within a portion of Operable Unit 5 (OU-5) of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site. Specifically, the TCRA was performed within a portion of Area 3 of OU-5. The TCRA Site (Site) is that area that extends between the M-89 Bridge and the former Otsego Township Dam (also referred to as the Bittersweet Dam) in Otsego Township, Michigan (MI) (CERCLA Site ID MID006007306) (*Figure 1-1*). The TCRA was performed in accordance with the UAO and was completed with oversight of the USEPA under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

1.1 Background

According to the UAO and the associated Action Memorandum (located *here*), USEPA determined that the conditions at the Otsego Township Dam Area (OTDA) constituted an "imminent and substantial" danger to public health and/or the environment. USEPA therefore ordered that a TCRA be completed at the Site to address the risks posed by the erosion of bank soil and in-stream sediment deposits containing PCBs. Response actions for the TCRA focused on removing bank soil and sediment with total PCB concentrations exceeding 5 milligrams per kilogram (mg/kg) and 1 mg/kg, respectively, and stabilization/restoration of the banks. Where necessary, bank soil was also removed and backfilled to create a minimum 10-foot buffer of uncontaminated bank soil (with less than 1 mg/kg total PCBs) between the river and potentially contaminated floodplain soil.

Prior to beginning TCRA activities, the Otsego Township Dam auxiliary spillway was deteriorating, and its stability was questioned. In 2015 and early 2016, the Michigan Department of Natural Resources (MDNR) installed a temporary water control structure (WCS) to relieve stress on the dam. The temporary WCS design life was reported to be less than three years. TCRA activities also included removal of the WCS.

The TCRA area was subdivided into nine bank removal/stabilization areas (BRSAs) as shown on *Figure 1-2*. Pre-design sampling of bank soil and sediment was completed in July 2016. Where historical sediment and bank data indicated hotspots (i.e., locations where PCB concentrations exceeded 50 mg/kg) the locations were re-sampled to try and verify the historical results; however, re-sampled results were less than 50 mg/kg total PCBs.

Data were evaluated using the natural neighbor interpolation method to identify removal extents for the banks. Pre-design sediment data were used to develop sediment stream tubes and surface-area weighted average concentrations (SWACs) for defining removal extents. A comprehensive description of the project is provided in the Removal Work Plan for the OTDA TCRA (located *here*). Prior to beginning removal activities, Site-wide Work Plans and BRSA-specific Technical Memoranda (TMs) were incrementally submitted to and approved by the USEPA. The Work Plans and TMs presented BRSA-specific site controls and removal actions to be completed as part of the TCRA and are discussed in later sections of this report.

1.2 Purpose

The purpose of this Final Report is to meet the requirements set forth in Section XI.31 (Work to be Performed, Final Report) of the UAO. This report documents the removal actions taken during the OTDA TCRA and describes USEPA-approved deviations from the original approved Work Plans and TMs.

1.3 Report Organization

This document is organized into the following sections:

- Section 1.0 Introduction
- Section 2.0 Project Setup
- Section 3.0 Site Monitoring
- Section 4.0 Field Sampling
- Section 5.0 General Construction
- Section 6.0 BRSA 1
- Section 7.0 BRSA 2
- Section 8.0 BRSA 3
- Section 9.0 BRSA 4
- Section 10.0 BRSA 5
- Section 11.0 BRSA 6
- Section 12.0 BRSA 7
- Section 13.0 BRSA 8
- Section 14.0 BRSA 9
- Section 15.0 Water Control Structure
- Section 16.0 Permitting
- Section 17.0 Community Relations
- Section 18.0 Summary of Costs
- Section 19.0 References

For reference, deliverables prepared as part of the TCRA are accessible via hyperlinks throughout this report. Hyperlinks are displayed as *underlined and italicized* text. Other items are available upon request (as noted throughout this report). Requests for these documents can be sent to:

Mr. Paul Ruesch
USEPA Region 5
77 West Jackson Blvd.
Chicago, IL 60604

It should be noted that submitted deliverables were approved as draft documents. Draft construction work plans were considered to be "living" documents; therefore, Draft versions were submitted and updated as needed. Draft versions of technical memoranda and work plans that are linked to this Final Report represent the most recently updated submittal that was approved by the USEPA, and are considered final with the USEPA-approved deviations/modifications that are documented herein. A photo log is included as Attachment A and Record Drawings are included as Attachment B. The Record Drawings for each BRSA and the former WCS corridor, as referenced in Sections 6.0 through 15.0, include the following:

- Remediation Record Drawings – show staging areas and access roads, river and bank stations, bank and (where applicable) stream tube grid delineation, and corresponding removal depths for each grid.
- Restoration / Record Drawings – show access roads, elevation contours, restoration treatment(s), and additional notes as necessary.
- Final Grade Record Drawings – show the final grade after completion of bank restoration.
- Record Drawing Cross Sections – show cross-sectional elevation contours at approximately 25-foot intervals along the bank.

2.0 PROJECT SETUP

This section presents the primary stakeholders involved during the TCRA and the planning documents submitted prior to beginning construction.

2.1 Project Team

Numerous companies and regulatory agencies were involved during the TCRA. Table 2.1 (below) lists the primary stakeholders:

Table 2.1 Project Team

Entity	Project Role
USEPA	On-Scene Coordinator (OSC)
Georgia-Pacific LLC	Respondent
International Paper	Respondent
Weyerhaeuser	Respondent
Wood Environment & Infrastructure Solutions, Inc. (Wood), formerly Amec Foster Wheeler Environment & Infrastructure, Inc.	Engineering Contractor and Construction Manager
Envirocon, Inc. (Envirocon)	Construction Contractor
Michigan Department of Environment, Great Lakes, and Energy (EGLE, formerly Michigan Department of Environmental Quality [MDEQ])	State Regulatory Agency
MDNR	State Regulatory Agency/Property Owner
TetraTech, Inc.	USEPA Superfund Technical Assessment and Response Team (START) Contractor
Mannik & Smith Group, Inc.	USEPA START Contractor

In accordance with Paragraph 18 of the UAO (located *here*), a list of subcontractors was submitted to the USEPA for approval prior to beginning work, and updated as applicable. The most recent list of subcontractors can be found *here*.

2.2 Work Plans

This section summarizes the Site-wide work plans developed as part of the TCRA (with the exception of the River-Wide Health and Safety Plan [HASP] and River-Wide Quality Assurance Project Plan [QAPP], which were developed prior to the TCRA). Prior to approval, work plans submitted to the USEPA were reviewed by a multi-agency group coordinated by the USEPA OSC (refer to Section 2.4 for further details). In general, the agencies providing input were MDNR, EGLE, U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration, and START.

At USEPA's request, work plans were considered to be "living" documents during the course of the project; therefore, work plans were not finalized. Instead, draft versions were submitted and updated as needed. The most recent USEPA-approved version of each document is hyperlinked for reference, and are considered final documents with the USEPA-approved deviations/modifications documented in this Final Report.

- HASP – describes controls implemented to minimize risk to workers and the public from potential chemical and physical hazards associated with the Site; can be found *here*.
- QAPP – outlines how environmental data were collected and analyzed to achieve project objectives, and describes the procedures implemented to obtain data of known and adequate quality; can be found *here*.
- Soil Erosion and Sedimentation Control (SESC) Plan – describes best management practices for mitigating and controlling storm water runoff, soil erosion, and in-stream turbidity related to removal activities; can be found *here*.
- Site Security Plan – describes security measures taken to notify and protect the general public from construction zone hazards, as well as procedures to protect the construction zone from trespassers and vandalism; can be found *here*.
- Traffic Control Plan – describes truck routes and general traffic pattern guidelines for the Site, staging areas, and public roads near the Site. The Traffic Control Plan also outlines decontamination procedures for vehicles and equipment; can be found *here*.
- Soil, Waste and Debris Management Plan – includes waste characterization procedures, requirements for acceptable backfill materials, and procedures for determining if Site soil/sediment was acceptable for reuse; can be found *here*.
- Water Treatment Plan – describes methods for treating contact water generated during dewatering operations and outlines water treatment plant (WTP) sampling procedures; can be found *here*.
- Contingency Plan – prepared to identify and minimize hazards to human health and/or the environment from unplanned events (e.g., severe weather), and provides emergency response procedures. Included as Appendix D of the Contingency Plan was the Discovery Plan, which identified procedures in the event that historic or culturally-significant artifacts were discovered during construction, and included contact information for appropriate state and tribal historic preservation officers; can be found *here*.
- Invasive Plant Management Plan – describes measures to control invasive plant species throughout the removal action area; can be found *here*.
- Data Management Plan – describes the life cycle of environmental data collected during TCRA activities, from data collection to storage and archiving; can be found *here*.
- Quality Management Plan – describes how quality was managed throughout the lifecycle of the project; can be found *here*.
- Field Sampling Plan (FSP) – describes sampling objectives and rationale, including pre-design sediment and soil sampling, surveying, and post-removal confirmatory sampling; can be found *here*.
- Removal Work Plan – outlines the removal actions performed during completion of the TCRA; can be found *here*.
- Post-Removal Site Control Plan (PRSCP) – presents the plan for removal of the WCS and restoration of the former WCS corridor, and outlines the monitoring and maintenance activities required following removal action; can be found *here*.

2.3 Chronology

TCRA construction activities began on August 1, 2016 and the project was considered substantially complete on August 15, 2018. Table 2.2 (below) outlines key project milestones by year.

Table 2.2 Project Chronology

Year	Accomplishments
2015	• MDNR began removal of Otsego Township Dam and installation of a WCS
2016	• Removal of Otsego Township Dam and installation of WCS completed • USEPA issued UAO to Parties • Pre-design sampling completed • Engineering and construction management contractor selected • Construction contractor selected • Removal construction activities began* • BRSA 1 remediation and restoration completed
2017	• Access road and staging area construction completed for BRSAs 3, 4, 6, 7, 8, 9 • BRSA 3 mid-channel bar removal complete • Removal excavation completed in BRSAs 3 and 4 • Removal excavation started in BRSAs 6 and 9 • Restoration completed in BRSAs 3 and 4 • Restoration began in BRSAs 6 and 9 • Pilot channel dredging completed • Drawdown of former WCS completed
2018	• Removal of WCS • Removal excavation completed in BRSAs 6, 7, 8 and 9 • Restoration completed in all BRSAs, Plunge Pool, and former WCS corridor • Demobilization completed • Began maintenance and monitoring phase (established vegetation study plots; competed first quarterly monitoring event)

*Tree removal activities were completed between October 1 and March 31 of each year to minimize impact to bat habitat. See Section 5.4 for more details.

2.4 Project Management

The TCRA was managed by the USEPA OSC. Representatives from the entities listed above in Table 2.1, as well as other local, state, and federal agencies, were invited to participate in various aspects of the project, including the following:

- Technical/Work Plan Coordination – face-to-face meetings and conference calls were held to discuss expectations, alternatives, and ideas for the technical approach and specific work plan components. By agreeing to the technical components of a Work Plan prior to its submittal, the time for review, comment, and revision was reduced.
- Weekly Construction Coordination Meetings – during active construction, Wood facilitated weekly on-Site meetings to discuss project status, work anticipated to be completed in the upcoming week, and a "3-Week Look-Ahead" schedule. A running action item list was maintained to document tasks and responsible persons. Questions, concerns, or issues raised by or among the team were discussed and resolved.
- Pre-Construction Meetings – meetings were held at the onset of removal activities in each BRSA. To minimize delays to work, periodic field meetings were also held to resolve concerns or address unanticipated issues.
- Project Reporting – as required by the UAO, monthly progress reports were submitted to the USEPA by Wood on behalf of the Parties. Wood also prepared daily and weekly

construction reports. These reports detailed progress made and included waste tracking, sample results, and status drawings. The monthly progress reports were posted on a website hosted by USEPA (https://response.epa.gov/otsegodam). USEPA developed bi-weekly progress reports (aka “PolReps”) which were distributed via email to over 120 contacts that requested updates.

- Lessons-Learned – two meetings were held to reflect on work progress: one after the first construction season, and the second at the conclusion of the project, prior to the maintenance and monitoring period. These meetings were held to discuss observations/issues noted during the project, and to discuss suggestions and solutions.

3.0 SITE MONITORING

This section discusses the monitoring conducted to assess Site conditions during construction.

3.1 Air Monitoring

Air monitoring was conducted by the START contractor to monitor fugitive dust levels generated by construction activities. Air monitors were set up daily outside the perimeter of the work area(s) and relocated as necessary as work progressed (see Photo 1 in Attachment A). Refer to the environmental monitoring figures, *here*, for air monitoring locations. Air monitors were not deployed in the rain. An automated notification was sent to the USEPA OSC and START contractor if dust levels exceeded the action level of 1.5 milligrams per cubic meter (mg/m^3). No fugitive dust notifications related to construction activities were sent. Refer to the USEPA/START TCRA Letter Report (TetraTech 2019) for additional information on air monitoring and a data summary. Access roads and work areas were routinely sprayed with water to help mitigate fugitive dust during dry conditions.

3.2 Turbidity Monitoring

Real-time turbidity monitoring was conducted by Wood to monitor potential changes to in-stream conditions caused by near-bank and in-stream remediation and restoration work, pilot channel dredging, removal of the WCS, and restoration of the former WCS corridor. Per the Turbidity Monitoring Plan (included as Attachment D of the SESC Plan, found *here*), three turbidity monitoring stations were installed and moved down river as work progressed: one approximately 100 feet upstream of construction areas to collect background turbidity data, and two downstream (approximately 200 and 300 feet) of construction areas (see Photo 2 in Attachment A). Refer to the environmental monitoring figures, *here*, for turbidity monitoring locations. The turbidity monitors continually collected data 24 hours per day, 7 days per week, with the exception of long breaks when no work was conducted (e.g., holiday breaks), when the monitors were disconnected.

During remediation and restoration activities, if turbidity levels exceeded 50 nephelometric turbidity units (NTUs), an automated notification was sent to designated personnel. When a notification was received during working hours, Wood and the START contractor on-Site determined the source of the alarm. Turbidity monitoring results were within the allowable parameters; no alarms were found to have resulted from construction activities, but were instead caused by maintenance needs or vegetation, debris, etc. caught on the monitor, resulting in false exceedances. When this happened, the affected monitor was cleared of the vegetation, debris, etc., and Wood/START collected a turbidity reading with a hand-held meter to confirm that the turbidity criterion was not exceeded. Turbidity monitor inspection forms are available upon request.

In general, Wood inspected and performed turbidity monitor maintenance once per week. Maintenance included clearing the turbidity monitors of vegetation, debris, etc. and comparing data from the monitoring stations with data collected using a handheld turbidity meter. Inspection frequency increased during activities that were more likely to create turbid conditions (e.g., hydraulic dredging of the pilot channel). See the Turbidity Monitoring Plan in Attachment D of the SESC Plan (located *here*) for further details.

4.0 FIELD SAMPLING

This section summarizes environmental sampling completed as part of TCRA activities.

4.1 Pre-Design Sampling

Historical data existed in the TCRA area; however, some of the data were over 15 years old and not sufficient to define removal extents. Additional sampling was completed prior to construction to obtain current data, refine the removal footprint (vertically and horizontally), and to support the bank restoration design. Samples were also collected to verify the presence of “hot spots” (i.e., locations where historical data indicated PCB concentrations exceeding 50 mg/kg) in order to delineate areas that would require special handling under the Toxic Substances Control Act (TSCA). Pre-design sampling was conducted by Wood and its subcontractors with oversight by START and EGLE. Samples were sent to Pace Analytical Services, LLC (Pace) in Green Bay Wisconsin where they were analyzed for total PCB Aroclors. Additionally, geotechnical samples were collected for stability analysis of the steep embankment areas in BRSAs 2, 5, and 7 (see Photo 3 in Attachment A).

Results of the pre-design samples were used to define removal locations and depths in bank soil and sediment. Sediment stream tubes identified for removal were provided in communications from USEPA on January 27, 2017, as discussed in the relevant BRSA-specific TMs. Results are presented in the BRSA-specific TMs referenced throughout this report. Pre-design sampling laboratory reports are available upon request. Refer to the FSP (located *here*) and Removal Work Plan (located *here*) for further information.

4.2 Post-Excavation Confirmation Sampling

To facilitate remediation progress tracking, banks were subdivided into grids measuring approximately 50 feet in length (parallel to the river) and varying in width (perpendicular from the river’s edge). After removal of soil to the specified depth (typically including an approximate 6-inch overcut), a systematic random five-point composite sample was collected from 0 to 6 inches below ground surface from each grid to confirm that the soil left in place was below the bank soil remedial action level (RAL) of 5 mg/kg total PCBs (see Photo 4 in Attachment A). Confirmation samples were collected using 1-inch diameter Lexan® tubes that were advanced by hand. Refer to Sections 2.8 and 3.3 and Figure 2-4 of the FSP (located *here*) for further details on the confirmation sampling methodology.

In addition to the surface 0 to 6-inch confirmation sample, a second, deeper five-point composite sample was collected using 1-inch diameter Lexan® tubes that were advanced by hand to the depth to which soil reuse was expected, or to refusal (whichever came first). If the result of the deeper sample was less than 1 mg/kg total PCBs, then the material was suitable for reuse in the bank treatment as clean buffer material. If the result was greater than 1 mg/kg, then the material was both re-excavated and re-sampled (until results were less than 1 mg/kg), or it was excavated to the restoration grade and disposed offsite. In this case, the bank treatment and clean buffer were installed using clean backfill from offsite.

Sediment stream tubes were also subdivided into grids measuring approximately 50 feet in length and varying in width. Sediment grid IDs corresponded with bank soil grid IDs (e.g., bank soil grid 9 and sediment grid 9 were located adjacent to each other). After removal of sediment to the specified depth, a systematic random five-point composite sample was collected from each stream tube grid to confirm the sediment left in place was below the sediment RAL of 1 mg/kg total PCBs.

Typically, confirmation samples were collected by hand using a 1-inch Lexan® tube as described in the FSP. However, when conditions were not safe to enter an excavation area on foot (e.g., when the soil or sediment was too soft to stand on), an excavator was used to scrape the surface of the grid at five random locations along the grid. An amount of material sufficient to create a composite sample was collected by hand from the excavator bucket from each of the five points and composited into a single sample.

Confirmation samples were sent to Pace for analysis of total PCB Aroclors. If a confirmation sample result exceeded its respective RAL, an additional overcut was made, and the base of the excavation was re-sampled. This process was repeated until the RAL was achieved. Excavation and confirmation sampling checklists were developed to verify that each grid was properly delineated and ready for excavation, that confirmation samples were collected after excavation was complete and before restoration began, and that the grid was restored in accordance with the work plan. These forms were jointly completed by Wood, START, and Envirocon. A blank copy of this form can be found *here*. Copies of completed grid checklists for each BRSA are available upon request. Confirmation sample results are presented in tables linked throughout this report. Laboratory reports are available upon request.

Split samples were collected by the START contractor for analysis at another laboratory on approximately 10% of the confirmation samples. Unless otherwise directed by the USEPA, the results of Wood's confirmation samples determined if additional excavation was required.

In 2017, it was noted that confirmation sample results reported by Pace were generally lower than split sample results reported by the START laboratory. USEPA, START, and Wood agreed that the discrepancies were likely due to laboratory differences, rather than field differences. Review of data packages from both laboratories found that while both laboratories followed USEPA Method 8082A, procedures within the method varied. It was determined that Pace's performance of the method included best practices that improved the accuracy and precision of its concentration estimates. START therefore switched to a laboratory that matched most of the best practice procedures used by Pace, and results of split samples reported by the new laboratory closely matched results reported by Pace.

4.3 Water Treatment Plant Sampling

Contact water (i.e., water that came into contact with disturbed soil or sediment) was pumped from the excavation area(s) and/or from the stabilization/loadout pad to one of the temporary on-Site WTPs (see Photos 5 and 16 in Attachment A and Section 5.12 for further details). Envirocon collected weekly samples in accordance with the Substantive Requirements Document (SRD), which is included as Attachment 1 of the Water Treatment Plan, located *here*. Samples were collected from the influent, effluent and two intermediate stage points, and analyzed for total PCBs and total suspended solids (TSS). Monthly phosphorus samples were also collected from the effluent. WTP samples were sent to Pace in Green Bay, Wisconsin for analysis. Discharge monitoring reports (DMRs) were generated to document the operation and maintenance of the treatment systems. Refer to the USEPA/START TCRA Letter Report (TetraTech 2019) for additional information on WTP sampling and split-sampling data. WTP sample results are presented in tables linked throughout this report. Laboratory reports and DMRs are available upon request.

Prior to discharging treated water, two batches of water were held in frac tanks until sample results were received (one sample per batch) and found to be in accordance with the SRD criteria (i.e., no PCB detections in the effluent samples). Upon receipt of acceptable laboratory results, the treated effluent was discharged to the river. This procedure was followed for each WTP during startup and commissioning, and was repeated when a WTP was relocated between BRSAs.

During the course of the project, PCBs were detected in only one effluent sample, collected from the BRSA 6 WTP on October 25, 2017. Results received on October 27, 2017 indicated a PCB concentration of 0.00029 miligrams per liter. The discharge was immediately shut down and USEPA and EGLE were notified (see the excursion notice *here*). The granular activated carbon (GAC) in the media vessels and the silt bag in the frac tank were replaced (see Section 5.12 for details on the WTP components). Water was batched back through the system and acceptable effluent results were received before discharging resumed.

The frequency of sampling and reporting required by the SRD is shown in Table 4.1 below. Refer to Section 5.12 for additional information on contact water management.

Table 4.1 SRD Reporting Requirements

Parameter	Monitoring Frequency	Reporting Frequency
Total PCBs (influent, intermediate, discharge)	Weekly	Daily
Flow Rate	Daily	Monthly
TSS	Weekly	Monthly
Total Phosphorus (effluent only)	Monthly	Monthly
Equipment Inspection	3x per Week	Monthly
Outfall Observation	Daily	Monthly

5.0 GENERAL CONSTRUCTION

This section outlines general construction activities completed during the TCRA. Additional details can be found in Section 2.2 of the BRSA 1 TM (located *here*) and Section 2.3.7 of the BRSAs 2 and 3 TM (located *here*).

5.1 Site Access

The TCRA area was closed to the public per a MDNR Land Use Order (located *here*) during construction activities. A central Command Center was constructed on the north side of the river, near the former Otsego Township Dam, to hold USEPA/START, Wood, and Envirocon office trailers. The Command Center was accessed via an easement owned by MDNR, located adjacent to Covault Lane. Envirocon maintained this easement during TCRA activities. Flagmen were staged at BRSA entrances to manage construction traffic entering and exiting the Site. Signs were posted on gates at BRSA entrances and up river indicating that the river was closed and access to the site was restricted to authorized personnel only (see Photos 6 and 7 in Attachment A). "River closed" buoys were placed in the river channel upstream of the TCRA area to attempt to discourage recreational users from entering the Site. A procedure was developed outlining appropriate response actions when a trespasser was observed on-Site. A copy of the Notification/Warning Procedure for Trespassers can be found *here*.

A total of six staging areas were constructed to provide crews with access to work areas, and a material/equipment laydown area was established in an open lot at 556 Lincoln Road (M-89). Access agreements were obtained from property owners for each property used. Driveway permits were obtained from Allegan County Road Commission and right-of-way/roadway signage permits were obtained from the Michigan Department of Transportation (MDOT) (see Section 16 for a complete list of permits obtained). After construction, properties were restored in coordination with the property owners.

5.2 Project Stationing

To facilitate construction, river stationing and bank stationing were established within the TCRA area. River station (RS) 00+00 was located at the former Otsego Township Dam and extended to the M-89 Bridge (RS 92+00), generally following the thalweg (deepest part of the channel). Bank stationing (STA) was set up along the left-descending bank (LDB) and right-descending bank (RDB) starting at station 10+00, just upstream of the M-89 Bridge, and extending to 100+41 along the RDB and 108+88 along the LDB.

5.3 Clearing and Grubbing

Prior to beginning removal activities, locations where temporary staging areas and access roads were to be constructed were cleared and grubbed. In consultation with USEPA and MDNR, mature trees were saved by shifting the access roads and/or staging area locations whenever possible. Trees of acceptable size (see Section 5.8, below) and with intact root systems, as well as other woody debris removed during clearing and grubbing were cleaned and reused for stabilization and restoration activities where possible. Cleared brush and vegetation remained on-Site and were incorporated into bank treatments or mulched and used for SESCs.

5.4 Threatened and Endangered Species

The Site is located within the range of several State and Federal listed threatened and endangered species, including the Indiana bat (*Myotis sodalis*), the Northern long eared bat (*Myotis septentrionalis*), and numerous mussel species.

USEPA requested a Section 106 consultation from USFWS on June 15, 2016. In response, the USFWS provided a “Not Likely to Adversely Affect” letter dated August 22, 2016 regarding the project approach to addressing potential bat habitat areas. The letter can be found *here*. Removal of trees to facilitate Site access were felled between October 1 and March 31 of each year to minimize impact to bat habitat in accordance with USFWS guidelines. Exceptions to this were rare and only occurred when a tree was leaning over the work area creating a safety hazard, it was removed.

To minimize negative impacts to mussel populations, Wood contracted Environmental Solutions & Innovations, Inc. (ESI) to conduct mussel surveys and relocations (see Photo 8 in Attachment A). ESI conducted mussel surveys and relocations in 2016 and 2017 in general accordance with the Michigan Mussel Survey Protocols and Relocation Procedures (MDNR 2016). In 2016, 571 live mussels were collected from BRSAs 1 through 6. The mussels were tagged and translocated to a suitable habitat upstream of the TCRA boundaries. In 2017, 504 live mussels were collected from the pilot channel area, plunge pool, Pine Creek confluence, and nearshore areas of BRSAs 7-9, and relocated to a suitable habitat outside of the TCRA boundaries. Details regarding the mussel surveys and relocation efforts are presented in reports titled Freshwater Mussel (*Unionidae*) Relocations in the Kalamazoo River for the Allied Paper, Inc./Portage Creek Kalamazoo River Superfund Site Project in Allegan County, Michigan. The 2016 report is located *here* and the 2017 report is located *here*.

According to the USFWS website (https://ecos.fws.gov/), other threatened and/or endangered species potentially found in Allegan County include the Piping plover (*Charadrius melodus*), Red knot (*Calidris canutus rufa*), Pitcher’s thistle (*Cirsium pitcheri*), and Karner blue butterfly (*Lycaeies Melissa samuelis*); however, the TCRA area is not considered suitable habitat for these species. The Eastern Massasauga rattlesnake (*Sistrurus catenatus*) is also potentially found in Allegan County, but did not become listed as a federally threatened species until the fall of 2016 (after construction had begun). Therefore, these species were not considered to be of concern at the Site.

5.5 Access Road and Staging Area Construction

Temporary access roads were constructed in each BRSA and generally extended along the bank removal area to a staging area. To minimize unnecessary soil disturbance in the floodplain, access roads were typically constructed within 75 feet of the bank. The temporary access roads were constructed by underlying layered road base material (21AA gravel over Class II fill sand) with geogrid and geotextile materials to improve existing surface stability. Vehicle passing areas were constructed at strategic points along the access roads to allow for two-way traffic operations. Where necessary, geotextile, stone, and culverts were used to direct upland tributaries/seeps (referred to as feeder streams) under the access roads to the river.

With the exception of BRSA 7 (refer to Section 12 for additional information), access roads were left in place after completion of the TCRA to facilitate maintenance and monitoring work, and future floodplain remediation, as necessary. The access road surfaces were scarified to loosen the surface soil and seeded with an upland seed mix and rye cover crop. Refer to the record drawings (Attachment A) for details on access roads that were left in place.

Staging areas were generally constructed near the BRSA entrances. Construction crew trailers, imported material stockpiles, stabilization/load out pads for excavated material, equipment staging, crew parking, and WTPs were located in the staging areas. Stabilization/loadout pads were lined areas primarily intended for transfer of excavated material from off-road trucks to on-road trucks, decontamination of equipment, stabilization and solidification of wet soil/sediment (as needed), and provisions for storm water collection and treatment (see Photo 15 in Attachment A).

A third-party surveyor documented the locations of staging areas and access roads (refer to the record drawings in Attachment B), and the surveys were provided to EGLE and MDNR. At the request of MDNR, START used the survey data to document wetland areas within the TCRA-area. This map is provided in the USEPA/START TCRA Letter Report (TetraTech 2019).

After completion of TCRA activities, staging areas were completely removed (including geotextile and road base material) and restored with topsoil and an upland/wetland seed mix as applicable. Trailers were demobilized from the Command Center and the area was graded and restored using topsoil, upland seed mix, and an assortment of hardwood and evergreen trees were planted to replace those that had been removed during construction activities. A replacement gate was also installed at the entrance to the MDNR property.

5.6 Pre-Construction Conditions

M-89 Bridge

Remediation in BRSAs 3 and 4 involved work near the M-89 Bridge abutments. On November 14, 2016, representatives from USEPA, START, Wood, and Envirocon met with representatives from the MDOT to review the proposed scope of work and discuss relevant MDOT requirements. An MDOT right-of-way permit (located *here*) was obtained prior to starting work. Wood conducted a pre-construction baseline condition assessment of the M-89 Bridge on March 7, 2017, prior to beginning construction activities in BRSAs 3 and 4. The results of the assessment can be found in the Pre-Construction Inspection Report, located *here*. After removal activities were completed in BRSAs 3 and 4, Wood conducted a post-construction inspection on September 13, 2017, the results of which are presented in the Post-Construction Inspection Report, located *here*. Copies of both reports were provided to the MDOT. No impacts to the M-89 Bridge related to removal activities were observed.

Pine Creek WCS

The confluence of Pine Creek is located within the TCRA area, between BRSAs 1 and 9 (near RS 50+00). The flow of water from Pine Creek into the Kalamazoo River is controlled by a WCS (regulated by the Allegan County Drain Commissioner). Due to the proximity of work to Pine Creek, Wood conducted pre- and post-construction assessments of the Pine Creek WCS. The results of these inspections are summarized in the Pre-and Post-Construction Inspection Report located *here*. No impact to the Pine Creek WCS related to construction activities was observed.

Residential Structural Survey

Prior to beginning work along the steep banks at the downstream end of BRSA 4, a structural survey of the single-family home and associated outbuildings located on Lincoln Road was completed by USEPA and START. A visual inspection was completed, and the structural elements of the dwelling were documented prior to removal activities. A second visual inspection was conducted after completion of removal activities. Pre- and post-construction surveys of a single-family home located on Covault Lane were also conducted. No impact to the dwellings related to construction activities were reported. Pre- and post- construction survey reports were provided to and accepted by the respective property owners.

Roads

Pre- and post-post construction video surveys were conducted of the roads surrounding the Site that received construction traffic. No significant impacts were observed.

5.7 Restoration

In general, banks were restored by backfilling excavations with imported fill from an approved off-site source (see Section 5.9 below) and/or on-Site material containing less than 1 mg/kg PCBs (see Section 4.2 above). Cofferdams were removed as restoration work progressed, and the material (sand/common fill) in the bulk bags was used for restoration. See Section 5.12 for details on the various types of cofferdams used. Banks were graded and stabilized using a combination of the bank restoration techniques described in Section 5.8. Shallow sediment stream tube excavations (less than 6 inches) were not backfilled. Exceptions are documented throughout this report.

Temporary seeding using an annual ryegrass mix, recommended and approved by MDNR, was applied to restored areas, in addition to permanent seeding using an emergent wetland seed mix. After completion of restoration in each BRSA, an irrigation system was set up by a subcontractor and operated by Envirocon for the remainder of the growing season. More information on the seed mixes and species of trees and shrubs planted (see Photo 14 in Attachment A) can be found on the record drawings included as Attachment A.

5.8 Bank Restoration Techniques

In general, three restoration techniques were used to stabilize banks (details are provided in the Record Drawings as Attachment B):

Rootwads – a combination of tree trunks with intact root masses anchored in place using buried rocks, logs, and soil, and topped with coir fabric (see below) at the surface. Rootwads were installed on outside bends (erosional areas where modeling predicted velocities to be high relative to other areas of the river). In general, rootwads consisted of approximately 8-foot long tree trunks (12 to 24-inch diameter) with the root mass still intact (3 to 5-feet diameter root mass), footer logs (10 to 16-inch diameter), support boulders (16 to 24-inch diameter), common fill, top soil, riparian seed mix/rye grass, coir fabric, live stakes, trees and shrubs (see Photo 13 in Attachment A). Off-Site sources of trees used for rootwad installation include Fennville Farm Managed Hunt Unit of the Allegan State Game Area, located in Fennville, MI, where a tornado downed numerous trees, and the Gourdneck State Game Area in Portage, MI.

Coir Fabric – a woven material made from biodegradable fibers. Coir fabric was installed in areas that are typically depositional (outside river bends). Coir fabric was placed over clean backfill and topsoil and secured temporarily using wooden stakes until vegetation becomes established (see Photos 13 and 46 in Attachment A). Coir fabric was also installed over rootwad installations. A riparian seed mix, live stakes and trees/shrubs were planted through the coir fabric.

Joint Planting – a layer of rock suitably sized to withstand modeled shear stresses, underlain by either # 57 stone or a non-woven geotextile fabric. Common fill or reusable sediment was placed on top of the rock and washed into the voids with river water and topped with a layer of topsoil. Live stakes were planted through the rock/topsoil mixture (see Photos 34 and 54 in Attachment A). Joint planting was installed in areas of high velocities and shear stresses, and at transition areas between rootwad and coir fabric treatments to attempt to prevent failure by flanking.

Refer to the design drawings in the BRSA 1 Tech Memo (located *here*) for additional details on the location and installation of each of these restoration techniques. Adaptations to these techniques are discussed throughout this report.

5.9 Imported Fill

As mentioned in Section 4.2, on-Site material was used for restoration whenever possible; however, additional imported fill material was required for restoration activities. Imported material was obtained from various approved off-site borrow sources. Analytical samples were collected from borrow sources prior to approval for on-Site use. Analytical results are available upon request. A list of the imported material sources is presented in Table 5.1, below.

Table 5.1 Imported Material Sources

Source	Location	Material
Aggregate Industries	Plainwell, MI	Riprap (various sizes) Asphalt Millings
Aggregate Resources	Kalamazoo, MI	Class II Sand Stone (various sizes)
Austin's Sand & Gravel	Kalamazoo, MI	Topsoil
R Smith & Sons	Allegan, MI	Class II Sand Stone (various sizes)
Renewed Earth	Kalamazoo, MI	Topsoil
Stoneco Ottawa Lake Quarry	Ottawa Lake, MI	Plain Riprap
Wray's Septic Tank Service	Allegan, MI	Common Fill

5.10 Feeder Streams

Feeder stream restoration was constructed to vent upland groundwater flow across access roads and through restoration areas. As mentioned in Section 5.5, geotextile, stone, and culverts were used to direct feeder streams under the access roads to the river during construction. During final restoration, the temporary culverts were removed. Where these feeder streams crossed the restoration areas, they were restored with modified joint planting. Installation details and locations of feeder streams are shown on the record drawings, included as Attachment B.

5.11 Waste Management

This section discusses solid waste management during TCRA activities. Refer to the Soil, Waste and Debris Management Plan (located *here*) for additional details.

5.11.1 Non-TSCA Waste

Non-TSCA waste material was characterized using cuttings from soil and sediment cores collected during pre-design sampling, and from soil cores collected from areas of bank excavation in BRSAs 3, 4, 6, and 9. Upon excavation of non-TSCA soil or sediment, the material was placed in an off-road truck and transported to a lined stabilization/load-out pad. The material was stockpiled in the stabilization/load-out pads to allow dewatering and to facilitate transfer to on-road trucks for off-site disposal. Stabilization/load-out pads were surrounded by a berm constructed to be protective of a 25-year flood event (see Photo 35 in Attachment A). If stockpiled material was too saturated to be transported, the material was stabilized by mixing it with either Calciment® or pebble lime. In general, non-TSCA material was transferred from the stabilization/load-out pad to unlined trucks for transportation to the landfill (see Photo 11 in Attachment A). During the winter of 2017/2018, however, trucks were lined with plastic to prevent material from freezing to the truck bed. Non-TSCA material was exclusively transported to Republic's Ottawa County Farms Landfill in Coopersville, Michigan for off-site disposal. A total of approximately 54,517 tons of non-TSCA material (bank soil/sediment) was removed from the Site. The volume of material removed during the TCRA was less than the estimated volume projected by USEPA in the Action Memorandum (located *here*). The initial USEPA estimates were based exclusively on historical data and assumed soil would be removed 50-feet back from the bank. The actual volume of material removed was based on approved design depths developed from historical and pre-design data and removing a maximum of 10-feet back from the bank.

Table 5.2, below, summarizes the amount of material removed per BRSA. Imported material used to construct the stabilization/loadout pads was also disposed as non-hazardous waste, yielding an additional 3,696 tons of material disposed. The non-TSCA waste tracking tables are presented in tables linked throughout this report. Waste characterization laboratory reports, waste profiles, manifests and load tickets are available upon request.

Table 5.2 Non-TSCA Waste Summary

BRSA	Tons[1]	Cubic Yards[1,2] (cyd)
1	6,022	3,764
3	3,543	2,214
4	7,803	4,877
6	10,750	6,719
7	9,357	5,848
8	8,730	5,456
9	8,312	5,195
Total	**54,517**	**34,073**

1. Values are approximate.
2. Assumed 1.6 tons per cyd.

5.11.2 TSCA Waste

TSCA material requiring special handling was excavated from BRSA 1 (see Section 6.1) and was characterized using cuttings from the soil cores collected during the pre-design investigation. TSCA material was directly loaded into seven lined roll-off containers (see Photo 12 in Attachment A) and transported to US Ecology in Belleville, Michigan for off-site disposal. A total of approximately 113 tons (approximately 71 cyd) of TSCA material was removed from the Site. The TSCA waste tracking table is located *here*. The waste characterization laboratory report, waste profile, manifests and load tickets are available upon request.

5.11.3 Recycling

To minimize the amount of material sent to the landfill, a site wide recycling program was implemented. Aluminum cans, scrap steel, plastic bottles, cardboard, and scrap paper were collected and recycled locally. Construction materials such as steel scrap metal from sheet piling were also collected and recycled if feasible. Table 5.3 below summarizes materials recycled during the project.

Table 5.3 Recycled Materials

Material	Weight (pounds)
Cardboard	1,660
Plastic	975
Metal	61,530
Project Total	**64,165**

5.12 Contact Water Management

To help facilitate remediation/restoraton activities and to attempt to prevent potentially contaminated water (contact water) from being released to the river, contact water was pumped from bank and sediment excavation areas and stabilization/loadout pads and sent to one of the temporary on-Site WTPs (see Photos 5 and 16 in Attachment A). In most areas, isolation and removal of bank or sediment contact water was facilitated by the installation of a sand bag cofferdam system. Bulk bags of various sizes were filled with sand and wrapped end-to-end in polyethylene sheeting to form a barrier between the excavation area and the main river channel (see Photos 10 and 44 in Attachment A). Areas where the sandbag cofferdam system was insufficient (e.g., areas that required deeper sediment removal or where the water was too deep) used either a sheet piling cofferdam or a fortified turbidity curtain (a standard turbidity curtain backed with a steel mesh fabric) installed on steel fence posts installed approximately every 15 to 20 feet to provide additional support.

Once remediation excavation began, water was pumped from the excavation areas (inside the cofferdam) to the WTP for treatment. Removing water from the excavation areas assisted in turbidity control and facilitated collection of confirmation samples from the base of the excavation. The WTPs also received contact water from the stabilization pads.

The BRSA 1 WTP consisted of an equalization tank, weir tank, 200-gallon per minute (gpm) transfer pump, dual stage sand filter, five-stage bag filter, two 5,000-pound GAC media vessels, post five-stage bag filter, and an effluent frac tank (see Photo 5 in Attachement A).

The components of the WTPs at the remaining BRSAs were the same as BRSA 1, but downsized for 100-gpm flow. These WTPs included a weir tank, 100-gpm transfer pump, dual stage sand filter, two-stage bag filter, four 2,000-pound GAC media vessels, post-two-stage bag filter, and an effluent frac tank (see Photo 16 in Attachment A). Refer to the Water Treatment Plan, located *here*, for additional information, including a process flow diagram.

A total of 2,049,645 gallons of water were treated during the course of the TCRA. Table 5.4 below lists the volume of water treated per BRSA. In addition, contact water was stored in portable tanks and shipped off-site for treatment at a USEPA-approved wastewater treatment plant. Approximately 69,039 gallons were handled off-site.

Table 5.4 Volume of Water Treated

BRSA	Volume Treated (gallons)
1	303,075
3	68,300
4	633,922
6	363,100
7 (onsite treatment)	169,561
7 (offsite treatment)	69,039
8	70,670
9	371,978
Total	**2,049,645**

5.13 Decontamination Procedures

To minimize the potential for contaminated material to be transported to "clean" areas, exclusion zones were established during removal excavation activities. Boot wash stations were located at the entrances/exits of the exclusion zones. Plastic sheeting was placed on the ground beneath off-road equipment to capture material spilled during loading of excavated material. Similarly, plastic sheeting was placed on the ground at the stabilization/loadout pads to capture material spilled during loading of trucks transporting material to the landfill. Trucks were visually inspected prior to leaving the Site; if excavated material was observed on the outside of a truck, the material was cleared and properly disposed before the truck left.

The access roads were continually monitored for material that may have spilled from the off-road haul vehicles. When spills were observed, the material was collected for proper disposal and, if necessary, the volume of material loaded into the haul vehicles was adjusted accordingly. Equipment and hand tools were decontaminated with water inside the stabilization/loadout pads prior to using for handling of clean materials. Water used for decontamination was captured in the stabilization/loadout pad and transferred to the WTP for treatment. Wipe samples were collected from equipment used to handle contaminated material (e.g., excavator buckets, WTP frac tanks, etc.) prior to being demobilized from the Site.

As mentioned in Section 5.11.2, TSCA material was excavated from BRSA 1. Equipment handling TSCA material requires modified decontamination procedures. An exclusion zone and boot wash station were set up as described above. Per 40 CFR 761.79, equipment handling TSCA material was decontaminated and wipe samples were collected. TSCA equipment was not used to handle non-TSCA or clean material until acceptable wipe sample results were received.

5.14 Invasive Species Control

Establishment of planted vegetation is critical to the success of the applied bank restoration techniques. Cardno Entrix, Inc. (Cardno) was contracted to provide invasive plant species control during the TCRA. Invasive plant species control will continue during growing seasons during the maintenance and monitoring (M&M) phase (see Section 5.15). Refer to the Invasive Plant Management Plan (located *here*) and the PRSCP (located *here*) for more details.

5.15 Inspections

During the construction period, inspections were conducted monthly (or after high water or significant [greater than 0.5 inches] rainfall events) in completed BRSAs to identify issues of concern (e.g., access road conditions, stressed vegetation, erosion, bank stability, etc.). Identified issues and recommended actions were addressed after consultation and in coordination with USEPA and MDNR. For example, during the BRSA 1 July 2017 inspection, an erosional area was observed and was immediately stabilized (see Section 6.3 for details). Copies of completed BRSA inspection checklists can be found *here*.

Upon completion of the TCRA, the M&M phase began and will continue for 12 months. M&M inspections of the Site will be performed once per quarter and after a significant flood/storm event (as confirmed by Wood and USEPA) to monitor the success of the streambank stabilization and restoration efforts. M&M inspections will be conducted by Wood and USEPA/START and will include both land- and boat-based inspections. As part of M&M inspections that occur during growing seasons, stem counts will also be conducted to assess the survivability of the vegetation. Stem counts will be conducted within vegetation study plots that were established by Wood and START in August 2018. Ten vegetation study plots were established – one in each BRSA (BRSAs 1, 3, 4, 6, 7, 8, and 9), one in the Plunge Pool area, one in the former WCS corridor, and one on the peninsula between the plunge pool and former WCS corridor (see Photo 9 in Attachment A for an vegetation example study plot). The vegetation study plot locations are shown on Figures 5-1a through 5-1c, which can be found *here*.

Refer to the PRSCP, *here*, for additional M&M details, including copies of the Post-Removal Site Control Plan Checklist and Kalamazoo River Superfund Site Monitoring Field Form – Study Plots. A running Corrective Action Item List will be maintained to document needed repairs and status. Any corrective action items necessary beyond the 1-year M&M phase will be integrated into the work plan for the remedial phase of the cleanup work in the floodplain conducted pursuant to the Area 3 ROD. After completion of the 1-year M&M phase, a final M&M report will be compiled and submitted to the USEPA separately from this final construction report.

6.0 BRSA 1

BRSA 1 is the region extending from LDB STA 27+05 to 55+97 (RS 50+00 to 78+00), immediately upstream of the Pine Creek confluence, as shown on *Figure 6-1*. BRSA 1 is located downstream of BRSA 2 and upstream of BRSA 9. BRSA 1 remediation and restoration activities were conducted between July and November 2016. This section summarizes those activities and documents USEPA-approved deviations from the design presented in the BRSA 1 TM, which can be found *here*.

6.1 Removal Action

Removal work in BRSA 1 began by installing a staging area in the area of a former abandoned bridge earthen abutment and a parking area, located at approximately LDB STA 48+00. The earthen abutment was partially pulled back from the river's edge and the soil was incorporated into the stabilization pad (beneath the liner) as fill. Access roads were constructed as described in Section 5.5. Prior to beginning excavation, a sand bag cofferdam system was installed as described in Section 5.12 (see Photo 10 in Attachment A).

Bank soil that exceeded the RAL was removed to design depths (or lower), and at least 10 feet perpendicular from the water's edge, creating the buffer zone mentioned in Section 1.1. Based on results of the pre-design sampling, BRSA 1 stream tube sediment did not require remediation. The excavated soil was loaded into off-road trucks and transported to the BRSA 1 stabilization/loadout pad for dewatering and stabilization before being transported to an approved off-site landfill. TSCA material was handled as described in Section 5.11. Restoration excavation material with concentrations between 1 and 5 mg/kg of total PCB's was removed and transported to the stabilization/loadout pad for disposal. After removal excavation was complete, post-excavation elevation surveys were completed to document removal depths, and confirmation samples were collected as described in Section 4.2. Completion of excavation was confirmed by use of the Excavation and Confirmation Sampling Checklists as described in Sections 4.2 and 6.3.

A total of approximately 6,022 tons (approximately 3,764 cyd, assuming 1.6 tons per cyd) of non-TSCA material and 113 tons (71 cyd) of TSCA material were removed from BRSA 1 (see Photo 5 in Attachment A). The BRSA 1 confirmation sample tracking table can be found *here*, the WTP sample tracking table can be found *here* and the non-TSCA waste tracking table can be found *here*.

6.2 Restoration

Historically, a bridge crossed the river between BRSAs 1 and 6. When the crossing was removed (between 1938 and 1955, according to aerial imagery), the earthen abutment was left in place. During restoration of the BRSA 1 staging area, the earthen abutment was pulled back to increase the floodway area and the soil was used to restore a parking lot located across from the Pine Creek Impoundment.

BRSA 1 banks were restored as described in Section 5.8 and stabilized using a combination of rootwads, coir fabric, and joint planting. Table 6.1, below, outlines the restoration techniques used for BRSA 1 and Table 6.2 summarizes the imported materials used (see Section 5.9 for sources). A final as-built survey was completed following restoration and is presented on the BRSA 1 Record Drawings, included as Attachment B (see Drawings C-101 to C-106 and C-201 to C-207).

Table 6.1 BRSA 1 Restoration Techniques

Bank Restoration Technique	LDB STA Start	LDB STA End	Total Linear Feet (approximate)
Rootwads	27+21 42+12	35+58 55+97	2,200
Coir Fabric	35+75	41+86	811
Joint Planting	27+05 35+58 41+86	27+21 35+75 42+12	91

Note: Feeder stream locations are shown on record drawings in Attachment B.

Table 6.2 BRSA 1 Imported Materials

Material	Quantity (tons)	Use
Class II Fill Sand	9,743.15	Access roads, sand bags, staging area/stabilization pad construction, restoration
21AA Natural Crush Stone	3,360.66	Access roads, sand bags, staging area/stabilization pad construction
1.5-inch Crush Stone	92.39	Restoration
1-inch Crush Stone	91.28	Restoration
Topsoil	1,394.68	Restoration
1x3 Riprap	181.15	Erosion repair
Common Fill	53.50	Erosion repair
Plain Riprap	165.00	Erosion repair

Note: Some materials (such as rootwads, footer logs, and anchor stones) were not tracked by unit, but by linear feet of restoration.

6.3 Deviations from Technical Memorandum

The following is a list of the USEPA-approved changes made following submittal of the design presented in the BRSA 1 TM:

- Results of confirmation samples collected at the design depths from bank grids 1, 2, 13, 37, 42, and 58 exceeded the bank soil RAL of 5 mg/kg PCBs. Additional soil was excavated from these grids and confirmation sampling was repeated. The results of the subsequent confirmation samples indicated PCB concentrations of less than 5 mg/kg. Refer to record drawings for final grid excavation depths.
- Sub-surface sample results from grids 1, 40, 42, 43, 53, and 57 exceeded the on-Site reuse criterion of 1 mg/kg PCBs (but were below the RAL of 5 mg/kg). The sub-surface material from these grids was therefore not approved for reuse, and was excavated to the restoration depth and disposed off-Site. The bank soil RAL was not exceeded; therefore, additional sub-surface samples were not collected. Refer to the record drawings for final grid excavation depths.
- Sub-surface sample results from grids 13 and 58 exceeded the on-Site reuse criterion. Additional excavation was completed and sub-surface samples were re-collected. Results of the subsequent sub-surface samples indicated PCB concentrations of less than 1 mg/kg and the material was approved for reuse. Refer to the record drawings for final grid excavation depths.
- The BRSA 1 staging area was meant to have a designated area for TSCA material handling; however, due to the minimal volume of TSCA material excavated, a small field

staging area was constructed, and lined roll-off containers were staged, near the TSCA removal area, rather than at the BRSA 1 staging area.

- Following restoration (coir fabric installation), an erosional area developed along the toe of the bank between grids 29 and 31. To stabilize the area, additional fill material, rock, and woody debris were installed below the normal water line to buttress the bank toe.
- A small triangular section of riverbank at the transition area between BRSA 1 and the steep slopes of BRSA 2 was added to the BRSA 1 design. BRSA boundaries were originally set based on topographic maps and this area was therefore considered to be part of BRSA 2. However, the BRSA 1 and 2 boundary was modified in the field and this area became the transitional area between BRSAs 1 and 2. The triangular area was approximately 15 feet long on each side. Remediation in this area was completed consistent with the means and methods described above and restored with joint planting.
- The revised transitional area mentioned above was restored with joint planting; therefore, the joint planting restoration originally planned for grid 1 was replaced with rootwads.
- As mentioned previously, the earthen abutment of a former bridge crossing was pulled back from the river's edge and used to restore the current parking lot as part of restoration activities. Two bridge piers that had been left in place when the bridge was abandoned (between 1938 and 1955) were removed from the river during BRSA 1 activities to increase channel stability.
- Per the BRSA 1 TM, removal work was initially planned to progress upstream to downstream; however, during construction higher than expected water levels created a change in bank conditions so work was conducted in both directions (upstream and downstream) for efficiency.
- Beginning with BRSA 1 grid 34, Excavation and Confirmation Sampling Checklists were developed and used as a means to verify that grids were excavated to the correct depths and that confirmation samples were collected and results received before restoration began. Additionally, wooden survey stakes with different colored flagging were used to communicate the status of a grid. Red flagging indicated that a grid had been excavated and confirmation samples had been collected but results were not yet received, green flagging indicated that confirmation sample results had been received and were within levels to allow restoration to begin, and blue flagging indicated that confirmation sample results had been received but the material was not acceptable for reuse. These procedures were used for the remainder of the project.
- At the request of MDNR, the parking area off Jefferson Road was expanded and a river access point was provided near LDB STA 49+41 during restoration activities (refer to the record drawings).
- With MDNR approval, the access road was left in place, but the turnouts and staging areas were completely removed. Refer to the record drawings (Attachment B) for the location of access road left in place.
- Signs were installed to discourage the public from entering the Site until the restoration planting was established.

7.0 BRSA 2

BRSA 2 is located downstream of BRSA 3 and upstream of BRSA 1, extending from approximately LDB STA 21+01 to 27+05 (RS 78+00 to 84+50, *Figure 1-2*). BRSA 2 is characterized by non-depositional, steep, wooded banks without floodplains. Pre-design sample results (see Section 1.1) indicated PCB concentrations in both the nearshore sediment and the bank soil were below their respective RALs. Due to these factors, no removal action was taken in BRSA 2. Refer to the BRSAs 2 and 3 TM *here* for additional details.

8.0 BRSA 3

BRSA 3 is located adjacent to the downstream side of the M-89 Bridge and upstream of BRSA 2, extending from approximately LDB STA 12+03 to 21+01 (RS 84+50 to 91+00) (*Figure 8-1*). Bank erosion in BRSA 3 was exacerbated by the orientation of the M-89 bridge piers directing river flow toward the banks. The banks therefore required a robust design with redundancies to mitigate these erosional effects. BRSA 3 activities were completed between March and May 2017. This section summarizes those activities and documents USEPA-approved deviations from the design presented in the BRSAs 2 and 3 TM, which can be found *here*.

8.1 Removal Action

Two types of cofferdams were installed to facilitate BRSA 3 activities. A sand bag cofferdam system was installed at the upstream and downstream ends of BRSA 3 as described in Section 5.10. Along the remainder of the bank, a riprap cofferdam was constructed at the restoration toe with common fill placed between the restoration bank and the remediation excavation area (refer to Figure 1-5 in the BRSAs 2 and 3 TM).

After installation of the cofferdams, bank soil that exceeded the RAL was removed to the design depth (or lower) and at least 10 feet perpendicular from the new water's edge based on the build-out (see Section 8.2), creating the buffer zone mentioned in Section 1.1. Based on results of the pre-design sampling, BRSA 3 sediment stream tubes did not require remediation. After removal excavation was complete, post-excavation elevation surveys were completed to document removal depths, and confirmation samples were collected as described in Section 4.2. Completion of excavation was confirmed by use of the Excavation and Confirmation Sampling Checklists as described in Sections 4.2 and 6.3.

A total of approximately 3,543 tons (2,214 cyd) of non-TSCA material was removed from BRSA 3. The BRSA 3 confirmation sample tracking table can be found *here*, the WTP sample tracking table can be found *here* and the non-TSCA waste tracking table can be found *here*.

8.2 Restoration

As mentioned above, the M-89 Bridge piers exacerbated erosion of the BRSA 3 banks. To mitigate future erosion, restoration activities consisted of building out the banks to create a more stable river width-to-depth ratio, constructing J-hook vanes to deflect water away from the banks, stabilizing the banks using joint planting, and placing additional heavy rock riprap downstream of the M-89 Bridge abutment in coordination with MDOT. Table 8.1, below, summarizes the BRSA 3 restoration treatments and imported materials are summarized in Table 8.2 (see Section 5.9 for sources). A final as-built survey was completed following remediation and is presented on the BRSA 3 Record Drawings, included as Attachment B (see drawings C-107 to C-109 and C-208 to C-211 in Attachment B).

Bank Build-Out
Erosion of the BRSA 3 banks resulted in a high width-to-depth ratio of the river and unstable banks. To re-establish the proper width-to-depth ratio, BRSA 3 banks were built out to their historical contours using imported fill and/or excavated Site soil approved for re-use (see Photo 17 in Attachment A). Refer to the BRSAs 2 and 3 TM (*here*) for details on determining the proper width-to-depth ratio. The riprap used as a cofferdam in the bank build out areas was incorporated into the joint planting bank treatment to further stabilize the banks. The toe of the bank was "keyed" into competent river bed material as an anchor and the bank was restored with joint planting. Several feeder streams were re-constructed and extended to the new water's edge (see Photo 21 in Attachment A, and Record Drawings in Attachment B).

Restoration planting and seeding was incorporated into the designed restoration treatments as described in Section 5.8. On-Site material was reused when possible (refer to Section 4.2) and additional backfill material was imported from an approved off-site source. Imported materials are summarized in Table 8.2, below.

Table 8.1 BRSA 3 Restoration Techniques

Bank Restoration Technique	LDB STA Start	LDB STA End	Total Linear Feet (approximate)
Bank Build-Out	13+06	16+27	304
Joint Planting	12+03	21+01	826

Note: Feeder stream locations are shown on record drawings in Attachment B.

Table 8.2 BRSA 3 Imported Materials

Material	Quantity (tons)	Use
Class II Fill Sand	2,978.15	Access roads, sand bags, staging area/stabilization pad construction
21AA Natural Crush Stone	1,179.28	Access roads, sand bags, staging area/stabilization pad construction
1-3 inch Washed Rock	13.90	Restoration
6-12 inch Riprap	39.90	Restoration
Heavy Riprap	40.75	Restoration
1-3 inch Limestone	50.50	Restoration
4-8 inch Riprap	372.75	Cofferdam/Restoration
8-12 inch Riprap	1,577.50	Cofferdam/Restoration
1x3 Stone (#57 Stone)	450.27	Cofferdam/Restoration
Common Fill	4,252.18	Bank build-out, restoration
Topsoil	975.78	Restoration

Note: Some materials (such as rootwads, footer logs, and anchor stones) were not tracked by unit, but by linear feet of restoration.

J-Hooks

Two J-hook vane structures were installed to redistribute the velocity in the river channel (see Photo 20 in Attachment A). The J-hooks reduce the near bank shear stress and keep the thalweg away from the outside bend and toward the center of the channel. For each J-hook, an anchor sill was excavated approximately 15 feet into the bank (perpendicular to the shoreline) and approximately 6 feet deep. MDOT heavy riprap was placed in the sill and covered with clean fill material, with the first set of J-hook stones placed on top, anchoring the J-hooks into the bank. After anchoring the head of the J-hooks into the banks, a trench was excavated into the stream bed for each J-hook. The trench excavation depth was determined based on the planned elevation of the top of the J-hooks, requiring excavation of between 1 and 4 vertical feet. Footer stones were placed in the trench and backfilled with excavated trench material. Finally, crest stones were placed on top and offset slightly upstream of the footer rocks (see Photos 18 and 19 in Attachment A). The upstream J-hook was installed first, followed by the downstream J-hook. Material excavated for installation of the J-hooks that was not acceptable for re-use was transported to the stabilization pad for off-Site disposal.

In addition to exacerbating erosion by directing flow toward the BRSA 3 banks, the M-89 Bridge piers resulted in deposition of coarse material near the center of the river, referred to as a mid-channel bar. This mid-channel bar deposit caused the thalweg to split, further contributing to erosion on both the RDB and LDB. To reduce pressure on the J-hooks and restored banks, a single thalweg was created along the LDB by removing the mid-channel bar. The mid channel bar was accessed during restoration of the BRSA 3 banks, but prior to installing the J-hooks. The mid-channel bar was removed starting at the upstream end. Turbidity was monitored during the mid-channel bar excavation; no exceedances were noted. Following excavation, the upstream end (head) of the newly created thalweg was armored with stone excavated from the mid-channel bar to attempt to prevent head cutting. The remainder of the material excavated from the mid-channel bar was cast toward the BRSA 4 bank for use during BRSA 4 restoration (refer to Sections 8.3 and 9.3 for details). The mid-channel bar was monitored using bathymetric surveys completed in May, June, August, and November 2017. Bathymetric surveys were submitted to USEPA, MDNR, and EGLE for review. At the time of this report, a final bathymetric survey is pending and will be completed when conditions allow. Results of the bathymetric surveys indicated that the channel remains stable.

8.3 Deviations from Technical Memorandum

The following is a list of the USEPA-approved changes made following submittal of the design presented in the BRSAs 2 and 3 TM:

- The material in grid 17 was extremely soft and the downstream end of the grid could not be safely reached with an excavator. The grid was split into two grids (renumbered as grids 17 and 18) to facilitate excavation. Grid 17 was remediated and acceptable confirmation results were received, then the grid was backfilled so that grid 18 could be accessed. Refer to the record drawings for final grid layout on drawing C-107 in Attachment B.
- Results of confirmation samples collected at the design depths from grid 17 exceeded the bank soil RAL of 5 mg/kg total PCBs. Additional soil was excavated and confirmation sampling was repeated. The results of the second confirmation sample indicated PCB concentrations of less than 5 mg/kg. Refer to record drawings for final grid excavation depths on drawings C-209 to C-211 in Attachment B.
- Material excavated from the mid-channel bar that was not used to armor the thalweg was to be used for BRSA 3 restoration; however, this was changed during construction and the material was instead cast toward the BRSA 4 bank. During BRSA 4 restoration, it was graded up against the bank on the RDB downstream of the M-89 bridge abutment (see Section 9.3).
- With MDNR approval, the access road was left in place, but the turnouts and staging areas were completely removed. Refer to the record drawings (Attachment B) for the location of access road left in place.

9.0 BRSA 4

BRSA 4 is located on the RDB immediately downstream of the M-89 Bridge, extending approximately 2,500 feet from approximately RDB STA 12+50 to 36+50 (RS 66+50 to 90+50, *Figure 9-1*). BRSA 4 remediation and restoration activities were conducted between April and August 2017. This section summarizes those activities and documents USEPA-approved deviations from the design presented in the BRSAs 4, 5, 6, and 9 TM, which can be found *here*.

9.1 Removal Action

Removal work in BRSA 4 began with installation of a sand bag cofferdam system as described in Section 5.10. BRSA 4 also required installation of a sheet piling cofferdam and a fortified turbidity curtain (see below). After installation of the cofferdam, bank soil that exceeded the RAL of 5 mg/kg total PCBs was removed to the design depth (or lower) and at least 10 feet perpendicular from the water's edge, creating the buffer zone mentioned in Section 1.1.

Removal work was required on banks at the downstream end of BRSA 4, between a privately-owned residential property and the river (see Figure 9-1 and Photo 26 in Attachment A). Due to the steep bank, access was limited in this area. A shelf was constructed through the steep bank to facilitate construction of an access road over the removal excavation area. The access road was constructed to the downstream end of BRSA 4 and removal excavation was completed in stages from downstream to upstream, removing the access road and completing restoration as work was completed.

Sediment in two BRSA 4 stream tubes required remediation: stream tube A3-SED-22C, extending from approximately RS 78+50 to 83+50, and stream tube A3-SED-19D, extending from approximately RS 67+00 to 69+25. To facilitate stream tube excavation, a temporary sheet pile cofferdam was installed around stream tube A3-SED-22C (see Photos 22 and 23 in Attachment A). Sand bags were placed inside the sheet piling to delineate grids and facilitate remediation and confirmation sampling. Contact water was pumped from inside the sheet piling and sent to the WTP.

Deeper water and access restrictions at the downstream stream tube (A3-SED-19D) necessitated the use of a reinforced turbidity curtain, which was installed as described in Section 5.12. Pumping water from the excavation area on the bank-side of the reinforced turbidity curtain helped maintain negative pressure to minimize the potential for contact water to enter the river (see Photo 24 in Attachment A). Contact water was pumped to the WTP.

Stream tube sediment was removed concurrently with bank soil. Excavated soil and sediment were loaded into off-road trucks and transported to the BRSA 4 stabilization/loadout pad for dewatering and stabilization before being transported to the landfill. After removal excavation of both bank soil and sediment was complete, post-excavation elevation surveys were completed to document removal depths, and confirmation samples were collected as described in Section 4.2. Completion of excavation was confirmed by use of the Excavation and Confirmation Sampling Checklists as described in Sections 4.2 and 6.3.

A total of approximately 7,803 tons (4,877 cyd) of non-TSCA material was removed from BRSA 4. The BRSA 4 confirmation sample tracking table can be found *here*, the BRSA 4 WTP tracking table can be found *here*, and the non-TSCA waste tracking table can be found *here*.

9.2 Restoration

BRSA 4 banks were restored as described in Section 5.7 and stabilized with rootwads and joint planting. Similar to BRSA 3, heavy rock riprap was installed around the M-89 Bridge abutment. Table 9.1, below, outlines the restoration techniques used for BRSA 4 and imported materials are summarized in Table 9.2 (see Section 5.9 for sources). A final as-built survey was completed following restoration and is presented on the BRSA 4 Record Drawings, included as Attachment B.

Table 9.1 BRSA 4 Restoration Techniques

Bank Restoration Technique	RDB STA Start	RDB STA End	Total Linear Feet (approximate)
Rootwads	02+32 03+99 05+80 08+12 11+55	03+70 05+63 07+85 11+30 24+82	1,845
Joint Planting	00+00 21+67	02+32 24+82	507

Note: Feeder stream locations are shown on record drawings in Attachment B.

Table 9.2 BRSA 4 Imported Materials

Material	Quantity (tons)	Use
Class II Fill Sand	9,902.47	Access roads, sand bags, staging area/stabilization pad construction
21AA Natural Crush Stone	6,328.26	Access roads, sand bags, staging area/stabilization pad construction
1x3 Riprap	211.46	Restoration
4x8 Riprap	306.60	Restoration
8x12 Riprap	248.83	Restoration
Heavy Riprap	330.77	Restoration
Common Fill	7,060.17	Restoration
Topsoil	2,675.30	Restoration
Asphalt	15.10	Residential driveway
Millings	71.50	Residential driveway

Note: Some materials (such as rootwads, footer logs, and anchor stones) were not tracked by unit, but by linear feet of restoration.

9.3 Deviations from Technical Memorandum

The following is a list of the USEPA-approved changes made following submittal of the design presented in the BRSAs 4, 5, 6, and 9 TM:

- Results of confirmation samples collected at the design depths from stream tube grids 24, 44, 45, 46, and 49 and bank grid 48 (see drawing C-111 in Attachment B) exceeded their respective RALs. Additional material was excavated and confirmation sampling was repeated. The results of the subsequent confirmation samples indicated PCB concentrations below the RALs. Refer to record drawings for final grid excavation depths.

- The sub-surface sample result from bank grid 11 (drawing C-110 in Attachment B) was greater than 1 mg/kg PCBs (but was below the RAL of 5 mg/kg). The sub-surface material from this grid was therefore not approved for reuse, and was excavated to the restoration depth and disposed off-Site. The bank soil RAL was not exceeded; therefore, additional subsurface samples were not collected. Refer to record drawings C-110 to C-115 and C-212 to C-217 in Attachment B for final excavation depths.
- Access to the downstream portion of BRSA 4 was limited due to the steep banks. The access road was removed from the upstream half of grid 50; the downstream half of grid 50 was re-named grid 51 (refer to the record drawings for final grid layouts). Removal excavation and confirmation sampling was completed in grid 50, then the road was re-built over the grid so that removal excavation and confirmation sampling could be completed in grid 51.
- Due to the steep slope in front of the residential property, the proposed 3:1 restoration slope was modified to a 2:1 slope.
- Results of the pre-design sampling indicated that stream tube A3-SED-22D did not require remediation; however, in order to access stream tube A3-SED-22C, stream tube A3-SED-22D was also excavated. Confirmation samples were not collected from stream tube A3-SED-22D. Refer to the record drawings (Attachment B) for final excavation depths.
- Stream tube A3-SED-19D extended beyond BRSA 4 into BRSA 5. However, BRSA 5 banks did not require remediation (see Section 10); therefore, the BRSA 5 stream tube was remediated during BRSA 4 work. Due to access issues caused by the steep bank and observation of cobble material at the toe of the BRSA 5 slope, samples were collected from BRSA 5 stream tube grids 1, 2 and 3 prior to beginning excavation. Results of these samples indicted that only BRSA 5 grid 1 (RS 66+50) required remediation.
- Due to its small size, a confirmation sample was not able to be collected from stream tube A3-SED-19D grid 43 following standard confirmation sampling procedures. Grids 43 and 44 were therefore sampled together. The sample result is identified as grid 44 in the BRSA 4 confirmation sample tracking table (*here*).
- As discussed above, deeper water and access restrictions at the downstream stream tube (A3-SED-19D) necessitated the use of a reinforced turbidity curtain (Photo 24, Attachment A), rather than the planned sandbag cofferdam.
- Per the request of the private resident at the downstream end of BRSA 4, shrub planting was modified and woody debris was installed to provide turtle habitat (Attachment A Photo 26).
- Several large trees located on the private residence at the downstream end of BRSA 4 were leaning over the remediation area and were therefore removed due to safety concerns. Following restoration, the trees were replaced at locations chosen by the property owner.
- As discussed in Section 8.3, material from the mid-channel bar excavation was used to armor the BRSA 4 bank.
- Two groundwater seeps were encountered during restoration activities in the residential restoration area. Buried stone drainage systems were installed to vent the groundwater through the restoration area to the river. The drainage systems consisted of 1x3-inch stone material wrapped with non-woven geotextile buried in the bank. Refer to the record drawings in Attachment B for the drainage system locations.
- With MDNR approval, the access road was left in place, but the turnouts and staging areas were completely removed. Refer to the record drawings (Attachment B) for the location of access road left in place.

10.0 BRSA 5

BRSA 5 extends approximately 500 feet from RDB STA 36+50 to 42+56 (RS 61+00 to 66+50, *Figure 1-2*). It is located downstream of BRSA 4 and upstream of BRSA 6 and is characterized by steep wooded banks without floodplains. Pre-design sample results indicated that PCB concentrations in bank soil were below the RAL of 5 mg/kg; therefore, no removal action was taken on the banks of BRSA 5. As discussed previously, however, a sediment stream tube extending from BRSA 4 into BRSA 5 required removal and was addressed during BRSA 4 removal activities. Refer to Section 9.3 of this report and the BRSAs 4, 5, 6, and 9 TM *here* for additional details.

11.0 BRSA 6

BRSA 6 extends approximately 3,300 feet from RDB STA 42+56 to 69+61. BRSA 6 is located downstream of BRSA 5 and upstream of BRSA 7 (RS 33+00 to 61+00, *Figure 11-1*). BRSA 6 remediation and restoration activities were conducted between July and October 2017. This section summarizes those activities and documents USEPA-approved deviations from the design presented in the BRSAs 4, 5, 6, and 9 TM, which can be found *here*.

11.1 Removal Action

Similar to BRSA 1, a former earthen bridge abutment was located on the BRSA 6 bank near RS 58+00. The abutment soil was re-used (above a protective liner) during construction of the BRSA 6 staging area. To facilitate bank removal, a sand bag cofferdam system was then installed in most areas as described in Section 5.12; however, steel sheet pile cofferdam was used for some areas as noted below. After installation of the cofferdams, bank soil that exceeded the RAL of 5 mg/kg total PCBs was removed to the design depth (or lower) and at least 10 feet perpendicular from the water's edge, creating the buffer zone mentioned in Section 1.1.

Four BRSA 6 sediment stream tubes required remediation: A3-SED-11E (extending from approximately RS 33+00 to 36+25), A3-SED-12E (extending from approx. RS 36+25 to 39+00), A3-SED-14E (extending from approximately RS 42+50 to 46+75), and A3-SED-17D (extending from approximately RS 56+50 to 61+25 (*Figure 11-1*). A temporary sheet piling cofferdam system was installed around these stream tubes. Stream tube sediment removal was completed concurrently with bank soil excavation. Excavated soil and sediment were loaded into off-road trucks and transported to the BRSA 6 staging area for stabilization before being transported to an approved off-site landfill. After removal excavation was complete, confirmation samples were collected as described in Section 4.2. When confirmation sample results indicated no additional excavation was required, post-excavation elevation surveys were completed. Completion of excavation was confirmed by use of the Excavation and Confirmation Sampling Checklists as described in Sections 4.2 and 6.3.

A total of approximately 10,750 tons (6,719 cyd) of non-TSCA material was removed from BRSA 6. The BRSA 6 confirmation sample tracking table can be found *here*, the WTP sample tracking table can be found *here* and the non-TSCA waste tracking table can be found *here*.

11.2 Restoration

BRSA 6 banks were restored as described in Section 5.7 and stabilized using a combination of rootwads, coir fabric, and joint planting (Photos 28 and 30, Attachment A). Table 11.1, below, outlines the restoration techniques used for BRSA 6 and Table 11.2 summarizes the imported materials (see Section 5.9 for sources). A final as-built survey was completed following restoration and is presented on the BRSA 6 Record Drawings, included as Attachment B (drawings C-120 and C-121).

Table 11.1 BRSA 6 Restoration Techniques

Bank Restoration Technique	RDB STA Start	RDB STA End	Total Linear Feet (approximate)
Joint Planting	42+56 47+67 60+48	42+95 47+92 69+61	985
Rootwads	42+95	47+67	478
Coir Fabric	47+92	60+48	1,257

Note: Feeder stream locations are shown on record drawings in Attachment B.

Hydrodynamic modeling indicated that a floodplain area located outside the project area in the BRSA 6 floodplain (historical oxbow) that discharges near RDB STA 65+50 to 66+53 had the potential for more concentrated flow. This area was restored with joint planting from the toe of the bank and extended back approximately 30 feet (Photo 29, Attachment A).

Restoration planting and seeding was incorporated into the designed restoration treatments as described in Section 5.8. On-Site material was reused when possible (refer to Section 4.2) and additional backfill material was imported from an approved off-site source. Imported materials are summarized in Table 11.2, below.

Table 11.2 BRSA 6 Imported Materials

Material	Quantity (tons)	Use
Class II Fill Sand	4,386	Staging area and access roads, stabilization pad, sand bags, backfill for stream tube A3-SED-17D, de-ice parking lot/access roads, winter maintenance, restoration
21AA Natural Crush Stone	6,859.49	Staging area and access roads, WTP, stabilization pad, stream tube, road maintenance
1x3 Riprap (limestone)	724.87	Temporary culvert inlet/outlet protection, joint planting, feeder streams, and bank toe stabilization
4x8 Riprap	524.17	Culvert inlet/outlet protection, joint planting
Common Fill	4,183.67	Restoration backfill
Topsoil	4,262.06	Restoration, repair for removing bridge abutment
MDOT Heavy Riprap	105.55	Joint Planting
8x12 Riprap (MDOT Plain)	709.53	Joint planting and feeder streams

Note: Some materials (such as rootwads, footer logs, and anchor stones) were not tracked by unit, but by linear feet of restoration.

11.3 Deviations from Technical Memorandum

The following is a list of the USEPA-approved changes made following submittal of the design presented in the Draft BRSA 4, 5, 6, and 9 TM:

- Results of confirmation samples collected at the design depths from bank grids 9-13, 16, 33, 36, 47, 49, 50, 52, and 54 exceeded the bank soil RAL of 5 mg/kg PCBs. Additional soil was excavated from these grids and confirmation sampling was repeated. The results of the subsequent confirmation samples indicated PCB concentrations of less than 5 mg/kg. Refer to record drawings for final grid excavation depths.

- Sub-surface sample results from bank grids 47, 49, 50, and 52 exceeded the on-Site reuse criteria of 1 mg/kg total PCBs. Additional excavation was completed and sub-surface samples were re-collected. Results of the subsequent sub-surface results indicated PCB concentrations of less than 1 mg/kg and the material was approved for reuse. Refer to the record drawings for final grid excavation depths.
- Sub-surface sample results from bank grids 8-13, 15-19, 25, 38, 48, 50, and 54 exceeded the on-Site reuse criteria of 1 mg/kg PCBs (but were below the RAL of 5 mg/kg). The sub-surface material from these grids was therefore not approved for reuse, and was excavated to the restoration depth and disposed off-Site. The bank soil RAL was not exceeded; therefore, additional sub-surface samples were not collected. Refer to the record drawings for final grid excavation depths.
- Following coir fabric installation and prior to restoration completion, an erosional area was observed at the toe of grids 40 to 43. The erosion appeared to be caused by a mid-channel bar exposed during drawdown of the WCS, creating increased shear stresses and velocities along the RDB near RS 40+00. A limited removal of the mid-channel bar was completed to increase the cross-sectional area, reducing shear stresses along the RDB. The bank in grids 40 to 43 was repaired and joint planting restoration was extended to include this area. Material excavated from the mid-channel bar consisted of approximately 4 to 8-inch diameter cobble, which was used for RDB restoration.
- Stream tube A3-SED-14E was backfilled at the toe of the bank. A 1:1 slope was constructed with MDOT plain riprap against the bank, then a 2:1 slope was constructed with #57 stone from the toe of the MDOT riprap into the river. The remainder of the stream tube was not backfilled and is expected to naturally fill over time.
- Due to the location of the access roads in some areas, there was insufficient room to plant trees for restoration in some areas. The trees were instead planted on BRSA 8.
- With MDNR approval, the access road was left in place, but the turnouts and staging areas were completely removed. Refer to the record drawings (Attachment B) for the location of access road left in place.

12.0 BRSA 7

BRSA 7 extends approximately 3,250 feet from RDB STA 69+56 to 102+09, terminating at the former Otsego Township Dam. BRSA 7 is located immediately upstream of the WCS and downstream of BRSA 6 (*Figure 12-1*). Similar to BRSAs 2 and 5, portions of BRSA 7 (grids 18 to 25 and 52 to 61) were characterized by steep slopes. Unlike BRSAs 2 and 5, however, some portions of BRSA 7 were not characterized by steep slopes and did require remediation. A pilot channel was dredged to, in part, facilitate BRSA 7 and 8 bank remediation activities. The WCS was drawn down and subsequently removed during BRSA 7 remediation. Pilot channel dredging was conducted between June and September 2017 with BRSA 7 remediation and restoration activities conducted between April and July 2018. This section summarizes those activities and documents USEPA-approved deviations from the design presented in the Draft BRSAs 7 and 8 TM, which can be found *here*. Details on the removal of the WCS are presented in Section 15. Due to the steep banks associated with grids 16-25, BRSA 7 was broken into two phases. Remediation and restoration of grids 1-25 were managed via the BRSA 6 access roads/staging area, while the downstream grids were approached from the Command Center staging area and temporary access roads.

12.1 Pilot Channel

To control development of the thalweg as the river elevation was lowered during removal of the former WCS, and to facilitate BRSA 7 and 8 remediation/restoration by directing the channel flow toward the center of the river, away from the edges, a pilot channel was dredged in the portion of the river between BRSAs 7 and 8.

Pre-design sediment sample results indicated that the material in the area where the pilot channel was dredged were below the PCB sediment RAL. The material was therefore relocated on-Site to fill a scour hole, or “plunge pool”, that had developed on the downstream side of the former Otsego Township Dam auxiliary spillway. A Swinging Ladder hydraulic dredge with an 8-inch rotating cutting head was used to create the pilot channel. Dredged material was pumped via an 8-inch floating pipeline into the plunge pool. See Section 13.2.1 for further details regarding restoration of the plunge pool.

To attempt to mitigate impacts during dredging and sediment relocation, a series of turbidity controls were installed around the plunge pool and downstream of the former dam (refer to Figures 3-3 and 3-4 of the Draft BRSA 7 and 8 TM). In-stream monitoring of turbidity and dissolved oxygen was conducted during these activities. EGLE and MDNR requested a short-term turbidity excursion limit of 500 NTUs during WCS drawdown and pilot channel dredging (refer to Section 3.7.1 of the BRSA 7 and 8 TM); however, no sustained exceedances occurred during pilot channel dredging. Though contingency plans were made, conditions during dredging did not require the use of a hydrocyclone or flocculant.

A total of approximately 15,435 cyd of sediment was dredged over 32 days. The depth of the pilot channel removal varied based on the existing channel depth and the desired final depth and grade. The pilot channel extends from approximate RS 05+00 to 26+40, measuring approximately 2,100 feet long by 3.2 feet deep by 60 feet wide and is shown on the BRSA 7 record drawings (see drawings C-122 to C-124 in Attachment B).

12.2 Removal Action

Construction of the pilot channel and drawdown of the former WCS resulted in lowered water elevations, subsequently resulting in a narrowed river channel and dewatered river edges. Soft banks made heavy equipment access difficult in certain areas. A marsh excavator was used for excavation of the soft banks in grids 28 to 38 (Photo 36 in Attachment A). High-density polyethylene mats were used to create temporary access roads from grids 28 through 49. Stone was used to create access roads in grids 17 through 26 and 52 through 62.

Bank-based excavators, including the marsh excavator (Photo 36 in Attachment A), removed bank soil that exceeded the RAL of 5 mg/kg total PCBs to the design depth (or lower) and at least 10 feet perpendicular from the water's edge, creating the buffer zone mentioned in Section 1.1.

With USEPA approval, the following portions of the BRSA 7 bank were not excavated: grids 19 through 25 where there was a very steep slope and no bank bench, and grids 52 through 61 where pre-design sample results indicated that remediation was not necessary (pre-design sampling results can be found in the BRSA 7 and 8 TM, *here*). Composite samples were collected from grids 52 through 61 during construction to verify that remediation was not required. The results of these BRSA 7 verification samples can be found *here*.

Three BRSA 7 sediment stream tubes required remediation: A3-SED-03E (extending from approximate RS 10+00 to 12+00), A3-SED-06E (extending from approximate RS 17+75 to 21+00), and A3-SED-09E (extending from approximate RS 27+25 to 30+25) (*Figure 12-1*). Sediment in stream tubes A3-SED-03E and A3-SED-06E was protected from mobilizing during pilot channel dredging and WCS drawdown by a non-permeable turbidity curtain; a temporary sheet pile cofferdam was installed around stream tube A3-SED-09E (Photo 33 in Attachment A). After the WCS was removed, A3-SED-03E and A3-SED-06E stream tubes were relatively dry. During excavation, the turbidity curtain was used to contain contact water by pumping water to the WTP, maintaining a negative pressure on the water in the excavation zone. Contact water originating from upland sources was also contained using non-permeable turbidity curtain. This water was pumped to the WTP for treatment and discharge or off-site disposal (see Section 12.4).

Stream tube sediment removal was completed concurrently with bank soil excavation. Excavated material was loaded into off-road trucks and transported to the stabilization/loadout pad for dewatering and stabilization before being transported to the approved off-site landfill.

After removal excavation was complete, post-excavation elevation surveys were completed to verify removal depths, and confirmation samples were collected as described in Section 4.2. Completion of excavation was confirmed by use of the Excavation and Confirmation Sampling Checklists as described in Sections 4.2 and 6.3. Soil re-used in the backfill and restoration grading was confirmed to not exceed 1 mg/kg of total PCBs. Restoration excavation material exceeding 1 mg/kg of total PCBs was removed and transported to the stabilization/loadout pad for disposal.

A total of approximately 9,357 tons (5,848 cyd) of non-TSCA material was removed from BRSA 7. The BRSA 7 confirmation sample tracking table can be found *here*, the WTP tracking table can be found *here* and the non-TSCA waste tracking table can be found *here*.

12.3 Restoration

BRSA 7 banks were restored as described in Section 5.7 and stabilized with joint planting. Table 12.1, below, outlines the restoration techniques used for BRSA 7 and Table 12.2 summarizes the imported materials (see Section 5.9 for sources). A final as-built survey was completed following restoration and is presented on the BRSA 7 Record Drawings, included as Attachment B (see drawings C-128 to C-130).

Table 12.1 BRSA 7 Restoration Techniques

Bank Restoration Technique	RDB STA Start	RDB STA End	Total Linear Feet (approximate)
Joint Planting	69+56	102+09	3,253.14

Note: Feeder stream locations are shown on record drawings in Attachment B.

Table 12.2 BRSA 7 Imported Materials

Material	Quantity (tons)	Use
Class II Fill Sand	1,040.69	Access roads and staging areas, de-ice roads, Command Center, road maintenance
21AA Natural Crush Stone	2,998.77	Access roads and staging areas, road maintenance
Common Fill	1,902.40	Restoration
1x3 Riprap	1,522.92	Temporary culvert inlet/outlet protection, joint planting, restoration, Command Center
4x8 Riprap	1,129.15	Temporary culvert inlet/outlet protection, Joint Planting, restoration, Command Center
MDOT Plain Riprap	6,733.98	Joint Planting, restoration, Command Center
MDOT Heavy Riprap	1,209.48	Joint Planting, restoration, Command Center
Topsoil	1,927.73	Restoration

Note: Some materials (such as rootwads, footer logs, and anchor stones) were not tracked by unit, but by linear feet of restoration.

12.4 Deviations from Technical Memorandum

The following is a list of the USEPA-approved changes made following submittal of the design presented in the BRSAs 7 and 8 TM:

- Results of confirmation samples collected at the design depths from bank grids 12, 14-17, 27, 41, and 63 and sediment grids 9, 33, and 34 exceeded their respective RALs. Additional material was excavated from these grids and confirmation sampling was repeated. The results of subsequent confirmation samples indicated PCB concentrations below the applicable RALs. Refer to record drawings for final grid excavation depths.
- Sub-surface sample results from bank grid 14 exceeded the on-Site reuse criterion. Additional excavation was completed and a sub-surface sample was re-collected. Results of the second sub-surface sample indicated PCB concentrations of less than 1 mg/kg and the material was approved for reuse. Refer to the record drawings for final grid excavation depths.
- Sub-surface sample results from bank grids 2, 10-13, 16, and 17 exceeded the on-Site reuse criterion of 1 mg/kg PCBs (but were below the RAL of 5 mg/kg). The sub-surface material from these grids was therefore not approved for reuse, and was excavated to the restoration depth and disposed off-Site. The bank soil RAL was not exceeded; therefore, additional sub-surface samples were not collected. Refer to the record drawings for final grid excavation depths.
- Excavated material from BRSA 7 was to be transported to the BRSA 6 stabilization/loadout pad for disposal; however, due to the steep banks of BRSA 7 making construction of the access roads difficult, and the extended distance material

would need to be hauled, it was necessary to construct a stabilization/loadout pad at the Command Center for material excavated from grids downstream of (and including) grid 26 (refer to Photo 35 in Attachment A and *Figure 12-1*).

- Contact water collected from the upstream grids of BRSA 7 was pumped to the BRSA 6 WTP for treatment and discharge; however, contact water from the downstream grids of BRSA 7 was pumped to the staging area at the Command Center. Rather than install an additional WTP at the Command Center, this contact water was collected and transported off-site for treatment and disposal at Liquid Industrial Waste in Holland, MI. The waste water tracking sheet is located *here*. The waste characterization laboratory report, waste profile, and waste manifests are available upon request.
- Following construction, the access road in grids 1-14 (located upstream of the first high bank area in BRSA 7) was left in place and restored as described in Section 5.5; the remainder of the BRSA 7 access roads were removed. Refer to the record drawings for the locations of access roads left in place.
- Due to its small size, a confirmation sample was not able to be collected from stream tube A3-SED-09E grid 14 following standard confirmation sampling procedures. Grids 13 and 14 were therefore sampled together. The sample result is identified as grid 13 in the sample tracking sheet.
- Results of a historical sample indicated PCB concentrations over 50 mg/kg in an area between the steep slope and bank near RDB STA 89+00. To attempt to verify the presence of the hotspot, step out samples were collected using the pre-design investigation methods described in the FSP (located *here*). The hotspot concentrations were not verified; however, the area was excavated and the banks between RDB STA 89+00 and 91+00 were restored to improve stability and drainage off of the steep slope. Excavated soil was handled and disposed as non-TSCA material.
- The bank extending from RDB STA 82+00 to 86+00 did not require remediation; however, this area was excavated and graded to improve drainage off of the steep slope and direct water to the river. Refer to the BRSA 7 record drawings for details.
- A significant flood event mobilized non-impacted sediment on the RDB exposing stumps that delineated a portion of the historical channel alignment in BRSA 7. Minor adjustments to the final bank dimensions in grids 47-52 were made to match this historical alignment.
- It was determined that the woody debris installed in BRSAs 1, 4, and 9 provided limited value and often dislodged despite various efforts to anchor it in place. It was also demonstrated in upstream BRSAs that woody debris will naturally deposit over time. Woody debris was therefore not installed along BRSA 7.
- The pilot channel was planned to be approximately 2,400 feet long; however, as mentioned above, the final length of approximately 2,100 feet was sufficient to meet the objectives described in Section 12.1.
- Log vanes were to be installed to protect the BRSA 7 stream tube sediment from mobilizing during the WCS final drawdown; however, based on visual inspections of the stream tube areas as well as velocity measurements collected inside and outside of the turbidity curtain, the non-permeable turbidity curtains were sufficient and log vanes were therefore not installed.
- Due to the location of the access roads, there was insufficient room to plant trees for restoration in some areas. The trees were instead planted in BRSA 8.
- With MDNR approval, the upstream access road was left in place, but the turnouts and staging areas were completely removed. Refer to the record drawings (Attachment B) for the location of access road left in place.

13.0 BRSA 8

BRSA 8 extends approximately 3,259 feet from LDB STA 77+63 to 110+27 (RS 3+50 to 33+00, *Figure 13-1*). BRSA 8 is located downstream of BRSA 9 and upstream of former auxiliary spillway. BRSA 8 remediation and restoration activities were conducted between December 2017 and May 2018 (with a one-month winter shut down from February 12 to March 12, 2018). Restoration of the plunge pool area was completed between June and August 2018. This section summarizes these activities and documents USEPA-approved deviations from the design presented in the BRSAs 7 and 8 TM, which can be found *here*.

13.1 Removal Action

Similar to BRSA 7, lowered water levels resulting from pilot channel dredging and drawdown of the WCS resulted in a narrowed river channel and dewatered river edges along BRSA 8. Bank soil that exceeded the RAL of 5 mg/kg total PCBs was removed to the design depth (or lower) and at least 10 feet perpendicular from the water's edge, creating the buffer zone mentioned in Section 1.1. Pre-design sample results indicated that portions of the BRSA 8 bank did not require remediation (bank grids 1-8, 52, 53, and 60-63). In these grids, a 6-inch overcut of bank soil was removed and confirmation samples were collected.

Three BRSA 8 sediment stream tubes required remediation: A3-SED-02A (extending from approximate RS 06+50 to 09+00), A3-SED-05A (extending from approximate RS 14+25 to 17+25), and A3-SED-07A (extending from approximate RS 20+50 to 23+50). Sediment in the BRSA 8 stream tubes was protected from mobilizing during pilot channel dredging and WCS drawdown by a combination of permeable and non-permeable turbidity curtain affixed with steel poles and anchors. This was monitored by daily visual inspections of the stream tube areas and velocity measurements collected inside and outside of the turbidity curtains. Velocity measurements were collected until ice buildup on the banks created unsafe conditions. After the WCS was removed, these stream tubes were relatively dry. During sediment removal in these stream tubes, the turbidity curtain was used to contain contact water by pumping water to the WTP, maintaining a negative pressure.

Stream tube sediment removal was completed concurrently with bank soil excavation. Excavated material was loaded into off-road trucks and transported to the stabilization/loadout pad for staging and stabilization (when necessary) before being transported to the approved off-site landfill.

After removal excavation was complete, post-excavation elevation surveys were completed to document removal depths, and confirmation samples were collected as described in Section 4.2. Completion of excavation was confirmed by use of the Excavation and Confirmation Sampling Checklists as described in Sections 4.2 and 6.3. Material re-used for restoration (i.e., washed into the joint planting voids) was confirmed to not exceed 1 mg/kg of total PCBs. Restoration excavation material with between 1 and 5 mg/kg of total PCB's was removed and transported to the stabilization/loadout pad for disposal.

A total of approximately 8,730 tons (5,456 cyd) of non-TSCA material was removed from BRSA 8. The BRSA 8 confirmation sample tracking table can be found *here*, the WTP tracking table can be found *here* and the non-TSCA waste tracking table can be found *here*.

13.2 Restoration

13.2.1 Plunge Pool

As discussed in Section 12.1, dredged pilot channel sediment was pumped to the plunge pool. The sediment was pumped and allowed to dewater along the LDB of the plunge pool; however, less material was dredged than anticipated due to the mobilization of non-impacted sediment after removal of the former WCS. The center and RDB of the plunge pool were therefore not filled. The banks around the plunge pool were restored as described in Section 5.7 and stabilized with rootwads and joint planting (see Photos 41 and 42 in Attachment A). Restoration techniques used in the plunge pool area are shown on *Figure 13-2* and summarized in Table 13.1, below and imported materials are summarized in Table 13.2 (see Section 5.9 for sources). A final as-built survey was completed following remediation and is presented on the BRSA 8 Record Drawings, included as Attachment B (drawings C-137 to C-139).

Table 13.1 Plunge Pool Restoration Techniques

Bank Restoration Technique	Bank	Total Linear Feet (approximate)
Toe Wood*	Left	293
Joint Planting	Right	339

*Toe wood restoration is similar to rootwad restoration, but with fewer anchor stones and no coir fabric.

Table 13.2 Plunge Pool Imported Materials

Material	Quantity (tons)	Use
21AA Natural Crush Stone	65.01	Restoration
1x3 Riprap	21.75	Restoration
4x8 Riprap	21.85	Restoration
MDOT Plain Riprap	1,012.57	Restoration
MDOT Heavy Riprap	22.55	Restoration

13.2.2 BRSA 8 Banks

BRSA 8 banks were restored as described in Section 5.7 and stabilized with joint planting. Table 13.3 below outlines the restoration techniques used for BRSA 8 and Table 13.4 summarizes the imported materials. A final as-built survey was completed following restoration and is presented on the BRSA 8 Record Drawings, included as Attachment B (drawings C-137 to C-139).

Table 13.3 BRSA 8 Restoration Techniques

Bank Restoration Technique	LDB STA Start	LDB STA End	Total Linear Feet (approximate)
Joint Planting	77+63	110+22	3,259

Note: Feeder stream locations are shown on record drawings in Attachment B.

Table 13.4 BRSA 8 Imported Materials

Material	Quantity (tons)	Use
Class II Fill Sand	420.18	Access roads and staging
21AA Natural Crush Stone	5,467.68	Access roads and staging
1x3 Riprap	1,074.34	Temporary culvert inlet/outlet protection, joint planting
4x8 Riprap	846.47	Temporary culvert inlet/outlet protection, joint planting, feeder stream
MDOT Plain Riprap	3,425.54	Joint Planting
Heavy Riprap	617.95	Joint Planting
Topsoil	1,898.18	Restoration

Note that common fill was not imported for BRSA 8 activities. Some materials (such as rootwads, footer logs, and anchor stones) were not tracked by unit, but by linear feet of restoration.

13.3 Deviations from Technical Memorandum

The following is a list of the USEPA-approved changes made following submittal of the design presented in the BRSAs 7 and 8 TM:

- Results of confirmation samples collected at the design depths from bank grids 9, 52, and 53 were greater than 5 mg/kg PCBs. Additional soil was excavated from each grid, and confirmation samples were retaken. The results of the subsequent confirmation samples indicated PCB concentrations below the bank soil RAL of 5 mg/kg. Refer to record drawings for final excavation depths.
- Sub-surface sample results from bank grids 8, 45, 52, and 53 exceeded the on-Site reuse criterion of 1 mg/kg PCBs (but were below the RAL of 5 mg/kg). The sub-surface material from these grids was therefore not approved for reuse, and was excavated to the restoration depth and disposed off-Site. The bank soil RAL was not exceeded; therefore, additional sub-surface samples were not collected. Refer to the record drawings for final grid excavation depths.
- Additional feeder stream swales that were not in the design drawings were installed. Refer to the record drawings for feeder stream locations.
- With MDNR approval, the access road was left in place, but the turnouts and staging areas were completely removed. Refer to the record drawings (Attachment B) for the location of access road left in place.
- Trees that were not able to be planted in BRSAs 6 and 7 for restoration were instead planted in BRSA 8.
- For the reasons discussed in Section 12.4, woody debris was not installed in BRSA 8.
- During restoration activities, the parking area off River Road was expanded at the request of MDNR. Refer to the record drawings for details.
- As mentioned in Section 13.2, based on the limited amount of material acquired from dredging, the plunge pool restoration plan was modified and the RDB was not filled. Refer to the BRSA 8 record drawings (Attachment B) for details.
- Based on final elevations after removal of the former auxiliary spillway, this area became part of the floodplain and therefore construction of a swale through the former auxiliary spillway was not necessary. Per MDNR request, this area was planted with tree clumps (see *Figure 13-2*).

- Remediation and restoration on the bank was completed from the access road; however, due to restricted access, a portion of the bank slope toe and near-shore sediment could not be reached. A marsh excavator was used to excavate the hard-to-access toe of slope and near-shore sediment (Photo 39 in Attachment A). Sediment that was excavated was used to fill void spaces in riprap associated with joint planting bank treatments.

14.0 BRSA 9

BRSA 9 extends approximately 1,782 feet from LDB STA 60+07 to 77+89 (RS 33+00 to 49+00, *Figure 14-1*). BRSA 9 is located immediately downstream of the Pine Creek confluence and upstream of BRSA 8. BRSA 9 and Pine Creek confluence remediation and restoration activities were conducted between September and December 2017. This section summarizes these activities and documents USEPA-approved deviations from the design presented in the BRSAs 4, 5, 6, and 9 TM, which can be found *here*.

14.1 Removal Action

BRSA 9 removal work began with installation of a sand bag cofferdam system as described in Section 5.12 (Photo 44 in Attachment A). Bank soil that exceeded the RAL of 5 mg/kg total PCBs was removed to the design depth (or lower) and at least 10 feet perpendicular from the water's edge, creating the buffer zone mentioned in Section 1.1. Bank-based excavators removed bank soil to the required design depths, including an overcut of approximately 6 inches. Pre-design sample results indicated that over half of the BRSA 9 bank did not require remediation excavation (bank grids 1-9, 16-29, and 36-38). In these grids, a 6-inch overcut of bank soil was removed and confirmation samples were collected.

Three stream tubes were removed during BRSA 9 remediation: A3-SED-11A (extending from approximate RS 34+00 to 36+00), and A3-SED-10B and A3-SED-10C, located on the RDB of Pine Creek at the confluence with the Kalamazoo River. A depositional area was observed upstream of the first A3-SED-11A stream tube grid, outside of the stream tube boundary. Based on this observation and with concurrence from USEPA, stream tube A3-SED-11A was extended from RS 36+00 to approximately RS 38+50.

To facilitate removal of the Pine Creek stream tubes the Pine Creek Reservoir was drawn down over a period of 15 days (September 5 to 20, 2017, see Photo 45 in Attachment A). A scope of work for the Pine Creek WCS drawdown (located *here*) was submitted to and accepted by the Allegan County Drain Commissioner. The USEPA and START notified Pine Creek area property owners about the drawdown. During this initial drawdown, a fortified turbidity curtain was installed around the Pine Creek stream tubes and sediment was excavated to the design depths. A temporary bridge constructed of riprap overlying three 36-inch diameter culverts was installed at the end of Pine Creek between BRSAs 9 and 1 to facilitate access to the Pine Creek stream tubes. The Pine Creek drawdown was managed through coordination between USEPA, MDNR, EGLE, and Allegan County Drain Commissioner. As discussed in Section 5.6, pre-and post-construction inspections of the Pine Creek WCS were conducted (report located *here*).

Excavated material was loaded into off-road trucks and transported to the stabilization/loadout pad for dewatering and stabilization before being transported to the approved off-site landfill. After removal excavation was complete, post-excavation surveys were completed to verify removal depths, and confirmation samples were collected as described in Section 4.2. Soil re-used in the backfill and restoration grading was confirmed to not exceed 1 mg/kg of total PCBs. Restoration excavation material exceeding 1 mg/kg of total PCBs was removed and transported to the stabilization/loadout pad for disposal. Completion of excavation was confirmed by use of the Excavation and Confirmation Sampling Checklists as described in Sections 4.2 and 6.3.

A total of approximately 8,312 tons (5,195 cyd) of non-TSCA material was removed from BRSA 9. The BRSA 9 confirmation sample tracking table can be found *here*, the WTP sample tracking table can be found *here*, and the non-TSCA waste tracking table can be found *here*.

14.2 Restoration

The banks of BRSA 9 and the Pine Creek confluence were restored as described in Section 5.7 and stabilized using a combination of rootwads, coir fabric, and joint planting (Photos 47 and 48 in Attachment A). Table 14.1, below, outlines the restoration techniques used and Table 14.2 summarizes the imported materials (see Section 5.9 for sources). A final as-built survey was completed following restoration and is presented on the BRSA 9 Record Drawings, included as Attachment B (drawings C-144 to C-145).

Table 14.1 BRSA 9 Restoration Techniques

Bank Restoration Technique	River Station Start	River Station End	Total Linear Feet (approximate)
Joint Planting	72+55 74+69	72+98 77+89	363
Pine Creek Joint Planting	55+96 57+88	57+06 60+07	320
Rootwads	60+07	72+55	1,248
Coir Fabric	72+98	74+69	171

Note: Feeder stream locations are shown on record drawings in Attachment B.

Table 14.2 BRSA 9 Imported Materials

Material	Quantity (tons)	Use
Class II Fill Sand	10,716.49	Access roads, staging, stabilization pad, sand bags, Pine Creek work pad, stream tube access road
21AA Natural Crush Stone	5,616.31	Access roads, staging, stabilization pad, Pine Creek stream tube excavation, road maintenance
Common Fill	952.52	Restoration
Topsoil	2,069.69	Stabilization pad, joint planting, staging area cover
1x3 Riprap	346.30	Restoration
MDOT Heavy Riprap	150.65	Joint Planting
4x8 Riprap	623.78	Restoration
MDOT Plain Riprap	619.96	Restoration
1x3 Limestone	11 cyd	Temporary culvert armor

Note: Some materials (such as rootwads, footer logs, and anchor stones) were not tracked by unit, but by linear feet of restoration.

14.3 Deviations from Technical Memorandum

The following is a list of the USEPA-approved changes made following submittal of the design presented in the BRSAs 4, 5, 6, and 9 TM:

- Results of confirmation samples collected at the design depths from bank grids 3, 5, 6, and 9 and sediment grids 34, 36, 43, and 44 exceeded their respective RALs. Additional material was excavated from these grids and confirmation sampling was repeated. The results of the subsequent confirmation samples indicated PCB concentrations below the RALs. Refer to record drawings for final grid excavation depths.
- Sub-surface sample results from bank grids 3, 5, 6, and 9 exceeded the on-Site reuse criterion. Additional excavation was completed and sub-surface samples were re-collected. Results of the second sub-surface samples indicated PCB concentrations of

less than 1 mg/kg and the material was therefore approved for reuse. Refer to the record drawings for final grid excavation depths.

- Sub-surface sample results from bank grids 33 and 34 exceeded the on-Site reuse criterion of 1 mg/kg PCBs (but were below the RAL of 5 mg/kg). The sub-surface material from these grids was therefore not approved for reuse, and was excavated to the restoration depth and disposed off-Site. The bank soil RAL was not exceeded; therefore, additional sub-surface samples were not collected. Refer to the record drawings for final grid excavation depths.
- Based on field observations, the bank at the west end of BRSA 9 required additional reinforcement in a portion of the coir face restoration area. Joint planting restoration was therefore extended upstream from RDB STA 76+25 to RDB STA 74+69.
- As described in Section 14.1, stream tube A3-SED-11 was extended east to (and including) grid 30 due to the presence of a depositional area outside the design boundary.
- A temporary sheet pile cofferdam was to be installed around the Pine Creek stream tubes; however, due to concerns about the structural stability of the Pine Creek WCS, and because the Pine Creek reservoir was dewatered prior to excavation, excavation was able to be completed with minimal river velocity and a non-permeable turbidity curtain was sufficient.
- Based on access limitations and engineering concerns over working too close to the Pine Creek WCS, grid 46 of Pine Creek stream tube A3-SED-10B was not removed.
- Per USEPA request on behalf of a private resident, trees were eliminated from the restoration in grids 18-24. Instead, shrubs were planted with increased density (approximately 5-foot on center).
- With MDNR approval, the access road was left in place, but the turnouts and staging areas were completely removed. Refer to the record drawings (Attachment B) for the location of access road left in place.

15.0 WATER CONTROL STRUCTURE

The former WCS, owned and installed by MDNR to relieve stress on the Otsego Township Dam, was removed as part of the TCRA. Drawdown and removal of the former WCS and restoration of the former WCS corridor were completed between January and June 2018. This section summarizes these activities and documents USEPA-approved changes from the design presented in the Water Control Structure Removal and Corridor Restoration plan, which is included as Attachment A of the PRSCP, located *here*.

15.1 WCS Removal

The former WCS superstructure spanned approximately 180 feet. Prior to its removal, water levels were drawn down in coordination with MDNR by removing stop logs (Photo 38 in Attachment A). Stop logs were removed from the WCS from October 12 through November 9, 2017, lowering water levels a maximum of 6 inches per day. After completion of the drawdown, the superstructure was removed in two approximately 90-foot sections: first the northern half followed by the southern half (which was removed in three approximately 30-foot sections) (Photo 52 in Attachment A).

A sheet pile cofferdam was installed extending out from the RDB upstream of the WCS to divert water and allow access to the RDB and northern portion of the WCS superstructure. While water was being diverted to the southern portion of the river, the northern bank was excavated to facilitate construction of the new channel bank, and approximately 90 feet of the WCS superstructure was removed. Removal of the WCS included selective demolition of the stop-log removal system (e.g., chain-fall and support beam) and walkways which were saved for re-use by the MDNR. Torch cuts were made on the steel cross-members between the vertical wide-flange piles to facilitate removal with a hydraulic vibratory hammer. After removal of the vertical piles, the sill plate was removed, and the steel cut-off wall sheet piling was extracted with the vibratory hammer. The former concrete core wall was removed to facilitate construction of the bank slope, and the existing WCS bank riprap was incorporated into the final joint planting restoration.

Following removal of the WCS superstructure, the area upstream of the former sill was excavated to an elevation of approximately 662 feet above mean sea level (amsl) to facilitate installation of an MDOT heavy riprap transition in the restored WCS corridor. During excavation of this transition, natural riverbed material was encountered consisting of approximately 8 to 12-inch diameter stone. Downstream of the WCS sill, the existing grouted 3- and 4-foot diameter riprap was broken with a hydraulic concrete breaker and left in place. Tracking of the excavator across the riprap also helped to break the grout and move boulders which created additional “roughness” in the restored WCS corridor (Photo 50 in Attachment A). An approximately 2 percent slope extending from the former location of the WCS sill downstream approximately 150 feet was constructed using imported riprap. During grading, surveys of the trailing edge of the WCS corridor were conducted and it was determined that there was not a significant scour pool. The trailing edge of the WCS corridor was armored with riprap and reused Site materials. A combination of spot elevations collected with the equipment-based GPS and bathymetric surveys completed by a third-party surveyor were used to verify the correct slope was achieved (see the WCS Record Drawings, included as Attachment B of the PRSCP, *here*).

Prior to removal of the southern half of the WCS, the riprap peninsula used to isolate the plunge pool during construction of the pilot channel was removed and saved for reuse. The peninsula between the former auxiliary spillway and WCS was also lowered to an elevation of approximately 672 feet amsl to facilitate removal and restoration of the WCS corridor. The southern half of the WCS was to be removed in a similar manner; however, a temporary cofferdam was installed from the center of the channel toward the bank due to limited crane access/reach from the south (Photo 51 in Attachment A). Sheeting was left in place from the northern temporary cofferdam and extended to the south. As the sheeting approached the LDB, a scour pool developed. The scour pool was filled with riprap and removal of the southern half of the WCS was modified to occur in three approximately 30-foot sections. This modification allowed for a larger portion of the river to remain open, helping to mitigate higher velocity and shear stress on the banks and along the temporary sheet pile cofferdam. Demolition of the WCS, removal of the core wall, installation of the leading-edge transition, breaking up the grouted riprap, construction of the 2 percent slope and trailing edge armoring was completed similar to the northern portion described above. Refer to the construction sequencing figures, *here*, for further details.

The former auxiliary spillway, located upstream of the plunge pool, was demolished under separate contract by the MDNR.

15.2 WCS Corridor Restoration

Joint planting was installed along both banks of the former WCS corridor, and included reuse of existing WCS material. A 20-foot wide low-flow bench was constructed with riprap along the LDB as described in the PRSCP. The north side of the WCS corridor, upslope of the joint planting restoration, was restored using erosion blankets and planted with an upland seed mix. A boat access ramp was constructed to facilitate access to the river for M&M activities. The entire peninsula on the south side of the WCS corridor was regraded to an upstream elevation of 672 feet amsl and a downstream elevation of 666 feet amsl to provide connection with the former auxiliary spillway area and to reduce velocities associated with higher flow events (Photo 53, Attachment A). Excess material from removal of the peninsula was used to establish proper grades and restoration upstream of the former auxiliary spillway. The peninsula was restored with top soil, seed, core fabric and live stakes (Photos 42 and 54 in Attachment A). Restoration techniques used in the WCS corridor are shown on *Figure 13-2*. A final as-built survey was completed following remediation. The as-built survey is presented on the WCS Records Drawings, which is included as Attachment B of the PRSCP (*here*). Photo 55 in Attachment A shows the WCS corridor prior to removal of the WCS, and Photo 56 shows the WCS corridor after removal and restoration

15.3 Deviations from Technical Design

The following is a list of the USEPA-approved changes made following submittal of the design presented in the WCS Removal and Corridor Restoration Plan:

- The northern one-third of the WCS structure was to be removed, followed by the southern two-thirds; however, this was changed to the northern and southern halves as a crane pad was constructed to improve access from the north and to limit sheer stress/velocities from a potential high flow event with only one-third of the river open.
- Removal of the southern half of the WCS was modified as described in Section 15.1.
- The low flow bench was extended upstream to tie into the existing bank. Refer to the WCS record drawings (Attachment B of the PRSCP) for details.
- The sand barrier installed downstream of the peninsula to isolate the plunge pool during pilot channel dredging was removed and the rip rap was re-used for construction of the low flow bench and final plunge pool restoration. Refer to the record drawings (Attachment B) for details.

16.0 PERMITTING

In accordance with CERCLA Section 121(e), permits are not required for "on-site" CERCLA response actions. However, the TCRA complied with the substantive requirements of regulations that would otherwise require permits. This section documents the compliance with the substantive requirements of these regulations during implementation of the TCRA.

16.1 EGLE

National Pollutant Discharge Elimination System (NPDES) Permit
A NPDES permit application was submitted through the MDEQ (now EGLE) Water Resources Division information system, MiWaters. The EGLE issued a SRD on August 29, 2016, for the discharge of treated water to the Kalamazoo River (refer to Section 4.3). A request to modify the SRD was submitted on December 6, 2016 and the revised SRD was issued on May 1, 2017. The modification request was to allow discharge at multiple locations along the Kalamazoo River using mobile, trailer-mounted treatment systems. The SRD is included as Attachment 1 of the Water Treatment Plan, which can be found *here*.

As discussed in Section 4.3, one non-compliance event occurred on October 25, 2017 (refer to the excursion notice *here*). No other non-compliance events occurred. A request for termination of the SRD was submitted on July 16, 2018. The termination letter, located *here*, was issued on September 17, 2018.

Aquatic Nuisance Control (ANC) Permit
As mentioned in Section 5.14, Cardno was contracted to assist with invasive plant control. The EGLE issued ANC permits to Cardno to permit spraying herbicides near water. The ANC permits can be found *here*.

16.2 MDNR

Land Use Permits
At MDNR's request, Land Use permits were obtained for the following activities: tree-clearing, off-site live stake and rootwad harvesting, construction of access roads and staging areas (including the Command Center), excavation/restoration (including irrigation and maintenance), removal of the former WCS, pilot channel dredging/spoils management, plunge pool restoration, and access for maintenance and monitoring. The Land Use permits can be found *here*.

Scientific Collector's Permits
At MDNR's request, ESI obtained Scientific Collector's permits from the MDNR prior to relocating mussels (refer to Section 5.4). The Scientific Collector's permits are included as Attachment A to the 2016 and 2017 Mussel Relocation reports prepared by ESI (located *here* and *here*, respectively).

Threatened and Endangered Species Permit
Prior to relocating mussels and at MDNR's request, ESI obtained a Threatened and Endangered Species Permit from the MDNR, which can be found *here*.

Land Use Order
To facilitate removal activities, MDNR issued a Land Use Order to allow for closure of the TCRA area. The Land Use Order was issued on September 8, 2016, and can be found *here*.

16.3 MDOT

MDOT permits were obtained for use of traffic warning signs on state roads at the BRSA 3, 4, 6 and Command Center entrances, and for BRSA 3 and 4 work at the M-89 Bridge. In some cases, advance notices of approval were provided by MDOT prior to issuance of the construction permits. Work did not begin until both advance notices and individual construction permits were obtained. MDOT permits are provided *here*.

16.4 Allegan County Road Commission

Permits for use of traffic warning signs on county roads (i.e., at the BRSA 8 entrance on River Road, BRSA 9 entrance, and the BRSA 3 temporary worker parking area on Jefferson Road) were obtained from the Allegan County Road Commission. Driveway permits for BRSAs 1, 4, 6, 8 (Plunge Pool), and 9 were also obtained. Allegan County Road Commission permits are located *here*.

16.5 Allegan County Health Department

Allegan County requires an SESC permit for sites with earth change greater than one acre and within 500 feet of a body of water. SESC permit applications were submitted to the Allegan County Health Department in 2016 and 2017. The SESC permits are provided *here*.

16.6 USFWS

A Native Endangered and Threatened Species Recovery permit was issued to ESI by the USFWS for relocation of mussels. The permit can be found *here*. As mentioned in Section 5.4, the USFWS provided a “Not Likely to Adversely Affect” letter (located *here*) regarding the project approach to addressing potential bat habitat areas.

16.7 Joint Permit Application

A Joint Permit Application for Work in Inland Lakes and Streams, Great Lakes, Wetlands, Floodplains, Dams, High Risk Erosion Areas and Critical Dune Areas was completed for EGLE and U.S. Army Corps of Engineers. TCRA activities were completed in accordance with the permit. The Joint Permit Application can be found *here*.

17.0 COMMUNITY RELATIONS

The USEPA, START, MDNR, and EGLE led community relations efforts, with support from other regulatory agencies and the Parties as needed. At various points throughout the project, the USEPA and/or MDNR hosted Site tours, held community meetings, and distributed fact sheets and flyers. Dates and topics of flyers that were distributed can be found *here*. Three fact sheets were made available throughout the TCRA, which can be found *here*. A list of meetings and Site tours can be found *here*. In addition, USEPA and MDNR held joint and separate press events and provided site tours to keep local press outlets apprised of progress and to be responsive to press inquiries.

18.0 SUMMARY OF COSTS

This section summarizes costs incurred during implementation of the TCRA. Table 18.1 summarizes Wood's project design, construction management, oversight, and engineering costs. Table 18.2 presents Envirocon's costs by BRSA as well as former WCS removal and restoration costs, and Pilot Channel dredging. Table 18.3 presents the total project cost.

Table 18.1 Wood Project Cost Summary

Item	Cost
Design	$2,563,654
Construction Management/Oversight, Project Engineering	$3,533,440
Wood Subtotal	**$6,097,094**

Table 18.2 Envirocon Project Cost Summary

Item	Cost
BRSA 1	$3,205,340
BRSA 3	$2,002,124
BRSA 4	$3,360,268
BRSA 6	$3,725,873
BRSA 7	$4,572,175
BRSA 8*	$3,391,581
BRSA 9	$3,074,809
WCS Removal/Restoration	$1,224,326
Pilot Channel Installation	$1,297,940
Envirocon Subtotal	**$25,854,435**

*BRSA 8 costs include restoration of the plunge pool

Table 18.3 Total Project Cost Summary

Item	Cost
Wood Subtotal	$6,097,094
Envirocon Subtotal	$25,854,435
Project Total*	**$31,951,529**

*USEPA Oversight Costs are not included in Project Total

19.0 REFERENCES

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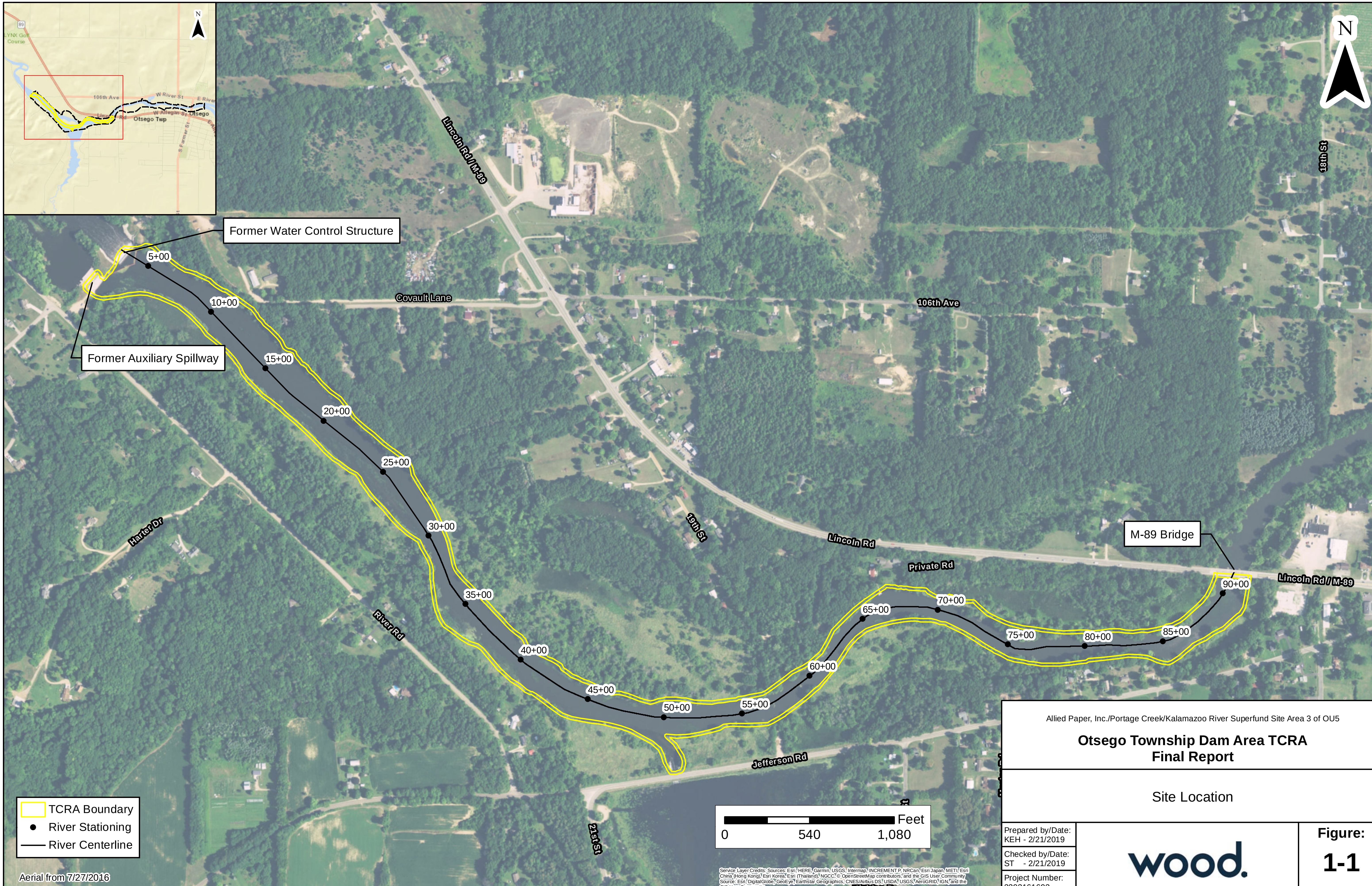
Table 19.1 Linked Documents

Section	Document Name	Additional Links to Document
1.0	UAO	2.1
	Figure 1-1	-
1.1	USEPA Action Memo	-
	Figure 1-2	7.0, 10.0
	Draft Removal Work Plan	2.2, 4.1
2.1	Subcontractor List	-
2.2	HASP	-
	QAPP	-
	Draft SESC Plan	3.2
	Draft Site Security Plan	-
	Draft Traffic Control Plan	-
	Draft Soil, Waste, and Debris Management Plan	5.11
	Draft Water Treatment Plan	4.3, 5.12, 16.1
	Draft Contingency Plan	-
	Draft Invasive Plant Management Plan	5.14
	Draft Data Management Plan	-
	Draft Quality Management Plan	-
	Draft Field Sampling Plan	4.1, 4.2, 12.4
	Draft Post-Removal Site Control Plan	5.14, 5.15, 15.0, 15.1, 15.2, 15.3
3.1	Environmental Monitoring Figures	3.2

Section	Document Name	Additional Links to Document
4.2	Blank Excavation Grid Checklist	-
4.3	Excursion Notice	16.1
5.0	Draft BRSA 1 TM	5.8, 6.0
	Draft BRSA 2 and 3 TM	7.0, 8.0, 8.2
5.1	Trespasser Procedure	-
	Closure Order – MDNR Land Use Permit	16.2
5.4	USFWS Bat Letter	16.6
	Kalamazoo River Mussel Relocation 2016	16.2
	Kalamazoo River Mussel Relocation 2017	16.2
5.6	MDOT Right-of-Way Permit	16.3
	M-89 Pre-Construction Inspection Report	-
	M-89 Post-Construction Inspection Report	-
	Pine Creek WCS Pre- and Post-Construction Report	14.1
5.11	TSCA Waste Tracking Table	-
5.15	Completed BRSA Inspection Checklists	-
	Figure 5-1a-c	-
6.0	Figure 6-1	-
6.1	BRSA 1 Confirmation Sample Tracking Table	-
	BRSA 1 WTP Sample Results	-
	BRSA 1 Non-TSCA Waste Tracking	-
8.0	Figure 8-1	-
8.1	BRSA 3 Confirmation Sample Tracking Table	-
	BRSA 3 WTP Sample Results	-
	BRSA 3 Non-TSCA Waste Tracking	-
9.0	Figure 9-1	-
	Draft BRSAs 4, 5, 6, and 9 TM	10.0, 11.0, 14.0
9.1	BRSA 4 Confirmation Sample Tracking Table	9.3
	BRSA 4 WTP Sample Results	-
	BRSA 4 Non-TSCA Waste Tracking	-
11.0	Figure 11-1	11.1
11.1	BRSA 6 Confirmation Sample Tracking Table	-
	BRSA 6 WTP Sample Results	-
	BRSA 6 Non-TSCA Waste Tracking	-
12.0	Figure 12-1	12.2
	Draft BRSAs 7 and 8 TM	12.2, 12.4, 13.0
12.2	BRSA 7 Alt. Sample Tracking Table	-
	BRSA 7 Confirmation Sample Tracking Table	-
	BRSA 7 WTP Sample Results	-
	BRSA 7 Non-TSCA Waste Tracking	-
12.4	Liquid Waste Tracking Sheet	-

Section	Document Name	Additional Links to Document
13.0	Figure 13-1	-
13.1	BRSA 8 Confirmation Sample Tracking Table	-
	BRSA 8 WTP Sample Results	-
	BRSA 8 Non-TSCA Waste Tracking	-
13.2.1	Figure 13-2	13.3, 15.2
14.0	Figure 14-1	-
14.1	Pine Creek WCS Drawdown SOW	-
	BRSA 9 Confirmation Sample Tracking Table	-
	BRSA 9 WTP Sample Results	-
	BRSA 9 Non-TSCA Waste Tracking	-
15.1	WCS South Side Sequencing Figures	-
16.1	MDEQ SRD Termination Letter	-
	MDEQ Aquatic Nuisance Control Permit	-
16.2	MDNR Land Use Permits	-
	MDNR Endangered Species Permit	-
16.3	MDOT Permits	-
16.4	Allegan County Road Commission Permits	-
16.5	SESC Permits	-
16.6	USFWS Permit	-
16.7	Joint Permit Application	-
17.0	Dates/Topics of Community Relations Flyers	-
	Fact Sheets	-
	List of Meetings/Site Tours	-

FIGURES



Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 of OU5

Otsego Township Dam Area TCRA
Final Report

Site Location

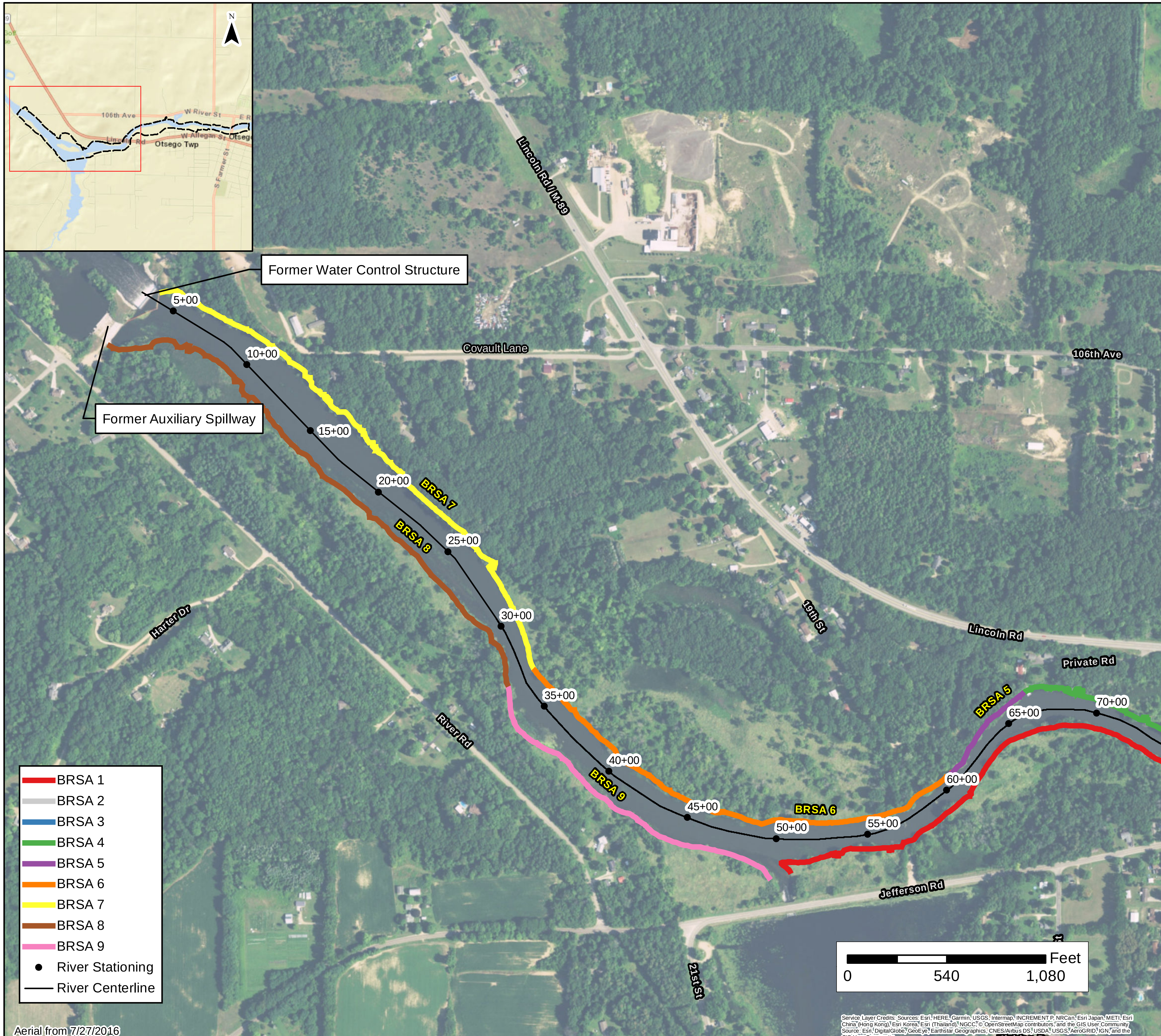
Prepared by/Date: KEH - 2/21/2019

Checked by/Date: ST - 2/21/2019

Project Number: 3293161693

wood.

Figure: 1-1



Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 of OU5

Otsego Township Dam Area TCRA
Final Report

Bank Removal/Stabilization Areas (BRSAs)

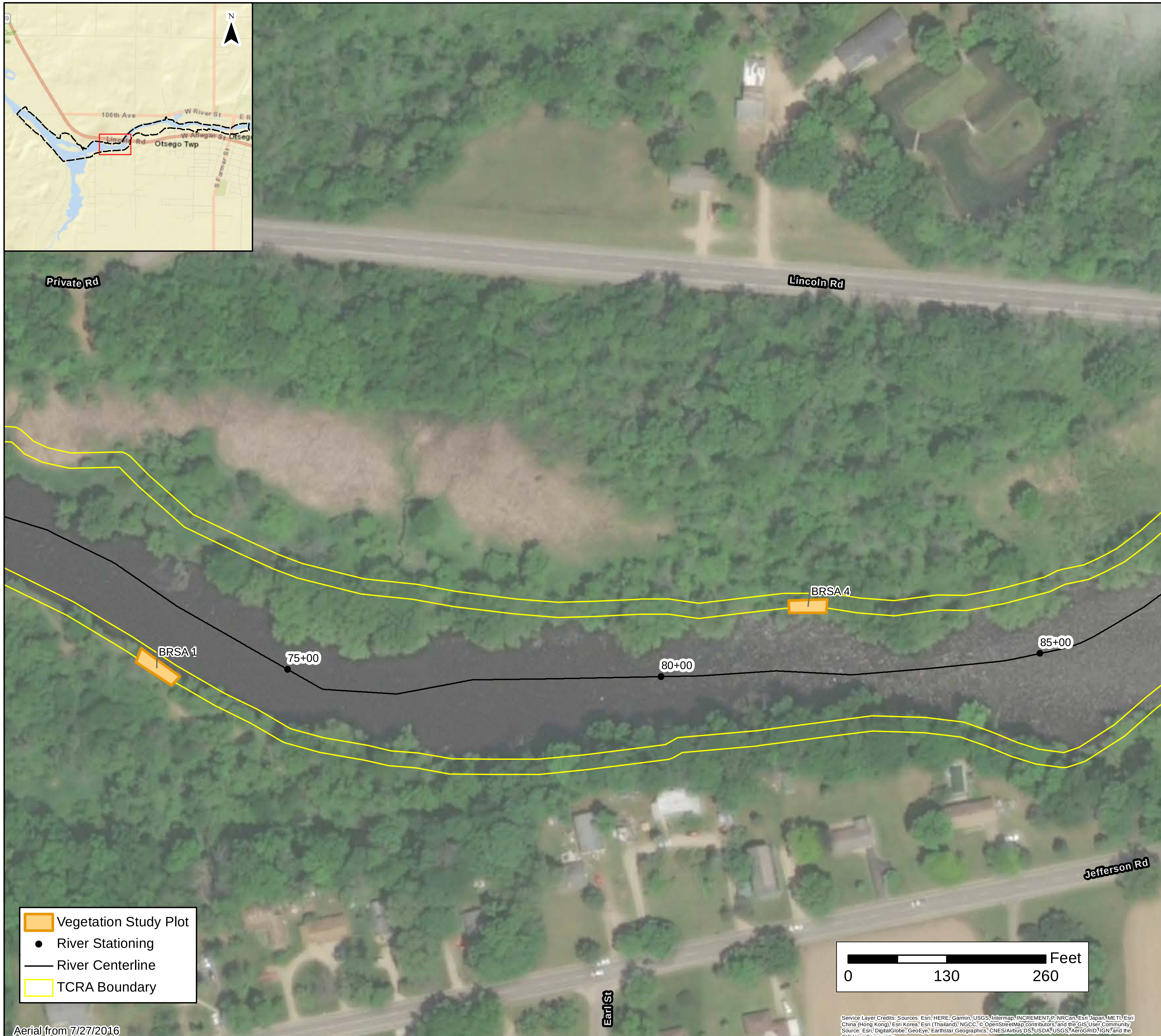
Prepared by/Date: KEH - 2/21/2019

Checked by/Date: ST - 2/21/2019

Project Number: 3293161693

wood.

Figure: **1-2**

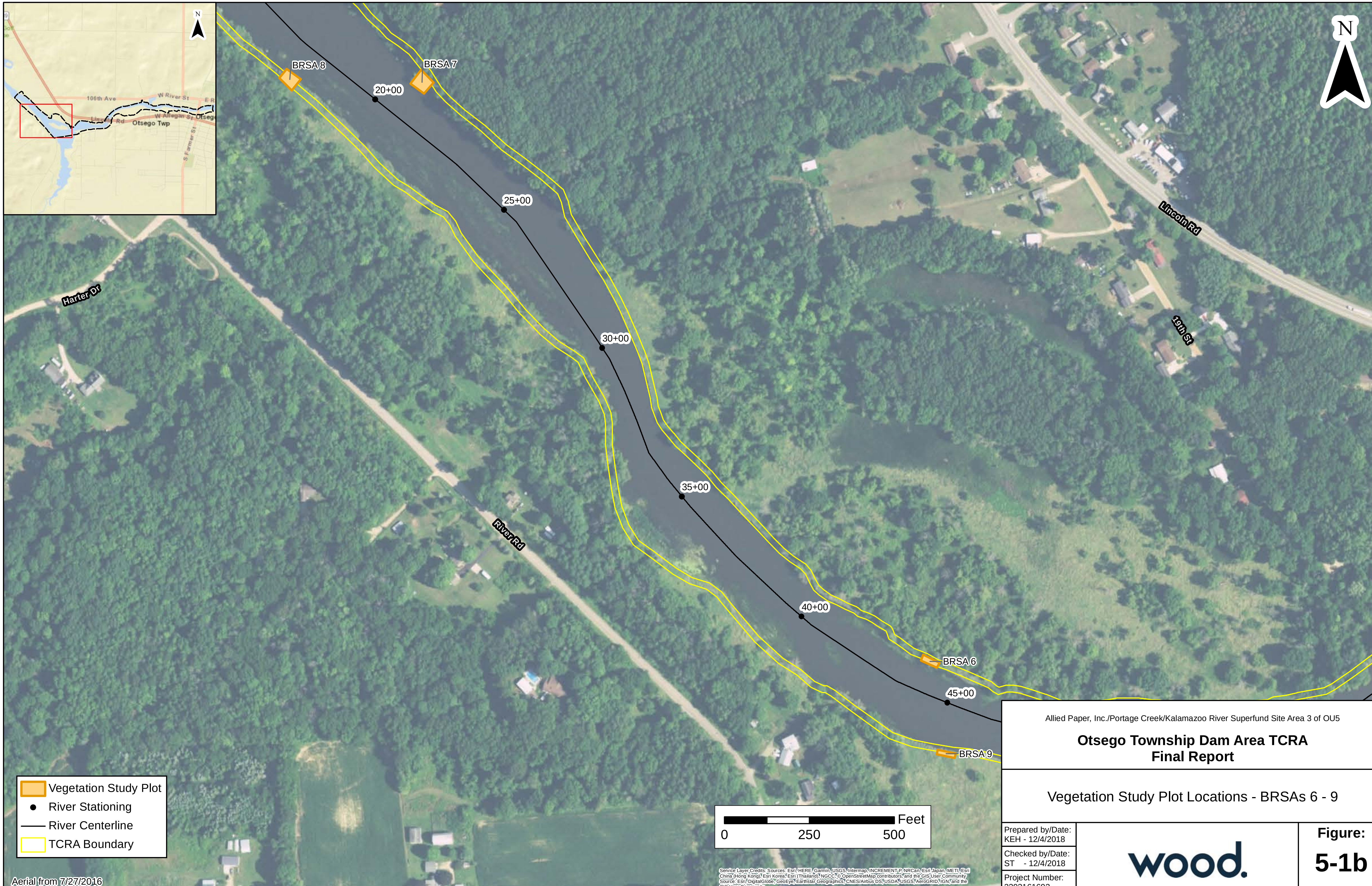


Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 of OU5

Otsego Township Dam Area TCRA
Final Report

Vegetation Study Plot Locations - BRSAs 1 - 4

Prepared by/Date: KEH - 12/4/2018	wood.	Figure: 5-1a
Checked by/Date: ST - 12/4/2018		
Project Number: 3293161693		



Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 of OU5

Otsego Township Dam Area TCRA
Final Report

Vegetation Study Plot Locations - BRSAs 6 - 9

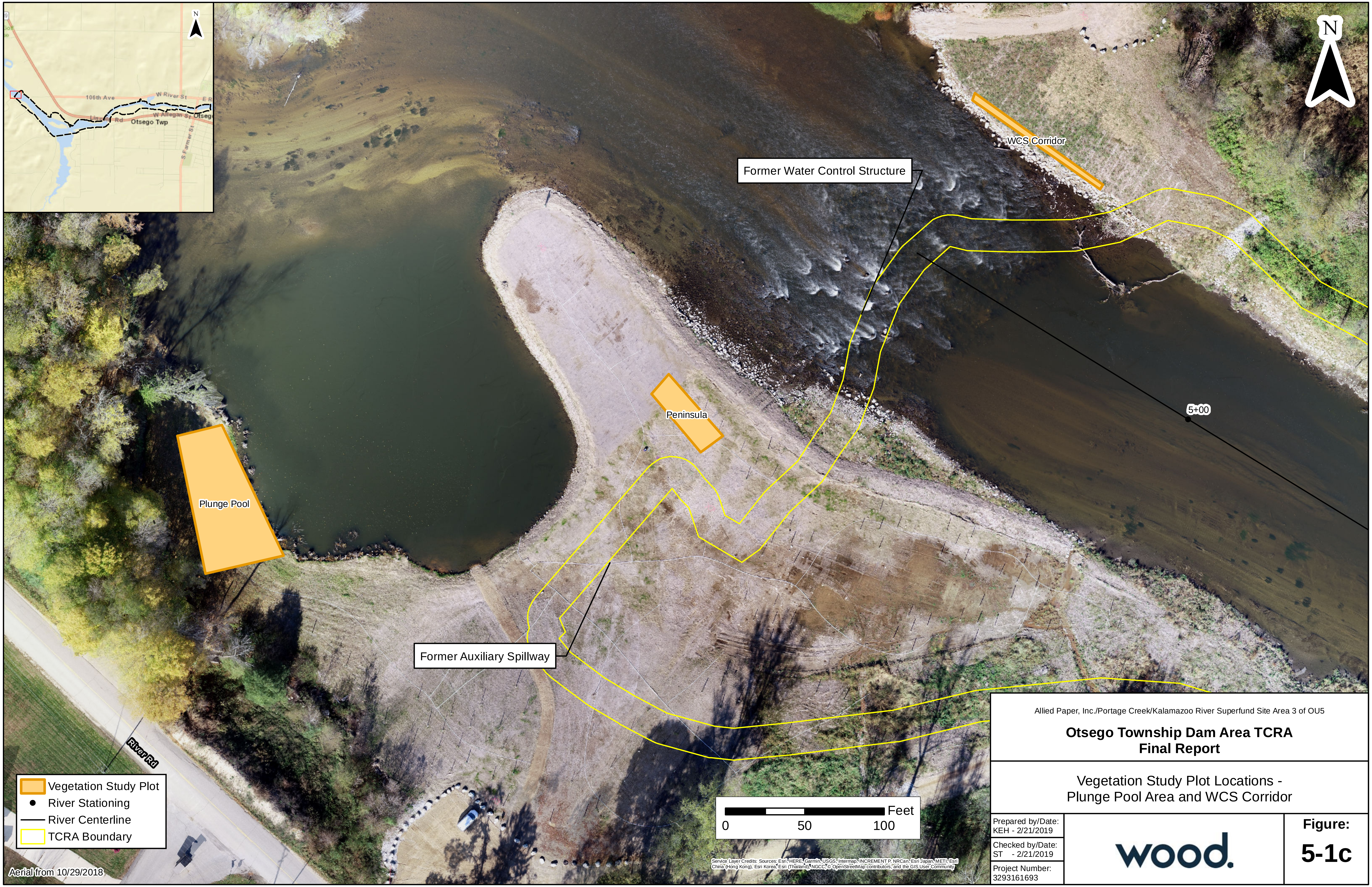
Prepared by/Date: KEH - 12/4/2018

Checked by/Date: ST - 12/4/2018

Project Number: 3293161693

wood.

Figure: 5-1b



Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 of OU5

Otsego Township Dam Area TCRA Final Report

Vegetation Study Plot Locations - Plunge Pool Area and WCS Corridor

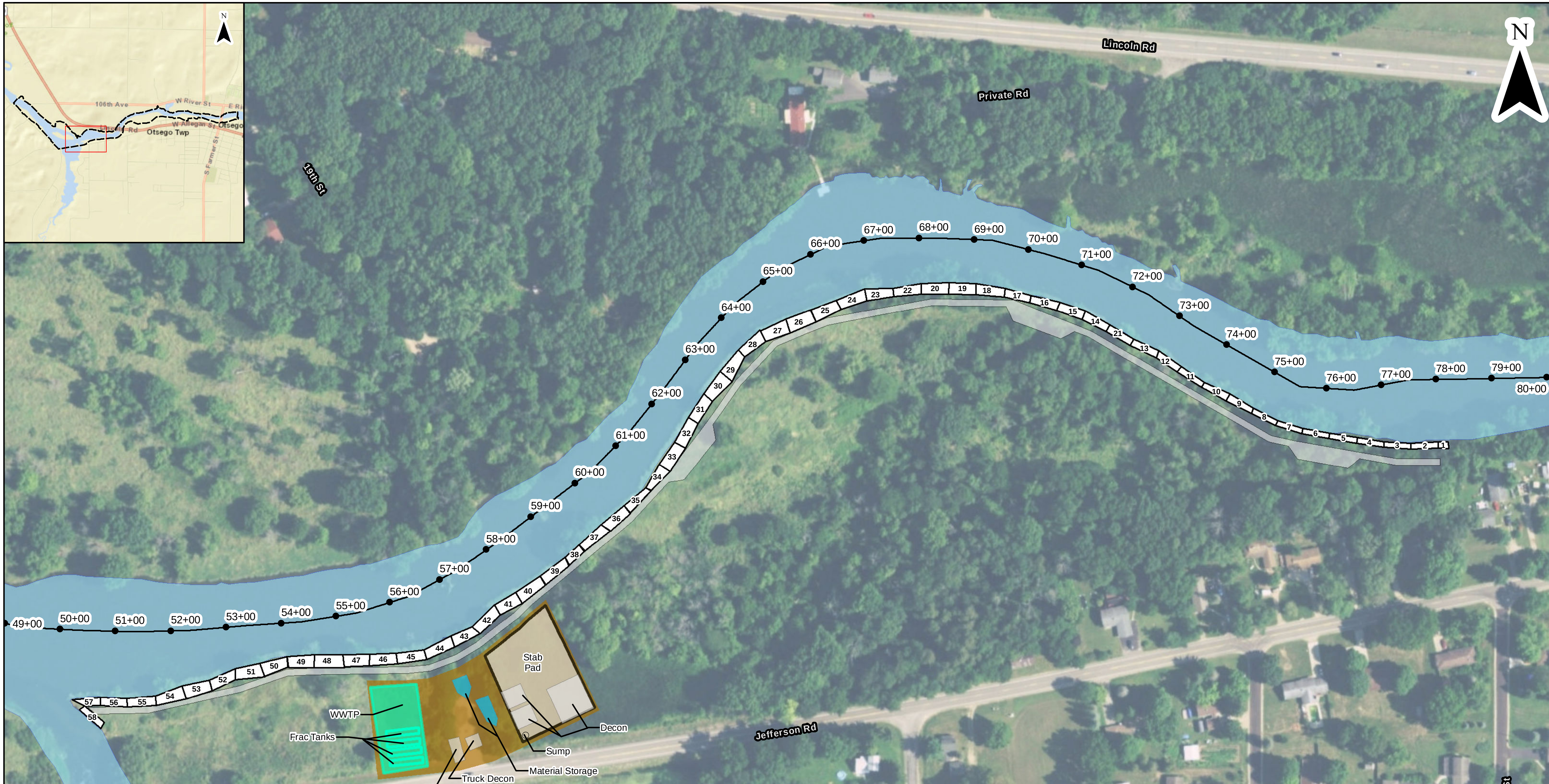
Prepared by/Date: KEH - 2/21/2019

Checked by/Date: ST - 2/21/2019

Project Number: 3293161693

wood.

Figure: 5-1c



Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 of OU5

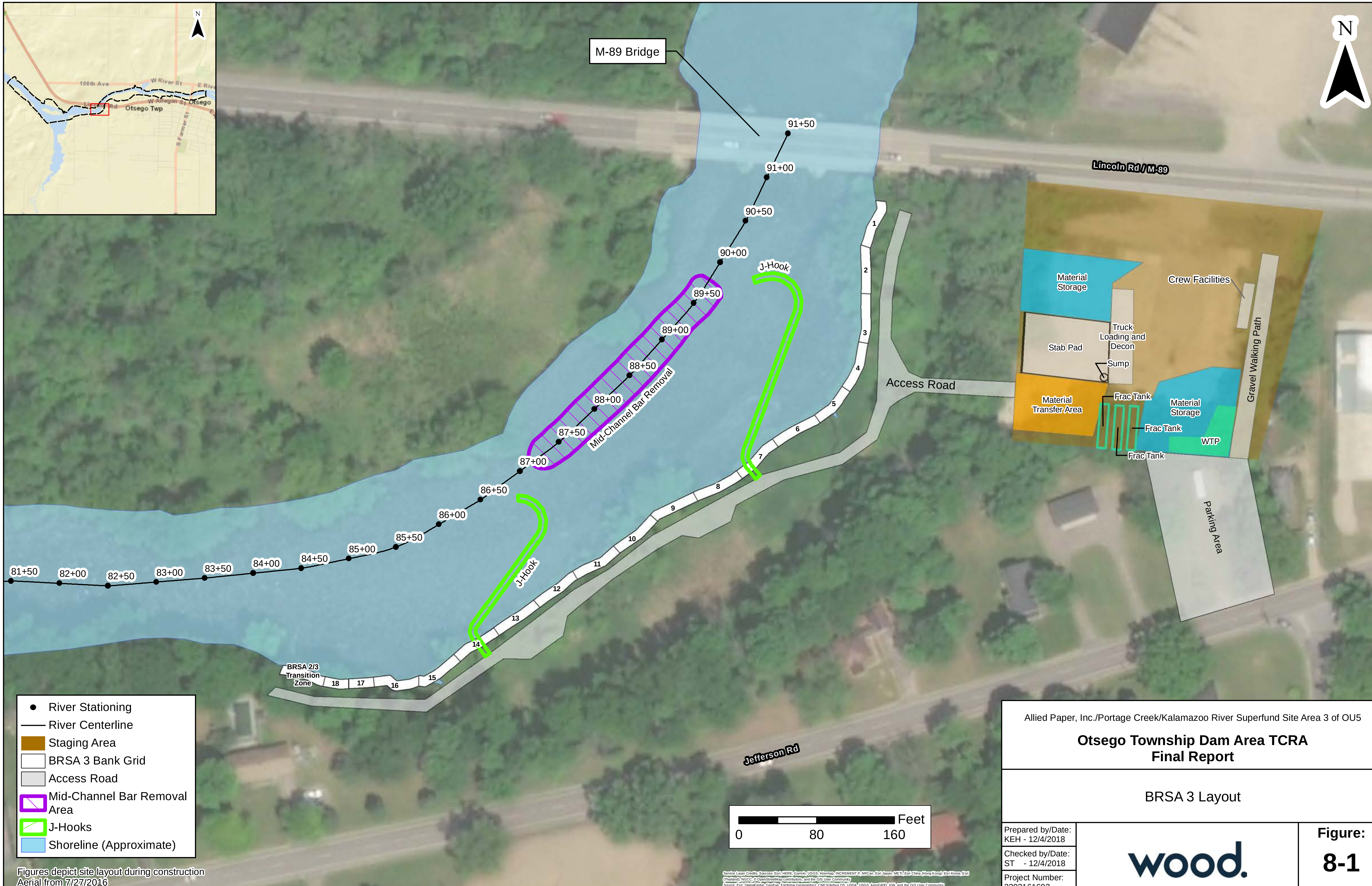
Otsego Township Dam Area TCRA
Final Report

BRSA 1 Layout

Prepared by/Date: KEH - 11/28/2018
Checked by/Date: ST - 11/28/2018
Project Number: 3293161693

wood.

Figure: 6-1



Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 of OU5

Otsego Township Dam Area TCRA
Final Report

BRSA 3 Layout

Prepared by/Date: KEH - 12/4/2018
Checked by/Date: ST - 12/4/2018
Project Number: 3293161693

wood.

Figure: 8-1

DRAFT

Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 of OU5

Otsego Township Dam Area TCRA
Final Report

BRSA 4 Layout

Prepared by/Date: KEH - 6/4/2019
Checked by/Date: ST - 6/4/2019
Project Number: 3293161693

wood.

Figure: 9-1

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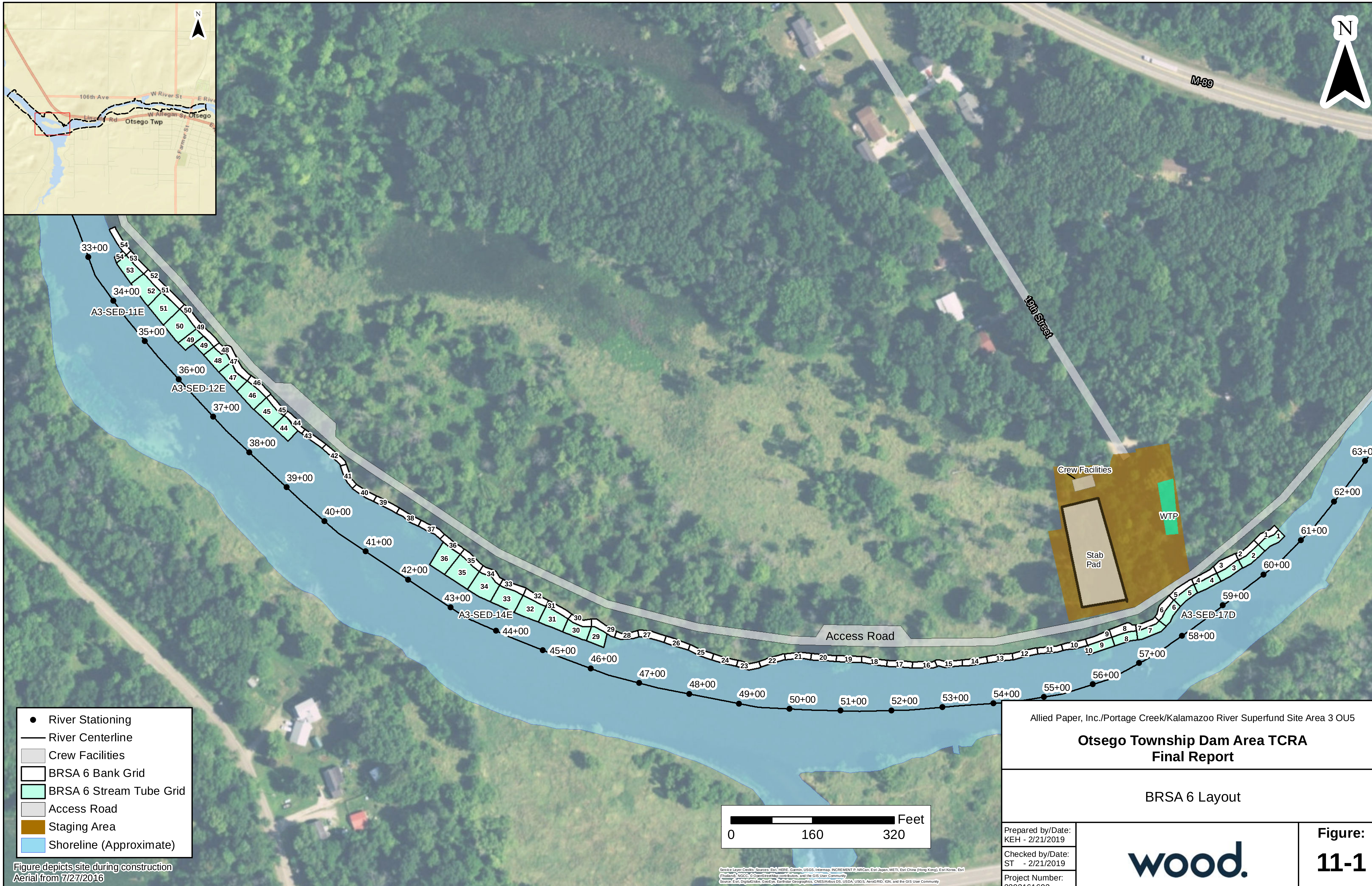


Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 OU5

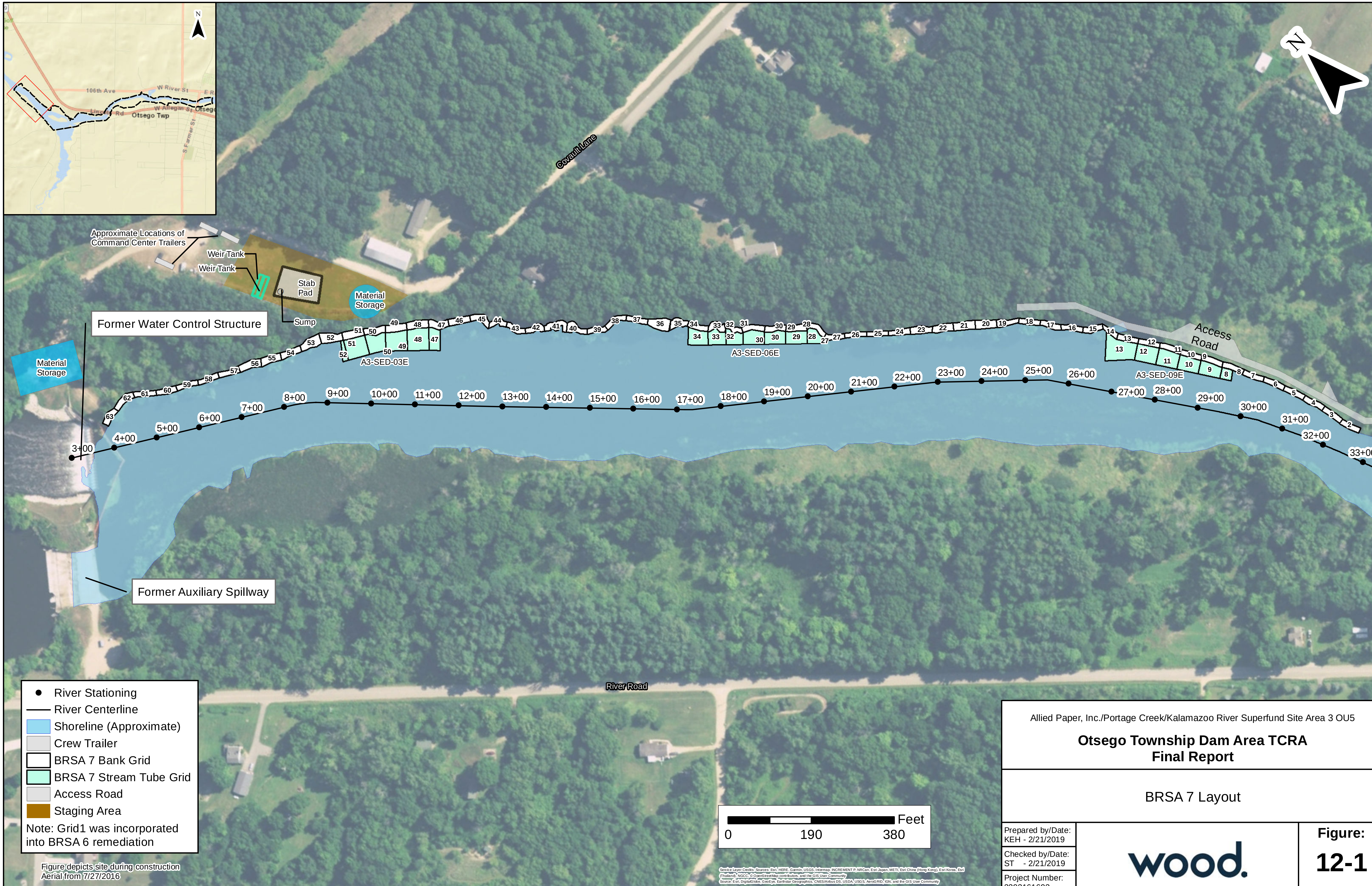
Otsego Township Dam Area TCRA
Final Report

BRSA 6 Layout

Prepared by/Date: KEH - 2/21/2019
Checked by/Date: ST - 2/21/2019
Project Number: 3293161693

wood.

Figure: **11-1**



Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 OU5

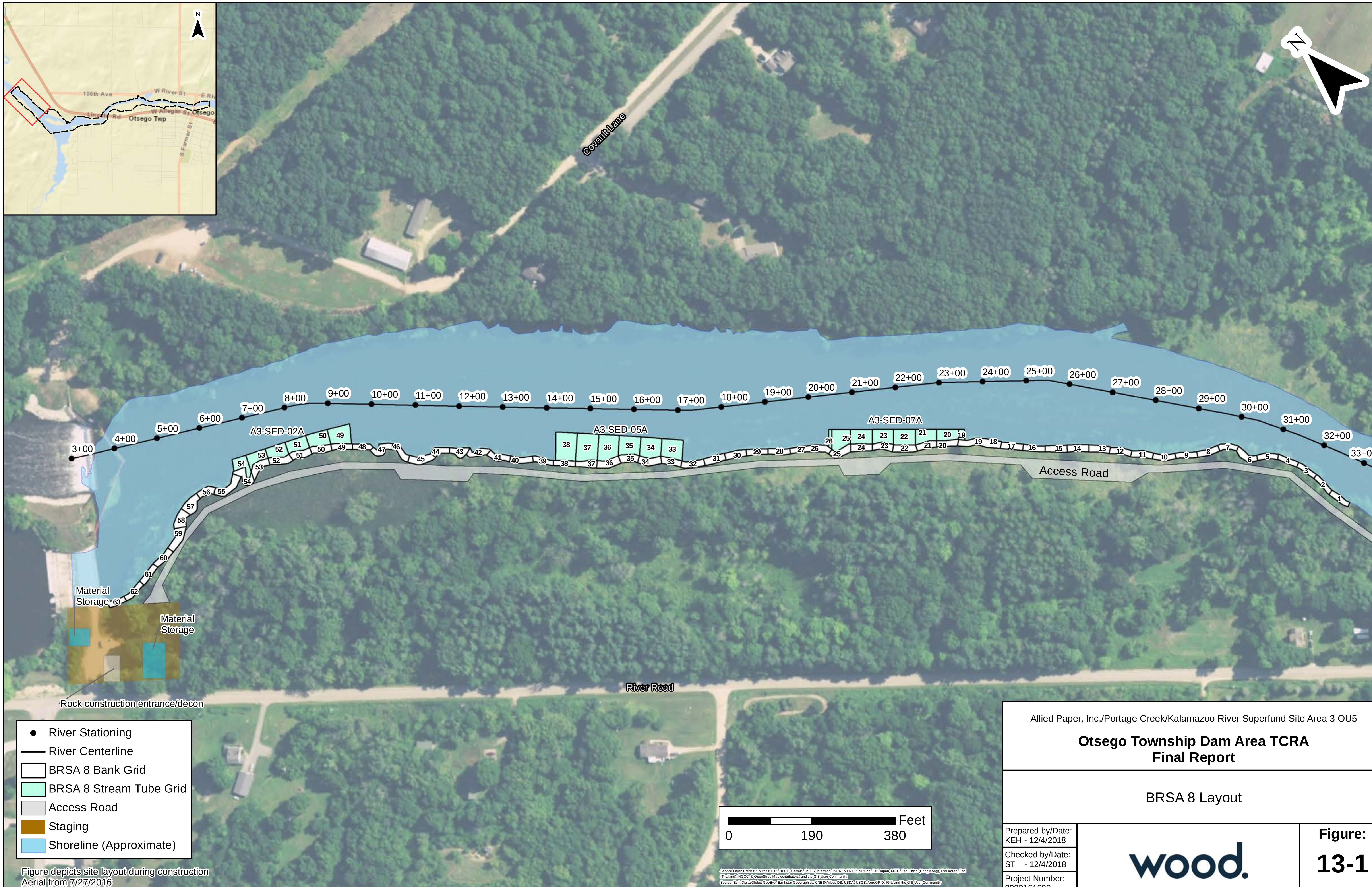
Otsego Township Dam Area TCRA
Final Report

BRSA 7 Layout

Prepared by/Date: KEH - 2/21/2019
Checked by/Date: ST - 2/21/2019
Project Number: 3293161693

wood.

Figure: **12-1**



Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 OU5

Otsego Township Dam Area TCRA
Final Report

BRSA 8 Layout

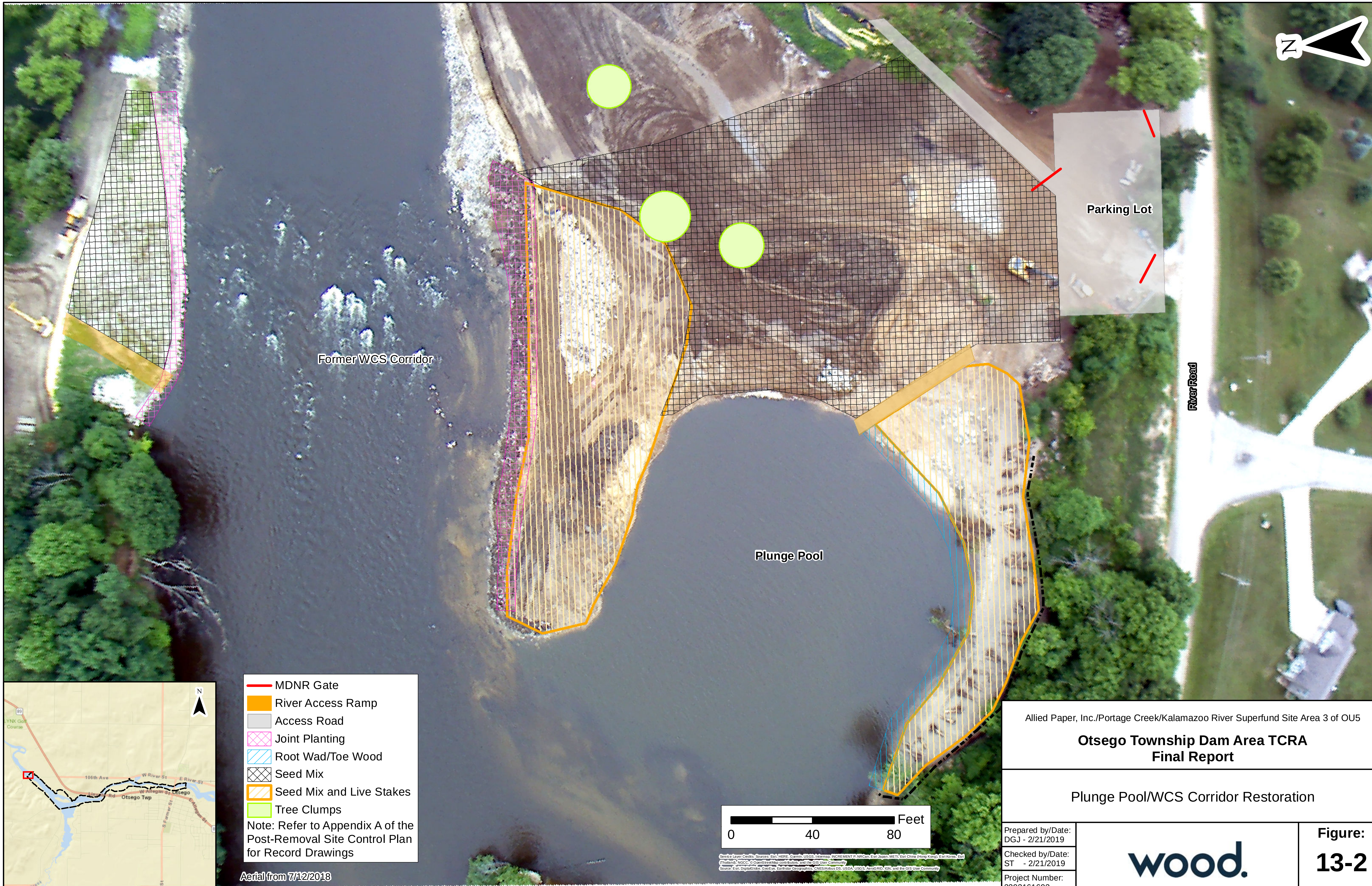
Prepared by/Date: KEH - 12/4/2018

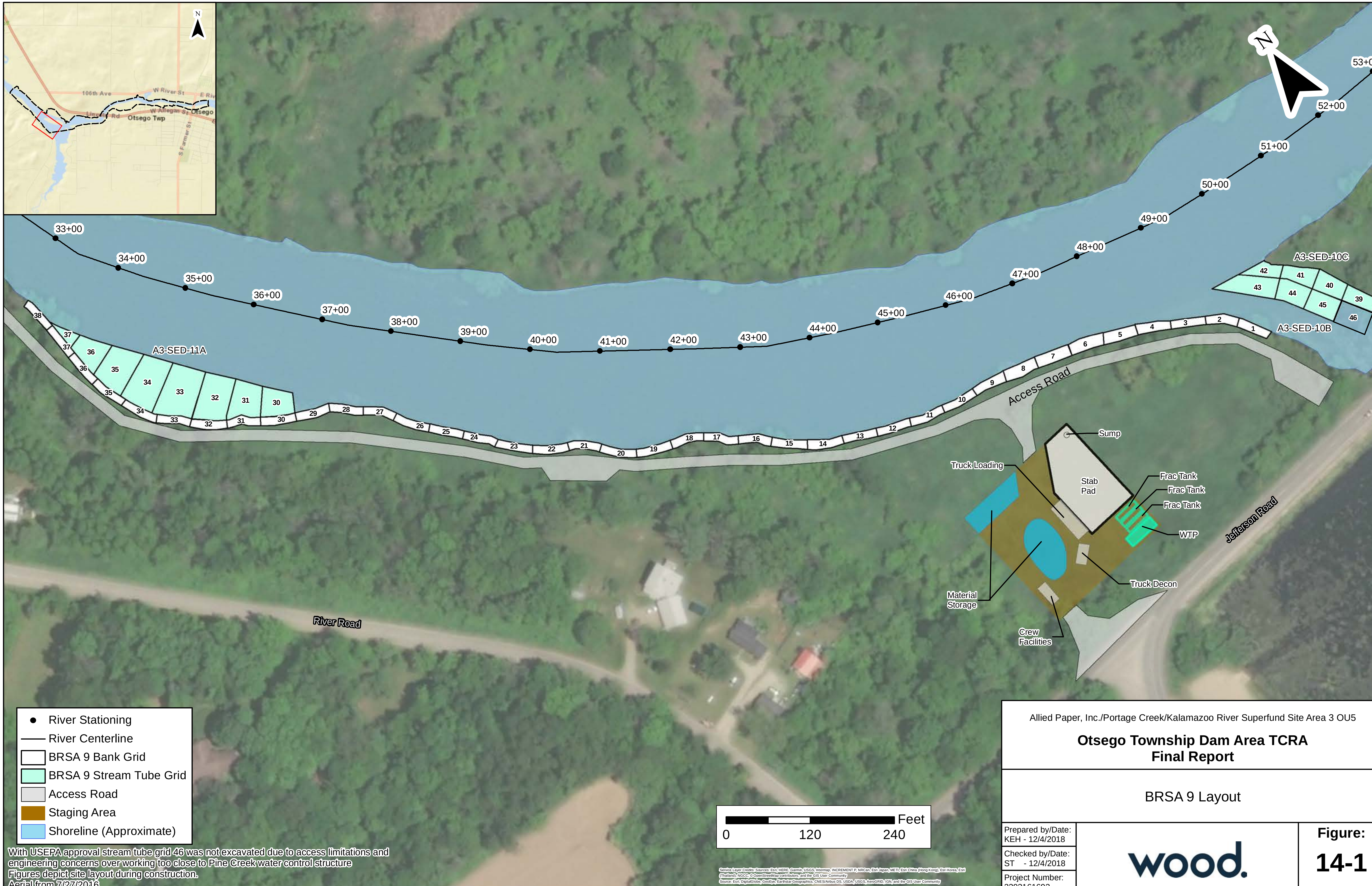
Checked by/Date: ST - 12/4/2018

Project Number: 3293161693

wood.

Figure: 13-1


Parking Lot
Former WCS Corridor
Plunge Pool
River Road
N
MDNR Gate
River Access Ramp
Access Road
Joint Planting
Root Wad/Toe Wood
Seed Mix
Seed Mix and Live Stakes
Tree Clumps
Note: Refer to Appendix A of the Post-Removal Site Control Plan for Record Drawings
Feet
0 40 80
Aerial from 7/12/2018
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 of OU5
Otsego Township Dam Area TCRA
Final Report
Plunge Pool/WCS Corridor Restoration
Prepared by/Date: DGJ - 2/21/2019
Checked by/Date: ST - 2/21/2019
Project Number: 3293161693
wood.
Figure:
13-2



Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site Area 3 OU5

Otsego Township Dam Area TCRA
Final Report

BRSA 9 Layout

Prepared by/Date: KEH - 12/4/2018

Checked by/Date: ST - 12/4/2018

Project Number: 3293161693

wood.

Figure: 14-1

ATTACHMENT A

Photo Log

Photo 1: Air monitor set up outside perimeter of work area (July 2017).

Photo 2: Turbidity monitor set up downstream of work area (2016).

Photo 3: Geotechnical boring (November 2016).

Photo 4: Collecting post-excavation confirmation sample (May 2017)

Photo 5: BRSA 1 Water Treatment Plant (September 2016).

Photo 6: Closure signs at BRSA 1 entrance (August 2016).

Photo 7: River closed sign posted upstream of M-89 Bridge (August 2016).

Photo 8: Mussels collected for relocation outside of TCRA Area (June 2017).

Photo 9: Study plot established to monitor vegetative success (BRSA 1, May 2019).

Photo 10: Installation of sandbag cofferdam (BRSA 1, September 2016).

Photo 11: Loading truck with material for transport to landfill (BRSA 1, October 2016).

Photo 12: TSCA roll-off setup (BRSA 1, October 2016).

Photo 13: Coir fabric installed over root wads (BRSA 1, October 2016).

Photo 14: Tree/shrub plantings (BRSA 1, November 2016).

Photo 15: Construction of BRSA 3 stabilization/loadout pad (March 2017).

Photo 16: BRSA 3 Water Treatment Plant (April 2017).

Photo 17: BRSA 3 riprap cofferdam (April 2017).

Photo 18: Installation of BRSA 3 J-hook (June 2017).

Photo 19: BRSA 3 J-hook (June 2017).

Photo 20: Aerial view of J-hooks installed on BRSA 3 bank (October 2017).

Photo 21: Feeder stream restoration (BRSA 3, June 2017).

Photo 22: Installing sheet pile cofferdam at stream tube 22C (BRSA 4, May 2017).

Photo 23: Aerial view of BRSA 4 sheet pile cofferdam (June 2017).

Photo 24: Reinforced turbidity curtain at stream tube 17D (BRSA 4, August 2017).

Photo 25: Restored BRSA 4 staging area (September 2017).

Photo 26: Restoration of steep slope at downstream end of BRSA 4 (October 2017).

Photo 27: Culvert installed beneath BRSA 6 access road for feeder stream flow (February 2017).

Photo 28: BRSA 6 root wad restoration (September 2017).

Photo 29: Restoration of BRSA 6 floodplain discharge area near RDB STA 65+50 to 66+53 (October 2017).

Photo 30: Restoration planting in BRSA 6 grids 1 through 4 (December 2017).

Photo 31: Turbidity controls installed downstream of former WCS and plunge pool during pilot channel dredging (September 2017).

Photo 32: Pilot channel dredge (September 2017).

Photo 33: BRSA 7 stream tube Grid 8 excavation inside sheet piling cofferdam (December 2017).

Photo 34: Topsoil placed over joint planting rock during BRSA 7 restoration (March 2018).

Photo 35: Construction of BRSA 7 stabilization/load out pad at Command Center (April 2018).

Photo 36: Marsh excavator used during BRSA 7 and 8 construction (June 2018).

Photo 37: BRSA 8 access road construction (October 2017).

Photo 38: Dredge material filling left descending bank of plunge pool (December 2017).

Photo 39: Constructing BRSA 8 bank buildout (March 2018).

Photo 40: BRSA 8 restoration planting (May 2018).

Photo 41: Restoration of plunge pool area (July 2018).

Photo 42: Plunge pool area restoration (July 2018).

Photo 43: Construction of BRSA 9 staging area (February 2017).

Photo 44: BRSA 9 sand bag coffer dam installation (August 2017).

Photo 45: Aerial view of Pine Creek reservoir during drawdown (September 2017).

Photo 46: BRSA 9 coir fabric restoration (October 2017).

Photo 47: BRSA 9 bank restoration (December 2017).

Photo 48: BRSA 9 joint planting riprap (March 2018).

Photo 49: View of former WCS before drawdown (April 2017).

Photo 50: Demolition of grouted riprap during removal of northern half of former WCS (January 2018).

Photo 51: Construction of crane pad for removal of southern portion former WCS (March 2018).

Photo 52: Aerial view during removal of former WCS (April 2018).

Photo 53: Excavator grading 2% riverbed slope (former WCS corridor restoration, April 2018).

Photo 54: Live stake planting (peninsula between former WCS corridor and plunge pool, August 2018).

Photo 55: View of former WCS and former auxiliary spillway prior to removal, looking downstream.

Photo 56: View after removal of former WCS and restoration of former WCS corridor and plunge pool area, looking upstream.

ATTACHMENT B

Record Drawings