

2022 Mill River (Fairfield, CT) Investigation: Lead (Pb) Contamination Levels in Blue Crab Tissue

Sampling & Analysis Plan
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1.0 BACKGROUND

The Mill River watershed is an approximately 35 square mile watershed located in Fairfield County, CT. Much of the upper watershed is managed for drinking water supply purposes. The river flows south through the Town of Fairfield, before emptying into Southport Harbor, the tidally influenced section of the Mill River estuary.

The focus of the investigation is Blue Crab (*Callinectes sapidus*) collected from the tidally influenced section of the lower Mill River located in Fairfield, Connecticut. Blue crab is a recreationally important estuarine crustacean that utilizes the lower river in this area. However, there is presently a Connecticut Department of Public Health issued 'do not eat' advisory for blue crab collected from the river between the tide gate (located just above Southport Harbor) north to Mill Hollow Park and Sturges Road.

The advisory, first issued in 2001, is due to concerns regarding lead impacted sediments. Lead was discharged into this section of the river by the former Exide Battery manufacturing plant, which operated on the east bank of the Mill River, between the Boston Post Road Bridge and the Amtrack railroad bridge, from 1950 to 1981. Since that time, a multi-decadal remediation effort has occurred at the site and lead contaminated sediments have been removed.

For remediation purposes, the river was conceptually divided into five project areas (Figure 1.1). The consumption advisory applies to Areas I-III and Area V; Southport Harbor (Area IV) is not included.

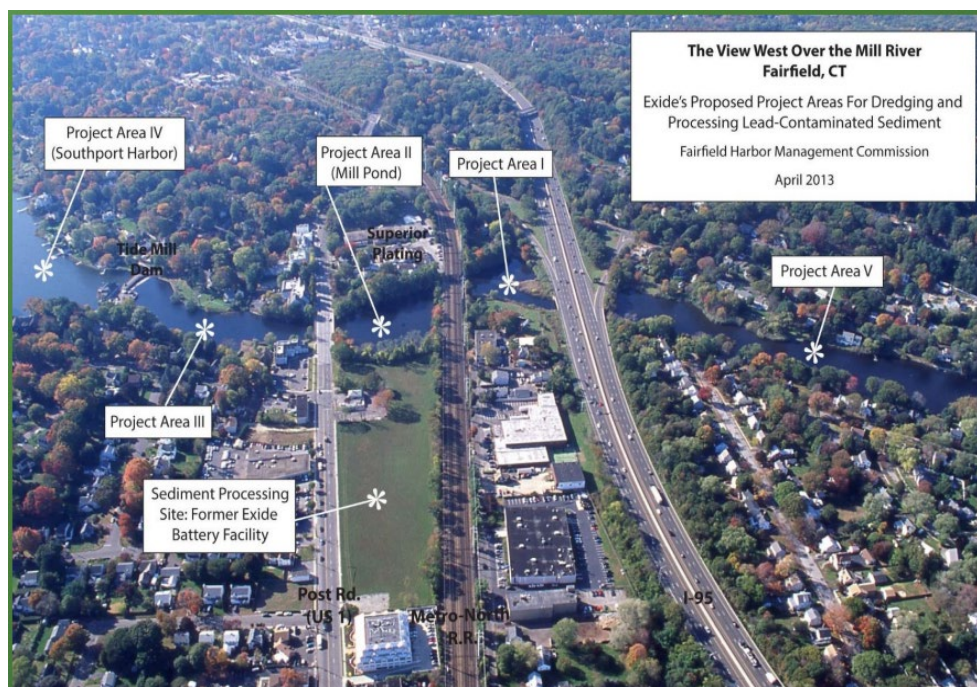


Figure 1.1. The Exide Battery lead remediation project areas. Image courtesy of the Fairfield Harbor Management Commission.

As part of the remediation efforts, between 1999 and 2000 Blue Crab were collected from each of the five designated project areas as part of a larger ecological impact study for the lower river. Tissue analysis results (Table 1.1) confirmed elevated lead tissue levels, with the highest levels found in crab collected from the Mill Pond adjacent to the former Exide facility (Area II). Given the migratory nature of blue crab and the tidal nature of the river, which could result in movement of contaminated sediment both upstream and downstream of the source area, the Fairfield Health Department, in conjunction with the CT Department of Environmental Protection and the CT Department of Public Health, issued the still-standing, 'do not eat' advisory for blue crab collected from Area II along with the areas upstream (Area V) and downstream (Areas I and III) of the Mill Pond. It was decided that only Blue Crab harvested from Project Area IV, Southport Harbor (below the Harbor Road tide dam structure), were safe to consume.

Table 1.1. Mill River Blue Crab tissue lead levels (1999-2000).

Source: Table 2-1: Sediment and Crab Concentrations, Mill River Human Health PRG Report, Fairfield, Connecticut. Mill River Human Health Risk-Based Preliminary Remediation Goals, Revision 1. Prepared for Inco United States, Inc. by Menzie-Cura & Associates, Inc. Dated October 31, 2002.

Project Areas (Listed in upstream to downstream order)	Crab Count	Lead Conc. (mg/kg)			Consumption Advisory Issued
		Avg.	Min.	Max.	
V - Upriver Area. From I-95 north to a constriction in the river 2,100 feet north of I-95 (near Mill Hollow Park/Sturges Road).	5	0.225	0.071	0.57	Y
I - Upstream Area. From I-95 downstream to the Metro North RR bridges	5	0.672	0.076	1.9	Y – crabbing prohibited in area
II - Mill Pond Area. From Metro North RR bridges downstream to US Route 1/Boston Post Road. <i>*Area includes the location of the former Exide facility.</i>	5	1.53	0.38	2.6	Y – crabbing prohibited in area
III – Downstream Area. From US Route 1/Boston Post Road downstream to Harbor Road/tidal dam.	5	0.129	0.048	0.2	Y
IV - Southport Harbor Area. Harbor Road downstream.	5	0.054	0.28	0.80	<u>N</u>

Since the early 1980s, substantial work has been completed to remove lead

impacted sediments from the lower Mill River. However, Blue Crab lead tissue levels have not been reevaluated. An August 2014 factsheet, “Mill River Cleanup Fairfield, Connecticut” noted that, “*Following the completion of the river cleanup, DEEP will sample Blue Crabs to evaluate the possibility of removing the fish consumption advisory for Blue Crabs (which is due to lead contamination).*” Given secondary remediation activities are now complete, the Agency seeks to determine whether lead levels in Blue Crab collected from the lower Mill River (i.e., Areas I-III and Area IV) remain elevated, or if the existing consumption advisory can be removed (i.e., tissue levels are safe for human consumption).

2.0 PROJECT OBJECTIVES

The 2022 Mill River (Fairfield, CT) Investigation has been designed to evaluate current lead (Pb) levels in edible portions of Blue Crab (*Callinectes sapidus*) collected from the lower Mill River in Fairfield, CT.

The scope of this document includes the field collection, transport, short-term storage, and tissue extraction, and delivery to the laboratory. Sample preparation (i.e., homogenization) and analysis are covered by the analytical laboratory (University of Connecticut Center for Environmental Science and Engineering) standard operating procedures, included as Appendix C.

2.1 Project Organization

This project is a collaboration between the DEEP Water Planning and Management Division and the DEEP Fisheries Division, with staff involvement as follows:

Role(s)	Name	Bureau/Unit
Project Lead Field Crew Lead	Meghan Lally, Environmental Analyst III	WPLR / Water Monitoring & Assessment Unit
Field Crew Lead	Katie O’Brien-Clayton, Environmental Analyst II	WPLR / Water Monitoring & Assessment Unit
Project Supervisor	Mary Becker, Supervising Environmental Analyst	WPLR / Water Monitoring & Assessment Unit
QC Officer	Chris Bellucci, Assistant Division Director	WPLR / Water Planning & Management Division
Project Development & Field Guidance	Justin Davis, Assistant Division Director Dave Molnar, Biologist	BNR / Fisheries Division

3.0 DATA USAGE

Once approved for release by the CT DEEP, the data will be utilized by

the CT DEEP to assist with water quality assessment decisions. Specifically, the data will be utilized to assess support for removing the current ‘impaired’ designation for the lower Mill River due to aquatic tissue contamination. In addition, at the conclusion of the study, results will be analyzed and summarized for use by the CT Department of Public Health (CT DPH) Environmental Health Section to assist with evaluating whether changes to the fish consumption (i.e., crab consumption) advisory for this area are warranted.

4.0 STUDY AREA

For the purposes of this investigation, the previously mentioned historic project areas I-III and Area V will be combined into a single study area, referred to collectively as the “lower Mill River” or the “project area” from this point on.

Although the areas are being combined into a single project area, when possible field collection will prioritize collection of crabs from areas in the following order: Area II (location of former Exide facility), Area III (downstream of former Exide location), Area I (immediately upstream of former Exide location), and, lastly, Area V (further upstream of former Exide location).

Southport Harbor is not included in this investigation as the Mill River (Fairfield) crab consumption advisory does not apply to the Harbor (and there are no other DPH-issued crab consumption advisories for the Harbor).

5.0 SAMPLE COLLECTION PROCEDURES

5.1 Collection Timeframe

Crabs will be collected between August and November 2022. (Open season for Blue Crab in Connecticut is May 1st through November 30th; the project will therefore seek to collect crab during the same timeframe as the general public.)

Actual dates of collection will be dependent on the availability of field staff, necessary equipment, and suitable field conditions.

5.2 Collection Methods

Methods employed for crab collection may include the following:

- Seining
- Scoop/dip netting
- Hand lining
- Trot lining
- Collapsible (or “pull”) star or box traps
- Collapsible ring net traps (26 inch diameter maximum)
- Semi-circular or cylindrical traps (12 inch diameter maximum)

The actual method employed within a given area to capture crabs will be dependent

upon available access (e.g., shoreline vs. bridge/pier) and field conditions (e.g., habitat, water depth, etc.). Per state regulations, any nets, traps and/or lines deployed will be attended at all times.

Bait will include chicken and/or fish purchased from a commercial retailer (e.g., chicken parts from a grocery store and/or commonly sold bait fish such as Scup from a bait shop). It is assumed that bait tissue is lead free and/or will not influence the lead concentrations in the sample tissue.

Field collection will cease when a sufficient number of crabs have been collected. If crabs collected are close to the 125 mm minimum size range, a total of 35 crabs will be targeted. If crabs are larger, the crew lead may determine that the minimum 25 crabs are sufficiently sized to produce the required tissue mass for sample analysis.

One or more holding areas will be designated for placement of captured crabs. Holding areas will consist of large plastic bins filled with ambient water, or, if available, wet ice. Similarly, 5-gallon buckets with ice may be used to sort crabs as needed, to determine groups for later tissue compositing.

If the target number of crabs are not collected on the first field day, a second day of field collection will be attempted utilizing similar methods. If, after two field day attempts, the above methods are unsuccessful, CT DEEP will work with the CT DEEP Fisheries Division to deploy crab pots. The DEEP EnCon Unit will be notified in advance of such deployments as they are regulated in Connecticut waters. A buoy labelled “DEEP” will be floated above the pot while deployed. If the target number of crabs are still not achieved, project staff will meet to determine the next best course of action.

5.3 Retention Criteria

Atlantic blue crab (*Callinectes sapidus*) are the target species for this study. A total of 25-35 legal size (125 mm or greater), hard shell crabs will be retained for analysis from the project area. Any egg-bearing females will be immediately returned to the water in accordance with the State regulations.

At the conclusion of sampling, crabs will be individually removed from the holding area for inspection and carapace width measurement. Soft shell crabs and crabs smaller than 5 inches (125 mm) in carapace width will be returned to the water. Any organisms with obvious deformities, signs of disease, or otherwise in apparent poor health will also be returned to the water.

Crabs will ultimately be composited in groups of 5-7 crabs of comparable size and, ideally, same sex and of the same location within the project area. Therefore, when needed, the crew leader will use best professional judgement to determine which organisms should be retained for analysis to best meet these compositing guidelines.

Crabs selected for retention will be given a unique field ID number, which will be marked in paint pen on the crab carapace. The crab will then be placed on ice in a cooler. If available, pelletized dry ice will be utilized to expedite crab dispatch.

5.4 Field Chain of Custody

A field chain of custody (field COC; Appendix B) is completed by the field crew lead for each location/date combination that crab are collected. At the conclusion of the visit, the field crew lead will review the Field COC and add any comments necessary to document unique field conditions and/or deviations from this plan. Once complete, the COC will be sealed in a LDPE zip bag and kept with the cooler containing the crab samples.

5.5 Sample Transport

Crabs will be stored in a cooler, on either wet ice or pelletized dry ice. If crabs are collected from more than one site during the field trip (i.e., on a given day by the same field crew), crabs will be separated in coolers by collection location. As described above, a unique field COC will be completed for each collection site on the given date. The Field COC will remain with the crab(s) in the cooler.

At the conclusion of the collection effort, the cooler will be securely shut and transported (with the field COC) to the DEEP Windsor Lab (9 Windsor Avenue, Windsor, CT) for short-term storage.

6.0 SAMPLE HANDLING AND PRESERVATION

DEEP staff will remove the edible crab muscle tissue and hepatopancreas from each crab at the Windsor Lab. Tissue will be composited prior to submission for laboratory analysis.

6.1 Temporary Preservation

At the lab, each crab is removed from the cooler, and individually placed in a LDPE zip-locking bag. The exterior of each bag will be labelled with the crab ID, date of collection and “Mill River (Fairfield)”. A label containing the following information will be placed inside the bag with the crab:

- Date of collection
- Waterbody name
- Collection Location
- Field accession number
- Species

The label should be placed so that the written information is clearly visible from inside the bag so that the bag does not need to be reopened until tissue extraction.

6.2 Composite Group Determination

Crab tissue will be composited in groups of 5-7 crabs per composite. Actual number of crabs in each composite will be determined based upon the total number of crabs collected and the number of individual crabs needed to achieve the

minimum tissue weight of 0.5g.

Each composite will be comprised such that all crabs are of similar size (e.g., the smallest crab width is no less than 75% that of the largest crab in the set.) In addition, priority will be given to grouping crabs by 1) collection site and 2) sex. (This may allow for additional data analysis by location and/or sex at the conclusion of the study.)

6.3 Work Area Preparation

Prior to tissue extraction, the work area will be cleaned and covered with aluminum foil. All extraction tools and trays will be of stainless steel and similarly cleaned. Staff will wear nitrile gloves while handling specimens.

A second ‘defrosting area’ will also be cleaned and covered with aluminum foil. Frozen crabs to be processed will be removed from the freezer and left to partially thaw in the dedicated area.

6.4 Tissue Extraction & Sample Labelling

The first composite group of 5-7 crabs will be moved to the work area. Two sample jars (one for muscle tissue and one for hepatopancreas tissue) will be labelled and placed in the work area. The labels will contain the following information:

- DEEP Composite Sample ID
- Waterbody
- Date of Collection
- Species
- Quantity (Number of crabs tissue was extracted from)
- Anatomy Part (e.g., Hepatopancreas or Muscle)

The first label will be placed on the outside of the sample jar and secured with packing tape prior to tissue extraction. The second label will be placed inside the sample jar at the conclusion of tissue extraction.

The hepatopancreas will be removed from each crab in the composite set and placed in the corresponding jar for compositing. Next, the edible muscle tissue will be removed from each of the five crabs and placed in the second labelled jar for compositing. The second label will be placed in each jar and the jar top securely closed. Jars will be returned to the freezer for further storage until submission to the analytical laboratory.

Any remaining crab and disposable materials (e.g., foil, gloves) will be discarded, and the work area will be thoroughly cleaned and re-lined with new foil prior to extracting tissues for the next 5-7 crab composite sample. Nitrile gloves will be changed between extraction of each tissue composite.

6.5 Sample Transport and Submission

Frozen extracted tissue samples will be driven to the UConn CESE laboratory (3107 Horsebarn Hill Road, Storrs, CT) by DEEP staff. Samples will be placed in a cooler with wet ice for transport.

Prior to delivery, a CESE COC will be prepared (Appendix B). A copy or scan of the completed COC will be made prior to transport, then the COC will be enclosed in a LDPE zip bag and placed inside the cooler to prevent damage or loss.

Upon delivery, CESE staff will verify the contents of the cooler(s) and be asked to sign the COC confirming receipt of the samples. A copy of the completed CESE COC, with delivery/receipt signatures and, if applicable, unique lab IDs, will be provided to DEEP within 48 hours for retention in the project file. The original laboratory COC will remain with CESE.

Samples will be analyzed by UConn CESE for total lead, percent moisture and percent lipids (Appendix C).

7.0 SAMPLE ANALYSIS

Tissue samples will be analyzed by the University of Connecticut Center for Environmental Science and Engineering (UConn CESE). The composited crab tissue samples will be prepared utilizing a modified version of EPA method 200.3 as described in Appendix C.1. Samples will be analyzed for lead utilizing EPA Method 6020A as described in Appendix C.2.

8.0 PROJECT TIMELINE

Crab collection will be conducted by DEEP staff between August and September 2022. (If needed, collection will continue into November 2022 to achieve target numbers.) Crabs are to be transported from the field to the DEEP lab and either processed (i.e., tissue extracted) or frozen whole within 12 hours of collection.

DEEP staff will extract and composite tissue samples. Composited tissue samples will be transported to the UConn CESE laboratory within 30 days of crab collection.

Samples will be prepared and analyzed by UConn CESE, with results reported to DEEP within 60 days of submission, so that the total holding time does not exceed 90 days from collection. Any questions or concerns will be submitted by DEEP to CESE within 10 business days of data receipt.

Upon receipt of all final data, DEEP will produce a final report within 45 days for internal distribution and distribution to CT DPH.

A project timeline is presented below. Darker shading indicates the timeline in the event that all crab collection is successfully completed in August 2022. Lighter shading indicates extensions to the timeline that would occur if crab collection is extended later into the season. Reasonable delays due to holidays should be expected.

Table 8.1. Project Timeline								
	2022					2023		
Task:	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Collection								
Tissue Extraction								
Analysis & Data Reporting								
Project Report								

Any deviations from the above timeline will be documented and noted in the final project report.

9.0 FIELD SAFETY

DEEP field safety protocols for river sampling will be followed by all sampling staff. Field teams will include at least two people. A first aid kit will be included in the utilized DEEP vehicle.

10.0 DATA QUALITY REQUIREMENTS AND ASSESSMENTS

The quality of the data is to be within the ranges associated with the specific approved protocols (referred to Appendix C).

10.1 Data Representativeness

Composite samples are expected to represent total lead levels of the particular species of crab (i.e., Blue Crab) in the waterbody where they were collected (i.e., Mill River) at the time of collection.

Field and laboratory conditions that may affect sample integrity are to be documented on the chain of custody forms, CESE sample receipt form and laboratory and field logs.

10.2 Data Comparability and Completeness

Data will be reported as concentration of total lead. In the analytical report the laboratory will also provide method number and name, all of which are in the analysis SOP title, reporting limit (RL), resultant value, percent solid, field sample number, and lab sample number for data management purposes.

The official analytical report of results will be sent to CTDEEP via Meghan Lally in a pdf format accompanied by an Excel spreadsheet of data.

10.3 Corrective Action

When it is found that data are incomplete or that results are unacceptable, UCONN CESE and DEEP Project Leads may determine that one or more of the following procedures for corrective action shall be undertaken:

Conflicting or poor quality data: When the test does not meet prescribed analytical QC goals, the available data will be reviewed by the project officers and UCONN CESE. The possibility of retesting will be considered as necessary by DEEP and CESE.

Reconsideration of acceptable limits with statement explaining the results of the action/rationale may be taken. Rejection of data and exclusion from the report may occur provided a written explanation from UCONN CESE lab is provided to DEEP. Rejection of the entire sample/station location with explanation for rejection and recommendation of correction including reconsideration of results may be recommended by project staff from CESE or DEEP.

11.0 DATA USABILITY

DEEP project officers will determine the usability of the data. If the QC criteria in Appendix C are met, then the data are considered usable for this project.

12.0 DOCUMENTATION, RECORDS, AND DATA MANAGEMENT

The project manager will log each crab into the laboratory tissue log by transferring the information from the field COC into the electronic log maintained by the Water Monitoring and Assessment Program on the “M Drive.” The log entry will include the unique field ID, date of collection, waterbody, collection location, species, sex, carapace width, weight (if recorded), and anatomy part(s) (e.g., muscle, hepatopancreas) to be analyzed. Once tissue extraction is complete, date of extraction, staff conducting the extraction, and the final DEEP composite ID will be added to the log. Upon submission to the analytical laboratory, the log will be updated to include date of submission, laboratory ID, and analysis parameters.

Final data from this project will be stored in a database developed and maintained by DEEP staff.

All UCONN CESE laboratory documentation including laboratory sample receipt, storage, sample processing and analysis will be maintained according to accepted UCONN CESE protocol.

13.0 FINAL REPORT

Following UCONN CESE review and approval, the results of this laboratory analysis containing the information described in Section 10.2 above will be released to Meghan Lally, the CTDEEP Project officer.

CT DEEP will produce a project report within 45 days of receipt of the final data for internal distribution. Following project staff review and approval, a final report will be released for external stakeholders.

Appendix A. Mill River Crab Consumption Advisory Documents

Appendix B. Chain of Custody Forms & Sample Labels

- **Appendix B1.** CT DEEP Field Chain of Custody Form
- **Appendix B2.** CT DEEP Individual Crab Field Labels
- **Appendix B3.** CT DEEP Tissue Sample Container Labels
- **Appendix B4.** UConn CESE Laboratory Chain of Custody Form

Appendix C. UConn CESE Laboratory Standard Operating Procedures

- **Appendix C1.** Standard Operating Procedure: Sample Preparation Procedure for the determination of Total Recoverable Elements in Biological Tissues (EPA 200.3 Modified). CESE SOP No. Mets-009-08. Revised March 01, 2022.
- **Appendix C2.** Standard Operating Procedure: ICP-MS Analysis Method EPA 6020A Inductively Coupled Plasma Mass Spectrometry. UConn CESE SOP No. METS-020-02. Revised March 01, 2022.