Norfolk Southern Railway Company

Comprehensive Sheen and Sediment Investigation Work Plan – Sulphur Run and Leslie Run

East Palestine Train Derailment

Columbiana County, Ohio

Rev: 2

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Version Control

Revision No.	Date Issued	Page No.	Description
0	October 25, 2023	---	Initial Plan
1	October 30, 2023	All	Revisions based on October 27 and 28, 2023 comments from USEPA
2	November 3, 2023	Several	Revisions as directed by USEPA's November 1, 2023 approval with modifications letter

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Appendix A. Standard Operating Procedures

- Standard Operating Procedure #1: Sediment Characterization via Probing and Sampling
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1 Introduction

This Comprehensive Sheen and Sediment Investigation Work Plan (Plan) was developed on behalf of Norfolk Southern Railway Company (NSRC) by Arcadis U.S., Inc. (Arcadis) and EnviroScience, Inc. (EnviroScience) in response to the February 3, 2023 derailment in East Palestine, Ohio in accordance with the United States Environmental Protection Agency (USEPA) issued Administrative Order (Docket No. CWA-1321-5-24-001) pursuant to Section 311 of the Clean Water Act (CWA), which became effective on October 18, 2023 (CWA Order). This Plan supports the actions to perform a comprehensive sheen and sediment survey within Sulphur Run and Leslie Run (Figure 1-1) as required in Paragraphs 51 and 52.

The extent of investigation will include the following waterbody areas:

- Sulphur Run from its confluence with Leslie Run to 1,000 feet upstream beyond the confluence with the Unnamed Tributary located just north of the railroad tracks, which is commonly called the North Ditch (Sulphur Run area)
- Leslie Run from its confluence with Bull Run to 1,000 feet upstream beyond the confluence with Sulphur Run (Leslie Run area)

The purpose of this Plan is to provide details on investigation actions proposed to assess potentially impacted sediment and resulting sheen in Sulphur Run and Leslie Run after the derailment. Potential environmental impacts may result from contaminants of potential concern (COPCs). The list of COPCs represents what was on the train, what was subsequently detected in surface water and sediment, and what is potentially toxic to human health. Associated degradation products and combustion products were also considered. The COPCs are listed in Table 1-1.

Table 1-1 COPC List

Analyte	CAS#	Analytical Method
1,2,4-Trimethylbenzene	95-63-6	VOCs (USEPA Method 8260)
2-Butanone	78-93-3	VOCs (USEPA Method 8260)
2-Ethylhexyl acrylate	103-11-7	VOCs (USEPA Method 8260)
2-Hexanone	591-78-6	VOCs (USEPA Method 8260)
4-Methyl-2-pentanone	108-10-1	VOCs (USEPA Method 8260)
Acetone	67-64-1	VOCs (USEPA Method 8260)
Benzene	71-43-2	VOCs (USEPA Method 8260)
Carbon disulfide	75-15-0	VOCs (USEPA Method 8260)
Ethylbenzene	100-41-4	VOCs (USEPA Method 8260)
m&p-Xylene	179601-23-1	VOCs (USEPA Method 8260)
Methyl Acrylate	96-33-3	VOCs (USEPA Method 8260)
n-Butyl acrylate	141-32-2	VOCs (USEPA Method 8260)
o-Xylene (1,2-Dimethylbenzene)	95-47-6	VOCs (USEPA Method 8260)
Styrene	100-42-5	VOCs (USEPA Method 8260)
Toluene	108-88-3	VOCs (USEPA Method 8260)
Vinyl chloride	75-01-4	VOCs (USEPA Method 8260)

Analyte	CAS#	Analytical Method
1-Methylnaphthalene	90-12-0	SVOCs (USEPA Method 8270)
2-Methylnaphthalene	91-57-6	SVOCs (USEPA Method 8270)
Acenaphthene	83-32-9	SVOCs (USEPA Method 8270)
Acenaphthylene	208-96-8	SVOCs (USEPA Method 8270)
Anthracene	120-12-7	SVOCs (USEPA Method 8270)
Benzo[a]anthracene	56-55-3	SVOCs (USEPA Method 8270)
Benzo[a]pyrene	50-32-8	SVOCs (USEPA Method 8270)
Benzo[b]fluoranthene	205-99-2	SVOCs (USEPA Method 8270)
Benzo[g,h,i]perylene	191-24-2	SVOCs (USEPA Method 8270)
Benzo[k]fluoranthene	207-08-9	SVOCs (USEPA Method 8270)
Chrysene	218-01-9	SVOCs (USEPA Method 8270)
Fluoranthene	206-44-0	SVOCs (USEPA Method 8270)
Fluorene	86-73-7	SVOCs (USEPA Method 8270)
Indeno[1,2,3-cd]pyrene	193-39-5	SVOCs (USEPA Method 8270)
Naphthalene	91-20-3	SVOCs (USEPA Method 8270)
Phenanthrene	85-01-8	SVOCs (USEPA Method 8270)
Pyrene	129-00-0	SVOCs (USEPA Method 8270)
2,4-Dinitrophenol	51-28-5	SVOCs (USEPA Method 8270)
2,6-Dinitrotoluene	606-20-2	SVOCs (USEPA Method 8270)
2-Butoxyethanol	111-76-2	SVOCs (USEPA Method 8270)
2-Nitrophenol	88-75-5	SVOCs (USEPA Method 8270)
3 & 4-Methylphenol (M, P-Cresols)	65794-96-9	SVOCs (USEPA Method 8270)
4,6-Dinitro-2-Methylphenol	534-52-1	SVOCs (USEPA Method 8270)
4-Nitrophenol	100-02-7	SVOCs (USEPA Method 8270)
Benzoic Acid	65-85-0	SVOCs (USEPA Method 8270)
Benzyl Alcohol	100-51-6	SVOCs (USEPA Method 8270)
Isophorone	78-59-1	SVOCs (USEPA Method 8270)
Nitrobenzene	98-95-3	SVOCs (USEPA Method 8270)
Phenol	108-95-2	SVOCs (USEPA Method 8270)
Diethylene glycol	111-46-6	Glycols (USEPA Method 8015)
Ethylene glycol	107-21-1	Glycols (USEPA Method 8015)

Investigation actions were developed as required by Paragraph 52 of the CWA Order to address a series of Data Quality Objectives (DQOs). The investigation will also consider background levels in the waterbodies. The defined DQOs (investigation questions) and associated actions are provided in Table 1-2. Work described herein will be conducted in accordance with the Qualitative Sheen and Sediment Investigation Quality Assurance Project Plan (QAPP; Arcadis 2023h). Ecological screening levels (ESLs) and human health screening levels (HHSLs) are provided in the QAPP.

Table 1-2 Data Quality Objectives and Actions

	Investigation Question	Action
1	Extent of sheen: What is the extent of sheen? Are there areas that contain medium to heavy sheens observed in the surface water and where are they located?	Conduct a qualitative stream assessment to score areas consistent with previous assessments. • If Scores of 2 (medium sheen[1]) and 3 (heavy sheen) are identified, conduct sediment and sheen sampling to address Questions 2 through 4. Results will be presented in a summary report with GIS mapping. • If no Scores of 2 (medium sheen) and 3 (heavy sheen), incorporate into CSM and review other sources and release mechanisms. Results will be presented in a summary report with GIS mapping.
2	Assessment of sheen composition: Are constituents of potential concern (COPCs) present in medium to heavy sheens observed on the water surface?	Collect sheen samples for each sheen type observed (i.e., rainbow sheen and translucent film) with qualitative analytical testing to assess if COPCs are present. • If COPC analytes are present in sheen, incorporate into CSM and review other media COPC levels at the locations where the sheen samples were collected. • If COPC analytes are not present in sheen, incorporate into CSM.
3	Assessment of sediment within the top 6 inches in medium to heavy sheen areas: Do concentrations exceed the Ecological Screening Levels (ESLs) or the Human Health Screening Levels (HHSLs)?	Conduct sediment sampling and analytical testing with comparison of each COPC result against ESLs and HHSLs. • If exceedances, there is a potential for sediment to serve as an ongoing point-source for COPCs – perform additional data collection and assess need for source evaluation/fingerprinting, data evaluation, and/or evaluate potential sediment removal actions or mitigation measures.. • If no exceedances, incorporate into CSM, review other sources and release mechanisms, and evaluate potential sediment removal actions or mitigation measures to address sheens.
4	Assessment of current conditions: Have sediment COPC concentrations changed over time?	Conduct sediment sampling and analytical testing at previously sampled locations with a comparison against previous results to assess changes over time.

[1] Paragraph 52 in the Administrative Order identifies areas with “moderate” sheen for additional sampling. For consistency with previous stream assessment activities, this Plan uses “medium” sheen that is scored as 2.

	Investigation Question	Action
		• If evidence of changes in COPC levels, incorporate into CSM and assess need for additional data collection and source evaluation/fingerprinting. • If COPC levels remain the same, incorporate into CSM.
5	Assessment of background concentrations (locations outside of the flow path from the derailment): Do background samples have detections of COPCs?	Conduct sediment sampling and analytical testing at background locations and assess detections of COPCs. • If background data indicate detections of COPCs, compare against sediment sample results from areas in the derailment flow path, assess against ESLs/HHSLs, and incorporate into the CSM. Assess need for source evaluation/fingerprinting. • If background data indicates no detections of COPCs, incorporate into the CSM.

The investigation actions proposed to address these DQOs will build upon the investigations identified in Section 2 that were conducted in February, March, May, and July/August 2023 in Sulphur Run and Leslie Run in accordance with the following Work Plans:

- Pre-Rainfall Event Sediment Sampling Work Plan (Arcadis 2023a)
- Sediment Reconnaissance Sampling Work Plan (Arcadis 2023b)
- Sediment Sampling Work Plan (Arcadis 2023c)
- Qualitative Stream Sediment Assessment Sampling and Analysis Plan and Quality Assurance Project Plan (EnviroScience 2023)
- Sediment Characterization Plan Quality Assurance Project Plan (Sediment QAPP) including the Sulphur Run Characterization Appendix H1 and appended plan (Arcadis 2023d and 2023e) and the Leslie Run and Downstream Creeks Characterization Appendix H2 and appended plan (Arcadis 2023g and 2023g)[2]

The sediment sampling and characterization work plans were developed pursuant to the USEPA February 21, 2023 Unilateral Administrative Order for Removal Actions (UAO), which became effective on February 27, 2023. The qualitative stream assessment plan was approved by the USEPA ecological group.

The investigation actions identified to address the DQOs identified herein are described in Sections 3 and 4, and include the scope, locations, and procedures. Section 5 identifies the COPCs and associated analytical testing. Section 6 provides a detailed schedule for implementation of the proposed investigation actions and reporting, and Section 7 lists references used throughout the Plan.

Work conducted under this Plan will be performed in accordance with the East Palestine Train Derailment Site Health and Safety Plan (version 3.2; July 23, 2023) and associated Job Safety Analyses. The results from the

[2] The Sulphur Run Characterization Plan (Arcadis 2023d and Arcadis 2023e) and Leslie Run and Downstream Creeks Sediment Characterization Plan (Arcadis 2023f and Arcadis 2023g) replaced the Sediment Sampling Work Plan included as Appendix H to the March 2023 Removal Work Plan (Arcadis 2023c).

investigation actions will be incorporated into the Conceptual Site Model (CSM) and may lead to additional investigation activities and/or evaluation and implementation of future potential removal approaches.

On-site sampling teams will notify USEPA and Ohio Environmental Protection Agency (OEPA) oversight personnel regarding the sampling schedule, locations, etc. to coordinate logistics and progress. USEPA may elect to take split or co-located samples during the investigation actions. On-site teams will accommodate these requests as needed.

2 Sediment Investigations Completed Post-Derailment

On February 3, 2023, a derailment occurred near the North Pleasant Drive crossing in East Palestine, Columbiana County, Ohio. The derailment involved 51 rail cars and resulted in a fire and breaches to tank cars that contained hazardous materials and non-hazardous materials. The release of hazardous materials from the damaged cars affected environmental media in the area of the derailment. NSRC immediately mobilized response personnel to the incident. On February 6, 2023, the vent and burn method was used to address hazards posed by five unstable vinyl chloride rail cars. This action was carried out in conjunction with a mandatory evacuation of local residents from a 1-mile radius of the site. After confirming via air monitoring that contaminants of potential concern (COPCs) were not present in the air at levels of concern, the evacuation order was lifted on February 8, 2023, and rail operations resumed. Response crews continue operations to stop, contain, and recover the releases. That work is ongoing and includes efforts to assess the nature and extent of potential impacts and conduct certain additional removal activities to protect human health and the environment.

As part of the investigation activities to delineate the extent of potential impacts, sediment characterization activities were performed in Sulphur Run and Leslie Run in February, March, May, and July/August 2023 in accordance with the Work Plans listed in Section 1 (Arcadis 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, and 2023g and EnviroScience 2023). Completed investigations include the following:

- February 2023
  - Sediment sampling was performed on February 15, 2023 to collect surface samples (top 2 to 10 inches based on depth of sediment present). One sample was collected in Sulphur Run co-located with water monitoring station W-2. Three samples were collected in Leslie Run co-located with water monitoring stations W-9, W1R, and W-4. One sample was collected co-located with water monitoring station W-11 in a tributary to Leslie Run.
  - Probing and visual observations were conducted to document conditions on February 21-23, 2023, immediately prior to the OEPA-directed stream washing operations in Sulphur Run. Probing was performed along a series of transects spaced approximately every 50 feet from just downstream of the railroad culvert and the unnamed ditch to the confluence with Leslie Run (63 transects).
  - Sediment sampling was performed on February 22, 2023 to collect surface samples (top 2 to 10 inches based on depth of sediment present). Samples were collected at the 5 locations sampled on February 15, 2023, including W-2, W-9, W-1R, W-4, and W-11, and at 2 additional downstream locations (SED-5 and SED-6) located within Leslie Run.
- March 2023
  - Sediment sampling was performed on March 16, 2023 at the 7 locations sampled on February 22, 2023 to collect surface samples (top 2 to 10 inches based on depth of sediment present).
  - A qualitative stream sediment assessment survey of Leslie Run was performed on March 16, 2023.
- May 2023
  - Qualitative stream sediment assessment surveys were performed on Sulphur Run on May 17, 2023 and Leslie Run on May 18-19, 2023. This survey was performed following implementation of the clean-up tactic completed between May 10-13, 2023 that included stream bed washing from just downstream of

the confluence of Sulphur and Leslie Runs to downstream of the East Palestine Wastewater Treatment Plant outfall.

- July and August 2023
  - Sediment sampling, pore water sampling, and sheen sampling was performed in Sulphur Run and Leslie Run from July 25 through August 15, 2023. A total of 44 sediment samples were collected from a total of 24 locations; these included the 0-6 inch interval and the 6-12 interval where present at locations identified to contain medium to heavy sheens during the May 2023 qualitative stream assessment. One location (L01S10) was proposed for sampling in Leslie Run adjacent to the Wastewater Treatment Plant; however, this location could not be sampled due to work being conducted by the Ohio Department of Transportation on the Park Street bridge that included dropping the bridge structure in the creek, water bypass, and dewatering upstream and downstream of the bridge to facilitate construction. The target sample location is within the dewatered area of the creek. Pore water and sheen samples were co-located with a subset of the sediment samples and included 13 and 8 samples, respectively.
  - Culvert inspections were conducted on August 3, 2023 within the three covered culverts in Sulphur Run using a remotely operated camera system and air quality monitoring equipment.

Data resulting from these completed efforts were considered in developing the scope outlined in Section 3.

The resulting data and findings from these previously completed efforts will be incorporated into the report described in Section 6 along with the information generated through implementation of the scope described in Section 3 herein to provide an updated CSM and full assessment of Sulphur Run and Leslie Run.

3 Sediment Investigation Scope

This section describes the investigation activities for Sulphur Run and Leslie Run proposed to answer the investigative questions identified in Section 1. Every effort will be made to follow the scope as presented. However, as conditions in the field may change, it may become necessary to implement minor modifications to field efforts presented in this plan. Any deviations deemed appropriate and necessary will be discussed and agreed upon by field and USEPA/OEPA oversight personnel, and a Field Change Form will be completed to document the adjustment. Use of an electronic field form will be integrated into the field efforts.

3.1 Access

Implementation of the scope described herein will require access agreements with property owners. In accordance with the State of Ohio laws, property owners adjacent to the creek own to the centerline of the creek. As such, there are at least 66 properties to be accessed to complete the investigation actions outlined in this section. Previous investigation efforts resulted in NSRC securing access agreements to 27 of these properties[3]; the terms of these agreements are currently being reviewed to determine if they need to be extended or amended.

NSRC is working to secure access to the remaining properties. Based on prior efforts, it is anticipated that NSRC may not be able to secure agreements from all owners due to being unable to reach the listed property owner or the property owner refusing access. Some of these property owners may also be represented by counsel, thereby requiring time for negotiation of an agreement.

Where new or updated agreements are required to implement the scope described herein, NSRC will make multiple attempts through the duration of the field work to contact and obtain agreements from property owners. These efforts will be documented and progress communicated with USEPA. NSRC may require USEPA support in gaining access or, as was done during the July/August 2023 investigation, the investigation locations may need to be adjusted to only those properties with access agreements in place.

3.2 Qualitative Sheen Assessment

A qualitative assessment of sheens will be made for the Sulphur Run area and Leslie Run area (Figure 1-1) using methods consistent with previous surveys conducted in these streams in March and May 2023. The field team will walk the length of the stream channel identified for each waterbody and record observations at a frequency of every 25 feet and biased toward areas with sediment present and/or sheen or staining, if already present. Sampling density may be adjusted to be more dense if there is evidence of significant change in characteristics or obvious other sources (e.g., pipe/outfall).

Observation points will be numbered sequentially from downstream to upstream (e.g., QALR1, QALR2, etc.). At each 25-foot location, the field team will disturb a representative transect across the stream bottom through agitating the sediment using their feet, turning over rocks, etc. and record visual observations regarding the degree of sheen observed. The degree of sheen observed will be judgmental in nature and include observations

[3] Approximately three weeks were needed to secure the agreements for the 27 properties.

of speed of release from the disturbed sediment, horizontal expanse of sheen, and smell of product. Areas with no sediment present will be noted.

Consistent with the previous approved qualitative assessments in March and May 2023, the qualitative observations will be scored using the following criteria:

- Score 0 = No sheen
- Score 1 = Light sheen assigned when a small presence of string-sheen is observed, and the majority of the stream bed area does not produce sheen during disturbance
- Score 2 = Medium sheen assigned when there is a step-down in the presence of sheen stream-wide, with basketball-sized bubbles and no odor
- Score 3 = Heavy sheen assigned when there is a stream-wide prevalence of sheen or larger amounts of sheen produced with odor upon disturbance

The field team will be equipped with a submeter accurate DGPS unit to geo-reference the mid-channel point of each 25-foot observation and delineate areas with different scores. Video and photographs will be captured during the assessment efforts to document the observed sheens and other notable field observations at each location. Qualitative flow observations [e.g., stagnant (no flow), low flow, significant flow (riffle), etc.] will be collected at each 25-foot observation point. Additional field observations include stream morphology (i.e., riffle/run/pool and glide) and wetted width. Water temperature will be collected at the first and last observation point of the day. If there are areas of the creeks that are dry during observations, this will be noted and the area revisited at least once during field efforts (e.g., after rain or flow event) with the intent of qualitatively assessing sheen in wet conditions. All data will be documented and saved on electronic data forms.

If flow of free product or tar balls are observed during the assessment, it will be mitigated through use of booms or pads in the field.

Considering the qualitative nature of this assessment, the evaluation for the approximate 5-mile stream segments will be completed by a single field team and over as short a duration as possible to avoid introducing individual bias or inconsistencies due to field conditions. This will ensure consistency in visual observations and qualitative scoring of criteria. NSRC requests that USEPA and OEPA staff provide oversight during the sheen assessment efforts to reach consensus on scoring consistent with the May 2023 efforts. Ideally these staff would be consistent with those that provided oversight during the May 2023 as possible. Agency oversight personnel will concur with the sheen assessment score prior to formal documentation.

3.3 Sediment Sampling

Sediment sampling is proposed for the Sulphur Run and Leslie Run areas to assess COPC concentrations in surface sediment (top 6 inches).

3.3.1 Sample Locations

The target sampling locations include the following:

Biased

- The samples are within areas identified during the qualitative assessment outlined in Section 3.2 to contain Scores of 2 and 3. The locations to be sampled will be determined in accordance with the following:
  - One location will be sampled in discrete areas scored as a 2 or 3. Discrete areas are defined as less than 25 feet in length to align with the minimum stream assessment observation frequency.
  - Where there are stretches with consecutive observations of a Score of 2 or consecutive observations Score 3, multiple samples will be collected from the area. These areas will be defined by the most upstream and downstream observation points scored as 2 or 3 (i.e., the next observation point is scored as a different value).
    - If the total length of creek with consecutive scoring observations is greater than 250 feet (10 consecutive observation points scored as a 2 or 3), the total length of the area will be identified and samples will be collected approximately 50 feet from the upstream and downstream extent of the area and every 75 feet between those points.
    - If the area is less than 250 feet in length, samples will be targeted at approximately 33% and 66% from the downstream observation point with adjustments made to align with the closest qualitative sheen observation point.
    - The target sampling distance is approximate and will be adjusted to align with the location identified to contain the greatest sheen at the time of sampling as described in Section 3.3.2.

Sediment sampling will start after the qualitative sheen assessment (see Section 3.2) and will progress in segments of the creeks as the sheen assessment progresses.

Baseline

- Locations previously sampled during the July/August 2023 event from the Sulphur Run and Leslie Run areas will be re-sampled. All baseline locations are within the waterbody extent included for the stream assessment outlined in Section 3.2; sampling at these locations will be performed regardless of the results of that assessment. This includes re-sampling 23 locations, with 11 locations in Sulphur Run and 12 locations in Leslie Run. Some of these locations may coincide with areas identified to contain sheens with Scores of 2 or 3 during the qualitative assessment; therefore, these samples will meet the intent of the biased locations and will not be sampled twice. The locations to be sampled are shown on Figures 3-2 and 3-3 and include the following (listed upstream to downstream):
  - Sulphur Run: SR1 through SR8, W-2, SR9, and SR10
  - Leslie Run: L01S10, W011, LR-01, LR-02, W001R, LR-03, L01S09, W004, LR-04, SED-5, 602010, and SED-6

If there are target locations (e.g., L01S10) that are dry, this will be noted and a sample will be collected in dry conditions, if possible.

Background

- Background areas are outside of the flow path from the derailment and not within the CWA Order-defined Sulphur Run and Leslie Run areas. This will include sampling locations previously sampled during the February and July/August 2023 events and additional locations proximate to Sulphur Run. The locations to be sampled are shown on Figure 3-1 and include the following:

- Sulphur Run: Locations SR-BG1 through SR-BG3 – located upstream of the derailment or in a tributary to the creek running under Taggart Street
- Leslie Run: Locations L01S11 and W009 – located upstream of the confluence with Sulphur Run
- Bull Creek: Locations L01S07 – located upstream of the confluence with Leslie Run
- North Fork Little Beaver Creek: L01S04 – located upstream of the confluence with Bull Creek
- Little Beaver Creek: ES1 – located upstream of the confluence with North Fork Little Beaver Creek

These locations will be assessed for sheens prior to sample collection using the same methods outlined in Section 3.2. If there are target locations that are dry, this will be noted and a sample will be collected in dry conditions, if possible.

3.3.2 Field Sampling Procedures

At each location, sampling will initially target the approximate mid-point of the stream width as a starting point for probing efforts. Probing will be performed around this target location (towards the banks and up to 25 feet upstream and downstream or as limited by the particular targeted sheen category) to identify locations with recoverable sediment (i.e., fine grained materials) that exhibit the greatest sheens when disturbed (i.e., bias sample collection towards sediment that visually appears to be impacted). Sampling will then be performed at the location identified to contain fine-grained materials and the greatest sheen in the vicinity of the target location (i.e., sampling will not be constrained to the mid-point of the stream but will be guided by probing and sheen results). Video and photographs will be captured during sampling to document observed sheens. If the sediment sampling crew is not able to recreate sheen to score 2 or 3 levels, the sediment sample will be collected from the location identified to contain fine-grained materials with the greatest amount of sheen. If the greatest amount of sheen is produced by turning over rocks or boulders, the sampling crew will attempt to collect the sample from fine-grained materials beneath the overturned rocks or boulders or from the nearest fine-grained sediments if such material is not present beneath the rocks/boulders. If the sampling crew is not able to generate any sheen observations (score of 0 after extensive probing methods described above are employed), the team will collect a sediment sample from the locations with the greatest amount of recoverable sediment near the mid-point of the stream.

Sampling will target the surface interval (up to 6 inches) of recoverable material (e.g., silt and sand, no or minimal gravel). If less than 6 inches are present, a single grab of the material will be sampled as long as an adequate volume can be obtained for the required analytical testing. If adequate material is not available with a single grab, multiple grab samples may be collected and composited to form a single sample with an adequate volume; however, this composite sample will not be submitted for analysis of volatile organic compounds (VOCs). For VOC testing, an additional single grab sample will be collected from one of the grab sample locations used to form the composite.

All sediment sampling will be performed in accordance with the approved Standard Operating Procedure (SOP) #1 provided in Appendix A. The SOP describes probing efforts and sediment sampling using various collection methods (e.g., methods range using a stainless-steel trowel to coring with steel sampling barrel and slide hammer).

3.4 Sheen Sampling

Sheen for the purpose of this sampling plan may be defined as a substance that when released from sediment, organic material, or physical entrainment, produces a color, film, or other temporary or permanent non-aqueous phased substance on the surface of the water. OEPA has documented the presence of rainbow sheens and a translucent film when the sediment is disturbed in the streams. Efforts will be made to capture both sheen types separately to allow for individual analysis.

Sampling is proposed to provide a qualitative mechanism to identify if COPCs are present in sheens observed on the water surface. Stream sheen assessment procedures will include sample collection using Teflon® (polytetrafluorethylene [PTFE]-fluorocarbon polymer) nets in accordance with the approved SOP #3 provided in Appendix A. Sheen samples will be collected from the same locations that the biased sediment samples are collected since those locations target areas with sheens; these locations are described in Section 3.3 and will target areas with medium (scored as 2) or heavy (scored as 3) sheens. Sheen samples will also be collected from background locations if any sheens are observed (e.g., scored as 1, 2, or 3). All baseline locations fall within the CWA Order defined area and are therefore considered in the assessment. Sheen and sediment samples will be collected concurrently by the same field crew.

At each target location, the field team will disturb the surface of the sediment bed to generate a sheen for sample collection. Field teams will initially target mid-channel and then work outward (i.e., upstream, downstream, and toward the banks) to generate and capture sheens. A minimum of three passes with each net will be made to capture adequate sheens for analytical testing. Four individual nets are required per sample for the suite of analyses. Up to two samples including one sample each of the rainbow sheen and translucent film may be collected from each location if field teams observe and can capture individually both sheen types. Trip blanks will be collected and analyzed as outlined in the QAPP (Arcadis 2023h). If the sediment/sheen sampling crew is unable to recreate sheen observations at a score of 2 or 3 after the above extensive probing methods are followed, then the team will record the findings and a sheen sample will not be collected from that location.

4 Sample Processing

Sediment and sheen samples for laboratory analysis will be collected per the procedures described in Appendix A. All samples will be preserved in accordance with analytical method requirements, sealed in coolers, and shipped or couriered to the selected laboratory under chain-of-custody protocol and analyzed within required holding times in accordance with the QAPP (Arcadis 2023h). Samples will be labeled using the nomenclature listed below.

Sediment samples

- Media sampled (SED)
- Location of sample
    - Biased samples will use the sheen assessment observation identifier (e.g., QALR1, QALR2, etc.)
    - Baseline and background samples will use the location identifier shown on Figures 3-1 through 3-3
- Sample depth in inches
- Sample Date in YYYYMMDD
- Example: **SED-QALR1(0-6)-20231103**
- Field duplicate samples
    - SFD (for Sediment Field Duplicate)
    - Sequential number
    - Sample Date in YYYYMMDD
    - Example: **SFD-1-20231103**

Sheen samples

- Media sampled (SHN)
- Location of sample
    - Biased samples will use the sheen assessment observation identifier (e.g., QALR1, QALR2, etc.)
    - Background samples will use the location identifier shown on Figure 3-1
- Sheen type (i.e., R for rainbow or F for translucent film)
- Sample Date in YYYYMMDD
- Example: **SHN-QALR1-R-20231103**
- Trip blank samples
    - SHNTB (for Sheen Sample Trip Blank)
    - Sequential number
    - Sample Date in YYYYMMDD
    - Example: **SHNTB-1-20231103**

5 Laboratory Analysis and QA/QC

Required laboratory analysis to assess the identified COPCs are described below. As directed by USEPA, the COPC list is consistent with the COPCs analyzed for in Appendices H1 and H2 (Arcadis 2023e and 2023g)..

5.1 Sediment

Sediment will be analyzed for the COPCs listed in Table 1-1 using USEPA Methods 8260 (VOCs), 8270 (SVOCs), and 8015 (Glycols). If composite sediment samples are collected, these samples will be submitted for non-VOC analysis only, with separate distinct grab samples collected for VOC analysis. Select sediment samples will also be submitted for total organic carbon analysis and grain size analysis to provide additional general information on sediment properties consistent with the July/August 2023 sampling event. These will include those locations not previously sampled for these parameters in July/August 2023, and will include the biased locations and a subset of background locations.

Equipment blanks (consisting of rinsate from sampling equipment), field duplicates, and matrix spike/matrix spike duplicates (MS/MSDs) will be collected and analyzed as outlined in the QAPP (Arcadis 2023h).

Deliverables will be requested from the laboratory for work conducted under this Plan, and data validation consistent with USEPA guidelines will be completed on each sample data group per the QAPP (Arcadis 2023h).

All analytical results will be uploaded into NSRC's EQuIS database in accordance with the QAPP (Arcadis 2023h).

5.2 Sheens

The nets will be analyzed for the COPCs provided in Table 1-1 using USEPA Methods 8260 (VOCs), 8270 (SVOCs), and 8015 (Glycols) to identify those analytes present in the samples. Results will be reported by the laboratory as mass per net. There are no screening levels for sheen samples; these are provided only for purposes of identifying the analytes present in the sample.

Trip blanks will be collected and analyzed as outlined in the QAPP (Arcadis 2023h).

Deliverables will be requested from the laboratory for work conducted under this Plan, and data validation consistent with USEPA guidelines will be completed on each sample data group per the QAPP (Arcadis 2023h).

All analytical results will be uploaded into NSRC's EQuIS database in accordance with the QAPP (Arcadis 2023h).

6 Schedule and Reporting

Figure 6-1 provides a detailed schedule for completing the investigation actions described in Section 3 as well as the associated reporting. Key schedule requirements per the Order are also identified. Each of the investigation actions included herein are proposed as a one-time event. The need and timing for any additional sampling events will be determined based on the results per the DQOs provided in Section 1.

Field work will start with the qualitative sheen assessment in Leslie Run working downstream to upstream. The actual starting location will be determined based on access agreements in place at the time the assessment begins. Sediment sampling will begin at the baseline and background locations concurrent with the qualitative sheen sampling, and then sediment and sheen sampling will be conducted at the biased locations. This approach will allow time to process the assessment findings and determine the biased sampling locations.

Ohio law requires calling 800-362-2764 or 8-1-1 and/or submitting a dig notification request through OHIO811 at least 48 hours (not including weekends and holidays) and no more than ten working days before digging. Based on previous work, it is not anticipated that the planned work will be impacted by utilities.

Field data (e.g., qualitative sheen values, coordinates, field observations, sample descriptions, photographs, etc.) will be provided to USEPA on a web-based portal. Field data will undergo internal quality review and will be expedited for provision to USEPA. Qualitative sheen scores, location IDs, date and time of collection, and coordinates for each observation location will be transmitted USEPA electronically in tabular format the day after collection. Field data will undergo internal quality review and will be expedited for provision to USEPA. Field data will be transmitted every 1-2 days during field activities.

Qualitative sheen assessment results collected over time will be overlain on a map of the creeks to graphically illustrate changes in sheen scores over time (i.e., March, May, and November events). All sediment data will be compared to ESLs and HHSLs to determine where exceedances of these screening levels may be present. Biased results will be assessed to determine if resulting sediment concentrations are correlated with qualitative sheen designations (i.e., scores of 2 and 3). Baseline sediment data will be evaluated to determine how concentrations have changed over time. Results from background locations will be considered to determine whether detected COPCs may be a result of the derailment and/or present historically. Resulting sheen data will be evaluated to assess which COPCs are present in the sheen and if detected COPCs are correlated to results obtained in the sediment samples.

Note that the pore water sampling setup established during the July/August 2023 investigation (i.e., screen, tubing, etc.) will be removed from the creeks during this effort.

7 References

Arcadis. 2023a. Pre-Rainfall Event Sediment Sampling Work Plan. February 15.

Arcadis. 2023b. Sediment Reconnaissance Sampling Work Plan. February 17.

Arcadis. 2023c. Sediment Sampling Work Plan. February 21. Plan included in Appendix H of the March 2023 Removal Work Plan.

Arcadis. 2023d. East Palestine Trail Derailment Site Sediment Quality Assurance Project Plan. Rev 4. July 21.

Arcadis. 2023e. Appendix H1 – Sulphur Run Characterization Work Plan. Rev 2. July 11.

Arcadis. 2023f. East Palestine Trail Derailment Site Sediment Quality Assurance Project Plan – Appendix H2. Rev 3. August 8.

Arcadis. 2023g. Appendix H2 – Leslie Run and Downstream Creeks Characterization Work Plan. Rev 2. July 31.

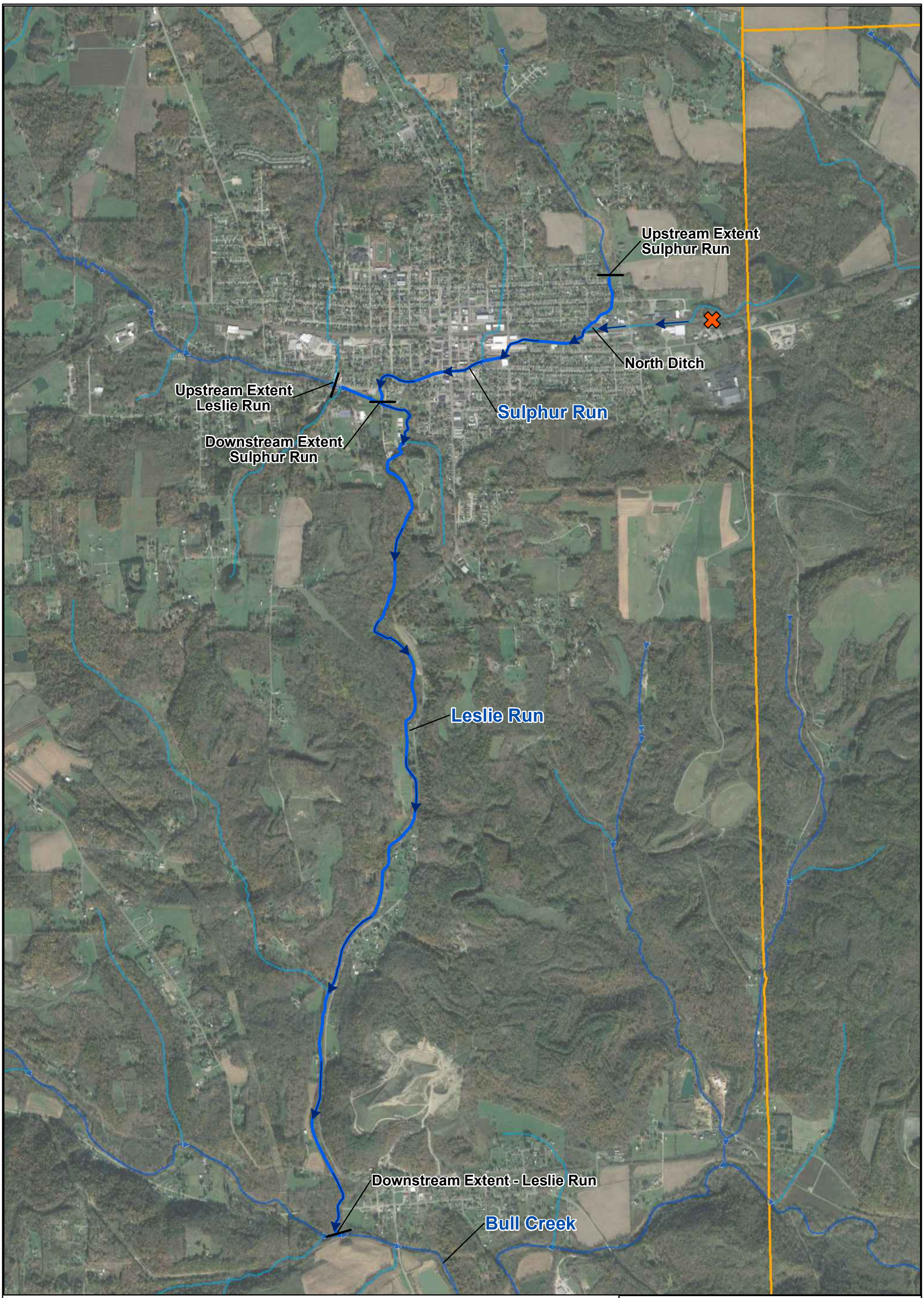
Arcadis 2023h. East Palestine Trail Derailment Site Qualitative Sheen and Sediment Investigation Quality Assurance Project Plan. Rev 0. October 27.

CTEH. 2023. Air Knifing Operations Assessment and Data Summary, February 21-April 15, 2023.

EnviroScience. 2023. East Palestine, Ohio – Qualitative Stream Sediment Assessment Sampling and Analysis Plan. March 15.

OEPA. 2023. Fact Sheet released by the Division of Water: Water Quality in Leslie Run and Sulphur Run. October. https://epa.ohio.gov/static/Portals/47/citizen/StreamUpdate.pdf

Figures



Legend

- Incident Location
- Ohio/Pennsylvania State Line
- Investigation Extent
- Flow Path from Derailment

NHD Flowlines

- Other Creek/Run Channels/Unnamed Tributaries

Map Date: 10/30/2023

Service Layer Credits:

0 0.5

Miles

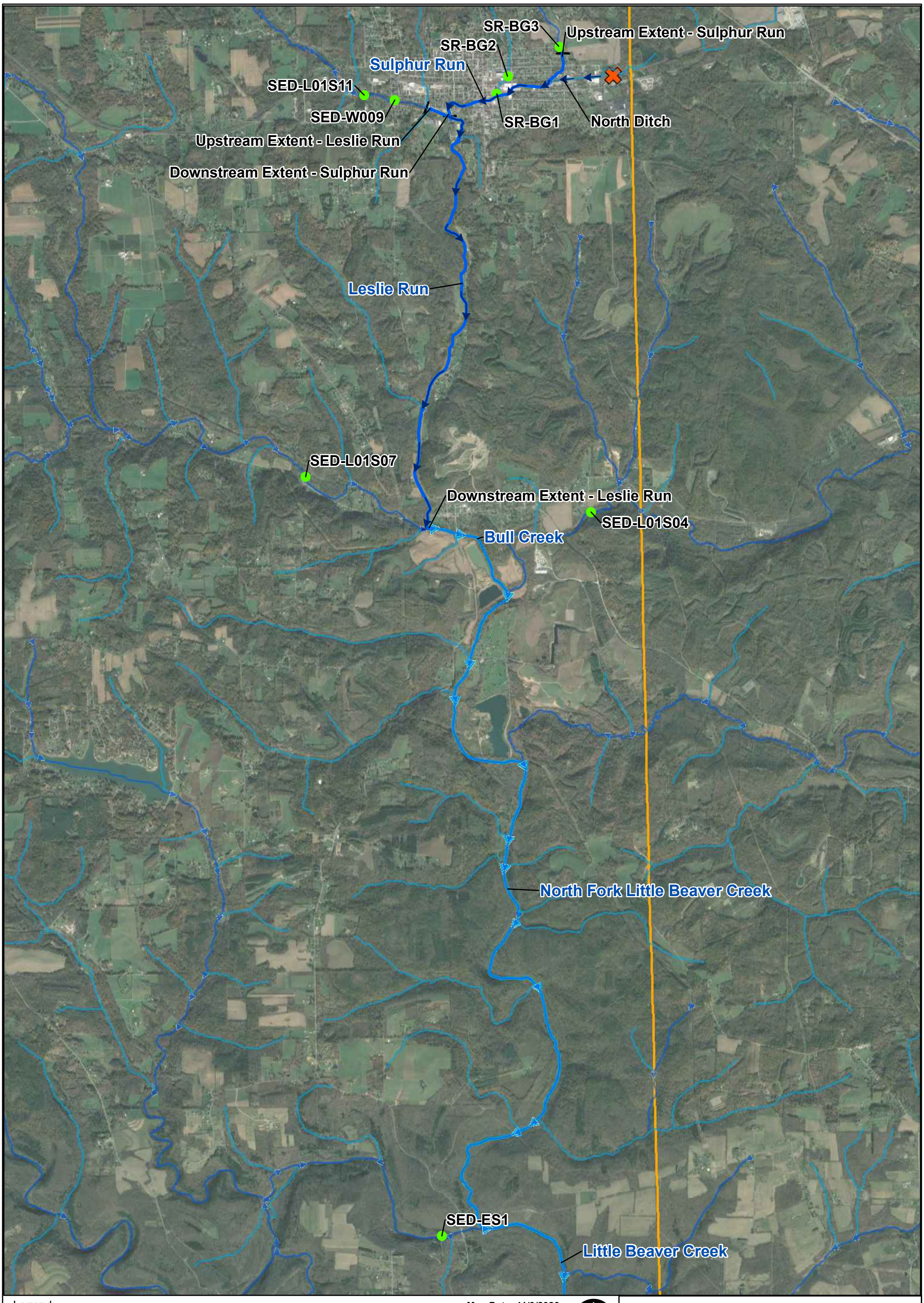
NORFOLK SOUTHERN
EAST PALESTINE, OHIO

INVESTIGATION EXTENT

ARCADIS

FIGURE
1-1

Document Path: T:_ENV\Norfolk Southern\East Palestine_Feb5_2023\MXD\SedimentSampling\Report Figures\Figure 1-1_Investigation Extent.mxd



Legend

- Incident Location
- Background Sample Location
- Investigation Extent
- Flow Path from Derailment
- Other Creek/Run Channels/Unnamed Tributaries
- Ohio/Pennsylvania State Line

Map Date: 11/3/2023

Service Layer Credits:

0 0.5

Miles

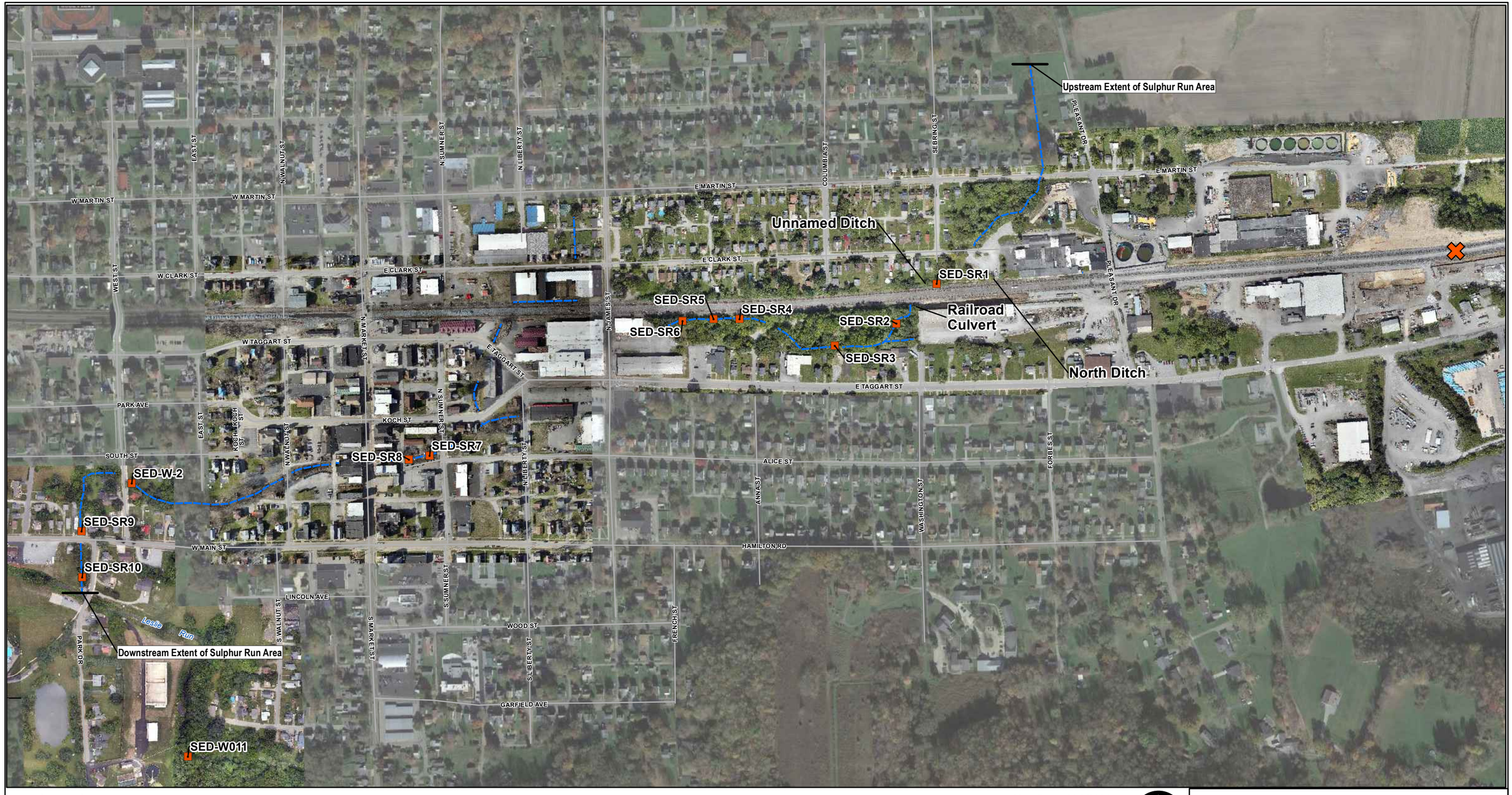
NORFOLK SOUTHERN
EAST PALESTINE, OHIO

BACKGROUND SAMPLING LOCATIONS

ARCADIS

FIGURE
3-1

Document Path: T:_ENV\Norfolk Southern\East Palestine_Feb5_2023\MXD\SedimentSampling\Report Figures\Figure 3-1 Background Sampling Locations.mxd



Legend

- Incident Location
- Sulphur Run
- 2023 Baseline Sediment Sample

Map Date: 11/3/2023

Drone image onsite dated: 10/23/2023
Drone image offsite dated: 10/23/2023

0 430 860
Feet

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

SULPHUR RUN BASELINE SAMPLING LOCATIONS

ARCADIS

FIGURE
3-2

Document Path: T:_ENV\Norfolk Southern\East Palestine_Feb5_2023\MXD\SedimentSampling\Report Figures\Figure 3-2_Sulphur Run Baseline Sampling Locations.mxd

Upstream Extent of Leslie Run Area

SED-L01S10

SED-W011

SED-LR-01

SED-LR-02

SED-W001R

SED-LR-03

SED-L01S09

SED-W004

SED-LR-04

SED-05

SED-602010

Downstream Extent of Leslie Run Area

SED-06

Legend

- 2023 Baseline Sediment Sample
- 2023 Target Sample - Not Collected

Map Date: 11/3/2023

Service Layer Credits:

0 1,250 2,500

Feet

NORFOLK SOUTHERN
EAST PALESTINE, OHIO

LESLIE RUN
BASELINE SAMPLING LOCATIONS

ARCADIS

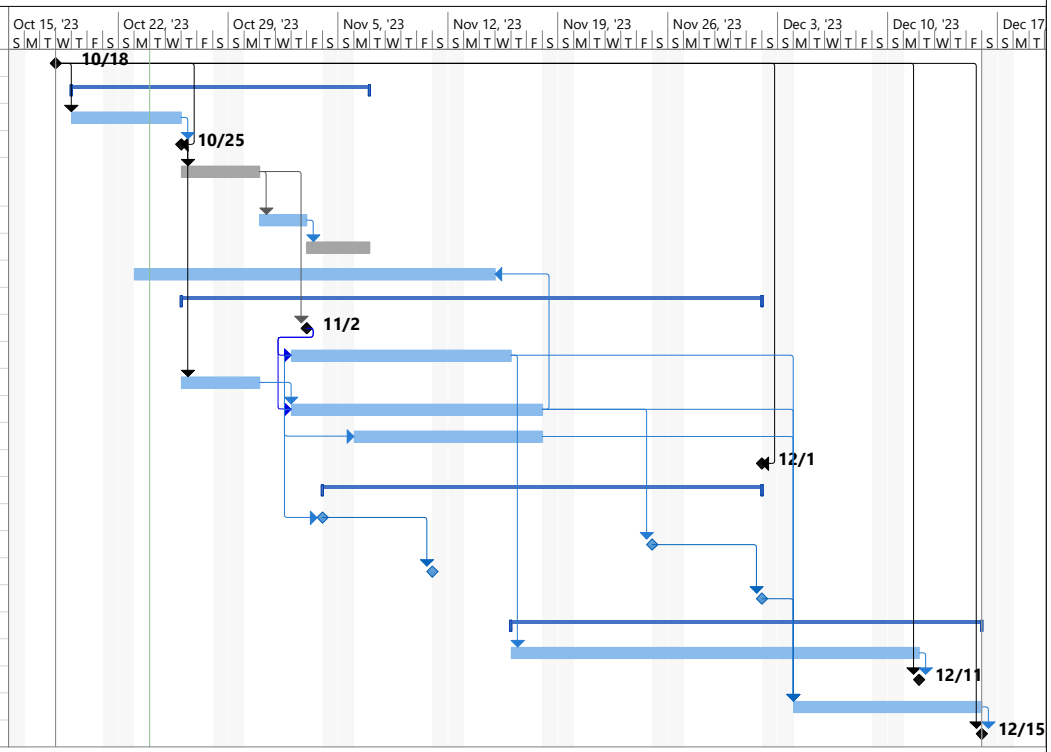
FIGURE
3-3

Document Path: T:_ENV\Norfolk Southern\EastPalestine_Feb5_2023\MXD\SedimentSampling\Report Figures\Figure 3-3_ Leslie Run Baseline Sampling Locations.mxd

Figure 6-1: Detailed Investigation Schedule

East Palestine Train Derailment Site, East Palestine, Ohio

ID	Task Name	Duration	Start	Finish	Predecessors
1	CWA 311 Order Issued	1 day	Wed 10/18/23	Wed 10/18/23	
2	Comprehensive Sheen and Sediment Work Pla	13 days	Thu 10/19/23	Mon 11/6/23	
3	Draft plan	5 days	Thu 10/19/23	Wed 10/25/23	1
4	Submit draft plan	0 days	Wed 10/25/23	Wed 10/25/23	1FF+5 days,3
5	USEPA review/comments and assumed approval with modifications	3 days	Thu 10/26/23	Mon 10/30/23	4
6	Revise and finalize plan	3 days	Tue 10/31/23	Thu 11/2/23	5
7	USEPA approval	2 days	Fri 11/3/23	Mon 11/6/23	6
8	Access agreements	17 days	Mon 10/23/23	Tue 11/14/23	13FF-3 days
9	Investigation Actions	27 days	Thu 10/26/23	Fri 12/1/23	
10	Order date to start investigations	0 days	Thu 11/2/23	Thu 11/2/23	5FS+3 days
11	Qualitative sheen assessment	10 days	Thu 11/2/23	Wed 11/15/23	10FS-1 day
12	Utility clearance	3 days	Thu 10/26/23	Mon 10/30/23	4
13	Sediment sampling	12 days	Thu 11/2/23	Fri 11/17/23	10FS-1 day,12
14	Sheen sampling	10 days	Mon 11/6/23	Fri 11/17/23	11SS+2 days
15	Order final date for investigations	0 days	Fri 12/1/23	Fri 12/1/23	1FF+32 days
16	Analytical Testing and Results	20 days	Fri 11/3/23	Fri 12/1/23	
17	Initiate laboratory testing	0 days	Fri 11/3/23	Fri 11/3/23	13SS+2 days
18	Complete laboratory testing	0 days	Fri 11/24/23	Fri 11/24/23	13FS+5 days
19	Initiate data validation	0 days	Fri 11/10/23	Fri 11/10/23	17FS+5 days
20	Complete data validation	0 days	Fri 12/1/23	Fri 12/1/23	18FS+5 days
21	Reporting	22 days	Thu 11/16/23	Fri 12/15/23	
22	Draft sheen assessment results	18 days	Thu 11/16/23	Mon 12/11/23	11
23	Submit comprehensive survey report	0 days	Mon 12/11/23	Mon 12/11/23	1FS+38 days,22
24	Draft comprehensive report	10 days	Mon 12/4/23	Fri 12/15/23	11,13,14,20
25	Submit full report	0 days	Fri 12/15/23	Fri 12/15/23	1FS+42 days,24



Project: Figure_7-1-Schedule
Date: Tue 10/24/23

Task | Summary | Manual Task | Progress
Milestone | Project Summary | Manual Summary | Manual Progress

Note: This schedule is an estimate and is subject to change based on several factors, including without limitation, obtaining required regulatory approvals, securing access to relevant properties, weather, equipment malfunction, receipt of validated laboratory results, etc.

Appendix A

Standard Operating Procedures

- Standard Operating Procedure #1: Sediment Characterization via Probing and Sampling
- Standard Operating Procedure #3: Surface Water Sheen Sampling

Standard Operating Procedure #1: Sediment Characterization via Probing and Sampling

Rev: 4

Rev Date: October 2023

1 Introduction

This Standard Operating Procedure (SOP) describes the general methods and procedures to characterize the stream via probing and sediment collection. This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Certified Project Manager (CPM) as well as a Technical Expert and reviewed with Incident Command and agreed upon prior to implementing. In addition, any changes will be documented through field notes and photographed as appropriate.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document.

It is the responsibility of the Arcadis CPM to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Related Documents

- Sediment Characterization Work Plan
- Quality Assurance Project Plan (QAPP)
- Health and Safety Plan (HASP)

4 Description of the Procedure

4.1 Pre-Collection

Arcadis field personnel will be versed in the relevant SOPs and will possess the skills and experience necessary to successfully complete the desired field work. Staff assigned the responsibility of collecting cores, samples, and probing information will be provided with the following information:

- Work documents;
- Site maps;
- Collecting and processing procedures; and
- Special instructions (if any).

4.2 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (as required by the HASP)
- Real-Time Kinematic (RTK) survey equipment
- Appropriate sample containers, labels, and forms
- Chest waders/personal floatation device
- Decontamination supplies
- Surveyor's rod
- Calibrated probe rod (⅝-inch outside-diameter metal pipe with maximum graduations of tenths of feet)
- Shovel
- Trowel
- Post-hole digger
- Steel sampling barrel (fitted with a clear PVC liner), slide hammer, and/or use of a jackhammer attachment
- Soil recovery auger containing an expendable liner
- Six-foot rule
- Plastic sealable bags
- Trash bags
- Indelible ink markers
- Digital camera
- Appropriate transport containers and packing, labeling, and shipping materials (coolers) with ice
- Field notebook

4.3 Field Notes

Field notes will be recorded during probing and/or sediment sampling activities, and at a minimum, will include the following:

- Names of field crew and oversight personnel if present;
- General weather conditions;
- Date, time, and sampling locations;
- Total water depth, probing depth, and material descriptions; and
- Any general observations.

Field crews will primarily record field information in a field notebook.

4.4 Stream Bed Probing Procedures

Probing efforts will be performed either as a stand-alone effort or in combination with sediment collection efforts. The following procedures describe the probing efforts.

1. Don personal protective equipment (as required by the HASP).
2. Locate the target location using RTK surveying techniques and identify the proposed probing location in the field notebook.
3. Measure the total depth of the water column using a surveyor's rod to the nearest 0.1 foot and record. Record the water surface elevation using RTK surveying techniques (i.e., elevation above sea level of the water's surface at the target location).
4. Lower the calibrated probing rod through the water column slowly to the stream bed surface.
5. Advance the rod vertically through the stream bottom materials to refusal using reasonable human force (e.g., arm strength and body weight). The depth of refusal will be interpreted as the interface between soft material (e.g., sediment) and rock or stiff bottom. Record depth, type, and presence of debris or obstructions.
6. Estimate the material thickness and type of material present. The thickness will be determined based on the water depth and the depth of refusal (i.e., depth of refusal minus water depth). The type of material present will be determined by feel of the probe rod as it advances (e.g., soft material, sand, clay, gravel, rock).

4.5 Sediment Collection Procedures

Sediment sampling efforts will be performed in combination with probing as described in Section 4.4. If probing indicates little to no sediment present, expand the probing efforts to an area around the sampling target location in accordance with the plan in an effort to identify a location with recoverable sediment. The following procedures describe the sediment sampling efforts.

1. Don personal protective equipment (as required by the HASP).
2. Locate the target sample location using RTK surveying techniques and confirm recoverable sediment present for sampling.
3. Identify the proposed sample location in the field notebook, document actual sampling coordinates using RTK surveying, and record other appropriate information collected during sampling activities.
4. Conduct steps outlined in Section 4.4. Determine the appropriate sampling equipment based on the results of the probing efforts (i.e., sediment thickness present and creek bed conditions including conditions at probe

rod refusal such as rocks or clay) and sediment type present (i.e., finer-grained versus coarser materials). Sampling options include a decontaminated stainless-steel trowel, post-hole digger, soil recovery auger containing an expendable liner, coring using a steel sampling barrel with slide hammer, or coring using a hand auger. Attempt collection using the selected option and adjustment selected method as needed based on sample recovery. Document the selected sampling techniques and rationale for its selection.

5. Lower the selected sampling equipment until it just reaches the stream bottom. Collect the sample from the stream bottom to the depth targeted in the plan or to refusal pending sub-surface conditions as determined through probing. The trowel and post-hole digger will primarily be used to collect sediment from the top 6 inches through scooping or grabbing. Collection of sediment up to 12 inches will be performed by coring using the sampling barrel with slide hammer or a hand auger – see steps a-b below for additional details.

    a. Coring will be performed using the steel sampling barrel with slide hammer. Insert the expendable liner into the sampling barrel. Drive the sampling barrel into the stream bottom to the targeted depth using a slide hammer. If refusal is met prior to target sample depth, reposition the sampling barrel readvance using the same method. Coring efforts will be considered complete and at refusal once several uses of the slide hammer does not advance the core further into the stream bed. (Note: previous sediment work at the site was successful using this method to depths beyond 1 foot below sediment surface.)

    b. Coring may also be performed using a soil recovery hand auger. Insert an expendable liner in the recovery auger body. Advance the hand auger using manual methods through rotation to the target depth. If refusal is met prior to target sample depth, reposition the sampling barrel readvance using the same method. Coring efforts will be considered complete and at refusal once the auger cannot longer be advanced further into the stream bed.

6. Record thickness of recovered material to determine the sample depth.

7. Slowly recover the sampling equipment from the stream bed and secure material as needed before it breaks the water surface.

8. Observe the sediment surface during sampling for evidence of impacts; record observations on the field form.

9. Photograph the sample location and general area (upstream, downstream, and each bank) to document conditions. Record observations of major landmarks or features of the channel morphology, adjacent bank conditions, and vegetative zones.

10. Document the appearance and recovery of the sample to confirm acceptability of the sample; sample finer-grained material (such as silt and sand, no to minimal gravel) only. Samples containing primarily gravel, stone, or rocks are not acceptable for analytical testing and will be rejected, placed back in the stream, and a new sample will be collected.

11. Photograph the sample. Describe sediment sample according to color, texture and grain size and document other observations such as type of organic material present, odor, sheen, staining, etc. and document.

12. Process samples for submittal to the laboratory. As appropriate, sediment samples will be collected in laboratory supplied and pre-preserved containers for the specified testing method. Collect ample volume of sediment for the proposed analysis. If adequate volume is not available from a single grab sample, multiple grab samples may be collected, composited and thoroughly homogenized to form a single sample for non-VOC analysis. If the event of compositing, document the area samples and number of grab samples collected and collect an additional grab sample for VOC analysis. Fill containers intended for volatile analysis with

sediment sample as soon as possible and prior to homogenization (except for composite samples) in accordance with the QAPP. Homogenize the sample and fill bottleware intended for non-VOC analysis in accordance with the QAPP.

13. Label sample containers in accordance with the procedures presented in the work plan.
14. Once the sample is collected in the appropriate container(s), place on ice in a cooler.
15. Thoroughly decontaminate reusable sampling equipment between each sample using Alconox® or similar product and triple rinse utilizing distilled water. Repeat the above procedures until all samples are collected.
16. Fill out the chain of custody form and handle, pack, and ship the samples in accordance with the procedures described in the QAPP.

5 Waste Management

Investigative-derived waste generated during the sampling activities and disposable equipment will be transported for offsite disposal in accordance with the site-specific Waste Management Plan.

6 Data Recording and Management

All sample and location measurements and observations will be maintained in a field notebook or log. Upon project completion, field notebooks will be forwarded to the Project Manager for storage in the project files.

7 Quality Assurance

Samplers will forward copies of field notes and chains of custody to the CPM for quality assurance checks during project implementation at a frequency determined by the CPM.

Field duplicates and other quality assurance samples (e.g., rinse blanks, trip blanks) will be collected at the frequency presented in the QAPP. Sample quality will be achieved by complying with the procedures outlined in this SOP and by following site-specific plans. Cross-contamination will be prevented by following the protocols described in the QAPP or SOP for Field Equipment Decontamination. Field activities will be supervised by appropriate experienced field supervisors. Additional quality assurance information is presented in the project-specific QAPP.

- END OF PROCEDURE

Standard Operating Procedure #3: Surface Water Sheen Sampling

Rev: 1

Rev Date: August 2023

1 Introduction

This Standard Operating Procedure (SOP) describes the general methods and procedures for collection of surface water sheen samples. This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Certified Project Manager (CPM) as well as a Technical Expert and reviewed with Incident Command and agreed upon prior to implementing. In addition, any changes will be documented through field notes and photographed as appropriate.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document.

It is the responsibility of the Arcadis CPM to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Related Documents

- Sediment Characterization Work Plan
- Quality Assurance Project Plan (QAPP)
- Health and Safety Plan (HASP)

4 Description of the Procedure

4.1 Pre-Collection

The sampling nets will be purchased from the vendor. Arcadis field personnel will be versed in the relevant SOPs and will possess the skills and experience necessary to successfully complete the desired field work. Staff assigned the responsibility of collecting samples will be provided with the following information:

- Work document;

- Site maps;
- Collecting and processing procedures; and
- Special instructions (if any).

4.2 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (as required by the HASP)
- Real-Time Kinematic (RTK) survey equipment
- Appropriate sample containers, labels, and forms
- Chest waders/personal floatation device
- Calibrated probe rod (⅝-inch outside-diameter metal pipe with maximum graduations of tenths of feet)
- Teflon® (tetrafluorethylene [TFE]-fluorocarbon polymer) sheen sampler net, 4-inch diameter (vendor: https://www.generaloceanics.com/net-oil-sampling-4-dia-teflon-5080-250.html)
- Polarizing filter
- Plastic pipe
- Zip ties
- Indelible ink markers
- Digital camera
- Appropriate transport containers and packing, labeling, and shipping materials (coolers) with ice
- Field notebook

4.3 Field Notes

Field notes will be recorded during sampling activities, and at a minimum, will include the following:

- Names of field crew and oversight personnel if present;
- General weather conditions;
- Date, time, and sampling locations;
- Sheen observations; and
- Any general observations.

Field crews will primarily record field information in a field notebook.

4.4 Sampling Procedures

The following procedures describe the collecting sheen samples from surface water.

1. Don personal protective equipment (as required by the HASP), including nitrile gloves.
2. Prepare the nets for use to collect the sheen. Start with the decontaminated nets received from the laboratory. Attach the net to the sampling ring.
3. Mobilize to the sampling location. Locate the target location using RTK surveying techniques and identify the proposed location in the field notebook.
4. While maintaining careful footing and balance, disturb the surface of the sediment bed with feet, by turning over rocks, or using probe rod to attempt to generate a sheen that can be visually observed on the water surface.
5. Photograph the sheen using a digital camera with standard photographic polarizing filter. Prior to taking the photo, hold the filter between your eye and the sheen, and rotate through 90 degrees to optimize the polarization by maximizing or minimizing admission of polarized light. The rotation of polarizing filter will screen out glare from reflective water surface in order to allow the true colors of sheen to pass through the camera sensor. Once the optimum orientation of the polarizing filter is determined, hold the filter in the optimum orientation between the camera lens and the area to be photographed. Take a photo with the polarizing filter looking down on the fluid surface (i.e., when the polarization is parallel to the fluid surface). Take a second a photo with the polarizing filter looking along the fluid surface (i.e., when the polarization is perpendicular to the fluid surface). Record the use of the polarizing filter, approximate photo direction (north, east, northeast, etc.), and photo number for each photo in the field book.
6. Observe and document the color (i.e., silver/gray, rainbow, metallic, dark/true color, or translucent – see table below) and structure of the sheen (i.e., streamers, patches, spots, or no structure).

Color	Code	Description
Sheen (Silver/Gray)	**S**	Near **transparent** for thinnest layers to **silver/gray** for slightly thicker.
Rainbow	**R**	Rainbow colors are visible.
Metallic	**M**	The sheen reflects/mirrors the color of the sky with some element of oil color, often between light gray and dull brown.
Dark (or True) Color	**D**	The sheen is a continuous true oil color.
Translucent	**F**	Translucent sheen / film characterized as “Biofilm”

7. Pass the net through the oil sheen to collect the sample. Get as much of the net in contact with the surface sheen as possible. The net is used in a mop-like manner, not straining. Hold the net so that the opening of the ring is perpendicular to the surface of the water. Submerge the ring so that about half of the ring is above the surface of the water and half is below the surface of the water. Move the ring parallel to the surface of the water and through the sheen, back and forth. The sheen will stick to the net.

8. Repeat Steps 5 and 7 throughout the extent of the target area. A minimum of three passes will be made with the same net to capture an adequate quantity of sheen for analytical analysis.
9. Remove the net from the ring by unsnapping the ring and rotating the net off the ring.
10. Place the net in a laboratory supplied sample container.
11. Secure the sample jar cap tightly.
12. Label the sample container in accordance with the tactic using indelible ink.
13. Place filled sample containers on ice in a cooler.

5 Cautions

Vendor purchased Teflon® nets often are not sufficiently decontaminated to prevent false positives from laboratory analysis. Coordinate with the selected laboratory to analyze trip blanks or other approved method to confirm no decontamination.

Do not touch the sheen sample net with bare hands, as oils from the skin can be detected in the analysis and will interfere with the sheen analytical results.

Typically, either a large sheen or a number of small sheens need to be sampled with one net to get sufficient mass on the net for adequate laboratory reporting limits. If the sheen is blossoming in single drops, approximately ten drops are needed to have sufficient mass. If there is not enough mass on the net, there may be elevated reporting limits because of laboratory analytical challenges.

6 Waste Management

Investigative-derived waste generated during the sampling activities and disposable equipment will be transported for offsite disposal in accordance with the site-specific Waste Management Plan.

7 Data Recording and Management

All sample and location measurements and observations will be maintained in a field notebook or log. Upon project completion, field notebooks will be forwarded to the Project Manager for storage in the project files.

8 Quality Assurance

Samplers will forward copies of field notes and chains of custody to the CPM for quality assurance checks during project implementation at a frequency determined by the CPM. Sample quality will be achieved by complying with the procedures outlined in this SOP and by following the site-specific tactic. Cross-contamination will be prevented by following the protocols described in the SOP. Field activities will be supervised by appropriate experienced field supervisors.

- END OF PROCEDURE

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