EAST PALESTINE TRAIN DERAILMENT SITE

EAST PALESTINE, OH

SURFACE WATER SAMPLING AND ANALYSIS PLAN (SWSAP)

Version 4.3

Prepared on Behalf of:

Norfolk Southern Railway Company

Prepared By:

CTEH, LLC
5120 Northshore Drive
Little Rock, AR 72118
501-801-8500

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SWSAP APPROVAL PAGE

Ralph Dollhopf USEPA Region 5 / USEPA Incident Commander	Date
Robert Wood NSRC Incident Commander	Date
Steven Aufdenkampe NSRC Operations Director	Date
Kelly Scinker Tuttle Dr. Kelly Tuttle, Ph.D., CIH, DABT CTEH Project Technical Director	June 28, 2023 Date
Ethan Currie Ethan Currie, CSP CTEH Project Manager	June 28, 2023 Date
Lourdes Mahoney, CHMM CTEH Project QA Director	June 28, 2023 Date

CHANGE MANAGEMENT

DATE	VERSION NUMBER	REASON FOR CHANGE	REVIEW PROCESS	NAME*	SIGNATURE
Feb. 6, 2023	1.0	Original Version	Author	Kamie Stecher	
			Reviewer	Kelly Tuttle, Ph.D., CIH, DABT	Kelly Scribner Tuttle
Feb. 11, 2023	2.0	Addition of TPH and specific VOCs to analyte table	Preparer	Kamie Stecher	
			Preparer	Jody Hawkins	Not signed here
			Reviewer	Kelly Tuttle	Kelly Scribner Tuttle
March 2, 2023	3.0	Updated title to Unified Command response title, removed preliminary from subtitle. Section 4.2.3 Added sampling location language. Updated method table to include USEPA 8015. Updated Introduction with reference to the overall Removal Action Plan	Preparer	Jody Hawkins	Not signed here
			Reviewer	Kelly Tuttle, Ph.D., CIH, DABT	Kelly Scribner Tuttle
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			Reviewer	Amanda Bates Vanlandingham, MS	Amanda Bates Vanlandingham
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			Reviewer	Lourdes Mahoney, CHMM	
May 14, 2023	4.2	Updated fonts, added language to a few sections, added paragraph in Section 4.1, incorporated comments received from EPA on May 10 from version 4.0. Removed reduction plan as Appendix C and Stream Mitigation Operational Procedures Appendix, referred to SW QAPP as a separate document.	Preparer	Kelly Tuttle, Ph.D., CIH, DABT	Kelly Scribner Tuttle
			Reviewer	Lourdes Mahoney, CHMM	
June 19, 2023	4.3	Updated based upon comments and conversations with EPA on 6/13/23, 6/15/23 and 6/19/2023. Moved Change management section. Updated Figure 1.5b. Added glycols back in.	Preparer	Kelly Tuttle	Kelly Scribner Tuttle
			Reviewer	Lourdes Mahoney	

*Note if not a CTEH team member in this column

DISTRIBUTION LIST

SWSAP RECIPIENTS	TITLE	ORGANIZATION	E-MAIL ADDRESS
Ralph Dollhopf	Incident Commander	US EPA Region 5	dollhopf.ralph@epa.gov
Marc Ferries, P.E.	Project Coordinator	Project Navigator	mferries@projectnavigator.com
Jeffrey Barwick, P.E.	QA Coordinator	NSRC	jeffrey.barwick@nscorp.com
Steven Aufdenkampe	NSRC Operations Director	NSRC	steven.aufdenkampe@nscorp.com
Bryan Naranjo	NSRC Commander	NSRC	bryan.naranjo@nscorp.com
Robert Wood	NSRC Commander	NSRC	Robert.wood2@nscorp.com
Michelle Kerr	Environmental Unit Leader	US EPA Region 5	Kerr.michelle@epa.gov
Jared Starkey	Project Manager	Pace Analytical, Inc	Jared.starkey@pacelabs.com
Shelley Bourgeois	Corporate Accounts Manager	Pace Analytical, Inc.	shelley.bourgeois@pacelabs.com
Ammie Martin	QA Auditor	Environmental Standards, Inc.	amartin@envstd.com
Kelly Tuttle, Ph.D., CIH, DABT	Project Technical Director	CTEH, LLC	ktuttle@cteh.com
Ethan Currie, CSP	Project Manager	CTEH, LLC	ecurrie@cteh.com
Cole Tinsley, EIT	Rotating PM	CTEH, LLC	ntinsley@cteh.com
Lourdes Mahoney, CHMM	Project QA Director	CTEH, LLC	lmahoney@cteh.com
Christine Gay, MBA, PMP, LSSBB	Project QA Consultant	CTEH, LLC	cgay@cteh.com
Sarah Burnett, Ph.D.	Toxicologist	CTEH, LLC	sburnett@cteh.com
Dana Currie, Ph.D.	Toxicologist	CTEH, LLC	dcurrie@cteh.com
Kaitlyn Podufalski	Data Validation Manager	EnvStd	kpodufalski@envstd.com
Heather Tahon	Field Oversight Proj. Director	Geosyntec Consultants	htahon@geosyntec.com
James Culp	Field Oversight Proj. Manager	Geosyntec Consultants	jculp@geosyntec.com

LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYM OR ABBREVIATION	DEFINITION OR EXPLANATION
CA	Corrective Action
CCEMA	Columbiana County Emergency Management Agency
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Chain of Custody
COI	Constituent of Interest
CRDL	Contract-Required Detection Limit
CSM	Conceptual Site Model
CTEH	Center for Toxicology and Environmental Health, LLC
DMP	Data Management Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
ESL	Ecological Screening Levels
FB	Field Blank
FRA	Federal Railroad Association
GC	Gas Chromatograph
GIS	Geographic Information System
GPS	Global Positioning System
IAP	Incident Action Plan
IC	Incident Command
ICAL	Initial Calibration
ICV	Initial Calibration Verification
IMT	Incident Management Team
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management Systems
LOQ	Limit of Quantitation
MB	Method Blank
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MDS	Mobile Data Studio
MPC	Measurement Performance Criteria
MQO	Measurement Quality Objectives
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NTSB	National Safety Transportation Board
NSRC	Norfolk Southern Railway Company
ODH	Ohio Department of Health
OEPA	Ohio Environmental Protection Agency

ACRONYM OR ABBREVIATION	DEFINITION OR EXPLANATION
ODNR	Ohio Department of Natural Resources
OSC	On-Scene Coordinators
PAH	Polycyclic aromatic hydrocarbons
PAL	Project Action Level
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PDF	Portable Document Format
PFD	Personal Flotation Device
PM	Project Manager
PPE	Personal Protective Equipment
PRQL	Project-Required Quantitation Limit
PT	Proficiency Testing (previously known as performance evaluation (PE) sample)
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
OSC	On-Scene Coordinator
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SD	Standard Deviation
SDG	Sample Delivery Group
SOP	Standard Operating Procedure
SQLs	Sample Quantitation Limits
SVOC	Semivolatile Organic Compound(s)
SWSAP	Surface Water Sampling and Analysis Plan
TIC	Tentatively Identified Compound
TNI	The NELAC Institute
UAO	Unilateral Administrative Order
UC	Unified Command
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
VC	Vinyl chloride
VOC	Volatile Organic Compound(s)
WP	Work Plan

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1.0 INTRODUCTION

On February 3, 2023, at approximately 20:55 EST, a train derailment occurred near Taggart Road in East Palestine, Columbiana County, Ohio (hereinafter referred to as the “East Palestine Train Derailment Site” or the “Site”). Norfolk Southern Railway Company (NSRC) reported the incident at 22:53 EST to the National Response Center. At that time, it was reported that an unknown number of the train cars had derailed. Later, it was verified that the train consisted of 149 rail cars, 50 of which were affected by the derailment and the rest of which were uncoupled and removed from the site. The rail cars directly impacted by the derailment contained both hazardous materials (i.e., vinyl chloride, butyl acrylate, ethylhexyl acrylate, ethylene glycol monobutyl ether, isobutylene) and non-hazardous materials (e.g., wheat, plastic pellets, propylene glycols, and malt liquors). The derailment resulted in a large fire affecting numerous rail cars, including rail cars carrying hazardous materials that were breached and/or burning. In response to the derailment, Center for Toxicology and Environmental Health, LLC (CTEH®) scientists were mobilized on behalf of NSRC to perform surface water sampling for delineation of impact and ecological and human health assessment.

Federal, state, and local officials, along with NSRC representatives and contractors, mobilized to the site after the derailment, including representatives of the United States Environmental Protection Agency (US EPA), EPA Superfund Technical Assessment Response Team (START), Ohio Environmental Protection Agency (OEPA), Pennsylvania Department of Environmental Protection, Ohio Department of Natural Resources (ODNR), Columbiana County Emergency Management Agency, Butler County Incident Management Team, Village of East Palestine, NSRC and its contractor CTEH, the Federal Railroad Administration, and the National Transportation Safety Board. Many of these comprise the Unified Command (UC).

1.1 Site History

There are no known previous releases at the Site. Thus, this section will focus on further information relevant to the incident and the purpose of this Surface Water Sampling and Analysis Plan (SWSAP or SAP). Releases of hazardous substances occurred after the derailment and subsequent fires. Hazardous substances were released from the rail cars and when smoke from burning rail cars was produced. Releases to surface water occurred when liquid product exited rail cars and also when run-off from firefighting efforts at the derailment location moved through a ditch to Sulphur Run, which joins Leslie Run, to Bull Creek, to North Fork Little Beaver Creek, to Little Beaver Creek, and then the Ohio River. Releases to soil occurred when liquid product exited rail cars.

In response to the incident, NSRC immediately mobilized response personnel to the incident to stop, contain, and recover the released content and rail cars and tank cars. That work continues and has expanded to include efforts to assess the nature and extent of the potential impacts to human health and the environment and to plan and implement actions to address any impacts to provide short- and long-term protection of human health and the environment. Subsequent emergency response activities continue, as well as operations that previously occurred, including the controlled “vent and burn” that occurred on February 6, 2023.

CTEH developed an Environmental SAP upon arrival on-site. Over the course of a few weeks, revisions were made to the SAP (i.e., versions 2.0 to 3.0) to account for updated analytes, operations, and site conditions. Version 4.0 of this SWSAP was prepared to comply with this Uniform Federal Policy (UFP) for this SWSAP in response to the Unilateral Administrative Order (UAO) for Removal Actions (hereinafter, UAO) after preparing the UFP, which was effective February 27, 2023. Version 4.1 and 4.2 included revisions based on EPA comments, updated data quality objectives (DQOs) and decision statements. This SWSAP includes recent comments from EPA, addition of sampling and analyzing a few addition constituents of interest (COIs) (i.e., glycols), and better defining stormwater sampling as a apart of this plan.

This SWSAP addresses the requirements set forth in Section XI (paragraph 40) and Section XII (paragraphs 47 and 48) of the UAO for activities associated with the immediate response for surface water monitoring and sampling activities performed by CTEH on behalf of NSRC. At the time of initial the SWSAP's development (e.g., versions 1.0-4.0), many aspects of the delineation and remediation activities were in planning stages and are not yet final or approved. Accordingly, this SWSAP provides historical and current overall guidance and is intended to assist CTEH in documenting the procedural and analytical requirements for the East Palestine Derailment project involving surface water sampling activities conducted to characterize areas of potential environmental contamination. This document is written in line with the site-specific Surface Water Sampling Quality Assurance Project Plan (SWQAPP v 1.2).

Within the framework of the UAO, this SWSAP will be updated to include QA requirements for additional investigation/delineation and remediation activities as operational activities change, sampling or monitoring is transitioned, or until CTEH is demobilized from the project. Quality objectives associated assessment and remediation of the Site include:

- NSRC and CTEH are committed to deliver products and services that adhere to the UAO, contractual requirements, and applicable guidelines. This includes but is not limited to timely, accurate, and defensible data, written deliverables, and services.
- To achieve DQOs as defined in this SWSAP to support regulatory compliance to the UAO (Table 3.1).
- To collect representative samples and results are valid for its intended use.
- To continually assess and improve work processes to comply with the SW QAPP.
- To collect data to characterize the COIs for data-driven decision making and compare to appropriate screening values (Appendix A).

1.2 Site Name

The site is designated as the "East Palestine Train Derailment Site," per the UAO for Removal Actions published by the US EPA (CERCLA Docket No. V-W-23-C-004).

1.3 Sampling Area Location

The Site is located within a mixed-use residential, commercial, and industrial area, with residential properties northwest, southeast, and south of the Site. Surface water sampling will occur: (1) within the defined work area(s) at the Site; (2) along the nearby Sulphur Run where remedial activities are ongoing; and (3) downstream waterways including Leslie Run, Bull Creek, North Fork Little Beaver Creek, Little Beaver Creek, and the Ohio River. In addition, background samples will be collected from locations upstream of the incident location, or upstream at convergence points in downstream locations. Background samples will be taken periodically throughout the study period. The U.S. EPA in consultation with Unified Command may direct NSRC to modify surface water sampling locations and procedures.

A map showing current locations of surface water sampling is provided in Figure 1.3, and location details are listed in Table 1.3.

Figure 1.3 Active Surface Water Sampling Locations

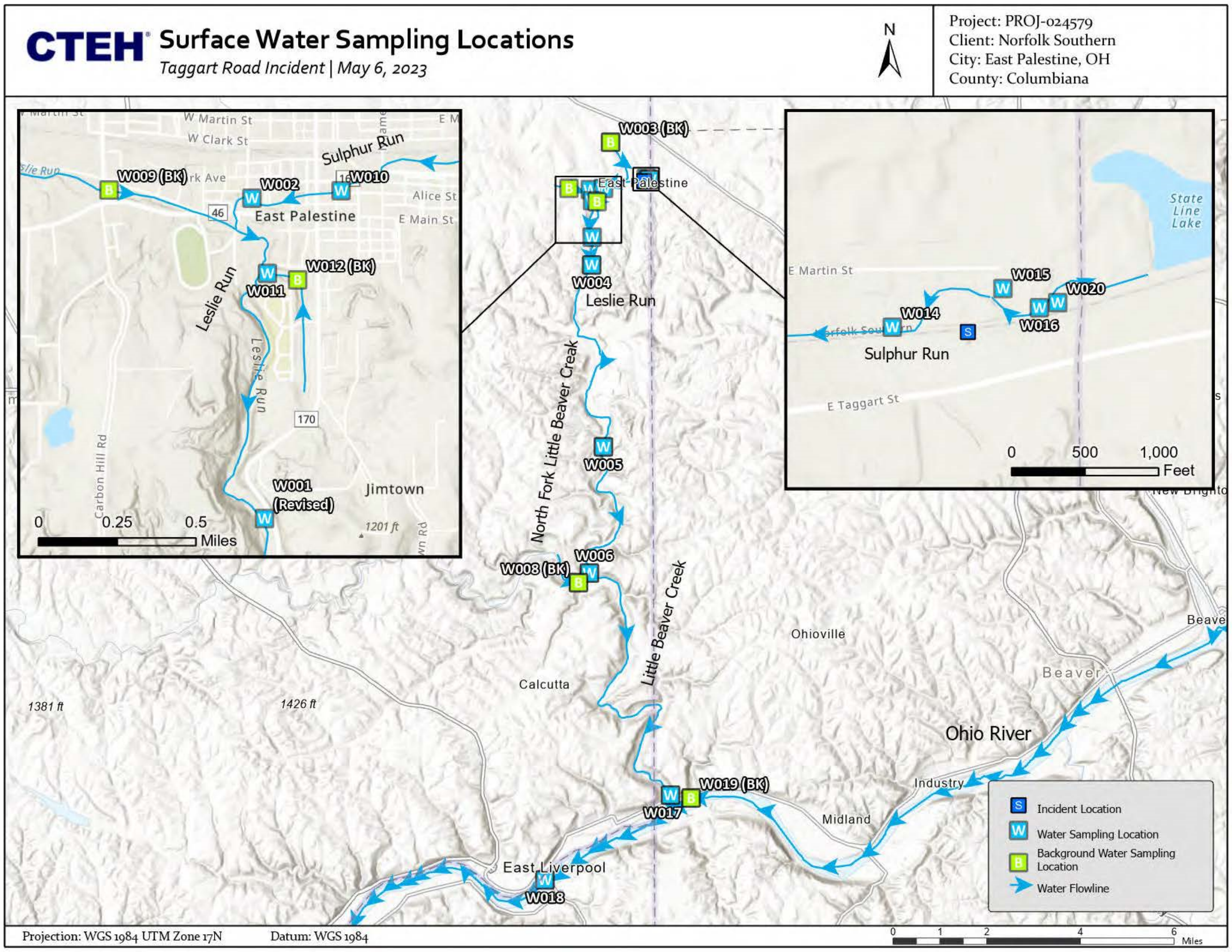

Table 1.3 Active Surface Water Sampling Locations

WATERBODY	LOCATION CODE	LATITUDE	LONGITUDE	LOCATION DESCRIPTION
Leslie Run	W001 (Revised)[1]	40.8187	-80.5433	Leslie Run South of East Palestine City Park
Sulphur Run	W002	40.8334	-80.5438	Sulphur Run - culvert under West St, between South St and Meadow Ln
Sulphur Run	W003 (BK)	40.8483	-80.5347	Sulphur Run at Concord Rd. Upstream of incident site
Leslie Run	W004	40.8102	-80.5430	Leslie Run at Big Valley Raceway
North Fork Little Beaver Creek	W005	40.7538	-80.5389	North Fork Little Beaver Creek approximately 10 yards north of Pancake Clarkson Rd bridge
North Fork Little Beaver Creek	W006	40.7152	-80.5444	North Fork Little Beaver Creek, approximately 20 yards north of crossing of Main St. bridge.
Little Beaver Creek	W007	40.6756	-80.5416	Little Beaver Creek, at intersection of Grimm Bridge Rd and Beaver Creek Camp Rd
Little Beaver Creek	W008 (BK)	40.7040	-80.5530	Little Beaver Creek on Old Fredericktown Rd, west of Jackson St bridge
Leslie Run	W009 (BK)	40.8335	-80.5524	U/S Leslie Creek at Brookdale Ave
Sulphur Run	W010	40.8339	-80.5396	NW corner of intersection of Alice St and Sumner St.
Leslie Run	W011	40.8300	-80.5427	Approximately 10 yards east of Leslie run and the tributary convergence. Southwest of Leake St.
Tributary of Leslie Run	W012 (BK)	40.8302	-80.5410	Upstream Leslie Run tributary, at bend. South of Leake St.
Sulphur Run	W013	40.8350	-80.5356	100 ft east of intersection of N Pleasant Dr and incident railroad tracks; Inactive since March, 9 2023 due to excavation activities
Drainage ditch	W014	40.8358	-80.4996	Approximately 20 yd SE of Brave Industries
Ohio State Line Lake overflow	W015	40.8367	-80.5207	Swamp south of cornfield, approximately 50 yds south of road
Ohio State Line Lake overflow	W016	40.8365	-80.5201	Swamp approximately 10yd west of earthen dam near water pumps
Little Beaver Creek	W017	40.6355	-80.5454	Ohioville Borough Boat Ramp
Ohio River	W018	40.6208	-80.5648	Along Ohio River, downstream of river and at mouth of two channels, West of Jennings Randolph Bridge 30 yards away
Ohio River	W019 (BK)	40.6459	-80.5058	Approximately 0.5 miles upstream of Little Beaver Creek entrance into the Ohio River
Ohio State Line Lake overflow	W020	40.8366	-80.5198	Upstream of Dam northeast of incident site on state line

(BK) indicates background sampling locations.

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[1] W001 (Original) was sampled on February 4, 2023 and was located approximately 10 yards downstream of the Park Drive Bridge (40.8321, -80.5444). W001 was relocated to "W001 (Revised)" due to the installation of an aeration station.

1.4 Responsible Agency

Surface water sampling in accordance with this SWSAP is being conducted by CTEH personnel on behalf of NSRC.

1.5 Project Organization

Overall project organization is described in the UAO. Project organization relative to implementation of the corresponding QAPP for surface water sampling is presented in Figure 1.5a. Figure 1.5b further identifies lines of authority and lines of communication within the Quality Assurance (QA) Program structure. Key personnel are listed in Table 1.5, project organization pathways for QA under the UAO in Figure 1.5a, and CTEH project organization relative to QA communications is presented in Figure 1.5b.

Table 1.5 Key Project Personnel Contact Information

ORGANIZATIONAL STAKEHOLDERS	NAME	CONTACT
US EPA Region 5 – Incident Commander	Ralph Dollhopf	dollhopf.ralph@epa.gov
NSRC Incident Commander	Robert Wood	robert.wood2@nscorp.com
NSRC Incident Commander	Bryan Naranjo	bryan.naranjo@nscorp.com
NSRC Operations Director	Steve Aufdenkampe	steven.aufdenkampe@nscorp.com
NSRC QA Coordinator	Jeffrey Barwick	jeffrey.barwick@nscorp.com
CTEH Project Technical Director	Dr. Kelly Tuttle	ktuttle@cteh.com
CTEH Project Manager	Ethan Currie	ecurrie@cteh.com
Rotating Project Manager	Nicholas Tinsley	ntinsley@cteh.com
CTEH Project QA Director	Lourdes Mahoney	lmahoney@cteh.com
CTEH Data Manager	Rotating	Contact ecurrie@cteh.com
CTEH Toxicologist	Dr. Sarah Burnett	sburnett@cteh.com
CTEH Toxicologist	Dr. Dana Currie	dcurrie@cteh.com

Figure 1.1a Project Organization and Communication Pathways: QA Under the UAO

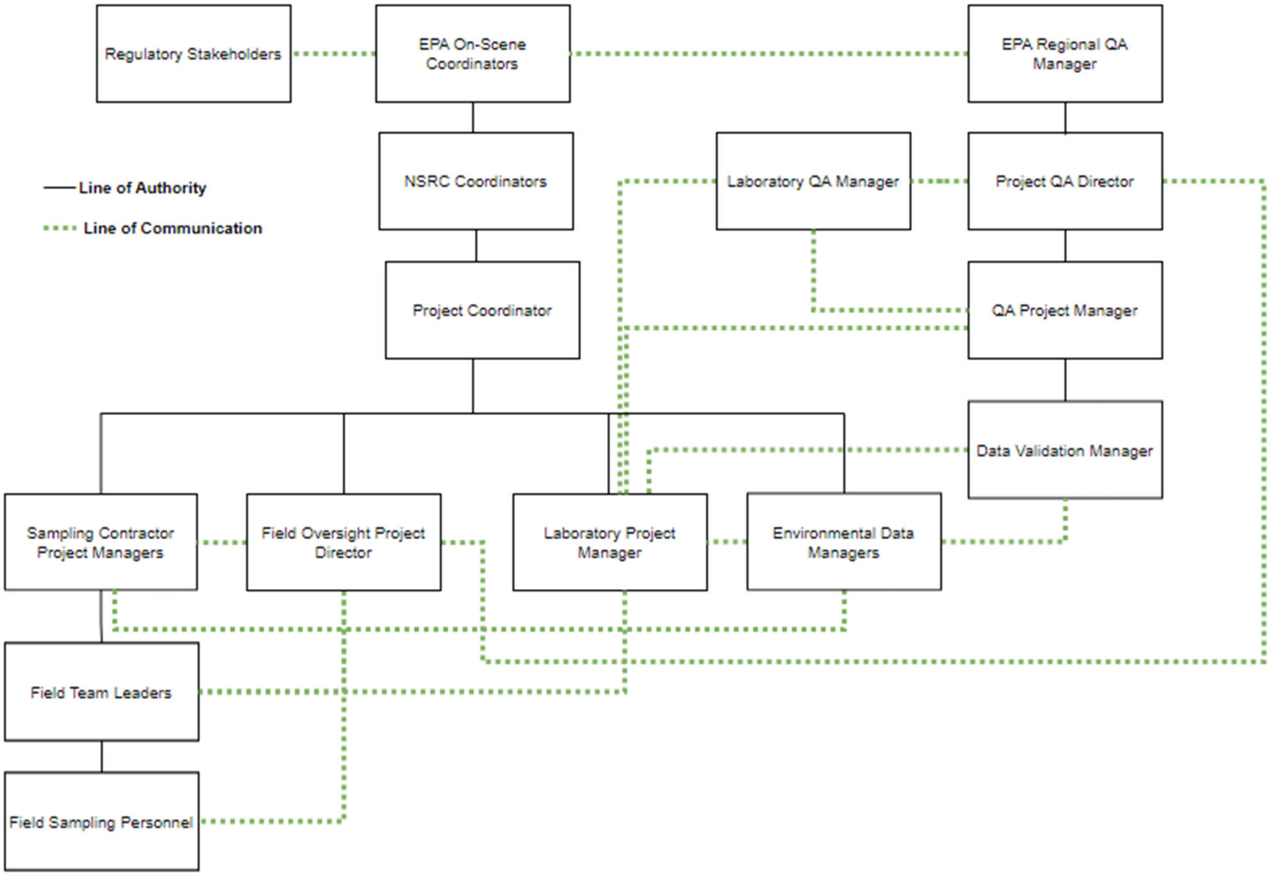
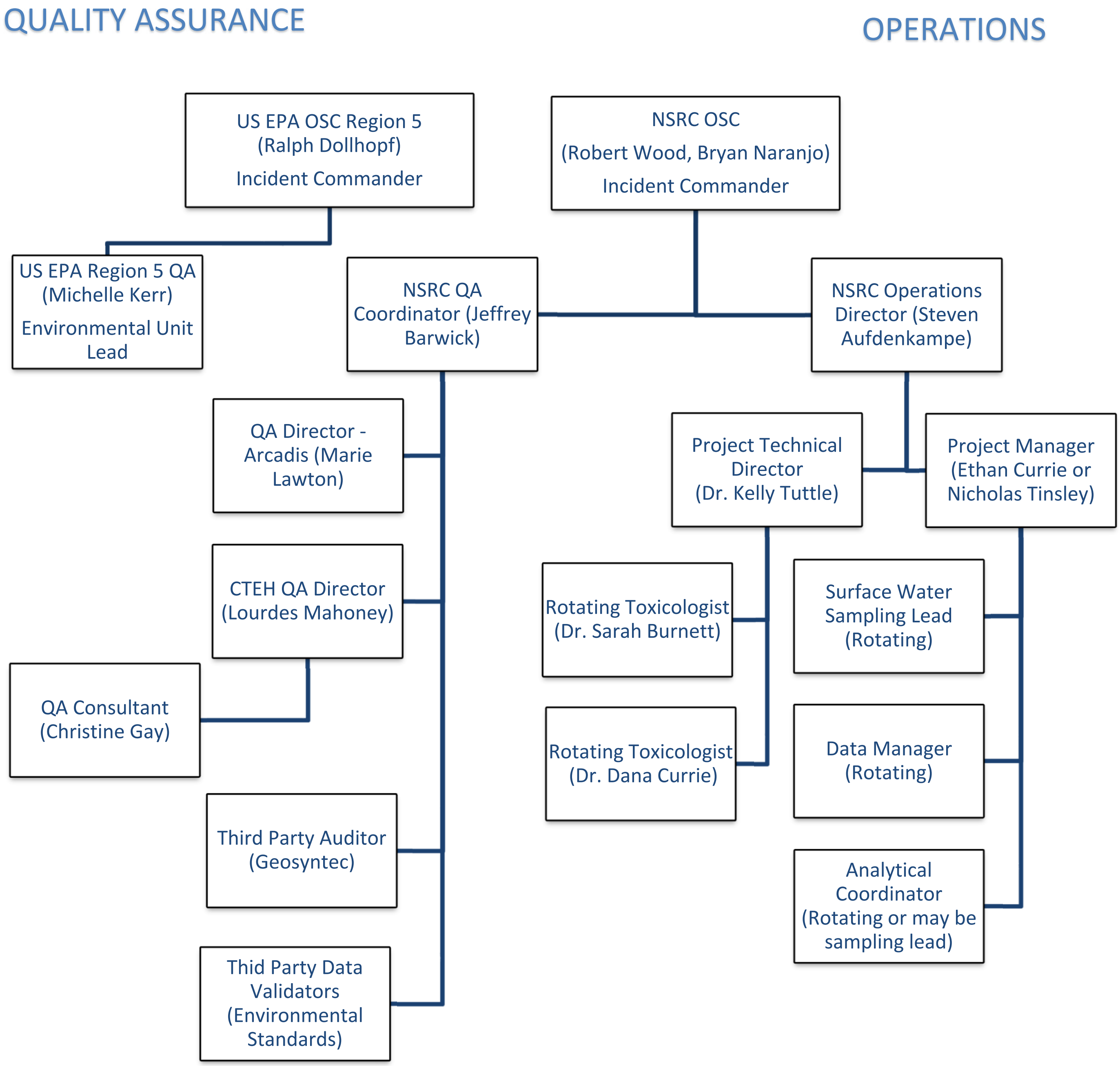


Figure 1.5b CTEH Organizational Structure for QA Communications*



*The CTEH Project QA Director will obtain operational information from the Project Manager or Project Technical Director. All organizational positions are two-way communication for information flow.

2.0 BACKGROUND

A description of the East Palestine Train Derailment Site and surroundings is provided in Section 2.1. Operational history and context are described in Section 2.2. The scope and intent of this SWSAP and potential impacts of the derailment are discussed in Sections 2.3 and 2.4, respectively.

2.1 Site Area Description

The derailment occurred on the property located at the Rail Line east northeast of the intersection of East Taggart Street and North Pleasant Drive (Latitude: 40.8360395; Longitude: -80.5222838) in East Palestine, Ohio (referred to as Site). The East Palestine Train Derailment Site is located within a mixed-use residential, commercial, and industrial area, with residential properties northwest, southeast, and south of the derailment area. The nearest residences are less than 1,000 feet from the derailment Site. Residential properties are also located along waterways which were impacted following the derailment and are within the affected area. The Ohio-Pennsylvania border is located less than 1 mile from the derailment location. The nearest public well supply is located approximately 1 mile from the derailment location. A ditch, located on the south side of the tracks flows west for approximately 1,000 feet before it empties into Sulphur Run, which joins Leslie Run, to Bull Creek, to North Fork Little Beaver Creek, to Little Beaver Creek before emptying into the Ohio River. Wetlands and State Line Lake are located immediately adjacent to the Northeast of the Site.

2.2 Operational History

As a result of the derailment, tank cars breached and released some of their contents, impacting soil, surface water, sediment, and the air environment around the Site. In response to the incident, NSRC immediately mobilized response personnel to the incident to stop, contain, and recover the released content and rail cars and tank cars. That work continues and has expanded to include efforts to assess the nature and extent of the potential impacts to human health and the environment and to plan and implement actions to address any impacts to provide short- and long-term protection of human health and the environment.

2.3 Scope

This SWSAP defines the objectives for surface water sampling conducted by CTEH on behalf of NSRC. This SWSAP is intended to be used during cleanup of product release from East Palestine, Ohio, where sampling of surface waters downstream to protect and inform nearby communities and the pubic are required. This SWSAP is designed to consider chemical components commonly associated with the spilled products. Data gathered during the implementation of this SWSAP will be used to assess the potential for community and ecological impacts and inform additional assessments and removal clean up actions. A human health and/or ecological risk assessment will not be performed as part of the data gathered during the implementation of this SWSAP, although the data will be compared against existing risk-based screening values. All fieldwork and data collection will be conducted in accordance with this work plan and associated QAPP. The use of this work plan will involve forethought and planning that should help direct the monitoring, sampling, and analytical work. It is meant to be used in emergency response events where monitoring and sampling teams (hereinafter referred to as Field Teams) are deployed to conduct surface water sampling in the work zone and downstream locations. Field Teams should always reference this SWSAP for standard quality procedures, standard operating procedures (SOPs), and standard methods for sampling and analytical guidance when necessary. The development of this SWSAP will improve the documentation, communication, planning, and overall quality associated with the monitoring/sampling and analysis by:

- Encouraging Field Teams to consider their goals and objectives before the generation of environmental data,
- Documenting predetermined information in a standardized format,
- Increasing the communication between sampling personnel and decision makers, and
- Detailing expectations and objectives before samples are collected.

2.4 Potential Impact on Human Health and the Environment

Hazardous substances discharged to surface soils, surface waters, and air present potential impacts to human health, ecological health, and the environment. Potential exposure pathways include consumption of contaminated drinking water or groundwater; contact with contaminated surface and subsurface soils; exposure to contaminated sediment and surface waters; and inhalation of contaminated air. This SWSAP focuses on characterizing surface water with respect to COIs to determine whether COIs are present in the surface water within the Site work areas and surrounding community and, if present, if the concentrations of COIs present in surface water exceed previously established risk-based ecological screening values and/or human health-based screening levels as provided by the USEPA. The data obtained in this SWSAP is aimed at the designing of future surface water sampling events, as a general characterization of surface water quality compared to pre-existing risk-based screening levels, and to inform additional assessments and removal clean up actions. A human health or ecological risk assessment are not performed under this SWSAP. Current primary COIs are listed in Appendix A.

2.5 Defining the Constituents of Interest

Original COIs associated with the event related to surface water were identified as the chemicals relating to derailment: vinyl chloride, n-butyl acrylate, 2-butoxyethanol, isobutylene, benzene, and 2-ethylhexyl acrylate. Surface water sampling commenced on February 5, 2023, assessing select volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) via USEPA methods 8260 and 8270, respectively. All analytes on the laboratory target compound lists were reported. In addition to target compounds, tentatively Identified compounds (TICs) were reported to assess for analytes that are not on the method's analyte list, including n-butyl acrylate, 2-ethylhexyl acrylate, and 2-butoxyethanol.

On February 11, 2023, the COI list was updated to include total petroleum hydrocarbons (TPH) to assess the presence of lube oil in surface waters downstream from the derailment site. At this time, the laboratory had obtained standards and calibrated for n-butyl acrylate, 2-ethylhexyl acrylate, and 2-butoxyethanol to add to the target compound list or standard analyte list for USEPA 8260 and 8270, as applicable.

On March 2, 2023, the COI list was updated to include glycols to assess the presence of glycols in surface waters downstream from the derailment site.

The EPA and ecological workgroup confirmed current COIs consisting of 47 compounds is shown in Appendix A of this SWSAP, on June 15, 2023. This COI list is to inform delineation of the extent of contamination for the derailment site, as required by the UAO, represents what was on the training and spilled, what subsequently has been detected in surface water, soil, and sediment, and what is potentially toxic to human health. Degradation products and combustion products associated with chemicals released were also considered. With the addition of polycyclic aromatic hydrocarbons (PAHs) to the COI list, the laboratory detection and reporting limits for six (6) PAH analytes are above the ecological screening values:

- anthracene
- benzo(a)pyrene
- benzo(g,h,i)perylene
- benzo(k)fluoranthene
- fluoranthene
- indeno(1,2,3-cd)pyrene

Of these six, only benzo(a)pyrene laboratory reporting limits are also above the human health screening values derived by the EPA (none were provided for benzo(g,h,i)perylene). Of note, anthracene has not been detected in any of the surface water samples collected to date, understanding that laboratory DLs are higher than ecological screening levels but below human health screening levels listed in Appendix A. To date, the remaining five (5) PAHs have been detected in surface water samples at a rate of <4%, respectively. Only benzo[a]pyrene has exceeded a human health screening level (note that no human health screening level was provided for benzo(g,h,i)perylene).

Based on ongoing surface water conditions, analytical results to date, an assessment of other analytical methods available, these analytes will continue to be reported under the current analytical methods and COI list. It should be noted that decisions cannot be made on PAH samples alone where reporting limits exceed ecological and/or human health values, and represents a potential source for uncertainty.

2.6 Project Task and Problem Definition

There is potential that compounds emitted from derailed tank cars and/or impacted soil, sediment, or water may be present in the surface water adjacent to work areas and community areas downstream of the incident site. If present at certain concentrations in surface water, these COIs, including vinyl chloride and butyl acrylate, could potentially pose a threat to the environment and human health. Therefore, the surface waters in work and downstream areas needs to be characterized to evaluate the presence and potential levels of COIs in surface water, inform additional assessments, and inform removal clean up actions.

The goal of this SWSAP is to protect the environment by characterizing the surface water in work and downstream areas with respect to the presence and potential levels of COIs in surface water. This SWSAP focuses on characterizing surface water with respect to COI to determine whether COIs are present in surface waters within the Site work areas and downstream and, if present, if the concentrations of COI present in surface water pose a risk to public health and the environment. This characterization is being accomplished through a surface water sampling approach in work areas where cleanup and remediation operations are ongoing and in areas downstream from the incident site. The specific objectives are: (1) to evaluate the presence of COIs in surface water; (2) if detected in surface water, to evaluate the concentrations of COIs in surface water; (3) to compare the concentrations of COIs in surface water to ecological and human health screening values established and approved in this SWSAP and the SWQAPP; (4) to record observations of activities and potential alternative sources of COIs unrelated to Site activities to determine “background” levels; (5) to use data generated to make data-driven decisions about the placement of surface water sampling locations and the frequency of surface water sampling, including when surface water sampling activities can decrease or cease; and (6) to use data generated to advise Site management, including the U.S. EPA and Operations Unit in Unified Command, (UC) on the potential need for engineering controls, informing additional assessments and removal cleanup actions. All results will be provided to NSRC and UC for sharing with appropriate parties to make data-driven decisions.

3.0 PROJECT AND DATA QUALITY OBJECTIVES

Project and data quality objectives will address what are the COIs, how COIs are measured, and the quality criteria on which the data are screened. The objectives for the project and associated data are described in the following section.

3.1 Data Quality Objectives

For the purpose of this investigation, data will be focused on achieving sufficient sensitivity to meet screening values protective of the community and ecological receptors. All personnel engaged with monitoring and sampling will review this document and a record will be preserved (e.g., Appendix C for acknowledgement page). A summary of the decision analysis and response actions based on the collected surface water sampling data is presented in Table 3.1.

Table 3.1 Data Quality Objectives and Decision Statements

DECISION STATEMENT #	INVESTIGATIVE QUESTION	ACTION
1	Are surface water sample concentrations above ecological and/or human health screening levels for the COIs?	If analytical surface water samples are above the ESLs for COIs, surface water sampling will continue until meeting the criteria for reduction. A consultation will be triggered with participating parties, including Unified Command, to assess whether further action is warranted. A retrospective assessment of the sampling location, upstream and background locations, weather conditions, and work activities will be evaluated to assess potential causes of the exceedance(s).
2	Are surface water sample results below the ecological and/or human health screening value for the COIs for an extended period of time?	If surface water sample results for the COIs are below the appropriate ecological and/or human health screening level for an extended period of time, then that sample location may be assessed for a reduction in sampling frequency. If a COI is below appropriate ecological and/or human health screening levels for an extended period of time, then that COI may be assessed for removal from the COI list. A retrospective assessment of the sampling location, laboratory results, and trending analysis will be performed. Analysis may include rolling averages, trendline analysis, comparison to background, or other statistical analysis. Any potential location or COI reductions will be proposed to and approved by UC in an updated, redlined SAP. Sampling may be reinstated if upstream or on-site conditions warrant at the discretion of UC.

3.2 Measurement Quality Objectives

Measurement Quality Objectives (MQO) are designed to evaluate overall uncertainty of a measurement process. MQOs for this response include the use of measurement performance criteria for field surface water QC samples and measurement performance criteria for samples collected via laboratory supplied containers, are provided in Tables 3.2a and 3.2b, respectively. Refer to Worksheet #12 in the SWQAPP for additional details on MQOs by method.

Table 3.2a Performance Criteria for Field Surface Water QC Samples

QC SAMPLE	ANALYTICAL GROUP†	FREQUENCY	DATA QUALITY INDICATORS (DQIS)	DESCRIPTION AND DETAIL	MEASUREMENT PERFORMANCE CRITERIA*
Field Duplicate	VOC, SVOCs, glycols	One per 10 field samples, when conducted	Precision, representativeness	Precision is determined from the analyzed concentrations of samples collected simultaneously from the same surface water sampling location using two sets of laboratory-supplied glassware; this determines the precision of the sampling and analysis processes.	If both the original and co-located results are ≥ 5× LOQ, the RPD+,** should be ≤ 30% for samples; preferrable ≤ 25%
MS/MSD	VOC, SVOCs, glycols	One per 20 samples or a minimum of 1 per sampling event	Precision, bias, representativeness	The use of duplicate is same description and detail listed above.	If both the original and duplicate results are ≥ 5× LOQ, the RPD** should be ≤ 30% for samples. Spikes are within %R QC limits in analytical report is bias. Matrix spikes assess the matrix and method performance. Lastly, the %R and %RPD are representative of the matrix at known concentrations.
Field Blanks	VOC, SVOC, glycols	One per day	Bias, contamination	Field blanks identify on-site contamination in sample collection, handling and analysis. To ensure that analyte or compound detections in investigative samples are not a result of contamination during the handling or sampling process prior to analysis.	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater. Each target VOC concentration should be approximately 20 ppt or less
Trip Blanks	VOC	1 per sampling event or 1 per cooler	Contamination	Trip blanks identify on-site contamination in sample handling. They are prepared by the laboratory and travel with samples to and from the laboratory. To ensure that analyte or compound detections in investigative samples are not a result of contamination during the handling or sampling process prior to analysis.	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater. Each target VOC concentration should be approximately 20 ppt or less

* LOQ = Limit of Quantification; %R = percent recovery, RPD = Relative Percent Difference

+A review of the duplicates (goal is a ~10%) show that prior to May 17, samplers tracked MS/MSD as duplicates. However, 1-2 duplicates have been collected per sampling event, which is a little over 11% of the investigative samples collected.

**the goal 1/10 (or 10%) co-located, and 1/20 (20%) MS/MSD as QC samples per investigative sample set. Samples were collected one after the other, so they are co-located and not duplicates. The goal is also to have an RPD of ≤ 30%, but some analytes have 100-200% RPD. Of note, a majority of results are sub-ppb or low ppb ranges, and the methods illustrate >30% RPDs.

Table 3.2b1 Measurement Performance Criteria for Surface Water Samples Analyses

DATA QUALITY INDICATOR(S)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	FREQUENCY	ERROR ASSESSED BY QC SAMPLE*
Completeness	≥ 95%	% Complete = $\frac{usable\ results}{results\ reported} \times 100\%$	-	S&A
Sensitivity	Method Detection Limits (MDL) for non-detect results are less than Project-Required Quantitation Limits (PRQL)	Evaluate laboratory MDLs and Limits of Quantification (LOQ)	-	A
Accuracy, bias, contamination	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater	Method Blank	Initially, every 24 hours	A
Accuracy, bias	≤ 30 %	Continuing Calibration Verification (CCV)	Initially, every 24 hours	A
Instrument performance	Tune criteria consistent with analytical method	Mass spectrometer tuning	Initially, every 24 hours	A
Sensitivity, accuracy, bias	Recoveries within 60% to 140% of ICAL midpoint standard area or the CCV on days when ICAL is not performed	Internal standards	Every field sample and QC sample, added prior to analysis	A
Precision	Relative percent difference (RPD) must be ≤ 25%	Laboratory duplicate	One per batch of 20 samples	A

* LOQ = Limit of Quantification; S = Sampling; A = Analysis; S&A = Both Sampling and Analysis

3.3 Data Review and Validation

Analytical data generated under the UAO will be subjected to data usability assessment as described in the QAPP. The purpose of analytical data verification and validation is to ensure data completeness, correctness, and method compliance/conformance, conformance to this SWSAP and SWQAPP (V1.2), identify unusable data that would not be sufficient to support environmental decisions, and data quality and usability. In addition to the laboratory QA review, the data presented in Level II, III, or IV data packages will be verified and validated by the Data Validators (company and names provided in the SWQAPP Worksheet #4 and #8. A Level II data package will be acquired for all surface water samples. Level II data validation will be performed on all surface water samples, and Level III or Level IV data validation will be performed on approximately 10% of samples. Environmental Standards, Inc. has been hired as the data validation firm by NSRC, for the following:

- Compliance with requested testing requirements
- Completeness
- Reporting accuracy (including hardcopy to EDD)
- Conformance to this SWSAP and SWQAPP

- Confirmation of receipt of requested items
- Traceability, sensibility, and usability of the data

Data review will be performed with guidance from the National Functional Guidelines for Organic Data Review (US EPA). These validation guidance documents specifically address analyses performed in accordance with the Contract Laboratory Program (CLP) analytical methods and are not completely applicable to the type of analyses and analytical protocols performed for the EPA and NIOSH methods utilized by the laboratory for these samples. Therefore, data validators will use professional judgment to determine the usability of the analytical results and compliance relative to EPA and NIOSH methods utilized by the laboratory.

Data usability directly affects whether project objectives can be achieved. The results of these evaluations will be included in the project report. Data characteristics will be evaluated for multiple concentration levels if the evaluator determines that it is necessary to do so. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound assessments of the data characteristics, as outlined in Table 3.3.

Table 3.3 Data Usability Assessment and Characteristics

DATA USABILITY INDICATOR	DESCRIPTION
Precision	The degree of agreement between the numerical values of a set of duplicate samples performed in an identical fashion constitutes the precision of the measurement. During the collection of data using field methods and/or instruments, precision is checked by reporting measurements at one location and comparing results. $\%RPD = abs\left[\frac{A - B}{\left(\frac{A + B}{2}\right)}\right] \times 100$ Where: A = Value of original sample B = Value of duplicate sample
Accuracy	Accuracy is the degree to which a given result agrees with the true value. The accuracy of an entire measurement system is an indication of any bias that exists. Spiked sample results provide information needed to assess the accuracy of analyses. Surrogate spike, MS/MSD, and LCS %Rs are used to assess accuracy. Every organic sample is spiked with known quantities of non-target surrogate compounds. The formula used to calculate accuracy for all accuracy indicators, except MS, is: $\%\, R = \left(\frac{A_T}{A_F}\right) \times 100$ Where: A_T = Total concentration of the analyte measured or recovered A_F = Concentration of the analyte spiked The formula used to calculate accuracy for the MS is: $\%\, R = \left(\frac{A_T - A_O}{A_F}\right) \times 100$ Where: A_T = Concentration of the analyte measured or recovered

DATA USABILITY INDICATOR	DESCRIPTION
	A_0 = Unspiked concentration of the analyte A_F = Concentration of the analyte spiked
Representativeness	Representativeness expresses the degree to which sample data are accurate and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter associated with the proper design of the sampling program.
Completeness	Completeness is a measure of the degree to which the amount of sample data collected meets the needs of the sampling program and is quantified as the relative number of analytical data points that meet the acceptance criteria (including accuracy, precision, and any other criteria required by the specific analytical method used). Completeness is defined as a comparison between actual numbers of usable data points expressed as a percentage of expected number of points. The minimum goal for completeness is 95%; the ability to exceed this goal is dependent on the applicability of the analytical methods to the sample matrix analyzed. If data cannot be reported without qualifications, project completion goals may still be met if the qualified data (data of known quality, even if not perfect) are suitable for specified project goals.
Comparability	Comparability is a qualitative parameter used to express the confidence with which one data set can be compared with another. The comparability of the data, a relative measure, is influenced by sampling and analytical procedures. By providing specific protocols for obtaining and analyzing samples, data sets will be comparable regardless of who collects the sample or who performs the sample analysis.
Sensitivity	Analytical sensitivity is a measure of an analytical technique's capability to reliably detect a positive signal compared to background noise. Sensitivity is measured in terms of laboratory-specific MDLs. The detection and reporting limits will be compared to project action levels (Als) and DQOs to ensure sufficient sensitivity to meet project objectives. If sensitivity goals are not achieved, the limitations on the data will be described.

Accuracy and precision will be quantitatively assessed by comparing recoveries and relative percent difference to the goals identified in the QAPP. Data associated with accuracy or precision indicators that do not meet these goals will be assigned data usability qualifiers as identified in QAPP. These data usability qualifiers, along with data qualification reason codes, will be stored as attributes to the analytical results in the project database.

The Data Validation PM will coordinate review data generated by the laboratories for analyses of project samples. Any issues observed during data validation will be brought to the attention of the Project QA Director; the Laboratory PM will be contacted to determine and implement an appropriate corrective action if warranted.

Data validation reports will be prepared and reviewed by the Data Validation PM. The data validation reports will summarize the data reviewed, the level of review, any issues observed, and any data qualification. Data validation reports will be submitted to the project data portal.

3.4 Data Assessment

Surface water monitoring will be conducted by CTEH personnel using a Horiba U-52 multi-parameter water quality meter or equivalent instrumentation. Surface water samples will be collected by CTEH personnel and sent to Pace Analytical for laboratory analysis. Surface water monitoring and sampling data will be assessed by comparison to established action levels and screening values and background concentrations. All of these will be done in accordance with this SWSAP and QAPP. Analytical methods and laboratory quantitation limits as well as screening values are listed by COI and sample category in Appendix A. Surface Water monitoring screening ranges are listed by parameter in Table 3.4 below.

Table 3.4 Surface Water Monitoring Parameters and Screening Levels

PARAMETER	INSTRUMENTATION	SCREENING VALUE	SOURCE
Temperature	Horiba U-52 or equivalent	No temp increase from background	Ohio EPA OMZA EWH
pH	Horiba U-52 or equivalent	6.5 – 9.0 (no change due to human influence)	Ohio EPA OMZA EWH
Conductivity	Horiba U-52 or equivalent	2,400µΩ/cm	Ohio EPA[a]
Dissolved Oxygen	Horiba U-52 or equivalent	5.0 mg/L	Ohio EPA OMZA WWH
		6.0 mg/L	Ohio EPA OMZA EWH
Turbidity	Horiba U-52 or equivalent	<10 NTU over background	USEPA 40CFR Part 131
Total Dissolved Solids (TDS)	Horiba U-52 or equivalent	1,500 mg/L	Ohio EPA OMZA

a – Equivalent 25°C specific conductance value to 1,500 mg/L dissolved solids.

3.5 Assessment Oversight

One of the goals of the project QA program is to quickly identify, correct, and resolve errors and to prevent recurrence. A description of assessments conducted as part of the project QA program and parties responsible for the corrective action response are presented in Table 3.5.

Table 3.5 Assessment Oversight and Corrective Actions

ASSESSMENT TYPE	FREQUENCY	INTERNAL OR EXTERNAL	ORG. PERFORMING ASSESSMENT	PERSON RESPONSIBLE FOR PERFORMING ASSESSMENT	PERSON(S) RESPONSIBLE FOR RESPONDING TO ASSESSMENT FINDINGS	PERSON(S) RESPONSIBLE FOR IDENTIFYING OR IMPLEMENTING CAs	PERSON(S) RESPONSIBLE FOR MONITORING EFFECTIVENESS OF CAs
Onsite Laboratory Systems Audit	During certification period, at discretion of the Accreditation Officer	External	TNI	TNI Auditor	Lab. QA Manager	Lab. QA Manager	Lab.QA Manager
Field Oversight, QA, Audits	Minimum 1 per investigation or matrix	External	Geosyntec Consultants	Field Oversight Project Director	Field Team Leader	Field Oversight Project Director	Field Oversight Project Director
QC of field readings, summaries, field forms, review against SWSAP requirements	Each sample event	Internal	Sampling Contractor	Field Team Leader	N/A	Sampling Contractor Project Manager	Sampling Contractor Project Manager
Laboratory Report Deliverables – verification of data package completeness, analytical compliance, and data correctness	Each SDG	Internal	Lab.	Lab. Project Manager	Lab. QA Manager	Lab. QA Manager	Lab. QA Manager
Data Validation	Each SDG	Internal	EnvStd	Data Validation PM	Lab. PM or Lab. QA Manager	Project QA Director and Lab. QA Manager	Project QA Director
Lab. CA Investigation	As needed	Internal	EnvStd	Project QA Director	Lab. QA Manager	Lab. QA Manager	Project QA Director
Performance Evaluation Samples	Minimum of 1 per investigation	External	EnvStd	Project QA Director	Lab. QA Manager	Lab. QA Manager	Project QA Director

*SDG = sample delivery group, EnvStd = Environmental Standards, Inc.

4.0 SAMPLING DESIGN AND RATIONALE

Strategy for surface water sampling activities as described in this SWSAP is provided in the following subsections.

4.1 Surface Water Sampling Strategy

As part of a larger group of plans collectively making up the project Removal Action Plan, the work described in this SWSAP will be conducted in accordance with the SWQAPP, Health and Safety Plan (HASP), and other overall documents that provide procedures for sample collection, identification, and analysis. Media-specific sampling and analysis procedures are presented below to support the scope of work discussed in the SWSAP. Sampling schedules will be communicated to the Agencies who may collect split or co-located samples. NSRC will accommodate such sampling, if and when applicable.

CTEH is focusing on the chemicals and indicators toxicity outlined in this SWSAP because they are among the most important and readily monitored hazards of spilled or released vinyl chloride, acrylates, and other substances involved in this derailment and their combustion products. The possible hazards of these substances vary with the environmental conditions associated with the release. Monitoring and sampling for some chemicals or indicators may be conducted less frequently or even discontinued as monitoring and sampling results indicate that these chemicals and indicators do not pose an ecological or human health concern. Any changes to sampling locations will be approved and directed by Unified Command.

Surface water sampling will generally take place in (1) the wetlands northeast of the derailment site (2) Sulphur Run, (3) Leslie Run, (4) North Fork Little Beaver Creek, (5) Little Beaver Creek, and (6) the Ohio river. The samples will generally be taken at locations where surface water is easy to access such as boat docks and bridges. The water bodies were previously chosen and profiled for indicator parameters, as well as upstream and background locations. If additional sampling is warranted at the request of NSRC, profiling will include appearance, odor, air monitoring readings may be collected, and information is logged electronically as a SIERA in projects.cteh.com.

Surface water sampling has generally been taking place daily, with the approval of this SAP sampling at each location will transition to a three day rotation as described in Section 4.4. During precipitation events predicted or above >0.25”, two sampling events will occur at each location: one before precipitation, and one later in the day after the precipitation event. Post-precipitation sampling will be compared to pre-precipitation and baseline sampling to assess whether there is a change in surface water quality associated with the precipitation event. Each location sampled during a precipitation event will be compared to the sample collected earlier in the day(s) to determine whether a change in surface water quality is occurring. Statistical analysis for one sampling event will not be possible; however, the variation at each location over multiple precipitation sampling events may be assessed. Hydrogeological assessments of the behavior of the waterways downstream of the derailment site as well as human health risk assessments are beyond the scope of this SWSAP.

Real-time monitoring data of surface water quality are not corrected or adjusted any chemical-specific correction factor. These criteria represent a general characterization of water quality. Data are then compared directly to standard water quality criteria, as outlined in this SWSAP.

Discrete surface water samples will be collected in all sampling locations and sent to an off-site laboratory for chemical analysis. These analytical sampling techniques may be used to provide surface water quality data beyond the scope of real-time instruments.

4.2 Ecological and Human Health Screening Levels

The results of the analysis will be reviewed following data validation and compared to applicable ecological screening levels (ESLs) in units of micrograms per liter (µg/L) and human health screening levels (HHSLs) as derived by the USEPA. ESLs for comparison to site data have been established based on the following criteria, which will be applied in a stepwise fashion in the order identified below:

1. Analytes with criteria provided by the Ohio EPA presented in the "Aquatic Life and Human Health Tier I Criteria and Tier II Values contained in and developed pursuant to Ohio Administrative Code (OAC) Chapter 3745-1 (OAC 3745-1). OMZA Aquatic Life Criteria will be utilized unless otherwise specified.
2. Analytes not listed in the Ohio EPA WQS will be compared to EPA Region IV Surface Water Screening Levels (Chronic Freshwater Criteria will be utilized).
3. Analytes not listed in either of the above will be compared to NOAA Screening Quick Reference Tables (SQuiRTs). Chronic Freshwater criteria for surface waters will be utilized.
4. If no screening values were available, Ohio EPA Tier II Chronic Aquatic Values were calculated using Ohio Administrative Code 3745-1-40, as illustrated in Appendix B for screening value derivations. Supporting documentation of these calculations is available upon request.

Screening levels and rationale, where applicable, are provided along with instrument details in Appendix A.

HHSLs were calculated by the USEPA in collaboration with the Columbiana County Health Department and are based upon a two-hour exposure per day for 39 weeks out of the year for 26 years over a lifetime.

4.3 Analytical Laboratory

A summary of the analytical methods that will be used are shown in Table 4.3. All samples will be sent to Pace Analytical Laboratories.

Table 4.3 Analytical Methods

ANALYTICAL GROUP	METHOD
Volatile Organic Compounds (VOCs)	USEPA Method 8260
Semivolatile Organic Compounds (SVOCs)	USEPA Method 8270
Glycols	USEPA Method 8015
pH	SM 4500-H+ B

* Including 2-ethylhexyl acrylate, n-butyl acrylate, and 2-butoxyethanol. HCl = hydrochloric acid.

4.4 Sampling Frequency

Surface water samples will be collected from the length of the unnamed ditch to the Ohio River. Surface water samples are currently being collected on a daily basis at the following locations:

W001 (revised)[2]
W002
W003 (background)
W004
W005
W006
W007
W008 (background)
W009 (background)
W010
W011
W012 (background)
W013 (discontinued on 3/9/2023 due to excavation activities)
W014 (discontinued on 5/5/2023 due to excavation activities)
W015
W016
W017
W018
W019
W020

During precipitation events >0.25”, these sample locations are sampled pre- and post-precipitation. As described above, post-precipitation samples will be compared to pre-precipitation and baseline samples to assess any changes to surface water quality as a result of the precipitation event as described above.

As of the drafting of this work plan (6/19/2023), no ecological or human health screening levels have been exceeded for any location since 5/1/2023, as shown in Appendix C. Upon approval of this plan, these surface water sampling locations, with the exception of W013 and W014 which have been discontinued, will be sampled on a three day rotating schedule as shown in Table 4.4. In the event of a precipitation event, sampling along Sulphur and Leslie runs will be prioritized. Based on on-site activity, sampling locations may be prioritized at the discretion of Unified Command. This reduction in frequency was discussed with EPA on June 19, but a reduction plan will be

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[2] W001 (original) was previously only sampled once, on February 4, 2023, and was located approximately 10 yards downstream of the Park Drive Bridge (40.8321, -80.5444). W001 was relocated to “W001 (Revised)” and is downstream of the aeration location.

provided at a later date that will propose location reductions. This will be executed by stream or tributary. Example, if we are sampling for Sulphur run, we will sample the upstream and downstream locations on the same day. Previously, all locations were sampled daily.

Table 4.4 Sampling Schedule Example

Day 1	Leslie Run	W004	W001	W011	W009(bk)	W012(bk)
	NF Little Beaver	W005	W006			
Day 2	Little Beaver	W007	W008 (bk)	W017		
	Ohio	W018	W019(bk)			
Day 3	Wetlands	W014	W015	W016		
	Sulphur Run	W002	W003(bk)	W010		

The locations and frequencies of future proposed sampling reductions will be detailed in a redlined and updated SWSAP and submitted for approval separately. Sampling locations and frequencies may be updated and altered at the discretion of UC.

5.0 FIELD METHODS AND PROCEDURES

Details of field methods and procedures are discussed in the paragraphs below.

5.1 Field Equipment

Field equipment includes the Horiba U-52 multi-parameter water quality meter and laboratory-supplied sample containers. Other equipment items used in the field as part of this sampling event are anticipated to consist of GPS units, digital cameras, and handheld data collection devices such as tablets or smart phones.

5.2 Calibration of Field Equipment

The Horiba U-52 multi-parameter water quality meter will be calibrated daily, prior to use. Serial numbers for all analytical equipment used in field deployment will be recorded in the Surface Water Field Sheets or in Carbon (apps.carboncm.com). Other equipment items are not anticipated to require field calibration. Operators of each piece of equipment are responsible for maintaining (including proper battery charge) and operating this equipment such that it conforms to each respective manufacturer's specifications.

5.3 Surface Water Sampling

Samples will be placed in laboratory supplied sample containers, appropriate for the intended analysis, labeled with sample identification number, sampler name, sample date, analysis and methodology requested, and time of sample collection, and immediately placed in a cooler on ice pending laboratory analysis. Samples will be packaged, labeled, retained on ice, and documented in an area which is free of impact and provides for secure storage. Custody seals will be placed on each sample containing cooler, and chain-of-custody (COC) procedures will be maintained from the time of sample collection until arrival at the laboratory to protect sample integrity. Surface water samples will be submitted to Pace Analytical for analysis of VOCs following EPA Method 8260, SVOCs by USEPA Method 8270, and glycols using USEPA Method 8015 (which all may be modified methods). In addition, volatile samples will also receive a pH check upon sample receipt by the laboratory. Shipping or transporting of samples to the laboratory will be done within a timeframe such that recommended holding times are met to the extent practically.

Per a request from CTEH on February 6, 2023, Pace Analytical obtained a standard(s) for specific COIs including 2-butoxyethanol, n-butyl acrylate, 2-ethylhexyl acrylate, and methyl acrylate. These analytes were added as target compounds to their USEPA 8260 method list to allow quantitative results reporting (e.g., meaning no longer TICs and estimated values). Analysis and reporting have been reduced to n-butyl acrylate, 2-ethylhexyl acrylate, and 2-butoxyethanol in accordance with the current COI list in Appendix A.

6.0 SAMPLE CONTAINERS, PRESERVATION, PACKING, AND SHIPPING

Information on sample containers, preservation, and shipping and holding times is shown in Table 6.0.

Table 6.0 Sample Containers, Preservation, and Holding Times

ANALYTICAL GROUP	CONTAINERS OR MEDIA	ANALYTICAL METHOD	PRESERVATION REQUIREMENTS	MAXIMUM HOLDING TIME[1]
Volatile Organic Compounds (VOCs)[2]	3 x 40mL VOA Vials	USEPA Method 8260	HCl[3] to pH<2; ice, maintained at 0-6°C	14 days preserved 7 days unpreserved
Semivolatile Organic Compounds (SVOCs)	2 x 100 mL amber glass	USEPA Method 8270	Ice, maintained at 0-6°C	7 days to extraction 40 days to analysis
Glycols	2 x 40 mL VOA Vials	USEPA Method 8015	Ice, maintained at 0-6°C	7 days unpreserved, 14 days preserved from sample collection to analysis
pH[4]	1× 250-mL High Density Polyethylene bottle	SM 4500-H+ B	None, but preferably on ice, maintained at	As soon as possible, upon lab receipt

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[1] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.
[2] Including 2-ethylhexyl acrylate, n-butyl acrylate, and 2-butoxyethanol.
[3] HCl = hydrochloric acid
[4] Methods differ on exact maximum holding time from 15 minutes to 24-hours to as soon as possible. Since measuring pH is not done in the field, the holding time is noted as soon as possible upon lab receipt.

7.0 DISPOSAL OF MATERIALS

Decontamination fluids and contaminated Personal Protective Equipment (PPE) will be containerized and collected at the designated onsite waste staging area as needed.

All produced waste onsite will be managed and disposed of in a manner consistent with all regulatory guidelines and requirements.

7.1 Decontamination

Decontamination procedures refer to the steps undertaken to minimize the potential for offsite contamination and cross-contamination between individual sampling locations. Currently, single use sampling equipment is being used to conduct surface water sampling related to East Palestine Derailment Site. Thus, decontamination procedures are not applicable. Furthermore, nitrile gloves will be worn by sampling personnel and changed between activities at each discrete sample collection location. Previously worn nitrile gloves will be discarded in appropriate waste receptacles with other PPE.

7.2 Sample Documentation

Surface water monitoring and sampling electronic logs, field logs, notebooks, photographs, and data will be accounted for in accordance with the data sources and data management guidance listed (Table 7.2).

Table 7.2 Data Sources and Data Management

DATA SOURCE	REQUIRED INFORMATION	PROCESSING INSTRUCTIONS	PROCESSING FREQUENCY	PROCESSING RESPONSIBILITY	STORAGE LOCATION	FINAL OUTPUT
Site Documents	Site files, plans, addendums	File hard copies & electronic copies in indicated storage location	Beginning of project and as needed	Field Sampling Project Manager	Digital: CTEH Projects Secure Server; Hard Copy: Project secure file	.pdf & other image formats
Field Sheets	Sample No., date, time, sampler, location, field conditions	Same as above	Per sampler, location, equipment, & date	Field Team Leads	Same as above	.pdf & other image formats
Real-Time Monitoring Data	Instrument data with time, date, and GPS location	Upload into Mobile Data Systems (MDS) software; Same as above	At least every 10 data logs	Data Manager	CTEH Secure Server	.csv, .pdf, and other image formats
Other data sources	As needed or requested	As needed or requested	As needed or requested	As needed or requested	Same as above for server and file locations	.pdf and other image formats

7.3 Sample Labeling

The following guidance is based on the CTEH Environmental Sample Nomenclature. Sample IDs will contain 12 characters, with characters 10, 14, and 15 optional. Sample IDs will contain no spaces; all zeros will contain lines and a strikethrough on the letter. Duplicates may remain blind to the laboratory unless stated on the chain-of-custody (COC) document.

Figure 7.3 Sample Nomenclature and Matrix Codes

CHARACTER	DESCRIPTION	EXAMPLE
1, 2, 3, 4	Four Character Site Prefix (City, State or Client Specific Prefix)	NELA or NOLA for New Orleans, Louisiana KETX for Kemah, Texas AWWU for Acme Widget West Unit
5, 6, 7, 8	Two Digit Month and Two Digit Day	0615 for June 15 20230615 or 06152023 if it is a long-term project with the possibility of spanning multiple years
9, 10	Matrix Code and Sample Types	Examples below
11, 12, 13	Two- or three-digit serial ID*	01-99 or could possibly be a three-digit code as in 001-999
14+	QC Sample Code	QC Sample Code, sequential replicate code (A-Z) or sample depth

Matrix Codes and Sample Types*

T – Trip Blank
F – Field Blank
W – Surface Water
V – Surface Water Duplicate or Co-located sample
MS/MSD - Matrix Spike/Matrix Spike Duplicate – indicated in the last position on sample ID
* Other values A through Z correspond to matrix types as assigned by field personnel.

Samples suspected of containing high concentrations of contaminants will be indicated on the COC record to prevent damage to laboratory equipment.

7.4 Chain-of-Custody Forms and Custody Seals

Changes or corrections to the information documented by the COC record (including, but not limited to, field sample ID or requested analyses) must be changed by marking through the incorrect information with a single strikethrough line and dating and initialing the change. If the request for a change or correction comes from the Field Sampling Personnel after the COC records have been relinquished to the laboratory, a copy of the COC record will be revised, initialed, and forwarded to the laboratory, where the revised version will supersede the original COC record, or the laboratory will be emailed with instructions to add information to the COC, for which the email will provide traceability. This record will be used to document sample custody transfer from the sampler to the laboratory and will become a permanent part of the Project File.

8.0 QUALITY CONTROL

Quality control measures for surface water sampling include field samples, matrix spike (MS) and matrix spike duplicates (MSD), and co-located samples (or field duplicates). Quality control samples are described in further detail below.

8.1 Field Quality Control Samples

Several quality control measures will be implemented, including field blanks, field duplicates, and field co-located samples. These quality control measures are intended to characterize accuracy, precision, and completeness of the data and to ensure that samples are not biased or contaminated.

8.1.1 Field Contamination

Trip blanks will be performed for surface water sampling to ensure that samples are not biased or contaminated being transported to/from the laboratory.

8.1.2 Field Variability (Field Duplicate Samples)

Field duplicates and/or field co-located samples will be collected to characterize the precision of the surface water sampling data. Initially, MSDs were collected and included in the daily calculation of 1/10 field duplicates to verify the reproducibility of the sampling methods in conjunction with the MS/MSD samples. On May 17, 2023, sampling was amended, for approximately every ten samples collected in the field, one field duplicate is and will be collected, independent of Matrix Spike/Matrix Spike Duplicate frequency (described in 8.1.4). Currently, there are about 5.8% field co-located samples for the data set, or over 11% when including the MSDs. Field duplicates will be prepared by separately submitting an aliquot from the same sample location to the laboratory for analysis consistent with the proscribed analyses. The submitted duplicate will be submitted such that the laboratory is not aware that it is a duplicate (i.e., the sample ID will not identify it as a "co-located or duplicate" for any specific sample location), following the nomenclature in Section 7.3. At least one field co-located or duplicate will be collected each day that samples are collected.

8.1.3 Field Split Samples

Field split samples refer to samples collected by the regulatory agency or its designee from the same sampling location and independently submitted to a different laboratory for analysis. Field split samples may be collected at the discretion of representatives of the regulatory agency or UC, but have not been collected thus far.

8.1.4 Matrix Spikes

MS/MSD samples refer to field samples spiked with the analytes of interest prior to being analyzed at the laboratory to gauge the quality of analysis. Approximately one in twenty field investigative samples will be analyzed as MS/MSD samples.

9.0 HEALTH AND SAFETY PROCEDURES

Refer to the site-wide Health and Safety Plan (HASP) for details. All CTEH surface water sampling teams will work in pairs. Samplers are expected to work on or over water when collecting surface water samples. Samplers will wear personal flotation devices (PFDs) when sampling any of the seven locations south of Beaver Creek (e.g., W005, W006, W007, W008, W017, W018, and W019), where there is deeper and faster moving water.

Samplers will wear nitrile gloves during all stages of sampling to avoid contact with preservatives and potential contaminants. Samplers shall don and doff gloves appropriately, in a manner that prevents the outer layer from coming into contact with the skin.

Samplers will be expected to handle glassware that has the potential break during handling storage. All glass containers shall be stored and transported in bubble wrap bags to avoid breakage.

CTEH staff are expected to lift coolers in excess of 25 pounds during the sample process. Samplers shall practice proper lifting techniques and if available, ask for assistance carrying heavy items.

10.0 GENERAL INFORMATION ON PROCEDURES USED

Table 10.0 Description of Surface Water Sampling Procedures

PROCEDURE	DESCRIPTION
Surface Water Sampling	When samplers arrive at the sample location, they remove sample bottleware from the coolers and write sample times on each label. Bottleware is placed on a fragrance-free trash bag and containers are always handled with nitrile gloves. Samplers affix labels to each container. While being as safe as possible, samplers will attempt to sample from representative areas in each water body, avoiding stagnant, isolated pools. Samplers shall exercise caution while navigating each water body, being careful not to walk or stand upstream and trying to minimize disturbance to the surrounding sediment. Samplers will submerge an unpreserved container facing upstream. Depending on the depth of the water and the volume of the sample container, it may be necessary to decant from smaller containers. Samplers shall not dip a preserved container into the water to sample or use a preserved container to decant from. All sample containers shall be filled as much as possible without losing preservative and containers for VOCs will be filled so that no headspace remains. Glass containers shall be placed in bubble wrap bags to avoid breakage and each sample will be transported together in a resealable bag. Samples shall be placed on ice in a cooler immediately after collection. Observations about each sample location are recorded electronically via mobile devices in Mobile Data Studio (MDS) and in field notes.

PROCEDURE	DESCRIPTION
Water Quality Monitoring	CTEH staff members will utilize a calibrated Horiba U-52 multiparameter water quality meter to assess real-time water quality. CTEH will attempt to place the probe into a representative area of each water body being measured. The sensor probe shall be placed downstream of the sample site to eliminate disturbance to the sample. If unable to place the sensor downstream, water quality metrics will be taken after the sample is collected. The Horiba probe is lowered into the water gently to minimize disturbance to the sediment. CTEH staff allow the metrics to stabilize before recording water quality metrics in MDS and in their field notes. The sensor probe is rinsed with distilled water between each sample location.
Sample Processing	Samples shall undergo field QC checks each day before being transported to the laboratory. When samplers return from the field, all samples are removed from the cooler and CTEH staff inspect each container to ensure the sample ID, date, time, analysis, and preservative match the COC. All field samples, co-located samples, MS/MSDs, and trip blanks are listed on the COC. Samples are returned to the cooler(s). Each cooler is labeled with which trip blanks and samples, and their times, that they contain. Samplers shall take care to separate background samples and those that they suspect may have high concentrations of contaminants. Coolers shall be sealed with a signed custody seal. The field coordinator and courier sign and date each page of the COC. The COC is then electronically recorded in MDS before the being given to the courier to accompany the samples to the laboratory.
Transportation	Sample bottleware is provided by the laboratory and transported in custody sealed coolers. CTEH staff transport sample bottleware to each sample location in closed coolers. Coolers are picked up and transported to the laboratory by a laboratory courier.
Duplicate Samples	For approximately every ten samples collected in the field, one field duplicate sample will be collected. Duplicate samples will be prepared by separately submitting an aliquot from the same sample location to the laboratory for analysis consistent with the prescribed analyses. Duplicate samples will be collected at the same time. The submitted duplicate sample will be submitted such that the laboratory is not aware that it is a duplicate (i.e., the sample ID may not identify it as a “duplicate” for any specific sample location).
Matrix Spike/Matrix Spike Duplicates (MS/MSD)	Approximately one in twenty samples will be analyzed as MS/MSD samples. MS/MSD samples will be collected in the same manner as field co-located samples, only in triplicate. Samples are not spiked in the field but are sent to the laboratory and labeled MS/MSD.
Trip blanks	Laboratory-provided trip blanks are analyzed for volatile organic compounds. Trip blanks are handled while wearing nitrile gloves and are never opened. Trip blanks accompany sample containers in each sample cooler transported to the lab.
Sample Management	CTEH staff gather at the beginning of each workday to prepare for sampling. Horiba calibrations are performed each morning and documented in the calibration log. Sample bottleware is stored in a temperature-controlled and secure room. Samplers prepare by assembling the necessary glassware, creating labels, and gathering supplies. The field coordinator tracks and selects where co-located and MS/MSD samples are collected. If left unattended, samples are kept in a locked CTEH vehicle.

Appendix A

Selected Screening Values for the COIs

ANALYTE	CAS #	RL	ANALYTICAL METHOD (EPA)	UNITS	ECOLOGICAL SCREENING LEVEL (ESL)	ESL SOURCE	HUMAN HEALTH SCREENING LEVEL (HHSL)[1]	NOTES
1,2,4-Trimethylbenzene	95-63-6	1.0	8260	µg/L	15	Ohio EPA OMZA	398	
1-Methylnaphthalene	90-12-0	1.0	8270	µg/L	6.1	EPA Region IV	4.7	
2,4-Dinitrophenol	51-28-5	2.5	8270	µg/L	71	EPA Region IV	485	
2,6-Dinitrotoluene	606-20-2	1.0	8270	µg/L	81	Ohio EPA OMZA	0.8	
2-Butoxyethanol	111-76-2	2.5	8270	µg/L	475	Calculated	26,700	Synonym for Ethylene glycol mono butyl ether
2-Ethylhexyl acrylate	103-11-7	1.0	8260	µg/L	27	Calculated	NSL	
2-Hexanone	591-78-6	10.0	8260	µg/L	99	EPA Region IV	1,160	
2-Methylnaphthalene	91-57-6	1.0	8270	µg/L	4.7	EPA Region IV	132	
2-Nitrophenol	88-75-5	1.0	8270	µg/L	73	Ohio EPA OMZA	NSL	
3 & 4-Methylphenol	65794-96-9	2.0	8270	µg/L	53	Ohio EPA OMZA	NSL	Synonym for m, p-cresols
4,6-Dinitro-2-methylphenol[2]	534-52-1	2.5	8270	µg/L			17	
4-Nitrophenol	100-02-7	1.0	8270	µg/L	58	EPA Region IV	NSL	
Acenaphthene	83-32-9	1.0	8270	µg/L	15	Ohio EPA OMZA	1,940	
Acenaphthylene	208-96-8	1.0	8270	µg/L	13	EPA Region IV	NSL	
Acetone	67-64-1	10.0	8260	µg/L	1700	EPA Region IV	255,000	
Anthracene	120-12-7	1.0	8270	µg/L	0.02	Ohio EPA OMZA	5,460	
Benzene	71-43-2	1.0	8260	µg/L	160	Ohio EPA OMZA	14	
Benzo(A)anthracene	56-55-3	1.0	8270	µg/L	4.7	EPA Region IV	5.2	
Benzo(A)pyrene	50-32-8	1.0	8270	µg/L	0.06	EPA Region IV	0.52	
Benzo(B)fluoranthene	205-99-2	1.0	8270	µg/L	2.6	EPA Region IV	5.2	
Benzo(g,h,i)perylene	191-24-2	1.0	8270	µg/L	0.012	EPA Region IV	NSL	
Benzo(K)fluoranthene	207-08-9	1.0	8270	µg/L	0.06	EPA Region IV	52	
Benzoic acid	65-85-0	15.0	8270	µg/L	42	EPA Region IV	808,000	
Benzyl alcohol	100-51-6	1.0	8270	µg/L	8.6	EPA Region IV	25,300	

ANALYTE	CAS #	RL	ANALYTICAL METHOD (EPA)	UNITS	ECOLOGICAL SCREENING LEVEL (ESL)	ESL SOURCE	HUMAN HEALTH SCREENING LEVEL (HHSL)[1]	NOTES
Carbon disulfide	75-15-0	1.0	8260	µg/L	15	Ohio EPA OMZA	16,600	
Chrysene	218-01-9	1.0	8270	µg/L	4.7	Ohio EPA OMZA	520	
Diethylene glycol	111-46-6	5000	8015	µg/L	4554	Calculated	NSL	
Ethylbenzene	100-41-4	1.0	8260	µg/L	61	Ohio EPA OMZA	26	
Ethylene glycol	107-21-1		8015	µg/L	140,000	Ohio EPA OMZA	233,000	
Ethylene glycol monobutyl ether	111-76-2		duplicate	µg/L	475	Calculated	27,000	Synonym for 2-butoxyethanol
Fluoranthene	206-44-0	1.0	8270	µg/L	0.8	Ohio EPA OMZA	11,700	
Fluorene	86-73-7	1.0	8270	µg/L	19	Ohio EPA OMZA	992	
Indeno(1,2,3-C,D)pyrene	193-39-5	1.0	8270	µg/L	0.012	EPA Region IV	5.2	
Isophorone	78-59-1	1.0	8270	µg/L	920	Ohio EPA OMZA	1,460	
m+p-xylene	179601-23-1	2.0	8260	µg/L	27	Ohio EPA OMZA	12,900	Or m,p-xylene
Methyl acrylate	96-33-3	1.0	8260	µg/L	14	Calculated	NSL	
Methyl ethyl ketone (MEK)	78-93-3	10.0	8260	µg/L	22,000	Ohio EPA OMZA	165,000	Synonym for 2-Butanone
Methyl isobutyl ketone (MIBK)	108-10-1	10.0	8260	µg/L	170	EPA Region IV	NSL	Synonym for 4-Methyl-2-Pentanon
Naphthalene	91-20-3	2.5	8270	µg/L	21	Ohio EPA OMZA	2.3	
n-Butyl Acrylate	141-32-2	1.0	8260	µg/L	26	Calculated	NSL	
Nitrobenzene	98-95-3	1.0	8270	µg/L	380	Ohio EPA OMZA	409	
o-xylene	95-47-6	1.0	8260	µg/L	27	Ohio EPA OMZA	13,500	Synonym for 1,2-Dimethylbenzene
Phenanthrene	85-01-8	1.0	8270	µg/L	2.3	Ohio EPA OMZA	NSL	
Phenol	108-95-2	1.0	8270	µg/L	160	Ohio EPA OMZA	67,000	
Pyrene	129-00-0	1.0	8270	µg/L	4.6	Ohio EPA OMZA	339	
Styrene	100-42-5	1.0	8260	µg/L	32	Ohio EPA OMZA	16,100	

ANALYTE	CAS #	RL	ANALYTICAL METHOD (EPA)	UNITS	ECOLOGICAL SCREENING LEVEL (ESL)	ESL SOURCE	HUMAN HEALTH SCREENING LEVEL (HHSL)[1]	NOTES
Toluene	108-88-3	1.0	8260	µg/L	62	Ohio EPA OMZA	7,510	
Vinyl chloride	75-01-4	1.0	8260	µg/L	930	Ohio EPA OMZA	0.05	

[1] HHSL sourcce is USEPA and CCHD

[2] An ecological screening level for 2-methyl-4,6-dinitrophenol has not been derived at this time due to there only having been one detection of the compound to date (3/5/2023). If data changes, an ecological screening level will be derived and provided in an updated workplan

Appendix B

Screening Level Derivation Addendum

Norfolk Southern Railway Company

Taggart Road Incident

East Palestine, OH

Screening Level Derivation Addendum

Prepared On Behalf Of:

Norfolk Southern Railway Company

Prepared By:

CTEH

5120 Northshore Drive

Little Rock, AR 72118

501-801-8500

Original Date: April 15, 2023

Updated: June 19, 2023

1.0 Introduction

In the drafting of the SWSAP Plan and associated QAPP and assessing analytes pertaining to the East Palestine Train Derailment on February 3, 2023, a list of primary chemicals of interest (COI) was identified. Of these, a hierarchy was established for ecological screening values pertaining to surface water sampling. A subset of these chemicals did not have any previously established screening values. This addendum summarizes the methodology for deriving the proposed surface water screening values for the East Palestine Train Derailment response. The primary chemicals of interest are summarized in Appendix B of the Surface Water Sampling and Analysis Plan (SWSAP).

2.0 Screening Level Determination

2.1 Established Screening Levels

The SWSAP lists the hierarchy of established screening values used to determine screening levels for comparison of surface water data. This hierarchy provides the following criteria:

1.) Analytes with criteria provided by the OhioEPA presented in the "Aquatic Life and Human Health Tier I Criteria and Tier II Values contained in and developed pursuant to Ohio Administrative Code (OAC) Chapter 3745-1 (OAC 3745-1). OMZA Aquatic Life Criteria will be utilized unless otherwise specified.
2.) Analytes not listed in the OhioEPA WQS will be compared to EPA Region IV Surface Water Screening Levels (Chronic Freshwater Criteria will be utilized).
3.) Analytes not listed in either of the above will be compared to NOAA Screening Quick Reference Tables (SQuiRTs). Chronic Freshwater criteria for surface waters will be utilized.
4.) If no screening values were available, Ohio EPA Tier II Chronic Aquatic Values were calculated using Ohio Administrative Code 3745-1-40.

In the application of this hierarchy to the COCs listed above, the proposed screening levels are included in Appendix A of the Surface Water Sampling and Analysis Plan (SWSAP) version 4.3, dated 6/19/2023. In the SAP five (5) analytes' ecological screening values were derived according to OAC 3745-1-40:

Table 1. Ecological Screening Values for COCs

Analyte	Cas No.	Proposed SW Screening Value (ug/L)	Source*
n-butyl acrylate	141-32-2	26	Ohio EPA Tier II Chronic Aquatic Value - Calculated[a]
2-ethylhexyl acrylate	103-11-7	27	Ohio EPA Tier II Chronic Aquatic Value - Calculated[a]
2-butoxyethanol	111-76-2	475	Ohio EPA Tier II Chronic Aquatic Value - Calculated[a]
diethylene glycol	111-46-6	4,554	Ohio EPA Tier II Chronic Aquatic Value - Calculated[a]
methyl acrylate	96-33-3	14	Ohio EPA Tier II Chronic Aquatic Value - Calculated[a]

3.0 Calculation of Novel Ecological Screening Values

3.1 Screening Value Calculation Methodology

In order to derive novel screening values for the chemicals for which no established criteria were established, the Ohio Administrative Code (OAC) Water Quality Standards Chapter 3745-1-40 were utilized.

None of the three (3) chemicals above satisfied the species criteria necessary to derive a Tier I acute aquatic criterion (AAC). Due to the nature of these chemicals, and the lack of a substantial ecotoxicological data set, Tier II Acute Aquatic Values (AAV) were calculated.

In accordance with OAC 3714-1-40 (A)(4) – the following methodology as utilized in the calculation of AAV:

- Paragraph (a) notes that if an EC50/LC50 from at least one species in the Daphnidae family is available then an AAC can be calculated. If multiple values were available a geometric mean was taken to derive a genus mean acute value (GMAV).
- For the purposes of this response, the ecotoxicology data was assessed, and if LC50/EC50 data was available for a game fish species or mollusc that was lower than that daphnidae data, then that value was used in the AAV/CAV calculations. Calculated (i.e., ECOSAR Calculations) values were only used if no appropriate experimental data was found. The ECOTOX data for these analytes is included.
- The EC50/LC50 and/or GMAV were then divided by the appropriate secondary acute factor as described below to derive the secondary acute value (SAV)
- The SAV was then divided by 2 to derive the AAV.

After AAVs were calculated, Tier II chronic aquatic values (CAV) were calculated. As none of the species had three or more acceptable studies from which to derive acute-chronic ratios (ACR), and out of an abundance of caution, a secondary ACR of 18 was used in all calculations. Those that had appropriate studies showed ACR values lower than 18.

The complete guideline for the derivation of these values is included.

3.2 n-Butyl Acrylate

N-butyl Acrylate Aquatic ECOTOX Criteria:

(a) The family Salmonidae in the class Osteichthyes.
  - Oncorhynchus mykiss (rainbow trout)

(b) One other family (preferably a commercially or recreationally important warmwater species) in the class Osteichthyes (e.g., bluegill, channel catfish).
  - Leuciscus idus

(c) A third family in the phylum Chordata (e.g., fish, amphibian).
  - Sheepshead minnow

(d) A planktonic crustacean (e.g., a cladoceran, copepod).
  - Daphnia magna

(e) A benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish).
  - N/A

(f) An insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge).
  - N/A

(g) A family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca).
  - Other phylums included: Euglenophycota, chlorophyta, ciliophora, cryptophycophyta, Cyanophycota

(h) A family in any order of insect or any phylum not already represented.
  - See above

Criteria met: 6/8

TIER II – Based on Daphnia Magna

Daphnia magna	230	mg/L	LC50	Bringmann,G., and R. Kuhn
Daphnia magna	8.2	mg/L	EC50	OECD SIDS
Daphnia Magna *	9.7	mg/L	EC50	OECD SIDS
Daphnia Magna *	19.8	mg/L	EC50	OECD SIDS
Daphnid	9.81	mg/L	Calc	ECOSAR Calculation (OECD SIDS)
Daphnid*	10.653	mg/L	Calc	ECOSAR Calculation (OECD SIDS)
GMAV	18.32	mg/L		

Secondary Acute Factor – 5.2
Tier II Secondary Acute Value (SAV) = 3.52 mg/L
Tier II Acute Aquatic Value (SAV/2) = 1.76 mg/L

Out of an abundance of caution an additional TIER II AAV has been derived based upon the LC50 data in bony fishes included in the ECOTOX Data.

-LC50 for bony fishes = 5 mg/L
-Secondary Acute Factor = 5.2
-Tier II Secondary Acute Value (SAV) = .96 mg/L
-Tier II Acute Aquatic Value (SAV/2) = **0.48 mg/L**

To Determine a chronic level in accordance with Ohio EPA Regulations (3745-40), The Tier II Acute Aquatic Value is divided by 18 in lieu of appropriate acute-chronic data to calculation an acute-chronic ratio.

26 ug/L – Tier II Chronic Aquatic Value

n-butyl acrylate ECOTOX data

Species Scientific Name	Species Common Name	Conc 1 Mean (Standardized)	Conc 1 Units (Standardized)	Endpoint	Author	Publication Year
Anacystis aeruginosa	Blue-Green Algae	1.3	AI mg/L		Bringmann,G., and R. Kuhn	1978
Chilomonas paramecium	Cryptomonad	3.5	AI mg/L		Bringmann,G., R. Kuhn, and A. Winter	1980
Chilomonas paramecium	Cryptomonad	3.5	AI mg/L		Bringmann,G., and R. Kuhn	1981
Cyprinodon variegatus	Sheepshead minnow	2.1	mg/L	LC50	OECD SIDS	
Daphnia magna	Water Flea	16	AI mg/L	LC0	Bringmann,G., and R. Kuhn	1977
Daphnia magna	Water Flea	500	AI mg/L	LC100	Bringmann,G., and R. Kuhn	1977
Daphnia magna	Water Flea	230	AI mg/L	LC50	Bringmann,G., and R. Kuhn	1977
Daphnia magna		8.2	mg/L	EC50	OECD SIDS	
Daphnia Magna *		9.7	mg/L	EC50	OECD SIDS	
Daphnia Magna *		19.8	mg/L	EC50	OECD SIDS	
Daphnid		9.81	mg/L	Calc	ECOSAR Calculation (OECD SIDS)	
Daphnid*		10.653	mg/L	Calc	ECOSAR Calculation (OECD SIDS)	
Desmodesmus Subspicatus*	Green Algae	3.18	mg/L	EC50	OECD SIDS	
Desmodesmus Subspicatus*	Green Algae	5.28	mg/L	EC50	OECD SIDS	
Entosiphon sulcatum	Flagellate Euglenoid	50	AI mg/L		Bringmann,G., and R. Kuhn	1980
Entosiphon sulcatum	Flagellate Euglenoid	50	AI mg/L		Bringmann,G.	1978
Entosiphon sulcatum	Flagellate Euglenoid	50	AI mg/L		Bringmann,G., and R. Kuhn	1981
Entosiphon sulcatum	Flagellate Euglenoid	50	AI mg/L		Bringmann,G., and R. Kuhn	1979
Fish		1.786	mg/L	Calc	ECOSAR Calculation (OECD SIDS)	
Fish*		1.836	mg/L	Calc	ECOSAR Calculation (OECD SIDS)	
Leuciscus idus	Carp	22	mg/L	EC50	WISER	
Microcystis aeruginosa	Blue-Green Algae	1.3	AI mg/L	LOEC	Bringmann,G., and R. Kuhn	1978
Microcystis aeruginosa	Blue-Green Algae	1.3	AI mg/L		Bringmann,G.	1975
Oncorhynchus mykiss	Rainbow Trout	5.2	mg/L		WISER	
Oncorhynchus mykiss	Steelhead Salmon	5.2	mg/L		WISER	
Osteichthyes	Bony Fishes	5	AI mg/L	LC50	Paulet,G., and M. Vidal	1975
Pimephales Promelas*	Fathead Minnow	2.09	mg/L		OECD SIDS	
Salmo Gairdneri	Rainbow Trout	5.2	mg/L	LC50	OECD SIDS	
Scenedesmus quadricauda	Green Algae	9.3	AI mg/L	LOEC	Bringmann,G., and R. Kuhn	1978
Scenedesmus quadricauda	Green Algae	9.3	AI mg/L		Bringmann,G., and R. Kuhn	1980
Scenedesmus quadricauda	Green Algae	9.3	AI mg/L		Bringmann,G., and R. Kuhn	1977
Scenedesmus quadricauda	Green Algae	9.3	AI mg/L		Bringmann,G., and R. Kuhn	1978
Scenedesmus quadricauda	Green Algae	9.3	AI mg/L		Bringmann,G., and R. Kuhn	1979
Selenastrum capricornutum	Green Algae	2.6	mg/L	EC50	OECD SIDS	
Uronema parduczi	Ciliate	21	AI mg/L		Bringmann,G., and R. Kuhn	1980
Uronema parduczi	Ciliate	21	AI mg/L		Bringmann,G., and R. Kuhn	1981

3.3 2-Ethylhexyl Acrylate

Ethylhexyl Acrylate Aquatic ECOTOX Criteria:

(a) The family Salmonidae in the class Osteichthyes.
  - Oncorhynchus mykiss (rainbow trout)

(b) One other family (preferably a commercially or recreationally important warmwater species) in the class Osteichthyes (e.g., bluegill, channel catfish).
  - Leuciscus idus

(c) A third family in the phylum Chordata (e.g., fish, amphibian).
  - Misc osteichthyes

(d) A planktonic crustacean (e.g., a cladoceran, copepod).
  - Daphnia magna

(e) A benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish).
  - Brine Shrimp (saltwater so may not be applicable)

(f) An insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge).

(g) A family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca).
  - Other phylums included: Euglenophycota, chlorophyta, cryptophycophyta, Cyanophycota

(h) A family in any order of insect or any phylum not already represented.
  - See above

Criteria met: 6/8 (didn't count brine shrimp out of caution)

TIER II – Based on Daphnia Magna

Daphnia magna	10	AI mg/L	EC50	Bringmann,G., and R. Kuhn, 1982
Daphnia magna	10	AI mg/L	LC50	Bringmann,G., and R. Kuhn, 1977
Daphnia magna	1.3	mg/L	EC50	OECD SIDS
GMAV	5.06	mg/L		

Secondary Acute Factor – 5.2
Tier II Secondary Acute Value (SAV) = 0.97 mg/L
Tier II Acute Aquatic Value (SAV/2) = **0.48 mg/L**

To determine a chronic level in accordance with Ohio EPA Regulations (3745-40), The Tier II Acute Aquatic Value is divided by 18 out of an abundance of caution to calculate an acute-chronic ratio.

27 ug/L – Tier II Chronic Aquatic Value

2-Ethylhexyl acrylate ECOTOX Data

Chemical Name	Species Scientific Name	Species Common Name	Conc 1 Mean Op (Standardized)	Conc 1 Mean (Standardized)	Conc 1 Units (Standardized)	Effect	Endpoint	Author	Publication Year
2-Ethylhexyl acrylate	Anacystis aeruginosa	Blue-Green Algae		0.055	AI mg/L	Population		Bringmann,G., and R. Kuhn	1978
2-Ethylhexyl acrylate	Artemia salina	Brine Shrimp		72	AI mg/L	Mortality	LC50	Price,K.S., G.T. Waggy, and R.A. Conway	1974
2-Ethylhexyl acrylate	Chilomonas paramecium	Cryptomonad		2.3	AI mg/L	Population		Bringmann,G., R. Kuhn, and A. Winter	1980
2-Ethylhexyl acrylate	Daphnia magna	Water Flea		10	AI mg/L	Behavior	EC0	Bringmann,G., and R. Kuhn	1982
2-Ethylhexyl acrylate	Daphnia magna	Water Flea	>	10	AI mg/L	Behavior	EC50	Bringmann,G., and R. Kuhn	1982
2-Ethylhexyl acrylate	Daphnia magna	Water Flea	>	10	AI mg/L	Intoxication	LC50	Bringmann,G., and R. Kuhn	1977
	Daphnia magna	Water Flea		1.3	mg/L		EC50	OECD SIDS	
	Desmodesmus	Green Algae		1.71	mg/L		EC50	OECD SIDS	
2-Ethylhexyl acrylate	Entosiphon sulcatum	Flagellate Euglenoid	>	10	AI mg/L	Population		Bringmann,G.	1978
2-Ethylhexyl acrylate	Leuciscus idus ssp. melanotus	Carp		9	AI mg/L	Mortality	LC0	Juhnke,I., and D. Luedemann	1978
2-Ethylhexyl acrylate	Leuciscus idus ssp. melanotus	Carp		45	AI mg/L	Mortality	LC100	Juhnke,I., and D. Luedemann	1978
2-Ethylhexyl acrylate	Leuciscus idus ssp. melanotus	Carp		23	AI mg/L	Mortality	LC50	Juhnke,I., and D. Luedemann	1978
2-Ethylhexyl acrylate	Microcystis aeruginosa	Blue-Green Algae		0.06	AI mg/L	Population	LOEC	Bringmann,G., and R. Kuhn	1978
	Oncorhynchus mykiss	Rainbow Trout		1.8	mg/L		LC50	OECD SIDS	
2-Ethylhexyl acrylate	Osteichthyes	Bony Fishes		200	AI mg/L	Mortality	LC50	Paulet,G., and M. Vidal	1975
2-Ethylhexyl acrylate	Scenedesmus quadricauda	Green Algae	>	1	AI mg/L	Population	LOEC	Bringmann,G., and R. Kuhn	1978
2-Ethylhexyl acrylate	Scenedesmus quadricauda	Green Algae	>	1	AI mg/L	Population		Bringmann,G., and R. Kuhn	1977
2-Ethylhexyl acrylate	Scenedesmus quadricauda	Green Algae	>	1	AI mg/L	Population		Bringmann,G., and R. Kuhn	1978

3.4 2-Butoxyethanol

2-butoxyethyl acetate Aquatic ECOTOX Criteria:

(i) The family Salmonidae in the class Osteichthyes.
  - Oncorhynchus mykiss (rainbow trout)

(j) One other family (preferably a commercially or recreationally important warmwater species) in the class Osteichthyes (e.g., bluegill, channel catfish).
  - Lepomis Macrochirus (bluegill)

(k) A third family in the phylum Chordata (e.g., fish, amphibian).
  - Leuciscus idus ssp. Melanotus (carp)

(l) A planktonic crustacean (e.g., a cladoceran, copepod).
  - Daphnia magna

(m) A benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish).
  - Chaetogammarus marinus (marine)
  - Crangon Crangon (sand shrimp – marine)
  - Artemia Salina (brine shrimp – marine)

(n) An insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge).

(o) A family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca).
  - Other phylum cyanophycota, chlorophyta, ciliophoran, euglenophycota, cryptophycophyta, mollusca

(p) A family in any order of insect or any phylum not already represented.
  - See above

Criteria met: 6/8 (didn't count marine crustaceans out of caution)

Due to potential prioritization of freshwater molluscs – AAV is calculated based upon ECO Tox Data for oysters, which had a lower LC50 than daphnia magna.

TIER II – Based on Crassostrea virginica (oyster)

Crassostrea virginica	89	mg/L	LC50	WHO

Secondary Acute Factor – 5.2
Tier II Secondary Acute Value (SAV) = 17.12 mg/L
Tier II Acute Aquatic Value (SAV/2) = **8.55 mg/L**

Molluscs represent the lowest available LC50 for a species of interest - to determine a chronic level in accordance with Ohio EPA Regulations (3745-40), The Tier II Acute Aquatic Value is divided by 18 out of an abundance of caution to calculate an acute-chronic ratio.

475 ug/L – Tier II Chronic Aquatic Value

2-Butoxyethanol ECOTOX Data

Chemical Name	Species Scientific Name	Species Common Name	Conc 1 Mean Op (Standardized)	Conc 1 Mean (Standardized)	Conc 1 Units (Standardized)	Endpoint	Author	Reference Number	Publication Year
2-Butoxyethanol	Poecilia reticulata	Guppy		0.46324992	AI mg/L	(log)LC50	Konemann,H.	6354	1981
2-Butoxyethanol	Anacystis aeruginosa	Blue-Green Algae		35	AI mg/L		Bringmann,G., and R. Kuhn	15134	1978
2-Butoxyethanol	Microcystis aeruginosa	Blue-Green Algae		35	AI mg/L	LOEC	Bringmann,G., and R. Kuhn	19121	1978
2-Butoxyethanol	Microcystis aeruginosa	Blue-Green Algae		35	AI mg/L		Bringmann,G.	10116	1975
	Crassostrea virginica	Oyster		89	mg/L	LC50	WHO		2004
2-Butoxyethanol	Entosiphon sulcatum	Flagellate Euglenoid		91	AI mg/L		Bringmann,G., and R. Kuhn	5303	1980
2-Butoxyethanol	Entosiphon sulcatum	Flagellate Euglenoid		91	AI mg/L		Bringmann,G.	6601	1978
2-Butoxyethanol	Entosiphon sulcatum	Flagellate Euglenoid		91	AI mg/L		Bringmann,G., and R. Kuhn	720	1981
2-Butoxyethanol	Entosiphon sulcatum	Flagellate Euglenoid		91	AI mg/L		Bringmann,G., and R. Kuhn	5014	1979
	Crypinodon variegatus	Sheepshead Minnow		116	mg/L	LC50	WHO		2004
2-Butoxyethanol	Leciscus idus melanotus	Golden Ide		186	mg/L	LC50	WHO		2004
2-Butoxyethanol	Uronema parduczi	Ciliate		463	AI mg/L		Bringmann,G., and R. Kuhn	720	1981
2-Butoxyethanol	Uronema parduczi	Ciliate		463	AI mg/L		Bringmann,G., and R. Kuhn	6791	1980
2-Butoxyethanol	Notropus Atherinoides	Emerald Shiner	>	500	mg/L	LC50	WHO		2004
2-Butoxyethanol	Crangon crangon	Sand Shrimp		775	AI mg/L	LC50	Blackman,R.A.A.	925	1974
2-Butoxyethanol	Crangon crangon	Sand Shrimp		800	AI mg/L	LC50	Blackman,R.A.A.	925	1974
2-Butoxyethanol	Scenedesmus quadricauda	Green Algae		900	AI mg/L	LOEC	Bringmann,G., and R. Kuhn	19121	1978
2-Butoxyethanol	Scenedesmus quadricauda	Green Algae		900	AI mg/L		Bringmann,G., and R. Kuhn	5303	1980
2-Butoxyethanol	Scenedesmus quadricauda	Green Algae		900	AI mg/L		Bringmann,G., and R. Kuhn	7453	1977
2-Butoxyethanol	Scenedesmus quadricauda	Green Algae		900	AI mg/L		Bringmann,G., and R. Kuhn	15134	1978
2-Butoxyethanol	Scenedesmus quadricauda	Green Algae		900	AI mg/L		Bringmann,G., and R. Kuhn	5014	1979
2-Butoxyethanol	Chilomonas paramecium	Cryptomonad		911	AI mg/L		Bringmann,G., R. Kuhn, and A. Winter	5719	1980
2-Butoxyethanol	Chilomonas paramecium	Cryptomonad		911	AI mg/L		Bringmann,G., and R. Kuhn	720	1981
2-Butoxyethanol	Poecilia reticulata	Guppy		983	AI mg/L	LC50	Verschueren, K		2001
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	LC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>	1000	AI mg/L	NR-ZERO	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chlorococcales	Green Algae Order	>	1000	AI mg/L	EC10	Krebs,F.	56359	1991
2-Butoxyethanol	Daphnia magna	Water Flea	>	1000	AI mg/L	EC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Daphnia magna	Water Flea	>	1000	AI mg/L	EC100	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Daphnia magna	Water Flea	>	1000	AI mg/L	EC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Daphnia magna	Water Flea	>	1000	AI mg/L	EC50	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Oncohynchus mykiss	Rainbow trout	>	1000	mg/L	LC50	WHO		2004
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>=	1000	AI mg/L	LC0	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>=	1000	AI mg/L	LC0	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>=	1000	AI mg/L	LC0	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>=	1000	AI mg/L	LC0	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>=	1000	AI mg/L	LC0	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>=	1000	AI mg/L	LC0	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>=	1000	AI mg/L	LC0	Adema,D.M.M.	63143	1985

2-Butoxyethanol	Chaetogammarus marinus	Amphipod	>=	1000	AI mg/L	LC0	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Daphnia magna	Water Flea	>=	1000	AI mg/L	EC0	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Daphnia magna	Water Flea	>=	1000	AI mg/L	EC0	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Artemia salina	Brine Shrimp		1000	AI mg/L	LC50	Price,K.S., G.T. Waggy, and R.A. Conway	2408	1974
2-Butoxyethanol	Chaetogammarus marinus	Amphipod		1000	AI mg/L	NOEC	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod		1000	AI mg/L	NOEC	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Chaetogammarus marinus	Amphipod		1000	AI mg/L	NR-ZERO	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Daphnia magna	Water Flea		1000	AI mg/L	NOEC	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Daphnia magna	Water Flea		1000	AI mg/L	NR-ZERO	Adema,D.M.M.	63143	1985
2-Butoxyethanol	Lepomis macrochirus	Bluegill		1000	AI mg/L	NR-ZERO	Dawson,G.W., A.L. Jennings, D. Drozdowski, and E. Rider	863	1977
2-Butoxyethanol	Daphnia magna	Water Flea		1140	AI mg/L	LC0	Bringmann,G., and R. Kuhn	5718	1977
2-Butoxyethanol	Leuciscus idus ssp. melanotus	Carp		1170	AI mg/L	LC0	Juhnke,I., and D. Luedemann	547	1978
2-Butoxyethanol	Menidia beryllina	Inland Silverside		1250	AI mg/L	LC50	Dawson,G.W., A.L. Jennings, D. Drozdowski, and E. Rider	863	1977
2-Butoxyethanol	Daphnia magna	Water Flea		1283	AI mg/L	EC0	Bringmann,G., and R. Kuhn	707	1982
2-Butoxyethanol	Leuciscus idus ssp. melanotus	Carp		1350	AI mg/L	LC0	Juhnke,I., and D. Luedemann	547	1978
2-Butoxyethanol	Leuciscus idus ssp. melanotus	Carp		1395	AI mg/L	LC50	Juhnke,I., and D. Luedemann	547	1978
2-Butoxyethanol	Lepomis macrochirus	Bluegill		1490	AI mg/L	LC50	Dawson,G.W., A.L. Jennings, D. Drozdowski, and E. Rider	863	1977
2-Butoxyethanol	Leuciscus idus ssp. melanotus	Carp		1490	AI mg/L	LC100	Juhnke,I., and D. Luedemann	547	1978
2-Butoxyethanol	Leuciscus idus ssp. melanotus	Carp		1575	AI mg/L	LC50	Juhnke,I., and D. Luedemann	547	1978
2-Butoxyethanol	Leuciscus idus ssp. melanotus	Carp		1620	AI mg/L	LC100	Juhnke,I., and D. Luedemann	547	1978
2-Butoxyethanol	Carassius auratus	Goldfish		1700	AI mg/L	LC50	Bridie,A.L., C.J.M. Wolff, and M. Winter	623	1979
2-Butoxyethanol	Daphnia magna	Water Flea		1720	AI mg/L	LC50	Bringmann,G., and R. Kuhn	5718	1977
2-Butoxyethanol	Daphnia magna	Water Flea		1815	AI mg/L	EC50	Bringmann,G., and R. Kuhn	707	1982
2-Butoxyethanol	Pimephales Promelas	Fathead Minnow		2137		LC50	WHO		2004
2-Butoxyethanol	Lepomis macrochirus	Bluegill		2400	AI mg/L	NR-LETH	Dawson,G.W., A.L. Jennings, D. Drozdowski, and E. Rider	863	1977
2-Butoxyethanol	Daphnia magna	Water Flea		2500	AI mg/L	EC100	Bringmann,G., and R. Kuhn	707	1982
2-Butoxyethanol	Daphnia magna	Water Flea		2500	AI mg/L	LC100	Bringmann,G., and R. Kuhn	5718	1977

3.4 Methyl Acrylate

Methyl Acrylate Aquatic ECOTOX Criteria:

(i) The family Salmonidae in the class Osteichthyes.
  - Oncorhynchus mykiss (rainbow trout)

(j) One other family (preferably a commercially or recreationally important warmwater species) in the class Osteichthyes (e.g., bluegill, channel catfish).
  - Leuciscus idus

(k) A third family in the phylum Chordata (e.g., fish, amphibian).
  - Kuhlia sandvicensis

(l) A planktonic crustacean (e.g., a cladoceran, copepod).
  - Daphnia magna or Moina macrocopa

(m) A benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish).

(n) An insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge).

(o) A family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca).
  - Other phylums included: Euglenophycota, chlorophyta, cryptophycophyta, Cyanophycota

(p) A family in any order of insect or any phylum not already represented.
  - See above

Criteria met: 6/8

TIER II – Based on Daphnia Magna

Daphnia Magna	2.6	mg/L	LC50	OECD SIDS
GMAV	2.6	mg/L		

Secondary Acute Factor – 5.2
Tier II Secondary Acute Value (SAV) = 0.5 mg/L
Tier II Acute Aquatic Value (SAV/2) = **0.250 mg/L**

To Determine a chronic level in accordance with Ohio EPA Regulations (3745-40), The Tier II Acute Aquatic Value is divided by 18 in lieu of appropriate acute-chronic data to calculation an acute-chronic ratio.

14 ug/L – Tier II Chronic Aquatic Value

Methyl Acrylate ECOTOX Data

Species Scientific Name	Species Common Name	Conc 1 Mean (Standardized)	Conc 1 Units (Standardized)	Endpoint	Author	Publication Year
Anacystis aeruginosa	Blue-Green Algae	1.3	AI mg/L		Bringmann,G., and R. Kuhn	1978
Chilomonas paramecium	Cryptomonad	10	AI mg/L		Bringmann,G., R. Kuhn, and A. Winter	1980
Chilomonas paramecium	Cryptomonad	10	AI mg/L		Bringmann,G., and R. Kuhn	1981
Chlorococcales	Green Algae Order	8	AI mg/L	EC10	Krebs,F.	1991
Chlorococcales	Green Algae Order	55	AI mg/L	EC50	Krebs,F.	1991
Cyclops sp.	Cyclopoid Copepod	1.2-9.6	AI mg/L		D'Angelo,A.M., and G. Signorile	1978
Cypria ophthalmica	Ostracod	1.2-9.6	AI mg/L		D'Angelo,A.M., and G. Signorile	1978
Daphnia Magna	Water Flea	2.6	mg/L	LC50	OECD SIDS	
Entosiphon sulcatum	Flagellate Euglenoid	11	AI mg/L		Bringmann,G.	1978
Entosiphon sulcatum	Flagellate Euglenoid	11	AI mg/L		Bringmann,G., and R. Kuhn	1981
Kuhlia sandvicensis	Aholehole	20	AI mg/L		Hiatt,R.W., J.J. Naughton, and D.C. Matthews	1953
Leuciscus idus ssp. melanotus	Carp	5	AI mg/L	LC0	Juhnke,I., and D. Luedemann	1978
Leuciscus idus ssp. melanotus	Carp	10	AI mg/L	LC100	Juhnke,I., and D. Luedemann	1978
Leuciscus idus ssp. melanotus	Carp	7.5	AI mg/L	LC50	Juhnke,I., and D. Luedemann	1978
Microcystis aeruginosa	Blue-Green Algae	1.3	AI mg/L	LOEC	Bringmann,G., and R. Kuhn	1978
Moina macrocopa	Water Flea	1.2-9.6	AI mg/L		D'Angelo,A.M., and G. Signorile	1978
Oncorhynchus mykiss	Rainbow Trout	0.01	AI mg/L		Kaiser,K.L.E., M.B. McKinnon, D.H. Stendahl, and W.B. Pett	1995
Oncorhynchus mykiss	Rainbow Trout	0.01	AI mg/L		Kaiser,K.L.E., M.B. McKinnon, D.H. Stendahl, and W.B. Pett	1995
Oncorhynchus mykiss	Rainbow Trout	0.01	AI mg/L		Kaiser,K.L.E., M.B. McKinnon, D.H. Stendahl, and W.B. Pett	1995
Oncorhynchus mykiss	Rainbow Trout	0.01	AI mg/L		Kaiser,K.L.E., M.B. McKinnon, D.H. Stendahl, and W.B. Pett	1995
Oncorhynchus mykiss	Rainbow Trout	0.01	AI mg/L		Kaiser,K.L.E., M.B. McKinnon, D.H. Stendahl, and W.B. Pett	1995
Osteichthyes	Bony Fishes	5	AI mg/L	LC50	Paulet,G., and M. Vidal	1975
Raphidocelis subcapitata	Green Algae	15.53	AI mg/L	EC50	Bollman,M.A., W.K. Baune, S. Smith, K. DeWhitt, and L. Kapustka	1989
Raphidocelis subcapitata	Green Algae	18.57	AI mg/L	EC50	Bollman,M.A., W.K. Baune, S. Smith, K. DeWhitt, and L. Kapustka	1989
Scenedesmus quadricauda	Green Algae	7	AI mg/L	LOEC	Bringmann,G., and R. Kuhn	1978
Scenedesmus quadricauda	Green Algae	7	AI mg/L		Bringmann,G., and R. Kuhn	1978
Scenedesmus quadricauda	Green Algae	7	AI mg/L		Bringmann,G., and R. Kuhn	1977
Tetrahymena pyriformis	Ciliate	24.105312	AI mg/L	IC50	Yarbrough,J.W., and T.W. Schultz	2007
Uronema parduczi	Ciliate	64	AI mg/L		Bringmann,G., and R. Kuhn	1980
Uronema parduczi	Ciliate	64	AI mg/L		Bringmann,G., and R. Kuhn	1981

3.5 Diethylene Glycol

Diethylene Aquatic ECOTOX Criteria:

(q) The family Salmonidae in the class Osteichthyes.
  - N/A

(r) One other family (preferably a commercially or recreationally important warmwater species) in the class Osteichthyes (e.g., bluegill, channel catfish).
  - Bluegill (Lepomis Macrochirus)

(s) A third family in the phylum Chordata (e.g., fish, amphibian).
  a. Carp (Leuciscus idus)

(t) A planktonic crustacean (e.g., a cladoceran, copepod).
  - Daphnia magna

(u) A benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish).

(v) An insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge).

(w) A family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca).
  - Other Phylumns include Chlorophyta, Ciliophora, Cyanophycota, euglenophycota, Cryptophycophyta

(x) A family in any order of insect or any phylum not already represented.
  a. See above

Criteria met: 5/8 (Bluegill data is LC0)

TIER II – Based on Bluegill

Bluegill	>1000	mg/L	LC0	Buzzell, 1968
SMAV	1,000	mg/L	EC50	

Secondary Acute Factor – 6.1
Tier II Secondary Acute Value (SAV) = 164 mg/L
Tier II Acute Aquatic Value (SAV/2) = **82 mg/L**

To determine a chronic level in accordance with Ohio EPA Regulations (3745-40), The Tier II Acute Aquatic Value is divided by 18 out of an abundance of caution to calculate an acute-chronic ratio.

4,554 ug/L – Tier II Chronic Aquatic Value

Diethylene Glycol ECOTOX Data

Species Scientific Name	Species Common Name	Conc 1 Mean (Standardized)	Conc 1 Units (	Endpoint	Author	Publication Year
Chlorella fusca var. vacuolata	Green Algae	0.05	AI mg/L	BCF	Freitag,D., L. Ballhorn, H. Geyer, and F. Korte	1985
Chlorococcales	Green Algae Order	1000	AI mg/L	EC10	Krebs,F.	1991
Selenastrum capricornutum	Green Algae	100	AI mg/L	NOEC	National Association of Photographic Manufacturers	1974
Entosiphon sulcatum	Flagellate Euglenoid	10745	AI mg/L		Bringmann,G., and R. Kuhn	1980
Entosiphon sulcatum	Flagellate Euglenoid	10745	AI mg/L		Bringmann,G., and R. Kuhn	1979
Entosiphon sulcatum	Flagellate Euglenoid	10745	AI mg/L		Bringmann,G., and R. Kuhn	1981
Chilomonas paramecium	Cryptomonad	4000	AI mg/L		Bringmann,G., R. Kuhn, and A. Winter	1980
Anacystis aeruginosa	Blue-Green Algae	1700	AI mg/L		Bringmann,G., and R. Kuhn	1978
Entosiphon sulcatum	Flagellate Euglenoid	10745	AI mg/L		Bringmann,G.	1978
Chilomonas paramecium	Cryptomonad	4000	AI mg/L		Bringmann,G., and R. Kuhn	1981
Microcystis aeruginosa	Blue-Green Algae	1700	AI mg/L	LOEC	Bringmann,G., and R. Kuhn	1978
Scenedesmus quadricauda	Green Algae	2700	AI mg/L	LOEC	Bringmann,G., and R. Kuhn	1978
Scenedesmus quadricauda	Green Algae	2700	AI mg/L		Bringmann,G., and R. Kuhn	1980
Scenedesmus quadricauda	Green Algae	2700	AI mg/L		Bringmann,G., and R. Kuhn	1977
Microcystis aeruginosa	Blue-Green Algae	1700	AI mg/L		Bringmann,G.	1975
Scenedesmus quadricauda	Green Algae	2700	AI mg/L		Bringmann,G., and R. Kuhn	1979
Scenedesmus quadricauda	Green Algae	2700	AI mg/L		Bringmann,G., and R. Kuhn	1978
Xenopus laevis	African Clawed Frog	18090	AI mg/L	EC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	12150	AI mg/L	EC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	21080	AI mg/L	EC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	16940	AI mg/L	EC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	18190	AI mg/L	EC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	17200	AI mg/L	EC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	17110	AI mg/L	EC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	6840	AI mg/L	EC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	10230	AI mg/L	EC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	32070	AI mg/L	LC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	34660	AI mg/L	LC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	31290	AI mg/L	LC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	43000	AI mg/L	LC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	45360	AI mg/L	LC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	30620	AI mg/L	LC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	28900	AI mg/L	LC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	30580	AI mg/L	LC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	30720	AI mg/L	LC50	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	3065	AI mg/L	LC50	De Zwart,D., and W. Slooff	1987
Xenopus laevis	African Clawed Frog	5000	AI mg/L	LOEC	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	2500	AI mg/L	LOEC	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	5100	AI mg/L	LOEC	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	2500	AI mg/L	LOEC	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	13000	AI mg/L	LOEC	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	24000	AI mg/L	LOEC	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	19000	AI mg/L	LOEC	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	15000	AI mg/L	LOEC	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Xenopus laevis	African Clawed Frog	20000	AI mg/L	LOEC	Bantle,J.A., R.A. Finch, D.J. Fort, E.L. Stover, M. Hull, M. Kumsher-King, and A.M. Gaudet-Hull	1999
Artemia salina	Brine Shrimp	10000	AI mg/L	LC50	Price,K.S., G.T. Waggy, and R.A. Conway	1974
Daphnia magna	Water Flea	10000	AI mg/L	EC50	Bringmann,G., and R. Kuhn	1982
Daphnia magna	Water Flea	10000	AI mg/L	LC50	Bringmann,G., and R. Kuhn	1977
Daphnia magna	Water Flea	3.7	AI mg/L	LC50	National Association of Photographic Manufacturers	1974
Daphnia magna	Water Flea	1	AI mg/L	LC50	National Association of Photographic Manufacturers	1974
Daphnia magna	Water Flea	100	AI mg/L		National Association of Photographic Manufacturers	1974
Leuciscus idus ssp. melanotus	Carp	0.05	AI mg/L	BCF	Freitag,D., L. Ballhorn, H. Geyer, and F. Korte	1985
Leuciscus idus ssp. melanotus	Carp	10000	AI mg/L	LC50	Juhnke,I., and D. Luedemann	1978

Gambusia affinis	Western Mosquitofish	32000	AI mg/L	LC50	Wallen,I.E., W.C. Greer, and R. Lasater	1957
Gambusia affinis	Western Mosquitofish	32000	AI mg/L	LC50	Wallen,I.E., W.C. Greer, and R. Lasater	1957
Gambusia affinis	Western Mosquitofish	32000	AI mg/L	LC50	Wallen,I.E., W.C. Greer, and R. Lasater	1957
Poecilia reticulata	Guppy	5.76	umol/L	(log)LC50	Konemann,H.	1981
Lepomis macrochirus	Bluegill	1000	AI mg/L	LC0	Buzzell,J.C.,Jr., R.H.F. Young, and D.W. Ryckman	1968
Pimephales promelas	Fathead Minnow	100	AI mg/L	LC50	National Association of Photographic Manufacturers	1974
Pimephales promelas	Fathead Minnow	75200	AI mg/L	LC50	Geiger,D.L., L.T. Brooke, and D.J. Call	1990
Carassius auratus	Goldfish	5000	AI mg/L	LC50	Bridie,A.L., C.J.M. Wolff, and M. Winter	1979
Uronema parduczi	Ciliate	8000	AI mg/L		Bringmann,G., and R. Kuhn	1980
Uronema parduczi	Ciliate	8000	AI mg/L		Bringmann,G., and R. Kuhn	1981
Tetrahymena pyriformis	Ciliate	24400	AI mg/L	IC50	Sauvant,M.P., D. Pepin, J. Bohatier, and C.A. Groliere	1995
Tetrahymena pyriformis	Ciliate	31500	AI mg/L	IC50	Sauvant,M.P., D. Pepin, C.A. Groliere, and J. Bohatier	1995
Tetrahymena pyriformis	Ciliate	22500	AI mg/L	IC50	Sauvant,M.P., D. Pepin, J. Bohatier, and C.A. Groliere	1995
Tetrahymena pyriformis	Ciliate	24400	AI mg/L	IC50	Sauvant,M.P., D. Pepin, J. Bohatier, and C.A. Groliere	1995
Tetrahymena pyriformis	Ciliate	41000	AI mg/L	IC50	Sauvant,M.P., D. Pepin, C.A. Groliere, and J. Bohatier	1995
Tetrahymena pyriformis	Ciliate	91150	AI mg/L	IC50	Sauvant,M.P., D. Pepin, C.A. Groliere, and J. Bohatier	1995

3745-1-40 Methodologies for development of aquatic life criteria and values.

All pollutants or combinations of pollutants, for which aquatic life criteria have not been adopted in rule 3745-1-35 of the Administrative Code, shall not exceed the water quality criteria or values derived using the procedures contained in this rule.

(A) Tier I acute aquatic criterion (AAC) and tier II acute aquatic value (AAV). This criterion and value apply outside the mixing zone to all aquatic life habitat use designations. This criterion and value shall be expressed as the quantity of chemical per liter of water (e.g., mg/l or ug/l). Paragraphs (A)(1) to (A)(3) of this rule shall be used to calculate the tier I AAC when acute toxicity data are available for species in at least eight families. Paragraph (A)(4) of this rule shall be used to calculate the tier II AAV when there are not enough toxicity data to use the procedures in paragraphs (A)(1) to (A)(3) of this rule but there is at least one EC_{50} or LC_{50} value for a species in one of the following three genera of the family Daphnidae: Ceriodaphnia sp., Daphnia sp., or Simocephalus sp.

(1) The procedures in paragraphs (A)(1) to (A)(3) of this rule shall be used to calculate the tier I AAC when LC_{50} or EC_{50} data are available for at least one species of freshwater animal in at least the eight different families identified as follows:

(a) The family Salmonidae in the class Osteichthyes.

(b) One other family (preferably a commercially or recreationally important warmwater species) in the class Osteichthyes (e.g., bluegill, channel catfish).

(c) A third family in the phylum Chordata (e.g., fish, amphibian).

(d) A planktonic crustacean (e.g., a cladoceran, copepod).

(e) A benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish).

(f) An insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge).

(g) A family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca).

(h) A family in any order of insect or any phylum not already represented.

(2) When data are not available to show that acute toxicity to two or more species is similarly related to a water quality characteristic (e.g., hardness, pH or temperature), the tier I AAC shall be calculated using the procedures in paragraphs (A)(2)(a) to (A)(2)(i) of this rule.

(a) For each species for which at least one acute value is available, the species mean acute value (SMAV) shall be calculated as the geometric mean of the results of all acceptable flow-through acute toxicity tests in which the concentrations of test material were measured with the most sensitive tested life stage of the species. For a species for which no such result is available, the SMAV shall be calculated as the geometric mean of all acceptable acute toxicity tests with the most sensitive tested life stage, i.e., results of flow-through tests in which the concentrations were not measured and results of static and renewal tests based on initial concentrations (nominal concentrations are acceptable for most test materials if measured concentrations are not available) of test material.

(b) For each genus for which one or more SMAVs are available, the genus mean acute value (GMAV) shall be calculated as the geometric mean of the SMAVs available for the genus.

(c) The GMAVs shall be ordered from high to low.

(d) Ranks (R) shall be assigned to the GMAVs from "one" for the lowest to "N" for the highest. If two or more GMAVs are identical, successive ranks are arbitrarily assigned.

(e) The cumulative probability (P), shall be calculated for each GMAV as R / (N + 1).

(f) The four GMAVs shall be selected which have cumulative probabilities closest to 0.05. If there are fewer than fifty-nine GMAVs, these will always be the four lowest GMAVs.

(g) Using the four selected GMAVs and Ps, the final acute value (FAV) shall be calculated as follows:

$$S^2 = \frac{\Sigma((\ln \mathrm{GMAV})^2) - \frac{(\Sigma(\ln \mathrm{GMAV}))^2}{4}}{\Sigma(P) - \frac{(\Sigma(\sqrt{P}))^2}{4}}$$

$$L = \frac{\Sigma(\ln \mathrm{GMAV}) - S(\Sigma(\sqrt{P}))}{4}$$

$$A = S(\sqrt{0.05}) + L$$

$$\mathrm{FAV} = e^A$$

(h) If, for a commercially, recreationally or ecologically important species, the geometric mean of the acute values from flow-through tests in which the concentrations of test material were measured is lower than the calculated FAV, then that geometric mean shall be used as the FAV instead of the calculated FAV.

(i) The AAC shall be calculated by dividing the FAV by two.

(3) When enough data are available to show that acute toxicity to two or more species is similarly related to a water quality characteristic (e.g., hardness, pH or temperature), the tier I FAV shall be calculated using the procedures in paragraphs (A)(3)(a) to (A)(3)(l) of this rule or using an analysis of covariance. The two methods are equivalent and produce identical results. If two or more factors affect toxicity, multiple regression analysis shall be used.

(a) For each species for which comparable acute toxicity values are available at two or more different values of the water quality characteristic, a least squares regression of the acute toxicity values on the corresponding values of the water quality characteristic shall be performed to obtain the slope and its ninety-five per cent confidence limits for each species. Because the best documented relationship is that between hardness and acute toxicity of metals and a log-log relationship fits these data, geometric means and natural logarithms of both toxicity and water quality are used in the rest of this method. For relationships based on other water quality characteristics, such as pH or temperature, no transformation or a different transformation might fit the data better, and appropriate changes shall be made as necessary throughout this method.

(b) Data for each species shall be evaluated as to whether or not they are relevant, taking into account the range and number of the tested values of the water quality characteristic and the degree of agreement within and between species. If useful slopes are not available for at least one fish and one invertebrate, or if the available slopes are too dissimilar, or if too few data are available to adequately define the relationship between acute toxicity and the water quality characteristic, the AAC shall be calculated using the procedures in paragraph (A)(2) of this rule, using the results of tests conducted under conditions and in waters similar to those commonly used for toxicity tests with the species.

(c) For each species, the geometric mean of the available acute values shall be calculated and then each of the acute values for a species shall be divided by the mean for the species. This calculation normalizes the acute values so that the geometric mean of the normalized values for each species individually and for any combination of species is 1.0.

(d) The values of the water quality characteristic shall be similarly normalized for each species individually using the procedure in paragraph (A)(3)(c) of this rule.

(e) Individually for each species a least squares regression of the normalized acute values on the water quality characteristic shall be performed. The resulting slopes and ninety-five per cent confidence limits will be identical to those obtained in paragraph (A)(3)(a) of this rule. If, however, the data are actually plotted, the line of best fit for each individual species will go through the point 1, 1 in the center of the graph.

(f) All the normalized data shall be treated as if they were for the same species and a least squares regression of all the normalized acute values on the corresponding normalized values of the water quality characteristic is performed to obtain the pooled acute slope, V, and its ninety-five per cent confidence limits. If all of the normalized data are actually plotted, the line of best fit will go through the point

1, 1 in the center of the graph.

(g) For each species the geometric mean, W, of the acute toxicity values and the geometric mean, X, of the values of the water quality characteristic shall be calculated. (These were calculated in paragraphs (A)(3)(c) and (A)(3)(d) of this rule.)

(h) For each species the natural logarithm (ln), Y, of the SMAV at a selected value, Z, of the water quality characteristic shall be calculated using the equation:

$Y = \ln W - V(\ln X - \ln Z)$.

(i) For each species the SMAV at Z shall be calculated using the equation:

$SMAV = e^{Y}$.

(j) The FAV shall be obtained by using the procedures described in paragraphs (A)(2)(b) to (A)(2)(g) of this rule.

(k) If, for a commercially or recreationally important species the geometric mean of the acute values at Z from flow-through tests in which the concentrations of the test material were measured is lower than the FAV at Z, then the geometric mean shall be used as the FAV instead of the FAV.

(l) The final acute equation shall be written as:

$FAV = e^{(V[\ln(\text{water quality characteristic})] + A - V[\ln Z])}$,

Where:

V = pooled acute slope, and A = ln (FAV at Z). Because V, A, and Z are known, the FAV can be calculated for any selected value of the water quality characteristic.

(m) For any value of Z, the AAC shall be calculated by dividing the FAV by two.

(4) Tier II values.

(a) If the required data to derive the tier I AAC in paragraphs (A)(1) to (A)(3) of this rule are not present in the acute toxicity data base and at least one EC_{50} or LC_{50} value is available for a species in one of the following three genera of the family Daphnidae - Ceriodaphnia sp., Daphnia sp., or Simocephalus sp., a tier II secondary acute value (SAV) shall be calculated by dividing the lowest GMAV in the data base by the secondary acute factor (SAF) (see table 40-1 of this rule) corresponding to the number of satisfied minimum data requirements listed in the tier I methodology (see paragraph (A)(1) of this rule).

(b) The tier II AAV equals the SAV divided by two.

(c) If appropriate, the AAV shall be made a function of a water quality characteristic in a manner similar to that described in paragraph (A)(3) of this rule.

(B) Tier I chronic aquatic criterion (CAC) and tier II chronic aquatic value (CAV). This criterion and value apply outside the mixing zone to all aquatic life habitat use designations except the limited resource water use designation. This criterion and value shall be expressed as the quantity of chemical per liter of water (e.g., mg/l or ug/l). Paragraphs (B)(1) and (B)(2) of this rule are used to calculate the tier I CAC. Paragraphs (B)(3) and (B)(4) of this rule shall be used to calculate the tier II CAV when there are not enough toxicity data to use the method in paragraphs (B)(1) and (B)(2) of this rule.

(1) If chronic values are available for species in eight families as described in paragraph (A)(1) of this rule, a species mean chronic value (SMCV) shall be calculated for each species for which at least one chronic value is available by calculating the geometric mean of the results of all acceptable life-cycle and partial life-cycle toxicity tests with the species; for a species of fish for which no such result is available, the SMCV shall be the geometric mean of all acceptable early life-stage tests. Appropriate genus mean chronic values (GMCVs) shall also be calculated. A GMCV shall be the geometric mean of the SMCVs for the genus. The CAC shall be obtained using the procedure contained in paragraphs (A)(1) to (A)(3) of this rule, substituting CAC for FAV, SMCV for SMAV and GMCV for GMAV.

(2) If chronic data for a chemical are not available for at least eight freshwater species meeting the requirements in paragraph (A)(1) of this rule, the CAC shall be calculated by dividing the FAV by a final acute-chronic ratio (FACR).

(a) Acute-chronic ratio (ACRs) are required for at least one species of aquatic animal in at least three different families provided that of the three species conform to the following:

(i) At least one is a fish.

(ii) At least one is an invertebrate.

(iii) At least one species is an acutely sensitive freshwater species (the other two may be saltwater species).

(b) For each chronic value for which at least one corresponding appropriate acute value is available, an ACR shall be calculated using the chronic value for the denominator and using the geometric mean of the results of all acceptable flow-through (except static is acceptable for daphnids and midges) acute tests in the same dilution water in which the concentrations are measured for the numerator. For fish, the acute test shall be conducted with juveniles. The acute test should be part of the same study as the chronic test. If acute tests were not conducted as part of the same study, but were conducted as part of a different study in the same laboratory and dilution water, then they may be used. If no such acute tests are available, results of acute tests conducted in the same dilution water in a different laboratory may be used. If no such acute tests are available, an ACR shall not be calculated.

(c) For each species, the species mean ACR shall be calculated as the geometric mean of all ACRs available for that species. If the minimum ACR data requirements (as described in paragraph (B)(2)(a) of this rule) are not met with freshwater data alone, saltwater data may be used along with the freshwater data.

(d) For some materials, the ACR seems to be the same for all species, but for other materials the ratio seems to increase or decrease as the SMAV increases. Thus the FACR shall be obtained in the following ways:

(i) If the species mean ACR seems to increase or decrease as the SMAVs increase, the FACR shall be calculated as the geometric mean of the ACRs for species whose SMAVs are close to the FAV.

(ii) If no major trend is apparent and the ACRs for all species are within a factor of ten, the FACR shall be calculated as the geometric mean of all of the species mean ACRs.

(iii) If the most appropriate species mean ACRs are less than 2.0, the FACR shall be assumed to be 2.0.

(e) The FCV shall be calculated by dividing the FAV by the FACR.

(f) If the SMCV of a commercially or recreationally important species is lower than the calculated CAC, then that SMCV shall be used as the CAC instead of the calculated CAC.

(3) Secondary acute-chronic ratio.

If fewer than three acceptable experimentally determined ACRs are available for the chemcial, the secondary acute-chronic ratio (SACR) shall be determined using enough assumed ACRs of eighteen so that the total number of ACRs equals three. Calculate the SACR as the geometric mean of the three ACRs. If no experimentally determined ACRs are available, the SACR shall be eighteen.

(4) Tier II chronic aquatic value.

(a) The CAV shall be calculated using one of the following equations:

(i) CAV = FAV / SACR (Use FAV from paragraph (A) of this rule and use SACR from paragraph (B)(3) of this rule).

(ii) CAV = SAV / FACR (Use SAV from paragraph (A)(4) of this rule and use FACR from paragraph (B)(2) of this rule).

(iii) CAV = SAV/ SACR (Use SAV from paragraph (A)(4) of this rule and use SACR from paragraph (B)(3) of this rule).

(b) If appropriate, the CAV shall be made a function of a water quality characteristic in a manner similar to that described in paragraph (A)(3) of this rule.

(c) If the SMCV of a commercially or recreationally important species is lower than the calculated CAV, then that SMCV shall be used as the CAV instead of the calculated CAV.

(C) Final plant value (FPV). This value applies in place of the CAC or CAV if it is lower than the CAC or CAV. Results of at least one acceptable test with a freshwater algae or vascular plant is required. If plants are among the aquatic organisms most sensitive to the material, results of a test with a plant in another phylum (division) shall also be available.

(1) A plant value shall be the result of a ninety-six-hour test conducted with an alga or a chronic test conducted with an aquatic vascular plant. A test of the toxicity of a metal to a plant shall not be used if the medium contained an excessive amount of a complexing agent, such as EDTA, that might affect the toxicity of the metal. Concentrations of EDTA above two hundred micrograms per liter shall be considered excessive.

(2) The FPV shall be obtained by selecting the lowest result from a test with an important aquatic plant species in which the concentrations of test material are measured and the endpoint is biologically important.

(D) Application of criteria and values.

(1) The FAV and SAV shall be applied as maximum concentrations inside the mixing zone.

(2) The AAC and AAV shall be applied as maximum concentrations outside the mixing zone.

(3) The CAC, CAV, and FPV if available shall be applied as thirty-day average concentrations outside the mixing zone.

Table 40-1. Secondary acute factors

Number of minimum data requirements satisfied	Secondary acute factor
1..................................	21.9
2 and neither requirement includes the family Salmonidae...........	13.0
2 and one requirement includes the family Salmonidae...........	7.9
3..................................	8.0
4..................................	7.0
5..................................	6.1
6..................................	5.2
7..................................	4.3

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Appendix C

Surface Water Analytical Results

Summary June 19, 2023

Surface Water Sampling Results

2/4/2023 – 6/12/2023

- Summary for all locations
- Last exceedance of screening level for any COI:
  5/1/2023
    2-butoxyethanol @ W014
    Acetone @ W014
- Greatest Number of SL exceedances:
  - 2-butoxyethanol (277 eco, 9 HH)
  - N-butyl acrylate (146 eco)
  - Vinyl Chloride (13 eco, 930 HH)

Analyte (Lab Results)	Cas No	Eco SL	HHSL	Max Detect Date	Count of Detections	Count of Lab Results	Range of Detections	# of exceedances	Date of Last Exceedance	Location	Date of Last Detect	Location
2-Butoxyethanol	111-76-2	475* ug/L	266,700 ug/L	4/30/2023	615	2,460	2.5 (J) - 848,000 µg/L	277	5/1/2023	W014	6/2/2023	W001, W004, W005, W006
2-Ethylhexyl acrylate	103-11-7	27* ug/L	NSL	2/6/2023	527	2,466	1 (J) - 122,000 µg/L	83	4/14/2023	W002	6/12/2023	W002, W010
2-Hexanone	591-78-6	99	1160 ug/L	2/4/2023	19	2493	0.58 - 126 µg/L	1	2/4/2023	W002	6/12/2023	W016
Acetone	67-64-1	1700 ug/L	255000 ug/L	4/30/2023	279	2485	5.6 (J) - 14,400 µg/L	5	5/1/2023	W014	6/12/2023	W001, W002, W004, W010, W015, W016, W020
Benzo(a)anthracene	56-55-3	4.7 ug/L	5.2 ug/L	2/22/2023	5	1,509	0.8 (J) - 9.1 (J) µg/L	2	2/22/2023	W010, W011	3/17/2023	W020
Benzo(a)pyrene	50-32-8	0.06 ug/L	0.52 ug/L	2/9/2023	28	1,510	0.76 (J) - 9.6 (J) µg/L	28	3/19/2023	W011, W014, W010, W002, W015, W009 (bk)	3/19/2023	W011, W014, W010, W002, W015, W009 (bk)
Benzo(b)fluoranthene	205-99-2	2.6 ug/L	5.2 ug/L	2/9/2023	7	1,509	0.89 (J) - 10.9 (J) µg/L	3	3/17/2023	W002	3/17/2023	W002, W010, W011, W020
Benzo(g,h,i)perylene	191-24-2	0.012 ug/L	NSL	3/3/2023	1	1,509	1.5 µg/L	1	3/3/2023	W011(b)	3/3/2023	W011(b)
Benzo(k)fluoranthene	207-08-9	0.06 ug/L	52 ug/L	2/9/2023	5	1,509	0.93 (J) - 8.3 (J) µg/L	5	3/17/2023	W010, W011	3/17/2023	W010, W011
Benzoic acid	65-85-0	42 ug/L	808,000 ug/L	2/4/2023	45	2387	4.3 (J) - 59.1 (J) µg/L	2	4/30/2023	W014	5/20/2023	W007
Diethylene glycol	111-46-6	4554	NSL	3/11/2023	28	919	5,060 - 89,100 µg/L	28	3/18/2023	W014	3/18/2023	W014
Fluoranthene	206-44-0	0.8 ug/L	11,700 ug/L	2/11/2023	11	1,510	1 - 8.7 (J) µg/L	11	3/17/2023	W010, W011	3/17/2023	W010, W011
Indeno(1,2,3-cd)pyrene	193-39-5	0.012 ug/L	5.2 ug/L	3/17/2023	13	1,509	0.72 (J) - 7.3 (J) µg/L	13	3/17/2023	W002, W002(b), W010(b), W015, W020	3/17/2023	W002, W002(b), W010(b), W015, W020
Methyl acrylate	96-33-3	14	NSL	2/4/2023	8	1,483	1.2 - 16.4 (J) µg/L	1	2/4/2023	W002	2/10/2023	W013, W013(b)
n-Butyl acrylate	141-32-2	26* ug/L	NSL	3/6/2023	328	2,492	1 - 357,000 µg/L	146	3/20/2023	W010	4/28/2023	W010
Phenanthrene	85-01-8	2.3 ug/L	NSL	2/18/2023	30	1,510	0.73 (J) - 12.5 µg/L	3	2/18/2023	W014	3/17/2023	W010
Pyrene	129-00-0	4.6 ug/L	339 ug/L	2/11/2023	9	1,510	0.85 (J) - 8.3 (J) µg/L	1	2/11/2023	W013(b)	3/17/2023	W010, W011
Vinyl chloride	75-01-4	930 ug/L	0.05 ug/L	2/8/2023	144	2,493	0.31 (J) - 8,100 µg/L	13	2/12/2023	W013 (eco)	4/22/2023	W014

Appendix D

Acknowledgement Sheet

By signing, I acknowledge that I have read, understand, and agree to follow Version 4.3 of this Surface Water Sampling and Analysis Plan.

Printed Name	Signature	Date

Reprint page for additional signatures and number accordingly.