



Air Monitoring Plan

Hattiesburg Derailment Drill
Hattiesburg, Forrest County, Mississippi

CN

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5551 Corporate Boulevard Suite 200 Baton Rouge Louisiana 70808
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1. Introduction and Objectives

At the request of Illinois Central Railway (CN), GHD Services Inc. (GHD) will provide air monitoring/sampling and industrial hygiene support in potentially impacted areas resulting from a derailment and release of Bakken crude oil near Hattiesburg, Mississippi (Site) on September 14, 2015. A vicinity map of the Site is included as Figure 1. These services are provided to assist CN in ensuring the health and safety of personnel working at Site and members of the surrounding community as well as evaluate potential environmental impacts from air emissions that may be emitted during the release and subsequent remediation efforts.

The purpose of this work plan is to address air monitoring/sampling during the response and remedial phases of the project. Air monitoring locations for the perimeter, community, and hot work zone are indicated on Figure 2. The specific objectives include the following:

- Perform real-time air monitoring for volatile organic compounds (VOC) at the perimeter of the work Site to characterize potential exposures to members of the community.
- Perform real-time air monitoring for VOCs in the breathing zones of workers to evaluate potential exposures during on-Site activities.
- Perform real-time airborne particulate matter monitoring inside the work areas and along the Site perimeter as deemed necessary during fire events.
- Collect personal air samples, (i.e., worker breathing zone samples, for benzene, toluene, ethyl benzene, xylene (BTEX) and total hydrocarbons during on-Site operations).
- Comply with the air monitoring requirements of the Occupational Safety and Health Administration (OSHA) Benzene Standard, 29 CFR 1910.1020.
- Establish and implement procedures to ensure appropriate responses to elevated levels of crude oil compounds in the air. This may include identifying areas requiring respiratory protection, or arranging for a timely evacuation of the work Site and/or in the event that hazardous concentrations of airborne BTEX vapors are detected.
- Communicate the hazards associated with exposures to Bakken crude oil constituents to the Site workers, members of the neighboring community, and other potential receptors.
- Provide recommendations for controlling Site exposures, respiratory protection and other personal protective equipment (PPE) to incident command.

GHD will continue air monitoring/sampling services until the clean-up phase of the project is completed and worker/community exposures to air impacts associated with the released crude oil are eliminated or until directed via CN that this service may be demobilized. The air monitoring/sampling data will be collected and compiled in accordance with established industrial hygiene guidelines and practices. In addition, the results will be communicated to CN, applicable agencies, Site workers, and others as required and/or as necessary to ensure the safety and health of potentially affected individuals.

2. Exposure Standards and Guidelines

GHD will rely on the standards and guidelines established in the United States for affected workers and community members. The air monitoring /sampling results, collected at the Site, will be compared to the applicable occupational exposure limits (OEL), Minimal Risk Levels (MRL), and other applicable guidelines, such as the United States Environmental Protection Agency’s (USEPA) Regional Screening Levels (RSLs) for residential receptors.

2.1 Occupational Exposure Limits

OSHA promulgates workplace standards to protect the safety and health of workers. The National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) have established guidelines to protect workers from chemical hazards on the job. Table 2.1 summarizes the OSHA permissible exposure limits (PEL), NIOSH Immediately Dangerous to Life and Health (IDLH) guidelines, and ACGIH threshold limit values (TLV) for crude oil constituents.

Table 2.1 Occupational Exposure Limits and Guidelines

Compound of Interest	OSHA PEL		ACGIH-TLV		IDLH ⁵	Units
	TWA ¹	STEL ²	TWA ³	STEL ⁴		
Benzene	1 (AL - 0.5)	5	0.5	2.5	500	ppm
Toluene ⁶	200	AC 300, MP 500	20	E 60, P 100	500	
Ethyl Benzene	100	NE	20	E 60, P 100	800	
Xylene	100	NE	100	150	900	
Total hydrocarbons (as n-Hexane)	500	NE	50	E 150, P 250	1,100	
⁷ PNOR _{TD}	15	NA	10	NE	NE	mg/m3

Notes:

1. Permissible Exposure Limit - Time Weighted Average (PEL-TWA) = An 8-hour time weighted average. An exposure to any material listed in 29 CFR 1910.1000, Tables Z1 and Z2, in any 8-hour work shift of a 40-hour workweek shall not exceed the 8-hour time weighted average limit given for that material in the table.
 2. Permissible Exposure Limit - Short Term Exposure Limit (PEL-STEL) = A 15 minute TWA exposure that should not be exceeded at any time during a workday.
 3. Threshold Limit Value - Time Weighted Average (TLV-TWA) = The TWA concentration for a conventional 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect (ACGIH, 2014).
 4. Threshold Limit Value – Short Term Exposure Limit (TLV-STEL) = A 15 minute TWA exposure that should not be exceeded at any time during a workday, even if the 8-hour TWA is within the TLV-TWA. (ACGIH, 2014)
 5. NIOSH Immediately Dangerous to Life and Health (IDLH) = Indicates an exposure to airborne contaminants that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.
 6. Acceptable Ceiling (AC) = An exposure to a substance listed in OSHA Table Z-2 shall not exceed at any time during an 8-hour shift the acceptable ceiling concentration given for the substance in the table, except for a time period and up to a concentration not exceeding the maximum duration and concentration allowed in the column under “acceptable maximum peak” (MP) above the acceptable ceiling concentration for an 8-hour shift
 7. PNOR_{TD} – Particulate Not Otherwise Regulated commonly referred to as “total dust.”
- AL = OSHA Action Level.
 E = ACGIH Excursion = Levels may exceed 3 times the TLV–TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed 5 times the TLV–TWA, provided that the TLV–TWA is not exceeded.
 P = ACGIH Peak = Under no circumstances should the concentrations exceed 5 times the TLV–TWA in a workday, provided that the TLV–TWA is not exceeded.

2.2 Response Action Levels

Action levels have been established to facilitate a timely and appropriate response to the detection of airborne hazards associated with crude oil constituents. Action levels have been set at levels lower than the established exposure limits and guidelines. The purpose is to ensure that if these levels are detected, they are effectively communicated to affected workers and off-Site receptors so that appropriate action can be taken. The Site-specific action levels for the work Site are listed in Table 2.2. Most real-time monitoring will be conducted for VOCs; chemical-specific monitoring for BTEX and TPH will be required as VOC levels dictate.

Table 2.2 Real Time Air Monitoring Site (Work Zone) Action Levels

Compound of Interest	Item	Action Level 1	Description of Action
VOCs	1	< 20 ppm	No action required.
	2	≥ 20-200 ppm	<ul style="list-style-type: none"> Communicate VOC levels to designated Site representatives and initiate Stop Work Authority (SWA). Immediately determine benzene concentrations using chemical-specific detection method. If benzene levels are < 0.25 ppm, work can continue with workers wearing full-face, air purifying respirators (APR) equipped with organic vapor cartridges. Perform VOC air monitoring continuously until VOC concentrations are below 20 ppm. As long as VOC concentrations remain in this range, periodically, collect a benzene specific air monitoring reading to confirm benzene levels are < 0.25 ppm. If benzene levels are ≥ 0.25 ppm, refer to actions listed in items 5 or 6 as applicable.
	3	≥ 200 ppm	<ul style="list-style-type: none"> Initiate SWA procedures and communicate concentrations to designated site representatives. Determine benzene concentrations using chemical-specific detection method. Consult with Project Industrial Hygienists, Project Toxicologists, or other sufficiently qualified individuals to recommend a course of action that maintains operational effectiveness and reduces worker exposures to acceptable levels.
Benzene	4	< 0.25 ppm	No action required.
	5	0.25-25 ppm	<ul style="list-style-type: none"> Confirm with a duplicate sample. Communicate benzene concentrations to designated site officials and initiate SWA. Notify workers of benzene levels and instruct them to don full-face, air purifying respirators (APR) equipped with organic vapor cartridges, if work is to continue. Workers that have passed a qualitative fit-test (irritant smoke, banana oil, or similar) can wear their respirator in environments not exceeding 5 ppm benzene. Workers that have passed a quantitative fit-test (controlled negative pressure or PortaCount) can wear their respirator in environments with benzene concentrations of 25 ppm or below.

Table 2.2 Real Time Air Monitoring Site (Work Zone) Action Levels

Compound of Interest	Item	Action Level 1	Description of Action
	6	≥ 25 ppm	Initiate SWA procedures and communicate benzene concentrations to designated site representatives. Consult with Project Industrial Hygienists, Project Toxicologists, or other sufficiently qualified individuals to recommend a course of action that maintains operational effectiveness and reduces worker exposures to acceptable levels.
PNOR _{TD}	7	< 15 mg/m ³	No action required.
	8	≥ 15-30 mg/m ³	<ul style="list-style-type: none"> Communicate PNOR_{TD} levels to designated site representatives and initiate SWA. Notify workers of PNOR_{TD} levels and instruct them to don full-face, air purifying respirators (APR) equipped with P100 filter cartridges, if work is to continue. Perform PNOR_{TD} air monitoring continuously until PNOR_{TD} concentrations are below 15 mg/m³.
	9	≥ 30 mg/m ³	Initiate SWA procedures and communicate PNOR _{TD} concentrations to designated site representatives. Consult with Project Industrial Hygienists, Project Toxicologists, or other sufficiently qualified individuals to recommend a course of action that maintains operational effectiveness and reduces worker exposures to acceptable levels.

Notes:

- Action Levels are based on sustained (> 1 min) airborne concentrations collected with the use of a PID with a 10.6 eV lamp and the VOC readings indicated are uncorrected values. The benzene concentrations are based on real-time readings collected using a benzene specific real-time instrument (UltraRAE) according to the manufacturer's instructions.
- A VOC reading of 20 ppm, with no benzene present, is equivalent to approximately 10 ppm of toluene or ethyl benzene, the compounds with the lowest exposure limits except for benzene.

2.3 Community Exposure Guidelines

The Agency for Toxic Substances & Disease Registry (ATSDR) has developed Minimal Risk Levels (MRLs) to serve as a screening tool for public health professionals to evaluate potential exposure to hazardous substances. MRLs are estimates of the daily exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure. MRLs are derived for acute (1-14 days), intermediate (> 14-364 days), and chronic (≥ 365 days) exposure durations. ATSDR uses the no observed adverse effect level/uncertainty factor (NOAEL/UF) approach to derive MRLs. They are set below levels that, based on current information, might cause adverse health effects in the people most sensitive to such substance-induced effects. Exposure to a level above the MRL does not mean that adverse health effects will occur. Due to the potential acute health effects associated with exposures, analytical results will also be compared to the applicable MRL. The community exposure guideline values for the identified compounds of interest (COI) are summarized in Table 2.3.

Table 2.3 Community Exposure Guidelines (Inhalation)

Compound Of Interest	Community Exposure Guideline	Standard	Units
Benzene	0.009	ATSDR Acute MRL (1-14 days)	ppm
Ethyl Benzene	5	ATSDR Acute MRL (1-14 days)	ppm
Toluene	1	ATSDR Acute MRL (1-14 days)	ppm
Xylene	2	ATSDR Acute MRL (1-14 days)	ppm

Particulate matter may not present a community exposure concern based on current conditions at the Site and MRLs have not been established for particulate matter associated with the burning crude oil. However, Temporary Emergency Exposure Levels (TEELs) have been established by the U.S. Department of Commerce and are guidelines designed to predict the response of members of the general public to different concentrations of a chemical during an emergency response incident. These values are provided in the event GHD determines that particulate matter is or is likely to present a potential health hazard to members of the nearby community. The TEEL-1 is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, non-sensory effects. However, these effects are not disabling and are transient and reversible upon cessation of exposure. The TEEL-2 is the airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape. For this response, the TEEL-1 of $30 \text{ mg}/\text{m}^3$ (as a 1-hour average) will be used as the action level to ensure that members of the community are protected from potential health effects of the Particulate overexposures. Table 2.4 summarizes the TEEL values established for particulate matter.

Table 2.4 Temporary Emergency Exposure Levels (TEELs) for Particulate Matter



Protective Action Criteria (PAC): Chemicals with AEGLs, ERPGs, & TEELs

[PAC Database Home](#)

[New Database Search](#)

PAC Database Revision 27

CHEMICAL IDENTITY				
Chemical	CAS#	UN#	Health Code Numbers	
Particulate material (PNOS)	z-0037		4.00	3.00
Formula	Synonyms			
[Unspecified]				

PHYSICAL PROPERTIES

Mol Wt	State	MP (°C)	BP (°C)	VP (Hg)	VP (°C)	SG	LEL (ppm)
	s						

PAC VALUES (Original Units: mg/m3)

PAC-1	PAC-2	PAC-3
30	330	2000

PAC VALUES (mg/m3)

PAC-1	PAC-2	PAC-3
30	330	2000

PAC values marked with a subscript "A" correspond to 60-minute AEGL values.
PAC values marked with a subscript "E" correspond to ERPG values.
*PAC values marked by * are $\geq 10\%$ lower explosive limit (LEL) but $< 50\%$ LEL.*
*PAC values marked by ** are $> 50\%$ LEL but $< 100\%$ LEL.*
*PAC values marked by *** are \geq LEL.*

3. Real-Time Air Monitoring

3.1 VOCs and Benzene

GHD will perform real-time air monitoring for VOCs during normal work operations using RAE Systems MultiRAE Plus Photoionization Detectors (PID) AreaRAE PIDs, and UltraRAE PIDs, with benzene-specific detection tubes. The MultiRAE and AreaRAE instrument detection limit for VOCs is 0.1 ppm and the UltraRAE instrument detection limit for benzene is 0.05 ppm. All instruments will be calibrated and operated in accordance with the manufacturer's specifications or applicable test/method specifications. Real time air monitoring will be performed at the following locations:

- Impacted areas where workers are present
- Site perimeter - upwind and downwind
- Off-Site receptors (as identified and appropriate)

AreaRAE PIDs will be placed at the perimeter of the work site and programmed to continuously monitor VOC concentrations. Using radio telemetry, the instantaneous readings for each AreaRAE will be transmitted to a single host computer at the Site, allowing GHD personnel to simultaneously monitor the airborne concentrations for all perimeter stations from a central location. MultiRAE and UltraRAE PIDs will be used to monitor the airborne concentrations of VOCs and benzene in the immediate work area and at designated off-Site locations.

If airborne concentrations of the chemicals listed in Table 1 are detected above the action levels established for the Site, designated Site safety personnel, operations officials, affected workers, and/or local regulatory representatives will be notified and appropriate actions will be taken to ensure the health and safety of the Site workers.

Table 3.1 lists correction factors for the COI on real-time instruments. In addition, a comparison of instrument readings and the chemical-specific OSHA PEL is provided.

Table 3.1 Real-time Monitoring Instruments Correction Factor for COI

Chemical of Interest	PID - Correction Factor	OSHA PEL	VOC reading indicating potential exceedance of the PEL
Benzene	0.53	1 ppm	1.9 ppm
Ethylbenzene	0.52	100 ppm	192 ppm
Toluene	0.5	200 ppm	400 ppm
Xylene	0.46*	100 ppm	217 ppm

Note:
* Maximum of o-, m-, and p-xylene

3.2 Particulate Matter

GHD will perform real-time airborne particulate matter monitoring inside the work areas and along the Site perimeter is deemed necessary during fire events, using TSI SidePak Aerosol Monitors and/or TSI DustTrak instruments. These monitors are capable of measuring the total dust fraction of airborne particulate matter. (PNOR_{TD})- Total dust monitoring will be conducted to evaluate airborne dust/smoke concentrations for comparison to relevant exposure guidelines and standards.

The real-time air monitoring instruments will be configured to measure the total airborne dust concentrations over a 1 minute rolling average (or less when necessary) for comparison to the airborne particulate matter action levels. Continuous real-time particulate matter air monitoring will be performed during all ground intrusive activities in contaminated areas at the Site and until the fire is extinguished. Ground intrusive activities include, but are not limited to, contaminated soil excavation and handling activities, which include transporting soils to other areas of the Site for temporary storage and/or processing. TSI DustTrak monitors will be placed at the perimeter of the work site and programmed to continuously monitor for airborne particulate concentrations in order to determine potential exposures to off-Site receptors.

GHD will periodically measure the airborne particulate concentrations inside the designated work areas in order to characterize the potential exposures to airborne particulate matter and evaluate the effectiveness of dust control measures. The periodic real-time particulate matter air monitoring will be performed using handheld TSI Side Pak and/or DustTrak Aerosol instruments.

4. Integrated Air Sampling

GHD will collect personal air samples for crude oil constituents from inside the breathing zones of affected workers (including GHD field technicians) in order to evaluate potential exposures during response and remediation activities. These air samples will be analyzed by an accredited laboratory for BTEX and total hydrocarbons. If dust and/or smoke concentrations, as determined from real-time air monitoring data, are elevated to approaching the work zone action levels, GHD will perform personal sampling for dust from the breathing zones of potentially affected workers.

A similar exposure group (SEG) analysis will be conducted to determine the number of samples which should be collected to represent the various job tasks conducted during the remediation efforts. SEGs are groups of workers having the same general exposure profile because of the similarities and frequency of the tasks they perform, the materials/processes in which they work, and the similarity of the way they perform the tasks. GHD personnel will identify and continuously observe work activities with potential crude oil exposures to determine SEGs. The primary work operations will be defined and correlated with the potential exposure to crude oil based on proximity to impacted areas.

Integrated air samples will be collected along the perimeter of the Site for comparison to the applicable community exposure guidelines for the Site COI. The integrated air samples will be co-located with the real-time air monitoring instruments and at key potentially impacted receptors. These samples will be collected in order to determine representative airborne exposures during routine remediation activities. The frequency and duration of the area air sampling will be determined by a GHD certified industrial hygienist (CIH), based on the recognized risk to off-Site receptors.

GHD will utilize different types of integrated air sampling equipment (i.e., sampling pumps w/media, passive diffusion monitors, etc.) as necessary and appropriate to collect the personal and area air samples and achieve the data quality objectives. All air samples will be collected and analyzed in accordance with established methods. All integrated air samples will be shipped daily (if possible) to SGS Galson Laboratories, an American Industrial Hygiene Association (AIHA) accredited laboratory. Sample media will be provided to the laboratory for field blank sample comparison. All samples will be shipped using appropriate Chain-of-Custody procedures. Table 4.1 lists the

methods which will be used for integrated air sampling at the Site. All samples will be shipped daily to Galson Laboratories, an American Industrial Hygiene Association (AIHA) accredited laboratory. Media will be provided to the laboratory for field blank sample comparison. All samples will be shipped using appropriate Chain-of-Custody (COC) procedures.

Table 4.1 Summary of Analytical Air Sampling Methods

Analytical Method (Sample Media)	Compound	Flow Rate (mL/min)	Approximate LOD
NIOSH 0500	Total Dust	2,000	*0.0469 mg/m ³
NIOSH 1500/1501 (3M 3500 or 3520 Passive Dosimeter)	Benzene	35.5	*0.025 ppm
	Toluene	31.4	*0.059 ppm
	Ethylbenzene	27.3	*0.059 ppm
	Xylene	27.3	*0.18 ppm
Radiello 130 PM	Benzene	80.0	**0.54 ppb
	Toluene	68.0	**0.25 ppb
	Ethylbenzene	74.0	**0.23 ppb
	Xylene	65.0 - 70.0	**0.25 ppb

Notes:
 LOD - Limit of Detection is based on the limit of quantitation (LOQ) established by the laboratory, the sampling rate, and either an 8 or 24-hour sample period.
 * LOD based on 12-hour sample period (720 minutes)
 ** LOD based on a 24-hour sample period (1440 minutes)

5. Quality Assurance/Quality Control (QA/QC) and Reporting

All real-time AreaRAE data collected will be stored in an on-Site electronic archive. All manually-collected real-time data and integrated sampling information will be reviewed to ensure accuracy and completeness. The manually-collected monitoring/sampling data will be entered into an electronic database (spreadsheet or equivalent), and will undergo a daily QA/QC review. All data entry forms and field notes will be kept on-Site and retained for reference upon completion of the project. If necessary, full laboratory analysis data packages will be provided, and associated data validation processes will be arranged.

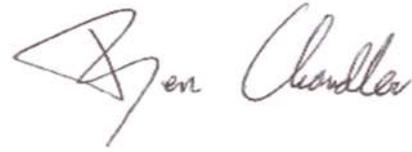
During the project, interim reporting of results may be required. This may include data summaries, maps, or other presentations of preliminary monitoring and sampling results. Such reporting will be considered preliminary, as a final QA/QC of the data will not be complete. At the completion of the project, a report will be prepared in which all data collected through real-time monitoring and integrated sampling analyses will be compiled, summarized, and reported to CN. All data contained in the final report will have been through the QA/QC process, will be reviewed and interpreted by a GHD CIH, and will be considered final. On-Site workers will also be notified of sampling results in accordance with applicable OSHA regulations.

This plan was prepared based on information available and provided to GHD at the time of the derailment. As additional information becomes available, the plan may be revised as necessary and appropriate to meet the objectives as previously stated.

This work plan was prepared by:

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Unified Command

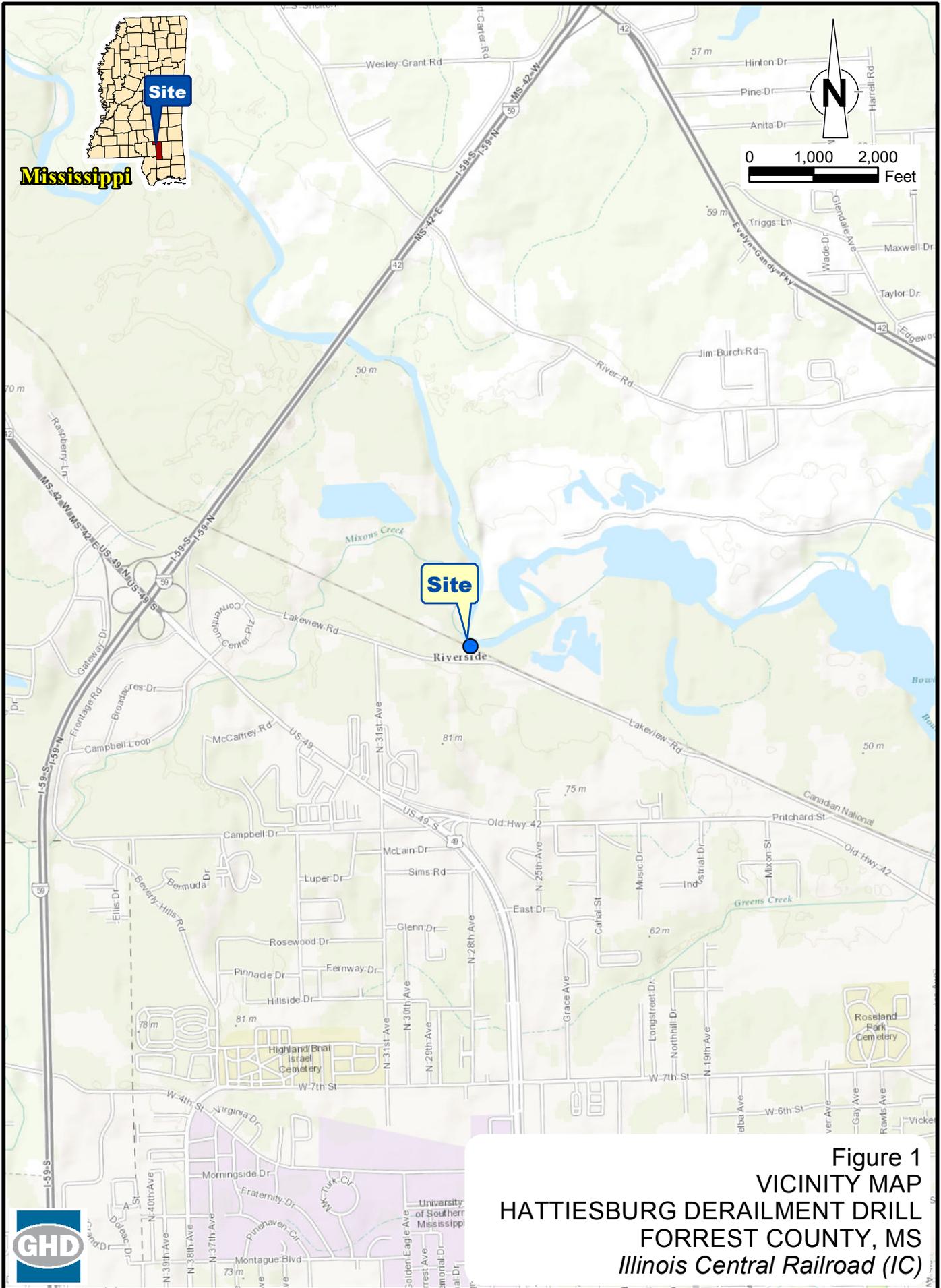


Figure 1
 VICINITY MAP
 HATTIESBURG DERAILMENT DRILL
 FORREST COUNTY, MS
 Illinois Central Railroad (IC)

RE: Esri World Topographic Map.





Point of Derailment
31.354342,
-89.330536

- Legend**
- Railroad
 - Rail Cars**
 - Breach, On Fire
 - Undamaged, In River
 - Other Rail Cars



Figure 2
HATTIESBURG DERAILMENT DRILL
FORREST COUNTY, MS
Illinois Central Railroad (IC)