Generic Statement of Work for Conducting Remedial Investigations and Feasibility Studies

Ohio EPA
Division of Emergency and Remedial Response
Remedial Response Program

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Generic Statement of Work
for Conducting
Remedial Investigations and Feasibility Studies

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GENERIC STATEMENT OF WORK
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

Purpose:

This Statement of Work (SOW) sets forth the generic requirements for conducting a Remedial Investigation and Feasibility Study (RI/FS) of the Site. The purpose of the RI is to characterize the nature and extent of any releases or potential releases of contaminants at or from the Site, assess potential risks to human health and the environment posed by such releases, and collect the information needed to support the development and evaluation of remedial alternatives. The purpose of the FS is to develop and evaluate remedial alternatives to provide the Ohio Environmental Protection Agency (Ohio EPA) with the information needed to select a site remedy. The RI and FS are conducted in an iterative manner to allow the information gathered during the RI to influence the development of remedial alternatives, which in turn affects data needs and the scope of the RI.

The RI/FS shall be performed in accordance with the requirements of the consensual Director's Final Findings and Orders for the Site, referred to herein as "Orders", and this SOW, and in a manner consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Final Rule (40 CFR Part 300). Respondent shall refer to U.S. EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA/540/G-89/004, October 1988) (U.S. EPA RI/FS Guidance) and other guidance that the Ohio EPA may use in conducting an RI/FS. A partial list of guidance is included as the Guidance List attached to the Orders. Sections of relevant guidance which further describe the RI/FS tasks are referenced throughout this SOW and appendices. Respondent shall furnish all personnel, materials, and services needed or incidental to performing the RI/FS except as otherwise specified in the Orders.

At the completion of the RI/FS, Ohio EPA shall be responsible for the selection of a site remedy and shall memorialize the selected remedy in a Decision Document. The site remedy selected by Ohio EPA shall be protective of human health and the environment, comply with applicable or relevant and appropriate requirements of federal and state environmental laws and regulations (ARARs), be cost-effective, utilize permanent solutions and treatment technologies or resource recovery technologies to the maximum extent practicable, and address the preference for treatment as a principal element. The final RI and FS Reports, as approved by Ohio EPA, shall, with the administrative record, form the basis for selection of the site remedy and provide the information needed to support development of a Decision Document.

Ohio EPA shall provide oversight of Respondent's activities throughout the RI/FS, including field activities. Respondent shall support Ohio EPA's conduct of oversight activities.

Section 1 - RI/FS Project Scoping

Scoping the RI/FS

Scoping is the planning process for the RI/FS. Ohio EPA developed and included in the Orders a general management approach for the Site and preliminary remedial action objectives (RAOs) for the RI/FS. Consistent with the general management approach and preliminary RAOs, and in consultation with Ohio EPA, Respondent shall plan the specific project scope and prepare and submit for review and comment a Pre-investigation Evaluation Report (PER).

Respondent shall document in the PER the performance and results of the scoping tasks identified in this Section 1 and Appendix A of this SOW, thus establishing the framework for subsequent development of the RI/FS Work Plan. Respondent shall address in the PER each RI/FS SOW task by one of the following three methods: 1) indicating that the task has already been performed and providing the results of the task and supporting documentation; 2) indicating that the task is not relevant to the Site and providing the technical justification for omitting the task; or 3) indicating that the task is relevant to the Site and will be addressed in the RI/FS Work Plan.

Respondent shall include in the PER a Level 1 Scoping Ecological Risk Assessment (ERA) meeting the requirements outlined in Appendix I of this SOW and the Ohio EPA Division of Emergency and Remedial Response (DERR) *Ecological Risk Assessment Guidance Document*, February, 2003 (DERR ECO Guidance). Respondent shall also include an annotated bibliography of existing reports relevant to the RI/FS. Upon request, Respondent shall provide copies of the reports to Ohio EPA

Scoping is continued, repeated as necessary, and refined throughout the RI/FS process as data become available. Appendix A of this SOW summarizes the RI/FS project scoping requirements and provides the format for the PER.

1.1 Project Initiation Meeting and Site Visit

Respondent shall contact Ohio EPA’s Site Coordinator to set up a Project Initiation Meeting, which is to be held prior to Respondent’s submittal of the PER. The purpose of the meeting is to afford Respondent and Respondent’s contractors an opportunity to review with Ohio EPA the technical requirements of the Orders and this SOW and seek

clarification regarding the performance of the required work and/or preparation of deliverables, and to establish a date for a site visit as discussed in A. 2. of Appendix A of this SOW. Topics of discussion may include, but need not be limited to, the site management strategy, preliminary RAOs, data quality objectives (DQOs), preparation of the baseline human health risk assessment (HHRA), ERA, initiation and/or integration of emergency or interim actions, involvement and coordination with other Ohio EPA programs and other agencies, community relations activities, performance of the FS, and communication between Respondent and Ohio EPA. The meeting will be attended by Ohio EPA's Site Coordinator and agency staff providing support to the Site Coordinator in overseeing Respondent's conduct of the RI/FS. Ohio EPA also encourages meeting attendance by those persons providing support to Respondent.

Section 2.0 - RI/FS Work Plan and Supporting Documents

RI/FS Work Plan (U.S. EPA RI/FS Guidance Section 2.3.1)

Following receipt of Ohio EPA's comments on the PER, Respondent shall prepare and submit for review and approval an RI/FS Work Plan and supporting documents, including a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). A Health and Safety Plan (HASP) shall also be submitted, but for review and comment only. Respondent shall incorporate the PER, revised in accordance with Ohio EPA's comments, into the RI/FS Work Plan to document the initial RI/FS scoping activities.

The RI/FS Work Plan shall detail the methods and procedures for performing the remaining RI/FS tasks (Sections 3 through 10 of this SOW) and shall be developed in conjunction with the FSP, QAPP, and HASP although each may be delivered under separate cover. The RI/FS Work Plan and supporting documents shall provide a detailed description of the tasks to be performed, the technical rationale for performing the work in the manner proposed, the information needed for each task, the information to be produced during and at the conclusion of each task, and a description of the work products that will be submitted to Ohio EPA. This includes the deliverables set forth in the Orders and this SOW, including Interim Technical Memoranda produced during the field investigation and at the conclusion of each major phase of the RI/FS and meetings and presentations to Ohio EPA.

If Respondent intends to rely on modeling to satisfy any RI/FS task, Respondent shall identify the models Respondent proposes to use and, in a manner consistent with U.S. EPA's *Guidance for Quality Assurance Plans for Modeling*, EPA QA/G-5M, fully explain their application in the RI/FS Work Plan and supporting documents, including model assumptions and operating conditions, input parameters, and verification and calibration procedures. If Respondent identifies the need to conduct modeling following approval

of the RI/FS Work Plan, Respondent shall submit for review and approval an addendum to the RI/FS Work Plan.

The RI/FS Work Plan shall reflect coordination with any identified treatability study requirements (Section 8 and Appendix L of this SOW) and shall include a process for refining and/or identifying additional ARARs and to be considered (TBC) criteria, conducting the HHRA and ERA, refining the conceptual site model (CSM), and submitting monthly progress reports and ITMs to Ohio EPA. The RI/FS Work Plan shall include a comprehensive RI/FS project schedule indicating critical path dependencies and including dates for the initiation, duration, and completion of each RI/FS task. The schedule shall also include field work and development and submittal of required deliverables. The RI/FS Work Plan, FSP, and QAPP must be approved by Ohio EPA prior to the initiation of field activities.

Due to the potentially unknown nature of the Site and the iterative nature of the RI/FS, additional RI/FS tasks may be identified following approval of the RI/FS Work Plan. Ohio EPA may require or Respondent may propose additional RI/FS tasks in accordance with the provisions of the Additional Work Section of the Orders.

2.1 Field Sampling Plan

Respondent shall submit for review and approval a FSP describing the field activities to be performed and defining the procedures and methods that must be used to collect field measurements and samples. Activities and procedures include collection of geophysical data, drilling of soil borings, installation of ground water monitoring wells, collection of multimedia samples, field control samples, and any field measurements. The FSP shall also address sample packaging and shipping requirements, proper testing, handling and disposal of investigation-derived wastes, field documentation procedures, and corrective action procedures.

The FSP shall detail the methods and procedures for each field activity. A field activity includes any task which involves the collection of environmental media or data. The FSP shall discuss the purpose of each task and how it will fulfill the DQOs provided in the associated QAPP. Respondent shall prepare the FSP in a manner consistent with Sections 3.3.4.1 through 3.3.4.12 of the U.S. Army Corps of Engineers' guidance *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, February, 2001, using the FSP outline provided in Appendix B of this SOW.

2.2 Quality Assurance Project Plan

Respondent shall submit for review and approval a site-specific QAPP. The QAPP shall address all relevant elements of U. S. EPA's *Guidance for Quality Assurance Project*

Plans, QA-G-5, EPA/240/R-02-009, December 2002, including DQOs developed in a manner consistent with the DQO guidance identified in the Guidance List attached to the Orders. Some QAPP elements may already be provided in the FSP, in which case, Respondent shall clearly cross-reference in the QAPP to the section and page number in the FSP where such information may be located. See Appendix C of this SOW for the QAPP elements included in the referenced U.S. EPA guidance.

Respondent shall include an electronic version of the laboratory(ies) QAPP on disc in PDF format. Upon request, Respondent shall provide to Ohio EPA any other records, documents, or other information generated or stored by the laboratory(ies) as a result of the work Respondent is required to perform by the Orders or this SOW.

2.3 Health and Safety Plan (U.S. EPA RI/FS Guidance Section 2.3.3)

Respondent shall submit for review and comment a HASP that complies with the Occupational Safety and Health Administration (OSHA) regulations and protocols outlined in Title 29 CFR, Part 1910 or as OSHA may otherwise require. See Appendix D of this SOW for the major elements of a HASP. Further, the HASP shall include all other monitoring, procedures, and protocols needed to protect the health and safety of those persons conducting site activities, visiting the Site, and residing or working in the surrounding community.

Section 3 - Site Characterization

Site Investigation

Respondent shall conduct such investigations as necessary to obtain data of sufficient quality and quantity to support the RI/FS. All sampling, analyses, and measurements shall be conducted in accordance with the approved QAPP and FSP. All sampling and measurement locations shall be documented in a project-specific field log and identified on site maps.

3.1. Environmental Setting

Respondent shall collect information to supplement and verify existing information on the environmental setting of the Site and surrounding the Site. Characterization of the environmental setting shall include but not be limited to regional hydrogeology, site hydrogeology, subsurface soil and rock units, surface soils, surface water and sediment, land use, land cover, and local climate. Appendix E of this SOW summarizes the requirements for characterizing the environmental setting at the Site.

3.1.1. Source Characterization

Respondent shall conduct an investigation to locate and characterize any known or potential source(s) of contaminant releases at the Site, including areas where wastes have been placed, collected, come to be located or removed. Methods for source characterization shall include but not be limited to test pits, trenches, and/or borings to characterize buried source areas; determine source area depth, thickness, and volume; and identify and investigate the integrity of any existing natural or engineered containment that may be present. Geophysical characterization methods, such as ground penetrating radar, magnetometry, tomography, or other electromagnetic methods shall be used as appropriate to assist in delineation and characterization of potential contaminant source areas. The source area investigation shall also include, as appropriate, leaching tests and/or modeling to assess the potential leaching of contaminants from source areas, and ground water investigations where potential source areas may exist in a saturated zone. Appendix F of this SOW summarizes the requirements for conducting the source characterization.

3.1.2. Nature and Extent of Contamination

Respondent shall collect analytical data to determine the nature and extent of contamination in all potentially affected media at the Site (see Section 3.2.4 of the U.S. EPA RI/FS Guidance). Data collected shall be sufficient to support determination of the origin, extent, direction, and rate of movement of contaminants. Data shall also be collected to support determination of background concentrations for contaminants in accordance with the background guidance identified in the Guidance List attached to the Orders. Respondent shall collect the data in accordance with the approved RI/FS Work Plan and shall document the methods and procedures used during the investigation in the RI Report. Appendix G of this SOW summarizes the requirements for determining the nature and extent of contamination at the Site.

Section 4 - Risk Assessment

Risk assessment is the process used to evaluate current and reasonably anticipated future site conditions in an effort to quantify risks or hazards to human health and the environment in the absence of any remedial action. Respondent shall collect all data necessary to support the assessments, and include the assessments in the RI Report.

4.1 Risk Assessment Assumptions Document

Respondent shall submit for review and approval a Risk Assessment Assumptions Document (RAAD) prior to performing the HHRA. The RAAD shall provide all

assumptions, inputs, and supporting information required to complete the assessment, including:

a) refined CSM;

b) all current and reasonably anticipated receptors to be evaluated;

c) all exposure scenarios to be evaluated;

d) all exposure media to be evaluated;

e) all screening values and sources for values used in the reduction of the contaminants of potential concern (toxicity-based and/or background). Respondent shall derive background concentrations in accordance with the background guidance, and shall include the methods and data used;

f) list of all contaminants of potential concern per medium;

g) all risk assessment exposure assumptions needed to complete the HHRA;

h) all exposure point concentrations and the supporting equations; and,

i) methods and input values that Respondent proposes to use to evaluate specific contaminants, such as lead, or environments, such as surface waters or wetlands.

Following Ohio EPA approval of the RAAD, Respondent shall prepare the HHRA in accordance with the approved RAAD.

4.2 Human Health Risk Assessment

Respondent shall prepare a baseline HHRA which evaluates current and potential future threats to human health in the absence of any remedial action. The HHRA shall focus on current and reasonably anticipated future risks or hazards to persons coming into contact with site-related contaminants or environmental media containing one or more contaminants (*e.g.*, ground water, soils, sediments, surface water, air, subsurface gases, contaminated organisms).

The HHRA relies upon information gathered at the Site. Respondent shall ensure that the site investigations and resultant data are sufficient in both quality (*e.g.*, DQOs, sample detection limits, quality assurance procedures) and quantity to fully describe the current and potential future threats to human health. Respondent shall plan and

conduct the HHRA in manner consistent with U.S. EPA's *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)* EPA/540/1-89/002 (RAGS, Part A, 1989) and other relevant state and federal guidance as identified in this SOW and the Guidance List attached to the Orders.

The HHRA shall organize and present the results and data from all site investigations such that relationships between and among environmental media and receptors are clear (see Exhibit 9-1 in RAGS Part A for a suggested outline for the baseline risk assessment report; RAGS Part D may also be followed for a suggested format). The HHRA shall project the potential risk of health problems occurring if no cleanup action is taken at the Site and identify areas and media where risks exceed a cumulative excess lifetime cancer risk of 1E-5 and/or a hazard index of 1. Appendix H of this SOW summarizes the requirements for conducting the baseline HHRA.

4.3 Ecological Risk Assessment

Respondent shall prepare an ERA which evaluates current or potential future adverse effects in the absence of any remedial action to flora and fauna at the population, community, ecosystem, and/or individual level as appropriate. The ERA shall be conducted in a manner consistent with the DERR ECO Guidance, U.S. EPA's guidance as referenced therein, and other relevant guidance as identified in the Guidance List attached to the Orders.

The ERA is generally conducted in an iterative or phased approach as data are gathered during the RI and decisions are made regarding the need, or lack thereof, for more comprehensive ecological assessment. Respondent shall conduct a Level I Scoping ERA during the preparation of the PER discussed in Section 1 and Appendix A of this SOW, and include the Level I ERA Report in the PER. If a Level II Screening ERA is needed, Respondent shall describe in detail the tasks necessary to complete the Level II ERA in the RI/FS Work Plan and supporting documents, and include a date for submittal of the Level II ERA Report in the RI/FS project schedule. If during the RI it is determined that additional ecological assessment is needed, Respondent shall, as necessary, submit addendum(s) to the RI/FS Work Plan and supporting documents detailing the tasks necessary to complete each subsequent level of assessment, including a revised RI/FS project schedule with dates for related deliverables. Respondent shall submit an ERA Report for review and approval at the conclusion of each level of the ERA. The ERA Report shall summarize the methodology and results of the assessment, include a recommendation and supporting rationale regarding the need for additional assessment, and provide all data and other site-specific information Respondent relied upon in conducting the assessment. The final ERA Report shall also provide all information necessary to evaluate the environmental impact of proposed

remedial alternatives in the FS. Appendix I of this SOW summarizes the requirements for conducting the ERA.

Section 5 - Site-Specific Preliminary Remediation Goals

Following the completion of the HHRA and the final level of ERA, Respondent shall revisit the preliminary remediation goals (PRGs) initially identified in the PER and develop site-specific PRGs for inclusion in the RI Report. Site-specific PRGs are interim remediation goals generally developed on a media specific basis to assist with risk management and engineering considerations during the development and screening of remedial alternatives (see Section 7.0 below). They do not consider potential cross-media exposures, and therefore, may not account for all exposures a given receptor may potentially experience at a Site absent remediation.

Site-specific PRGs are generally calculated by rearranging the risk assessment equations to derive single chemical, single pathway remediation goals based on a hazard quotient (HQ) of 1 or an excess lifetime cancer risk of 1E-5 for receptors identified to be at risk due to actual or potential site-related exposures. Site-specific PRGs for protection of human health are then adjusted as necessary to account for multiple chemical and/or multiple routes of exposures within a given medium (*e.g.,* soil, ground water, air) so as not to exceed a cumulative 1E-5 excess lifetime cancer risk and a hazard index (HI) as appropriate, of 1 for the same receptor population.

Site-specific PRGs for potential ecological hazards are derived in the same manner using an HQ or HI of 1 as appropriate, or other appropriate ecological evaluation (*e.g.*, toxicity test, bioassay, biosurvey, water quality standard, or screening value). Where site-specific ecological PRGs are developed based on multiple receptors, it may be possible to reduce the list of PRGs by selecting the lowest PRG for a given chemical/receptor combination.

Adjustment of PRGs for the protection of human health to account for possible exposures to multiple chemicals and/or multiple routes of exposure is site-specific and dependent on the exposures and associated risks at the Site. Generally, PRGs are calculated for each chemical that individually exceeds or significantly contributes to risk above the cumulative excess lifetime cancer risk of 1E-5 and the non-cancer HI of 1. Adjustment of the PRGs based on a cancer disease endpoint to account for multiple chemical exposures is completed by dividing each PRG by the total number of chemicals of concern. For PRGs based on a non-cancer disease endpoint, the same procedure is followed. However for PRGs based on non-cancer effects, adjustments or groupings may be made to account for specific toxicological effects of the chemical contaminants. These groups and considerations should be consistent with those used

in the baseline risk assessment. See Section 2.8 of RAGS, Part B for additional information on development of site-specific PRGs.

Some site-specific PRGs may depend on Contaminant and/or site-specific circumstances, such as PRGs for lead, or leach-based values for soils or wastes for the protection of ground and surface waters. PRGs may also be based on background concentrations where the use of background concentrations is determined to be appropriate based on the guidance included in the Guidance List attached to the Orders. These PRGs are stand-alone values and are not generally adjusted to account for exposure to multiple contaminants.

Further adjustment of the site-specific PRGs is dependent on the risk management approach and configuration of each of the remedial alternatives subjected to detailed analysis in the FS. This analysis may include the concept of driver chemicals and other specific attributes of the Site and or contamination. Each alternative must be able to maintain protection of human health and the environment during implementation and achieve a residual site-wide cumulative excess lifetime cancer risk of 1E-5 and a non-cancer HI of 1 following implementation. Final remediation goals are determined by Ohio EPA as part of the remedy selection process and are not part of the AOC or this SOW. See Chapter 2 of RAGS, Part C for additional information on the risk evaluation of remedial alternatives.

Section 6 - Remedial Investigation Report

RI Report

Respondent shall submit for Ohio EPA review and approval a RI Report detailing the methods and results of the remedial investigation and the risk assessments. The format for the RI Report is provided in Appendix J of this SOW.

Section 7 - Alternatives Array Development

Developing and Screening of Remedial Alternatives (U.S. EPA RI/FS Guidance Chapter 4)

Respondent shall begin to develop and evaluate a range of remedial alternatives during RI/FS scoping (Section 1.0 and Appendix A of this SOW; Section 2.2.3 of the U.S. EPA RI/FS Guidance). Respondent shall continue to develop and evaluate the remedial alternatives initially developed during project scoping as RI data become available. With the exception of the “no action” alternative, all alternatives under consideration

must, at a minimum, ensure protection of human health and the environment and comply with the applicable or relevant and appropriate requirements of state and federal laws and regulations.

7.1 Refine Remedial Action Objectives (U.S. EPA RI/FS Guidance Section 4.2.1)

Respondent shall further refine the preliminary RAOs identified during project scoping. RAOs for protection of human health should specify a site-specific PRG, an exposure pathway and receptor, and preliminary points of compliance. RAOs for protecting environmental receptors should seek to preserve or restore a resource (*e.g.*, as ground water) and should be expressed in terms of the medium of interest and target remediation goals whenever possible (see U.S. EPA's RI/FS Guidance, Table 4-1). The refined RAOs shall be based on the results of the RI and the risk assessments, and shall be consistent with Section 300.430 of the NCP. Respondent shall prepare and submit for review an ITM identifying the refined RAOs for protection of human health and the environment and detailing the methods and procedures used to refine them. Respondent shall revise the refined RAOs per Ohio EPA's comments, if any, and include the refined RAOs in the Alternatives Array Document described in 7.2 below.

7.2 Alternatives Array Document (U.S. EPA RI/FS Guidance Chapter 4)

Respondent shall prepare an Alternatives Array Document (AAD) which documents the methods, rationale, and results of the technology, process option, and alternatives development and the screening process. Respondent shall include an evaluation of whether the amount and type of data existing for the Site will support the subsequent detailed analysis of the alternatives. Respondent shall modify the alternatives based on Ohio EPA's comments, if any, to assure identification of an appropriate range of viable alternatives for consideration in the detailed analysis. The AAD, as revised by Respondent to incorporate Ohio EPA comments, shall be combined with the detailed analysis of alternatives to form the FS Report described in Section 9 and Appendix M of this SOW. Appendix K of this SOW summarizes the requirements for conducting the alternatives screening process and provides the required contents of the AAD.

Section 8 - Treatability Studies

Determining the Need for Treatability Studies

Treatability studies are laboratory or field tests designed to provide critical data needed to evaluate one or more treatment technologies. These studies generally involve characterizing untreated waste and evaluating the performance of the technology under different operating conditions. These results may be qualitative or quantitative,

depending on the level of treatability testing. Treatability studies conducted during the RI/FS to support remedy selection are generally used to determine whether the technology can achieve the RAOs and to provide information needed to support the detailed analysis of alternatives in the FS.

Potential remedial technologies and associated treatability study needs are initially evaluated by Respondent during RI/FS scoping activities (Section 1 and Appendix A of this SOW). Due to the iterative nature of the scoping process throughout the conduct of the RI/FS, potential remedial technologies and the need for treatability studies may be reevaluated as data from the RI becomes available. Regardless of when a potential remedial technology is identified, it is incumbent upon Respondent to identify the need for treatability studies as early in the RI/FS process as possible such that treatability studies are substantially completed prior to performing the detailed analysis of alternatives (Section 9 of this SOW). Ohio EPA may also identify the need for treatability studies during the course of the RI/FS and communicate that need to Respondent. Respondent shall conduct treatability studies in a systematic fashion to ensure that the data generated can support the detailed analysis of alternatives during the FS.

Should the need for treatability studies be identified, Respondent shall submit to Ohio EPA a Treatability Study Work Plan for review and approval. Appendix L of this SOW summarizes the requirements for treatability studies.

Section 9 - Feasibility Study Report

Detailed Analysis of Alternatives

Once it has been determined that sufficient data exist to proceed, Respondent shall conduct a detailed analysis of the alternatives surviving the screening process to provide Ohio EPA with the information needed for selection of a site remedy. The detailed analysis shall consist of an individual analysis of each alternative against eight evaluation criteria followed by a comparative analysis of the alternatives using the same evaluation criteria as the basis for comparison.

9.1 Feasibility Study Report (U.S. EPA RI/FS Guidance Section 6.5)

Respondent shall prepare and submit a FS Report for review and approval. The AAD, revised based on comments received from Ohio EPA, shall be incorporated into the FS as it is prepared. Respondent will refer to Table 6-5 of the U.S. EPA RI/FS Guidance for an outline of the FS Report format and required report content. Appendix M of this

SOW summarizes the process and criteria for conducting the detailed analysis of alternatives and provides additional information on the content of the FS Report.

Section 10 - Progress Reports

Respondent shall submit written monthly progress reports in accordance with Section XII of the Orders, Progress Reports and Notice. The Progress Reports shall include the following information:

a) A description of the Work performed during the reporting period. For field activities, include boring logs, drilling and sampling locations, depths, and descriptions, and field notes;

b) A description of any deviations from approved work plans or schedules during the reporting period and the date of Ohio EPA's approval of any such deviations;

c) A summary of all field and laboratory analytical data generated or received during the reporting period;

d) Summaries of all contacts during the reporting period with representatives of the local community, public interest groups or government agencies related to conducting the Work;

e) Summaries of problems or potential problems encountered during the reporting period and any actions taken to rectify or prevent problems;

f) Changes in project personnel or contractors during the reporting period;

g) Tasks scheduled for the next two reporting periods;

h) Copies of daily reports, inspection reports, or other reports as may be required by an approved work plan;

i) Identification of the sources, types, quantities, test results, and disposition of investigation derived and other project wastes generated or disposed of during the reporting period.

In addition, Respondent shall provide all laboratory data within the Progress Reports and in no event later than 60 days after samples are shipped for analysis for raw analytical data and 90 days after samples are shipped for validated analytical data.

Appendix A

Preinvestigation Evaluation Report

Respondent shall prepare and submit for Ohio EPA review and comment a Preinvestigation Evaluation Report (PER) which documents Respondent's performance of the scoping tasks identified in Section 1 and Appendix A of this SOW. The PER shall also include a Level 1 Scoping ERA as described in Appendix I of this SOW and Chapter 2 of the DERR ECO Guidance.

PER Tasks

I. Description of Current Conditions

Respondent shall collect and analyze existing information available for the Site to develop a preliminary CSM to assist in assessing the nature and the extent of contamination, identifying potential exposure pathways and potential human and ecological receptors, preliminarily evaluating ARARs, developing general response actions and preliminary remedial alternatives, and gathering and analyzing existing Site background information. Sources of information include a review of Ohio EPA and other public files (including analytical results obtained from prior site investigations and assessments conducted by Ohio EPA and others relative to the Site) and interviews with employees, officers and agents (past and present) associated with the Site. Additional sources of existing information are described in Table 2.1 of the U.S. EPA RI/FS Guidance and Chapter 2 of the DERR ECO Guidance.

A. Existing Analytical Data (U.S. EPA RI/FS Guidance Section 2.2.2)

Respondent shall compile existing analytical data relating to contamination at the Site, and summarize the results in terms of physical and chemical characteristics, contaminant concentrations, and media affected. Data relating to soil, ground water, surface water, sediment, air, or biotic contamination shall be included as available. Use of any data that was not collected and analyzed pursuant to a QAPP approved by Ohio EPA must be supported by inclusion of all relevant quality assurance and quality control information. Consistent with the DQO guidance listed in the Guidance List attached to the Orders, Respondent shall identify the DQOs for all existing data on which Respondent intends to rely.

B. Conduct Site Visit

Respondent shall coordinate a site visit with Ohio EPA to assist in developing a conceptual understanding of sources and areas of contamination, potential exposure pathways, and potential human and ecological receptors. Respondent shall also observe the Site's physiography, hydrology, geology, demographics, natural resources, and ecological and cultural features.

C. Site Background

Respondent shall prepare and include in the PER a summary of the regional location, pertinent area boundary features, and physical geography at and near the Site. The summary shall be based on existing information and shall include characteristics such as surface hydrology, hydrogeology, geology (including cross-sections if available), and the total area of the Site. The summary shall also include the general nature of the problem, particularly with respect to the historic use of the Site relative to disposal or release of contaminants. Respondent shall also include background information on land use, natural resources, and climatology. Respondent may reference applicable existing reports. Respondent shall, at a minimum, provide the following:

1. Map(s) depicting;

   a. General geographic location;
   b. Property lines, with the owners of all adjacent property clearly indicated;
   c. Topography and surface drainage with appropriate contour interval and scale depicting all waterways, wetlands, flood plains, water features, drainage patterns, and surface water containment areas;
   d. All tanks, buildings, utilities, paved areas, easements, rights-of-way, and other features;
   e. All known active or past waste treatment, storage or disposal areas and the dates of their operation;
   f. All known past and present product and waste underground tanks and/or piping;

g. All known past or present locations of spills or other releases of contaminants or any other potential contaminant source areas;
h. Surrounding land uses (residential, commercial, agricultural, recreational) including zoning designations;
i. Wetlands and surface water bodies;
j. Previous sampling locations and dates of sampling for all media;
k. The location of all wells, including monitoring and public and private water supply wells. These wells shall be clearly labeled and ground and top of casing elevations and construction details shall be included where available (elevations and construction details may be included as an appendix to the PER). Respondent shall determine whether any of the identified wells are currently being used, particularly as a source of potable water;
l. Federal Sole Source Aquifer designations and Drinking Water Source Water Protection Areas for public water supplies.

Maps shall be of sufficient detail and accuracy to locate and depict current and future work performed at the Site. Maps shall be submitted as hard copy and in a digital format, using either a shapefile (*.shp) or drawing exchange format file (*.dxf) in a known coordinate system (*e.g.*, Ohio State Plane South Zone, Datum = NAD83, units = feet)[1]. Significant features will be created using standard survey techniques or with a global positioning system unit capable of sub-meter accuracy horizontal data capture.

2. A history and description of ownership and operation (past and current), including: generation of wastes and any treatment, storage and/or disposal activities at the Site;

[1] The term "shapefile" (*.shp) refers to the electronic file format used by the ArcGIS software systems produced by the ESRI Company, a major supplier of geographic information system products. The term "dxf" means "drawing exchange format" (*.dxf), a standard electronic file format used by AutoCad® and other graphics software systems.

3. Approximate dates or periods of past product and waste spills or discharges, identification of the materials spilled or discharged, the amount spilled or discharged, the location where spilled or discharged, and a description of any response actions conducted at the time (local, state, or federal response units or private parties), including any inspection reports or technical reports generated as a result of the response;

4. A summary of past and present permits requested and/or received and a list of permit related documents and studies;

5. A summary of past and present enforcement actions and a list of related documents and studies;

6. Identification of any violations of past or present discharge permit limitations and related documents;

7. A summary of any previous response actions conducted by either local, state, federal, or private parties, a summary of the data generated as a result of the response actions, and a list of response related documents and studies; and

8. A summary of known or suspected source areas and other areas of known or suspected contamination, and a list of related documents and studies.

D. Nature and Extent of Contamination (U.S. EPA RI/FS Guidance, Section 2.2.2)

Respondent shall prepare a summary of the nature and extent of contamination at the Site based on the review of existing information. The summary shall include, but not be limited to, descriptions of the types, physical states, and amounts of contaminants known or suspected to be associated with the Site; the type and volume of environmental media affected or potentially affected by the contaminants; any known or suspected contaminant source areas; the presence and condition of any drums, tanks, lagoons, landfills, or other forms of containment; the potential pathways of contaminant migration; and any actual or potential human and/or ecological exposure to contaminants. Emphasis should be placed on describing the threat or potential threat that may exist to public health and/or the environment. The summary shall include tables

displaying the minimum and maximum levels of detected contaminants for Site areas and media, and identification of areas where additional information is necessary.

E. Develop a Conceptual Site Model (U.S. EPA RI/FS Guidance, Figure 2-2)

Based on the results of the above tasks, Respondent shall develop a preliminary CSM to evaluate potential threats to human health and the environment. The CSM shall include known and suspected sources of contamination, types of contaminants and affected media, known and potential routes of contaminant migration, and known or potential human and environmental receptors.

II. Review and Integration of Emergency or Interim Actions

Respondent shall evaluate any previous response actions that may have been undertaken at the Site for consistency with the preliminary CSM and to determine if the initial response objectives are being met. Respondent shall include this evaluation and proposals to address identified issues, if any, in the PER.

III. Pre-investigation Evaluation of Remedial Action Technologies, Process Options, and Broadly Defined Remedial Alternatives

Following the review of existing information and development of the preliminary CSM, Respondent shall refine the preliminary RAOs identified in the Orders to specify the contaminants of potential concern, the actual or potential exposure pathways, and the preliminary remediation goals (PRGs) for each exposure pathway (see the Guidance List attached to the Orders, DERR-00-RR-038, *Use of Risk-based numbers in the Remedial Response Process, Overview*, and Section 4.2.1 of the U.S. EPA RI/FS Guidance). The refined RAOs shall be consistent with the preliminary CSM.

Based on the preliminary CSM and refined RAOs, Respondent shall develop, evaluate and screen a preliminary range of potential remedial technologies and associated process options, and develop broadly defined remedial alternatives (Sections 4.2.2 through 4.2.6 of the U.S. EPA RI/FS Guidance). The screening of technologies and process options shall be based on their effectiveness, implementability, and cost as these terms are defined and used in Sections 4.2.5.1 - 4.2.5.3 of the U.S. EPA RI/FS Guidance.
Respondent shall consider the following during development of a preliminary range of potential remedial alternatives:

A. Technologies and process options that may be appropriate for treating, containing, or disposing of wastes shall be identified, along with sources of literature on the technologies' effectiveness, application, and cost. Innovative technologies and resource recovery options will be included if they appear feasible.

B. A preliminary list of broadly defined remedial alternatives that reflect the goal of preserving a range of alternatives in which treatment that significantly reduces the toxicity, mobility, or volume of waste is a principal element; one or more alternatives that involve containment with little or no treatment; a limited number of ground-water alternatives that attain site-specific remediation levels within differing time frames, and a no action alternative.

C. For alternatives involving treatment, the need for treatability studies shall be evaluated as early in the RI/FS process as possible. The need for such studies shall be discussed in the Pre-investigation Evaluation Report.

Respondent shall also preliminarily identify potential ARARs and TBC criteria which may influence potential remedial alternatives and/or site characterization activities (Section 2.2.5 of the U.S. EPA RI/FS Guidance).

Respondent will revise and refine the preliminary CSM and supporting information (RAOs, contaminants of concern, routes of exposure, receptors, preliminary remedial alternatives, ARARs, and TBC criteria) throughout the RI/FS process as data become available and uncertainties are reduced.

IV. Identification of Data Needs and Data Usage

Based on the results of the above scoping tasks, Respondent shall identify the types of data that will need to be collected during the RI. At a minimum, data shall be collected sufficient to:

A. Define Source Areas of Contamination;

B. Define the Nature and Vertical and Horizontal Extent of Contamination;

C. Define the Environmental Setting at the Site;

D. Define Potential Pathways of Contaminant Migration;

E. Define Hot Spots (see: U.S. EPA 1991 *A Guide to Principal Threat and Low Level Threat Wastes*) within source areas;

F. Define Potential Receptors;

G. Support the HHRA and ERA; and

H. Support the Development and Evaluation of Remedial Alternatives (support development of the AAD and the FS).

Identification of data needs shall be coordinated with the expected uses for the data and the DQOs. Respondent shall identify the intended uses for the data and its adequacy in meeting the DQOs.

V. Pre-investigation Evaluation Report Format

A. Introduction

B. Project Initiation Meeting - summary of discussion and conclusions

C. Description of Current Conditions

1. Site Background

2. Existing Data Analysis

3. Site Visit

4. Nature and Extent of Contamination

5. Potential Receptor Identification

D. Conceptual Site Model

E. Level I Ecological Risk Assessment

F. Pre-investigation Evaluation of Remedial Alternatives

1. Preliminary Remediation Goals

2. Remedial Action Objectives

3. Federal ARARs, state requirements, and TBCs

4. Preliminary Remedial Alternatives
   a. Preliminary Screening of Remedial Technologies
   b. Preliminary Screening of Process Options
   c. Development of Preliminary Remedial Alternatives

G. Identification of Data Needs and Data Usage

1. Analysis of RI/FS SOW Tasks

2. Data Needs

3. Data Quality Objectives

Appendix B

Field Sampling Plan Format

Respondent shall prepare the FSP consistent with Sections 3.3.4.1 through 3.3.4.12 of the U.S. Army Corps of Engineers' guidance *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, February, 2001, using the following format:

Title Page
Table of Contents

1.0 Project Background
- 1.1 Site History and Contaminants
- 1.2 Summary of Existing Site Data
- 1.3 Site-Specific Definition of Problems

2.0 Project Organization and Responsibilities

3.0 Project Scope and Objectives
- 3.1 Task Description
- 3.2 Applicable Regulations/Standards
- 3.3 Project Schedule

4.0 Nonmeasurement Data Acquisition

5.0 Field Activities by Area of Concern (AOC)
- 5.1 Geophysics
  - 5.1.1 Rationale/Design
    - 5.1.1.1 Method
    - 5.1.1.2 Study Area Definition and Measurement Spacing
  - 5.1.2 Field Procedures
    - 5.1.2.1 Equipment
    - 5.1.2.2 Preliminary Method Testing and Early Termination Procedures
    - 5.1.2.3 Instrument Calibration and QC Procedures
    - 5.1.2.4 Field Progress/Interpretation Reporting
    - 5.1.2.5 Measurement Point/Grid Surveying
    - 5.1.2.6 Data Processing
    - 5.1.2.7 Potential Interpretation Techniques

5.2 Soil Gas Survey
5.2.1 Rationale/Design
5.2.1.1 Soil Gas Sample Locations
5.2.1.2 Sample Collection and Field and Laboratory Analysis
5.2.1.3 Background, QA/QC, and Blank Samples and Frequency
5.2.2 Field Procedures
5.2.2.1 Drilling Methods and Equipment
5.2.2.2 Materials (Casing, screen, etc.)
5.2.2.3 Installation
5.2.2.4 Sampling Methods
5.2.2.5 Field Measurement Procedures and Criteria
5.2.2.6 Documentation
5.3 Ground Water
5.3.1 Rationale/Design
5.3.1.1 Monitoring Well Location and Installation
5.3.1.2 Sample Collection and Field and Laboratory Analysis
5.3.1.3 Upgradient, QA/QC, and Blank Samples and Frequency
5.3.2 Monitoring Well Installation
5.3.2.1 Drilling Methods and Equipment
5.3.2.2 Materials
5.3.2.2.1 Casing/Screen/Centralizers
5.3.2.2.2 Filter Pack, Bentonite Seal, Cement/Bentonite Grout
5.3.2.2.3 Surface Completion
5.3.2.2.4 Water Source
5.3.2.2.5 Delivery, Storage, and Handling of Materials
5.3.2.3 Installation
5.3.2.3.1 Test Holes
5.3.2.3.2 Soil Sampling and Rock Coring During Drilling
5.3.2.3.3 Geophysical Logging
5.3.2.3.4 Borehole Diameter and Depth
5.3.2.3.5 Screen and Well Casing Placement
5.3.2.3.6 Filter Pack Placement
5.3.2.3.7 Bentonite Seal
5.3.2.3.8 Cement/Bentonite Grout Placement
5.3.2.3.9 Concrete/Gravel Pad Placement
5.3.2.3.10 Protective Cover Placement
5.3.2.3.11 Well Identification
5.3.2.3.12 Well Development
5.3.2.3.13 Well Survey
5.3.2.3.14 Alignment Testing
5.3.2.3.15 In Situ Permeability Testing

5.3.2.4 Documentation
5.3.2.4.1 Logs and Well Installation Diagrams
5.3.2.4.2 Development Records
5.3.2.4.3 Geophysical Logs
5.3.2.4.4 Decommission/Abandonment Records
5.3.2.4.5 Photographs
5.3.2.5 Well Decommission/Abandonment
5.3.2.6 Water Level Measurement
5.3.3 Determine Free Product Presence and Sampling
5.3.4 Aquifer Testing
5.3.5 Field Measurement Procedures and Criteria
5.3.6 Sampling Methods for Ground Water - General
5.3.7 Sample Handling Methods for Ground Water - Filtration
5.3.8 Sample Containers and Preservation Techniques
5.3.9 Field Quality Control Sampling Procedures
5.3.10 Decontamination Procedures

5.4 Subsurface Soil
5.4.1 Rationale/Design
5.4.1.1 Soil and Rock Boring Locations
5.4.1.2 Discrete/Composite Soil Sampling Requirement
5.4.1.3 Sample Collection and Field and Laboratory Analysis
5.4.1.4 Background, QA/QC, and Blank Samples and Frequency
5.4.2 Field Procedures
5.4.2.1 Drilling Methods
5.4.2.2 Boring Logs
5.4.2.3 Field Measurement Procedures and Criteria
5.4.2.4 Sampling for Physical/Geotechnical Analyses
5.4.2.5 Sampling for Chemical Analyses
5.4.2.6 Sample Containers and Preservation Techniques
5.4.2.7 Field Quality Control Sampling Procedures
5.4.2.8 Decontamination Procedures
5.5 Surface Soil and Sediment
5.5.1 Rationale/Design
5.5.1.1 Surface Soil Sample Locations
5.5.1.2 Sediment Sample Locations from Onsite and/or Offsite Drainage Channels
5.5.1.3 Sediment Sample Locations from Ponds, Lakes, and Lagoons
5.5.1.4 Discrete/Composite Soil and/or Sediment Sampling Requirements
5.5.1.5 Sample Collection and Field and Laboratory Analysis

5.5.1.6 Upgradient, QA/QC, and Blank Samples and Frequency
5.5.2 Field Procedures
5.5.2.1 Sampling Methods for Surface Soil/Dry Sediment
5.5.2.2 Sampling Methods for Underwater Sediments from Ponds, Lakes, and Lagoons
5.5.2.3 Field Measurement Procedures and Criteria
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5.5.2.5 Sampling for Chemical Analyses
5.5.2.6 Sample Containers and Preservation Techniques
5.5.2.7 Field QC Sampling Procedures
5.5.2.8 Decontamination Procedures
5.6 Surface Water
5.6.1 Rationale/Design
5.6.1.1 Surface Water Sample Locations
5.6.1.2 Sample Collection and Field and Laboratory Analysis
5.6.1.3 Upgradient, QA/QC, and Blank Samples and Frequency
5.6.2 Field Procedures
5.6.2.1 Sampling Methods for Surface Water - General
5.6.2.2 Sample Handling Methods for Surface Water - Filtration
5.6.2.3 Field Measurement Procedures and Criteria
5.6.2.4 Sample Containers and Preservation Techniques
5.6.2.5 Field Quality Control Sampling Procedures
5.6.2.6 Decontamination Procedures
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5.7.1 Rationale/Design
5.7.1.1 Sample Locations
5.7.1.2 Discrete/Composite Sampling Requirements
5.7.1.3 Sample Collection and Field and Laboratory Analysis
5.7.1.4 Background/Upgradient, QA/QC, and Blank Samples and Frequency
5.7.2 Field Procedures
5.7.2.1 Sampling Methods
5.7.2.2 Field Measurement Procedures and Criteria
5.7.2.3 Sample Containers and Preservation Techniques
5.7.2.4 Field Quality Control Sampling Procedures
5.7.2.5 Decontamination Procedures

6.0 Field Operations Documentation
6.1 Daily Quality Control Reports (QCR)
6.2 Field Logbook and/or Sample Field Sheets
6.3 Photographic Records

6.4 Sample Documentation
6.4.1 Sample Numbering System
6.4.2 Sample Labels and/or Tags
6.4.3 Chain-of-Custody Records
6.5 Field Analytical Records
6.6 Documentation Procedures/Data Management and Retention

7.0 Sample Packaging and Shipping Requirements

8.0 Investigation-Derived Wastes (IDW)

9.0 Field Assessment/Three-Phase Inspection Procedures
9.1 Contractor Quality Control (CQC)
9.2 Sampling Apparatus and Field Instrumentation Checklist

10.0 Nonconformance/Corrective Actions

Appendices
A. References

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Appendix C

Quality Assurance Project Plan Elements

Group A. Project Management	Group B. Data Generation and Acquisition	Group C. Assessment and Oversight
A1 Title and Approval Sheet	B1 Sampling Process Design (Experimental Design)	C1 Assessments and Response Actions
A2 Table of Contents	B2 Sampling Methods	C2 Reports to Management
A3 Distribution List	B3 Sample Handling and Custody	
A4 Project/Task Organization	B4 Analytical Methods	**Group D. Data Validation and Usability**
A5 Problem Definition and Background	B5 Quality Control	D1 Data Review, Verification, and Validation
A6 Project/Task Description	B6 Instrument/Equipment Testing, Inspection, and Maintenance	D2 Verification and Validation Methods
A7 Quality Objectives and Criteria	B7 Instrument/Equipment Calibration and Frequency	D3 Reconciliation with User Requirements
A8 Special Training/ Certifications	B8 Inspection/Acceptance of Supplies and Consumables	
A9 Documentation and Records	B9 Non-direct Measurements	
	B10 Data Management	

Appendix D

Health and Safety Plan (HASP) - see also SOW Section 2.3

I. Respondent shall submit a HASP that at a minimum addresses the following:

A. Facility or site description including availability of resources such as roads, water supply, electricity and telephone service;

B. Description of the known hazards and an evaluation of the risks

C. Listing of key personnel (including the site safety and health officer) and alternates responsible for site safety, response operations, and for protection of public health;

D. Delineation of work area, including a map;

E. Description of levels of protection to be worn by personnel in the work area, including a description of the personal protective equipment to be used for each of the site tasks and operations being conducted;

F. Description of the medical monitoring program;

G. Description of standard operating procedures established to assure the proper use and maintenance of personal protective equipment;

H. The establishment of procedures to control site access;

I. Description of decontamination procedures for personnel and personal protective equipment;

J. Establishment of site emergency procedures, including a contingency plan that meets the requirements of 29 CFR 1910.120(l)(1) and (l)(2);

K. Availability of emergency medical care for injuries and toxicological problems;

L. Description of requirements for an environmental monitoring program. (This should include a description of the frequency and type of air and personnel monitoring, environmental sampling techniques and a

description of the calibration and maintenance of the instrumentation used.);

M. Specification of any routine and special training required for site personnel;

N. Entry procedures for confined spaces; and

O. Establishment of procedures for protecting workers from weather-related problems.

II. The HASP shall be consistent with:

A. NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (1985);

B. Section 111©)(6) of CERCLA;

C. U.S. EPA Order 1440.3 -- Respiratory Protection;

D. U.S. EPA Order 1440.2 -- Health and Safety Requirements for Employees Engaged in Field Activities;

E. U.S. EPA Occupational Health and Safety Manual;

F. U.S. EPA Standard Operating Safety Guides (Publication 9285.1-03, PB92-963414, June 1992;

G. OSHA regulations particularly in 29 CFR 1910 and 1926;

H. State and local regulations; and

I. Site or facility conditions.

Although Ohio EPA will review and may provide comment on the draft HASP, Ohio EPA will not approve the HASP. It is Respondent's responsibility to comply with applicable rules and regulations and to ensure that site workers, site visitors, and the surrounding community are protected from any hazards or potential hazards associated with the Site throughout the conduct of the RI/FS.

Appendix E

Environmental Setting

Respondent shall characterize the environmental setting of the Site. Characterization shall include discussion of regional and site hydrogeology, surface water and sediment, local climate, and human and ecological receptors. Components to be addressed include but are not limited to:

I. Regional Hydrogeology

Respondent shall characterize the regional hydrogeology surrounding the facility, including:

A. Depth to bedrock;

B. Hydrostratigraphic unit correlation (both map and profile view);

C. Aquifer and aquitard delineation;

D. Active and inactive residential, public, industrial, agricultural, and other production well locations within a four (4) mile radius of the Site;

E. Well logs, with well construction details and average yield;

F. Average pumping rates for production wells;

G. Ambient ground water quality characterization;

H. Average depth to water;

I. Seasonal variation in ground water flow direction;

J. Recharge and discharge area identification;

K. Source water protection area identification;

L. Aquifer designation (*i.e.;* federal Sole Source Aquifer; Drinking Water Source Water Protection Area);

M. Regional geomorphology and topography, including locations of surface water bodies and floodways. This description should include an analysis of any features that may influence the ground water flow system; and

N. Structural feature delineation, including bedding planes and fold, joint, and fracture trace orientation.

II. Site Hydrogeology

Respondent shall characterize site-specific hydrogeology based on data collected from bore holes, monitoring wells, piezometers, and laboratory and field tests. Characterization shall include but not be limited to the following:

A. An accurate classification and description of the consolidated and unconsolidated stratigraphic units beneath the Site, including:

1. Hydraulic conductivity (vertical and horizontal);

2. Porosity, effective porosity, and bulk density;

3. Rock and soil (ASTM 2488 and 2487) classification;

4. Grain size distribution (sieve and hydrometer) curves;

5. Moisture content;

6. The attenuation capacity and mechanisms of attenuation of the natural earth material and/or fill (*i.e.*, ion exchange capacity, base saturation, organic carbon content, mineral content, soil sorptive capacity, storage capacity); and

7. pH;

B. Surface soils, including:

1. Soil Conservation Service soil classification;

2. Surface soil distribution;

3. Depth and profile;

4. Organic carbon;

5. pH;

6. Porosity (total, air-filled);

7. Bulk density;

8. Gravimetric soil moisture content;

9. Fraction of vegetative cover (of contaminated areas);

10. ion exchange capacity;

11. Infiltration; and

12. Evapotranspiration.

C. A description of the local ground water flow regime, including:

1. Identification of all aquitards and aquifer systems (hydrogeologic formations wholly or partially saturated and capable of transmitting flow);
2. Identification of saturated zones;

3. Identification of water table and potentiometric surface depth with degree of seasonal fluctuation;

4. Identification of seasonal ground water flow direction for each aquifer system including water table and/or potentiometric surface contour maps for each significant zone of saturation;

5. Quantification of flow rate throughout each aquifer system;

6. Quantification of horizontal and vertical gradients;

7. Quantification of infiltration rates through the unsaturated zone;

8. Quantification of flow across and lateral to hydrostratigraphic units, including the degree of seepage and upward leakage;

9. Quantification of flow budget across the Site with identification of recharge and discharge areas;

10. Location of nearest hydraulic boundaries;

11. Characterization of ambient ground water chemistry both upgradient and downgradient of the Site;

12. Hydrostratigraphic cross sections depicting horizontal and lateral extent, depth, and thickness of units. Cross sections shall be developed both longitudinally and transverse to the dominant direction of flow across the Site. Cross sections shall include flow nets distinguishing vertical and horizontal components of flow across stratigraphic units; and

13. Delineation of structural features, including orientation, density, and distribution.

D. A description of man-made influences that may affect the hydrogeology of the Site, identifying:

1. Active and inactive water supply and production wells with pumping schedules; and

2. Man-made structures such as injection wells, pipelines, french drains, ditches, unlined and lined ponds, lagoons, septic tanks, NPDES permitted out falls, retention areas and utility lines.

E. An area-specific description of the geomorphology at the Site. At a minimum this shall include;

1. An analysis of any topographic feature that may influence the ground water flow system;
2. A surface topography map depicting (at a minimum) streams, wetlands, topographic depressions and springs. The topographic map shall be constructed by a qualified professional and shall provide contour intervals at a level of detail appropriate for the site-

specific hydrogeologic investigation (*e.g.*, two-foot intervals). The map shall depict the location of all borings, monitoring wells and cross sections.

F. The RI Report shall document the methods and procedures used to gather and evaluate the hydrogeologic data. These methods and procedures shall be in accordance with the approved RI/FS Work Plan. Field methods may include but are not limited to:

1. Borehole characterization;

2. Ground water level measurements;

3. Ground water sampling;

4. Monitoring well and piezometer installation;

5. Aquifer testing (*e.g.*, pump and slug testing) to determine the degree of hydraulic communication between hydrostratigraphic units and subsurface structure;

6. Remote sensing, including geophysical techniques to identify zones of saturation, ydrostratigraphic units, and subsurface structure;

7. Ground water tracer testing to assist in determining migration pathways and hydraulic conductivity; and

8. Isotopic age dating of ground water to assist in migration pathway identification.

III. Surface Water and Sediment

Respondent shall conduct a program to characterize any surface water bodies in the vicinity of the Site. Such characterization shall include, but is not limited to:

A. Description of the perennial and ephemeral surface water bodies including:

1. For lakes and estuaries: location, elevation, surface area, inflow, outflow, depth, temperature stratification and volume;

2. For impoundments: location, elevation, surface area, depth, volume, freeboard and purpose of impoundment;

3. For streams, ditches, drains, wetlands, and channels: location, hydraulic gradient, flow velocity, base flow, depth, width, bank height and slope, gaining and losing stream sections, seasonal fluctuations, stabilization of stream bead; description of stream banks; flood plain areas, and flood zones (*i.e.*, 50 and 100 year events); area of drainage basin;

4. Drainage patterns/storm water runoff;

5. Degree of ground water seepage and/or recharge to surface waterbodies;

6. Any known discharges including those permitted by NPDES; and.

B. Description of the chemical, physical and biological/biochemical characteristics of the surface water and sediments. This includes but is not limited to:

1. Chemical (surface water and/or sediment)

   a. Total organic carbon (TOC);
   b. pH;
   c. total dissolved solids;
   d. total suspended solids;
   e. biochemical oxygen demand (BOD);
   f. conductivity; and
   g. dissolved oxygen.

2. Physical (surface water and/or sediment)

   a. temperature;
   b. particle/grain size;
   c. appearance/texture/odor/color;
   d. organic matter deposition;
   e. Deposition area, patterns, and rates; and
   f. Thickness profile.

3. Biological/Biochemical

a. Aquatic life use designation based on Ohio's Water Quality Standards[2];
b. Attainment status of water body; and
c. Ohio wetland classification.

The RI Report shall document the methods and procedures used to gather and evaluate the surface water and sediment data. These methods and procedures shall be in accordance with the approved RI/FS Work Plan. Field methods may include but are not limited to:

a. drain tracer studies;
b. seepage meter installation and data acquisition;
c. stream piezometer installation and water level acquisition; and
d. stream weir gauge installation and data acquisition.

IV. Local Climate

Respondent shall provide information characterizing the climate in the vicinity of the Site in general, and at the time of the investigation(s). Such information shall include, but not be limited to:

A. A description of the following parameters:

1. Annual and monthly rainfall averages;

2. Monthly temperature averages and extremes;

3. Wind speed and direction;

4. Relative humidity/dew point;

5. Atmospheric pressure;

[2] Ohio Water Quality Standards, OAC Chapter 3745-1

6. Evaporation data;

7. Development of inversions; and

8. Climate extremes that have been known to occur in the vicinity of the facility, including frequency of occurrence.

B. A description of topographic or manmade features which may affect air flow or emission patterns, including:

1. Ridges, hills or mountain areas;

2. Canyons or valleys;

3. Surface water bodies;

4. Wind breaks and forests;

5. Buildings; and

6. Any other features that may affect air flow or emission patterns.

V. Human receptors potentially exposed to Site-related contaminants, including:

A. human population data including demographics;

B. sensitive sub-populations;

C. populations served by surface water intakes or ground water wells; and

D. land use (e.g., residential, commercial, recreational).

VI. Ecological receptors potentially exposed to site-related contaminants, including:

A. terrestrial receptors;

B. aquatic receptors; and

C. special interest species (including Threatened and Endangered species).

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Appendix F

Source Characterization

Respondents shall characterize the source or sources of site contamination, including the unit/disposal area and physical and chemical characteristics of source area contaminants. The source characterization shall include but not be limited to the following:

I. Unit/Disposal Area:

   A. Location;

   B. Type;

   C. Design features;

   D. Operating practices (past and present);

   E. Period of operation;

   F. Age;

   G. General physical conditions;

   H. Methods used to closure and monitoring; and

   I. Estimation of initially disposed contaminant mass.

II. Waste/Contaminant Characteristics

   A. Type of waste

      1. Waste types and classification (*e.g.*, hazardous due to listed, flammable, reactive, corrosive, oxidizing or reducing agent; Toxic Substances Control Act wastes, solid, municipal, and/or industrial);

      2. Quantity; and

      3. General chemical class (*e.g.*, acid, base, solvent).

B. Waste/Contaminant Physical and chemical characteristics

1. Phase (*e.g.*, solid, liquid, gas);
2. Physical description (*e.g.*, powder, oily sludge);
3. Temperature;
4. pH;
5. Molecular weight;
6. Density;
7. Boiling point;
8. Viscosity;
9. Solubility in water;
10. Cohesiveness of the wastes;
11. Vapor pressure;
12. Henry's law constant;
13. K_{ow};
14. Kd; and
15. Flash point.

C. Waste/Contaminant migration and dispersal characteristics

1. Retardation;
2. Biodegradation rates;
3. Photodegradation rates;
4. Hydrolysis rates;

5. Chemical transformation rates and degradation products;

6. Chemical interactions;

7. Products of all such reactions or processes;

8. Leachate infiltration rates and contaminant mass loading to aquifer systems; and

9. Soil screening concentrations.

Respondent shall document the procedures used in making the above determinations.

Appendix G

Nature and Extent of Contamination

I. Ground water Contamination

Respondent shall conduct a ground water investigation to characterize the nature and extent of any ground water contamination at the Site. The investigation shall include a description and quantification of ground water quality in the aquifer systems and all zones of saturation or permeable zones that may act as pathways for contaminant migration. The investigation shall include but not be limited to the following:

A. Characterization of the horizontal and vertical extent of any immiscible or dissolved phase contaminant plume(s), including sampling of ground water potentially discharging contaminants to surface waters for compliance with Water Quality Standards;

B. Delineation of contaminant specific flow velocity vectors in map and profile view;

C. Construction of contaminant specific isopleths in map and profile view. Isopleths should be superimposed over map and profile views for each aquifer system, including significant zones of saturation above the water table;

D. Extrapolation of future contaminant migration rates and distribution;

E. Identification and sampling of ground water production wells, including residential, public, industrial, agricultural, and other production wells within or in the vicinity of the contamination; and

F. Determination of the degree of seasonal variation in ground water contaminant concentrations.

II. Surface and Subsurface Soil Contamination

Respondent shall conduct an investigation to characterize the nature and extent of surface and subsurface soil contamination at the Site. This includes areas where contaminants may have migrated due to airborne deposition or transport

with surface water runoff. The investigation shall include but not be limited to the following information:

A. A description of the vertical and horizontal extent and pattern of contamination;

B. A description of contaminant and soil chemical, biological, and physical properties, including contaminant solubility, speciation, adsorption, leachability, exchange capacity, biodegradation, hydrolysis, photolysis, oxidation and other factors that might affect contaminant migration and transformation;

C. Delineation of contaminant specific concentrations;

D. Description of mechanisms and patterns of soil contaminant migration; and

E. An extrapolation of future soil contaminant movement.

III. Surface Water and Sediment Contamination

Respondent shall conduct an investigation to characterize the nature and extent of contamination in or discharging to surface waters and sediments. The investigation shall include, but not be limited to, the following:

A. Characterization of the horizontal and vertical extent of any immiscible or dissolved phase contamination in surface waters, sediments, and seeps, including sampling of seeps potentially discharging contaminants to surface waters for compliance with Water Quality Standards;

B. Delineation of the horizontal and vertical distribution of any immiscible, dissolved, or suspended surface water contamination in map and profile view;

C. Delineation of the horizontal and vertical distribution of any sediment and sediment pore water contamination in map and profile view;

D. The velocity and direction of contaminant migration in surface water and sediment;

E. An evaluation of the physical, biological and chemical factors influencing contaminant migration; and

F. An extrapolation of future contaminant migration.

IV. Subsurface Gas Contamination

Respondent shall conduct an investigation to characterize the nature and extent of subsurface gases emitted from contaminants in soil, wastes, or ground water. Respondent shall investigate and evaluate the soil vapor intrusion exposure pathway to determine whether soil vapor poses an unacceptable threat to human health, including the potential for the generation of flammable or explosive gases such as methane.

The subsurface gas investigation shall include the following information:

A. A description of the extent of subsurface gas contamination, including horizontal and vertical contaminant concentration profiles;

B. An evaluation of preferential subsurface gas migration pathways;

C. The chemical composition of subsurface gases;

D. The rate, amount, and density of the subsurface gases being emitted;

E. Subsurface gas contaminant fate and transport;

F. A survey of inhabitable structures (residential and commercial/industrial) and land use;

G. An investigation and evaluation of the indoor air vapor intrusion pathway;

H. An investigation and evaluation of the threat of fire or explosive conditions as a result of subsurface gas migration; and

I. Determination of the degree of seasonal variation in subsurface gas contaminant concentrations, migration rates, and distribution.

Respondent shall refer to the vapor intrusion guidance included in the Guidance List attached to the Orders when planning and conducting the vapor intrusion component of the subsurface gas investigations.

V. Air Contamination

Respondent shall investigate the extent of atmospheric contamination resulting from contaminants found to be present at the Site. The investigation shall include an assessment of the potential for the contaminants to enter the atmosphere, description of local wind patterns, and the anticipated fate of airborne contaminants. The investigation shall provide the following information:

A. A description of the horizontal and vertical direction and velocity of contaminant movement;

B. The rate and amount of the release;

C. Ambient (outdoor) air contaminant concentrations;

D. Indoor air contaminant concentrations resulting from ambient releases;

E. The chemical and physical nature of contaminated particulates including respirable portion, source emission rates, and contaminant concentrations in respirable portions;

F. The chemical and physical composition of the contaminants released, including vertical and horizontal concentration profiles; and

G. Environmental factors that affect fate and transport of contaminants in the atmosphere.

VI. Other Media

Respondent shall conduct additional investigations as necessary to support the HHRA and/or ERA with respect to other media that may be contaminated. This may include tissue contaminant concentrations in vegetation, crops, home grown produce, meats, prey, macroinvertebrates, fish, shellfish or other tissues for which exposure is reasonably anticipated by human and/or ecological receptors.

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Appendix H

Human Health Risk Assessment

Respondent shall conduct a baseline HHRA, which includes, but not limited to:

I. Revise the Conceptual Site Model

Prior to preparing the baseline HHRA, Respondent shall revise the CSM prepared during scoping based on the data collected during the RI and include the revised CSM in the Risk Assessment Assumptions Document (RAAD) discussed in Section 4.1 of this SOW. See Section 4.2 of RAGS, Part A and Section 2.2.2.2 of the U.S. EPA RI/FS Guidance for specific details on the development of the CSM. The revised CSM shall identify all potential or suspected sources of contamination, types and concentrations of contaminants, potential exposure pathways, and all current and potential receptors. Based upon the revised RAAD, Respondent shall prepare a baseline HHRA as outlined below to be included in the RI/FS Report.

II. Data Collection and Evaluation Process

The purpose of data collection and evaluation is to obtain reliable chemical release and exposure data for quantitative human health risk assessment. The data collection and evaluation process is accomplished via the completion of the approved work plans. It should be noted that the evaluation of risk to human health is an iterative process as data are gathered during the RI. See Chapters 4 and 5 of RAGS Part A for specific details on the data collection and evaluation process. The following is a general outline of the data collection and evaluation step in the HHRA:

A. Data Collection

1. collect existing data;

2. collect background data; and

3. collect data per the work plan(s)

B. Data Evaluation

1. combine data from site investigations;

2. evaluate analytical methods;

3. evaluate quantitation limits;

4. evaluate qualified and coded data;

5. evaluate blanks;

6. evaluate tentatively identified compounds; and
7. identify chemicals of potential concern (based on):

   a. Background concentrations derived in accordance with the background guidance, and;
   b. Contaminant toxicity (including as appropriate, toxicologically-based screening values).

III. Exposure Assessment

The objective of the exposure assessment is to estimate the type and magnitude of exposures of potential receptors to chemicals of potential concern. The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential health risks. See Chapter 6 of Part A for specific details on conducting an acceptable exposure assessment.
Respondent shall:

A. Combine site data and environmental modeling results to:

   1. identify potentially exposed populations;

   2. identify potential exposure pathways; and

   3. estimate exposure point concentrations.

B. Estimate of Chemical Intakes. Respondent shall provide estimates of chemical intakes as appropriate from:

   1. Air (atmospheric and indoor air);

   2. Soil;

3. Ground water;

4. Surface water;

5. Sediment; and

6. Other exposure pathways as appropriate (e.g., food-stuffs, fish and game (see Chapter 6 of RAGS, Part A for exposure assessment information regarding intake of contaminated food items)).

IV. Toxicity Assessment

The purpose of the toxicity assessment is to weigh evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likely-hood and/or severity of adverse effects.

Respondent shall evaluate critical toxicity values (*e.g.*, numerical values describing a chemical toxicity) and review general toxicological information for the indicator chemicals. Chapter 7 of RAGS, Part A provides specific details for conducting an acceptable toxicity assessment. DERR's *Assessing Compounds without Formal Toxicity Values for Use in Human Health Risk Assessment* identifies sources for obtaining acceptable toxicity criteria. Respondent shall:

A. Gather qualitative and quantitative toxicity information for substances being evaluated;

B. Identify exposure periods for which toxicity values are necessary;

C. Determine toxicity values for non-carcinogenic effects;

D. Identify, if possible, mechanism or mode of action of toxicity and/or target organ(s) for all non-carcinogenic potential contaminants of concern; and,

E. Determine toxicity values (*e.g.*, slope factors) for all carcinogenic chemicals.

V. Risk Characterization

A. Respondent shall provide a detailed characterization of the risks or hazards posed by releases from the Site. See Chapter 8, RAGS Part A for specific information on completing the risk characterization process. The characterization shall include the following elements:

1. Review outputs from toxicity and exposure assessments;

2. Quantify risks/hazards from individual chemicals;

3. Quantify risks/hazards from multiple chemicals where appropriate;

4. Combine risks/hazards across exposure pathways where appropriate;

5. Assess present uncertainty; and

6. Consider site-specific human studies where appropriate.

B. Potential non-carcinogenic adverse effects are evaluated using the Hazard Quotient or Hazard Index approach, where:

For individual non-cancer chemical evaluations, the Hazard Quotient (HQ) methodology is used:

$$HQ = E/RfV$$

where:

E = exposure level (or intake) for the toxicant

RfV = reference dose (RfD) or concentration (RfC) for the toxicant; and,

E and RfV are expressed in the same units and represent the same exposure period (*i.e.*, chronic, sub-chronic, or shorter term) and route of exposure (*i.e.*, inhalation, ingestion, or, dermal absorption).

Exposures to multiple non-cancer toxicants are evaluated using the Hazard Index (HI) approach, where:

$$HI = E_1/RfV_1 + E_2/RfV_2 + ... E_i/RfV_i$$

where:

E_i = exposure level (or intake) for the ith toxicant

RfV_i = reference dose for the ith toxicant

E and RfV are expressed in the same units and represent the same exposure period (*i.e.*, chronic, sub-chronic, or shorter term) and route of exposure (*i.e.*, inhalation, ingestion, or, dermal absorption)

Hazards for the various exposure pathways are to be summed as appropriate based on reasonable exposure pathway combinations and receptor exposure. See Section 8.2.2 of Chapter 8 of RAGS Part A for details on the aggregation of hazards. Non-cancer hazard estimates should be expressed using one significant figure only.

C. Potential carcinogenic effects are estimated using the predicted risk approach, where:

Risk = CDI x SF

where:

Risk = a unitless probability (*e.g.*, 1 E-5) of an individual developing cancer;

CDI = chronic daily intake averaged over 70 years ($mg.kg^{-1}.day^{-1}$); and,

SF = slope factor, expressed in $(mg.kg^{-1}.day^{-1})^{-1}$.

Exposure to multiple carcinogens are evaluated using the following equation:

$$Risk_T = \Sigma\ Risk_i$$

where:

$Risk_T$ = the total cancer risk, expressed as a unitless probability; and,

$Risk_i$ = the risk estimate for the ith substance.
It is assumed that risks are additive when receptors are exposed to multiple carcinogenic compounds. Risks for the various exposure pathways are to be summed as appropriate based on reasonable exposure pathway combinations and receptor exposure. Resulting cancer risk estimates should be expressed using one significant figure only.

D. Uncertainties

Respondent shall provide a discussion of the uncertainties and assumptions made in the assessment process. See Section 8.4 in Chapter 8 of RAGS Part A for specific details regarding the assessment and presentation of uncertainty.

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Appendix I

Ecological Risk Assessment

The DERR ECO Guidance follows a phased approach for ecological risk assessment. Specifically, the DERR ECO Guidance is divided into 4 levels:

I. Level I Scoping ERA

The purpose of the Level I Scoping ERA is to determine whether there exists any potential for site contamination to impact or aversely effect any important ecological resource at or in the vicinity of the Site. Respondent shall complete a Level I Scoping ERA during the RI/FS scoping phase (Section 1 and Appendix A of this SOW) and incorporate the Level I ERA Report into the Preinvestigation Evaluation Report (PER). The major tasks of the Level I Scoping ERA consist of:

A. Site Characterization

Based on a review of existing data and a habitat evaluation of the Site and its surroundings, Respondent shall consider the following:

1. Site Background/Site History;

2. Identification of any Important Ecological Resource potentially impacted by site-related contamination (see: page 6-2 of DERR ECO Guidance for the definition of Important Ecological Resource); and

3. Known or suspected releases of contamination in any medium present at the Site.

B. Decision to complete additional ecological assessment

Respondent shall:

1. Summarize the completed risk assessment and, based on the results, determine if additional risk assessment if warranted.

Specific requirements for conducting the Level I Scoping ERA are described in Chapter 2 of the DERR ECO Guidance. Respondent shall address each of these requirements, including the check sheets, and include the results in the PER.

II. Level II Screening ERA

If the approved Level I Scoping ERA identifies an important ecological resource that may potentially be exposed to contamination from the Site, Respondent shall include in the RI/FS Work Plan and supporting documents all tasks necessary to conduct a Level II Screening ERA. The purpose of the Level II Screening ERA is to use the data generated during the RI to refine the list of detected contaminants per medium, identify chemicals of potential ecological concern (COPECs) and non-chemical stressors, evaluate potentially impacted aquatic habitats for attainment of Water Quality Standards, complete the list of ecological receptors, and refine the CSM. The major tasks of the Level 2 Screening ERA consist of:

A. Description of the Site:

1. Describe the physical and chemical factors that impact site ecology (*e.g.*, fate and transport of contaminants, bioavailability, etc.);

2. Describe past or current practices, disturbances, or stressors that may have impact(ed) site ecology;

3. Describe the areal extent of environmental assessment; and

4. Describe current and projected land use in and around the Site as relevant to site ecology.

B. Identify all impacted and potentially impacted exposure media (*e.g.,* soil, sediment, surface water, and tissue).

C. Identify/list important ecological resources and potentially impacted site-specific ecological receptors.

D. Perform semi-quantitative surveys of flora and fauna that are or may be exposed to contamination, including but not limited to:

1. Vegetative strata;

2. Flora and fauna in all contaminated media;

3. Population parameters (*e.g.*, density, frequency, age distribution); and

4. Community parameters (*e.g.*, diversity, structure, stability).

Seasonal effects can impart a profound influence on the results of biological or ecological sampling. Respondent shall address seasonal requirements for sampling or testing of terrestrial flora and fauna in the RI/FS Work Plan and RI/FS project schedule.

E. List chemicals of potential ecological concern (COPECs) (contaminants remaining following the screening process; full documentation of the screening process is required).

F. Evaluate site-specific chemical concentrations and attainment Water Quality Standards. Both chemical-specific and biological criteria may apply to the water body. Respondent shall address seasonal requirements for biological sampling for the demonstration of full attainment of surface water criteria in the RI/FS Work Plan and RI/FS project schedule.

G. Identify complete exposure pathways and refine the CSM.

H. Define ecologically appropriate assessment endpoints, measurement endpoints, and endpoint selection criteria.

I. Propose one of the following decisions based on the results of the Level II Screening ERA:

1. Unacceptable actual or potential hazards identified (*e.g.*, concentrations above screening levels and/or surface waters fail to meet Water Quality Standards), ERA completed;

2. Continued evaluation (Level III Baseline ERA), or

3. No unacceptable actual or potential hazard identified (*e.g.*, concentrations below screening levels and surface waters meet Water Quality Standards), ERA completed.

J. Summarize the completed risk assessment and the decision for additional risk assessment if warranted.

K. Specific requirements for conducting the Level II Screening ERA are further described in Chapter 3 of the DERR ECO Guidance. At the conclusion of the Level II ERA, Respondent shall submit for review and approval a Level II Screening ERA addressing each of the tasks in Chapter 3 of the DERR ECO Guidance. If the approved Level II Screening ERA Report concludes that performance of a Level III Baseline ERA is appropriate and additional site characterization is necessary to support the Level III ERA, Respondent shall submit for review and approval an addendum to the RI/FS Work Plan and supporting documents, including a revised RI/FS project schedule, describing in detail the tasks necessary to conduct the Level III Screening ERA. If the approved Level II ERA concludes the performance of a Level III Baseline ERA is appropriate but additional site characterization is not necessary to support the Level III Baseline ERA, Respondent shall submit a revised RI/FS project schedule for review and approval which includes the date for submittal of the Level III ERA Report.

III. Level III Baseline ERA

If the approved Level II Screening ERA concludes that additional assessment is necessary, Respondent shall complete a Level III Baseline ERA which includes an exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. The major tasks of the Level III Baseline ERA consist of:

A. Exposure Assessment

The exposure assessment is a quantitative evaluation of the magnitude, frequency, duration, and route of exposure for ecological receptors to site-related ecological stressors identified in the screening ERA. The exposure assessment may consist of direct contact evaluations of more sessile organisms (*e.g.*, plants, soil invertebrates), or food web models to estimate exposure of chemicals of potential ecological concern (COPECs) to more mobile ecological receptors (*e.g.*, short-tailed shrew, meadow

vole, red fox etc.) via ingestion of soil, and/or food items. See chapter 4 of DERR ECO Guidance for additional details.

B. Toxicity Assessment

The toxicity assessment shall evaluate the appropriate toxicity data for all COPECs and develop an ecologically-based reference dose (ERfD) for each COPEC to be used in assessing possible harm to ecological receptors. Respondent shall perform a literature review of toxicity information for the toxicity of each COPEC, and apply the appropriate uncertainty factors or other approved methods (*e.g.*, allometric scaling) to derive the corresponding ERfD values. See chapter 4 of DERR ECO Guidance.

C. Risk Characterization

Risk characterization estimates the potential hazards to endpoint species under a specific set of circumstances. Risk characterization involves a quantitative and, when necessary, qualitative estimation of potential harm and includes a narrative description of the harm.

1. For all quantitative assessments, hazard is assessed with the use of a quotient methodology. The environmental hazard quotient (EHQ) = (exposure point concentration) (EPC) (*i.e.*, dose or medium concentration as appropriate) / ERfD. An environmental hazard index (EHI) is derived by summing all appropriate EHQs per receptor (EHI = ΣEHQ).

2. Hazard description is a qualitative narrative of the potential hazards presented by the Site and includes a discussion of any toxicological and ecological factors beyond those embodied in the quantitative estimates (*e.g.*, COPECs without toxicity data). Hazards must be described for each COPEC-pathway-receptor combination and each assessment endpoint.

3. Uncertainty Analysis

The uncertainty analysis summarizes assumptions made for each element of the assessment, evaluates their validity, strengths and weaknesses of the analyses, and quantifies to the extent possible the uncertainties associated with each potential hazard. Both qualitative and quantitative assessment results shall be described and discussed. If additional data or more certainty in the assessment process or results is needed, Respondent shall conduct a field-baseline ERA (Level IV).

D. Respondent shall propose one of the following decisions based on the results of the Level II Screening ERA:

1. Unacceptable actual or potential hazards identified (*e.g.*, concentrations above screening levels and/or surface waters fail to meet Water Quality Standards), ERA completed;

2. Continued evaluation (Level IV Field-Baseline ERA), or

3. No unacceptable actual or potential hazard identified (*e.g.*, concentrations below screening levels and surface waters meet Water Quality Standards), ERA completed.

E. Summarize the completed risk assessment and the decision for additional risk assessment if warranted.

Specific requirements for conducting the Level III Baseline ERA are further described in Chapter 4 of the DERR ECO Guidance. At the conclusion of the Level III Baseline ERA, Respondent shall submit for review and approval a Level III Baseline ERA Report consistent with Chapter 4 of the DERR ECO Guidance. If the approved Level III Baseline ERA Report concludes that performance of a Level IV Field-Baseline ERA is appropriate, Respondent shall submit for review and approval an addendum to the RI/FS Work Plan and supporting documents, including a revised RI/FS project schedule, describing in detail all tasks necessary to conduct the Level IV Filed-Baseline ERA.

IV. Level IV Field-Baseline ERA

A. If the approved Level III Baseline ERA concludes that additional assessment is necessary, Respondent shall complete a Level IV Field-Baseline ERA consistent with the requirements of Chapter 5 of the DERR ECO Guidance. The objective of the Level IV Field-Baseline ERA is to quantify, based on field observations, potential adverse impacts to populations of representative species based on the hazard calculations developed in the Level III Baseline ERA. Respondent shall evaluate the information generated during the Level IV Field-Baseline ERA as additional lines of evidence to support a more robust weight-of-evidence conclusion regarding the potential adverse effects identified and quantified in the Level III Baseline ERA. Given the nature of field measurements, it should be noted that results from the Level IV Field-Baseline ERA are likely to be less than definitive in the identification of actual adverse ecological impact(s). Field-baseline assessments may consist of but are not limited to the following methods:

1. Tissue analysis/bioaccumulation studies;

2. Population/community assays (using appropriate reference sites);

3. Laboratory Toxicity tests (bioassays); and

4. In situ Toxicity Tests.

B. At the conclusion of the level IV Field-Baseline ERA, propose one of the following decisions based on the results:

1. Unacceptable hazards identified (*e.g.*, concentrations above screening levels and/or surface waters fail to meet Water Quality Standards), ERA completed; or

2. No unacceptable hazard identified (*e.g.*, concentrations below screening levels and surface waters meet Water Quality Standards); ERA completed.

C. Respondent shall summarize the completed risk assessment and the decision for additional risk assessment if warranted.

D. Specific requirements for conducting the Level IV Field-Baseline ERA are further described in Chapter 5 of the DERR ECO Guidance. At the conclusion of the Level IV Field-Baseline ERA, Respondent shall submit for review and approval a Level IV Field-Baseline ERA Report consistent with Chapter 5 of the DERR ECO Guidance.

V. Final ERA Report(s)

Respondent shall include all approved ERA Report(s) in the RI Report. Respondent shall ensure that the ERA Report for the highest level of ERA completed also contains all of the information necessary to evaluate the environmental impact of proposed remedial alternatives in the FS. Format for the RI Report is provided below, in Appendix J of this SOW.

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Appendix J

I. Draft RI Report Format

A. RI Report Format

The RI Report shall organized as follows:

Executive Summary

1. Introduction

2. Purpose of the Report

3 Site Background

   a. Site Description
   b. Site History
   c. Previous Investigations
   d. Previous Emergency or Interim Actions

4. Report Organization

B. Study Area Investigation

1. Includes field activities associated with site characterization, including as appropriate physical and chemical monitoring of the following:

   a. Surface Features (*e.g.;* topographic mapping, natural and manmade features)
   b. Contaminant Source Investigations
   c. Meteorological Investigations
   d. Surface-water and Sediment Investigations
   e. Geological Investigations
   f. Soil and Vadose Zone Investigations
   g. Ground water Investigations
   h. Human Population Surveys
   i. Ecological Investigations

2. Interim Technical Memoranda related to field investigations as revised by Ohio EPA comments, if any, shall be included in an appendix and summarized in this section.

C. Physical Characteristics of the Study Area

1. Includes the results of field activities to determine physical characteristics, including as appropriate the following:

   a. Surface Features
   b. Meteorology
   c. Surface water hydrology
   d. Geology
   e. Soils
   f. Hydrogeology
   g. Demography and Land use
   h. Ecology

D. Nature and Extent of Contamination

1. Presents the results of site characterization, both natural and chemical components and contaminants as appropriate in the following media:

   a. Sources (*e.g.;* lagoons, sludges, tanks)
   b. Soils and Vadose Zone
   c. Ground Water
   d. Surface Water and Sediments
   e. Air
   f. Subsurface Gases

E. Contaminant Fate and Transport

1. Potential Routes of Migration (*e.g.;* air, ground water, soils)

2. Contaminant Persistence

   a. As applicable, describe estimated persistence in the study area environment and physical, chemical, and/or biological factors of importance for the media of interest.

3. Contaminant Migration

a. Discuss factors affecting contaminant migration for the media of interest (e.g.; sorption onto soils, solubility in water, movement of ground water, etc.).
b. Discuss modeling methods and results if applicable.

F. Baseline Risk Assessments

1. Human Health Risk Assessment

a. Exposure Assessment
b. Toxicity Assessment
c. Risk Characterization

2. Final Ecological Risk Assessment

a. Level I Scoping ERA Report (included in PER)
b. Level II Screening ERA Report (if required)
c. Level III Baseline ERA Report (if required)
d. Level IV Field-Baseline ERA Report (if required)

G. Site-Specific PRGs

1. Site-specific PRGs for protection of human health

2. Site-Specific PRGs for protection of ecological receptors

H. Summary and Conclusions

1. Summary

a. Nature and Extent of Contamination
b. Fate and transport
c. Risk Assessment

2. Conclusions

a. Data Limitations and Recommendations for Future Work
b. Revised Remedial Action Objectives

I. References

J. Tables and Figures
(At least one set of figures shall be no larger than 11" x 17")

K. Appendices

1. Log Books
2. Soil Boring Logs
3. Test Pit/Trenching Logs
4. Soil Gas Probe Construction Diagrams
5. Monitoring Well Construction Diagrams
6. Sample Collection Logs
7. Private and public Well Records
8. Technical Memoranda on Field Activities
9. Analytical Data and QA/QC Evaluation Results
10. Human Health Risk Assessment Information
11. Detailed Modeling Reports

Appendix K

Development and Screening of Remedial Alternatives

Respondent shall develop and screen remedial alternatives to arrive at an appropriate range of waste management options for detailed analysis. The range of alternatives shall include: a) options in which treatment is used to reduce the toxicity, mobility, or volume of wastes, but varying in the types of treatment, the amount treated, and the manner in which long-term residuals or untreated wastes are managed; b) options involving containment with little or no treatment; c) options involving both treatment and containment; and d) a no-action alternative. The following activities are to be performed by Respondent during the development and screening of remedial alternatives.

I. Technologies Screening (Section 4.2.2 through 4.2.5.3 of the U.S. EPA RI/FS Guidance)

A. Develop General Response Actions (U.S. EPA RI/FS Guidance 4.2.2)

Respondent shall refine the general response actions initially identified during project scoping. General response actions shall be identified for each medium of interest, describing containment, treatment, excavation, pumping, or other actions, singly or in combination, to satisfy the RAOs.

B. Identify Areas and/or Volumes of Media (U.S. EPA RI/FS Guidance 4.2.3)

Respondent shall identify areas or volumes of media to which general response actions may apply, taking into account requirements for protectiveness as identified in the RAOs, site conditions, and the nature and extent of contamination (Section 4.2.3 of the U.S. EPA RI/FS Guidance).

C. Identify, Screen, and Document Remedial Technologies (U.S. EPA RI/FS Guidance 4.2.4)

Respondent shall identify, screen and evaluate remedial technologies applicable to each general response action to eliminate those that cannot be technically implemented at the Site based on contaminant types and concentrations and/or site characteristics. Decisions made during the remedial technology screening shall be documented for inclusion in the Alternatives Array Document.

D. Evaluate and Document Process Options (U.S. EPA RI/FS Guidance 4.2.5)

Process options for each surviving technology type shall be identified and evaluated on the basis of effectiveness, implementability, and cost as those criteria are defined in Section 4.2.5 of the U.S. EPA RI/FS Guidance. Respondent shall select and retain, wherever possible, one or more representative process options for each implementable technology type. The evaluation should focus on effectiveness factors at this stage with less effort directed at the implementability and cost factors. Identifying and screening process options shall be documented for inclusion in the Alternatives Array Document described under 7.1.5 below. Respondent shall consider the NCP's preference for treatment over conventional containment or land disposal approaches.

II. Alternatives Array (U.S. EPA RI/FS Guidance 4.2.6)

Respondent shall submit for review and comment an AAD consisting of the following:

A. Assemble and Document Alternatives

Respondent shall assemble the selected representative technologies into remedial alternatives. Each alternative should comprehensively address the site-specific PRGs, RAOs, and ARARs. A range of remedial alternatives shall be developed which include combinations of treatment and containment technologies that will address the Site as a whole. Each alternative shall describe the locations of the Site affected; approximate volumes of media to be removed or treated; and any other information needed to adequately describe the alternative and document the logic behind each specific remedial alternative.

B. Conduct and Document the Screening Evaluation of Each Alternative

Respondent may perform, or Ohio EPA may require, that the assembled alternatives undergo a screening process based on short and long term aspects of effectiveness, implementability, and relative cost as those criteria are defined in Section 4.3 of the U.S. EPA RI/FS Guidance. Screening of the alternatives is generally performed when there are many feasible alternatives available for detailed analysis. The screening may be

conducted to assure that only those alternatives with the most favorable composite evaluation of all factors are retained for further analysis, while at the same time preserving an appropriate range of remedial options. Prior to conducting a screening of alternatives, Respondent shall further define the alternatives such that design considerations for technologies, remediation time frames, interactions among media, and site-wide protectiveness aspects of the alternatives are described (ability of the alternative to satisfy all of the RAOs). The purpose shall be to ensure that a basis exists for evaluating and comparing the alternatives before proceeding with the alternative screening step (Section 4.3.1 of the U.S. EPA RI/FS Guidance).

The screening shall preserve the range of treatment and containment alternatives that was initially developed. The range of remaining alternatives shall include options that use treatment technologies and permanent solutions to the maximum extent practicable and minimize inter-media transfer of contaminants. Chemical and physical characterization of the Site shall also be considered by identifying relationships between source areas with ongoing releases and the media affected by the release. Where interactions among media appear to be important, the effect of source control actions on remediation levels or time frames for other media should be evaluated. Respondent shall prepare a summary of the assembled remedial alternatives and their related ARARs, and provide the reasoning employed in the alternative screening. The alternatives summary will be submitted with the Alternatives Array Document.

III. Post-screening Considerations

A. At the conclusion of the alternative screening phase, or if no screening is needed, Respondent shall determine if the amount and type of data existing for the Site will support the detailed analysis of the surviving remedial alternatives (Section 4.3.3.3 of the U.S. EPA RI/FS Guidance). Specifically, Respondent shall consider whether any additional field investigation or treatability testing is necessary prior to proceeding with the detailed analysis of alternatives. If Respondent determines that additional site data or treatability testing is needed, Respondent shall document the determination, the specific types of data needed; and the time frame for obtaining the data in the AAD. If Ohio EPA concurs with Respondent's determinations, Respondent shall submit for review and approval an addendum to the RI/FS Work Plan and supporting documents and/or a

treatability study work plan for obtaining the additional data. Should Ohio EPA determine, based on review of the AAD, that additional data is needed to perform the detailed analysis of alternatives, Ohio EPA shall notify Respondent of the need for additional data, and Respondent shall submit for review and approval an addendum to the RI/FS Work Plan and supporting documents and/or a Treatability Study Work Plan to obtain the additional data.

Appendix L

Treatability Studies

Treatability Study Work Plan

If the need for treatability studies arises during the conduct of the RI/FS , Respondent shall submit for review and approval a Treatability Study Work Plan prepared in a manner consistent with U.S. EPA's *Guidance for Conducting Treatability Studies Under CERCLA*, EPA/540/R-92/071a, October, 1992 (Treatability Study Guidance). The Treatability Study Work Plan may incorporate by reference approved portions of the RI/FS Work Plan and supporting documents.

I. Data Quality Objectives (Section 3.2 of the Treatability Study Guidance)

Respondent shall establish DQOs for the treatability study and incorporate them into the Treatability Study Work Plan, the study design, the FSP, and the QAPP.

II. The Treatability Study Work Plan shall address the following elements:

A. Project Description

Respondent shall provide background information on the Site and summarize existing waste characterization data (matrix type and characteristics and the concentrations and distribution of the contaminants of concern). Respondent shall also specify the type of study to be conducted, *i.e.*, remedy screening; remedy selection testing; or remedy implementation.

B. Treatment Technology Description

Respondent shall briefly describe the treatment technology to be tested. Respondent may include a flow diagram showing the input stream, the output stream, and any side-streams generated as a result of the treatment process. Respondent shall also include a description of the pre- and post treatment requirements.

C. Test Objectives

Respondent shall define the objectives of the treatability study and the intended use of the data (*i.e.*, to determine potential feasibility; to develop

performance or cost data for remedy selection; or to provide detailed design, cost and performance data for implementation. Respondent shall include performance goals that are based on established cleanup criteria for the Site or, where such criteria do not exist, on contaminant levels that are protective of human health and the environment.

D. Experimental Design and Procedures

For any experimental design, Respondent shall identify the tier and the scale of the testing, the volume of waste material to be tested, the critical parameters, and the type and amount of replication. For the design of the experiment, Respondent must consider the DQOs and the costs associated with replication. Respondent shall describe the specific steps involved in the performance of the treatability study in the standard operating procedures (SOPs). The SOPs should be sufficiently detailed to allow the laboratory or field technician conducting the test to operate the equipment and to collect the samples.

E. Equipment and Materials

Respondent shall list the equipment, materials, and reagents that will be used in the performance of the treatability study, including quantity, volume/capacity, calibration or scale, equipment manufacturer and model numbers, and reagent grades and concentrations.

F. FSP and QAPP

Respondent shall describe how the existing FSP (Section 2.2 and Appendix B of this SOW) and QAPP (Section 2.3 and Appendix C of this SOW) shall be modified or amended to address field sampling, waste characterization, and sampling and analysis activities in support of the treatability study. Respondent shall describe the kinds of samples that will be collected and specify the level of QA/QC required.

G. Data Management

Respondent shall describe the procedures for recording observations and raw data in the field or laboratory. If proprietary processes are involved, Respondent shall describe how confidential information will be handled.

H. Data Analysis and Interpretation

Respondent shall describe the procedures for analyzing and interpreting data from the treatability study, including methods of data presentation and statistical evaluation.

I. Health and Safety Plan (HASP)

Respondent shall describe how the existing HASP (Section 2.4 and Appendix D of this SOW) shall be modified or amended to address the hazards associated with treatability testing.

J. Residuals Management

Respondent shall describe the management of treatability study residuals. Respondent should include estimates of both the types and quantities of residuals expected to be generated during treatability testing based on the treatment technology and the experimental design. Respondent shall also outline how treatability study residuals will be analyzed to determine if they are hazardous wastes and discuss how such wastes will be managed.

K. Reports

Respondent shall describe the preparation of interim and final reports documenting the results of the treatability study. For treatability studies involving more than one tier of testing, Respondent shall provide interim reports, which provide a means of determining whether to proceed to the next tier. Respondent shall also describe how the existing monthly progress reports (Section 11 of this SOW) shall be modified or amended to include reporting of treatability study progress.

L. Schedule

Respondent shall include a comprehensive treatability study project schedule indicating critical path dependencies and including dates for the initiation, duration, and completion of each treatability study task. The schedule shall also include field work and development and submittal of required deliverables. To the extent that the performance of the treatability study will impact the RI/FS project schedule (Section 2 of this SOW), Respondent shall submit a revised RI/FS project schedule for review and approval concurrent with the Treatability Study Work Plan.

III. Treatability Study Report Format (Section 3.12 of the Treatability Study Guidance)

Upon completion of the treatability study(ies), Respondent shall submit for review and approval a Treatability Study Report. The report shall be organized as follows:

A. Introduction

1. Site Description

a. Site Name and Location
b. History of Operations
c. Prior Removal and Remediation Activities

2. Waste Stream Description

a. Waste Matrices
b. Pollutants/Chemicals

3. Treatment Technology Description

a. Treatment Process and Scale
b. Operating Features
c. Treatment Residuals Management

4. Previous Treatability Studies at the Site

B. Conclusions and Recommendations

1. Conclusions

2. Recommendations

C. Treatability Study Approach

1. Test Objectives and Rationale

2. Experimental Design and Procedures

3. Equipment and Materials

4. Sampling and Analysis

a. Waste stream
b. Treatment Process

5. Data Management

6. Deviations from the Work Plan

D. Results and Discussion

1. Data Analysis and Interpretation

a. Analysis of Waste Stream Characteristics
b. Analysis of Treatability Study Data
c. Comparison to Test Objectives

2. Quality Assurance/Quality Control

3. Costs/Schedule for Performing the Treatability Study

4. Key contacts

References

Appendices

A. Data Summaries

B. Standard Operating Procedures

Contents

Appendix M

Feasibility Study (FS) Report

The FS Report consists of the revised AAD and the detailed analysis of the remedial alternatives surviving screening in the revised AAD. The detailed analysis of remedial alternatives shall consist of the following elements:

I. Detailed Description of Each Alternative (U.S. EPA RI/FS Guidance Sections 6.2.1 to 6.2.4)

The detailed narrative description of each alternative shall include at a minimum:

A. Description of each technology component;

B. Refinement of the volumes and/or areas of contaminated media to be addressed;

C. Special engineering considerations required to implement the alternative, *(e.g.*, pilot treatment facility or additional studies needed to proceed with final remedial design);

D. Operation, maintenance and monitoring requirements;

E. Temporary storage requirements;

F. Health and safety requirements related to implementation and operation and maintenance of the alternative, including on- and off-site (site worker and general public) health and safety considerations;

G. An analysis of how the alternative could be phased into individual operations and a discussion of how these operations could best be implemented to produce significant environmental improvement;

H. A review of any off-site treatment or disposal facilities and transportation needs to ensure compliance with the Resource Conservation and Recovery Act, TSCA, and state requirements; and

I. An analysis of the projected performance and expected results of the alternative with emphasis on potential for further future release of hazardous substances.

II. Environmental Impact of alternatives

Respondent shall conduct an assessment of the environmental impact of each alternative, including the impacts of residual contamination and the impact of physical/habitat alterations (*e.g.,* loss of wetlands or riparian habitat due to filling or grading, destruction of benthic substrate, nesting areas). The assessment shall include a discussion of methods for mitigating identified environmental impacts. The environmental impact of each alternative shall then be assessed relative to the other alternatives under consideration.

III. Apply the Eight Criteria and Document the Individual Alternative Analysis

Respondent shall apply the eight evaluation criteria described below to each individual alternative. Respondent shall document the decision making process and the results of the individual analysis of alternatives.

A. Overall Protection of Human Health and the Environment.

Respondent shall assess the alternatives to determine if they can adequately protect human health and the environment from unacceptable risks posed by hazardous substances, pollutants or contaminants present at the Site by eliminating, reducing or controlling exposures to levels established during development of remediation goals. This is a threshold requirement and the primary objective of the remediation program.

B. Compliance with Applicable or Relevant and Appropriate Requirements.

Respondent shall assess the alternatives to determine if they attain applicable or relevant and appropriate standards, criteria and requirements of federal, state, and local laws. This is also a threshold requirement.

C. Long-term Effectiveness and Permanence.

Respondent shall assess the alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered include the following:

1. Nature and magnitude of residual risk; potential for exposure of human and environmental receptors; concentrations of hazardous substances, pollutants or contaminants remaining after implementing the remedial alternative, considering the persistence,

toxicity, mobility and propensity to bio-accumulate such hazardous substances and their constituents (see RAGS Part C);

2. The type, degree and adequacy of long-term management required for untreated substances and treatment residuals, including engineering controls (such as containment technologies), institutional controls, monitoring and operation and maintenance;

3. Long-term reliability of the engineering and institutional controls, including uncertainties associated with land disposal of untreated hazardous substances, pollutants, contaminants, and treatment residuals, and;

4. Potential need for replacement of the remedy, and the continuing need for repairs to maintain the performance of the remedy.

D. Reduction of Toxicity, Mobility or Volume Through Treatment

Respondent shall assess the degree to which alternatives employ treatment that reduces toxicity, mobility or volume of contaminants. Respondent shall identify alternatives which, at a minimum, address the principal threats posed by the Site through treatment. Factors that shall be considered include the following:

1. The treatment or recycling processes the alternatives employ and materials they will treat;

2. The amount of hazardous substances, pollutants or contaminants that will be destroyed, treated, or recycled;

3. The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment or recycling and the specifications of which reduction(s) are occurring;

4. The degree to which the treatment is irreversible;

5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility and propensity to bio-accumulate;

6. The degree to which treatment will reduce the inherent hazards posed by the principal threats at the Site; and

7. The degree to which the treatment processes employed reduce the transfer of contaminants between environmental media.

E. Short-term Effectiveness

Respondent shall assess the short-term impacts of the alternatives during the construction and implementation phase, and until the objectives of the remedial action have been met. Factors that shall be considered include the following:

1. Short-term risks that may be posed to the community during construction and implementation of an alternative and until the RAOs have been met;

2. Potential impacts on workers during remedial action and with the objectives of remedial action have been met, the effectiveness and reliability of protective measures;

3. Potential environmental impacts that may result from the remedial action and the effectiveness and reliability of mitigative measures during implementation and until the objectives of the remedial action have been met; and

4. Time until response action objectives are achieved.

F. Implementability.

Respondent shall assess the technical and administrative feasibility of implementing the alternatives. Factors that shall be considered include the following:

1. Technical Feasibility:

   a. Degree of difficulty or uncertainty associated with construction and operation of the alternative;

   b. Expected operational reliability of the alternative;

   c. Ease of undertaking additional remedial action(s); and

   d. Ability to monitor the effectiveness of the remedy.

2. Administrative Feasibility:

   a. Activities needed to coordinate implementation of the remedy with state, local, and federal agencies (*e.g.*, obtaining necessary approvals and permits; right-of-way for construction) and the feasibility of obtaining needed permits; and

   b. Likelihood of property owner to enter into an environmental covenant.

3. Feasibility of Obtaining Services and Materials:

   a. Capacity and location of adequate treatment, storage, and disposal services;

   b. Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources;

   c. Availability of services and materials; and

   d. Availability of prospective technologies

G. Cost

The types of costs that shall be assessed include the following:

1. Direct and indirect capital costs, including contingency and engineering fees;

2. Annual operation and maintenance costs; and

3. Net present value of capital and O&M costs.

H. Community Acceptance.

This criteria is addressed by Ohio EPA throughout the conduct of the RI/FS and during the public comment period for the Preferred Plan by determining which components of the alternatives local government and other interested persons in the community support, have reservations about, or oppose. The assessment of community acceptance of the

preferred remedy is conducted exclusively by Ohio EPA and is not part of this SOW or the Orders.

IV. Compare Alternatives Against Each Other and Document the Comparison of Alternatives (U.S. EPA RI/FS Guidance Sections 6.2.5 and 6.2.6)

At the conclusion of the individual analysis of alternatives, Respondent shall perform a comparative analysis between the alternatives. That is, each alternative will be compared against the others using the eight evaluation criteria as a basis of comparison. Respondent shall document the decision making process and the results of the comparative analysis of alternatives for inclusion in the FS.

Contents

Appendix N

RI/FS Submittals

1) Pre-investigation Evaluation Report (PER)

1) RI/FS Work Plan and Supporting Documents
   - Field Sampling Plan (FSP)
   - Quality Assurance Project Plan (QAPP)
   - Health and Safety Plan (HASP)

3) Human Health Risk Assessment Assumptions Document (RAAD)

4) ERA Report(s) (as may be required)
   - Level I ERA Report
   - Level II ERA Report
   - Level III ERA Report
   - Level IV ERA Report

5) Remedial Investigation Report (RI Report)

6) Refined Remedial Action Objectives ITM

7) Alternatives Array Document (AAD)

8) Feasibility Study Report (FS Report)

9) Interim Technical Memoranda (as may be required)

10) Treatability Study Work Plan (as may be required)

11) Interim Action Work Plan (Addendum to RI/FS Work Plan; as may be required)

12) Other addendum(s) to the RI/FS Work Plan and Supporting Documents (as may be required)

13) Monthly Progress Reports

Appendix O

Acronym List

AAD	Alternatives Array Document
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
BOD	Biological Oxygen Demand
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPEC	Chemical of Potential Ecological Concern
CSM	Conceptual Site Model
DQOs	Data Quality Objectives
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ERfD	Ecological Reference Dose
EHI	Ecological Hazard Index
EHQ	Ecological Hazard Quotient
FS	Feasibility Study
FSP	Field Sampling Plan
HHRA	Human Health Risk Assessment

HASP	Health and Safety Plan
HI	Hazard Index
HQ	Hazard Quotient
ITM	Interim Technical Memoranda
NCP	National Contingency Plan, Final Rule (40 CFR Part 300)
NPDES	National Pollution Discharge Elimination System
Ohio EPA	Ohio Environmental Protection Agency
O&M	Operation and Maintenance
Orders	Director's Final Findings and Orders
PDF	Portable Document Format
PER	Preinvestigation Evaluation Report
PRGs	Preliminary Remediation Goals
QAPP	Quality Assurance Project Plan
QA/QC	Qaulity Assurance/Quality Control
RAAD	Risk Assessment Assumptions Document
RAGS	Risk Assessment Guidance for Superfund
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation

RI/FS	Remedial Investigation/Feasibility Study
SCS	Soil Conservation Service
SF	Slope Factor
SOP	Standard Operating Procedure
SOW	Statement of Work
TBC	To Be Considered criteria
TOC	Total Organic Carbon
TSCA	Toxic Substances Control Act
U.S. ACE	United States Army Corps of Engineers
U.S. EPA	United States Environmental Protection Agency