QUALITY CONTROL PLAN
for
HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS: RESERVOIR NO. 2 BURNING GROUND
At the
FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

Final

Prepared for:

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1.0 INTRODUCTION

This Quality Control Plan (QCP) has been prepared for the U.S. Army Corps of Engineers- Nashville District (CELRN). CELRN has contracted with Jacobs Engineering Group Inc. (Jacobs) to conduct a Remedial Investigation (RI), Part 1,Reservoir No. 2 Burning Ground (2BG) located within the National Aeronautics and Space Administration (NASA) Plum Brook Station (PBS) in Sandusky, Ohio. PBS is part of the John Glenn Research Center at Lewis Field (GRC). Formerly at PBS, the Department of Defense (DOD) operated the Plum Brook Ordnance Works (PBOW) from 1941 to 1945 as a manufacturing plant for trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite.

In general, this Task Order addresses a baseline human health and screening level ecological risk assessments of the Reservoir No. 2 Burning Ground (2BG), where the burning of TNT, sodium, and other waste materials is believed to have occurred during the operation of PBOW. An initial investigation performed in 1996 by International Technology (IT) confirmed the presence of toluene, PAHs, metals, and nitro-aromatics at the site. An RI was performed in 2004 and 2005 by Jacobs Engineering (Jacobs) to further characterize soil contamination and to evaluate groundwater, surface water, and sediment. This risk assessment will evaluate the risks to human health and the environment based on data collected during the SI and RI.

This QCP will be used as guidance during the entire project. The purpose of the QCP is to assure delivery of a quality product and to document the critical project decisions during development of the project documents so they can be monitored by the CELRN. The QCP will be updated as necessary during the course of the project to account for changing project needs.

The following sections include the listed items:

Section 2.0 **SCOPE OF WORK** includes a clear description of the task(s).

Section 3.0 **QCP TEAM** includes: (1) the composition of the QCP team; (2) Jacobs personnel, qualifications and responsibilities; and (3) the composition of an independent review team.

Section 4.0 **SCHEDULE OF WORK** includes: (1) a schedule for an interim review of the QCP and the various plans and reports; and (2) a schedule for an independent review of the various plans and reports.

Section 5.0 **PROVISIONS FOR TECHNICAL CHECKS** includes: (1) a technical review checklist; (2) a general review checklist; and (3) the identification of quality indicators.

Section 6.0 **DOCUMENTATION OF PROJECT DECISIONS** includes such documents as meeting minutes and records of important telephone calls.

Section 7.0 **PROJECT CLOSEOUT** includes provisions concerning closeout of the project. Lessons learned and a final product verification are subjects of the close-out activities.

The QCP presents direction, purpose, and responsibilities for personnel assigned specific jobs, such as Client Project Manager (Technical Coordinator) and Contractor Project Manager. Recognized responsibilities will facilitate the success of fulfilling job responsibility and job accomplishment.

1.1 CLIENT INVOLVEMENT

Jacobs' direct client is the United States Army Corps of Engineers-Nashville District (CELRN). OEPA is the regulatory agency for PBOW. Client and regulatory agency involvement will be an important part of the success of this project. Client and regulatory agency responsibilities include, among others imposed by law, regulation, or the contract documents, the following:

- Full and complete disclosure of facts
- Provision of project funding
- Enhancement of communications
- Establishment of reasonable and attainable requirements
- Delegation or assignment of decision-making appropriately and support of that authority
- Being realistic in assumption of risks and liabilities
- Demanding quality projects
- Making timely decisions
- Allowing adequate time for good performance
- Allowing freedom for innovation

- Exercising financial responsibility and making timely payment

1.2 OVERALL MANAGEMENT APPROACH

USACE Huntington District (CELRH) is the primary point of contact with the regulatory agency but has designated the CELRN Technical Team to review the project reports for completeness and technical accuracy. Following this review, Jacobs will submit these documents to the OEPA and NASA. It is understood that the CELRN Project Technical Team will also monitor project performance.

The organizational structure for project activities reflects the relationship previously described between PBOW and the consulting team of CELRN, CELRH, and Jacobs who are responsible for planning, controlling, and executing the project tasks. The project organizational structure is designed to accommodate delineated task assignments and can be adjusted in response to changing project needs. The Project Management Control Process section of the Work Plan for the risk assessment should be referenced for the detailed project organization and field personnel assignments.

1.3 JACOBS' QUALITY PROCESS

Jacobs' Quality System is based upon four fundamental elements:

1. The continuous elevation of quality consciousness throughout Jacobs and the involvement of personnel at all levels in the pursuit of continuous quality improvement.

2. The implementation of strategic planning for quality improvement.

3. The ongoing assessment of client expectations for quality and of client satisfaction with Jacobs deliverables and services.

4. The constant and uniform application of Quality Control procedures based upon requirements derived from both service standards as well as project specific criteria.

Jacobs' Quality System Manual (QSM) is the principal document of Jacobs' internal QC processes and provides the policies, procedures, and roles and responsibilities of individuals. Project specific quality planning documents are also required for each project. These include:

- Project Execution Plan (PEP) – The PEP is developed by the Project Manager at the initiation of the project and provides the project team with a clear, concise team organization, schedule, scope of work, and detailed administrative procedures for execution of the project.
- Client Expectation Survey – This process explores and documents the parameters, deliverables, and methods of performance that will meet the objectives of our client, CELRN.

1.4 INDEPENDENT TECHNICAL REVIEW

Jacobs will conduct an independent technical review (ITR) of all documents generated during the execution of this Task Order. These internal reviews will be performed by peers of the author prior to submission of the document to the CELRN and other reviewing agencies. A Certification of Independent Technical Review will be signed by each of the reviewers as well as the Jacobs Program Manager. The independent technical reviewers will issue comments on the document and the author will include these comments as appropriate.

1.5 ADDITIONAL QA WITH DrCHECKS

DrChecks (Design Review and Checking System, a web-based system developed by the Corps of Engineers) will be used to document and track all comments and responses regarding the Internal Technical Review (ITR) performed by Jacobs and Quality Assurance (QA) reviews performed by the customer, regulators, Corps and any other reviewers. It is Jacobs' responsibility to enter all non-CELRN comments and responses into the DrChecks system.

The Nashville District Engineering-Construction Division's Quality Manager (EC-QM) administers DrChecks locally. The DrChecks system has three categories of users - the designer, the reviewer, and the manager.

Jacobs' Project Manager, Al Hardesty, will coordinate with CELRN's Technical Coordinator, Ms. Kathy McClanahan, and request a project or review be added to DrChecks. At this time, the Project Manager will identify persons assigned to the project as designers and reviewers, the project start and completion dates, the type of review, and the start and stop dates of the review.

1.6 PROBLEM RESOLUTION

Problems pertaining to any aspect of the project will be addressed using the following guidelines.

- Identify quality problems.
- Propose recommendations for resolving quality problems.
- Independently confirm implementation and effectiveness of solutions.
- Provide documented assurance to management that, when problems are identified, further work performed is monitored carefully until the problems are suitably resolved.
- Identify and cite noteworthy practices that may be shared with others to improve the quality of their operations and products.

Any member of the project team can initiate the problem solving process. However, all quality problems will be brought to the attention of the CELRN Technical Coordinator. The quality problem and recommended solutions should be discussed in a meeting and/or phone conversation with all project personnel present.

2.0 SCOPE OF WORK

This project consists of preparing work plans for a Baseline Human Health Risk Assessment (BHHRA) and a Screening Level Ecological Risk Assessment (SLERA), conducting the risk assessments, and preparing final risk reports. These risk assessments are warranted based on the results from the site investigations performed in 1996 and results from the remedial investigation performed in 2004 and 2005. These results will be used to calculate risks to human health and the environment.

The overall methodology for human health risk assessment will be based on current risk guidance, policy, documentation and agreements as recommended by the OEPA, USEPA, and USACE. The AE shall incorporate methodology and information as described in documentation used for conducting the Acid Area 2 & 3 risk assessments.

A previous investigation (IT 1996) concluded that some contamination was present within 2BG and that further definition of the extent and concentrations were warranted. Contaminants in soil include dioxins/furans, PCBs, explosives, PAHs, and metals.

All work will be in accordance to the SOW in CELRN contract number DACW62-03-D-0004, Delivery Order Number 8 (6 December 2007), hereafter referred as CELRN Delivery No. 8.

As part of the risk assessment, Jacobs will be conducting the following services described below as tasks:

Task 1: Preparation and Submittal of Quality Control Plan (QCP);
Task 2: Prepare Baseline Human Health and Screening Level Ecological Risk Assessment Work Plans;
Task 3: Human Health Risk Assessment;
Task 4: Ecological Risk Assessment;
Task 5: Risk Assessment Submittals;
Task 6: Meetings;
Task 7: Project Management.

2.1 PLANNING DOCUMENTS

Tasks 1 and 2 are performed in the planning phase of the project. These tasks include a preparation and submittal of a QCP (Task 1), preparation and submittal of the Baseline Human Health and Screening Level Ecological Risk Assessment Work Plans (Task 2).

2.1.1 Task 1 – Completion of a Quality Control Plan

This QCP has been prepared according to CEORD 1110-1-9 *Quality Control* and ER 1110-1-12 *Quality Management* for this scope of work. The purpose of the QCP is to establish procedures and responsibilities within the Jacobs organization to assure delivery of a quality product and to document the critical project decisions and developments so they can be monitored by CELRN. The Draft QCP will become final upon its acceptance by CELRN. The QCP shall be updated as necessary during the course of the project to account for changing project needs. The QCP shall include, but not be limited to:

- A clear definition of the task(s)
- Identification of the functional team that will develop the required project documents including the SSHP, SAP, Remedial Investigation Report and the Quarterly Groundwater Monitoring Reports.
- A discussion of customer involvement
- An interim document review schedule
- Identification of the independent review team
- The schedule for independent review
- Checklists
- Provisions for technical checks
- Meeting schedule
- Identification of quality indicators
- Documentation of project decisions, including minutes of meetings and records of important telephone calls

2.1.2 Task 2 – Preparation and Submittal of the Baseline Human Health and Screening Level Ecological Risk Assessment Work Plans

Jacobs will summarize information about the PBOW site background and history, characteristics for Reservoir No. 2 Burning Ground. Jacobs will provide a detailed approach in completing both human health and ecological risk assessments that satisfies regulatory and USACE requirements. The work plan will include detailed methodology and algorithms for subtasks of a human health risk assessment including, but not limited to, data evaluation, selection of chemicals of potential concern, exposure assessment, toxicity assessment, risk characterization, uncertainty analysis, preliminary risk-based remediation concentrations, conclusions, recommendation, and findings reporting. The work plan will include detailed methodology and algorithms for subtasks of a screening level ecological risk assessment including, but not limited to, problem formulation, chemical of potential ecological concern screening, exposure assessment, ecological effects assessment, risk characterization, uncertainty analysis, conclusions, recommendations and findings reporting. The work plans for human health and ecological risk assessments will be in one volume, but under separate sections.

The work plans for 2BG shall be of comparable quality, layout and content as the Baseline Risk Assessment Work plans for Acid Areas 2 & 3, Plum Brook Ordnance Works, Sandusky, OH (April, 2007). Jacobs will prepare a Human Health Risk Assessment Work Plan and an

Ecological Risk Assessment Work Plan, and these shall be separate sections in one volume of work plans.

Jacobs will submit an internal draft, draft, and final version of this plan. The internal draft version shall be submitted to CELRN for review. Jacobs will be responsible for revising the plan as per CELRN comments before a draft version is submitted to all reviewing parties, USACE, RAB, NASA, OEPA, HTRW-CX and CHPPM. Jacobs will be responsible for revising the plan as per all agency comments. Jacobs will assume two conference calls with the reviewing agencies for comment resolution, and the will be responsible for conference call capability and execution. Work plans will not be finalized until all agencies provide concurrence or acceptance of the work plans, and response to comments. Jacobs will submit official response to comments to CELRN, and attach as an appendix, accepted responses to comments in the final version of the work plans. At least one electronic version of the final work plans in the entirety shall be submitted to CELRN for file as well as the official hard copies.

2.2 TASK 3 - Human Health Risk Assessment

Jacobs will complete a human health risk assessment (HHRA) for 2BG. The HHRAs shall be consistent with HHRAs conducted at Acid Areas 2 & 3. The following sub-sections of this scope will apply to the 2BG human health risk assessment.

2.2.1 Site Background Jacobs will document previous studies, background information, site operational history, site regulatory history, graphics, deeds and other key information about the Plum Brook Ordnance Works and 2BG.

2.2.2 Risk Assessment Site Conceptual Model (SCM) Jacobs will prepare a risk assessment site conceptual model to provide a basis for identifying and evaluating potential risk to human health. The SCM shall include a source, source medium, chemical release mechanism, transport pathways, transport media, exposure media, receptors and routes of exposure. Jacobs will describe the SCM both in text and in flowchart graphic form. Receptor scenarios evaluated at other PBOW AOCs, and appropriate here are groundskeeper, construction worker, indoor worker, hunter, and on-site resident. Jacobs will highlight which pathways are complete and significant for quantitative evaluation.

Jacobs will assume two groundwater zones for this risk assessment, perched and bedrock groundwater. If perched groundwater is of volume as an acceptable potable water supply, then its evaluation shall include it as drinking water, as well as a direct contact medium for a construction worker. The bedrock groundwater is of sufficient volume to be used as a potable water supply. Jacobs will assume current on-site use is NASA, no potable groundwater source, and 24-hr fenced and guarded property. The future land use is assumed to be unrestricted. Jacobs will also assume that there is no current contact to bedrock groundwater in the current NASA industrial setting.

2.2.3 Data Evaluation Jacobs will perform a site data evaluation on all data sets (PA, SI and RI data shall be evaluated) to be used in a risk assessment to (1) identify a set of chemicals that are likely to be site related, and (2) reported concentrations are of acceptable quality for use in a quantitative human health risk assessment (USEPA, 1989). 100% of the data collected during this phase of work will be validated. The method for data usability analysis shall be documented. Jacobs will organize the data by media and chemical group, and present the data in summary tables that include, but are not limited to, assumed statistical distribution, frequency of detection, range of detection, range of detection limits, mean, 95% UCL, associated background UTL (for metals) and associated risk-based screening level, and units.

2.2.4 Background Levels Jacobs will be provided with the site-wide background UTL statistic for metals to be used for soil and groundwater. There are no site-wide background values for sediment and surface water. Upgradient sample results for sediment and surface water may be used in a qualitative way to determine chemical site relatedness in sediment and surface water.

2.2.5 Chemicals of Potential Concern (COPC) Selection Jacobs will select COPCs which will be identified as a subset of detected chemicals at the site that may potentially pose a risk or hazard to human health of an exposed population. The method of COPC screening shall be the same as what was conducted at the other AOCs with risk assessments. In screening for each exposure media, the maximum detected concentration (MDC) shall be used. Criteria that may be used for screening for COPC include, but are not limited to, non-detection, frequency of detection, comparison to background UTL, detected concentrations in blanks, assured off-site anthropogenic derivation, chemical role as an essential nutrient, and risk-based screening levels. Risk-based screening levels should be 1/10 of USEPA Region 9's residential soil preliminary remediation goals (PRGs, most current version is Oct. 2004 at the time of this scope); the residential soil PRG for sediment; and groundwater PRGs for surface water. If a detected chemical does not have an USEPA Region 9 associated PRG, an appropriate surrogate chemical shall be selected to use as a risk-based screen.

There will be two types of background screening. First, Jacobs will screen MDC metals against the representative background concentration, and by this method, may eliminate metals from further consideration if the data provides evidence to do so. Second, Jacobs will compare on-site PAH and BTEX MDCs to the representative background concentration, but this comparison will NOT eliminate any PAH or BTEX from further consideration. This comparison may be used during discussion after risk characterization is complete.

Chemicals will not be excluded from the human health risk assessment based only on screening criteria, rather expert judgment will also be applied prior to exclusion. COPC shall be presented in data summary tables that are organized by media, chemical group, and the representative concentration for each chemical in each media. Jacobs will summarize a list of COPCs, excluded chemicals, rationale for inclusion or exclusion, assumed statistical distribution, frequency of detection, detection limit ranges, and detected value ranges.

It is assumed that the media to be assessed for COPCs are surface soil, total soil (0 - 10'), surface water, sediment, perched groundwater, and bedrock groundwater.

2.2.6 Exposure Assessment Jacobs will conduct an exposure assessment to determine or estimate the nature, magnitude, frequency, duration and route of exposure to current, potential future and sensitive human populations (USACE, 1999 and USEPA, 1989).

2.2.6.1 Exposure Point Concentrations. Jacobs will calculate appropriate 95% UCL derived exposure point concentrations to be used in the HHRA exposure assessment, and ProUCL USEPA software may be used to do this. Data useability for calculation of exposure point concentration shall be consistent with the risk assessment of Acid Area 2 & 3.

In an appendix, AOC analytical data used in the risk assessment (detected at least once in an exposure media) shall be presented by exposure medium for chemicals detected at least once in a medium, and the associated detected value or method detection limit value and qualifier. The data shall be grouped by media, and by analyte list. It is assumed that databases to be presented are for surface soil, total soil, groundwater, surface water and sediment. The data shall be submitted in a form to enable reviewers to easily use the data for statistical input and for cross checking statistical manipulations.

2.2.6.2 Exposure Setting Characterization. Jacobs will provide a summary of the AOC's physical characteristics including geology, hydrogeology, meteorology, climate, vegetation, and soil type, and provide graphics and isopleths where appropriate. Jacobs will identify the location of current residents or populations, potential future populations, and sensitive sub-populations that may be impacted by site chemicals. Jacobs will develop a site conceptual model describing the extent of contamination, and the current and potential receptors that may be impacted from the contamination.

2.2.6.3 Exposure Pathway Identification Jacobs will identify and document existing or potential exposure pathways at the AOC. An exposure pathway may be defined as a source and mechanism of chemical release, an intermediate transport mechanism (if the exposure point differs from the source), a migration pathway, a route of exposure which chemical uptake by the receptor occurs, and a receptor group. Current and future land use, exposure area (portion or portions of the site), COPC available for uptake in each area, attenuation period of COPC, receptor populations, and type of receptor contact shall be determined and documented.

2.2.6.4 Exposure Quantification. Jacobs will estimate exposure concentrations and pathway-specific intakes for all receptor populations. Exposure shall be quantified with respect to magnitude, frequency, and duration of exposure for populations and pathways of concern. Chemical intake shall incorporate exposure point concentration estimation and intake factors. Exposure point concentrations may be estimated with proper statistical methods, and predictive modeling may be applicable. If models are used, rationale and method shall be documented. Estimation of chemical intake shall be documented, tabulated, and based on USEPA intake algorithms, and alternative algorithms acceptable to OEPA and USACE. Exposure factors used

shall be documented, support a reasonable maximum exposure, and be based on recommended USEPA, OEPA, and defensible site-specific information.

2.2.6.5 Exposure to Lead. If lead becomes a COPC, than lead shall be assessed by the USEPA Integrated Exposure Uptake Biokinetic Model (IEUBK). Guidance may be found on the USEPA website: http://www.epa.gov/superfund/programs/lead/pbrisk.htm

2.2.7 Toxicity Assessment Jacobs will select, derive or interpret the appropriate toxicity values for both carcinogenic and non-carcinogenic (chronic and sub-chronic) effects to use in generating estimates of potential health risks and hazards associated with chemical exposure. Toxicity values shall be presented in tabular form for all COPCs. Chemicals that have specific methodology for toxicity evaluation (ex. lead), shall have toxicity derivations which are documented and acceptable to OEPA, USEPA and USACE. Preparation of toxicological profiles is required for all chemicals retained as COPCs, and shall be attached in an appendix to the end of the report. These toxicity profiles shall minimally include a summary of the study(s) used to derive the reference dose (RfD) and/or cancer slope factor, confidence, weight of evidence, and indicated effect. The hierarchy for toxicity values to be used in the risk assessment shall be as follows:

- Tier I values: IRIS (USEPA database).
- Tier II values: USEPA's provisional peer-reviewed toxicity values. The provisional peer-reviewed toxicity values are developed by the USEPA Office of Research and Development, the National Center for Environmental Assessment, and the Superfund Health Risk Technical Support Center on a chemical specific basis when requested by the Superfund program.
- Tier III values: Other toxicity values from additional USEPA and non-USEPA sources of toxicity information. Other sources include, but not limited to USEPA HEAST, U.S. Army Center for Health Promotion and Preventive Medicine, and/or the California Environmental Protection Agency (2005) Office of Environmental Health Hazard Assessment Toxicity Criteria Database.

2.2.8 Risk Characterization Jacobs will utilize the chemical intakes estimated in the exposure assessment and the appropriate toxicity values identified in the toxicity assessment to characterize the risk and hazards posed by COPC. Methods shall be documented and consistent with current OEPA, USEPA and USACE methodology. Carcinogenic risk for each chemical of each exposure pathway, simultaneous chemical exposure of each pathway, and simultaneous chemical exposure of multiple pathways shall be documented and tabulated consistent with the risk assessment reporting for Acid Areas 2 & 3. Non-carcinogenic effects hazard quotients for each chemical of each pathway, simultaneous chemical exposure of each pathway, and simultaneous chemical exposure of multiple pathways shall be documented and tabulated. Chemical names, chemical concentrations, intake algorithm with exposure factors, intake values, toxicity values, and risk or hazard outcome for each exposure pathway shall be presented in tabular form. Summary tables shall include receptor population designation, exposure pathways associated with the receptor population, associated reasonable maximum exposure risk and hazard (to one significant figure) for each pathway, chemical names of major contributors to the

risk and hazard, and a summary of risk and hazard over all pathways associated with the receptor population.

A discussion of risk and hazard characterization for exposure scenarios shall be included. Along with the numerical estimates of potential health risks and hazards, a narrative describing the major contributors of health risks and hazards, and factors qualifying the risk shall be presented. A list of chemicals of concern (COCs) per evaluated media shall be presented.

2.2.9 Uncertainty Analysis For each acid area, Jacobs will address the qualitative and quantitative features of the human health risk assessment, identify the assumptions and uncertainties inherent in a human health risk assessment as to place risk estimates in proper perspective, and to provide relevant discussion for risk managers to make decisions. This uncertainty analysis shall include, but is not limited to, overall risk assessment methodology, uncertainties associated with sampling and analysis, data evaluation, selection of COPC, exposure assessment, toxicity assessment and risk characterization. The uncertainty analysis shall include defensible and appropriate parameter sensitivity analysis, quantitative background risk analysis, and other tools to help bring the risk assessment into perspective.

2.2.10 Preliminary Risk-Based Remediation Goals (PRBRG) Jacobs will develop risk-based remediation goals for chemicals of concern in media that may potentially warrant corrective action and do not have ARARs (note, EPA Region 9 PRGs are screening levels only, not ARARs). Methodology shall be based on guidance from OEPA, USEPA, USACE and this and other PBOW baseline risk assessments. A balance of site risks and hazards from surface (soil, surface water, and sediment) and groundwater need to be considered during PRBRG development. A range of target hazard indices and risk values shall be evaluated, and consideration shall be given to target organs and site chemical spatial variation. PRBRG derivations shall be documented and tabulated. Jacobs will document remediation concentration ARARs in the same table as PRBRG, as well.

2.2.11 Summary, Conclusions and Recommendations Jacobs will summarize human health associated with releases from this site. This summary shall be supported by tasks performed during the previous paragraphs. Additionally, Jacobs will make recommendations for managing risk or further investigating risk. Finally, the Jacobs will develop site specific preliminary remedial objectives for this site

2.3 TASK 4 - Ecological Risk Assessment

Jacobs will complete a SLERA for 2BG, which will include the scope as discussed below.

The screening level ecological risk assessment is to evaluate potential ecological effects that may be posed on sensitive receptors by stressors associated with the site. This effort shall be consistent with SLERAs conducted at all other PBOW AOCs that had SLERAs. Biological analysis (e.g. bioassays) shall not be conducted in this phase of work. Sub-tasks are described in the following sub-sections.

2.3.1 Problem Formulation Jacobs will define objectives of the ecological risk assessment; provide a conceptual site model that describes stressors, receptors, and endpoints; and an analysis plan.

2.3.1.1 Ecological Site Description Jacobs will describe the AOC's physical characteristics including geology, hydrogeology, meteorology, climate, flora, fauna, soil type, environmental settings (e.g. wetlands and wildlife refuge areas), sensitive settings as defined in FR Vol. 55, Pages 51624 - 51648, government (federal, state and local) designated protected areas, and habitats, and provide graphics and isopleths where appropriate. Jacobs will document land uses in and around the area, any existing facilities, potential off-site contamination migration, and potential fate and transport mechanisms (e.g. surface water runoff). This information shall be assembled from existing sources, aerial photographs, and reports without conducting additional field studies. Jacobs will contact natural resource personnel (whether Federal or State Officials) to discern relevant data or useful ecological information.

2.3.1.2 Stressor Selection Jacobs will perform a site data evaluation on all data sets (PA, SI and RI data) of surface soil (0-5 ft bgs for eco evaluation), sediment and surface water, to be used in a risk assessment to (1) identify a set of chemicals that are likely to be site related, and (2) ensure that reported concentrations are of acceptable quality for use in a quantitative ecological risk assessment. Jacobs will organize the data by media and chemical group, and present the data in summary tables that include, but is not limited to, assumed statistical distribution, frequency of detection, range of detection, range of detection limits, mean, 95% UCL, and units.

Jacobs will select chemicals of potential ecological concern (CPECs) which shall be identified as a subset of detected chemicals at the site that may potentially pose a risk to the environment. The method of CPEC screening will be documented, consistent with eco screening done at other PBOW AOCs, and consistent with OEPA, 2001 draft guidance. For this level of screening the MDC, or if USACE, NASA and OPEA agree on another statistic, will be used. Criteria that may used for screening for CPEC include, but are not limited to, non-detection, frequency of detection, comparison to background concentrations, detected concentrations in blanks, assured off-site anthropogenic derivation, low toxicity/bioconcentration screen, low potential for bioaccumulation, low environmental effects potential, and ecological screening values. Chemicals shall not be excluded from the ecological risk assessment based only on screening criteria, rather expert judgment shall also be applied prior to exclusion. CPECs shall be presented in data summary tables that are organized by media and chemical group, and the representative concentration for each chemical in each media. Jacobs will submit a list of CPECs, excluded chemicals, rationale for inclusion or exclusion, assumed statistical distribution, frequency of detection, detection limit ranges, and detected value ranges to the USACE for review.

In an appendix, AOC analytical data used in the eco risk assessment (detected at least once in an exposure media) shall be presented by exposure medium for chemicals detected at least once in a medium, and the associated detected value or method detection limit value and qualifier. The

data shall be grouped by media, and by analyte list. The data shall be useable by reviewers to be able to easily use the data for statistical input, and for cross checking statistical manipulations. It is assumed the databases to be presented are for eco soil (0-5 ft bgs), surface water and sediment.

2.3.1.3 Endpoint Selection Jacobs will define assessment endpoints that express actual environmental value that is to be protected, and include both the ecological entity of interest and attributes of the entity. Screening level endpoints, as defined by USEPA, 1997b, can be any adverse effect on ecological receptors. Criteria for assessment endpoint selection include, but not limited to: governmental or societal protection, ecological relevance, susceptibility to CPECs, and environmental management decisions. Assessment endpoints shall be acceptable to OEPA, USEPA, and USACE.

Once an agreement on assessment endpoints is determined, Jacobs will define measurement endpoints as measurable ecological characteristics that relate to the assessment endpoint value, a measurable stressor characteristics, or a measurable characteristic of the receptor. When possible, receptors and endpoints are concurrently selected by identifying those that are known to be adversely affected by chemicals at the site based on published literature.

2.3.1.4 Reconnaissance (Biota Checklist) Jacobs will perform two ecological site walkovers. One walkover shall document conditions in spring/summer and the second shall document conditions in fall/winter. These reconnaissance missions shall be performed by expert ecologist/wildlife biologists with strong Northern Ohio flora and fauna identification skills. Prior to arrival at the site, Jacobs personnel will obtain information about the site, including topographic maps; township, county or other appropriate maps; and location of potential ecological units such as streams, creeks, ponds, grasslands, forest, and wetlands on-site. Jacobs will visually inspect and verify wetlands on-site. Jacobs will complete a checklist similar to that on USEPA's (1993) *Checklist for Ecological Assessment/Sampling*. A checklist of biological species present at the site will be tabulated. Species known to be in the area of the site, but not confirmed by a site reconnaissance, will be ranked by the likelihood of being present at the site, and tabulated. The location of known or potential contaminant sources affecting the site and the probable gradient of pathway by which contaminants may be released from the site to the surrounding environment shall be identified. Jacobs personnel will use the walkovers to evaluate the site for more subtle clues of potential effects from contaminant release. Jacobs will submit a copy of the reconnaissance checklist as an appendix to the risk assessment report.

2.3.1.5 Documentation of Potential Receptors of Special Concern and Critical Habitat Jacobs will document in the risk assessment, designated wetlands, critical or sensitive habitats of threatened or endangered species.

2.3.1.6 Significant Ecological Threats Jacobs will determine and document whether significant ecological threats exist and whether these threats are related to chemical contamination caused by DOD activities. The initial screening of whether significant threats exist shall be based on the absence of biota or animal life where expected.

2.3.1.7 Site Ecological Conceptual Model. Jacobs will define how site chemicals may affect ecosystems at the site. Jacobs will prepare a pictorial representation of the exposure characterization. The pictorial and any text necessary to clarify the representation will be completed. The model will trace the contaminant pathways through both abiotic and biotic components of the environment, and food web components of the system. The model will present all potential exposure pathways, and shall identify those pathways which are complete and incomplete. The model will be used as tool for evaluating the appropriateness and usefulness of the selected measurement endpoints in evaluating the assessment endpoints and for identifying sources of uncertainty in the exposure characterization. If full pathways are considered incomplete, then no further analysis of the pathway is required.

2.3.1.8 Selection of Indicator Receptors Jacobs will select key indicator receptors for evaluation during the assessment. Indicator receptors selection can include, but is not limited to, likelihood of contacting chemicals, a key component of ecosystem structure or function (ex. importance in the food web, ecological relevance); listing as rare, threatened, or endangered by a governmental organization; or critical habitat for such; sensitivity to chemicals and recreational or commercially valued species (ex. game and livestock). Selection of indicator receptors will be agreed upon by OEPA and USACE, and confirmed by issuing a memorandum to both OEPA and USACE.

2.3.2 Exposure Assessment Jacobs will describe the contact or co-occurrence of CPEC and indicator receptors in terms of the nature, extent and magnitude of potential exposure of receptors to CPECs.

2.3.2.1 Exposure Profiles Jacobs will describe the exposure profile by identifying the receptor, the exposure pathway the chemical travels from source to receptor, and degree of impact (contact or intake of exposure point concentration) in terms of intensity and spatial and temporal extent of co-occurrence or contact. The exposure profiles developed for the ecological receptors and CPECs will serve as input for the risk characterization.

2.3.2.2 Exposure Analysis Jacobs will tabulate the estimated reasonable maximum chemical contacts or intakes for each indictor receptor under each exposure pathway and scenario. Jacobs will identify all pertinent exposure factors and algorithms. Exposure factors such as area-use, body weight, life stage during chemical contact, bioaccumulation factors, bioavailablity, and dietary percentage shall be highly conservative when based on site-specific information, and shall be conservative assumptions as agreed upon by OEPA, USEPA and USACE when no site-specific information is available. Algorithms or estimations of chemical bioaccumulation shall be agreed upon by OEPA and USACE prior to submittal of the draft ecological risk assessment. For exposure analysis for measure of characteristic or effects endpoints, a qualitative analysis of exposure shall be documented.

2.3.3 Ecological Effects Evaluation and Toxicity Data Jacobs will perform an ecological effects evaluation to determine a cause and response relationship between stressor levels and

ecological effects, evaluating plausible effects that may occur as a result of exposure, and like measurable ecological effects with the assessment endpoints when endpoints cannot be directly measured. The outcome of the effects evaluation should consist of contaminant exposure levels that can be translated to conservative no adverse ecological effects level.

Jacobs will develop toxicity reference values (TRVs) using published literature on toxicological experiments that exhibit levels below which an organism could be exposed without producing an adverse effect. Effort shall be made to use toxicity data that is closely related to indicator receptor, route of exposure, and duration of exposure, and note that there may be different TRVs for each exposure pathway and exposure route. All TRV derivation from LD50s, LOAELs and NOAELS shall be documented in tabular form with chemical name, study species, toxicity endpoint, studied effect, dosage, administration method (e.g. gavage), duration, reference, safety factors applied, and TRV. Safety factor shall be defined in the work plan and the ecological risk assessment, safety factors shall be sufficient as to protect assessment endpoints. A qualitative statement, with expert judgment, about plausible toxic effects on indicator receptors will be included in the ecological risk assessment for chemicals that have no appropriate published studies or no available studies.

2.3.4 Risk Characterization Jacobs will use results from the analysis of exposure and effects to estimate potential for adverse ecological effects to the assessment endpoints. Potential adverse effects shall be represented quantitatively where applicable, and qualitatively otherwise.

Quantitative hazard quotient calculations that compare exposure values with TRVs may serve as surrogate measurement endpoints. Chemical names, chemical concentrations, intake algorithm with exposure factors, intake values, toxicity values, hazard quotient for each exposure pathway will be presented in tabular form. Best professional judgment may be used to describe risk qualitatively by using schemes of yes/no or low/medium/high, if a quantitative analysis is not available.

If the first round of risk characterization, based on maximum exposure factors and NOAELs, expresses hazards greater than 10, then the indicator receptor will be evaluated on a central tendency basis. Central tendency evaluation shall include exposure assessment on reasonable median/mean exposure factors and toxicity data shall be based on LOAELs.

A narrative of risk characterization and relevance to assessment endpoints, and a summary of the major contributors (chemical stressors) to risk will be conducted. A discussion of the central tendency risk results shall be conducted.

2.3.5 Uncertainty Analysis Jacobs will conduct an uncertainty analysis of all components of the ecological risk assessment in problem formulation, exposure assessment, ecological effects assessment, and risk characterization. Jacobs will present the level of uncertainty as a qualitative discussion about the range of confidence in the risk estimation (i.e. low, medium, high) accompanied by the factors that may contribute to an overestimation or underestimation of risk. Whenever possible, risk will be expressed in terms of magnitude, direction (over- or

underestimation), and probability, using either sensitivity analysis (examining the appropriateness of the risk estimation by maximizing one or more values) or through other methods of analysis.

2.3.6 Eco Summary, Conclusions and Recommendations Jacobs will summarize the potential for adverse ecological effects associated with releases from this site. This summary shall be supported by tasks performed during the previous paragraphs. Additionally, Jacobs will make recommendations for managing risk or further investigating risk. Finally, Jacobs will develop site specific preliminary ecological remedial objectives for this site if appropriate.

2.4 TASK 5 - Risk Assessment Submittals

The major submittals for the risk assessment component of this scope are the human health risk assessment and an ecological risk assessment. This section covers submittals, document production, and document revision requirements.

2.4.1 Volume 1 Human Health Risk Assessment Submittal Jacobs will complete a human health risk assessment (HHRA) for 2BG, which will be presented consistent with the risk reports for Acid Areas 2 & 3 (February 2008).

Jacobs will submit an internal draft, draft and final version of this volume. The internal draft version shall be submitted to CELRN for review. Jacobs will be responsible for revising the risk assessment as per CELRN comments before a draft version is submitted to all reviewing parties, USACE, RAB, NASA, OEPA, HTRW-CX and CHPPM. Jacobs will be responsible for revising the risk assessment as per all agency comments. Jacobs will conduct two conference calls with the reviewing agencies for comment resolution, and the will be responsible for conference call capability and execution. Risk assessments shall not be finalized until all agencies provide concurrence or acceptance of the documents, and response to comments. Jacobs will submit official response to comments to CELRN, and attach as an appendix, accepted responses to comments in the final version of the volume. At least one electronic version of the final volume in the entirety shall be submitted to CELRN for file as well as the official hard copies.

2.4.2 Volume II Ecological Risk Assessment Submittal Jacobs will prepare a separate Ecological Risk Assessment Volume for 2BG, which will be presented consistent with the risk reports for Acid Areas 2 & 3 (February 2008)

Jacobs will submit an internal draft, draft and final version of this volume. The internal draft version shall be submitted to CELRN for review. Jacobs will be responsible for revising the risk assessment as per CELRN comments before a draft version is submitted to all reviewing parties, USACE, RAB, NASA, HTRW-CX, OEPA, and CHPPM. Jacobs will be responsible for revising the risk assessment as per all agency comments. Jacobs will conduct two conference calls with the reviewing agencies for comment resolution, and will be responsible for conference call capability and execution. Risk assessments will not be finalized until all agencies provide

concurrence or acceptance of the documents, and response to comments. Jacobs will submit official response to comments to CELRN, and attach as an appendix, accepted responses to comments in the final version of the work plans. At least one electronic version of the final volume in the entirety will be submitted to CELRN for file as well as the official hard copies

2.5 TASK 6 – MEETINGS

Jacobs will assume three meetings with regards to risk assessment. The meetings will consist of one team meeting and one RAB on the same day. Meeting one will be assumed to be a risk assessment kick-off meeting, meeting two shall be assumed to be a presentation of the risk assessment work plans, and meeting three will be assumed to be a presentation for risk assessment findings. Jacobs will provide one risk assessor and one project manager be in attendance at these meetings.

2.6 TASK 7 – Project Management Risk Assessments

All project management activities are included in this task. This includes Delivery Order management, quality management, prime contract and subcontract administration, projects controls and closeout are included in this task.

3.0 QCP TEAM

The contractor, Jacobs, develops the QCP and various plans and reports. By developing the QCP, plans, and reports, the Client's needs and requirements are recognized and stated at the beginning of the project. As a result, the goals of the project may better be achieved by the Contractor.

3.1 CELRN PERSONNEL, QUALIFICATIONS, AND RESPONSIBILITIES

Ms. Kathy McClanahan of CELRN is designated as the leader of the QA team and is also the Technical Coordinator for PBOW projects. Should a concern or need not be addressed satisfactorily by parties of the QA team, Ms. McClanahan should be contacted and a meeting arranged between the parties to identify the Quality Defect. Ms. McClanahan has several personnel available to her for consultation concerning technical matters of the project: Mr. Jim Beaujon, geologist; Ms Lannae Long, risk assessor/health and safety; Ms. Paula Coleman, chemist; and Mr. Doug Mullendore, chemical engineering/ chemical engineer/Chief, EC-R.

3.2 JACOBS PERSONNEL, QUALIFICATIONS, AND RESPONSIBILITIES

Jacobs' project team description discusses: (1) the overall management approach to the project; (2) the personnel performing or directing the investigation (including a description of their functions); (3) the management and control of the project (including the project schedule); and (4) the deliverable reports.

The key Jacobs personnel responsible for project planning, control, and execution of the Remedial Investigation is the Jacobs Project Manager. The Program and Project Manager is Mr. Al Hardesty. Additional key personnel include: the Quality Manager, Mr. Joe Petrilli; the Project Quality Manager, Mr. Steve Lampkins; the Chemist and Data Analyst, Mr. Lonnie Fallin; and the Data Manager, Mr. David Greenberg, the toxicologist for the human health and ecological risk assessments, Mr. Mark Stack; and the wild life biologist/botanist for the ecological risk assessment, Mr. Jon Russ. The duties and responsibilities associated with these key Jacobs project positions are outlined below.

Program Manager

The Jacobs Program Manager, among other duties, manages the contract for the work at Plum Brook and provides status updates to Jacobs Management concerning the various projects at Plum Brook, including the RI, and provides oversight of the various Jacobs Project Managers when necessary. Duties may include:

- Maintaining contact and coordinating with the CELRN Technical Coordinator throughout the work.
- Negotiating and executing contracts and modifications.
- Ensuring that sufficient resources are available to the project.
- Assisting Jacobs Project Managers with required aspects of a given delivery order.
- Serving as Jacobs Project Manager for a given delivery order.

- Ensuring that Jacobs' QA/QC program is applied.

Al Hardesty will serve as Jacobs' Program Manager for project related tasks. Mr. Hardesty holds a M.S. degree in Geology and is a Professional Geologist (PG) and has 15 years experience in environmental and hydrogeologic investigations.

Jacobs Project Manager

Jacobs' Project Manager (PM) will be responsible and accountable to CELRN for overall project direction and performance, including:

- Quality and timeliness of deliverables
- Application of resources
- Schedule, budget tracking, and revision, if necessary
- Progress reporting
- Assist in preparing and negotiating subcontracts
- Problem resolution
- Keeping all parties appropriately informed
- Principal project contact and liaison with the CELRN Technical Coordinator and Contracting Officer.

Al Hardesty will serve as the Jacobs Project Manager.

Data Manager

The Jacobs Data Manager is responsible for storage and retrieval of all electronic and hard copy data obtained at the site. Specifically, the Data Manager duties include:

- Reviewing laboratory contracts and specifications for compliance with the CELRN Delivery Order No. 2
- Specifying format of electronic data deliverables
- Entering laboratory and field data into an electronic relational database
- Submitting daily reports to data validators when necessary
- Storing hardcopy data
- Providing data tables for the RI Reports

Mr. Dave Greenberg will serve as the Data Manager. Mr. Greenberg holds a B.S. degree in Mechanical Engineering and has 18 years of experience in programming and data management.

Quality Manager

The Jacobs Quality Manager is responsible for assuring that Jacobs' QA/QC program is implemented in all appropriate project activities.

Joe Petrilli will serve as the Quality Manager. Mr. Petrilli holds a B.S. degree in Civil Engineering and has 34 years of work experience.

Project Quality Manager

The Jacobs Project Quality Manager is responsible for assuring that Jacobs' Quality Assurance Project Plan (QAPP) and the QA/QC program is implemented in all appropriate project activities, including:

- QC protocols and procedures
- Audits to see that all deliverables are properly reviewed and checked.
- Documenting that all quality objectives have been met.
- Implementing corrective actions.

Steve Lampkins will serve as the Project Quality Manager. Mr. Lampkins holds a B.S. degree in Geology and is a Professional Geologist (PG) with 17 years experience in environmental projects.

Chemist / Data Analyst

The Jacobs Chemist is responsible for assuring that the analytical requirements are met and validating the resulting data. The Chemist provides technical peer review on sampling plans and other technical program documents.

Mr. Lonnie Fallin will serve as both the Chemist and Data Analyst for this project. Mr. Fallin holds a B.A. degree in Chemistry has 18 years experience in the field of analytical chemistry.

Toxicologist

The Jacobs toxicologist is responsible for supporting the human health and ecological risk assessments. Activities to be performed by the toxicologist are presented in Section 2.2 and 2.3.

Mr. Mark Stack holds a B.S degree in Botany. Mr. Stack has 16 years of experience and will serve as the lead for the human health and ecological risk assessments.

Botanist / Wildlife Biologist

The Jacobs Botanist / Wildlife Biologist is responsible for conducting the ecological site walkovers and will support the ecological risk assessment.

Mr. Jon Russ holds a B.S degree in Wildlife Sciences. Mr. Russ has 21 years of experience and will serve as the lead on the ecological site walkovers.

3.3 INTERNAL TECHNICAL REVIEW TEAM

The ITR Team will be responsible for reviewing the Work Plans and the RI Reports. The ITR Team will be required to meet the schedule of work presented in Section 4.0 Schedule of Work. Requirements of the document review are discussed in Section 5.0 Provisions For Technical Checks.

Jacobs personnel described in Section 3.2 above will serve as originators of documents or sections of documents and may also serve as reviewers/checkers of documents or sections they have not originated. Jacobs QA/QC check off sheets will be distributed within the completed deliverables for review. Additional Jacobs personnel listed below may be involved in the review of documents

related to activities associated with the requirements of this project. The following lists the authors and members of the ITR Team for each of the project deliverables:

Document	Author	ITR Reviewers	Qualification	Phone#	E-mail
Human Health and Ecological Risk Assessment Work Plans & Reports	Mark Stack		toxicologist	(865) 220-5158	mark.stack@jacobs.com
		Steve Lampkins	Geologist	(865) 220-6043	steve.lampkins@jacobs.com
		Jon Russ	Botanist / Biologist	(303) 462-7208	jon.russ@jacobs.com
		Chris Skinner	Statistician	(303) 462-7294	chris.skinner@jacobs.com

A certification statement signed by the independent reviewers identified in the QCP will be included with each product submitted to CELRN. The statement will declare that the reviewers have reviewed the product; their comments have been satisfactorily resolved; and the product is ready for release to CELRN. Comments generated by Jacobs' independent reviewers and the resolution of those comments shall be submitted with the certification statement.

4.0 SCHEDULE OF WORK

4.1 DOCUMENT SCHEDULE

The review by CELRN includes review of this QCP and the required plans and reports developed by Jacobs. The plans and reports are due to CELRN in accordance with the following schedule:

NTP	29 Jan 2008
Draft QCP	29 Feb 2008
Final QCP	15 Mar 2008
Internal Draft Risk Assessment Work Plans	21 Mar 2008
Draft Risk Assessment Work Plans	15 Apr 2008
Final Risk Assessment Work Plans	15 Jul 2008
Ecological Site Survey (Spring)	8 May 2008
Internal Draft Risk Assessment Report	15 Sep 2008
Draft Risk Assessment Report	15 Nov 2008
Final Risk Assessment Report	28 Feb 2009

4.2 FIELD SCHEDULE

The ecological site survey will be conducted in early May. This survey will be performed prior to submittal of the final work plans.

5.0 PROVISIONS FOR TECHNICAL CHECKS

Jacobs' SOPs dictate procedures to be used to review and check company deliverables. Documents are checked for concept suitability, theory, applicability and correct numbers. The checks are done according to explicit Quality Control procedures. Additionally, documents are to receive a Technical Coordination Review and if needed, a Document Coordination Review during the development process. A Final Package Review is required prior to the deliverable being submitted.

The following subsections present check lists for technical and general review of project documents. The checklists are to be read before, during and after review of project documents.

5.1 TECHNICAL REVIEW CHECKLIST

The technical review checklist of a project document includes at a minimum:

- Scope of Work is properly presented and explained
- Objectives clearly stated
- Historic information is correct
- Number of samples is correct
- Laboratory methods are correct
- Figures are clear and contain a north arrow, scale, source, title block and legend
- Field procedures follow referenced procedure manuals
- Recommendations and conclusions of the investigation and their basis are clearly identified and discussed in the report
- Response to comments are understandable and clearly worded in complete sentences

5.2 GENERAL REVIEW CHECKLIST

The general review check list of a project document includes at a minimum:

- Table of contents is correct
- Acronyms are defined in table of contents and text and used consistently throughout
- Figures and sections are referenced correctly
- Grammar and spelling are correct
- Comments are understandable and clearly worded in complete sentences

5.3 QUALITY INDICATORS

An evaluation of the overall project quality will be performed by the Project Manager on a periodic basis. This evaluation will include an assessment of the items outlined in Sections 5.1 and 5.2, and an additional evaluation of those quality indicators that accurately describe the status of the project. Those additional quality indicators for this project will include the following:

- Compliance with Approved Project Schedule. Schedule variances will be outlined by the Project Manager, and corrective actions will be discussed with the CELRN.
- Compliance with Scope of Work and Project Planning Documents. Out of scope items will be identified early-on, and discussed with the CELRN. Variances with the Project Planning Documents will be tracked and corrective actions implemented per the approved plans.
- Number and Content of the Comments on each Project Deliverable. The CELRN, CELRH, NASA, and OEPA typically review project deliverables. A subjective evaluation on the number and types of review comments will be performed by the Project Manager, and corrective actions implemented as necessary to improve deliverable format, content, technical presentation, etc., on subsequent deliverables.
- Overall Client Satisfaction with Work Products. The Project Manager will communicate with the CELRN on a routine basis, and overall client satisfaction will be assessed. The Project Manager, along with the Program Manager, will identify areas for improvement, and determine an implementation plan for those improvements.

6.0 DOCUMENTATION OF PROJECT DECISIONS

Jacobs will make a record of substantive phone conversations, written correspondence, and meetings regarding information related to the performance of this work. These records will be maintained in the Jacobs project files, and will be submitted to the CELRN during the course of the performance of the work when appropriate.

7.0 PROJECT CLOSEOUT

At the completion of this work, a project closeout meeting will be conducted. This will be at a time and place determined by the CELRN personnel, and may take the form of a teleconference. The purpose of this meeting will be to exchange feedback, discuss lessons learned, and to conduct a final product verification.