TCEQ REGULATORY GUIDANCE
Remediation Division
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Corrective Action Plans for LPST Sites

Introduction

This document contains guidelines for the selection, development, and design of a corrective action plan (CAP). It is intended to help registered corrective action specialists (RCASs), licensed corrective-action project managers (CAPMs), or licensed professional engineers to decide on the appropriate technology and develop a systematic approach to bring the site of a leaking petroleum-storage tank to closure in an efficient and effective manner. It does not include instruction on design and construction of remediation systems, but rather focuses on the CAP process and its role in remedial alternatives that use engineered systems.

What Is a CAP?

When a release from a petroleum-storage tank results in contaminant levels that exceed target concentrations, remediation may be necessary to reduce the contamination to concentrations protective of human health, safety, and the environment. Once the RCAS and CAPM have performed a risk-based evaluation that determines that remediation is necessary, they must select, design, and implement an appropriate remedial technology.

This process is memorialized by developing a CAP, defined in 30 TAC 334.2(26),[1] as:

> *A detailed plan developed to address site remediation of soil, groundwater, or surface water contamination that provides for required protection of human health, safety, and the environment. The selection of the most effective and efficient remedial method will be dictated by the nature and location of the release, the site soils, hydrogeological conditions, and the required degree of remediation. The remedial method selection should take into consideration such factors as cost, time, and state compliance requirements with each method.*

When Is a CAP Necessary?

Pursuant to Texas Water Code 26.351 <www.tceq.texas.gov/goto/pst-downloads>, the Petroleum Storage Tank program uses a risk-based approach for managing the assessment and remediation of leaking petroleum storage tanks. The first step is a Plan A evaluation, where the

[1] Short for 'Title 30, Texas Administrative Code, Subsection 334.2(26).'

RCAS and CAPM compare the site's maximum contaminant concentrations to the conservative pre-established target concentrations for the beneficial-groundwater-use category and land use applicable to the site. If contaminant concentrations are at or below Plan A target concentrations, the site may be eligible for "closure," meaning that no more assessment or remediation is warranted. Sites that do not screen for possible closure under Plan A evaluation are further evaluated using the exit-criteria flowcharts available in the guidance document entitled *"Risk-Based Corrective Action for LPST Sites"* (RG-523/PST-03), available online at

<www.tceq.texas.gov/goto/pst-downloads>.

The flowcharts evaluate potential risk posed by the groundwater and soil-exposure pathways. An exposure pathway that does not appear to pose a risk to human health, safety, or the environment can be closed, and if all pathways close then a Plan B evaluation is not needed.

If the site does not meet closure requirements during the exit-criteria evaluation, the open exposure pathways are further evaluated under a Plan B evaluation. The RCAS and CAPM develop target concentrations based on the geologic and hydrologic conditions and the actual receptor information for each site. Remediating a site to target concentrations often saves money and time, compared to the more conservative Plan A target concentrations. The development of a CAP is necessary if concentrations exceed the established target concentrations as determined in the Plan B report.

Selecting a Remedial Technology

The TCEQ adheres to *How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plan Reviewers* (EPA 510-B-94-003; EPA 510-B-95-007; EPA 510-R-04-002; and EPA 510-B-16-005) from the U.S. Environmental Protection Agency (the *EPA CAP Manual*) when evaluating remedial technologies, system designs, and criteria for operation, monitoring, and performance (OMP) at LPST sites. However, where there are discrepancies between the *EPA CAP Manual* and *Operation, Monitoring and Performance of Remediation Systems at LPST Sites* (TCEQ publication RG-523/PST-11), TCEQ guidance takes precedence. The latest version of the *EPA CAP Manual* can be downloaded at

<www.tceq.texas.gov/goto/pst-downloads>.

Although the manual does not provide instruction on the design and construction of remediation systems, it serves as a good reference when combined with other published references, current journals, training courses, and other industry practices for engineering-related considerations in developing a CAP.

The TCEQ requires that a submitted CAP contain a detailed description of resources consulted in the technology selection for review and evaluation of the selected technology's effectiveness, with respect to the location of the release, site geology, hydrogeological conditions, and the required degree of remediation. After selecting an appropriate remedial technology, complete the Remedial Technology Screening (RTS) Form (TCEQ-00695).

The RTS Form contains the minimum criteria for specific remedial technologies to perform effectively at any given site. Feasibility tests are used to evaluate the selected technology further.

Feasibility Testing

Once the RCAS and CAPM have established the need for remediation, the applicable target concentrations, and the appropriate remedial technology, the next step in CAP preparation is to identify and complete the necessary feasibility tests. Feasibility tests have a twofold application. They not only demonstrate the effectiveness of the technology on a test scale but also derive critical data essential to designing the full-scale fixed system. Please refer to the *EPA CAP Manual* for technology-specific requirements for feasibility testing.

Once the RCAS and CAPM have established the need for a feasibility test, submit a work plan for the testing and a description of the remedial technology for the site to the TCEQ for review. Following TCEQ concurrence with the proposed feasibility test, conduct the test and evaluate the results. If the results indicate that the technology is not suitable for the remediation of the site, reevaluate the suitability of that technology or consider alternative remedial methods. Otherwise, select the appropriate remedial technology and proceed by documenting the feasibility data in a feasibility report.

Submit the feasibility-test results along with a CAP using the selected remedial technology for the site for TCEQ review and concurrence. All activities related to CAP preparation should be overseen by a licensed professional engineer (P.E.). The following items must be included with the CAP:

- the results of any feasibility tests
- a discussion of why the selected remedial technology was chosen over other technologies
- a discussion of the proposed CAP
- the RTS Form

Preparing the CAP

A strong correlation between the feasibility test results and corresponding design parameters is used in the design of the CAP. The content of the CAP will vary according to the type of remedial technology proposed; however, all CAPs must at least include the information described in this section. Please submit all information in the format specified below. Each section must be clearly identified with a divider. You may subdivide the sections in a manner that allows further organization of the information to facilitate review. Place any information that does not clearly fit into one of the following sections in Section IX, “Additional Information.” Format the CAP report as follows.

Table of Contents with Page Numbers

Section I: CAP Worksheet(s) (TCEQ-00707)

Section II: Site-Specific Geology and Hydrogeology

- A discussion of how the site geology and hydrogeology support the type of remediation selected for use at the site and a description of any measures or special design considerations necessary to overcome any geologic limitations. Include references to any previously submitted reports that contain any field tests conducted to determine site-specific conditions and all related calculations.
- At least one (for smaller sites) and no more than three (for larger sites) representative geologic cross-sections through each area to be treated with the proposed remediation system. Each cross-section should support the CAP design and include sufficient detail to support recovery-well placement and screening, pump intake depth, etc.
- Drawing of geologic cross-sections and subsurface interpretation and evaluation must be sealed by a licensed professional geoscientist or a P.E., as required by Texas Occupations Code Chapter 1002 <www.tceq.texas.gov/goto/pst-downloads> and 22 TAC 851 <www.tceq.texas.gov/goto/pst-downloads>.

Section III: Site-Assessment History

- Cumulative tables for all sampling media (soil, groundwater, surface water, and vapor analytical results) as well as tank removal or repair.
- Cumulative tables of all gauging data (water-level data, thicknesses of non–aqueous phase liquids, corrected water-level data, and well-screen intervals).
- A table including the vapor pressure (mm Hg at 20ºC), Henry's law constant (atm), and solubility (mg/L at 20ºC) for all of the chemicals of concern (COCs).
- The most current maps of soil and groundwater contaminant concentrations.
- The most recent groundwater gradient map.
- The most recent vapor-concentration map with readings and surface water criteria (if applicable).
- A graph of groundwater and non-aqueous phase liquid (NAPL) elevations versus time for each monitoring well.
- A graph of groundwater concentrations versus time for each COC for each monitoring event. (May be on one graph, but broken out by constituent.)

Section IV: Target Concentrations

- A cumulative table of the COCs in soil, which includes both the location and the maximum concentration of each COC documented at the site as well as the target concentration for each.
- A cumulative table of the COCs in groundwater, which includes both the location and the maximum concentration of each COC documented at the site as well as the target concentration for each.
- If applicable, a table of the COCs in surface water, which includes both the location and the maximum concentration of each COC documented at the site as well as the target concentration for each.
- Reference any previously submitted reports that contain the determination of target concentrations. Provide the date of each report, the title, and the type of report (i.e., Plan A, Plan B, etc.).
- The estimated cumulative mass of contaminants to be removed. Include all calculations and methodologies used to obtain this estimate.
- The estimated time to achieve the target concentration using the proposed technology. Include all calculations and methodologies used to obtain this estimate.

Section V: Remediation-System Design

- A summary of the feasibility-test data that were used in the system design.
- A brief description of the proposed remediation system, engineering data, and utility requirements to operate the system.
- Remediation-system layout drawn to scale on a base site map and plan-view schematic.
- Design drawings or modifications to the design drawings and specifications of the system—must be sealed by a licensed P.E.
- Design drawings of the recovery wells and if applicable, design of the injection well.
- The estimated radius of influence (or radii of influences) overlaid on a contaminant concentration map of each COC above the target concentration.
- One or more groundwater capture zones overlaid on a contaminant concentration map of the COC or COCs requiring the highest degree of cleanup.
- Operating conditions, including weather concerns, access problems and agreements, building constraints, etc.
- Discussion of any waste-disposal considerations including the type of waste, estimated frequency of disposal, final disposition, etc.
- If vapor treatment is proposed, a table of vapor concentrations measured during feasibility testing, by direct measurement or other

methods used to determine treatment and design criteria. Include the COC name, measured concentration, location, and date of measurement.

- If applicable, a description of any air-discharge treatment system that will be used. Discuss the length of operation and whether a change in treatment technology will be required with changes in effluent and influent concentrations.
- Discuss any permits or approvals that will be necessary to implement the CAP. Identify the agencies involved and any sampling or monitoring requirements associated with the permit or approval. Include copies of any permits or approvals already obtained.
- Discuss how telemetry will be used to monitor system operations.
- Discuss a contingency plan or alternative approach that will be performed if the proposed remediation system is not effective once implemented.
- An implementation schedule that includes estimated dates for permit approval, system installation, startup, etc.

Section VI: Operation, Monitoring and Performance Plan

- A complete OMP Plan as specified in *Operation, Monitoring and Performance of Remediation Systems at LPST Sites* (RG-523/PST-11).

Section VII: Closure Plan

- A description of procedures that the RCAS and CAPM will use to determine when system operation can be discontinued and a plan for returning the system to service if contaminant concentrations rebound.
- A description of procedures for decommissioning the system and returning the site to original conditions or as near as practicable, once the TCEQ grants closure.
- For soils, the depth and locations of verification borings. Discuss the number of soil samples that will be collected, the sampling locations (intervals), and the laboratory analyses that will be conducted. Include a site plan illustrating the proposed boring locations.
- For groundwater, the number and locations of monitoring wells to be sampled and the laboratory analyses that the RCAS and CAPM will conduct.

Section VIII: Monitoring Plans

- Separate plans for: (1) system installation and startup monitoring, including a Field Activity Report (FAR) (TCEQ-00017) to document startup activities; and (2) long-term OMP monitoring that includes system modifications and any required reporting.

Section IX: Additional Information

- Include any pertinent information that does not fit into Sections I through VIII.

Appendix A: CAP Worksheet Calculations

- All information supplied on the CAP Worksheets (TCEQ-00707) for the specified technology or technologies must be supported by data and calculations wherever applicable. If the data or calculations appear elsewhere in the CAP report, they do not need to be duplicated in this appendix but should be referenced in the CAP Worksheets.

Appendix B: Equipment Specifications

- Include any equipment brochures, vendor information, or system or component specifications from the vendor.

CAP Worksheets

Applicable CAP Worksheets for the selected remedial technology must be completed and included with the CAP to facilitate all critical information in a concise and consistent manner. If two or more remedial technologies are proposed at a site, then the RCAS and CAPM must complete all applicable worksheets. The RCAS and CAPM must complete the Groundwater Extraction Worksheet whenever groundwater is being extracted, either by itself or in conjunction with another remedial technology. Groundwater extraction (pump-and-treat) has been proven to be costly and ineffective as a sole method for groundwater remediation and therefore is used concurrently to enhance the effectiveness and efficiency of an alternate method (e.g., soil vapor extraction, air sparging, or enhanced aerobic bioremediation technology).

Interim or Emergency Measures

Where there is imminent threat to human health and the environment, interim measures may be implemented for containment and removal of the contaminant plume while the permanent CAP is being implemented. The data obtained during this interim phase can be incorporated in the design of a permanent CAP.

Approval from the TCEQ is not required to begin emergency abatement or recovery of non–aqueous phase liquids, as immediate response for such situations is required under 30 TAC 334.77 and 334.79. However, if a remediation system installed for initial abatement continues to be operated to reduce contaminant concentrations, the RCAS and CAPM must submit a CAP after the initial emergency abatement period. Often, a remedial technology selected for emergency abatement may not be capable of achieving long-term goals without modifications—for example,

groundwater extraction (pump and treat) as a stand-alone remedial technology used for interim containment is not effective for long-term remediation. Therefore, continued operation of a remediation system used for initial abatement requires TCEQ approval.

System Installation

After the TCEQ has approved the CAP, submit a Notice of Remediation System Installation (NRSI) Form (TCEQ-00694) to both the appropriate TCEQ regional office and the central office in Austin at least five business days before the start of system installation. A licensed P.E. must supervise installation of the system. When installation is complete, the system must be started up and monitored immediately according to the submitted and approved OMP plan. Please refer to TCEQ publication RG-523/PST-11 for guidance on completing OMP Plans. Within 45 days of system startup, the RCAS and CAPM must submit a FAR (TCEQ-00017) documenting the completed installation activities to the TCEQ. The following items must be included with the FAR:

- Construction details of the system (if different from original drawings included in the CAP report).
- Photographic documentation of the installed system.
- The results of the startup monitoring activities (refer to Table 1 from RG-523/PST-11), including any analytical results.

System Operation

System operation, monitoring, and reporting must continue as specified in publication RG-523/PST-11. The system must be constantly monitored for efficiency, performance, and effectiveness and to determine whether target concentrations have been met. System modifications and updates must be performed as necessary to maintain efficiency.

If the system is not operating as designed (efficiently or effectively), notify the TCEQ immediately, and evaluate the system. Make adjustments as soon as possible to bring the system into optimal effective running status.

If the system is no longer effective, the RCAS and CAPM must submit a work plan for system modifications or for a new remedial approach to the TCEQ. Repairs or redesign of an engineered system must be overseen by a licensed P.E.

The contaminant concentrations must be constantly monitored and compared to the target concentrations to determine if the remediation goals have been met. When target concentrations have been met for two consecutive quarters, operations should cease (with concurrence from the TCEQ). The RCAS and CAPM must submit to the TCEQ a current Operation, Monitoring and Performance Report (OMPR) (TCEQ-00696) (see publication RG-523/PST-11) and any other documentation necessary to demonstrate that the target concentrations have been met. Upon TCEQ concurrence, conduct all confirmation-monitoring activities. At least four quarters of

confirmatory monitoring showing stable or decreasing concentrations is required to demonstrate that target concentrations have been achieved. If rebound of groundwater concentrations occurs over two consecutive quarters, notify the TCEQ, and submit a work plan for further remediation necessary to obtain site closure (system restart, targeted system operations, secondary remediation activities, etc.). Continue with remediation until target concentrations have been achieved.

Site Closure

Once confirmation monitoring indicates that the target concentrations have been met and that no further corrective action is necessary, prepare and submit a Site Closure Request (SCR) (TCEQ-00028) to the TCEQ with the results of the confirmation monitoring. The TCEQ will review the SCR and issue a Final Site Closure Letter if appropriate. Once site closure has been approved, plug and abandon all monitoring, recovery, and injection wells as well as conducting any needed site restoration. In most circumstances, the remediation system will be removed from the site during closure.

Points to Note

1. The RCAS and CAPM must submit an RTS Form (TCEQ-00695) and technical justification for remedial technology selection prior to completion of feasibility tests. Soil and aquifer parameters can be obtained from a reliable source (hydrogeology textbooks, manuals, cited literature, etc.).
2. All engineered plans and specifications for on-site equipment, structures, or systems used in the remediation or management of wastes (except soil excavation, landfill disposal, well sampling, or monitoring), must be properly sealed by a licensed P.E. Additionally, the construction and installation of such equipment, structures, or systems must be performed under the supervision of a licensed P.E.
3. The RCAS or CAPM is required to notify both the local TCEQ regional office and central office in Austin at least five business days before beginning remediation-system installation by filling out the NRSI Form (TCEQ-00694). This notification is required to allow the TCEQ ample time to schedule on-site inspections and observe the installation.
4. The TCEQ will not accept any documents submitted as a CAP that do not contain all the information required by 30 TAC 334.81.

Corrective Action Plan (CAP) Process

Part 1. Are You Ready to Begin Preparation of a CAP?

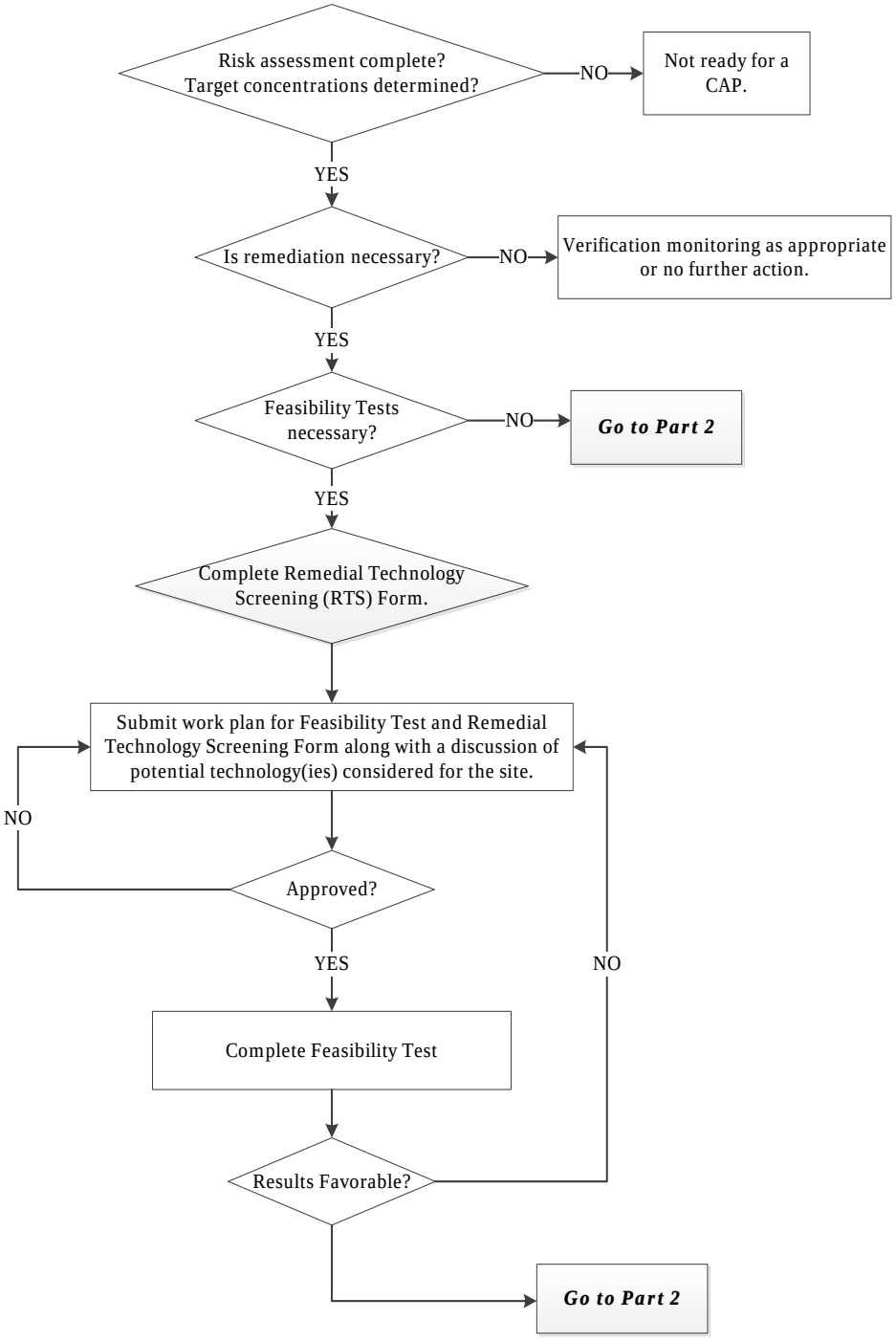

Figure 1

Corrective Action Plan Process

Part 2. Submitting and Implementing the CAP

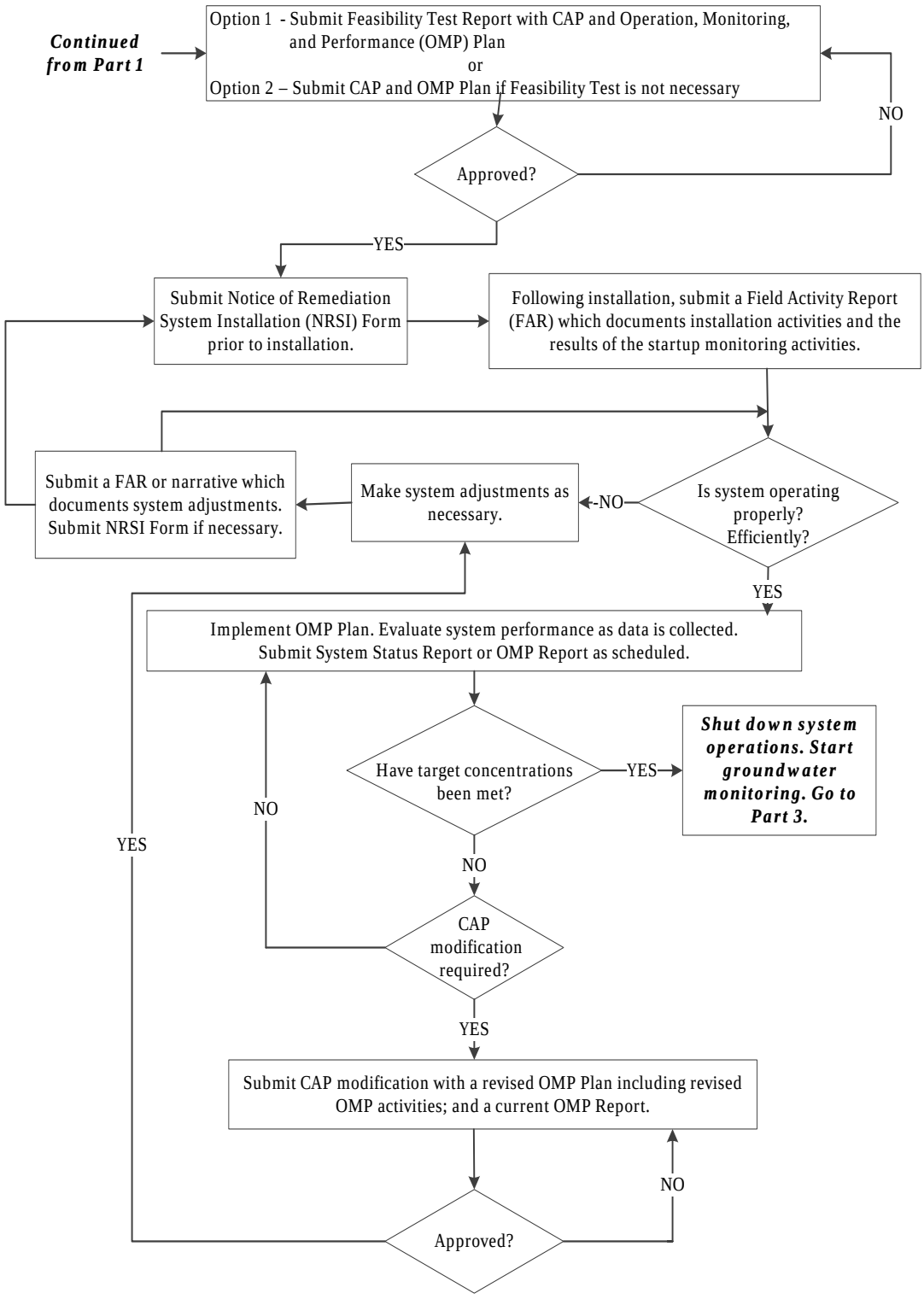

Figure 2

Corrective Action Plan Process

Part 3. Monitoring and Closure

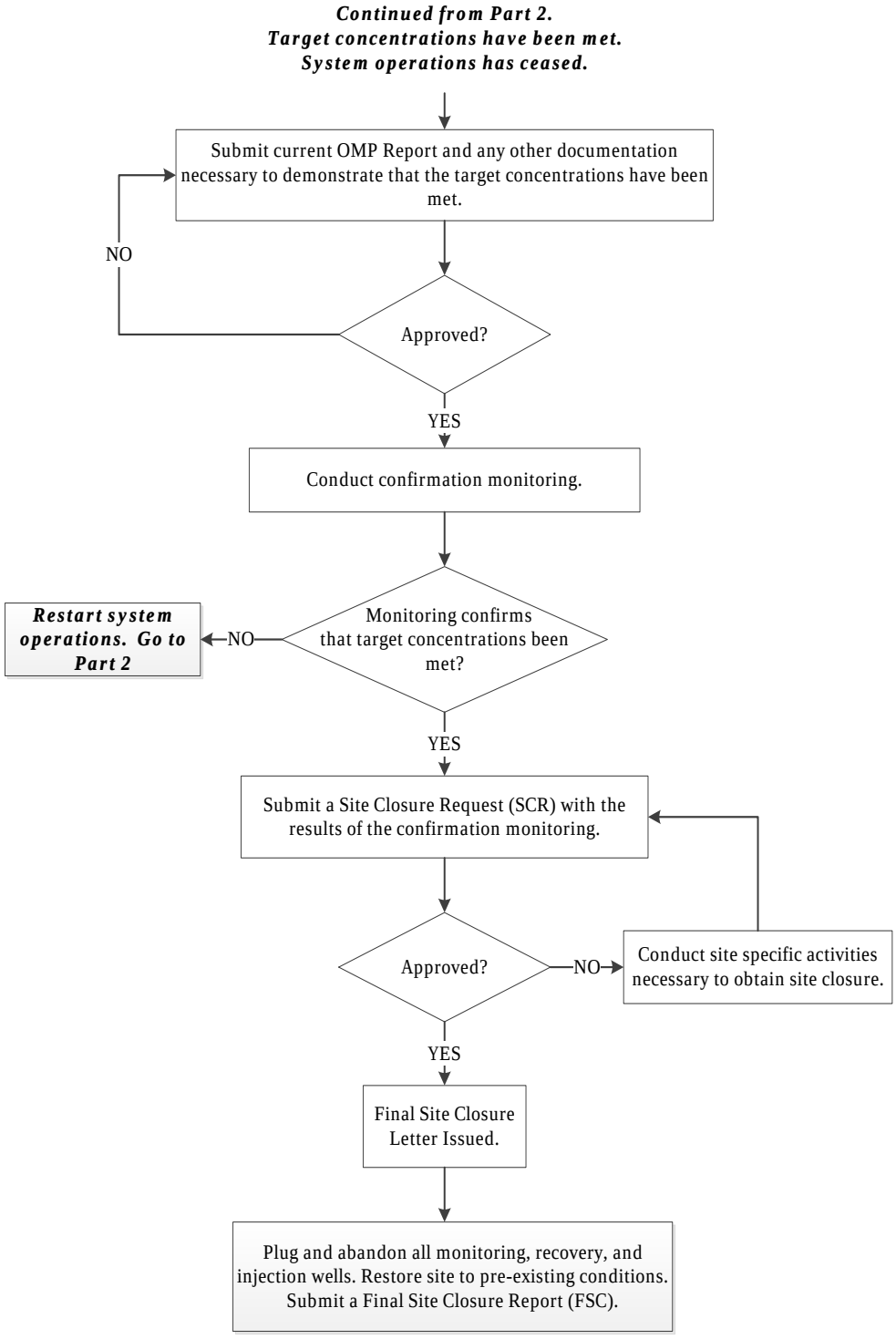

Figure 3