

# Construction Quality Control/Quality Assurance Plan Bozeman Landfill LFG/SVE/AI and Treatment System City of Bozeman Landfill; Bozeman, MT

#114-560487

July 10, 2015

## PRESENTED TO

---

### City of Bozeman

PO Box 1230  
Bozeman, MT 59711-1230

## PRESENTED BY

---

### Tetra Tech, Inc.

303 Irene Street  
Helena, MT 59601

P +1-406-443-5210

F +1-406-449-3729

tetrattech.com

Prepared by:

---

Mary Bell

July 10, 2015

Reviewed by:

---

Larry Cawfield, P.E., P.H.  
Engineer/Hydrologist

July 10, 2015

Authorized by:

---

Larry Cawfield, P.E., P.H.  
Engineer/Hydrologist

July 10, 2015

## TABLE OF CONTENTS

---

|   |          |
|---|----------|
| <b>1.0 INTRODUCTION .....</b>   | <b>1</b> |
| 1.1 CQCQAP Organization .....   | 1        |
| <b>2.0 PROJECT QA/QC ORGANIZATION .....</b>                             | <b>2</b> |
| 2.1 Responsibilities and Authorities of Key Personnel .....             | 2        |
| 2.1.1 Engineer of Record.....   | 2        |
| 2.1.2 QA On-Site Supervisor .....                                       | 3        |
| 2.1.3 QC Supervisor .....   | 3        |
| <b>3.0 INSPECTION AND VERIFICATION ACTIVITIES .....</b>                 | <b>3</b> |
| 3.1 General Construction Inspection and Verification Requirements ..... | 3        |
| 3.1.1 QC Inspections .....  | 3        |
| 3.1.2 QA Inspections .....  | 4        |
| 3.1.3 Construction Audits .....   | 5        |
| <b>4.0 CONSTRUCTION DEFICIENCIES .....</b>                              | <b>5</b> |
| 4.1 Contractor QC Deficiency Identification and Control .....           | 5        |
| 4.2 Contractor Deficiency Correction .....                              | 6        |
| 4.3 Preventive Actions .....  | 6        |
| <b>5.0 FIELD CHANGES .....</b>  | <b>6</b> |
| 5.1 CQCQAP Changes .....  | 6        |
| <b>6.0 DOCUMENTATION.....</b>   | <b>6</b> |
| 6.1 QC Daily Record Keeping.....  | 6        |
| 6.2 QA Daily Construction Report.....                                   | 7        |
| 6.3 Inspection and Testing Checklists .....                             | 7        |
| 6.4 Record Drawings.....  | 7        |
| 6.4.1 Responsibilities.....   | 7        |
| 6.4.2 Preparation of As-Built Drawings .....                            | 7        |
| 6.4.3 Review of As-Built Drawings .....                                 | 8        |
| 6.5 Control of Quality Records .....                                    | 8        |
| 6.6 Post-Construction Documentation .....                               | 8        |
| <b>7.0 REFERENCES .....</b>   | <b>8</b> |

## LIST OF TABLES

---

|  |          |
|--|----------|
| <b>Table 3-1. Quality Assurance Testing and Frequency.....</b> | <b>4</b> |
|--|----------|

## APPENDICES

---

### APPENDIX A - FIELD FORMS

## ACRONYMS/ABBREVIATIONS

---

| Acronyms/Abbreviations | Definition  |
|------------------------|---|
| AI                     | Air Injection                                       |
| CQCQAP                 | Construction Quality Control/Quality Assurance Plan |
| LFG                    | Landfill Gas  |
| GC                     | General Contractor                                  |
| OSS                    | On-Site Supervisor                                  |
| QA                     | Quality Assurance                                   |
| QC                     | Quality Control                                     |
| QC/QA                  | Quality Control/Quality Assurance                   |
| SVE                    | Soil Vapor Extraction                               |

---

## 1.0 INTRODUCTION

On behalf of the City of Bozeman, Tetra Tech, Inc. (Tetra Tech) has prepared this Construction Quality Control/Quality Assurance Plan (CQCQAP) to support the proposed Landfill Gas/Soil Vapor Extraction/Air Injection (LFG/SVE/AI) and Treatment System at the City of Bozeman Landfill in Bozeman, Montana. The system will include installation of: 1) an equipment slab; 2) flare or thermal oxidizer; 3) gas handling system; 4) condensate holding tank; 5) air compressor; 6) six LFG extraction wells; 7) six AI wells; 8) five SVE wells; and 9) SVE vaults, AI vaults, and condensate sumps. Collectively, the construction activities are referred to as Alternative F as described in a Revised Corrective Measures Assessment Report (Tetra Tech, 2014). This CQCQAP is a companion document to the Plans, Specifications and Contract Documents for Alternative F and establishes project procedures and general responsibilities for the quality control program to ensure that the LFG/SVE/AI and Treatment System is executed in accordance with the relevant portions of the Plans and Specifications.

The objectives of this CQCQAP are to:

- Describe the quality program and organization to be implemented so that the project is conducted in accordance with contract requirements and industry standards;
- Describe guidelines for inspection and documentation of activities;
- Provide reasonable assurance that the completed work will meet or exceed the requirements of the construction drawings and specifications;
- Describe how any unexpected changes or conditions that could affect the construction quality will be detected, documented, and addressed during construction.

A General Contractor (GC) will be selected through a competitive bidding process and be responsible for conducting the work and providing quality control in accordance with the approved plans and specifications. Each subcontractor is also responsible for controlling the quality of his/her work to meet contract plans, specifications, and related requirements. Quality Control (QC) is the systematic implementation of a program of inspections, tests, and controls to attain the required standards of quality and to preclude problems resulting from noncompliance.

Tetra Tech will provide Quality Assurance (QA) through daily monitoring and scheduled inspections to verify that contract requirements are being met. Tetra Tech's On-Site Supervisor (OSS) will be responsible for the day-to-day coordination of QA measures in the field. The OSS will assure that QA is working effectively and that the resultant construction complies with the quality requirements established by the contract.

### 1.1 CQCQAP ORGANIZATION

This Construction Quality Control Plan is organized as follows:

**Section 1 — Introduction:** Provides a CQCQAP quality program overview

**Section 2 — Project QC Organization:** Presents organization and key personnel involved in the second-phase expansion, their responsibilities and authorities, and the structure of the Quality Control/Quality Assurance (QC/QA) organization

**Section 3 — Inspection and Verification Activities:** Provides procedures for tracking construction inspection and verification activities for the contract, construction acceptance criteria, and construction audits

**Section 4 — Construction Deficiencies:** Describes the procedures for tracking construction deficiencies from identification through acceptable corrective action

**Section 5 — Field Changes:** Describes handling of quality plan changes to assure QC/QA objectives are met

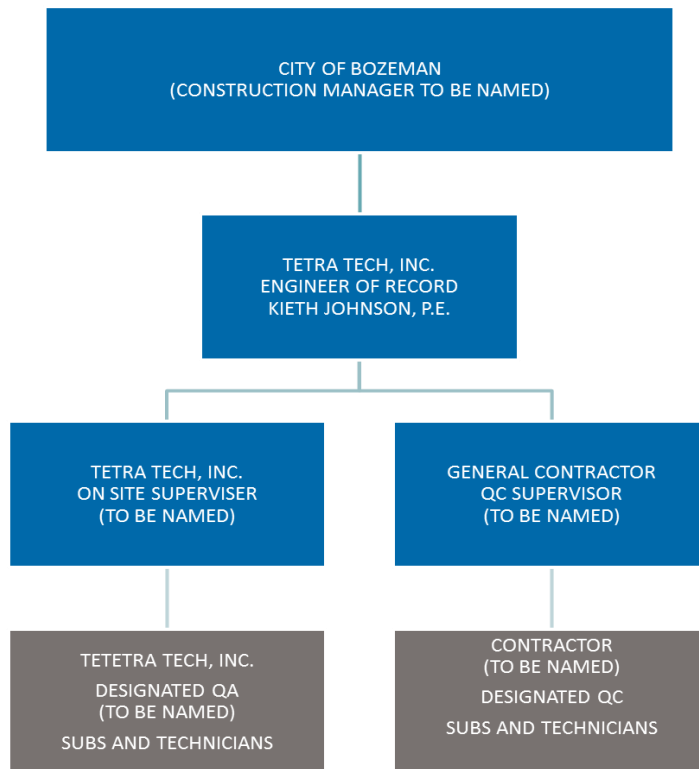
**Section 6 — Documentation:** Describes procedures for project document management in a secure document filing and storage system

## 2.0 PROJECT QA/QC ORGANIZATION

This section presents the responsibilities and authorities of key personnel involved in the construction of Alternative F, and the structure of the QC/QA organization.

### 2.1 RESPONSIBILITIES AND AUTHORITIES OF KEY PERSONNEL

Key personnel involved in the LFG/SVE/AI and Treatment System construction and their QC/QA roles and responsibilities are described below in Section 2.1.1 and Section 2.1.2. The OSS will maintain a CQCQAP Staffing List of CQCQAP personnel, including each person’s role and organization. When personnel changes occur, Tetra Tech will provide an updated list for this CQCQAP. The figure below shows an organization chart for the CQCQAP team.



#### 2.1.1 Engineer of Record

Tetra Tech is the engineer and will provide resolution of design issues as they arise during the expansion work with approval from the City of Bozeman for any changes in the design. The Engineer of Record is Keith Johnson, P.E., a Montana-licensed Professional Engineer sealing the design report and other design documents. The Engineer of Record will serve as the ultimate decision maker for questions relating to design issues or questions regarding QC/QA measures during construction.

### 2.1.2 QA On-Site Supervisor

The OSS, who shall be named at a later date, is responsible for implementation of this CQCQAP. The OSS is the Tetra Tech primary point of contact for the City of Bozeman on all construction management issues. The OSS is responsible for the overall management of activities related to the construction program, including the implementation of the CQCQAP and the health and safety program. The OSS will manage the Alternative F construction on behalf of the City of Bozeman. The OSS will provide QA and monitor the day-to-day construction QC activities performed by the GC and its subcontractors to verify compliance with the contract plans and specifications. Additionally, the OSS may be assigned management of any third party QA inspection and testing firms retained by the City of Bozeman or the GC. The OSS may designate other Tetra Tech employees as necessary to provide QA oversight.

### 2.1.3 QC Supervisor

The GC shall designate a QC Supervisor who shall be responsible for implementing all the aspects of QC described in this plan. The QC Supervisor will be named at a later date after a GC has been selected and before construction begins. The QC Supervisor will implement the QC plans by implementing the following:

- Inspect all materials and equipment for conformance with technical specifications,
- Perform all QC tests as required by the technical specifications,
- Coordinate all QC activities among its subcontractors, and
- Submit all QC reports and other QC documentation to the OSS.

The QC Supervisor may designate other GC employees as necessary to perform QC measures or reporting, including employees of its subcontractors.

## 3.0 INSPECTION AND VERIFICATION ACTIVITIES

### 3.1 GENERAL CONSTRUCTION INSPECTION AND VERIFICATION REQUIREMENTS

The GC QC Supervisor and all other personnel as designated will perform the inspections and tests as prescribed in the technical specifications. QA inspection and testing will be used to verify the adequacy and effectiveness of the GC's QC program.

#### 3.1.1 QC Inspections

The GC will establish and implement a program for inspection of activities affecting quality that will cover the entire construction site. Inspections will be performed to verify compliance with documented instructions, drawings, procedures, and specifications as required by the contract. All inspections will be documented by the contractor. A four-phase inspection program will be followed for each definable feature of the work. The four phases of inspection are:

##### 3.1.1.1 Preparatory Inspection

The QC Supervisor will perform preparatory inspections prior to beginning any work on any definable feature of the work. As part of the preparatory inspection, the QC Supervisor will:

- Ensure that preparatory work includes a review of contract requirements
- Ensure that all materials and/or equipment have been tested, submitted, and approved

- Examine materials and equipment to ensure that they conform to design documents, that all materials and/or equipment are on hand, and that all monitoring and measuring equipment is properly calibrated and in proper working condition
- Record preparatory inspections in the QC documentation

### 3.1.1.2 Initial Inspection

The QC Supervisor will perform an initial inspection as soon as a representative portion of the particular feature of work has been accomplished. The QC Supervisor will:

- Examine the quality of workmanship
- Review control testing for compliance with contract requirements
- Review dimensional aspects of the work
- Record initial inspections in the QC documentation

### 3.1.1.3 Follow-up Inspection

The QC Supervisor will perform follow-up inspections daily to:

- Ensure continuing compliance with contract requirements
- Ensure continuing compliance with control testing until completion of particular feature of work
- Record follow-up inspections in the daily inspection report
- Conduct final follow-up inspections and correct test deficiencies prior to the addition of new features of work

### 3.1.1.4 Completion Inspection

The QC Supervisor will perform a completion inspection of the work to:

- Develop a “punch list” of items that do not conform to the approved plans and specifications
- Include the punch list in the construction QC documentation
- Indicate the estimated date by which the deficiencies will be corrected
- Perform a second completion inspection after punch list items have been completed

The daily inspection reports will identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective action taken or proposed.

When deficiencies are discovered during the four-phase or other inspection processes, the OSS will be informed of any quality issues and the resolution. When material or performed work is found to be deficient and/or does not meet the project specifications on the basis of focused inspections, the OSS will assure deficiency correction is implemented, as discussed in Section 4.

## 3.1.2 QA Inspections

The OSS will perform periodic testing and inspection of construction activities. These will include witnessing of the GC’s testing or performance of independent tests and inspections. At a minimum, the testing will be as described in **Table 3-1**.

**Table 3-1.** Quality Assurance Testing and Frequency

| Construction Element | Type of Test             | Test Subject  | Minimum Frequency       |
|----------------------|--------------------------|---------------|-------------------------|
| Buried Piping        | Witness                  | Pressure Test | Each QC Test            |
|                      | Independent Verification | Compaction    | 1 Per Every 10 QC Tests |



|               |                          |  |               |
|---------------|--------------------------|--|---------------|
|               | Material                 | Gradation, Atterberg Limits  | 1 Per Project |
| Concrete      | Independent Verification | Rebar Size and Placement   | Each Pour     |
|               | Witness                  | Concrete Mix   | Each Pour     |
|               | Independent Verification | Pad Location, Dimensions and Depth   | Each Pour     |
| Well Drilling | Witness                  | Well Completion Details (Depth, Casing Type, Wellhead Details, Gravel Placement) | Each Well     |
| Excavation    | Witness                  | Utilities Marked. Utility Locate Ticket Active.                                  | Each Day      |

### 3.1.3 Construction Audits

Tetra Tech will establish and document an auditing system to verify its own (and the GC’s) implementation of and conformance to the CQCQAP and contract technical specification requirements. The auditing system will be used to make a determination regarding the effectiveness of the QC/QA system.

Audits will be performed by qualified and properly trained personnel who are familiar with the QC/QA system, auditing procedures and techniques. Selection of auditors and the conduct of audits will ensure the objectivity and impartiality of the audit process. The OSS or any designated QA personnel designated by the OSS may not be an independent auditor. The auditing system will cover all activities affecting quality for construction. The results of the audits will be documented and reported to the OSS. All non-conformance conditions identified during the audit will be re-audited to verify effectiveness of corrective actions taken by the appropriate organization. Audits will be conducted periodically during construction of Alternative F.

## 4.0 CONSTRUCTION DEFICIENCIES

This section provides procedures for tracking construction deficiencies (noncompliance) from identification through acceptable corrective action. It defines the controls and related responsibilities and authorities for dealing with noncompliant products or services.

Deficiency occurs when performed work does not meet the plans and/or specifications for the project.

### 4.1 CONTRACTOR QC DEFICIENCY IDENTIFICATION AND CONTROL

When performed work is found deficient, a QC Supervisor (or designee) will ensure that the non-conforming work is identified and controlled to prevent unintended use or delivery. The QC Supervisor will notify the OSS of any noncompliance with any of the foregoing requirements. Minor deficiencies noted during inspection are verbally reported to the OSS and noted on the Daily Construction Report. Minor deficiencies are items that do not require significant rework or repair work to correct and will not result in significant deviations from required quality standard if corrected immediately. Control and disposition of minor deficiencies will be conducted by the QC Supervisor and do not require formal action by the OSS. Ideally, such minor deficiencies can be corrected on the

spot by agreement with the OSS. Non-conformances are major deviations from the contract requirement and/or accepted standard of quality, which must be formally documented for corrective action by the QC Supervisor and the OSS.

## 4.2 CONTRACTOR DEFICIENCY CORRECTION

When performed work is found to be deficient and/or does not meet the project specifications, the QC Supervisor will ensure deficiency correction is implemented. The QC Supervisor will ensure that the non-conforming work is identified and controlled to prevent unintended use. The QC Supervisor is responsible for documenting the non-conformance.

The GC will implement corrective actions to remedy work that is not in accordance with the drawings and specifications. The corrective actions will include removal and replacement of deficient work using methods approved by OSS. Replacement will be done in accordance with the corresponding technical specifications. Replacement will be subjected to the same scope of QC/QA inspection and testing as the original work. If the replacement work is not in accordance with the drawings and specifications, the replacement work will be removed, replaced, re-inspected, and re-tested.

## 4.3 PREVENTIVE ACTIONS

Preventive actions are taken to eliminate the cause of a potential non-conformity. The OSS will take preventive actions as necessary to eliminate the causes of potential deficiencies so as to prevent their occurrence.

## 5.0 FIELD CHANGES

Field changes for QC/QA will be limited to changes to this CQCQAP. Changes to construction processes or design plans and specifications are governed by the design change order procedures.

## 5.1 CQCQAP CHANGES

The City of Bozeman, the OSS, or the QC Supervisor may initiate revisions to this CQCQAP. The CQCQAP may be revised when it becomes apparent that existing procedures or controls are inadequate or deemed to be more excessive than required to support work being produced in conformance with the specified quality requirements. Tetra Tech will notify managing contractor in writing of changes to QA or QC procedures necessitating modification to this CQCQAP. All changes are subject to City of Bozeman acceptance.

## 6.0 DOCUMENTATION

Documentation will cover all aspects of QC/QA program activities and include Daily Construction Reports, equipment and system inspection forms, and testing checklists.

## 6.1 QC DAILY RECORD KEEPING

Project documents will be managed through a combination of a secure document filing and storage system. Sufficient records will be prepared and maintained as work is performed to furnish documentary evidence of the quality of construction and activities affecting quality. The QC Supervisor will maintain a daily log of all QC inspections performed and subcontractor operations on a form acceptable to the OSS.

The daily log will be signed by the QC Supervisor. At least one copy of each daily log will be provided to the OSS on the work day following the day of record.

---

## 6.2 QA DAILY CONSTRUCTION REPORT

---

A Daily Construction Report (**Appendix A**) will be prepared and signed by the OSS. The report will include a summary of the daily construction activities. Supporting inspection data sheets will be attached to the daily report where needed. At a minimum, the Daily Construction Report will include the following information:

- Date, project name, location, and other identification
- Reports and results of any meetings held
- Record of visitors to site
- Locations of construction underway during that day
- Equipment and personnel working in each activity, including subcontractors
- Descriptions of work being inspected
- Decisions made regarding approval of units of material or work and corrective actions to be taken
- Description of problems or delays and resolution
- Communications with contractor staff
- Construction activities completed and/or in progress
- Signature of the report preparer

The QA Daily Construction Reports will be routed on a daily basis to the project QC/QA files and maintained as part of the permanent project record. These reports are reviewed by the Engineer of Record, and also distributed to the City of Bozeman.

---

## 6.3 INSPECTION AND TESTING CHECKLISTS

---

Inspection forms and testing checklists, provided in **Appendix A**, will be completed and include:

- Description or title of the inspection activity
- Location of the inspection activity
- Recorded observation or test data
- Results of the inspection activity
- Personnel involved in the inspection activity
- Signature of the inspector

---

## 6.4 RECORD DRAWINGS

---

Tetra Tech will prepare final record drawings. The draft record drawings will be submitted on one set of CDs. Record drawings submitted on CD will be the latest version of AutoCAD by AutoDesk, Inc.

### 6.4.1 Responsibilities

The QC Supervisor will be responsible for ensuring that red-line record drawings are maintained daily throughout the construction process. These red-line record drawings will be used to update the design drawings to as-built status at the completion of the work.

### 6.4.2 Preparation of As-Built Drawings

The QC will be responsible for red-lining construction drawings in the field as preparation for as-built drawings. The as-built drawings will record actual, approved field conditions upon completion of the work. The original design drawings will be marked up by the QC Supervisor as the project progresses to indicate as-built conditions. Where there was a change to a dimension, location, or other feature, the as-built drawing will indicate the work performed.

### 6.4.3 Review of As-Built Drawings

Upon completion of the as-built red-line drawings, the QC Supervisor will submit the red-line mark-up drawings to the Engineer of Record who will incorporate the mark-ups and issue the final as-built drawings to the City of Bozeman and the managing contractor representative.

## 6.5 CONTROL OF QUALITY RECORDS

---

The OSS verifies QA record accuracy and maintains copies of all quality-related documentation. This includes, but may not be limited to:

- Daily construction QA logs and records
- Daily QC reports
- Inspection checklists and reports
- Surveillance reports
- Non-conformance reports

These records will be stored in files maintained in the project document control files. All original documents pertaining to project information will be maintained in the project file located at the Tetra Tech Helena, Montana, office.

The OSS has primary responsibility for the centralized document control files for the project and construction documentation. All records will be available for inspection and audit by the City of Bozeman at any time.

## 6.6 POST-CONSTRUCTION DOCUMENTATION

---

Tetra Tech will include quality related documents for the LFG/SVE/AI and Treatment System with the post-construction documentation, which will consist of the as-built drawings and updated System Operation and Maintenance Manual.

## 7.0 REFERENCES

Tetra Tech, 2014. Draft Revised Corrective Measures Assessment, Bozeman Landfill, Gallatin County Montana. Helena, MT. September 4, 2014.

---

## APPENDIX A - FIELD FORMS

---



**Bozeman Landfill**  
Corrective Measures Assessment Implementation

**DAILY CONSTRUCTION REPORT**

DATE: \_\_\_\_\_ ARRIVAL TIME: \_\_\_\_\_ DEPARTURE TIME: \_\_\_\_\_

WEATHER CONDITIONS: \_\_\_\_\_

**SUMMARY OF WORK / MAJOR ACTIVITIES**

|  |
|--|
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |

**PERSONNEL ON-SITE:**

| Name | Company | Name | Company |
|------|---------|------|---------|
|      |         |      |         |
|      |         |      |         |
|      |         |      |         |

**HEALTH & SAFETY TOPICS OR ISSUES:** (see daily work permit[s])

**QC PROCEDURES/INSPECTIONS/TESTING TO BE PERFORMED TODAY:**

**STATUS OUTSTANDING ISSUES AND ACTIONS/DEFICIENCIES CORRECTED TODAY:**

**PLANNED ACTIVITIES FOR NEXT WORKING DAY:**