4.3

REMEDIATION TECHNOLOGIES, INC.

GROUNDWATER MONITORING PLAN
BALCHEM CORPORATION
SLATE HILL, NEW YORK

Prepared for:

BALCHEM CORPORATION
P.O. Box 175
Routes 6 & 284
Slate Hill, New York 10973

Prepared by:

REMEDIATION TECHNOLOGIES, INC.
3040 William Pitt Way
Pittsburgh, PA 15238

Project Number: 3-2245-100

NOVEMBER 1996

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1.0 INTRODUCTION

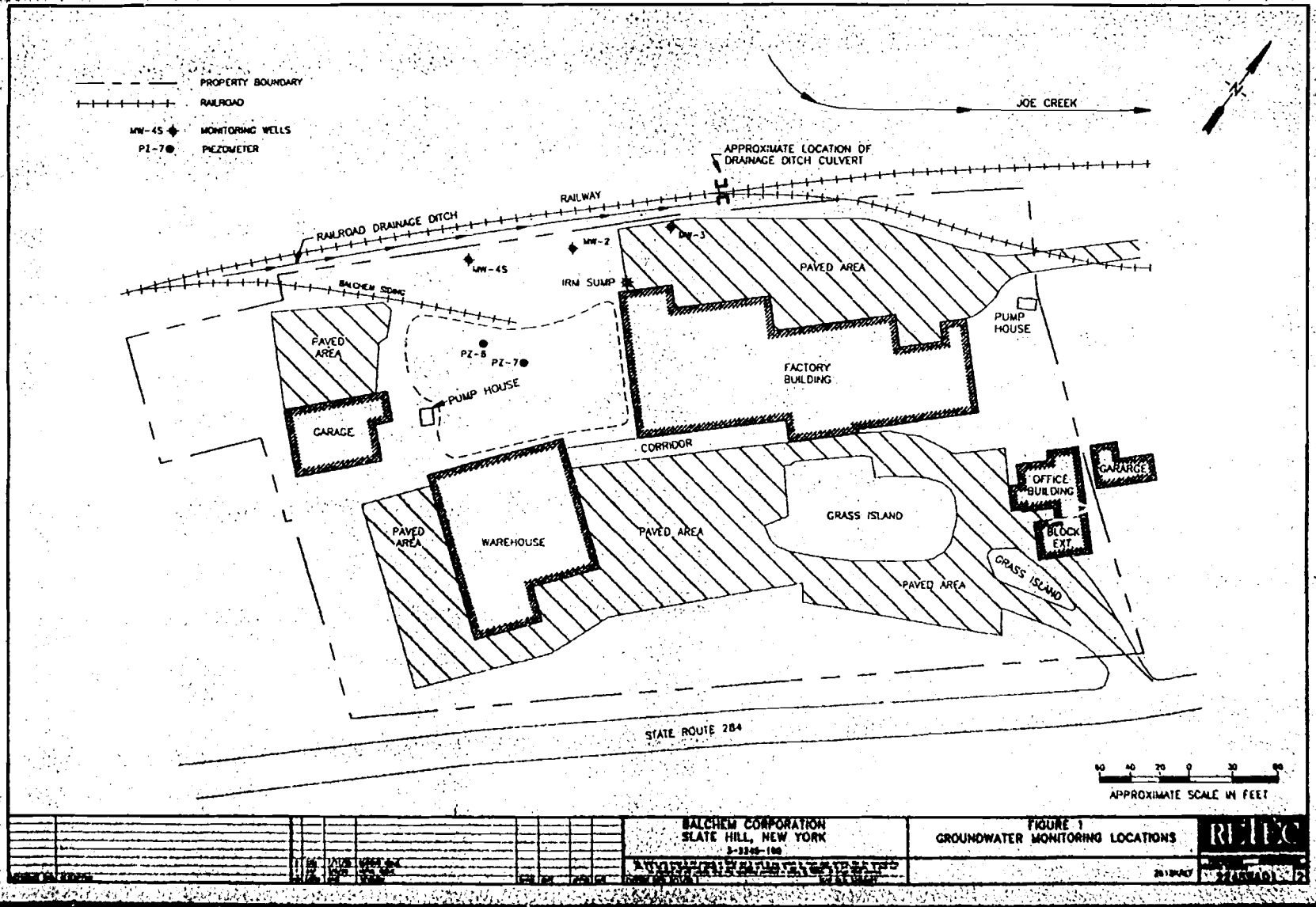
This Groundwater Monitoring Plan (GMP) for Balchem Corporation's (Balchem) Slate Hill, New York plant, has been prepared on behalf of Balchem to address the Record of Decision (ROD) prepared by the New York State Department of Environmental Conservation (NYSDEC) dated December 7, 1995.

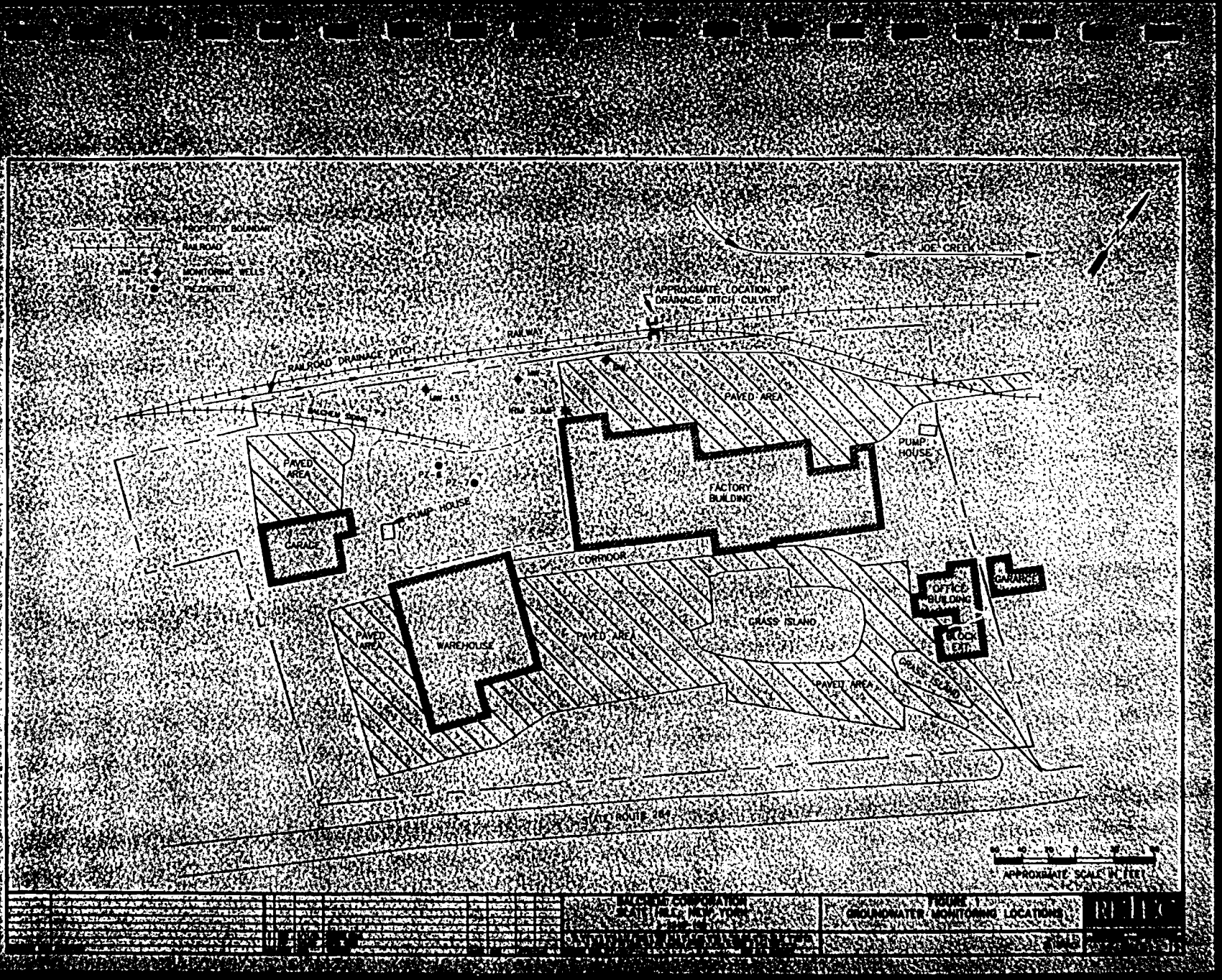
The Balchem plant occupies approximately 4.4 acres at the intersection of U.S. Route 6 and New York Route 284 in Slate Hill, New York. Several investigations have been performed at the site which resulted in the installation of groundwater monitor wells and piezometers. Remedial activities were undertaken in late July and August of 1996, consisting of the excavation, testing, and subsequent disposal of lead-containing soils (>450 ppm) from the site.

The ROD and subsequent discussions with NYSDEC have determined that groundwater monitoring will be performed at the site to monitor the effectiveness of the implemented remedy. The groundwater monitoring plan was discussed in the document titled *Remedial Action Plan and Remediation Work Plan [RETEC, 1996]* This Groundwater Monitoring Plan details the monitoring to be conducted.

2.0 SAMPLING LOCATIONS

The groundwater sampling will include the sampling of three monitor wells, two piezometers, and the Interim Remedial Measures (IRM) sump. Wells to be sampled include monitor wells MW-2, MW-3 and MW-4S. The piezometers were not originally listed in the sampling described in the Remedial Action Plan [RETEC 1996]; however, were added after comments by the NYSDEC in a letter from John Helmset dated April 26, 1996. The locations of the groundwater sampling points are presented on Figure 1.


PROPERTY BOUNDARY
RAILROAD
MW-4S MONITORING WELLS
PZ-7 PIEZOMETER
JOE CREEK
N
APPROXIMATE LOCATION OF DRAINAGE DITCH CULVERT
RAILWAY
RAILROAD DRAINAGE DITCH
MW-2
MW-3
MW-4S
IRM SUMP
BALCHEM STORM
PAVED AREA
PUMP HOUSE
FACTORY BUILDING
PAVED AREA
PZ-8
PZ-7
PUMP HOUSE
GARAGE
CORRIDOR
OFFICE BUILDING
GARAGE
GRASS ISLAND
PAVED AREA
WAREHOUSE
PAVED AREA
BLOCK EXT.
GRASS ISLAND
PAVED AREA
STATE ROUTE 284
60 40 20 0 30 60
APPROXIMATE SCALE IN FEET
BALCHEM CORPORATION
SLATE HILL, NEW YORK
FIGURE 1
GROUNDWATER MONITORING LOCATIONS
REMEC


PROPERTY BOUNDARY
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APPROXIMATE LOCATION OF DRAINAGE DITCH CULVERT
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MW-1
MW-4S
RW SUMP
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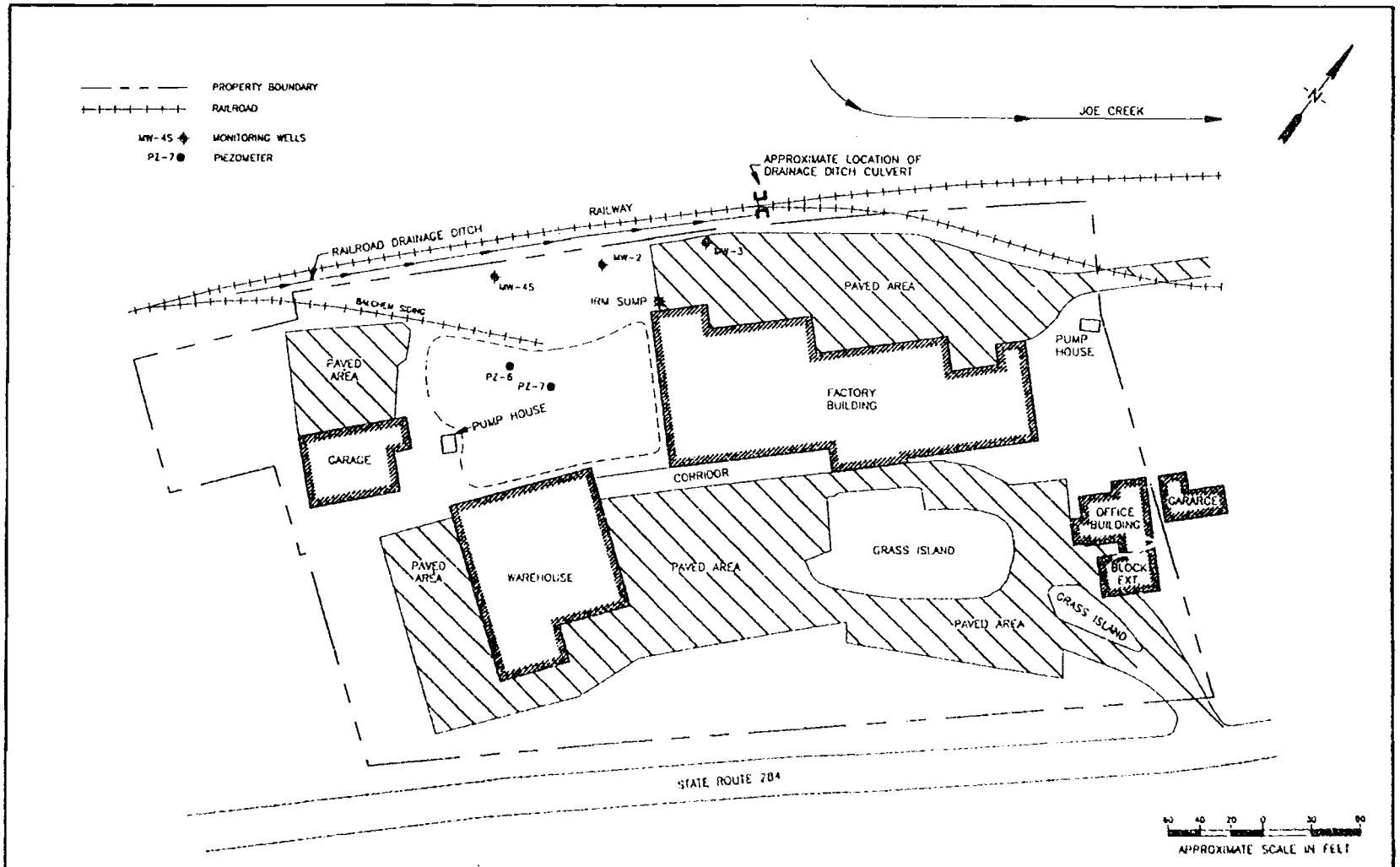
PUMP HOUSE
PZ-8
PZ-7
FACTORY BUILDING
GARAGE
CORRIDOR
OFFICE BUILDING
GARAGE
GRASS ISLAND
PAVED AREA
WAREHOUSE
PAVED AREA
PAVED AREA
STATE ROUTE 154
APPROXIMATE SCALE IN FEET
FIGURE CONFIGURATION
FIGURE
GROUNDWATER MONITORING LOCATIONS



BALCHEM CORPORATION SLATE HILL, NEW YORK 5-2245-100	FIGURE 1 GROUNDWATER MONITORING LOCATIONS	REMEC 22455A01

3.0 SAMPLING METHODS

Samples of water will be collected from the monitor wells, piezometers and IRM sump using the procedures outlined in the Remedial Action Plan [RETEC, 1996]. Prior to sampling, the depth to water will be measured and recorded for each of the monitor wells and piezometers.

- **Groundwater Samples** will be collected from each of the monitor wells/piezometers using a precleaned, single-use bailer. Each well be purged of at least three well volumes of water. After each equivalent of one volume of groundwater is removed, the field parameters of temperature, specific conductance, pH and oxidation/reduction potential will be measured and recorded. The final turbidity will also be measured and recorded. Groundwater samples will be analyzed for VOCs and lead. During collection of the actual samples, the volatile sample will be collected first, followed by the lead sample. Groundwater samples will be identified using the well name and the sample date. For instance, sample MW-4S-7-25-96 is a sample collected from well MW-4S on July 25, 1996.

- **The Sump Water Sample** will be collected using a disposable bailer. Because the sump can not be purged and water flows into the sump on a seasonal basis, this sample will be a grab sample. No field measurements of the water will be made. The water will be sampled for the volatile constituents of interest and lead. This sample will be identified using the prefix "sump-" followed by the date of sample collection. For example, sample sump-7-25-96 was collected from the sump on July 25, 1996.

It is anticipated that the piezometers may be dry most of the year, and will therefore not be available to be sampled. An attempt will be made during each sampling event to obtain groundwater samples from the piezometers; however, if no water is found, a notation will be made and the piezpmeters will not be sampled until the next scheduled groundwater sampling round. It is also possible that no water will be encountered in the IRM sump during the scheduled groundwater sampling events. If the sump is found to be dry, no sample will be collected until the following groundwater sampling event.

Quality control will be facillitated by the collection of one duplicate sample of groundwater per each round of sampling, plus one trip blank for analysis of Volatile organic compounds (VOCs).

The samples will be placed in appropriate containers as specified in the project Quality Assurance Project Plan (QAPP) [RETEC, 1996], cooled to 4 degrees centigrade using ice, and placed in coolers for delivery to the laboratory. Sample custody is also described in the QAPP, which is appended to this document.

4.0 ANALYTICAL PROGRAM

The trip blank sample will be analyzed for volatile organic compounds (VOCs) using USEPA Method 8240. The remainder of the samples will be analyzed for VOCs (Method 8240) and lead (Method 6010). The accuracy, precision and sensitivity requirements are specified in the QAPP.

5.0 SCHEDULE AND REPORTING

The initial round of groundwater sampling was conducted just prior to, and the soil removal work in August, 1996. Three additional rounds of sampling were specified in the Work Plan. These sampling events are scheduled for February 1997, February 1998, and February 1999.

Balchem will submit a short letter report of each of the last three groundwater monitoring events to the NYSDEC. The reports will consist of short letter reports which include water levels and analylitical results, and will be submitted within three weeks of receipt of each complete set of validated analytical results.

QUALITY ASSURANCE PROJECT PLAN
FOR THE
REMEDIATION WORK PLAN

BALCHEM CORPORATION
SLATE HILL, NEW YORK

Prepared for:

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Prepared by:

REMEDIATION TECHNOLOGIES, INC.
3040 William Pitt Way
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Project Number: 3-2245-100

February 20, 1996
Revised July 10, 1996

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Project Number: 3-2245-100

Prepared by: John M Flaherty

Reviewed by: [signature]

February 20, 1996
Revised July 10, 1996

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1.0 PROJECT DESCRIPTION

Remediation Technologies, Inc. (RETEC) has prepared the following Quality Assurance Project Plan (QAPjP) to accompany the Remedial Action Plan (RAP) for remediation activities and sample collection activities to be performed at Balchem Corporation's (Balchem) Slate Hill, New York plant. The objectives of the QAPjP are to insure that sample collection procedures are followed, that site activities are correctly performed, that sample analyses are correct, and that engineering designs are followed. The work includes tasks that will be completed at the location of the former drum disposal area, the railroad drainage ditch, and general sample collection at the site.

1.1 Facility Location and Background Information

The Balchem site is located on New York Route 284, in Slate Hill, Orange County, New York. The facility currently manufactures food additives and re-packages ethylene oxide into drums. Past operations (1969 through 1974) included the manufacturing of dimethylamino ethyl methacrylate, diethylamino ethyl acrylate, and dimethyl maleate. Since the discovery of the drum disposal area in 1982, numerous investigations of the site have been completed. These investigations were reviewed and used to develop the Feasibility Study (FS) [RETEC, May 2, 1995] and the New York State Department of Environmental Conservation's (NYSDEC) Record of Decision (ROD) [NYSDEC, December 7, 1995]

The data collected to date indicate that the majority of the contaminants in the former drum disposal area have been removed from the site through a series of removal actions. Based on the results of the expanded Remedial Investigation [RETEC, April 28, 1995], the FS, and the ROD, the only constituent of interest at the site is lead found in soil located within the former drum disposal area and the railroad drainage ditch. Low levels of organic constituents (1,2-dichloroethene and trichloroethene) are not considered for remediation due to their ability to biodegrade and attenuate to acceptable levels during the life of the remediation project. Groundwater samples will, however, be analyzed for the organic constituents during the life of the project to confirm that their concentrations are being reduced by natural processes.

1.2 Project Scope and Objectives

The primary objectives of the remediation project at the site are to achieve site closure and to have the site be removed from the NYSDEC's Inactive Hazardous Waste Site list when the remediation project is complete. The objectives will be met through the following actions:

- remove soil with greater than 500 parts per million (ppm) of lead from the former drum disposal area and the railroad drainage ditch; and
- show through groundwater sample collection that organic constituents have, and continue to naturally biodegrade and attenuate.

The following activities will be undertaken to meet the objectives of the remediation program:

- Conduct an initial soil and groundwater sample collection and analysis program that will include surface soil, subsurface soil, all site monitor wells and the interceptor drainage system sump.
- Excavate lead-impacted soil with confirmation soil sample collection from the former drum disposal area.
- Excavate lead-impacted soil/sediments with confirmation soil sample collection from the railroad drainage ditch.
- Maintain the interceptor drainage system for three years.
- Maintain parking and driveway areas and the security fence that surrounds the site
- Landscape the backfilled excavation and remainder of the former drum disposal area to prevent surface runoff of lead.
- Initiate institutional controls such as deed restrictions that will prevent the site from being developed into a residential area.
- Perform periodic groundwater monitoring for three years in the three monitor wells located downgradient from the former drum disposal area and screened in the weathered till aquifer

1.3 Intended Data Usage and Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made during site activities and are based on the end uses of the data to be collected. As such, different data uses may require different levels of data quality. There are five levels which address various data used and the QA/QC effort and methods required to achieve the desired level of quality. The levels are:

- Screening (DQO Level 1). This provides the lowest data quality but the most rapid results. It is often used for health and safety monitoring at the site, preliminary comparison to ARARs, initial site characterization to locate areas for subsequent and more accurate analyses, and for engineering screening of the alternatives (bench-scale tests). These type of data include those generated onsite through the use of HNu, pH, conductivity, and other real-time monitoring equipment at the site.

- Field Analyses (DQO Level 2). This provides rapid results and better quality than in Level 1. This level may include mobile lab generated data depending on the level of quality control exercised.

- Engineering (DQO Level 3). This provides an intermediate level of data quality and is used for site characterization. Engineering analysis may include mobile lab generated data and some analytical lab methods.

- Conformational (DQO Level 4). This provides the highest level of data quality and is used for purposes of risk assessment, and the evaluation of remedial alternatives. These analyses require full CLP analytical and data validation procedures in accordance with EPA recognized protocol.

- Non-standard (DQO Level 5). This refers to analyses by non-standard protocols, for example, when exacting detection limits or analysis of an unusual chemical compound is required. These analyses often require method development or adaptation. The level of quality control is usually similar to DQO Level 4 data.

The data collected during this remedial action will be collected at a DQO Level 4. Field screening data will be collected at DQO Level 1. Sample types and frequency of analysis are presented below in Table 1-1.

TABLE 1-1

SAMPLE TYPES AND FREQUENCY OF ANALYSIS

BALCHEM CORPORATION
SLATE HILL, NEW YORK

Sample Type	Volatile Organic Compounds (Method 8240)	Lead (Method 6010) [1]
Groundwater	13[2]	13
Groundwater MS/MSD	1	1
Surface Soil	0	4[2]
Surface Soil MS/MSD	0	1
Subsurface Soil	0	3
Field Blank	2	2
Equipment Blank	2	2
Trip Blank	2	0

Notes

[1] Method 7421 may be necessary to achieve DQO Level 4 criteria.

[2] The total number of samples shown for groundwater and surface soil both include one duplicate sample.

1.4 Project Schedule

The time needed to complete the remediation project is three years. Most of the work will be completed during the first year of the project. The work that will be completed during the first year of the project includes the following tasks:

- Initial soil and groundwater sample collection and analysis program;
- Excavation of lead-impacted soil from the former drum disposal area and the railroad drainage ditch;
- Landscaping;
- Implementation of institutional controls; and

- Collection and analysis of groundwater samples from the three wells located downgradient from the former drum disposal area six months after the initial sample collection program.

Balchem will receive the draft report, in letter format, from the excavation and landscape activities one week after the completion of the associated site activities and receipt of the results of analyses of confirmation samples. The NYSDEC will receive the final report one week after RETEC receives Balchem's suggestions for the report.

Balchem will receive the draft report of the initial sample program one week after RETEC receives the results of analyses. The NYSDEC will receive the final report one week after RETEC receives Balchem's suggestions for the report. This report will be in the form of a letter.

During the second and third years of the project, the following tasks will be completed:

- Continued maintenance of the interceptor drainage system;
- Continued maintenance of the driveway/parking areas and the security fence; and
- Annual groundwater monitoring in the three wells located downgradient from the former drum disposal area.

Three weeks after RETEC receives the results of analyses from the final groundwater sample event, the draft site closure report will be submitted to Balchem. NYSDEC will receive the draft closure report one week after RETEC receives Balchem's comments on the report. The final site closure report will be submitted to the NYSDEC one week after RETEC receives comments to the final draft report from the NYSDEC. The final site closure report will include the following items:

- A review of Balchem site history from the discovery and removal of the drums through the various site investigations;
- The results of the three-year remediation program; and
- A recommendation for final site closure and removal of the site from the NYSDEC Inactive Hazardous Waste Sites list.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Under the direction of the Balchem Remediation Project Manger, RETEC will have responsibility for several phases of the remediation project. RETEC will perform the initial sample collection program, excavation oversight and report preparation. The various quality assurance and management responsibilities of key project personnel are defined below.

The primary responsibility for project quality rests with RETEC's Project Principal. Independent quality assurance will be provided for RETEC by the Project QA Director and the Laboratory Data Manager prior to release of all data to either Balchem or the NYSDEC.

Balchem Corporation Remediation Project Manager

The remediation project manager for Balchem, Mr. Robert Lueck, P.E., has the overall responsibility for all phases of the remediation project. Mr. Lueck, an independent consulting engineer, has consulted for Balchem on environmental issues for many years.

State Project Manager

The NYSDEC project manger, Mr. John Helmeset, Environmental Engineer I, has overall oversight responsibility for all phases of the remediation project.

RETEC Project Principal

The RETEC project principal, Dr. Alonzo Lawrence, Ph.D., P.E., has overall responsibility for ensuring that the project meets the objectives of the NYSDEC and Balchem, and RETEC's quality standards. The project principal is responsible for technical quality control and project oversight.

Site Manager

The site manager, Mr. Ron Keffer, is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. The site manager's primary function is to ensure that technical, financial, and scheduling objectives of the

project are achieved. The site manager will provide the major point of contact for Balchem and between Balchem and the RETEC project team, and control for matters concerning the project. The site manager will:

- define project objectives and develop a detailed work plan and schedule;
- establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- inform all field leaders and support staff of the project's special considerations;
- monitor and direct the field leaders;
- develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- review the work performed on each task to ensure its quality, responsiveness, and timeliness;
- review and analyze overall task performance with respect to planned requirements and authorizations;
- review and approve all external reports (deliverables);
- ultimately be responsible for the preparation and quality of interim and final reports; and
- represent the project team at meetings.

Field Supervisor

The site manager will be supported by the field supervisor who is responsible for leading and coordinating the day-to-day activities of the various resource specialists. The field supervisor is an experienced environmental professional with sufficient field experience for this project and will report directly to the site manager. The responsibilities of the field supervisor include:

- implementation of field changes, with NYSDEC concurrence, to the work plan on an as-needed basis

- day-to-day coordination with the site manager on technical issues in specific areas of expertise;
- development and implementation of field-related work plans, assurance of schedule compliance, and adherence to study requirements;
- coordination and management of field staff;
- implementation of QC for technical data provided by the field staff, including field measurement data;
- adherence to work schedules provided by the project manager;
- authorship and review of text and graphics required for field team efforts;
- coordination and oversight of technical efforts of subcontractors assisting the field team;
- identification of problems at the field team level, discussion of resolutions with the site manager, and provision of communication between the field team and the project management; and
- participation in the preparation of the final report.

Technical Staff

The technical staff will be drawn from RETEC's pool of corporate resources to gather and analyze data, and to prepare various task reports. Personnel will be selected based on the needs of the tasks and their level of expertise.

Project QA Director

The Project QA Director, Mr. John A. Quagliotti, Jr., will remain independent of direct job involvement and day-to-day operations, and has direct access to RETEC corporate executive staff as necessary to resolve any QA dispute. The QA Director is responsible for auditing the implementation of the QA program in conformance with the demands of the specific investigation, and NYSDEC and US EPA requirements. Specific functions and duties include:

- provide QA audit on various phases of the field operations;

- review and approval of QA plans and procedures;
- providing QA technical assistance to project staff;
- reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the site manager.

Laboratory Data Manager

The Laboratory Data Manager, Mr. John Flaherty, will remain also independent of direct job involvement and day-to-day operations, and has direct access to RETEC corporate executive staff as necessary to resolve any laboratory dispute. The Laboratory Data Manager is responsible for the correctness and appropriateness of the specified analytical program found in the work plan and will ensure that the analytical program remains in conformance with the demands of the specific investigation, and NYSDEC and EPA requirements. The Laboratory Data Manager provides guidance during preparation of the work plan and during the field effort.

Specific functions and duties include:

- review of the work plan to ensure that:
  - the correct methods of analyses have been selected for the project;
  - the correct number of blanks and duplicates have been specified; and
  - the correct sample containers and methods of preservation have been specified.
- implement and oversee the data validation process.

3.0 QUALITY ASSURANCE OBJECTIVE FOR MEASUREMENT DATA

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results which are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, laboratory, instruments calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPjP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability. If the analytical work fails to meet the specified criteria, additional sampling may be required.

The initial soil and groundwater sample collection program at the site uses both random and predetermined sample locations. The initial soil sample collection program in the former drum disposal area will be random. The initial groundwater sample program will include the existing monitor wells and the interceptor drainage system sump.

3.1 Level of Quality Control Effort

Field blank, equipment blank, trip blank, duplicate, and matrix spike samples will be analyzed to assess the quality of the data resulting from the initial sample collection program. Field, equipment and trip blanks, which consist of distilled/deionized water, will be provided by the analytical laboratory and will be submitted for analysis as a means of assessing analyte levels resulting from the field sampling program. Field blank samples are analyzed to check for procedural contamination at the site which may cause sample contamination. Equipment blanks are used to assess decontamination procedures. Trip blanks are used to assess the potential for contamination of the samples due to sample shipment and storage.

Duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix spikes provide information about the effect of the sample matrix on the digestion and measurement methodology. All matrix spikes are performed in duplicate and are referred to as MS/MSD samples. One MS/MSD will be collected for every 20 or fewer investigative samples. MS/MSD samples are collected for organic analyses. Inorganic analyses require a single MS and a laboratory duplicate according to the New York State Department of Health (NYSDOH) Analytical Services Protocol

(ASP) program. The laboratory will be selected by Balchem Corporation. The selected laboratory will be ELAP certified and will provide Category B deliverables as specified in the NYSDEC ASP Rev. 12/91.

The general level of the QC effort for the initial sample collection program will be one field blank, one equipment blank and one duplicate sample for each medium sampled. One volatile organic analysis (VOA) trip blank consisting of distilled deionized ultra pure water will be included along with each sample cooler containing samples to be analyzed for VOCs.

MS/MSD samples are investigative samples. Triplicate volume samples will be collected for MS/MSD analyses. One MS/MSD sample will be collected for each medium sampled, i.e., one groundwater MS/MSD and one soil MS/MSD will be collected.

The level of QC effort provided by the laboratory will be equivalent to the level of QC effort specified in the NYSDOH ASP program for the methods and parameters to be tested. The level of QC effort for testing of inorganics will also conform to the protocols of the ASP.

The QC level of effort for the field measurement of pH consists of a pre-measurement calibration and a post-measurement verification using two standard reference solutions appropriate to the sample pH. The QC effort for field conductivity and organic vapors measurements will include daily calibration of the instruments using standard conductivity solutions and calibration gases.

3.2 Accuracy, Precision and Sensitivity of Analysis

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols. The laboratory will follow the specified methods and be certified by the NYSDOH Environmental Laboratory Approval Program (ELAP). The required accuracy, precision, sensitivity of the analyses for this project, are specified in Table 3-1 below.

TABLE 3-1

ACCURACY, PRECISION AND SENSITIVITY REQUIREMENTS REMEDIATION PROJECT

BALCHEM CORPORATION SLATE HILL, NEW YORK

Analytical Parameter	Method of Analysis		Detection Limit		Precision		Accuracy		Completeness
	Soil	Water	Soil	Water	Soil	Water	Soil	Water	
VOCs	---	8240	---	10 ppb	22	14	---	As per EPA SW846	95 %
Lead	6010	6010	0.6 ppm	3 ppb	20	20	75-125	---	95 %

3.3 Completeness, Representativeness and Comparability

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. It is expected that the laboratory will provide data meeting QC acceptance criteria for 95% or more for all samples tested. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$Completeness\ (\%) = \left[\frac{Number\ of\ Valid\ Data}{Number\ of\ Samples\ Collected\ for\ Each\ Parameter\ Analyzed}\right] \times 100$$

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter which is dependent upon the

proper design of the sampling program and proper laboratory protocol. Representativeness will be assessed by the analysis of blind field duplicate samples.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPjP, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and QA objectives.

4.0 SAMPLE COLLECTION PROCEDURES

Sample collection procedures are described in detail in Section 3.0, Remediation Work Plan, of the RAP. Section 3.0 of the RAP serves as the Field Sampling and Analysis Plan (FSAP) for this project. Table 4-1 shows a summary of the sample containers, volume of sample needed, preservatives and holding times for each parameter.

TABLE 4-1

SAMPLE SUMMARY

BALCHEM CORPORATION
SLATE HILL, NEW YORK

Parameter	Volume Needed [1]		Preservative		Holding Time
	Water	Soil	Water	Soil	
VOCs	2 X 40 ml	---	None	---	7 days
Total Lead	500 ml	16 ounces	HNO_3 [2]	None	6 mos.

Notes
[1] Triple volume needed for MS/MSD sample.
[2] To pH less than 2.

In addition to specific preservatives indicated in Table 4-1, all samples will be cooled to 4 centigrade using ice or frozen ice packs. The temperature will be maintained in the cooler until delivery to the laboratory, where the samples will be removed from the cooler and placed in a refrigerated holding area.

5.0 SAMPLE CUSTODY

The sample custody or chain of custody protocols as described in *NEIC Policies and Procedures*, EPA-330/978-DDI-R, revised June 1985, and NYSDOH ASP chain of custody protocols will be followed for this project. This custody is in three parts:

- sample collection,
- laboratory analysis, and
- final evidence files.

Final evidence files, including all originals or laboratory reports and purge files, are maintained under document control in a secure area. A sample or evidence file is under your custody if they:

- are in your possession,
- are in your view, after being in your possession,
- are in your possession and you place them in a secured location, or
- are in a designated secure area.

5.1 Field of Chain-of-Custody Procedures

The sample packaging and shipment procedures summarized below will insure that the samples will arrive at the laboratory with the chain-of-custody intact. The protocol for specific sample numbering are included in Section 3.0, Remediation Work Plan, of the Remedial Action Plan.

5.1.1 Field Procedures

[1] The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

[2] All bottles will be tagged with sample numbers and locations.

[3] All sample tags will be completed for each sample using waterproof ink.

[4] The site manager will review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

5.1.2 Field Logbooks/Documentation

Field logbooks will provide the means of recording data collecting activities performed. Entries in the logbooks will be described in as much detail as possible so that persons going to the site could re-construct a particular situation without reliance on memory.

Field logbooks will be bound, field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- person to whom the logbook is assigned,
- logbook number,
- project name,
- project start date, and
- project or logbook end date.

Entries into the logbook will contain a variety of information and should form a contemporaneous record of the daily activities. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with

a single strike mark. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station, which includes compass and distance measurements, shall be recorded. The number of the photographs taken, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the collection procedures documented in the RAP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

5.1.3 Transfer of Custody and Shipment Procedures

[1] Samples will be accompanied by a properly completed RFI/EC chain-of-custody form, which is completed in triplicate. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, or the laboratory (Figure 5-1).

[2] Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with the original signed custody record enclosed in each sample box or cooler. Samples will be delivered to the analytical laboratory within 24 hours of the collection time. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

[3] Whenever samples are co-located with the owner or government agency, a separate sample receipt is prepared for those samples and marked to indicate where the samples are being co-located. The person relinquishing the samples to the facility or agency should request the representatives signature acknowledging sample receipt.

FIGURE 5-1

RETEC Chain Of Custody Form

[4] All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record will accompany the shipment, and the copies will be retained by the sampler for returning to the sampling office.

[5] If the samples are sent by common carrier, a bill of lading, or air bill should be used. Receipts will be retained as part of the permanent documentation. A verified time of sample receipt (VTSR) will be completed for each sample shipment. The VTSR will be used when calculating holding times. Carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.

5.2 Final Evidence File Custody Procedures

The evidence files for analytical data will be maintained in RETEC's Pittsburgh, Pennsylvania office. The content of the evidence file will include all relevant records, such as reports, correspondence, logs, filed logbooks, laboratory sample preparation and analysis logbooks, data package, pictures, subcontractor's reports, chain-of-custody records/forms, and data review reports.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment which are used for conducting field tests and laboratory analyses. The instruments and equipment should be calibrated prior to each use or on a scheduled, periodic basis.

6.1 Field Instruments/Equipment

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications

Equipment to be used during the field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual and the instructions to ensure that all maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that any prior equipment problems are not overlooked, and all necessary repairs to equipment have been performed. A spare electrode, batteries, standards, and thermometers will be sent with the equipment to be used for field measurements.

Calibration of field instruments is governed by the specific SOP for the applicable field analysis method, and such procedures take precedence over the following general discussion.

Calibration of field instruments will be performed at the intervals specified by the manufacturer or more frequently as conditions dictate. Field instruments will include a water quality meter that measures pH, temperature (T), specific conductance (SC), and oxidation reduction potential (ORP), a turbidity meter, an organic vapor photoionization detector (PID), and a water level meter. In the event that an internally calibrated field instrument fails to meet calibration checkout procedures, it will be returned to the manufacturer for service.

The pH probe will be calibrated with standard buffer solutions prior to a field trip. In the field, the meter will be calibrated daily with two buffers bracketing the expected range of the samples before use. Calibration procedures and frequency will be recorded in a field log book along with the lot numbers of the buffer solutions. The general procedures for the equipment are described below:

pH Calibration

- Temperature of sample and buffer should be the same.
- Connect pH electrode into pH meter and turn on pH meter.
- Set temperature setting based on the temperature of buffer; place electrode in first buffer solution.
- After reading has stabilized, adjust "CALIB" knob to display correct value.
- Repeat procedure for second buffer solution.
- Place pH electrode in the buffer and record the pH as displayed.
- Remove pH electrode from buffer and rinse with distilled water.
- The pH meter must be recalibrated every time it is turned off and turned back on, or if it starts giving erratic results.

The calibrations performed, standard used, and sample pH values are to be recorded in the field notebook. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement in the field as necessary.

Temperature Calibration

Temperature measurements are carried out utilizing a temperature probe (thermocouple). The temperature probe must be inspected before use to ensure there is no physical damage. The probe should be rechecked in the field before and after use to see if the readings are logical. The probe should be checked biannually for calibration, by immersing it in a bath of known temperature until equilibrium is reached. The temperature probe should be discarded if found to have more than 10% error. The reference thermometer used for the bath calibration should be NBS traceable.

Specific Conductance Meter Calibration

The conductivity cells of the specific conductance meter will be cleaned and checked against known conductivity standards before each field trip. In the field, the instrument will be checked daily with two standards. The calibration procedure is described below.

- Place the probe in conductivity calibration standard solution.
- Set temperature knob for temperature of standard solution.
- Turn to appropriate scale and set the instrument for the value of calibration standard.
- Rinse off the electrode with distilled water.
- Measure the conductivity for distilled water to be used for a field blank, making sure temperature is set correctly for temperature of solution to be tested.
- If the conductivity of blank (distilled water) is high, it must be discarded and a new blank sample procured.

All readings and calibrations should be recorded in the field notebook.

Photoionization Detector

The PID will be checked daily by use of the internal calibration mechanism. The PID will be calibrated daily with a gas of known concentration daily. The daily procedure is described below.

- Connect probe to meter.
- Check battery and lamp operation.
- Connect probe to calibration gas and adjust.

6.2 Laboratory Instruments

Calibration of laboratory equipment will be based on approved method specific procedures that are in accordance with the NYSDOH ASP.

7.0 ANALYTICAL PROCEDURES

All groundwater water and soils samples collected during sample collection activities for the remediation project will be analyzed by a NYSDEC/ASP qualified laboratory. The laboratory will be ELAP-certified by NYSDOH for all applicable analysis.

7.1 Laboratory Analysis

Laboratory analysis will be conducted in accordance with the specific methods in the ASP.

7.2 Field Screening Analytical Protocol

The procedures for field measurement of pH, temperature, specific conductance, oxidation/reduction potential , turbidity, and organic vapors will be performed in accordance with the instrument manufacturers' instructions, RETEC's SOPs and the FSAP (Section 3.0 of the RAP).

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Field Sample Collection

The assessment of field sampling precision and accuracy will be made through collection of field duplicates and field blanks in accordance with the applicable procedures and at a one in 20 frequency.

8.2 Field Measurement

QC procedures for pH, specific conductance, temperature and oxidation/reduction potential measurements are limited to checking the reproducibility of the measurement by obtaining multiple readings on a single sample or standard and by calibrating the instruments.

8.3 Laboratory Analysis

Two types of quality assurance will be used by the laboratory to ensure the production of analytical data of known and documented usable quality are as follows: quality assurance program and quality control checks.

8.3.1 QA Program

The selected laboratory will have a written quality assurance/quality control program which provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA/QC program is coordinated and monitored by a quality assurance unit (QAU), which is independent of the operating department.

8.3.2 Quality Control Checks

These specifications include the types of audits required (sample spikes, surrogate spikes, reference samples, controls, blanks), the frequency of each audit, the compounds to be used for sample spikes and surrogate spikes, and the quality control acceptance criteria for these audits.

The laboratory will document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in non-conformance with the QC criteria will be reanalyzed by the laboratory, if sufficient sample volume is available. It is expected that sufficient volume of samples will be collected for reanalyses.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 Field Measurements and Sample Collection

Raw data from field measurements and sample collection activities will be recorded in the field log book. If the data are to be used in the project reports, they will be summarized and the method of data reduction will be documented in the report.

9.2 Laboratory Services

The laboratory will perform in-house analytical data reductions and validation under the direction of the laboratory QA officer. The laboratory QA officer is responsible for assessing data quality and advising of any data which are rated "preliminary" or "unacceptable" or other notations which would caution the data user of possible unreliability. Data reduction, validation, and reporting by the laboratory will be conducted as follow:

- Raw data produced by the analyst is turned over to the respective area supervisor.
- The supervisor reviews the data for attainment of quality control criteria as outlined in the ASP.
- Upon acceptance of the raw data by the area supervisor, a computerized report is generated and sent to the laboratory QA officer.
- The laboratory QA officer will complete a thorough audit of reports at a frequency of one in ten, and audit every report for consistency.
- The QA officer and the appropriate supervisors will decide whether any sample reanalysis is required.
- Upon acceptance of the preliminary reports by the QA officer, final reports will be generated and signed by the laboratory project manager. The laboratory package shall be presented in the same order in which the samples were analyzed.

Data reduction reporting procedures will be those specified in the ASP for inorganic and organic analyses.

The laboratory will prepare and retain full analytical and QC documentation required by the ASP. As needed the laboratory will supply hard copy of the retained information.

The laboratory will report the data in the order specified in the NYSDOH ASP. The laboratory will provide as a minimum the following information in each analytical data package:

- cover sheets listing the samples included in the report and narrative comments describing problems encountered in analysis;
- tabulated results of inorganic and organic compounds identified and quantified;
- analytical results for QC sample spikes, sample duplicates, initial and a continuous calibration verifications of standards and blanks, standard procedural blanks, laboratory control samples and ICP interference check samples;
- tabulation of instrument detection limits determined in pure water; and
- raw data system printouts or photocopies identifying the date of analyses, analyst, parameters determined, calibration curve, calibration verifications, method blanks, sample and any dilutions, sample duplicates, spikes and control samples.

For organic analyses, the data packages must include matrix spikes, matrix spike duplicates, surrogate spike recoveries, chromatograms, GC/MS spectra and computer printouts. The data package will be reported to NYSDEC.

9.3 Data Validation and Assessment

The data assessment will be accomplished by the RETEC Laboratory Data Manager. The data assessment will be based on the criteria that the sample was properly collected and handled according to Section 5 of the QAPjP.

The RETEC Laboratory Data Manager will conduct a systematic review of the data for compliance with the established QC criteria based on the spike, duplicate and blank results provided by the laboratory. An evaluation of data accuracy, precision, sensitivity and completeness will be performed and presented in the appropriate report.

The RETEC Laboratory Data Manager will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Decisions to repeat sample

collection and analyses may be made by the site manager based on the extent of the deficiencies and their importance in the overall context of the project.

All data generated for the site will be computerized in a format compatible with the EPA GRITS system and organized to facilitate data review and evaluation. The computerized data set will include the data flags provided by the laboratory in accordance with the ASP, as well as additional comments of the data reviewer. The laboratory-provided data flags will include such items as:

- concentrations below required detection limit;
- estimated concentration due to poor below required detection limit;
- estimated concentration due to poor spike recovery; and
- concentration of chemical also found in the laboratory blanks.

The Laboratory Data Manager comments will indicate that the data are:

- usable as a quantitative concentration;
- usable with caution as an estimated concentration; and
- unusable due to out-of-control QC results.

The site data set will be available for controlled access by the project manager, and authorized personnel using a site-specific code. The complete data set will be incorporated into the investigation report.

Since a significant amount of data exists for the site, the review of the data by the Laboratory Data Manager is an appropriate alternative to independent third party validation. As such, the Laboratory Data Manager will prepare a Data Usability Summary Report (DUSR) per NYSDEC Division of Hazardous Waste Remediation, Quality Assurance Unit guidelines.

10.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the Remedial Action Work Plan and QAPjP. The audits of field and laboratory activities include separate internal and external audits.

10.1 Field Audits

Internal audits of field activities will be conducted by the RETEC QA officer or field team leader. The audits will include examination of field sampling records, field instrument operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain-of-custody and other appropriate documentation. These audits will be conducted to correct deficiencies, and to verify that QA procedures are maintained throughout the activities at the site. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation.

External audits could be conducted by NYSDEC's project manager.

10.2 Laboratory Audits

The internal performance and system audits of the laboratory may be conducted by the RETEC Laboratory Data Manager. The system audits, which will be done on an annual basis, will include examination laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedure, sample preparation and analysis, instrument operating records and other appropriate records.

External performance and system audits of the laboratory selected for the project may be conducted by NYSDEC.

11.0 PREVENTIVE MAINTENANCE

11.1 Field Instruments/Equipment

The field equipment for this project includes a water quality meter that measures pH, T, SC and ORP, a turbidity meter, a PID organic vapor meter, and a water level meter. Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturer.

Field instruments will be checked and calibrated in RETEC's laboratory before they are shipped to the field. These instruments will be checked and calibrated daily before use. Calibration checks will be performed after every 10 samples and will be documented on the field meter/calibration log sheets.

Critical spare parts such as pH probes, electrodes, and batteries will be kept on-site to minimize instrument down time. Back-up instruments and equipment will be available within one-day shipment to avoid delays in the field schedule.

11.2 Laboratory Instruments

As part of their QA/QC Program, a routine preventative maintenance program must be conducted by the selected laboratory to minimize the occurrence of instrument failure and other system malfunctions.

12.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

12.1 Field Measurements

Field data will be assessed by the site QC officer. The QC officer will review the field results for compliance with the established QC criteria that are specified in the QAPjP and Remedial Action Work Plan. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and analysis of blanks. Precision will be assessed on the basis of reproducibility by multiple reading of a single sample. Data completeness will be calculated using the following equation:

$$Completeness = \left(\frac{Valid\ Data\ Obtained}{Total\ Data\ Planned}\right) x\ 100 \qquad (12\text{-}1)$$

12.2 Laboratory Data

Laboratory results will be assessed for compliance with required precision, accuracy, completeness and sensitivity as outlined in the following sections.

12.2.1 Precision

Precision of laboratory analysis will be assessed by comparing the analytical results between MS/MSD for organic analysis, and laboratory duplicate analyses for inorganic analysis. The relative percent difference (%RPD) will be calculated for each pair of duplicate analysis using the following equation:

$$\%RPD = \frac{(S - D)}{\left(\frac{S + D}{2}\right)} x\ 100 \qquad (12\text{-}2)$$

where:

S = first sample value (original or MS value), and

D = second sample value (duplicate or MSD value)

12.2.2 Accuracy

Accuracy of laboratory results will be assessed for compliance with the established QC criteria that are described in Section 3 of the QAPjP using the analytical results of method blanks, reagent/preparation blank, matrix spike/matrix spike duplicate samples, field blank, and bottle blanks. The percent recovery (%R) of matrix spike samples will be calculated using the following equation:

$$\%R = \left(\frac{A - B}{C}\right) x\ 100 \qquad (12\text{-}3)$$

where:

A = the analyte concentration determined experimentally from the spiked sample,

B = the background level determined by a separate analysis of the unspiked sample; and

C = the amount of the spike added.

12.2.3 Completeness

The data completeness of laboratory analyses results will be assessed for compliance with the amount of data required for decision making the completeness is evaluated using equation 12-1. The completeness objective for the project will be 100% valid data for the samples collected and analyzed. If this objective cannot be met due to matrix problems, etc., the problems may be addressed in the DUSR. Any data deficiencies will be evaluated in terms of their impact on project goals, and corrective action will be taken if necessary.

12.2.4 Sensitivity

The achievement of method detection limits depend on instrument sensitivity method detection units and matrix effects. Therefore, it is important to monitor the instrumental sensitivity to ensure the data quality through constant instrument performance. The instrumental sensitivity will be monitored through the analysis of calibration check sample and laboratory control samples.

13.0 CORRECTIVE ACTIONS

Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review. Corrective actions may be required for either:

- analytical and equipment problems, and
- non-compliance problems.

For non-compliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the project manager. If the problem is analytical in nature, information on these problems will be promptly communicated to NYSDEC and the EPA quality assurance section. Implementation of corrective action will be confirmed in writing through the same channels.

Any non-conformance with the established quality control procedures in the QAPjP or Remediation Work Plan will be identified and corrected in accordance with the QAPjP. The NYSDEC project manager will issue a non-conformance report for each non-conformance condition.

Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by stop-work order.

13.1 Sample Collection/Field Measurements

Technical staff and project personnel will be responsible for reporting all suspected technical or QA non-conformances or suspected deficiencies of any activity or issued document by reporting the situation to the site manager or field manager. This manger will be responsible for assessing the suspected problems in consultation with the project QA manager and making a decision based on the potential for the situation to impact the quality of the data. If it is determined that the situation warrants a reportable non-conformance requiring corrective action, then a non-conformance report will be initiated by the manager.

The manager will be responsible for ensuring that corrective action for non-conformances are initiated by:

- evaluation of all reported non-conformances;
- control of additional work on nonconforming items;
- determination of disposition or action to be taken;
- maintenance of a log of non-conformances;
- review of non-conformance reports and corrective actions taken;
- include non-conformance reports in the final site documentation and in project files.

If appropriate, the field manager will ensure that no additional work that is dependent on the non-conforming activity is performed until the corrective actions are completed. Corrective action for field measurements may include:

- repeat the measurement to check the error,
- check for all proper adjustments for ambient conditions such as temperature,
- check the batteries,
- recalibration,
- check the calibration,
- replace the instrument or measurement devices, and
- stop work (if necessary).

The site manager is responsible for all site activities. In this role, the site manager is required to adjust the site programs to accommodate site specific needs. When it becomes necessary to modify a program, the responsible person notifies the project manager of the anticipated change and implements the necessary changes after obtaining the approval of the project manager. The change in the program will be documented in the field log and on a field change request (FCR) that will be signed by the initiators, the NYSDEC representative and the Team Leader. The FCR for each

document will be numbered serially as required. The FCR shall be attached to the file copy of the affected document. The project manager must approve the change in writing or verbally prior to field implementation, if feasible. If unacceptable, the action taken during the period of deviation will be evaluated to determine the significance of any departure from established program practices and action taken.

The project manager for the Balchem site is responsible for the controlling, tracking, and implementation of the identified changes. Reports on all changes will be distributed to all affected parties.

13.2 Laboratory Corrective Action

Corrective actions are required whenever an out of control event or potential out of control event is noted. The investigative action taken is somewhat dependent on the analysis and the event. Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy;
- blanks contain target analytes above acceptable levels;
- undesirable trends are detected in spike recoveries or RPD between duplicates;
- there are unusual changes in detection limits;
- deficiencies are detected during internal or external audits or from the results of performance evaluation samples; or
- inquiries concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, and instrument sensitivity. If the problem persists or cannot be identified, the matter is referred to the laboratory manager for further investigation. Once resolved, full documentation of the corrective action is filed.